Stormwater Management Report

Simcoe County Housing Corporation

2 Borland Street
Orillia
County of Simcoe

Pearson Engineering Ltd.
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20002

Table of Contents

Appendices

Lists of Figures and Drawings

STORMWATER MANAGEMENT REPORT
SIMCOE COUNTY HOUSING CORPORATION – 2 BORLAND STREET

1. INTRODUCTION

PEARSON Engineering Ltd. has been retained by MCL Architects on behalf of Simcoe County Housing Corporation (Client) to prepare a Stormwater Management Report in support of the proposed six (6) Storey residential building (Project) in Orillia in the County of Simcoe (County).

The subject property is approximately 3.81 ha in size and currently consists of a vacant school and parking lot on the west side and a running track and field area on the east side of the site. The project site is bounded by Borland Street East to the south, West Street North to the west, Peter Street North to the east, and North Street East to the north. The Project proposes the construction of a six (6) Storey residential building on the south east side of the site, including a parking lot and amenity space. The location of the site can be seen on Figure 1.

1.1. TERMS OF REFERENCE

The intent of this SWM Report is to:

- Identify the existing site characteristics including any external drainage conditions;
- Illustrate the design of the stormwater conveyance and detention system, capable of accommodating both minor and major storm flows from the site;
- Incorporate the appropriate Best Management Practices for controlling on-site erosion and sedimentation during construction while ultimately ensuring that the post-development release of stormwater is of adequate quality; and
- Summarize this design in a technically comprehensive and concise manner.

2. STORMWATER MANAGEMENT

A key component of the Development is the need to address environmental and related SWM issues. These are examined in a framework aimed at meeting the Ministry of the Environment, Conservation, and Parks (MECP) requirements. SWM parameters have evolved from an understanding of the location and sensitivity of the site's natural systems. This Report focuses on the necessary measures to satisfy the approval agency's SWM requirements.

It is understood the objectives of the SWM plan are to:

- Protect life and property from flooding and erosion;
- Maintain existing storm drainage and runoff patterns;
- Maintain water quality for ecological integrity, recreational opportunities etc.;
- Protect aquatic and fishery communities and habitats.

COUNTY OF SIMCOE
AFFORDABLE HOUSING
ORILLIA, 2 BORLAND STREET EAST

SITE LOCATION PLAN

PEARSON ENGINEERING LTD.
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY	AA	HORIZ SCALE	NTS	PROJECT #	20002
DRAWN BY	AA	VERT SCALE		DRAWING #	FIG 1
CHECKED BY	MWD	DATE	NOVEMBER 2020	REVISION #	0

P:\Autodesk Vault\Working Folders\20002 - MCL, 2 Borland St., E., Orillia\Engineering\20002 - BASE.dwg Layout:FIG 1 Plotted Nov 13, 2020 @ 8:57am by aaiello @ PEARSON ENGINEERING LTD.

2.1. Analysis Methodology

The design of the SWM Facilities for this site has been conducted in accordance with:

- The Ministry of the Environment Stormwater Management Planning and Design Manual, March 2003
- The City of Orillia, Engineering Design Criteria, July 2012 (Revised February 2015)

In order to design the facilities to meet these requirements, it is essential to select the appropriate modeling methodology for the storm system design. Given the size of the site, the Modified Rational Method is appropriate for the design for the SWM system.

2.2. Existing Drainage Conditions

The project site currently consists of a vacant school with asphalt and gravel parking on the west side of the site and a grass and track area on the west side. It generally slopes west to east towards Peter Street North and Borland Street East at an average slope of 2% over the majority of the site with a steep 15% slope at the northern corner of the site. The majority of the site is conveyed via sheet flow to a storm sewer on Peter Street North with a portion of the south side being conveyed to Borland Street East, ultimately outletting to Lake Couchuching.

An external drainage area west of the site of approximately 12.81 ha flows through the site from West Street North via sheet flow. The existing 775 mm diameter storm sewer on West Street North is estimated to be sized for a 2-year storm and convey flow from the majority of the external catchment. The stormwater runoff from any storm event greater than a 2-year storm event flows south down West Street North and a low point at the existing driveway forces the runoff to spill over into our project site. Drawing STM-1 in Appendix F shows the existing storm drainage patterns for the development.

Terraprobe Inc. performed a geotechnical investigation for the site in March 2018. The investigation revealed that the site is composed of a topsoil layer, a silty sand or sand layer, and a native basal silty sand till deposit underneath. The report indicates that there is infiltration potential within the upper soils (sand/silty sand layer) while the dense silty sand till is considered to have medium to low infiltration potential.

Given the size of the site, the Modified Rational Method will be used to determine the pre-development peak flows. IDF curve parameters were taken from the MTO Curve Lookup tool which were utilized for determining the storm intensity values and the following pre-development release rates have been calculated. The allowable peak flows for the proposed condition will be determined using the pre-development peak flows as shown in Table 1. Detailed calculations can be found in Appendix A.

Table 1: Pre-Development Peak Flows

	2 Year Storm	5 Year Storm	10 Year Storm	25 Year Storm	50 Year Storm	100 Year Storm
Peak Flows to Peter St. N. & North St. E. (m^3/s)	0.12	0.16	0.18	0.24	0.29	0.33
Peak Flows to Peter St. N. & Borland St. E. (m^3/s)	0.36	0.47	0.55	0.71	0.86	0.98
Total Site Peak Flow (m^3/s)	**0.48**	**0.63**	**0.73**	**0.95**	**1.15**	**1.31**
External Area Peak Flows (m^3/s)	0.71	0.94	1.09	1.41	1.71	1.95

Note: External Area Peak Flows are greater than the 2-year storm event spill that is conveyed through the site.

2.3. Proposed Drainage Conditions

The proposed development includes construction of a six (6) Storey residential building surrounded by a curbed asphalt parking area and designated amenity area. The post-development storm drainage for the project will generally follow pre-development conditions. The Development's building and parking lot area will drain via catch basin and storm sewer system to the proposed SWM dry pond which eventually outlets to the existing storm sewer at the intersection of Peter Street North and North Street East at a controlled flow rate. The catch basin and storm sewer system are designed to convey the 2-year storm event peak flows. The parking lot areas will drain to permeable paver areas prior to entering the storm sewer system. Runoff from the majority of the roof will be directed into underground storage units for infiltration with the remainder flowing directly into the storm sewer system. The underground infiltration chambers are designed as an offline system with an overflow pipe that connects into the storm sewer system providing an outlet if the tanks surcharge. Detailed information on StormTech Chambers can be found in Appendix D. Flows from the landscaped areas surrounding the building to the west, south, and east will flow via sheet flow uncontrolled to the existing storm sewers on the streets. The flows from the northeast grassed area will flow uncontrolled to storm sewer on Peter Street North.

In the event of a storm greater than the 2-year storm, the proposed storm sewer will surcharge, forcing stormwater to the surface. The site will be graded so that the major storm event runoff route flows through the site and into the pond. Peak flows are controlled by a hickenbottom outlet structure and a major storm control weir. The SWM Pond and channel will outlet to a double inlet catch basin in the northeast corner of the site and outlet to the Peter Street North storm sewer. The proposed storm drainage patterns can be seen on Drawing STM-2 in Appendix F.

Flows from the external area to the northwest will overtop the curb on West Street North and be conveyed through the project site through a proposed drainage channel. The channel will flow along the northern property line to the northeast corner of the project site where the flows will be captured within a catch basin and be conveyed to the Peter Street North storm sewer system. Capacity calculations for the cross section of the swale can be found in Appendix A.

2.4. Quantity Control

The proposed development will increase the imperviousness of the site and as such the post-development peak flows will increase. It is important to quantify the increase in stormwater runoff rates and attenuate these increases. The calculated post-development runoff coefficient of 0.60 is greater than the pre-development runoff coefficient of 0.54. Runoff coefficient calculations can be found in Appendix A.

The Project's parking lot will be drained via catch basin and storm sewer system. Quantity control in the form of a dry pond located north of the parking lot will be implemented to reduce post-development peak flows to pre-development values. Flows will be controlled utilizing a 300 mm diameter orifice tube within a hickenbottom outlet structure. The Pond outlets through the outlet and is conveyed through an OGS treatment unit to the existing storm sewer system on Peter Street North. The pond provides 535 m^3 of quantity storage to reduce the 100-year flow to pre-development flow values. Detailed calculations are found in Appendix A. Table 2 below summarizes post-development peak flows and demonstrates that the post-development flows for all storm events are equal to or less than the pre-development peak flows.

Table 2: Post-Development Peak Flows

	2 Year Storm	5 Year Storm	10 Year Storm	25 Year Storm	50 Year Storm	100 Year Storm
Controlled Area Peak Flows (m^3/s)	0.19	0.22	0.23	0.26	0.29	0.30
Uncontrolled Peak Flows to Peter St. N. & Borland St. E (m^3/s)	0.04	0.06	0.07	0.09	0.10	0.12
Uncontrolled Peak Flows to Peter St. N. & North St. E (m^3/s)	0.08	0.10	0.12	0.16	0.19	0.22
Total Site Peak Flow (m^3/s)	**0.31**	**0.38**	**0.42**	**0.51**	**0.58**	**0.64**
External Area Peak Flows (m^3/s)	0.71	0.94	1.09	1.41	1.71	1.95

2.5. Dry Pond Design

The majority of the site's runoff will drain to a proposed dry pond. Major system storm runoff will be conveyed via overland flow and will enter the pond through the storm sewer at an inlet located on the south side of the pond. The proposed dry pond is designed with 4:1 side slopes and a 100-year storage capacity of 535 m^3 at an elevation of 267.07 m within the pond. The top of the berm elevation is 267.59 m, providing 0.52 m of freeboard.

A 300 mm diameter orifice tube located within a hickenbottom outlet structure at the northeast corner of the pond will control outflow from the pond and reduce it to pre-development values. The dry pond has been designed to provide quantity control for all storm events up to and including the 100-year storm event. A 3.0 m wide major storm event control weir at an elevation of 267.29 m is proposed to convey storm events greater than a 100-year storm overland to the grassed drainage channel on the northeast side of the site.

Table 3: SWM Pond Stage-Storage-Discharge

	2 Year Storm	5 Year Storm	10 Year Storm	25 Year Storm	50 Year Storm	100 Year Storm
Total Flow (m^3/s)	0.19	0.22	0.23	0.26	0.29	0.30
Elevation (m)	266.16	266.35	266.47	266.71	266.91	267.07
Total Storage (m^3)	130	193	238	340	444	535

2.6. West Street External Drainage Flow

As mentioned earlier, there is an external drainage area from that spills through West Street North at the location of the existing driveway into the project site via sheet flow. This external flow would ultimately flow to Peter Street North where it would be conveyed easterly along North Street East. A drainage channel is proposed to convey this external drainage along the western and northern property line around the perimeter of the project site. The drainage channel will convey the external flow to a double catchbasin connected to the existing storm sewer at the intersection of Peter Street North and North Street East.

The proposed channel has been designed as a v-channel with 3:1 side slopes in order to convey the uncontrolled 100-year flow from the external area of 1.95 m^3/s. The channel will be designed with a minimum depth of 0.83 m, offering 0.30 m of freeboard above the 100-year water level. The drainage channel details can be seen on Drawing SG-3 in Appendix F. Capacity calculations for the cross section of the overland drainage channel can be found in Appendix A.

2.7. Quality Control

The Ministry of the Environment (MOE) in March 2003 issued a "Stormwater Management Planning and Design Manual". This manual has been adopted by a variety of agencies including the Township of Tay. The development's Stormwater Quality Control objective is to provide Enhanced Protection quality control as stated in the MOE manual. To achieve enhanced protection, permanent and temporary control of erosion and sediment transport are proposed and are discussed in the following sections.

2.7.1. Permanent Quality Control

The development's active parking facilities pose a risk to stormwater quality through the collection of grit, salt, sand, and oils on the paved surfaces. Stormwater from the parking lots areas will drain across the permeable pavers and get filtered through the stone layer before draining into the storm sewer system through a perforated pipe located within the stone layer. Major storm event stormwater flows from the will be conveyed via overland flow into the dry pond.

After outletting the SWM dry pond, stormwater will flow through an oil/grit separator (OGS) unit before outletting to the storm sewer on Peter Street North. A CDS PMSU30-30m treatment unit is the proposed OGS to treat the storm water released from this site to the MOE's Enhanced Level Protection standard. This MOE standard stipulates a Total Suspended Solids (TSS) removal of at least 80%. The OGS unit will treat the post development flows to the required MOE quality standard, with a TSS removal rate of approximately 81.9%. Detailed information regarding the OGS unit can be seen in Appendix E.

2.7.2. Quality Control during Construction

During construction, earth grading and excavation will create the potential for soil erosion and sedimentation. It is imperative that effective environmental and sedimentation controls are in place and maintained throughout the duration of construction activities to ensure the stormwater runoff's quality. Therefore, the following recommendations shall be implemented and maintained during construction to achieve acceptable stormwater runoff quality:

- Installation of filter strips, silt fences and rock check dams or other similar facilities throughout the site, and specifically during all construction activities, in order to reduce stormwater drainage velocities and trap sediment on-site; and,
- Restoration of exposed surfaces with vegetative and non-vegetative material as soon as construction schedules permit; the duration in which surfaces are disturbed/exposed shall not exceed 30 days.
- Provision of a mud-mat where applicable at the construction entrances in order to control the tracking of sediment and debris onto municipal streets.
- Reduce stormwater drainage velocities where possible.
- Minimize the amount of existing vegetation removed.

3. Phosphorus Budget

Since the post-development state will increase the imperviousness of the site, considerations were taken in regard to phosphorus reduction. As there is no conservation authority in the area of the proposed site, the reduction was based on conservative values derived from the Lake Simcoe Region Conservation Authority (LSRCA) and Nottawasaga Conservation Authority (NVCA). Best efforts are to be employed in order to reduce phosphorus levels to pre-development levels or better.

The existing site generates approximately 6.93 kg of phosphorous annually and the proposed Project will generate approximately 5.03 kg of phosphorous annually. Due to the change of classification of the site from institutional to high-density residential, the site will produce less phosphorus than in pre-development conditions. However, best efforts to further decrease phosphorous will be used in order to reduce the phosphorus loading as much as is reasonably possible.

To minimize the amount of phosphorous being discharged from the site, a treatment train approach is proposed. A portion of the rooftop area will be conveyed to an underground infiltration system which will infiltrate any storm event of 1 mm or less over a portion of the rooftop area. When the chambers surcharge, storm runoff will overflow to the storm sewer and catch basin system which outlets into the dry pond. Stormwater from the parking areas will flow across the permeable pavers to be treated. According to the NVCA Standards the typical phosphorus reduction is 45% for permeable pavers, 10% for a dry pond and is 100% of infiltrated volume within underground storage chambers.

Additionally, while NVCA guidelines state that the OGS unit receives 0% phosphorous removal, it will assist in the capture of sediment and therefore inherently provide some reduction in phosphorous levels. The following chart details the anticipated phosphorous loadings for the pre and post-development conditions. Detailed calculations can be found in Appendix B.

Table 3: Phosphorus Loadings

	Total P (kg)
Pre-Development	6.93
Uncontrolled Post-Development	5.03
Controlled Post-Development	3.31

4. Water Balance

Since the post-development state will increase the imperviousness of the site, considerations were taken in regard to groundwater recharge. A water budget was completed as per LSRCA guidelines. Under pre-development conditions, the project site had an annual recharge volume of 3,601 m^3. With the increased imperviousness of the site, this recharge will be reduced to 3,579 m^3, resulting in a deficit volume of 22 m^3.

In order to infiltrate an additional 22 m^3 annually, a yearly rainfall depth of 13.5 mm from the western rooftop is required to be infiltrated resulting in a storage volume of 1.7 m^3. This percentage of annual rainfall occurs for rain events of 1 mm or less.

StormTech underground infiltration chambers are proposed to be utilized to meet the volume requirement by providing a storage volume of 2.0 m^3. The StormTech chambers are designed with a flat bottom in order to ensure equal infiltration throughout the chambers. The MECP recommends a minimum separation of 1.0 m from the bottom of the infiltration feature to the water table. The water table is 0.6 m to 5.0 m (average of 2.6 m) below ground as per the Geotechnical Investigation and therefore this criteria has been met. When the chambers back up due to them being at capacity, it will discharge through the overflow manhole and/or overflow pipe and be conveyed to the storm sewer system.

In-situ testing will be completed prior to construction to confirm infiltration rates. The soil infiltration rates are to be used in drawdown calculations for the sizing of the infiltration facilities. As per the geotechnical investigation, general soil types are expected to be conducive for infiltration and a conservative infiltration rate of 20 mm/hr was assumed for the design. Detailed water balance calculations have been provided in Appendix C.

5. Maintenance

5.1. Grassed Drainage Channel

The grassed drainage channel requires minimal maintenance once the vegetation has established. Vehicles should not drive or park on the vegetated area, and light mowing equipment should be utilized in order to avoid soil compaction which will reduce the infiltration capacity of the underlying soil. Grass should be cut to a height of 75 mm to 150 mm.

The swales should be inspected twice a year or after a major storm event (greater than the 25 mm storm) for damage or channelization. If any trash/debris is observed during inspections, it should be removed. Sediment buildup with a depth in excess of 25 mm should be removed during dry weather.

5.2. Permeable Pavers

Permeable pavers require regular inspection and maintenance to ensure that it functions properly. The limiting factor for permeable pavers is clogging within the aggregate layers, filler, or underdrain. The pavers themselves can be reused. Annual inspections of permeable pavers should be conducted in the spring to ensure continued infiltration performance and use the vacuum truck to verify the salt/sediment between the pavers is cleared. These inspections should check for spilling or deterioration and investigate whether water is draining between storms. The pavement reservoir should drain completely within 48 hours of the end of the storm event.

5.3. Underground Infiltration Chambers

The StormTech Chambers are proposed to provide 2.0 m^3 of underground infiltration volume. The chambers should be inspected every six (6) months and after each major rainfall event during the first year to ensure that the storm tanks are free of any debris. In subsequent years, the chambers should be inspected semi-annually, or more if deemed necessary for this specific site.

If the average depth of sediment exceeds 3 in throughout the length of the chamber, a cleanout should be performed. Maintenance should be executed using a vacuum pump truck to evacuate sediment and debris from system. The system should be flushed with clean water, with care taken to avoid extreme direct water pressures and is to be performed in dry weather. Material removed from the unit will be disposed of in a similar manner to that of other SWM facilities.

5.4. Oil/Grit Separator

The OGS unit should be inspected on a monthly basis during the rainy season to ensure that the unit is cleaned out at the appropriate time. Maintenance is to be performed in dry weather. Material removed from the unit will be disposed of in a similar manner to other SWM facilities. When oils are encountered in the unit, they should be immediately removed upon discovery using a small portable pump and/or adsorbent pads and the remaining water should be decanted to the sanitary sewer system for treatment at the local sewage treatment facility. Contact supplier for a listing of recommended oil sorbents. Any sludge or sediment in the bottom of the unit should them be removed and disposed of appropriately. Servicing should be performed immediately after any oil/containment spills in the area. Regular maintenance of the OGS unit will ensure satisfactory and long-term treatment.

5.5. Dry Pond

The dry pond should be inspected on a monthly basis and after significant rainfall events. All garbage and debris should be removed from the dry pond immediately. If permanent water is noticed, the hickenbottom structure should be inspected for clogging. The grass in the pond should not be cut unless absolutely necessary for aesthetic reasons. All grass clippings should be removed from the pond area such that the hickenbottom structure does not get clogged.

The hickenbottom structure is located in the proposed pond and should be inspected monthly during the first year of operation and in the spring and fall thereafter. Any standing water in the pond that does not drain away may indicated a blocked hickenbottom. It should be kept clear of debris, and any offending debris should be removed.

The overflow weir and spillways should be inspected every six months. Trash or other debris that is affecting the performance of the rip rap spill way should be removed. The overflow weir should be inspected to ensure that it is maintaining its original designed shape and configuration, with repairs being completed, as necessary.

5.6. Hickenbottom Outlet Structure

An orifice tube is located in the hickenbottom structure and should be inspected monthly during the first year of operation and in the spring and fall thereafter. Any standing water observed above the orifice invert of 266.45 m during inspection of the SWM Pond may indicate a blocked orifice tube. It should be kept clear of debris, and any offending debris should be removed.

6. Conclusions

Quantity control for the development will be provided in the SWM dry pond with the use of a hickenbottom outlet structure allowing post-development peak flows to be released at pre-development values.

A treatment train approach is implemented consisting of permeable pavers, the SWM dry pond, and an OGS to obtain quality control for the site and reduce phosphorus levels leaving the site.

All of which is respectfully submitted,

Pearson Engineering Ltd.

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Appendix A

Stormwater Management Calculations

PEARSON ENGINEERING LTD.

County of Simcoe Affordable Housing - Orillia
Calculation of Runoff Coefficients

Runoff Coefficient	=	0.20	0.95	0.95	0.60	0.95		Weighted
Surface Cover	=	Grass	Asphalt	Building	Gravel	Conc.		Runoff Coefficient
External	Total Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)		
EXT-1	128080	94314	0	33766	0	0		0.40
External Total	128080	94314	0	33766	0	0		0.40
Pre-Development	Total Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)		
1	7550	2673	227	4257	0	393		0.68
2	30534	15183	4368	4833	6145	5		0.51
Pre Total	38084	17856	4595	9090	6145	398		0.54
Post-Development	Total Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)		
1	123	0	0	0	0	123		0.95
2	4125	0	0	4125	0	0		0.95
3	5603	1271	3166	0	0	1166		0.78
4	2582	684	1652	19	0	227		0.75
5	3699	510	2525	405	0	259		0.85
6	3786	653	2483	405	0	245		0.82
7	3627	3602	0	0	0	25		0.21
8	1165	1165	0	0	0	34		0.23
9	1747	1228	57	0	0	462		0.42
10	3788	3293	235	0	0	260		0.30
11	7837	5337	0	2351	0	149		0.44
Post Total	38084	17744	10119	7305	0	2950		0.60

Notes:
1. Catchment Area 11 allow for future buildings adjacent to Peter Street North (Assuming 30% building area coverage).
2. Future building adjacent to West Street North is based on information provided by SCHC.
3. External Area assumed based on City of Orillia - 2020 Storm Drainage System Inventory, Drawing Sheet 16

PEARSON ENGINEERING LTD.

County of Simcoe Affordable Housing - Orillia
Pre-Development Peak Flows

City of Orillia

Storm Event (yrs)	Coeff A	Coeff B
2	22.5	-0.728
5	29.9	-0.725
10	34.8	-0.724
25	40.9	-0.723
50	45.5	-0.722
100	50.0	-0.722

Modified Rational Method
Q = CiCIA / 360

Where:
- Q - Flow Rate (m^3/s)
- C - Rational Method Runoff Coefficient
- I - Storm Intensity (mm/hr)
- A - Area (ha.)
- Ci - Peaking Coefficient

	External Flow from West Street & North Street	Project Site Area to Peter & North	Project Site Area to Peter & Borland
Area Number	EXT-1	1	2
Area	12.81 ha	0.76 ha	3.05 ha
Runoff Coefficient	0.40	0.68	0.51
Time of Concentration	20 min	10 min	10 min
Return Rate	2 year	2 year	2 year
Peaking Coefficient (Ci)	1.00	1.00	1.00
Rainfall Intensity	50.1 mm/hr	82.9 mm/hr	82.9 mm/hr
Pre-Development Peak Flow	0.71 m^3/s	0.12 m^3/s	0.36 m^3/s
Return Rate	5 year	5 year	5 year
Peaking Coefficient (Ci)	1.00	1.00	1.00
Rainfall Intensity	66.3 mm/hr	109.6 mm/hr	109.6 mm/hr
Pre-Development Peak Flow	0.94 m^3/s	0.16 m^3/s	0.47 m^3/s
Return Rate	10 year	10 year	10 year
Peaking Coefficient (Ci)	1.00	1.00	1.00
Rainfall Intensity	77.1 mm/hr	127.3 mm/hr	127.3 mm/hr
Pre-Development Peak Flow	1.09 m^3/s	0.18 m^3/s	0.55 m^3/s
Return Rate	25 year	25 year	25 year
Peaking Coefficient (Ci)	1.10	1.10	1.10
Rainfall Intensity	90.5 mm/hr	149.4 mm/hr	149.4 mm/hr
Pre-Development Peak Flow	1.41 m^3/s	0.24 m^3/s	0.71 m^3/s
Return Rate	50 year	50 year	50 year
Peaking Coefficient (Ci)	1.20	1.20	1.20
Rainfall Intensity	100.6 mm/hr	165.9 mm/hr	165.9 mm/hr
Pre-Development Peak Flow	1.71 m^3/s	0.29 m^3/s	0.86 m^3/s
Return Rate	100 year	100 year	100 year
Peaking Coefficient (Ci)	1.25	1.25	1.25
Rainfall Intensity	110.5 mm/hr	182.3 mm/hr	182.3 mm/hr
Pre-Development Peak Flow	1.95 m^3/s	0.33 m^3/s	0.98 m^3/s

County of Simcoe Affordable Housing - Orillia
Post-Development Peak Flows

Storm Event (yrs)	City of Orillia Coeff A	Coeff B
2	22.5	-0.728
5	29.9	-0.725
10	34.8	-0.724
25	40.9	-0.723
50	45.5	-0.722
100	50.0	-0.722

Modified Rational Method
$Q = CiCIA / 360$

Where:
- Q - Flow Rate (m^3/s)
- C - Rational Method Runoff Coefficient
- I - Storm Intensity (mm/hr)
- A - Area (ha.)
- Ci - Peaking Coefficient

	External Flow from West Street & North Street	Areas to SWM Pond	Uncontrolled Areas to Peter & Borland	Uncontrolled Area to Peter & North
Area Number	EXT-1	Areas 1 - 8	Areas 9 & 10	Area 11
Area	12.81 ha	2.47 ha	0.55 ha	0.78 ha
Runoff Coefficient	0.40	0.71	0.34	0.44
Time of Concentration	20 min	10 min	10 min	10 min
Return Rate	2 year	2 year	2 year	2 year
Peaking Coefficient (Ci)	1.00	1.00	1.00	1.00
Rainfall Intensity	50.1 mm/hr	82.9 mm/hr	82.9 mm/hr	82.9 mm/hr
Post-Development Peak Flow	0.71 m^3/s	0.41 m^3/s	0.04 m^3/s	0.08 m^3/s
Return Rate	5 year	5 year	5 year	5 year
Peaking Coefficient (Ci)	1.00	1.00	1.00	1.00
Rainfall Intensity	66.3 mm/hr	109.6 mm/hr	109.6 mm/hr	109.6 mm/hr
Post-Development Peak Flow	0.94 m^3/s	0.54 m^3/s	0.06 m^3/s	0.10 m^3/s
Return Rate	10 year	10 year	10 year	10 year
Peaking Coefficient (Ci)	1.00	1.00	1.00	1.00
Rainfall Intensity	77.1 mm/hr	127.3 mm/hr	127.3 mm/hr	127.3 mm/hr
Post-Development Peak Flow	1.09 m^3/s	0.62 m^3/s	0.07 m^3/s	0.12 m^3/s
Return Rate	25 year	25 year	25 year	25 year
Peaking Coefficient (Ci)	1.10	1.10	1.10	1.10
Rainfall Intensity	90.5 mm/hr	149.4 mm/hr	149.4 mm/hr	149.4 mm/hr
Post-Development Peak Flow	1.41 m^3/s	0.80 m^3/s	0.09 m^3/s	0.16 m^3/s
Return Rate	50 year	50 year	50 year	50 year
Peaking Coefficient (Ci)	1.20	1.20	1.20	1.20
Rainfall Intensity	100.6 mm/hr	165.9 mm/hr	165.9 mm/hr	165.9 mm/hr
Post-Development Peak Flow	1.71 m^3/s	0.97 m^3/s	0.10 m^3/s	0.19 m^3/s
Return Rate	100 year	100 year	100 year	100 year
Peaking Coefficient (Ci)	1.25	1.25	1.25	1.25
Rainfall Intensity	110.5 mm/hr	182.3 mm/hr	182.3 mm/hr	182.3 mm/hr
Post-Development Peak Flow	1.95 m^3/s	1.11 m^3/s	0.12 m^3/s	0.22 m^3/s

County of Simcoe Affordable Housing - Orillia
Stage-Storage-Discharge Table

Elevation (m)	Area (m^2)	Volume (m^3)	Cum. Vol. (m^3)	Orifice Tube Head (m)	Orifice Tube Flow (m^3/s)	Weir Head (m)	Weir Flow (m^3/s)	Total Flow (m^3/s)
265.45	0	0	0	0.00	0.000	0.00	0.000	0.000
265.50	49	1	1	0.00	0.000	0.00	0.000	0.000
265.60	136	9	10	0.00	0.000	0.00	0.000	0.000
265.70	163	15	25	0.10	0.079	0.00	0.000	0.079
265.80	190	18	43	0.20	0.112	0.00	0.000	0.112
265.90	217	20	63	0.30	0.137	0.00	0.000	0.137
266.00	246	23	87	0.40	0.158	0.00	0.000	0.158
266.10	276	26	113	0.50	0.177	0.00	0.000	0.177
266.20	306	29	142	0.60	0.194	0.00	0.000	0.194
266.30	338	32	174	0.70	0.210	0.00	0.000	0.210
266.40	370	35	209	0.80	0.224	0.00	0.000	0.224
266.50	403	39	248	0.90	0.238	0.00	0.000	0.238
266.60	437	42	290	1.00	0.250	0.00	0.000	0.250
266.70	472	45	336	1.10	0.263	0.00	0.000	0.263
266.80	508	49	385	1.20	0.274	0.00	0.000	0.274
266.90	545	53	437	1.30	0.286	0.00	0.000	0.286
267.00	583	56	494	1.40	0.296	0.00	0.000	0.296
267.10	621	60	554	1.50	0.307	0.00	0.000	0.307
267.20	661	64	618	1.60	0.317	0.00	0.000	0.317
267.29	697	61	679	1.69	0.326	0.00	0.000	0.326
267.30	701	7	686	1.70	0.327	0.01	0.005	0.331
267.40	741	72	758	1.80	0.336	0.11	0.239	0.575
267.50	781	76	834	1.90	0.345	0.21	0.793	1.139
267.59	817	72	906	1.99	0.353	0.30	1.606	1.960

Orifice Tube	
Diameter	300 mm
Invert Elevation	265.45
Orifice Constant	0.80
Orifice Centroid	265.60
Orifice Flow Formula	$0.80\pi(D/2000)^2 x(2x9.81xH)^{0.5}$

Major Storm Control Weir	
Width	3.00 m
Invert of Weir	267.29 m
Weir Flow Formula	$1.7WH^{1.5}$

PEARSON ENGINEERING LTD.

County of Simcoe Affordable Housing - Orillia
Quantity Control Volume Calculations

DATE:	13-Nov-20
FILE:	20002
CONTRACT/PROJECT:	SCHC Orillia
COMPLETED BY:	MJWP

Modified Rational Method Parameters

Pre Development Area (ha)	Post Development Area (ha)	Time of Concentration (min)	Time Increments (min)	Pre Development Runoff Coefficient	Post Development Runoff Coefficient
3.05	2.47	10	1.0	0.51	0.71

Note: Refer to page Calculation of Runoff Coefficients for detailed calculations of Modified Rational Method parameters.

Pre-Development Runoff Rate

	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
C	0.51	0.51	0.51	0.56	0.61	0.63
I	82.92	109.61	127.34	149.39	165.90	182.30
A	3.05	3.05	3.05	3.05	3.05	3.05
Q	0.36	0.47	0.55	0.71	0.86	0.98

Note: Q= 0.00278CIA

SWM Pond Design Input

Storm Event (yrs)	Chicago Storm Coefficient A	Chicago Storm Coefficient B	Allowable Outflow (m^3/s)	Post Development Runoff Coefficient
2	22.5	-0.728	0.187	0.71
5	29.9	-0.725	0.217	0.71
10	34.8	-0.724	0.234	0.71
25	40.9	-0.723	0.264	0.78
50	45.5	-0.722	0.287	0.85
100	50.0	-0.722	0.303	0.89

Results

Storm Event (yrs)	Storage (m^3)	Time (min)
2	132	13
5	196	15
10	243	17
25	346	21
50	452	24
100	544	27

Note: Storage volume calculated as per Hydrology Handbook, Second Edition, American Society of Civil Engineers, 1996

Time (min)	2 Year Intensity mm/hr	Inflow m^3/s	Outflow m^3/s	Storage m^3	Difference	5 Year Intensity mm/hr	Inflow m^3/s	Outflow m^3/s	Storage m^3	Difference
1	443.28	2.168	0.187	68	21	581.88	2.844	0.217	99	29
2	267.63	1.309	0.187	90	13	352.03	1.720	0.217	128	18
3	199.22	0.974	0.187	102	9	262.37	1.282	0.217	146	12
4	161.58	0.790	0.187	111	6	212.98	1.041	0.217	159	9
5	137.35	0.672	0.187	117	5	181.17	0.885	0.217	168	7
6	120.28	0.588	0.187	122	3	158.73	0.776	0.217	175	6
7	107.51	0.526	0.187	125	3	141.95	0.694	0.217	181	4
8	97.55	0.477	0.187	128	2	128.85	0.630	0.217	185	3
9	89.53	0.438	0.187	130	1	118.31	0.578	0.217	188	3
10	82.92	0.406	0.187	131	1	109.61	0.536	0.217	191	2
11	77.36	0.378	0.187	132	0	102.29	0.500	0.217	193	1
12	72.62	0.355	0.187	132	0	96.03	0.469	0.217	195	1
13	68.51	0.335	0.187	132	0	90.62	0.443	0.217	196	1
14	64.91	0.317	0.187	132	-1	85.88	0.420	0.217	196	0
15	61.73	0.302	0.187	131	-1	81.69	0.399	0.217	196	0
16	58.89	0.288	0.187	131	-1	77.95	0.381	0.217	196	0
17	56.35	0.276	0.187	130	-1	74.60	0.365	0.217	196	-1
18	54.06	0.264	0.187	128	-1	71.57	0.350	0.217	195	-1
19	51.97	0.254	0.187	127	-2	68.82	0.336	0.217	194	-1
20	50.06	0.245	0.187	126	-2	66.31	0.324	0.217	193	-1
21	48.32	0.236	0.187	124	-2	64.01	0.313	0.217	192	-1
22	46.71	0.228	0.187	122	-2	61.88	0.302	0.217	191	-2
23	45.22	0.221	0.187	120	-2	59.92	0.293	0.217	189	-2
24	43.84	0.214	0.187	118	-2	58.10	0.284	0.217	187	-2
25	42.56	0.208	0.187	116	-2	56.41	0.276	0.217	185	-2
26	41.36	0.202	0.187	114	-2	54.82	0.268	0.217	183	-2
27	40.24	0.197	0.187	111	-2	53.34	0.261	0.217	181	-2
28	39.19	0.192	0.187	109	-109	51.96	0.254	0.217	179	-2
29	38.20	0.187	0.000	0	0	50.65	0.248	0.217	177	-2
30	37.27	0.182	0.000	0	0	49.42	0.242	0.217	174	-3

Time (min)	10 Year Intensity mm/hr	Inflow m^3/s	Outflow m^3/s	Storage m^3	Difference	25 Year Intensity mm/hr	Inflow m^3/s	Outflow m^3/s	Storage m^3	Difference
1	674.47	3.296	0.234	121	35	789.45	4.244	0.264	168	46
2	408.33	1.996	0.234	155	21	478.28	2.571	0.264	214	29
3	304.46	1.488	0.234	177	15	356.75	1.918	0.264	242	21
4	247.21	1.208	0.234	192	11	289.76	1.558	0.264	263	16
5	210.33	1.028	0.234	203	9	246.59	1.326	0.264	279	13
6	184.32	0.901	0.234	212	7	216.13	1.162	0.264	292	10
7	164.86	0.806	0.234	219	6	193.34	1.039	0.264	302	9
8	149.67	0.731	0.234	225	5	175.55	0.944	0.264	311	7
9	137.43	0.672	0.234	229	4	161.22	0.867	0.264	318	6
10	127.34	0.622	0.234	233	3	149.39	0.803	0.264	324	5
11	118.85	0.581	0.234	236	2	139.44	0.750	0.264	329	4
12	111.59	0.545	0.234	238	2	130.94	0.704	0.264	333	3
13	105.31	0.515	0.234	240	1	123.58	0.664	0.264	336	3
14	99.81	0.488	0.234	241	1	117.13	0.630	0.264	339	2
15	94.94	0.464	0.234	242	0	111.43	0.599	0.264	341	2
16	90.61	0.443	0.234	242	0	106.35	0.572	0.264	343	1
17	86.72	0.424	0.234	243	0	101.79	0.547	0.264	344	1
18	83.20	0.407	0.234	242	0	97.67	0.525	0.264	345	1
19	80.01	0.391	0.234	242	-1	93.93	0.505	0.264	346	0
20	77.09	0.377	0.234	241	-1	90.51	0.487	0.264	346	0
21	74.42	0.364	0.234	240	-1	87.37	0.470	0.264	346	0
22	71.95	0.352	0.234	239	-1	84.48	0.454	0.264	346	0
23	69.67	0.341	0.234	238	-1	81.81	0.440	0.264	346	-1
24	67.56	0.330	0.234	237	-2	79.33	0.426	0.264	345	-1
25	65.59	0.321	0.234	235	-2	77.02	0.414	0.264	344	-1
26	63.76	0.312	0.234	233	-2	74.87	0.402	0.264	343	-1
27	62.04	0.303	0.234	231	-2	72.85	0.392	0.264	342	-1
28	60.43	0.295	0.234	229	-2	70.96	0.381	0.264	340	-2
29	58.91	0.288	0.234	227	-2	69.19	0.372	0.264	338	-2
30	57.48	0.281	0.234	225	-2	67.51	0.363	0.264	337	-2

Time (min)	50 Year Intensity mm/hr	Inflow m^3/s	Outflow m^3/s	Storage m^3	Difference	100 Year Intensity mm/hr	Inflow m^3/s	Outflow m^3/s	Storage m^3	Difference
1	874.65	5.130	0.287	213	57	961.16	5.872	0.303	252	66
2	530.26	3.110	0.287	270	36	582.71	3.560	0.303	318	42
3	395.69	2.321	0.287	306	26	434.82	2.656	0.303	360	31
4	321.48	1.885	0.287	332	20	353.27	2.158	0.303	390	24
5	273.64	1.605	0.287	352	16	300.70	1.837	0.303	415	20
6	239.89	1.407	0.287	369	14	263.61	1.610	0.303	434	16
7	214.62	1.259	0.287	382	11	235.85	1.441	0.303	450	14
8	194.90	1.143	0.287	394	10	214.17	1.308	0.303	464	12
9	179.01	1.050	0.287	403	8	196.71	1.202	0.303	476	10
10	165.90	0.973	0.287	412	7	182.30	1.114	0.303	486	9
11	154.86	0.908	0.287	419	6	170.18	1.040	0.303	495	8
12	145.43	0.853	0.287	425	5	159.82	0.976	0.303	503	7
13	137.27	0.805	0.287	430	4	150.84	0.922	0.303	509	6
14	130.12	0.763	0.287	434	4	142.99	0.873	0.303	515	5
15	123.79	0.726	0.287	438	3	136.04	0.831	0.303	520	4
16	118.16	0.693	0.287	441	3	129.84	0.793	0.303	525	4
17	113.10	0.663	0.287	444	2	124.28	0.759	0.303	529	3
18	108.53	0.636	0.287	446	2	119.26	0.729	0.303	532	3
19	104.37	0.612	0.287	448	1	114.69	0.701	0.303	535	2
20	100.58	0.590	0.287	450	1	110.52	0.675	0.303	537	2
21	97.09	0.569	0.287	451	1	106.70	0.652	0.303	539	2
22	93.89	0.551	0.287	451	0	103.17	0.630	0.303	541	1
23	90.92	0.533	0.287	452	0	99.91	0.610	0.303	542	1
24	88.17	0.517	0.287	452	0	96.89	0.592	0.303	543	1
25	85.61	0.502	0.287	452	0	94.08	0.575	0.303	543	0
26	83.22	0.488	0.287	451	-1	91.45	0.559	0.303	544	0
27	80.98	0.475	0.287	451	-1	88.99	0.544	0.303	544	0
28	78.88	0.463	0.287	450	-1	86.69	0.530	0.303	544	0
29	76.91	0.451	0.287	449	-1	84.52	0.516	0.303	543	-1
30	75.05	0.440	0.287	448	-1	82.47	0.504	0.303	543	-1

(highlighted) = Maximum Storage Volume

County of Simcoe Affordable Housing - Orillia
Permeable Pavers Sizing Calculations

Infiltration volumes from MOE Stormwater Management Planning and Design Manual to size Permeable Pavers Table 3.2 Water Quality Storage Requirements are as follows:

Design Area Total	=	2.47	ha		
Total Imperviousness	=	71%			
Storage Volume	=	35.5	m^3/ha		(Enhanced 80% long-term S.S. removal)
Area 1 Storage Volume Required	=	2.47		x	35.5
	=	87.7	m^3		

Find Storage Volume provided in Permeable Pavers:

Area of Pavers (A)	=	678.8	m^2
Depth of Trench (d)	=	0.50	m
Storage Volume (V)	=	0.4(A x d)	
	=	135.8	m^3

		Required		**Provided**	
Area Storage Volume	=	87.7	m^3	135.8	m^3

Use Equation 4.12 to find Area of Permeable Pavers:

Area Design Volume (V)	=	135.8	m^3
Depth of Controlling Filter Medium (d)	=	0.50	m
Coefficient of Permeability of the Controlling Filter Media (k)	=	45.0	mm/hr
Operating Head of Water On the Filter (h)	=	0.15	m
Design Drawdown Time (t)	=	24	hr

Surface Area of Filter (A) $= \frac{1000Vd}{k(h+d)t}$

$= 96.7\ m^2$

		Required		**Provided**	
Surface Area	=	96.7	m^2	678.8	m^2

Q = 0.0028*C*I*A (m^3/s)
C = Runoff Coefficient
I = Rainfall Intensity = A*Time^{C}
A = Area (ha)

County of Simcoe Affordable Housing - Orillia
Storm Sewer Design
2-Year Storm Event

DATE: 13-Nov-20
FILE: 20002
CONTRACT/PROJECT: SCHC Orillia

Areas	Manhole		Length	Increment			Total	Flow Time (min)		I	Total Q	S	D	Q Full	V Full
	From	To	(m)	C	A	CA	CA	TO	IN	(mm/h)	(m^3/s)	(%)	(mm)	(m^3/s)	(m/s)
Area 1	CB1	MH7	13.7	0.95	0.01	0.01	0.01	10.00	0.17	82.92	0.003	1.0	300	0.097	1.37
-	MH7	MH1	49.1	0.00	0.00	0.00	0.01	10.17	0.60	81.93	0.003	1.0	300	0.097	1.37
-	MH1	EX. CBMH28	7.0	0.00	0.00	0.00	0.01	10.76	0.09	78.59	0.003	1.0	300	0.097	1.37
Area 2	STM CAP	MH4	23.9	0.95	0.41	0.39	0.39	10.00	0.22	82.92	0.090	1.8	300	0.129	1.82
-	MH3	CBMH5	34.3	0.00	0.00	0.00	0.39	10.22	0.40	81.63	0.089	1.1	300	0.101	1.42
Area 2	STM CAP	MH3	19.7	0.95	0.41	0.39	0.39	10.00	0.17	82.92	0.090	2.0	300	0.137	1.94
-	MH3	CBMH5	42.1	0.00	0.00	0.00	0.39	10.17	0.51	81.91	0.089	1.0	300	0.097	1.37
Area 3	CBMH5	CBMH4	40.5	0.78	0.56	0.44	1.22	10.68	0.43	79.03	0.268	1.0	375	0.175	1.59
Area 4	CBMH4	CBMH3	37.6	0.75	0.26	0.19	1.41	11.11	0.39	76.82	0.302	1.0	375	0.175	1.59
Area 5	CBMH3	CBMH2	27.0	0.85	0.37	0.31	1.73	11.50	0.25	74.89	0.359	1.0	450	0.285	1.79
-	FUT. STM CAP	MH5	25.7	0.00	0.00	0.00	0.00	10.00	0.22	82.92	0.000	2.0	300	0.137	1.94
-	MH5	CBMH2	36.1	0.00	0.00	0.00	0.00	10.22	0.31	81.61	0.000	2.0	300	0.137	1.94
Area 6	CBMH2	STM POND	36.9	0.82	0.38	0.31	2.04	11.75	0.44	73.72	0.417	0.5	525	0.304	1.40
Area 8	STM POND	OGS	12.2	0.23	0.12	0.03	0.03	10.00	0.09	82.92	0.158	2.0	375	0.248	2.25
-	OGS	DIMH1	39.6	0.00	0.00	0.00	0.03	10.09	0.29	82.38	0.158	2.0	375	0.248	2.25
Area 7 & EXT-1	DIMH1	CBMH1	17.9	0.39	13.17	5.17	5.19	10.38	0.10	80.68	1.323	2.0	600	0.868	3.07

Note: Higlighted Cell Indicates SWM Dry Pond Flow Through the Orifice Structure.

Channel Report

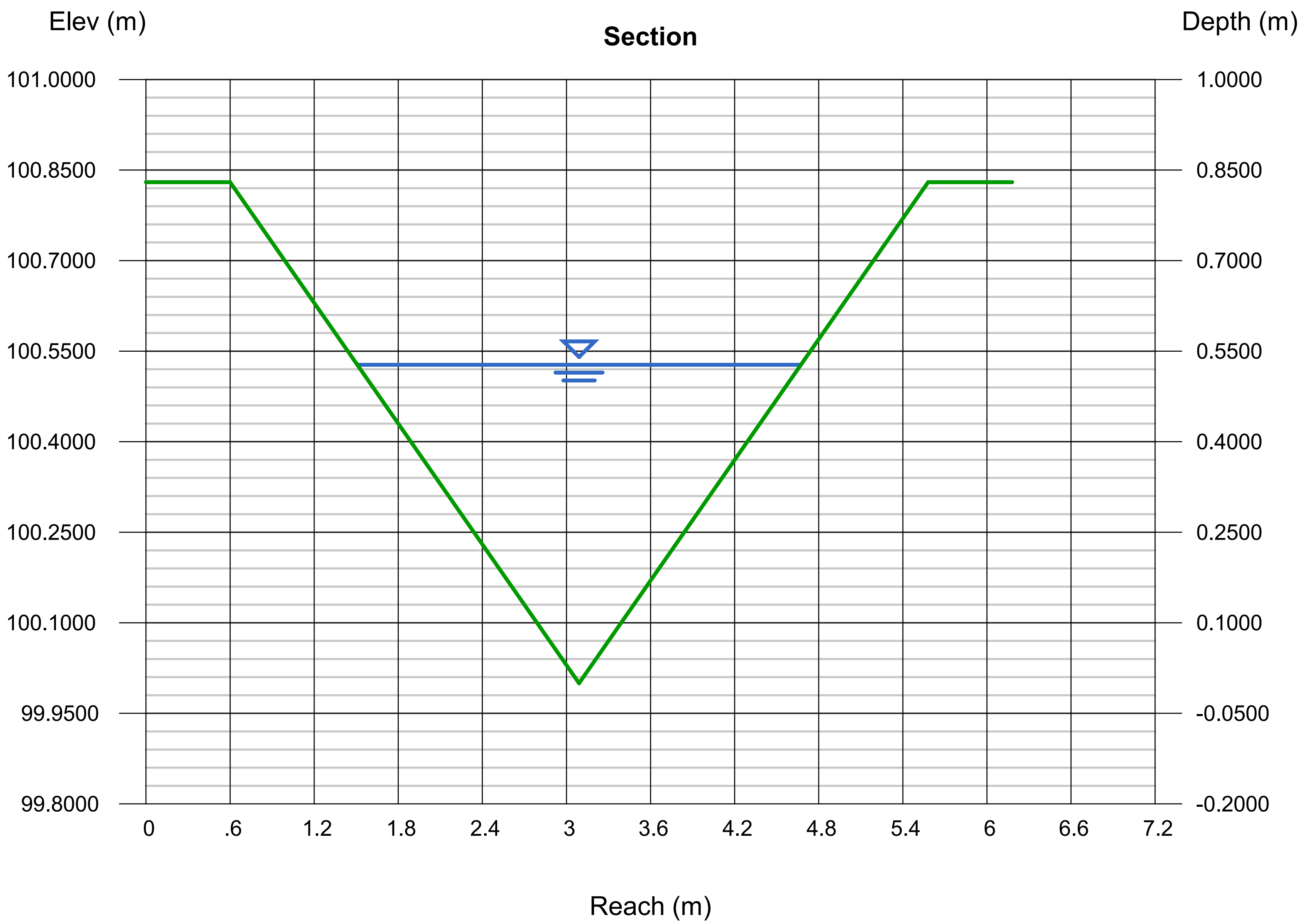
SCHC - Orillia Drainage Channel

Triangular
Side Slopes (z:1) = 3.0000, 3.0000
Total Depth (m) = 0.8300

Invert Elev (m) = 100.0000
Slope (%) = 0.5000
N-Value = 0.012

Calculations
Compute by: Known Q
Known Q (cms) = 1.9500

Highlighted
Depth (m) = 0.5273
Q (cms) = 1.9500
Area (sqm) = 0.8341
Velocity (m/s) = 2.3377
Wetted Perim (m) = 3.3350
Crit Depth, Yc (m) = 0.6126
Top Width (m) = 3.1638
EGL (m) = 0.8061



Appendix B

Phosphorous Budget Calculations

County of Simcoe Affordable Housing - Orillia
Phosphorus Budget

Barrie Creeks	**Forest**	**Hay / Pasture**	**High Intensity Residential**	**High Intensity Institutional**
Phosphorus Export (kg/ha/year)	0.05	0.07	1.32	1.82

Pre-Development Condition:

	Forest	Hay / Pasture	High Intensity Residential	High Intensity Institutional
Area (ha)	0.00	0.00	0.00	3.81
Total P (kg)	0.00	0.00	0.00	6.93
Total Pre-Development P (kg)		**6.93**		

Post-Development Condition (Uncontrolled):

	Forest	Hay / Pasture	High Intensity Residential	High Intensity Institutional
Area (ha):	0.00	0.00	3.81	0.00
Total P (kg) :	0.00	0.00	5.03	0.00
Total Uncontrolled Post-Development (kg):		**5.03**		

Post-Development Condition (Controlled):

Uncontrolled Total Area	Forest	Hay / Pasture	High Intensity Residential	High Intensity Institutional
Area (ha):	0.00	0.00	1.34	0.00
Total P (kg) :	0.00	0.00	1.77	0.00

Area Draining to Permeable Pavers and Dry Pond	Forest	Hay / Pasture	High Intensity Residential	High Intensity Institutional
Area (ha):	0.00	0.00	2.11	0.00
Total P (kg) :	0.00	0.00	2.78	0.00

Sand or Media Filters	
Total P (kg):	2.78
Sand or Media Filters Proficiency (%):	45
P Removed (kg):	1.25
P Remaining (kg):	1.53

Dry Detention Ponds	
Total P remaining from Permeable Pavers (kg):	1.53
Dry Detention Ponds Proficiency (%):	10
P Removed (kg):	0.15
P Remaining (kg):	1.38

Area Draining to Grassed Channel	Forest	Hay / Pasture	High Intensity Residential	High Intensity Institutional
Area (ha):	0.00	0.00	0.36	0.00
Total P (kg) :	0.00	0.00	0.48	0.00

Vegetated Filter Strip	
Total P (kg):	0.48
Vegetated Filter Strip Proficiency (%):	65
P Removed (kg):	0.31
P Remaining (kg):	0.17
Total Post-Development (kg):	**3.31**

Appendix C

Water Balance Calculations

County of Simcoe Affordable Housing - Orillia
Pre-Development Water Balance

Catchment Designation	Site				
	Grassed	Impervious	Building	Total	
Area	17856	11138	9090	38084	
Pervious Area	17856	0	0	17856	
Impervious Area	0	11138	9090	20228	
Infiltration Factors					
Topography Infiltration Factor	0.3	0.0	0.0		(From MOE Table 3.1 for Rolling Land)
Soil Infiltration Factor	0.3	0.0	0.0		(From MOE Table 3.1 for an average value between Medium combinations of clay and loam and Open sandy loam)
Land Cover Infiltration Factor	0.0	0.0	0.0		
MOE Infiltration Factor	0.6	0.0	0.0		
Actual Infiltration Factor	0.6	0.0	0.0		
Run-Off Coeffiecient	0.4	1.0	1.0		
Runoff from Impervious Surfaces*	0.0	0.8	0.8		
Inputs (per Unit Area)					
Precipitation	932.9	932.9	932.9		(Precipitation values from Environment Canada)
Run-On	0.0	0.0	0.0		
Other Inputs	0.0	0.0	0.0		
Total Inputs	932.9	932.9	932.9		
Outputs (per Unit Area)					
Precipitation Surplus	336.2	746.3	746.3	376	
Net Surplus	336.2	746.3	746.3	376	
Evapotranspiration	596.7	186.6	186.6	334	(Evapotranspiration values from Table 5-2 in the City of Barrie Tier Three Recharge Estimation, dated June 2012)
Infiltration	201.7	0.0	0.0	95	
Rooftop Infiltration	0.0	0.0	0.0	0	
Total Infiltration	201.7	0.0	0.0	202	
Runoff Pervious Areas	134.5	0.0	0.0	134	
Runoff Impervious Areas	0.0	746.3	746.3	1493	
Total Runoff	134.5	746.3	746.3	1627	
Total Outputs	932.9	932.9	932.9	2799	
Difference (Inputs - Outputs)	0.0	0.0	0.0	0	
Inputs (Volumes)					
Precipitation	16658	10391	8480	35529	
Run-On	0	0	0	0	
Other Inputs	0	0	0	0	
Total Inputs	16658	10391	8480	35529	
Outputs (Volumes)					
Precipitation Surplus	6002	8313	6784	21099	
Net Surplus	6002	8313	6784	21099	
Evapotranspiration	10656	2078	1696	14430	
Infiltration	3601	0	0	3601	
Rooftop Infiltration	0	0	0	0	
Total Infiltration	3601	0	0	3601	
Runoff Pervious Areas	2401	0	0	2401	
Runoff Impervious Areas	0	8313	6784	15097	
Total Runoff	2401	8313	6784	17497	
Total Outputs	16658	10391	8480	35529	
Difference (Inputs - Outputs)	0	0	0	0	

Note: Highlighted cells are input cells.

County of Simcoe Affordable Housing - Orillia
Post-Development Water Balance (Without Infiltration)

Catchment Designation	Site			
	Grassed	Impervious	Building	Total
Area	17744	13069	7305	38118
Pervious Area	17744	0	0	17744
Impervious Area	0	13069	7305	20374
Infiltration Factors				
Topography Infiltration Factor	0.3	0.0	0.0	
Soil Infiltration Factor	0.3	0.0	0.0	
Land Cover Infiltration Factor	0.0	0.0	0.0	
MOE Infiltration Factor	0.6	0.0	0.0	
Actual Infiltration Factor	0.6	0.0	0.0	
Run-Off Coeffiecient	0.4	1.0	1.0	
Runoff from Impervious Surfaces*	0.0	0.8	0.8	
Inputs (per Unit Area)				
Precipitation	932.9	932.9	932.9	932.9
Run-On	0.0	0.0	0.0	0.0
Other Inputs	0.0	0.0	0.0	0.0
Total Inputs	932.9	932.9	932.9	932.9
Outputs (per Unit Area)				
Precipitation Surplus	336.2	746.3	746.3	555.4
Net Surplus	336.2	746.3	746.3	555.4
Evapotranspiration	596.7	186.6	186.6	377.5
Infiltration	201.7	0.0	0.0	93.9
Rooftop Infiltration	0.0	0.0	0.0	0.0
Total Infiltration	201.7	0.0	0.0	93.9
Runoff Pervious Areas	134.5	0.0	0.0	62.6
Runoff Impervious Areas	0.0	746.3	746.3	398.9
Total Runoff	134.5	746.3	746.3	461.5
Total Outputs	932.9	932.9	932.9	932.9
Difference (Inputs - Outputs)	0.0	0.0	0.0	
Inputs (Volumes)				
Precipitation	16553	12192	6815	35560
Run-On	0	0	0	0
Other Inputs	0	0	0	0
Total Inputs	16553	12192	6815	35560
Outputs (Volumes)				
Precipitation Surplus	5965	9754	5452	21170
Net Surplus	5965	9754	5452	21170
Evapotranspiration	10589	2438	1363	14390
Infiltration	3579	0	0	3579
Rooftop Infiltration	0	0	0	0
Total Infiltration	3579	0	0	3579
Runoff Pervious Areas	2386	0	0	2386
Runoff Impervious Areas	0	9754	5452	15206
Total Runoff	2386	9754	5452	17591
Total Outputs	16553	12192	6815	35560
Difference (Inputs - Outputs)	0	0	0	0

(From MOE Table 3.1 for Rolling Land)

(From MOE Table 3.1 for an average value between Medium combinations of clay and loam and Open sandy loam)

(Precipitation values from Environment Canada)

(Evapotranspiration values from Table 5-2 in the City of Barrie Tier Three Recharge Estimation, dated June 2012)

Note: Highlighted cells are input cells.

County of Simcoe Affordable Housing - Orillia
Post Development Water Balance (With Infiltration)

Catchment Designation	Site: Grassed	Site: Impervious	Site: Building (w. Infiltration)	Site: Total	
Area	17744	18706	1668	38118	
Pervious Area	17744	0	0	17744	
Impervious Area	0	18706	1668	20374	
Infiltration Factors					
Topography Infiltration Factor	0.3	0.0	0.0		(From MOE Table 3.1 for Rolling Land)
Soil Infiltration Factor	0.3	0.0	0.0		(From MOE Table 3.1 for an average value between Medium combinations of clay and loam and Open sandy loam)
Land Cover Infiltration Factor	0.0	0.0	0.0		
MOE Infiltration Factor	0.6	0.0	0.0		
Actual Infiltration Factor	0.6	0.0	0.0		
Run-Off Coeffiecient	0.4	1.0	1.0		
Runoff from Impervious Surfaces*	0	0.8	0.8		
Inputs (per Unit Area)					(Precipitation values from Environment Canada)
Precipitation	932.9	932.9	932.9	932.9	
Run-On	0.0	0.0	0.0	0.0	
Other Inputs	0.0	0.0	0.0	0.0	
Total Inputs	932.9	932.9	932.9	932.9	
Outputs (per Unit Area)					
Precipitation Surplus	336.2	746.3	746.3	555.4	
Net Surplus	336.2	746.3	732.8	554.8	
Evapotranspiration	596.7	186.6	200.1	378.1	(Evapotranspiration values from Table 5-2 in the City of Barrie Tier Three Recharge Estimation, dated June 2012)
Infiltration	201.7	0.0	0.0	93.9	
Rooftop Infiltration	0.0	0.0	**13.5**	0.6	
Total Infiltration	201.7	0.0	13.5	94.5	Depth of rainfall over the rooftop required to be infiltrated to achieve water balance.
Runoff Pervious Areas	134.5	0.0	0.0	62.6	
Runoff Impervious Areas	0.0	746.3	719.3	397.7	
Total Runoff	134.5	746.3	719.3	460.3	
Total Outputs	932.9	932.9	932.9	932.9	
Difference (Inputs - Outputs)	0.0	0.0	0.0	0.0	
Inputs (Volumes)					
Precipitation	16553	17451	1556	35560	
Run-On	0	0	0	0	
Other Inputs	0	0	0	0	
Total Inputs	16553	17451	1556	35560	
Outputs (Volumes)					
Precipitation Surplus	5965	13961	1245	21170	
Net Surplus	5965	13961	1222	21148	
Evapotranspiration	10589	3490	334	14412	
Infiltration	3579	0	0	3579	
Rooftop Infiltration	0	0	23	23	
Total Infiltration	3579	0	23	3601	
Runoff Pervious Areas	2386	0	0	2386	
Runoff Impervious Areas	0	13961	1200	15160	
Total Runoff	2386	13961	1200	17546	
Total Outputs	16553	17451	1556	35560	
Difference (Inputs - Outputs)	0	0	0	0	

Note: Highlighted cells are input cells.

County of Simcoe Affordable Housing - Orillia
Water Balance Calculations

Annual Rainfall Depth Required

Depth of Rainfall Required	=	13.5	mm	(From Post-Development Water Balance (w. Infiltration))

Find Percent of Annual Rainfall that Required Rainfall Depth represents:

Annual Rainfall for Study Area	=	932.9	mm
% Annual Rainfall	=	13.5 mm / 932.9 mm	
	=	1%	

From MOE Figure C-2, 1% of annual rainfall occurs for storm events of 1 mm or less.

Find storage volume required for rainfall events of 1 mm to Rooftop Infiltration Gallery:

Roof Top Area	=	1,668	m^2	
Rainfall Depth	=	1	mm	
Storage Volume Required	=	A	x	D
	=	1,668	x	1.0
	=	1.7	m^3	

It is proposed to infiltrate any storm event of 1 mm or less over the rooftop area, resulting in a storage volume of 2 m^3. Therefore, water balance for the site is achieved.

Appendix D

Stormtech Underground Infiltration Chamber Information

StormTech®

Detention • Retention • Water Quality

A division of ADS

Product Catalog

(Not intended for design layouts, refer to the appropriate "StormTech Design Manual" for specific chamber design information.)

StormTech Subsurface Stormwater Management

Table of Contents

StormTech has thousands of chamber systems in service throughout the world. All StormTech chambers are designed to meet the most stringent industry performance standards for superior structural integrity. The StormTech system is designed primarily to be used under parking lots, roadways and heavy earth loads saving valuable land and protecting water resources for commercial and municipal applications. In our continuing desire to answer designers' challenges, StormTech has expanded the family of products providing engineers, developers, regulators and contractors with additional site specific flexibility.

Advanced Structural Performance for Greater Long-Term Reliability

StormTech developed a state of the art chamber design through:

- Collaboration with world-renowned experts of buried drainage structures to develop and evaluate the structural testing program and product design
- Designing chambers to exceed American Association of State Highway and Transportation Officials (AASHTO) LRFD design specifications for HS-20 live loads and deep burial earth loads
- Subjecting the chambers to rigorous full scale testing, under severe loading conditions to verify the AASHTO safety factors for live load and deep burial applications
- Designing chambers to conform to the requirements of ASTM F2418 (polypropylene chambers) and ASTM F2922 (polyethylene chambers) and design requirements of ASTM F2787 ensuring both the assurance of product quality and safe structural design

Our Chambers Provide...

- Large capacity that *fits very tight footprints* providing developers with more useable land for development.
- *A proven attenuation alternative* to cumbersome large diameter metal pipe or snap together plastic crates and unreliable multi-layer systems.
- Provides the *strength* of concrete vaults at a very competitive price.
- The robust *continuous true elliptical arch design* which effectively transfers loads to the surrounding backfill providing the long-term safety factor required by AASHTO. Offers developers a cost-effective underground system that will perform as designed for decades.
- *Designed in accordance with the AASHTO LRFD Bridge Design Specifications* providing engineers with a structural performance standard for live and long-term dead loads.
- *Polypropylene and polyethylene* resins tested using ASTM standards to ensure long and short-term structural properties.
- *Injection molded* for uniform wall thickness and repeatable quality.
- Third party *tested and patented Isolator Row* for less frequent maintenance, water quality and long-term performance.
- Incorporates *traditional manifold/header designs* using conventional hydraulic equations that can easily verify flow equalization and scour velocity.
- *Open chamber design* requiring only one chamber model to construct each row assuring ease of construction and no repeating end walls to obstruct access or flow.

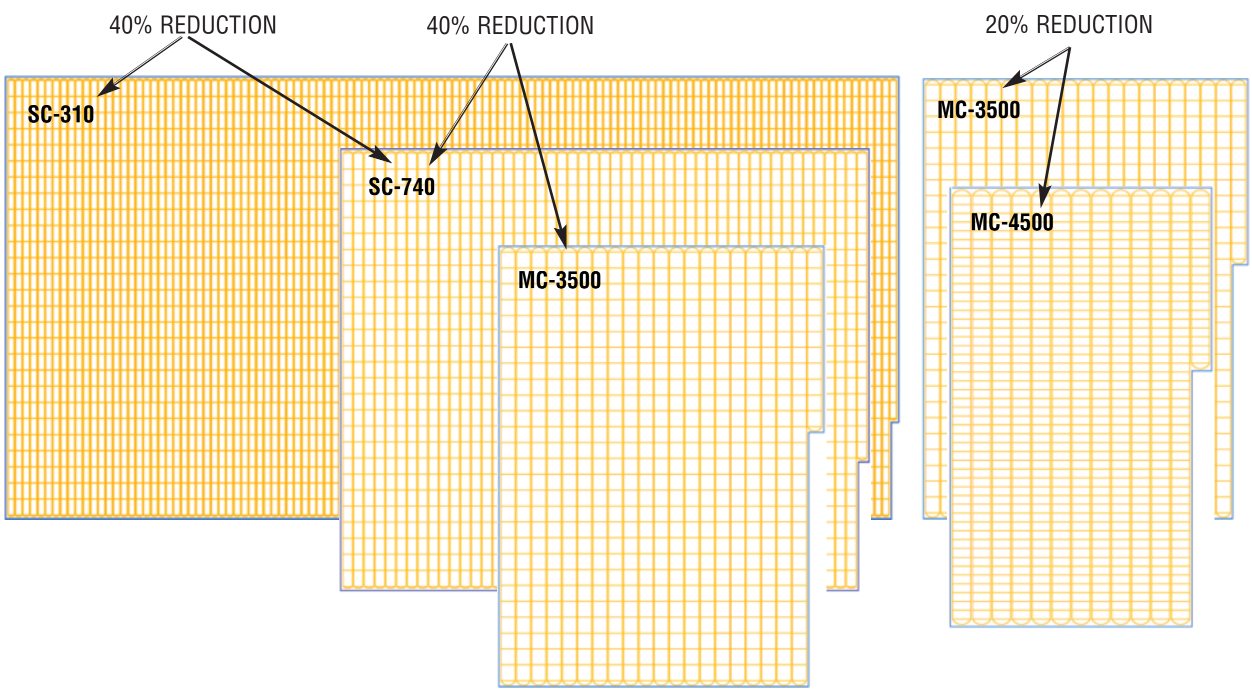
StormTech offers a variety of chamber sizes (SC-310, SC-740, DC-780, MC-3500 and MC-4500) so the consulting design engineer can choose the chamber that is best suited for the site conditions and regulatory requirements. StormTech has thousands of chamber systems in service worldwide. We provide plan layout and cost estimate services at no charge for consulting engineers and developers.

StormTech Subsurface Stormwater Management

PRODUCT SPECIFICATIONS	SC-310	SC-740	DC-780	MC-3500	MC-4500
Height, in. (mm)	16 (406)	30 (762)	30 (762)	45 (1143)	60 (1524)
Width, in. (mm)	34 (864)	51 (1295)	51 (1295)	77 (1956)	100 (2540)
Length, in. (mm)	90.7 (2300)	90.7 (2300)	90.7 (2300)	90 (2286)	52 (1321)
Installed Length, in. (mm)	85.4 (2170)	85.4 (2170)	85.4 (2170)	86.0 (2184)	48.3 (1227)
Bare Chamber Storage, cf (cm)	14.7 (0.42)	45.9 (1.30)	46.2 (1.30)	109.9 (3.11)	106.5 (3.01)
Stone above, in. (mm)	6 (152)	6 (152)	6 (152)	12 (305)	12 (305)
Stone below, in. (mm)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)
Row Spacing, in. (mm)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)
Minimum Installed Storage, cf (cm)	**31.0 (0.88)**	**74.9 (2.12)**	**78.4 (2.22)**	**178.9 (5.06)**	**162.6 (4.60)**
Storage Per Unit Area, cf/sf (cm/sm)	1.31 (0.39)	2.21 (0.67)	2.32 (0.70)	3.48 (1.06)	4.45 (1.35)

***NOTE**: Spec sheets for our RC-310 and RC-750, recycled chambers, are available upon request.*

Example: Footprint Comparison – 100,000 CF Project



StormTech and LEED

List of LEED Credits that StormTech may contribute towards:

SUSTAINABLE SITES

- **SS Credit 5.1 - Site Development: Protect or Restore Habitat**
  Utilizing StormTech System beneath roadways, surface parking, walkways, etc. may reduce overall site disturbance
- **SS Credit 5.2 - Site Development: Maximize Open Space**
  Utilizing StormTech System can increase overall open space and may reduce overall site disturbance
- **SS Credit 6.1 - Stormwater Design: Quantity Control**
  Design StormTech System per local or LEED stormwater quantity requirements, whichever is more stringent
- **SS Credit 6.2 - Stormwater Design: Quality Control**
  Use of Isolator Row provides sediment removal, and can also promote infiltration and groundwater recharge
- **SS Credit 7.1 - Heat Island Effect: Non-Roof**
  Use of StormTech System may eliminate need for above ground detention ponds, thus reducing thermal impacts of stormwater runoff

Water Efficiency

- **WE Credit 1 - Water Efficient Landscaping**
  Utilize StormTech System to store captured rainwater for landscape irrigation
- **WE Credit 2 - Innovative Wastewater Technologies**
  Utilize StormTech System to store captured rainwater to reduce potable water demand.
- **WE Credit 3 - Water Use Reduction**
  Utilize StormTech System to store captured rainwater and allow reuse for non-potable applications

Materials and Resources

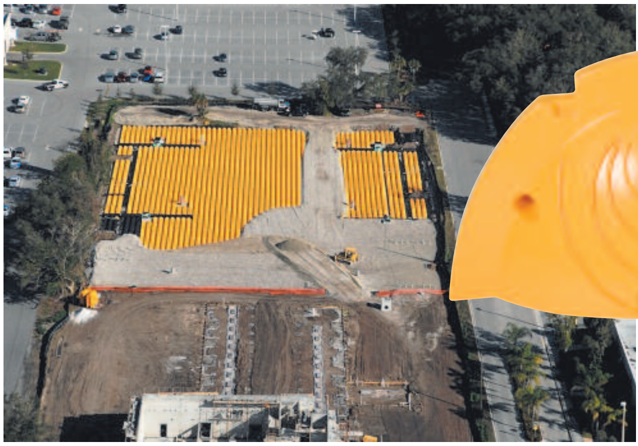
- **MR Credit 4 – Recycled Content**
  Utilize recycled concrete as the backfill material for the StormTech System.
- **MR Credit 5 – Regional Materials**
  Stone backfill material for the StormTech System will apply if extracted within 500 miles of project site.

Innovation & Design

- **ID Credit 1 – Innovation in Design**
  Utilize StormTech System to substantially exceed a performance credit

StormTech SC-310 Chamber

Designed to meet the most stringent industry performance standards for superior structural integrity while providing designers with a cost-effective method to save valuable land and protect water resources. The StormTech system is designed primarily to be used under parking lots thus maximizing land usage for commercial and municipal applications.



StormTech SC-310 Chamber (not to scale)

Nominal Chamber Specifications

Size (L x W x H)	85.4" x 34.0" x 16.0" (2170 x 864 x 406 mm)
Chamber Storage	14.7 ft^3 (0.42 m^3)
Min. Installed Storage*	31.0 ft^3 (0.88 m^3)
Weight	37.0 lbs (16.8 kg)

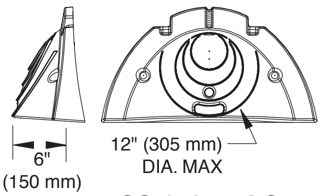
*Assumes 6" (152 mm) stone above, below and between chambers and 40% stone porosity.

Shipping

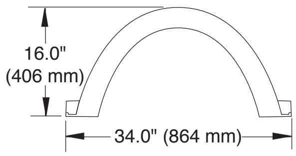
41 chambers/pallet

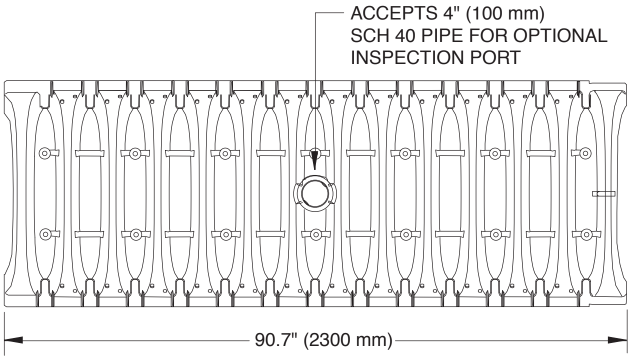
108 end caps/pallet

19 pallets/truck

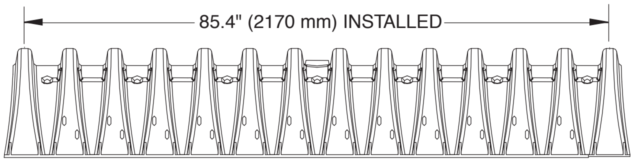


SC-310 End Cap





SC-310 Chamber



StormTech SC-310 Chamber

SC-310 Cumulative Storage Volumes Per Chamber

Assumes 40% Stone Porosity. Calculations are Based Upon a 6" (152 mm) Stone Base Under the Chambers.

Depth of Water in System Inches (mm)	Cumulative Chamber Storage ft^3 (m^3)	Total System Cumulative Storage ft^3 (m^3)
28 (711)	14.70 (0.416)	31.00 (0.878)
27 (686)	14.70 (0.416)	30.21 (0.855)
26 (680)	Stone 14.70 (0.416)	29.42 (0.833)
25 (610)	Cover 14.70 (0.416)	28.63 (0.811)
24 (609)	14.70 (0.416)	27.84 (0.788)
23 (584)	14.70 (0.416)	27.05 (0.766)
22 (559)	14.70 (0.416)	26.26 (0.748)
21 (533)	14.64 (0.415)	25.43 (0.720)
20 (508)	14.49 (0.410)	24.54 (0.695)
19 (483)	14.22 (0.403)	23.58 (0.668)
18 (457)	13.68 (0.387)	22.47 (0.636)
17 (432)	12.99 (0.368)	21.25 (0.602)
16 (406)	12.17 (0.345)	19.97 (0.566)
15 (381)	11.25 (0.319)	18.62 (0.528)
14 (356)	10.23 (0.290)	17.22 (0.488)
13 (330)	9.15 (0.260)	15.78 (0.447)
12 (305)	7.99 (0.227)	14.29 (0.425)
11 (279)	6.78 (0.192)	12.77 (0.362)
10 (254)	5.51 (0.156)	11.22 (0.318)
9 (229)	4.19 (0.119)	9.64 (0.278)
8 (203)	2.83 (0.081)	8.03 (0.227)
7 (178)	1.43 (0.041)	6.40 (0.181)
6 (152)	0	4.74 (0.134)
5 (127)	0	3.95 (0.112)
4 (102)	0	3.16 (0.090)
3 (76)	Stone Foundation 0	2.37 (0.067)
2 (51)	0	1.58 (0.046)
1 (25)	0	0.79 (0.022)

Note: Add 0.79 cu. ft. (0.022 m^3) of storage for each additional inch (25 mm) of stone foundation.

Storage Volume Per Chamber ft^3 (m^3)

	Bare Chamber Storage	Chamber and Stone Stone Foundation Depth in. (mm)		
	ft^3 (m^3)	6 (152)	12 (305)	18 (457)
StormTech SC-310	14.7 (0.4)	31.0 (0.9)	35.7 (1.0)	40.4 (1.1)

Note: Assumes 6" (152 mm) of stone above chambers, 6" (152 mm) row spacing and 40% stone porosity.

Amount of Stone Per Chamber

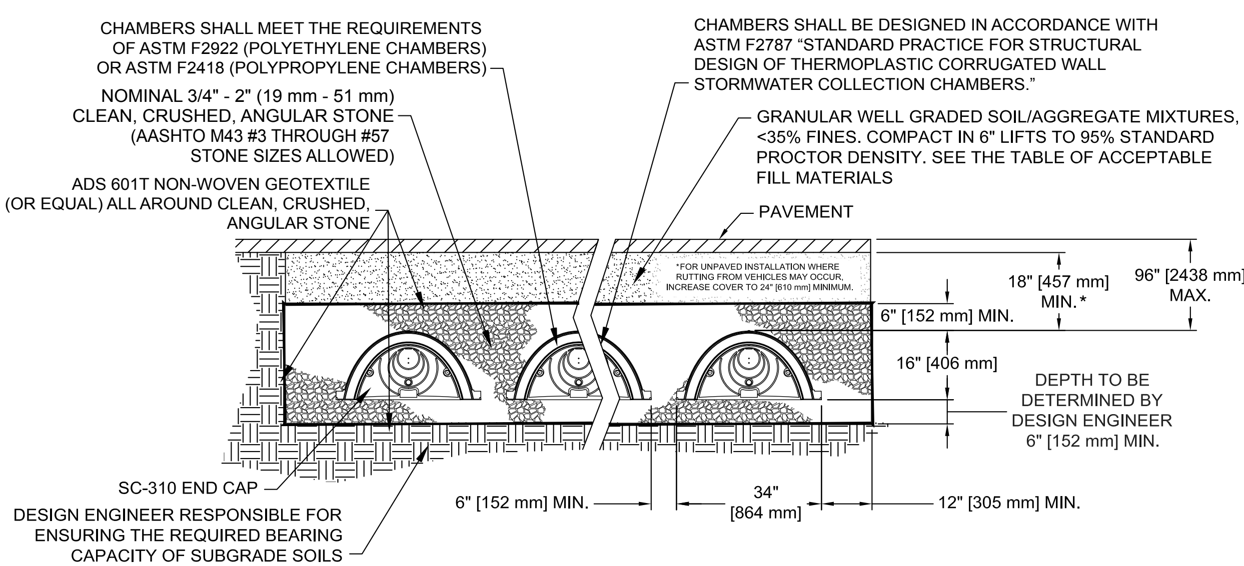
	Stone Foundation Depth		
ENGLISH TONS (yds^3)	**6"**	**12"**	**18"**
StormTech SC-310	2.1 (1.5 yd^3)	2.7 (1.9 yd^3)	3.4 (2.4 yd^3)
METRIC KILOGRAMS (m^3)	**152 mm**	**305 mm**	**457 mm**
StormTech SC-310	1830 (1.1 m^3)	2490 (1.5 m^3)	2990 (1.8 m^3)

Note: Assumes 6" (152 mm) of stone above, and between chambers.

Volume of Excavation Per Chamber yd^3 (m^3)

	Stone Foundation Depth		
	6" (152 mm)	12" (305 mm)	18" (457 mm)
StormTech SC-310	2.9 (2.2)	3.4 (2.6)	3.8 (2.9)

Note: Assumes 6" (152 mm) of row separation and 18" (457 mm) of cover. The volume of excavation will vary as the depth of the cover increases.



THE INSTALLED CHAMBER SYSTEM SHALL PROVIDE THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12 FOR EARTH AND LIVE LOADS, WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.

StormTech SC-310-3 Chamber

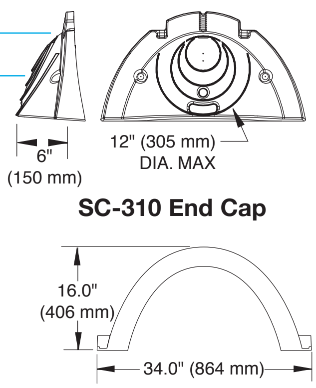
The proven strength and durability of the SC-310-3 Chamber allows for a design option for sites where limited cover, limited space, high water table and escalated aggregate cost are a factor. The SC-310-3 has a minimum cover requirement of 16" (406 mm) to bottom of pavement and reduces the spacing requirement between chambers by 50% to 3" (76 mm). This provides a reduced footprint overall and allows the designer to offer a traffic bearing application yet comply with water table separation regulations.

StormTech SC-310-3 Chamber (not to scale)

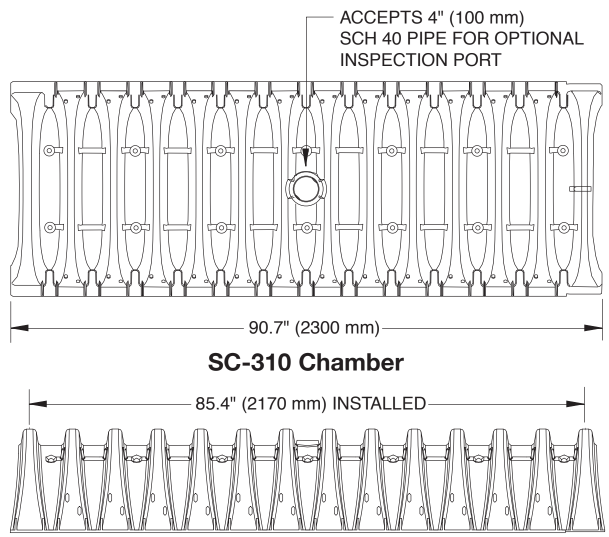
Nominal Chamber Specifications

Size (L x W x H)	85.4" x 34.0" x 16.0" (2170 x 864 x 406 mm)
Chamber Storage	14.7 ft³ (0.42 m³)
Min. Installed Storage*	29.3 ft³ (0.83 m³)
Weight	37.0 lbs (16.8 kg)

*Assumes 6" (152 mm) stone above and below chambers, 3" (76 mm) row spacing and 40% stone porosity.



SC-310 End Cap

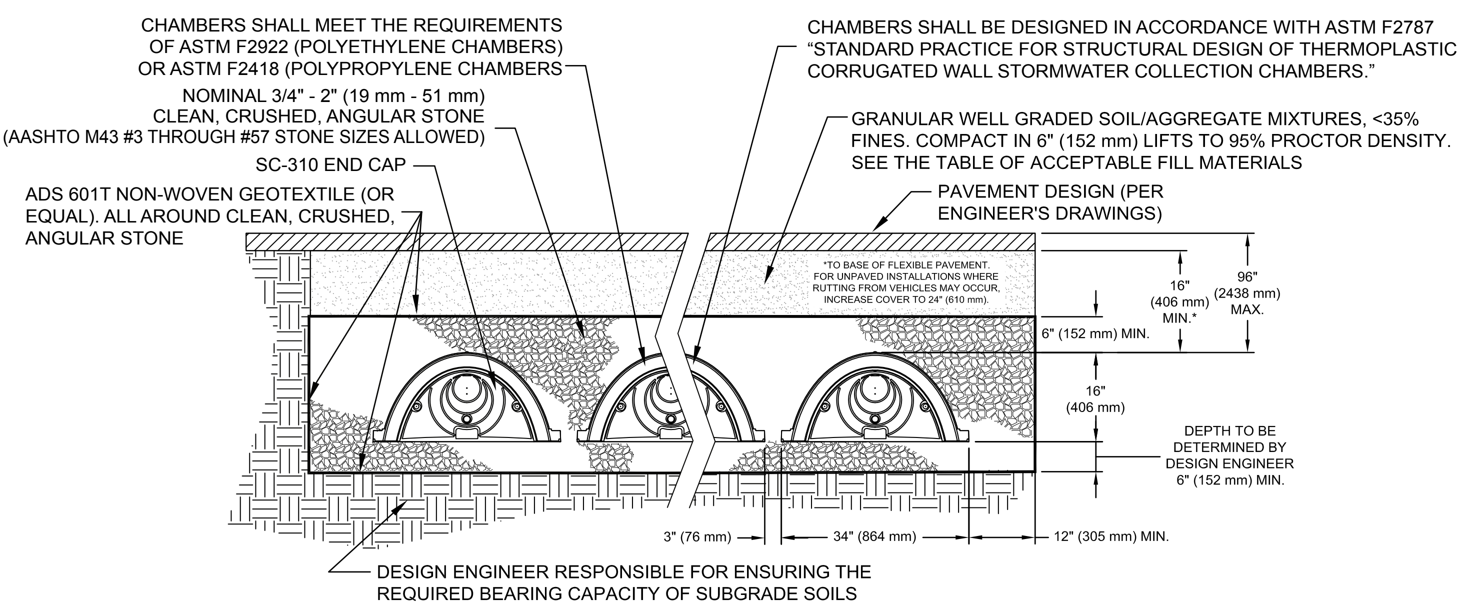


SC-310 Chamber

Shipping

- 41 chambers/pallet
- 108 end caps/pallet
- 19 pallets/truck

Typical Cross Section Detail



THE INSTALLED CHAMBER SYSTEM SHALL PROVIDE THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12 FOR EARTH AND LIVE LOADS, WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.

StormTech SC-310-3 Chamber

SC-310-3 Cumulative Storage Volume Per Chamber

Assumes 40% Stone Porosity. Calculations are Based Upon a 6" (152 mm) Stone Base Under the Chambers.

Depth of Water in System Inches (mm)	Cumulative Chamber Storage ft³ (m³)	Total System Cumulative Storage ft³ (m³)
28 (711)	14.7 (0.416)	29.34 (0.831)
27 (686)	14.7 (0.416)	28.60 (0.810)
26 (660)	Stone 14.7 (0.416)	27.87 (0.789)
25 (635)	Cover 14.7 (0.416)	27.14 (0.769)
24 (610)	14.7 (0.416)	26.41 (0.748)
23 (584)	14.7 (0.416)	25.68 (0.727)
22 (559)	14.7 (0.416)	24.95 (0.707)
21 (533)	14.64 (0.415)	24.18 (0.685)
20 (508)	14.49 (0.410)	23.36 (0.661)
19 (483)	14.22 (0.403)	22.47 (0.636)
18 (457)	13.68 (0.387)	21.41 (0.606)
17 (432)	12.99 (0.368)	20.25 (0.573)
16 (406)	12.17 (0.345)	19.03 (0.539)
15 (381)	11.25 (0.319)	17.74 (0.502)
14 (356)	10.23 (0.290)	16.40 (0.464)
13 (330)	9.15 (0.260)	15.01 (0.425)
12 (305)	7.99 (0.226)	13.59 (0.385)
11 (279)	6.78 (0.192)	12.13 (0.343)
10 (254)	5.51 (0.156)	10.63 (0.301)
9 (229)	4.19 (0.119)	9.11 (0.258)
8 (203)	2.83 (0.080)	7.56 (0.214)
7 (178)	1.43 (0.040)	5.98 (0.169)
6 (152)	0	4.39 (0.124)
5 (127)	0	3.66 (0.104)
4 (102)	Stone Foundation 0	2.93 (0.083)
3 (76)	0	2.19 (0.062)
2 (51)	0	1.46 (0.041)
1 (25)	0	0.73 (0.021)

Note: Add 0.73 ft³ (0.021 m³) of storage for each additional inch (25 mm) of stone foundation.

Storage Volume per Chamber ft³ (m³)

	Bare Chamber Storage	Chamber and Stone Volume Stone Foundation Depth in. (mm)		
	ft³ (m³)	6 (152)	12 (305)	18 (457)
SC-310-3	14.7 (0.42)	29.3 (0.83)	33.7 (0.95)	38.1 (1.08)

Note: Assumes 6" (152 mm) of stone above chambers, 3" (76 mm) row spacing and 40% stone porosity.

Volume of Excavation Per Chamber yd³ (m³)

	Stone Foundation Depth		
	6" (152)	12" (305)	18" (457)
SC-310-3	2.6 (2.0)	3.0 (2.3)	3.4 (2.6)

Note: Assumes 3" (76 mm) of row separation, 6" (152 mm) of stone above the chambers and 16" (406 mm) of cover. The volume of excavation will vary as depth of cover increases.

Amount of Stone Per Chamber

	Stone Foundation Depth		
ENGLISH TONS (yd³)	**6"**	**12"**	**18"**
SC-310-3	1.9 (1.4)	2.5 (1.8)	3.1 (2.2)
METRIC KILOGRAMS (m³)	**152 mm**	**305 mm**	**457 mm**
SC-310-3	1724 (1.0)	2268 (1.3)	2812 (1.7)

Note: Assumes 6" (152 mm) of stone above chambers and 3" (76 mm) row spacing.

Cover ft (m)	Minimum Required Bearing Resistance for Service Loads ksf (kPa) 3.0 (144)	2.9 (139)	2.8 (134)	2.7 (129)	2.6 (124)	2.5 (120)	2.4 (115)	2.3 (110)	2.2 (105)	2.1 (101)	2.0 (96)
1.5 (0.46)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)
2 (0.61)	6 152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)
2.5 (0.76)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)
3 (0.91)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)
3.5 (1.07)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	12 (305)
4 (1.22)	6 152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)
4.5 (1.37)	6 152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)
5 (1.52)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)
5.5 (1.68)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	12 (305)
6 (1.83)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)
6.5 (1.98)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)
7 (2.13)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)
7.5 (2.29)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)
8 (2.44)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	15 (381)

NOTE: The design engineer is solely responsible for assessing the bearing resistance (allowable bearing capacity) of the subgrade soils and determining the depth of foundation stone. Subgrade bearing resistance should be assessed with consideration for the range of soil moisture conditions expected under a stormwater system.

StormTech SC-740 Chamber

Designed to meet the most stringent industry performance standards for superior structural integrity while providing designers with a cost-effective method to save valuable land and protect water resources. The StormTech system is designed primarily to be used under parking lots thus maximizing land usage for commercial and municipal applications.

StormTech SC-740 Chamber (not to scale)

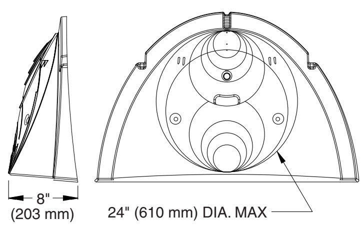
Nominal Chamber Specifications

Size (L x W x H)	85.4" x 51.0" x 30.0" (2170 x 1295 x 762 mm)
Chamber Storage	45.9 ft^3 (1.30 m^3)
Min. Installed Storage*	74.9 ft^3 (2.12 m^3)
Weight	74.0 lbs (33.6 kg)

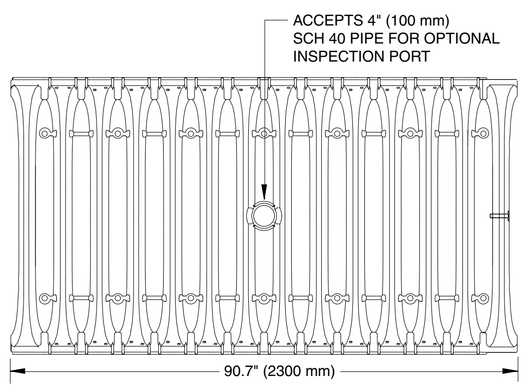
*Assumes 6" (152 mm) stone above, below and between chambers and 40% stone porosity.

Shipping

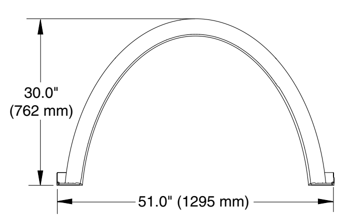
- 30 chambers/pallet
- 60 end caps/pallet
- 12 pallets/truck

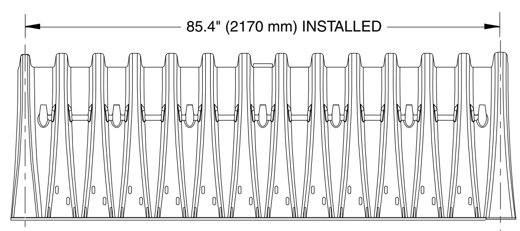


SC-740 End Cap



SC-740 Chamber





StormTech SC-740 Chamber

SC-740 Cumulative Storage Volumes Per Chamber

Assumes 40% Stone Porosity. Calculations are Based Upon a 6" (152 mm) Stone Base Under the Chambers.

Depth of Water in System Inches (mm)	Cumulative Chamber Storage Ft³ (m³)	Total System Cumulative Storage Ft³ (m³)
42 (1067)	↑ 45.90 (1.300)	74.90 (2.121)
41 (1041)	45.90 (1.300)	73.77 (2.089)
40 (1016)	Stone 45.90 (1.300)	72.64 (2.057)
39 (991)	Cover 45.90 (1.300)	71.52 (2.025)
38 (965)	45.90 (1.300)	70.39 (1.993)
37 (948)	↓ 45.90 (1.300)	69.26 (1.961)
36 (914)	45.90 (1.300)	68.14 (1.929)
35 (889)	45.85 (1.298)	66.98 (1.897)
34 (864)	45.69 (1.294)	65.75 (1.862)
33 (838)	45.41 (1.286)	64.46 (1.825)
32 (813)	44.81 (1.269)	62.97 (1.783)
31 (787)	44.01 (1.246)	61.36 (1.737)
30 (762)	43.06 (1.219)	59.66 (1.689)
29 (737)	41.98 (1.189)	57.89 (1.639)
28 (711)	40.80 (1.155)	56.05 (1.587)
27 (686)	39.54 (1.120)	54.17 (1.534)
26 (660)	38.18 (1.081)	52.23 (1.479)
25 (635)	36.74 (1.040)	50.23 (1.422)
24 (610)	35.22 (0.977)	48.19 (1.365)
23 (584)	33.64 (0.953)	46.11 (1.306)
22 (559)	31.99 (0.906)	44.00 (1.246)
21 (533)	30.29 (0.858)	41.85 (1.185)
20 (508)	28.54 (0.808)	39.67 (1.123)
19 (483)	26.74 (0.757)	37.47 (1.061)
18 (457)	24.89 (0.705)	35.23 (0.997)
17 (432)	23.00 (0.651)	32.96 (0.939)
16 (406)	21.06 (0.596)	30.68 (0.869)
15 (381)	19.09 (0.541)	28.36 (0.803)
14 (356)	17.08 (0.484)	26.03 (0.737)
13 (330)	15.04 (0.426)	23.68 (0.670)
12 (305)	12.97 (0.367)	21.31 (0.608)
11 (279)	10.87 (0.309)	18.92 (0.535)
10 (254)	8.74 (0.247)	16.51 (0.468)
9 (229)	6.58 (0.186)	14.09 (0.399)

SC-740 Cumulative Storage Volumes Per Chamber (cont.)

Depth of Water in System Inches (mm)	Cumulative Chamber Storage Ft³ (m³)	Total System Cumulative Storage Ft³ (m³)
8 (203)	4.41 (0.125)	11.66 (0.330)
7 (178)	2.21 (0.063)	9.21 (0.264)
6 (152)	↑ 0	6.76 (0.191)
5 (127)	0	5.63 (0.160)
4 (102)	Stone Foundation 0	4.51 (0.125)
3 (76)	0	3.38 (0.095)
2 (51)	0	2.25 (0.064)
1 (25)	↓ 0	1.13 (0.032)

Note: Add 1.13 cu. ft. (0.032 m³) of storage for each additional inch (25 mm) of stone foundation.

Storage Volume Per Chamber ft³ (m³)

	Bare Chamber Storage	Chamber and Stone Stone Foundation Depth in. (mm)		
	ft³ (m³)	6 (152)	12 (305)	18 (457)
StormTech SC-740	45.9 (1.3)	74.9 (2.1)	81.7 (2.3)	88.4 (2.5)

Note: Assumes 6" (152 mm) of stone above chambers, 6" (152 mm) row spacing and 40% porosity.

Amount of Stone Per Chamber

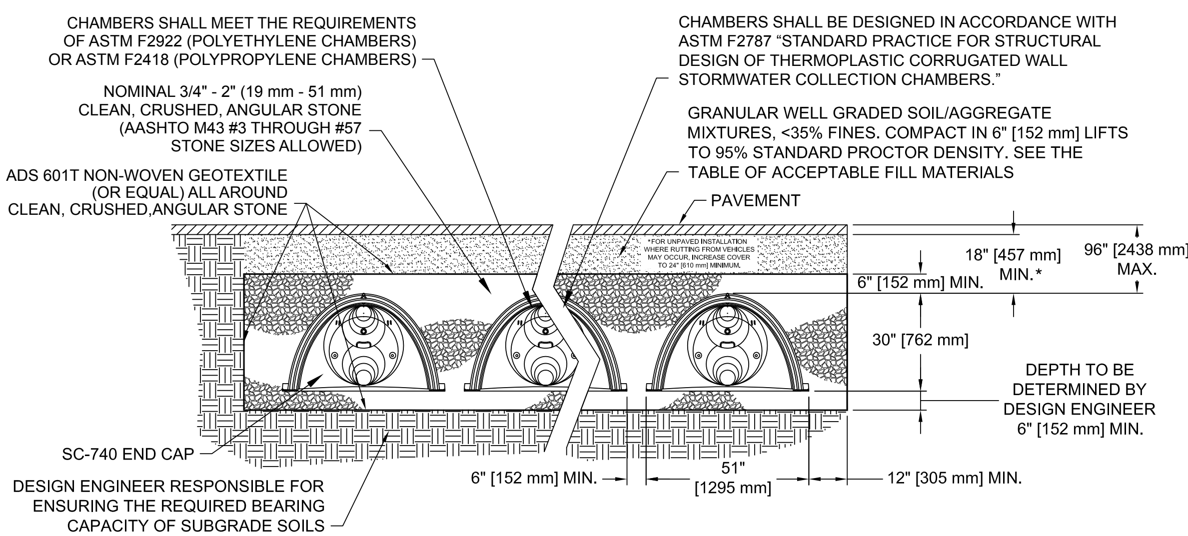
	Stone Foundation Depth		
ENGLISH TONS (yd³)	6"	12"	18"
StormTech SC-740	3.8 (2.8 yd³)	4.6 (3.3 yd³)	5.5 (3.9 yd³)
METRIC KILOGRAMS (m³)	**152 mm**	**305 mm**	**457 mm**
StormTech SC-740	3450 (2.1 m³)	4170 (2.5 m³)	4490 (3.0 m³)

Note: Assumes 6" (150 mm) of stone above, and between chambers.

Volume of Excavation Per Chamber yd³ (m³)

	Stone Foundation Depth		
	6" (152 mm)	12" (305 mm)	18" (457 mm)
StormTech SC-740	5.5 (4.2)	6.2 (4.7)	6.8 (5.2)

Note: Assumes 6" (152 mm) of row separation and 18" (457 mm) of cover. Volume of excavation will vary as depth of cover increases.

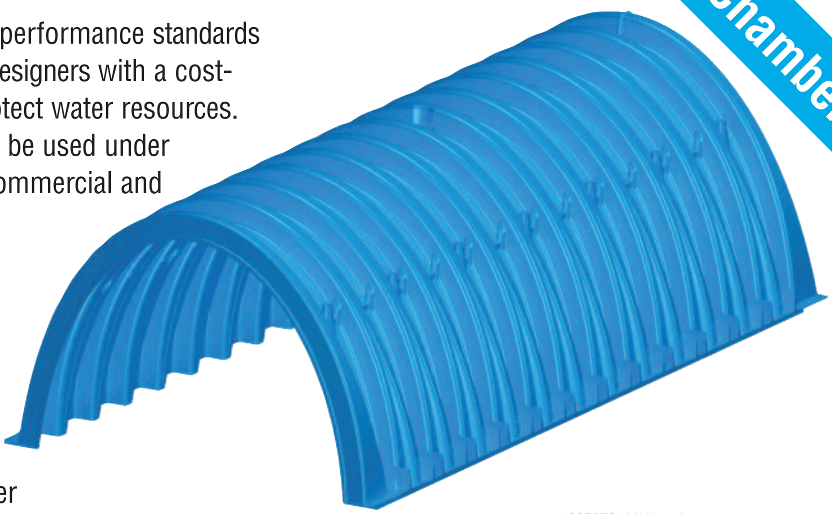


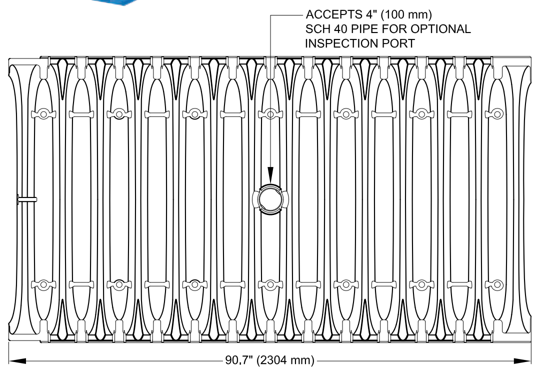
THIS CROSS SECTION DETAILS THE REQUIREMENTS NECESSARY TO SATISFY THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12 FOR EARTH AND LIVE LOADS USING STORMTECH CHAMBERS

StormTech DC-780 Chamber

Designed to meet the most stringent industry performance standards for superior structural integrity while providing designers with a cost-effective method to save valuable land and protect water resources. The StormTech system is designed primarily to be used under parking lots thus maximizing land usage for commercial and municipal applications.

- 12' Deep Cover applications.
- Designed in accordance with ASTM F 2787 and produced to meet the ASTM F 2418 product standard.
- AASHTO safety factors provided for AASHTO Design Truck (H20) and deep cover conditions





StormTech DC-780 Chamber (not to scale)

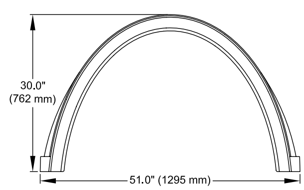
Nominal Chamber Specifications

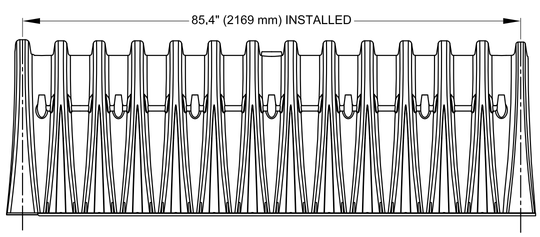
Size (L x W x H)	85.4" x 51.0" x 30.0" (2169 x 1295 x 762 mm)
Chamber Storage	46.2 ft³ (1.3 m³)
Min. Installed Storage*	78.4 ft³ (2.2 m³)

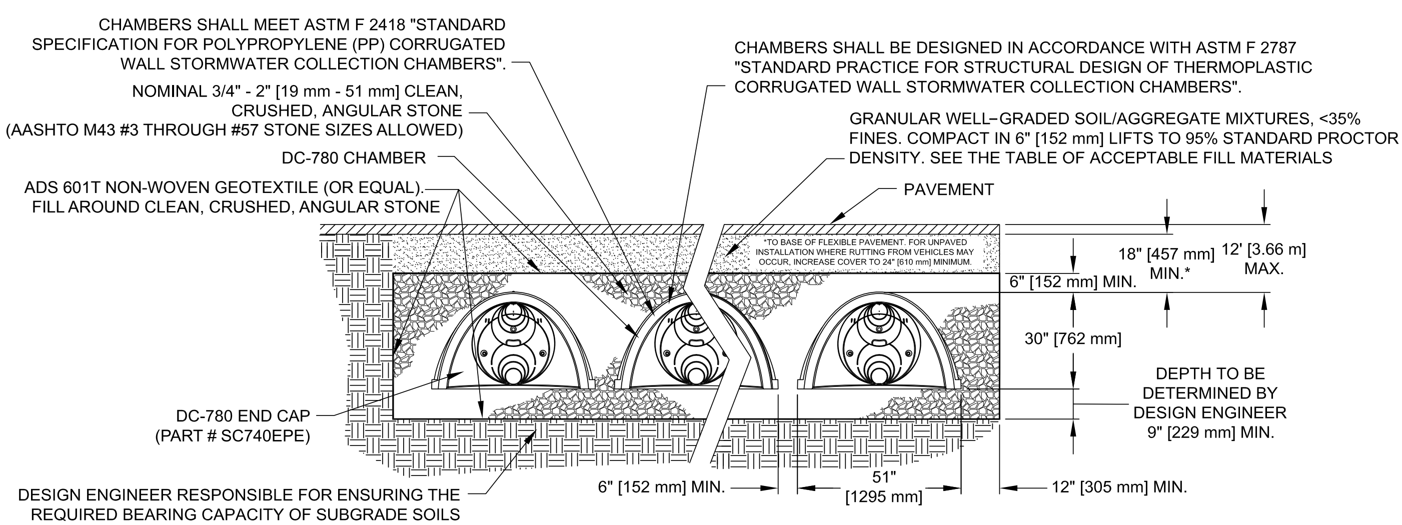
* Assumes 9" (229 mm) stone below, 6" (152 mm) stone above, 6" (152 mm) row spacing and 40% stone porosity.

Shipping

- 25 chambers/pallet
- 60 end caps/pallet
- 12 pallets/truck







THIS CROSS SECTION DETAILS THE REQUIREMENTS NECESSARY TO SATISFY THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12 FOR EARTH AND LIVE LOADS USING STORMTECH CHAMBERS

StormTech DC-780 Chamber

DC-780 Cumulative Storage Volumes Per Chamber

Assumes 40% Stone Porosity. Calculations are Based Upon a 9" (229 mm) Stone Base Under the Chambers.

Depth of Water in System Inches (mm)	Cumulative Chamber Storage ft³ (m³)	Total System Cumulative Storage ft³ (m³)
45 (1143)	46.27 (1.310)	78.47 (2.222)
44 (1118)	46.27 (1.310)	77.34 (2.190)
43 (1092)	Stone 46.27 (1.310)	76.21 (2.158)
42 (1067)	Cover 46.27 (1.310)	75.09 (2.126)
41 (1041)	46.27 (1.310)	73.96 (2.094)
40 (1016)	46.27 (1.310)	72.83 (2.062)
39 (991)	46.27 (1.310)	71.71 (2.030)
38 (965)	46.21 (1.309)	70.54 (1.998)
37 (940)	46.04 (1.304)	69.32 (1.963)
36 (914)	45.76 (1.296)	68.02 (1.926)
35 (889)	45.15 (1.278)	66.53 (1.884)
34 (864)	44.34 (1.255)	64.91 (1.838)
33 (838)	43.38 (1.228)	63.21 (1.790)
32 (813)	42.29 (1.198)	61.43 (1.740)
31 (787)	41.11 (1.164)	59.59 (1.688)
30 (762)	39.83 (1.128)	57.70 (1.634)
29 (737)	38.47 (1.089)	55.76 (1.579)
28 (711)	37.01 (1.048)	53.76 (1.522)
27 (686)	35.49 (1.005)	51.72 (1.464)
26 (660)	33.90 (0.960)	49.63 (1.405)
25 (635)	32.24 (0.913)	47.52 (1.346)
24 (610)	30.54 (0.865)	45.36 (1.285)
23 (584)	28.77 (0.815)	43.18 (1.223)
22 (559)	26.96 (0.763)	40.97 (1.160)
21 (533)	25.10 (0.711)	38.72 (1.096)
20 (508)	23.19 (0.657)	36.45 (1.032)
19 (483)	21.25 (0.602)	34.16 (0.967)
18 (457)	19.26 (0.545)	31.84 (0.902)
17 (432)	17.24 (0.488)	29.50 (0.835)
16 (406)	15.19 (0.430)	27.14 (0.769)
15 (381)	13.10 (0.371)	24.76 (0.701)
14 (356)	10.98 (0.311)	22.36 (0.633)
13 (330)	8.83 (0.250)	19.95 (0.565)
12 (305)	6.66 (0.189)	17.52 (0.496)
11 (279)	4.46 (0.126)	15.07 (0.427)

DC-780 Cumulative Storage Volumes Per Chamber (cont.)

Depth of Water in System Inches (mm)	Cumulative Chamber Storage ft³ (m³)	Total System Cumulative Storage ft³ (m³)
10 (254)	2.24 (0.064)	12.61 (0.357)
9 (229)	0	10.14 (0.287)
8 (203)	0	9.01 (0.255)
7 (178)	0	7.89 (0.223)
6 (152)	Stone 0	6.76 (0.191)
5 (127)	Foundation 0	5.63 (0.160)
4 (102)	0	4.51 (0.128)
3 (76)	0	3.38 (0.096)
2 (51)	0	2.25 (0.064)
1 (25)	0	1.13 (0.032)

Note: Add 1.13 cu. ft. (0.032 m³) of storage for each additional inch (25 mm) of stone foundation.

Storage Volume Per Chamber ft³ (m³)

	Bare Chamber Storage	Chamber and Stone Volume-Stone Foundation Depth inches (millimeters)		
	ft³ (m³)	9 (229)	12 (305)	18 (457)
StormTech DC-780	46.2 (1.3)	78.4 (2.2)	81.8 (2.3)	88.6 (2.5)

Note: Assumes 40% porosity for the stone, the bare chamber volume, 6" (152 mm) stone above, and 6" (152 mm) row spacing.

Amount of Stone Per Chamber

	Stone Foundation Depth		
ENGLISH TONS (YD³)	9"	12"	18"
StormTech DC-780	4.2 (3.0 yd³)	4.7 (3.3 yd³)	5.6 (3.9 yd³)
METRIC KILOGRAMS (M³)	**229 mm**	**305 mm**	**457 mm**
StormTech DC-780	3810 (2.3 m³)	4264 (2.5 m³)	5080 (3.0 m³)

Note: Assumes 6" (152 mm) of stone above, and between chambers.

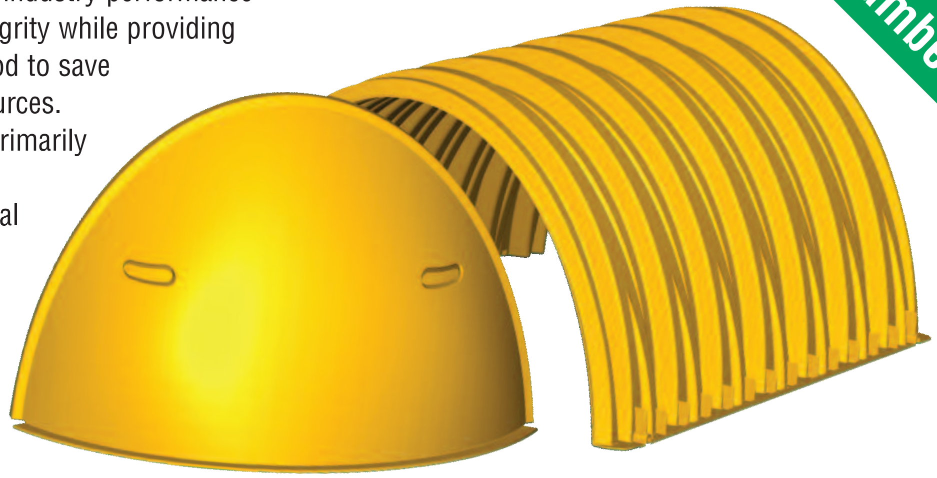
Volume of Excavation Per Chamber yd³ (m³)

	Stone Foundation Depth		
	9" (229 mm)	12" (305 mm)	18" (457 mm)
StormTech DC-780	5.9 (4.5)	6.3 (4.8)	6.9 (5.3)

Note: Assumes 6" (152 mm) of separation between chamber rows and 18" (457 mm) of cover. The volume of excavation will vary as the depth of the cover increases.

StormTech MC-3500 Chamber

Designed to meet the most stringent industry performance standards for superior structural integrity while providing designers with a cost-effective method to save valuable land and protect water resources. The StormTech system is designed primarily to be used under parking lots thus maximizing land usage for commercial and municipal applications.



StormTech MC-3500 Chamber (not to scale)

Nominal Chamber Specifications

Size (L x W x H)	90" (2286 mm) x 77" (1956 mm) x 45" (1143 mm)
Chamber Storage	109.9 ft^3 (3.11 m^3)
Min. Installed Storage*	178.9 ft^3 (5.06 m^3)
Weight	134 lbs (60.8 kg)

* This assumes a minimum of 12" (305 mm) of stone above, 9" (229 mm) of stone below chambers, 9" (229 mm) of stone between chambers/end caps and 40% stone porosity.

StormTech MC-3500 End Cap (not to scale)

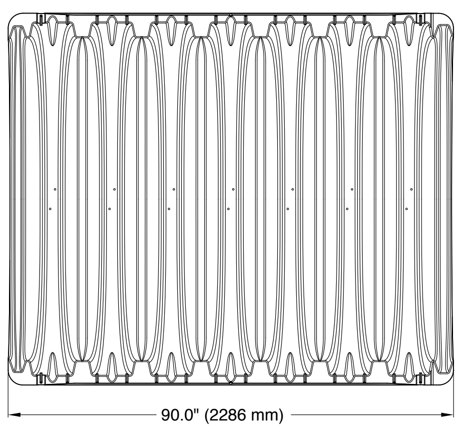
Nominal End Cap Specifications

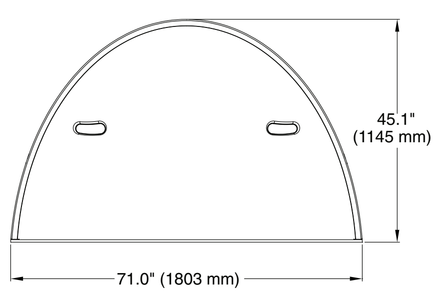
Size (L x W x H)	26.5" (673 mm) x 71" (1803 mm) x 45.1" (1145 mm)
End Cap Storage	15.6 ft^3 (0.44 m^3)
Min. Installed Storage*	46.9 ft^3 (1.33 m^3)
Weight	43 lbs (19.5 kg)

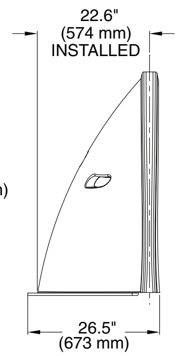
*This assumes a minimum of 12" (305 mm) of stone above, 9" (229 mm) of stone below, 6" (152 mm) of stone perimeter, 9" (229 mm) of stone between chambers/end caps and 40% stone porosity.

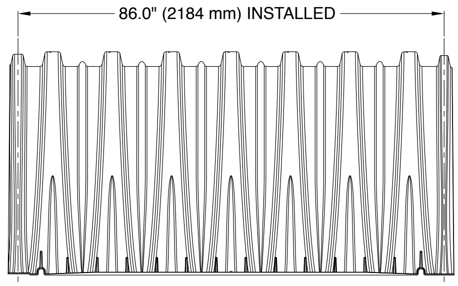
Shipping

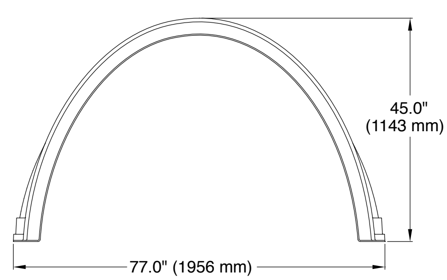
- 15 chambers/pallet
- 16 end caps/pallet
- 7 pallets/truck











StormTech MC-3500 Chamber

Storage Volume Per Chamber/End Cap ft³ (m³)

	Bare Unit Storage	Chamber/End Cap and Stone Volume — Stone Foundation Depth in. (mm)			
	ft³ (m³)	9 (229)	12 (305)	15 (381)	18 (457)
MC-3500 Chamber	109.9 (3.11)	178.9 (5.06)	184.0 (5.21)	189.2 (5.36)	194.3 (5.5)
MC-3500 End Cap	15.6 (0.44)	46.9 (1.33)	48.6 (1.38)	50.3 (1.43)	52.0 (1.47)

NOTE: Assumes 9" (229 mm) row spacing, 40% stone porosity, 12" (305 mm) stone above and includes the bare chamber/end cap volume. End cap volume assumes 6" (152 mm) stone perimeter.

Amount of Stone Per Chamber

ENGLISH tons (yd³)	Stone Foundation Depth			
	9"	12"	15"	18"
MC-3500	9.1 (6.4 yd³)	9.7 (6.9 yd³)	10.4 (7.3 yd³)	11.1 (7.8 yd³)
End Cap	4.1 (2.9 yd³)	4.3 (3.1 yd³)	4.6 (3.2 yd³)	4.8 (3.4 yd³)
METRIC kg (m³)	**229 mm**	**305 mm**	**381 mm**	**457 mm**
MC-3500	8220 (4.9 m³)	8831 (5.3 m³)	9443 (5.6 m³)	10054 (6.0 m³)
End Cap	3729 (2.2 m³)	3933 (2.3 m³)	4136 (2.5 m³)	4339 (2.6 m³)

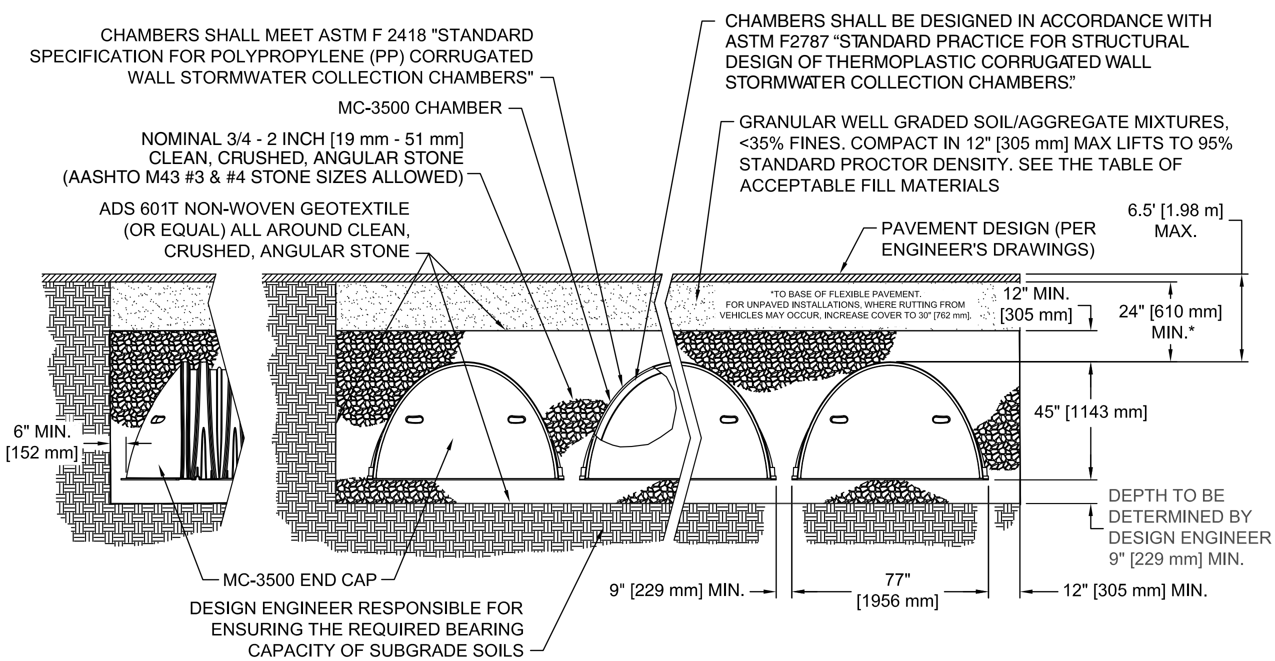
NOTE: Assumes 12" (305 mm) of stone above, and 9" (229 mm) row spacing, and 6" (152 mm) of perimeter stone in front of end caps.

Volume of Excavation Per Chamber/End Cap in yd³ (m³)

	Stone Foundation Depth			
	9" (229 mm)	12" (305 mm)	15" (381 mm)	18" (457 mm)
MC-3500	12.4 (9.5)	12.8 (9.8)	13.3 (10.2)	13.8 (10.5)
End Cap	4.1 (3.1)	4.3 (3.3)	4.4 (3.4)	4.6 (3.5)

NOTE: Assumes 9" (229 mm) of separation between chamber rows and 24" (610 mm) of cover. The volume of excavation will vary as the depth of cover increases.

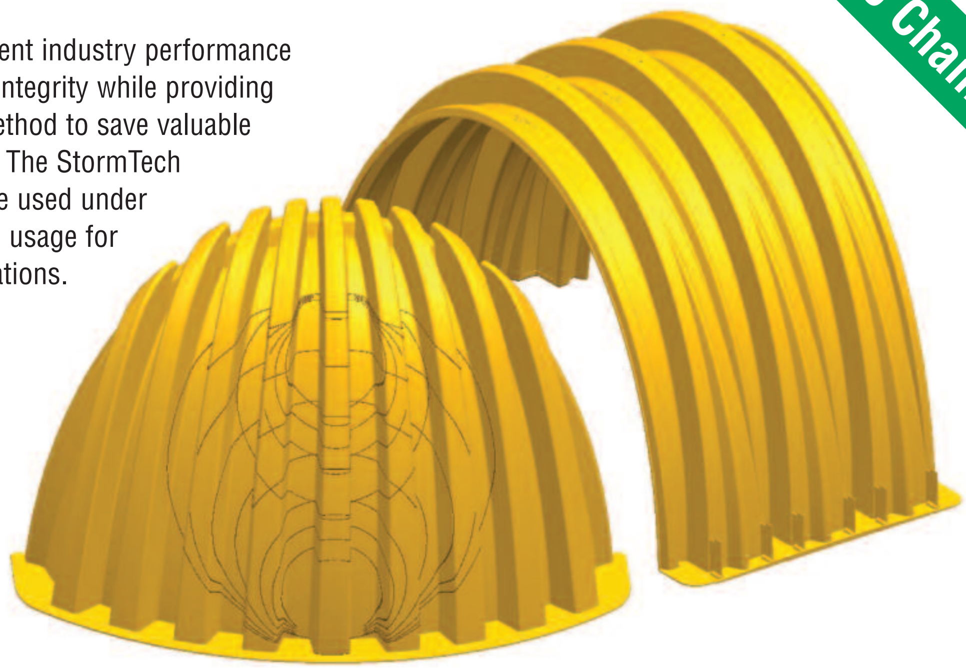
General Cross Section



THE INSTALLED CHAMBER SYSTEM SHALL PROVIDE THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12 FOR EARTH AND LIVE LOADS, WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.

StormTech MC-4500 Chamber

Designed to meet the most stringent industry performance standards for superior structural integrity while providing designers with a cost-effective method to save valuable land and protect water resources. The StormTech system is designed primarily to be used under parking lots thus maximizing land usage for commercial and municipal applications.



StormTech MC-4500 Chamber (not to scale)

Nominal Chamber Specifications

Size (L x W x H)	52" (1321 mm) x 100" (2540 mm) x 60" (1524 mm)
Chamber Storage	106.5 ft^3 (3.01 m^3)
Min. Installed Storage*	162.6 ft^3 (4.60 m^3)
Nominal Weight	120 lbs (54.4 kg)

* This assumes a minimum of 12" (305 mm) of stone above, 9" (229 mm) of stone below chambers, 9" (229 mm) of stone between chambers/end caps and 40% stone porosity.

StormTech MC-4500 End Cap (not to scale)

Nominal End Cap Specifications

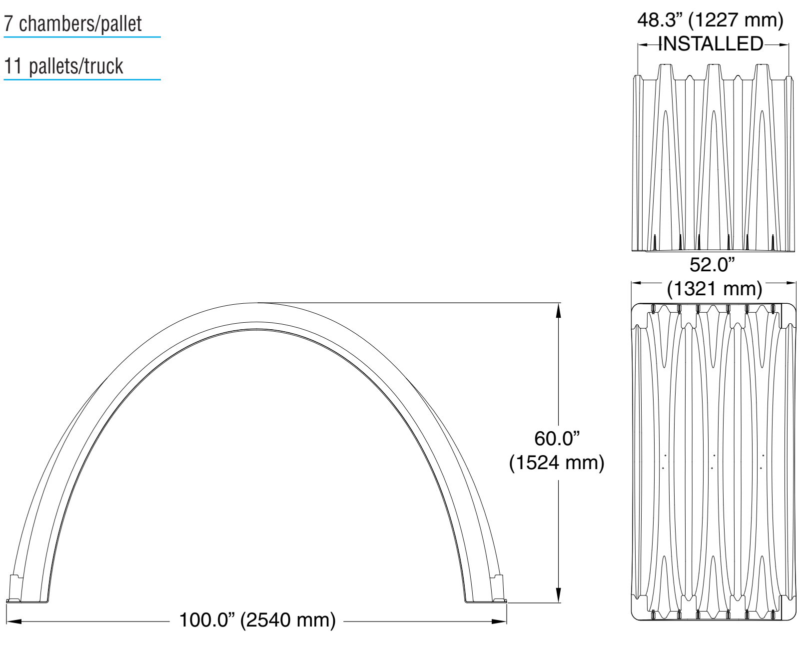
Size (L x W x H)	35.1" (891 mm) x 90.2" (2291 mm) x 59.4" (1509 mm)
End Cap Storage	35.7 ft^3 (1.01 m^3)
Min. Installed Storage*	108.7 ft^3 (3.08 m^3)
Nominal Weight	120 lbs (54.4 kg)

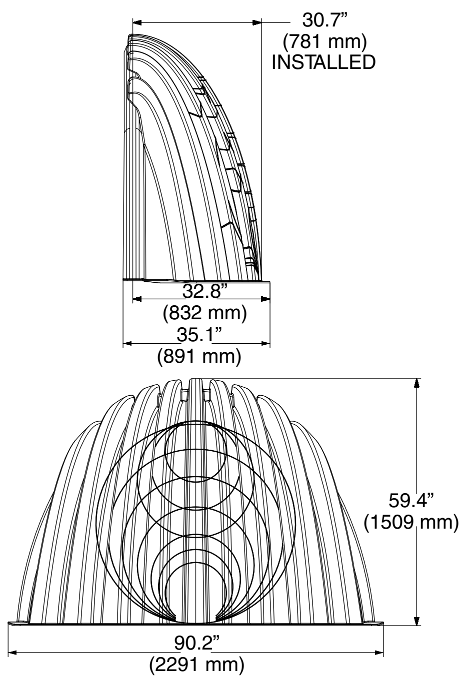
*This assumes a minimum of 12" (305 mm) of stone above, 9" (229 mm) of stone below, 12" (305 mm) of stone perimeter, 9" (229 mm) of stone between chambers/end caps and 40% stone porosity.

Shipping

7 chambers/pallet

11 pallets/truck





StormTech MC-4500 Chamber

Storage Volume Per Chamber/End Cap ft³ (m³)

	Bare Unit Storage ft³ (m³)	Chamber/End Cap and Stone Volume — Stone Foundation Depth in. (mm) 9 (229)	12 (305)	15 (381)	18 (457)
MC-4500 Chamber	106.5 (3.02)	162.6 (4.60)	166.3 (4.71)	169.9 (4.81)	173.6 (4.91)
MC-4500 End Cap	35.7 (1.01)	108.7 (3.08)	111.9 (3.17)	115.2 (3.26)	118.4 (3.35)

NOTE: Assumes 9" (229 mm) row spacing, 40% stone porosity, 12" (305 mm) stone above and includes the bare chamber/end cap volume. End cap volume assumes 12" (305 mm) stone perimeter.

Amount of Stone Per Chamber

ENGLISH tons (yd³)	Stone Foundation Depth 9"	12"	15"	18"
MC-4500	7.4 (5.2)	7.8 (5.5)	8.3 (5.9)	8.8 (6.2)
End Cap	9.6 (6.8)	10.0 (7.1)	10.4 (7.4)	10.9 (7.7)
METRIC kg (m³)	**229 mm**	**305 mm**	**381 mm**	**457 mm**
MC-4500	6681 (4.0)	7117 (4.2)	7552 (4.5)	7987 (4.7)
End Cap	8691 (5.2)	9075 (5.4)	9460 (5.6)	9845 (5.9)

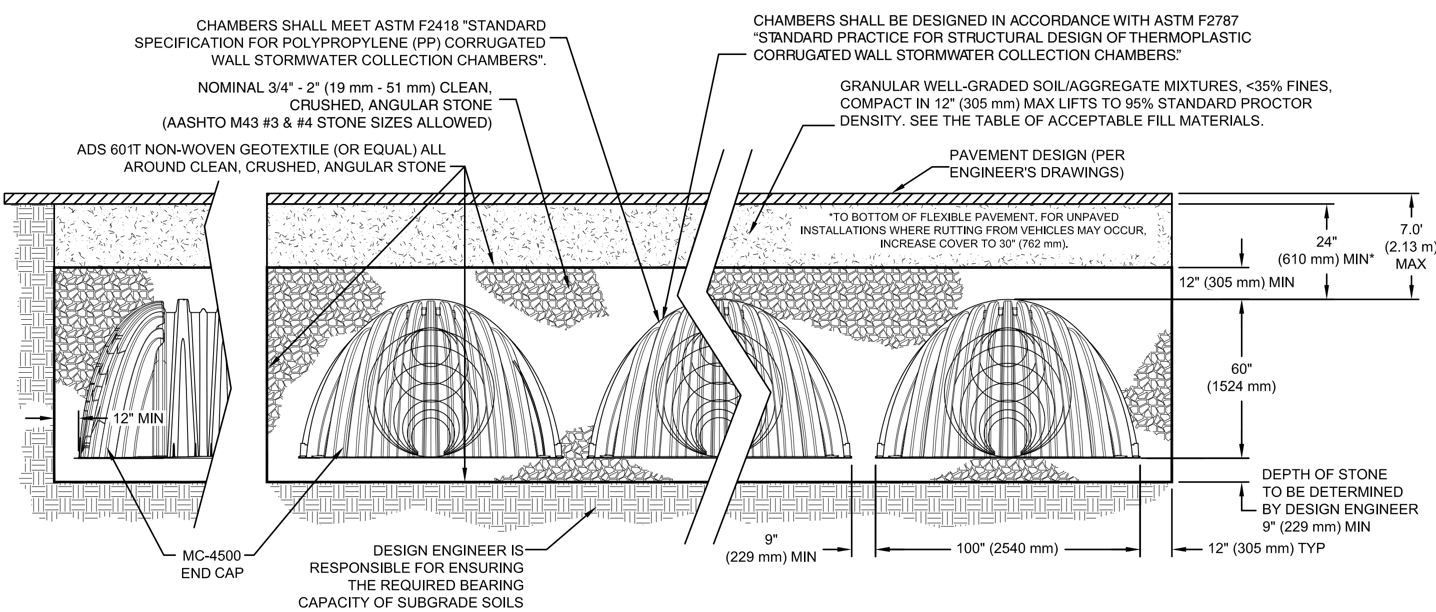
NOTE: Assumes 12" (305 mm) of stone above, 9" (229 mm) row spacing, and 12" (305 mm) of perimeter stone in front of end caps.

Volume of Excavation Per Chamber/End Cap in yd³ (m³)

	Stone Foundation Depth 9" (229 mm)	12" (305 mm)	15" (381 mm)	18" (457 mm)
MC-4500	10.5 (8.0)	10.8 (8.3)	11.2 (8.5)	11.5 (8.8)
End Cap	9.3 (7.1)	9.6 (7.3)	9.9 (7.6)	10.2 (7.8)

NOTE: Assumes 9" (229 mm) of separation between chamber rows, 12" (305 mm) of perimeter in front of end caps, and 24" (610 mm) of cover. The volume of excavation will vary as the depth of cover increases.

General Cross Section



THE INSTALLED CHAMBER SYSTEM SHALL PROVIDE THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12 FOR EARTH AND LIVE LOADS, WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.

StormTech Isolator® Row

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row is a patent pending technique to inexpensively enhance Total Suspended Solids (TSS) removal and provide easy access for inspection and maintenance.

The Isolator Row is a row of StormTech chambers that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for settling and filtration of sediment as stormwater rises in the Isolator Row and ultimately passes through the filter fabric. The open bottom chambers and perforated sidewalls (SC-310, SC-310-3, and SC-740 models) allow stormwater to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row, protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

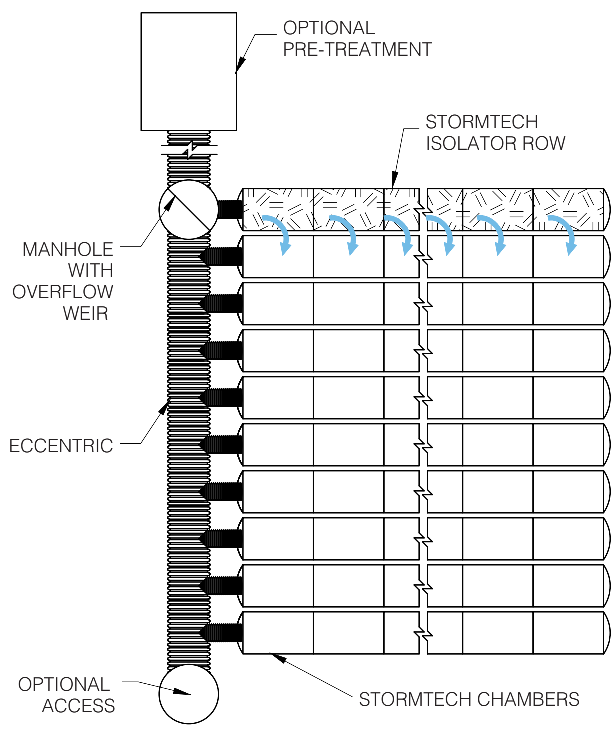
Two different fabrics are used for the Isolator Row. A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The tough geotextile provides a media for stormwater filtration and provides a durable surface for maintenance operations. It is also designed to prevent scour of the underlying stone and remain intact during high pressure jetting. A non-woven fabric is placed over the chambers to provide a filter media for flows passing through the perforations in the sidewall of the chamber. The non-woven fabric is not required over the DC-780, MC-3500 or MC-4500 models as these chambers do not have perforated side walls.

The Isolator Row is typically designed to capture the "first flush" and offers the versatility to be sized on a volume basis or flow rate basis. An upstream manhole not only provides access to the Isolator Row, but typically includes a high flow weir such that stormwater flow rates or volumes that exceed the capacity of the Isolator Row crest the weir and discharge through a manifold to the other chambers.

The Isolator Row may also be part of a treatment train. By treating stormwater prior to entry into the chamber system, the service life can be extended and pollutants such as hydrocarbons can be captured. Pre-treatment best management practices can be as simple as deep sump catch basins and oil-water separators or can be innovative storm water treatment devices. The design of the treatment train and selection of pretreatment devices by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, the Isolator Row is recommended by StormTech as an effective means to minimize maintenance requirements and maintenance costs.

Note: See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row.

StormTech Isolator Row with Overflow Spillway
(not to scale)



StormTech Isolator Row

INSPECTION

The frequency of Inspection and Maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial, residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

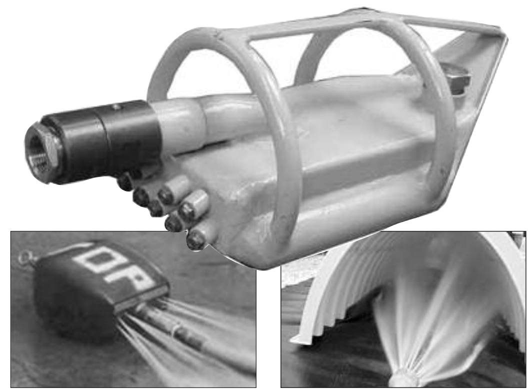
At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

The Isolator Row incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If, upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row, clean-out should be performed.

MAINTENANCE

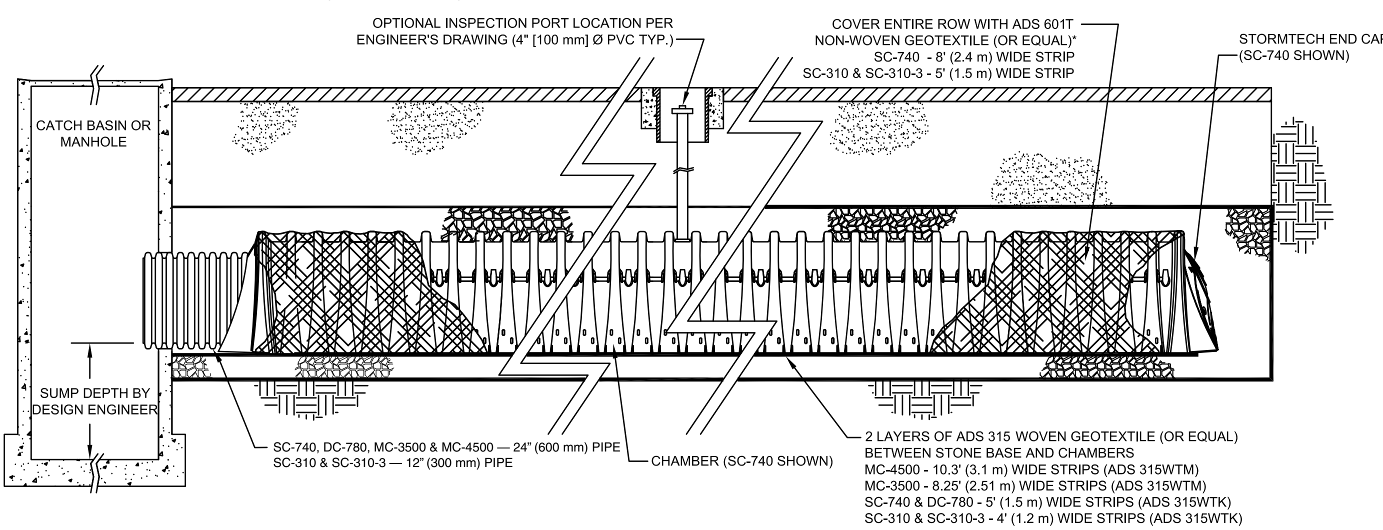
The Isolator Row was designed to reduce the cost of periodic maintenance. By "isolating" sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entries.



Examples of culvert cleaning nozzles appropriate for Isolator Row maintenance. (These are not StormTech products.)

Maintenance is accomplished with the jetvac process. The jetvac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/jetvac combination vehicles. Selection of an appropriate jetvac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45" are best. Most jetvac reels have 400 feet of hose allowing maintenance of an Isolator Row up to 50 chambers long. **The jetvac process shall only be performed on StormTech Isolator Rows that have AASHTO class 1 woven geotextile (as specified by StormTech) over their angular base stone.**

StormTech Isolator Row (not to scale)



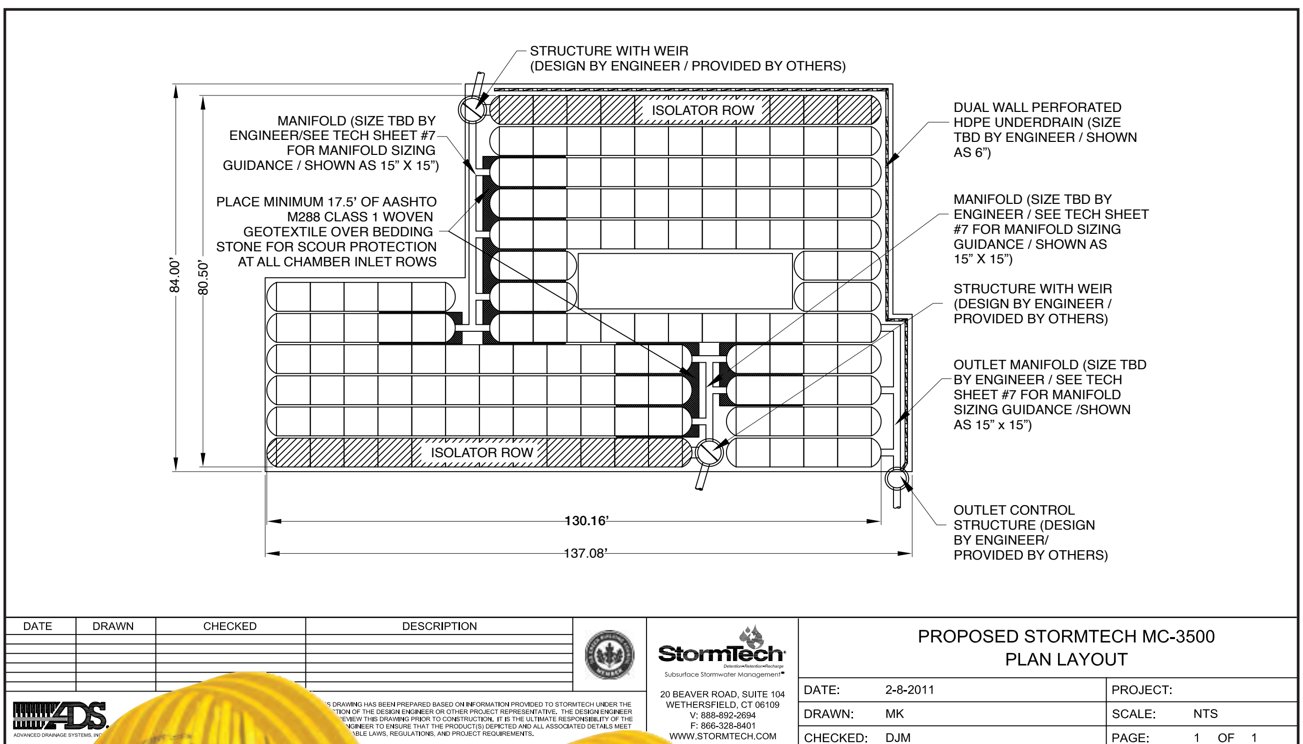
*NOTE: NON-WOVEN FABRIC IS ONLY REQUIRED OVER THE INLET PIPE CONNECTION INTO THE END CAP FOR DC-780, MC-3500 AND MC-4500 CHAMBER MODELS AND IS NOT REQUIRED OVER THE ENTIRE ISOLATOR ROW.

A Family of Products and Services

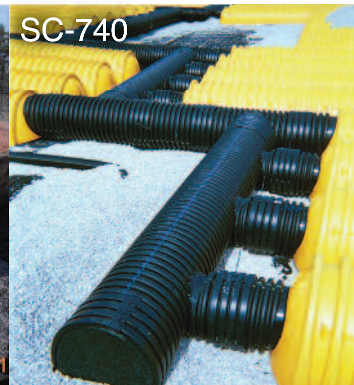
- MC-4500 Chambers and End Caps
- MC-3500 Chambers and End Caps
- SC-310 Chambers and End Caps
- SC-310-3 Chambers and End Caps
- DC-780 Chambers and End Caps
- SC-740 Chambers and End Caps
- SC, DC and MC Fabricated End Caps
- Fabricated Manifold Fittings
- Patented Isolator Row for Maintenance and Water Quality
- Chamber Separation Spacers
- In-House System Layout Assistance
- On-Site Educational Seminars
- Worldwide Technical Sales Group
- Centralized Product Applications Department
- Research and Development Team
- Technical Literature, O&M Manuals and Detailed CAD drawings all downloadable via our Web Site

StormTech provides state of the art products and services that meet or exceed industry performance standards and expectations. We offer designers, regulators, owners and contractors the highest quality products and services for stormwater management that "Saves Valuable Land and Protects Water Resources."

Please contact one of our inside Technical Service professionals or Engineered Product Managers (EPMs) to discuss your particular application. A wide variety of technical support material is available from our website at **www.stormtech.com.** For any questions, please call StormTech at **888-892-2694**.



Example of a Typical Chamber Layout



StormTech®

Detention • Retention • Water Quality

A division of ADS

70 Inwood Road, Suite 3 | Rocky Hill | Connecticut | 06067

860.529.8188 | 888.892.2694 | fax 866.328.8401 | fax 860-529-8040 | www.stormtech.com

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Appendix E

Oil/Grit Separator Details

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD
BASED ON A FINE PARTICLE SIZE DISTRIBUTION

Project Name:	SCHC - Orillia	**Engineer:**	**Pearson Engineering**
Location:	Orillia, ON	**Contact:**	M. Dejean, P.Eng.
OGS #:	OGS	**Report Date:**	13-Nov-20

Area	2.47	ha	**Rainfall Station #**	203	
Weighted C	0.71		**Particle Size Distribution**	FINE	
CDS Model	3030		**CDS Treatment Capacity**	85	l/s

Rainfall Intensity[1] (mm/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (l/s)	Treated Flowrate (l/s)	Operating Rate (%)	Removal Efficiency (%)	Incremental Removal (%)
0.5	8.7%	8.7%	2.4	2.4	2.9	98.0	8.6
1.0	10.8%	19.6%	4.9	4.9	5.7	97.2	10.5
1.5	9.5%	29.0%	7.3	7.3	8.6	96.4	9.1
2.0	8.4%	37.4%	9.8	9.8	11.5	95.6	8.0
2.5	6.8%	44.2%	12.2	12.2	14.3	94.7	6.4
3.0	5.6%	49.8%	14.6	14.6	17.2	93.9	5.2
3.5	5.1%	54.9%	17.1	17.1	20.1	93.1	4.7
4.0	4.9%	59.8%	19.5	19.5	23.0	92.3	4.5
4.5	4.1%	63.9%	21.9	21.9	25.8	91.5	3.7
5.0	3.5%	67.4%	24.4	24.4	28.7	90.6	3.2
6.0	4.9%	72.3%	29.3	29.3	34.4	89.0	4.4
7.0	4.0%	76.3%	34.1	34.1	40.2	87.3	3.5
8.0	3.2%	79.5%	39.0	39.0	45.9	85.7	2.8
9.0	2.2%	81.7%	43.9	43.9	51.6	84.1	1.9
10.0	2.0%	83.7%	48.8	48.8	57.4	82.4	1.6
15.0	8.2%	91.9%	73.1	73.1	86.1	74.2	6.1
20.0	3.4%	95.2%	97.5	85.0	100.0	61.2	2.1
25.0	2.5%	97.7%	121.9	85.0	100.0	48.9	1.2
30.0	1.4%	99.1%	146.3	85.0	100.0	40.8	0.6
35.0	0.3%	99.4%	170.6	85.0	100.0	34.9	0.1
40.0	0.6%	100.0%	195.0	85.0	100.0	30.6	0.2
45.0	0.0%	100.0%	219.4	85.0	100.0	27.2	0.0
50.0	0.0%	100.0%	243.8	85.0	100.0	24.5	0.0
							88.4
						Removal Efficiency Adjustment[2] =	6.5%
						Predicted Net Annual Load Removal Efficiency =	**81.9%**
						Predicted % Annual Rainfall Treated =	**97.7%**

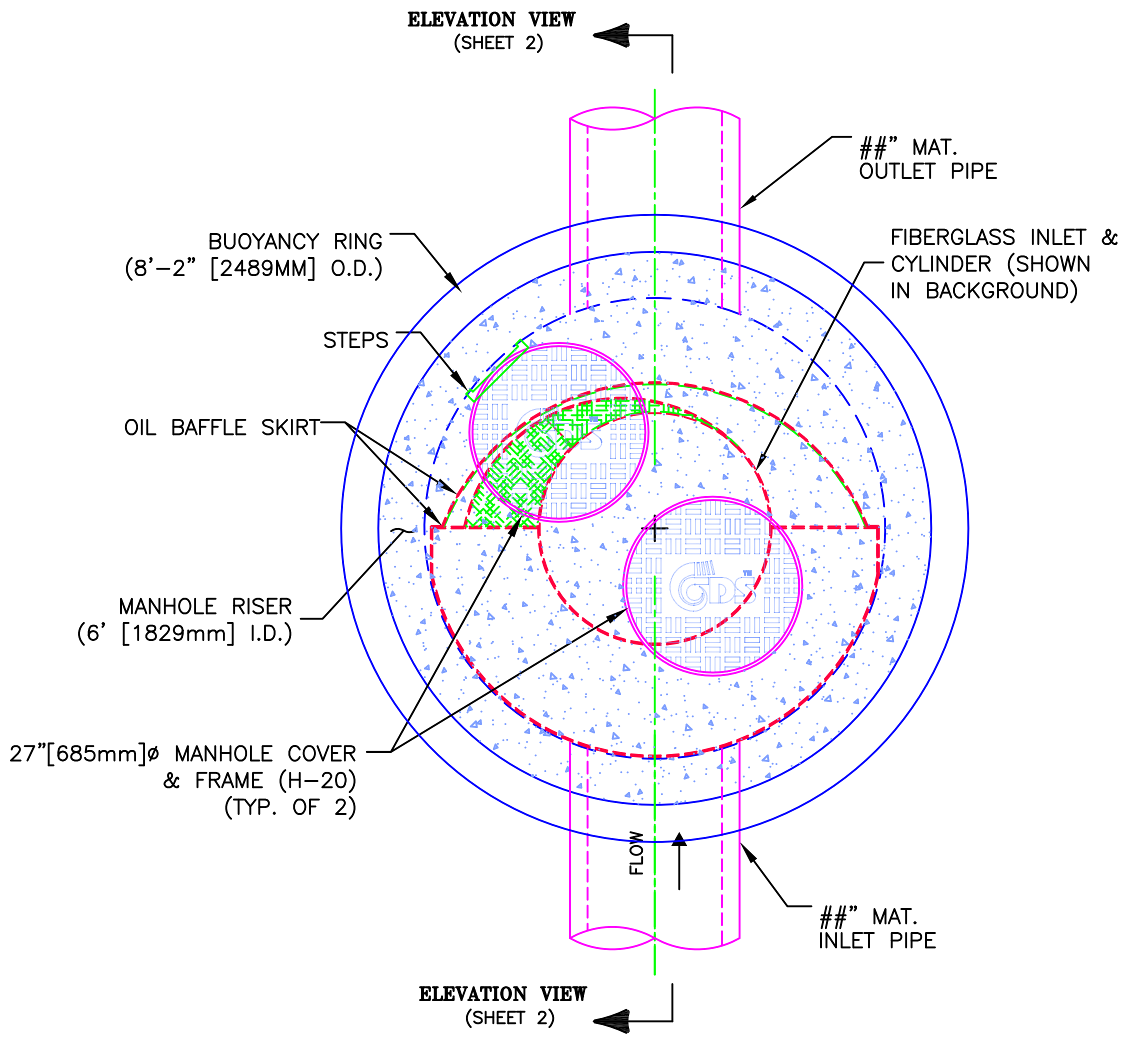
1 - Based on 27 years of hourly rainfall data from Canadian Station 6110557, Barrie ON

2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

3 - CDS Efficiency based on testing conducted at the University of Central Florida

4 - CDS design flowrate and scaling based on standard manufacturer model & product specifications

PLAN VIEW

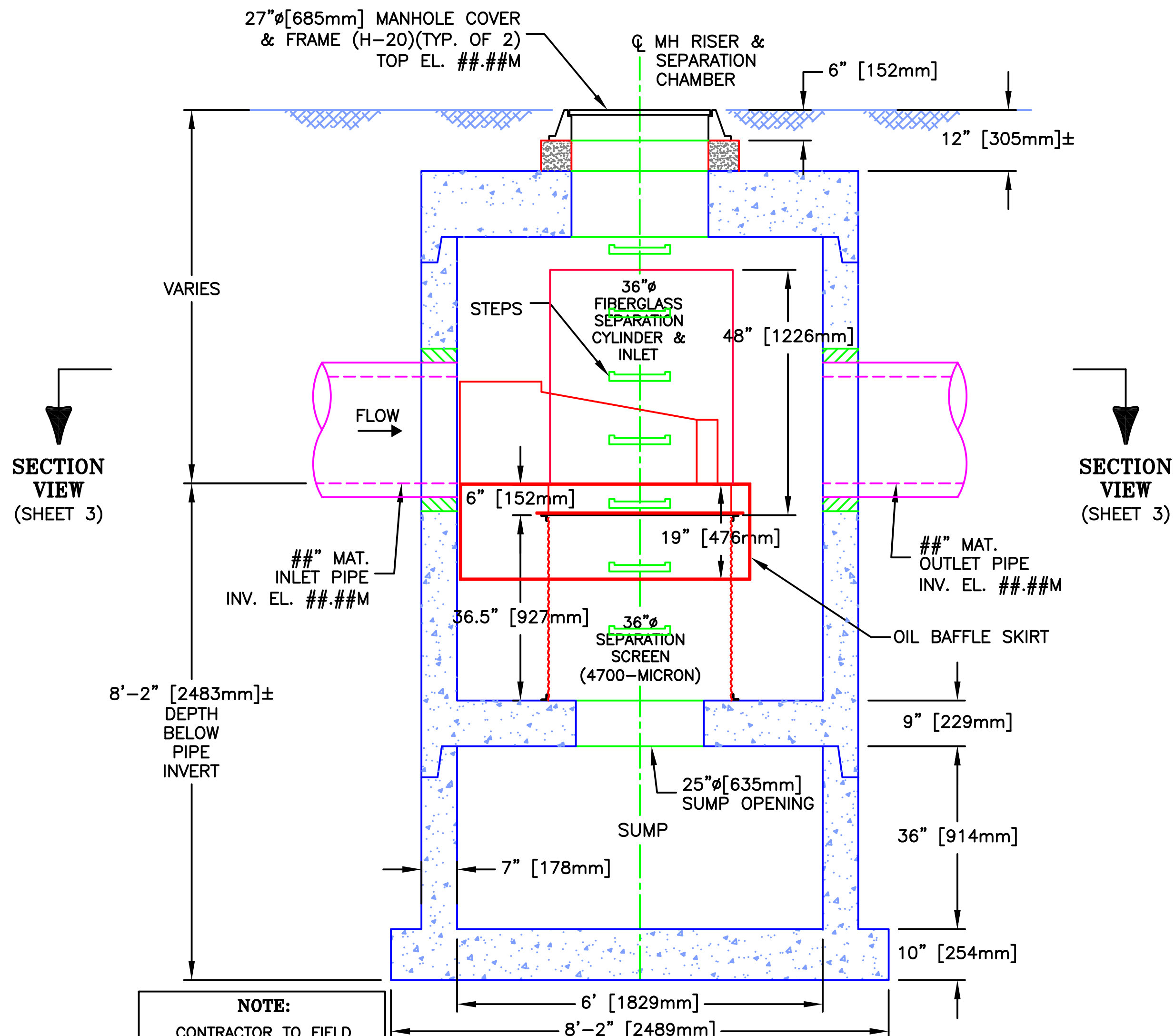


CDS MODEL PMSU30_30m, 85 L/s TREATMENT CAPACITY STORM WATER TREATMENT UNIT

CONTECH STORMWATER SOLUTIONS INC	PROJECT NAME CITY, STATE	JOB#	CAN–##–###	SCALE 1" = 3'
		DATE	##/##/##	SHEET
		DRAWN	INITIALS	1
		APPROV.		

Echelon Environmental 505 Hood Road, Unit 26, Markham, Ontario L3R 5V6 Tel: (905) 948–0000 Fax: (905) 948–0577
CONTECH Stormwater Solutions Inc. 930 Woodcock Road, Suite 101, Orlando, Florida 32803 Tel: (800) 848–9955

ELEVATION VIEW



NOTE:
CONTRACTOR TO FIELD
VERIFY DIMENSIONS OF
OR CONCRETE SECTIONS

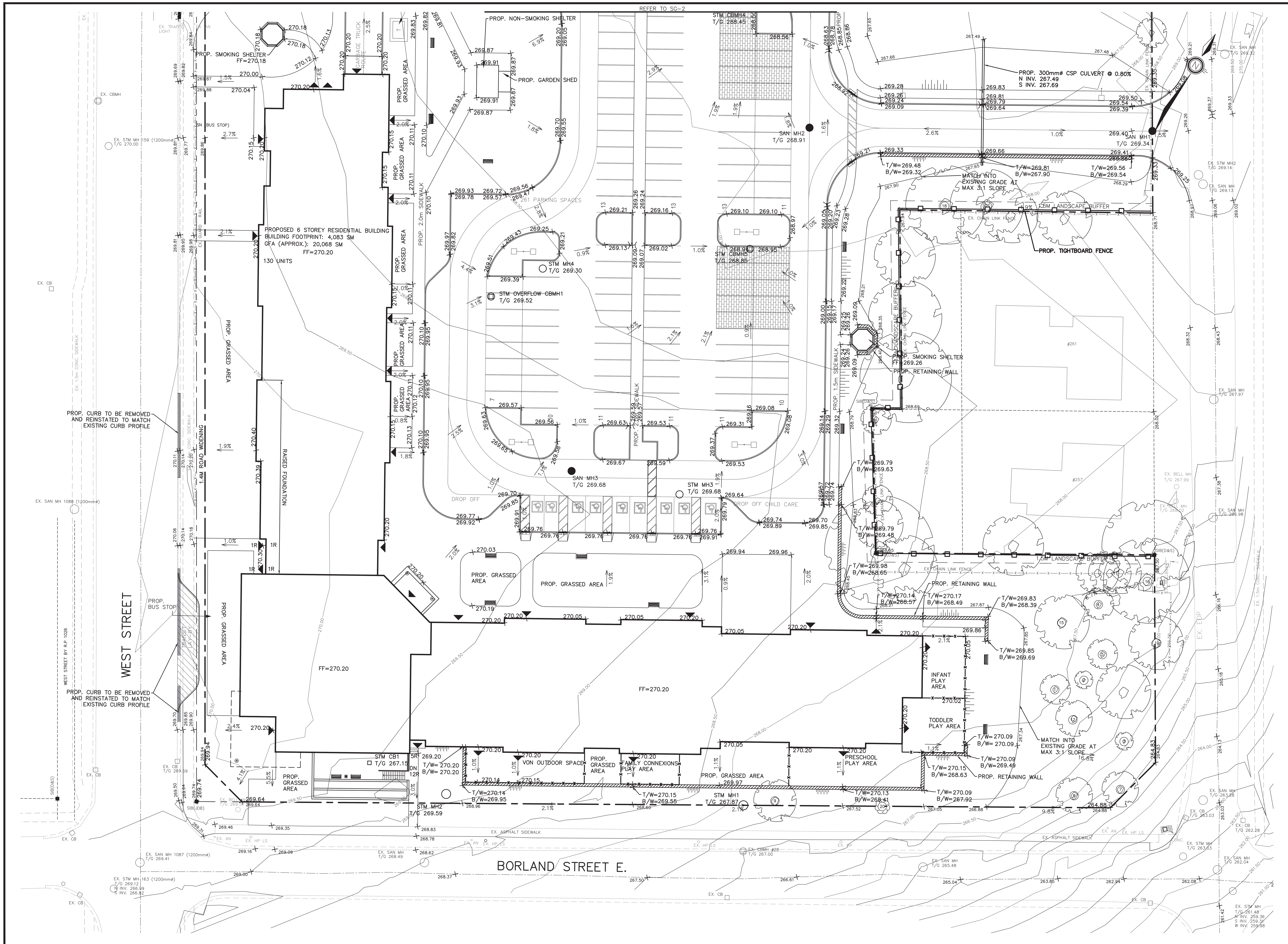
CDS MODEL PMSU30_30m, 85 L/s TREATMENT CAPACITY STORM WATER TREATMENT UNIT

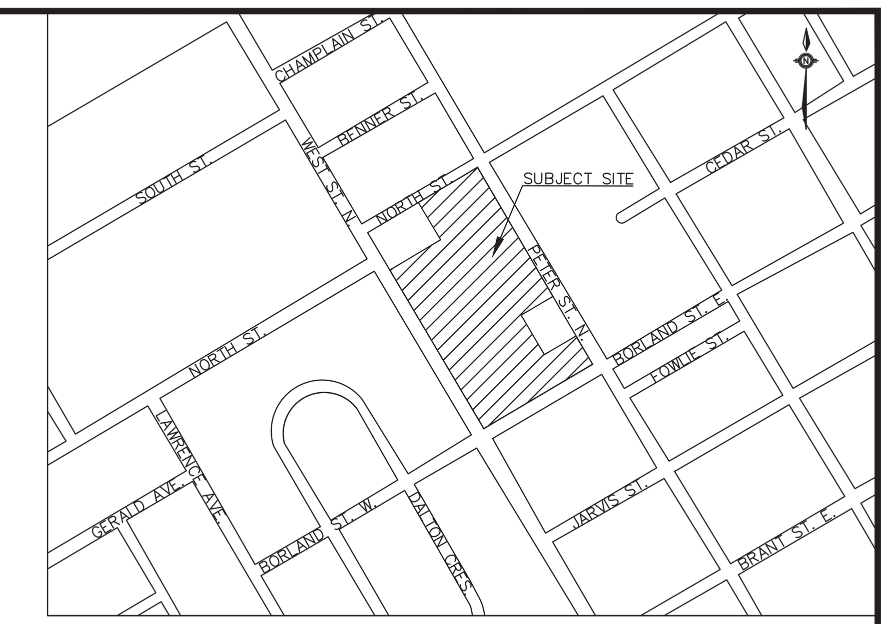
CONTECH STORMWATER SOLUTIONS	PROJECT NAME CITY, STATE	JOB#	CAN-##-###	SCALE 1" = 3'
		DATE	##/##/##	SHEET
		DRAWN	INITIALS	2
		APPROV.		

Echelon Environmental 505 Hood Road, Unit 26, Markham, Ontario L3R 5V6 Tel: (905) 948-0000 Fax: (905) 948-0577
CONTECH Stormwater Solutions Inc. 930 Woodcock Road, Suite 101, Orlando, Florida 32803 Tel: (800) 848-9955

Appendix F

Pearson Engineering Drawings





KEY MAP
NTS

LEGEND

CB	CATCH BASIN
DCB	DOUBLE CATCH BASIN
CBMH	CATCH BASIN
MH	STORM MANHOLE
MH	SANITARY MANHOLE
	SERVICE CAP
HYD.	FIRE HYDRANT
VB	WATER VALVE
CS	CURB STOP W/ SERVICE
× 254.63 / 254.09	PROPOSED ELEVATION / EXISTING ELEVATION
1.5%	PROPOSED DIRECTION AND GRADE
	BACK OF CURB
	EDGE OF PAVEMENT
	CURB CUT LOCATION
) (	HIGH POINT
—x—x—	EX. CHAINLINK FENCE
	EX. BELL BOX
	EX. TREE
	PROP. RETAINING WALL
	PROP. TIGHTBOARD FENCE
	PROP. LIGHT STANDARD

NO.	REVISION NOTE	DATE	BY

BENCHMARK

LICENSED PROFESSIONAL ENGINEER G.M. PEARSON 100061986 11/12/20 PROVINCE OF ONTARIO

COUNTY OF SIMCOE
AFFORDABLE HOUSING
ORILLIA, 2 BORLAND STREET EAST

SITE GRADING PLAN
1 OF 3

PEARSON ENGINEERING LTD.
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY	AA	HORIZ SCALE	1:300	PROJECT #	20002
DRAWN BY	AA	VERT SCALE		DRAWING #	SG-1
CHECKED BY	MWD	DATE	NOVEMBER 2020	REVISION #	0

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COUNTY OF SIMCOE
AFFORDABLE HOUSING
ORILLIA, 2 BORLAND STREET EAST

SITE GRADING PLAN
2 OF 3

PEARSON ENGINEERING LTD.
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY AA	HORIZ SCALE 1:300	PROJECT #	20002
DRAWN BY AA	VERT SCALE	DRAWING #	SG-2
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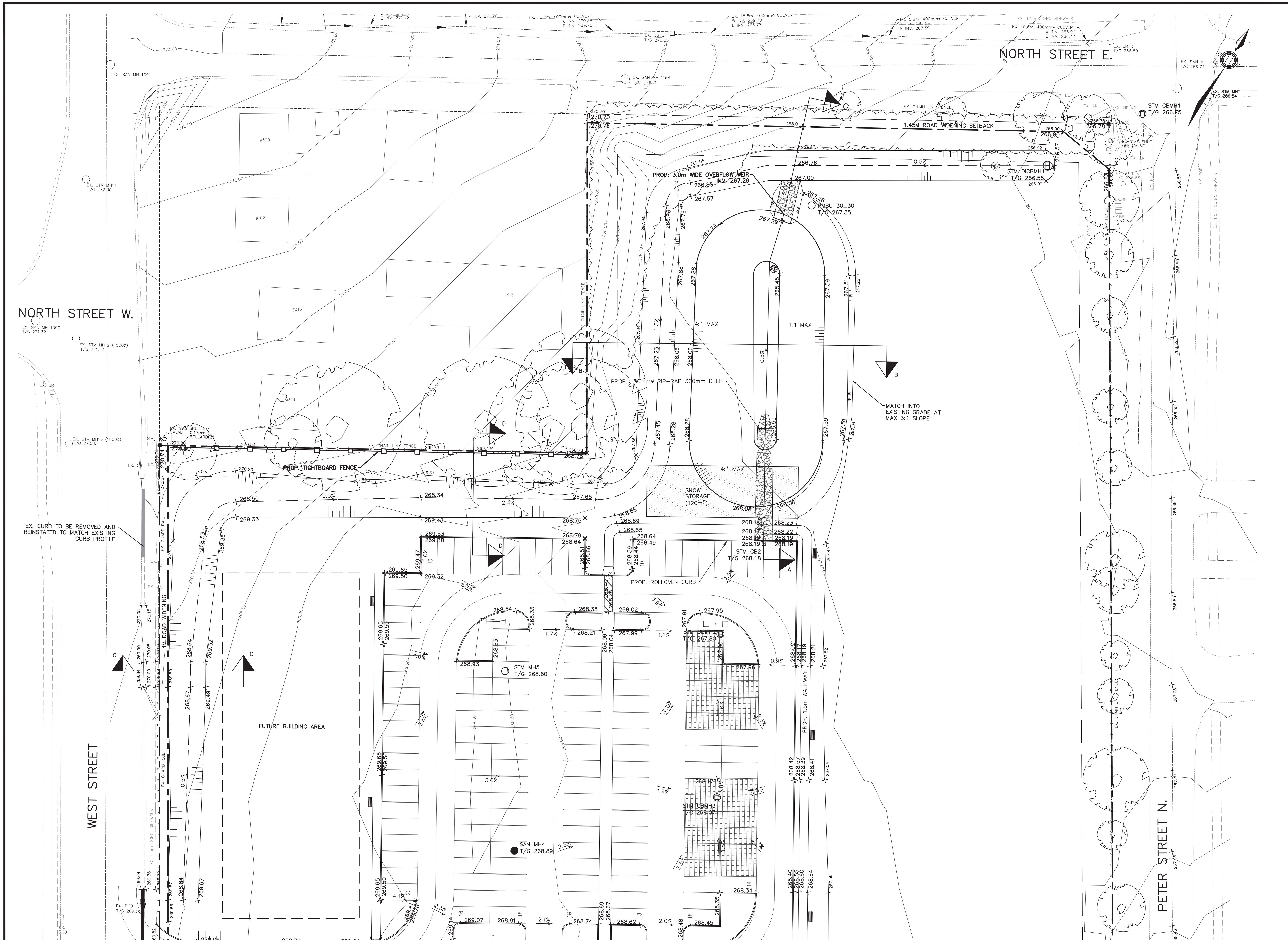

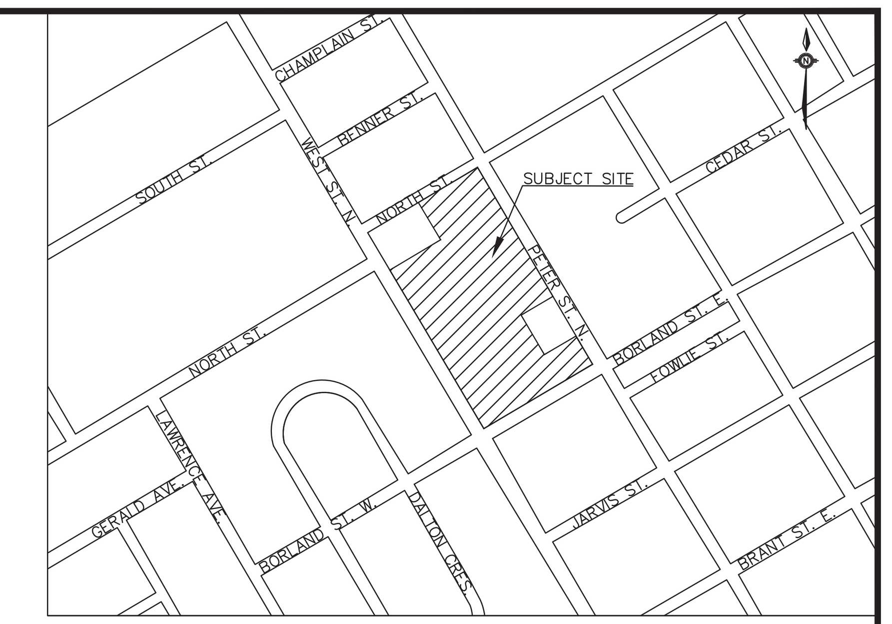

KEY MAP
NTS

LEGEND

- CB — CATCH BASIN
- DCB — DOUBLE CATCH BASIN
- CBMH — CATCH BASIN
- MH — STORM MANHOLE
- MH — SANITARY MANHOLE
- SERVICE CAP
- HYD. — FIRE HYDRANT
- VB — WATER VALVE
- CS — CURB STOP W/ SERVICE
- 254.63 — PROPOSED ELEVATION; 254.09 — EXISTING ELEVATION
- 1.5% — PROPOSED DIRECTION AND GRADE
- BACK OF CURB
- EDGE OF PAVEMENT
- CURB CUT LOCATION
-) (— HIGH POINT
- EX. CHAINLINK FENCE
- EX. BELL BOX
- EX. TREE
- PROP. RETAINING WALL
- PROP. TIGHTBOARD FENCE
- PROP. LIGHT STANDARD

NO.	REVISION NOTE	DATE	BY

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100061986
11/12/20
PROVINCE OF ONTARIO

COUNTY OF SIMCOE
AFFORDABLE HOUSING
ORILLIA, 2 BORLAND STREET EAST

SITE GRADING PLAN
3 OF 3

PEARSON ENGINEERING LTD.
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY AA	HORIZ SCALE 1:300	PROJECT #	20002
DRAWN BY AA	VERT SCALE	DRAWING #	SG-3
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BENCHMARK

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100061986
LICENSED PROFESSIONAL ENGINEER
PROVINCE OF ONTARIO
11/12/20

COUNTY OF SIMCOE
AFFORDABLE HOUSING
ORILLIA, 2 BORLAND STREET EAST

SITE SERVICING PLAN
1 OF 3

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DESIGNED BY	AA	HORIZ SCALE	1:300	PROJECT #	20002
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SITE SERVICING PLAN
2 OF 3

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AFFORDABLE HOUSING
ORILLIA, 2 BORLAND STREET EAST

SITE SERVICING PLAN
3 OF 3

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COUNTY OF SIMCOE
AFFORDABLE HOUSING
ORILLIA, 2 BORLAND STREET EAST

PRE-DEVELOPMENT STORMWATER MANAGEMENT PLAN

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COUNTY OF SIMCOE
AFFORDABLE HOUSING
ORILLIA, 2 BORLAND STREET EAST

POST–DEVELOPMENT STORMWATER MANAGEMENT PLAN

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County of Simcoe Affordable Housing - Orillia
Storm Sewer Design
2-Year Storm Event

PEARSON ENGINEERING LTD.

Q = 0.0028*C*I*A (m³/s)
C = Runoff Coefficient
I = Rainfall Intensity = A*Time^-C
A = Area (ha)

DATE: 13-Nov-20
FILE: 20002
CONTRACT/PROJECT: SCHC Orillia

Areas	Manhole From	Manhole To	Length (m)	Increment C	Increment A	Increment CA	Total CA	Flow Time (min) TO	Flow Time (min) IN	I (mm/h)	Total Q (m³/s)	S (%)	D (mm)	Q Full (m³/s)	V Full (m/s)
Area 1	CB1	MH7	13.7	0.95	0.01	0.01	0.01	10.00	0.17	82.92	0.003	1.0	300	0.097	1.37
-	MH7	MH1	49.1	0.00	0.00	0.00	0.01	10.17	0.60	81.93	0.003	1.0	300	0.097	1.37
-	MH1	EX. CBMH28	7.0	0.00	0.00	0.00	0.01	10.76	0.09	78.59	0.003	1.0	300	0.097	1.37
Area 2	STM CAP	MH4	23.9	0.95	0.41	0.39	0.39	10.00	0.22	82.92	0.090	1.8	300	0.129	1.82
-	MH3	CBMH5	34.3	0.00	0.00	0.00	0.39	10.22	0.40	81.63	0.089	1.1	300	0.101	1.42
Area 2	STM CAP	MH3	19.7	0.95	0.41	0.39	0.39	10.00	0.17	82.92	0.090	2.0	300	0.137	1.94
-	MH3	CBMH5	42.1	0.00	0.00	0.00	0.39	10.17	0.51	81.91	0.089	1.0	300	0.097	1.37
Area 3	CBMH5	CBMH4	40.5	0.78	0.56	0.44	1.22	10.68	0.43	79.03	0.268	1.0	375	0.175	1.59
Area 4	CBMH4	CBMH3	37.6	0.75	0.26	0.19	1.41	11.11	0.39	76.82	0.302	1.0	375	0.175	1.59
Area 5	CBMH3	CBMH2	27.0	0.85	0.37	0.31	1.73	11.50	0.25	74.89	0.359	1.0	450	0.285	1.79
Area 6	CBMH2	STM POND	36.9	0.82	0.38	0.31	2.04	11.75	0.44	73.72	0.417	0.5	525	0.304	1.40
Area 8	STM POND	OGS	12.2	0.23	0.12	0.03	0.03	10.00	0.09	82.92	0.158	2.0	375	0.248	2.25
-	OGS	DIMH1	39.6	0.00	0.00	0.00	0.03	10.09	0.29	82.38	0.158	2.0	375	0.248	2.25
Area 7 & EXT-1	DIMH1	CBMH1	17.9	0.39	13.17	5.17	5.19	10.38	0.10	80.68	1.323	2.0	600	0.868	3.07

Note: Higlighted Cell Indicates SWM Dry Pond Flow Through the Orifice Structure.

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COUNTY OF SIMCOE
AFFORDABLE HOUSING
ORILLIA, 2 BORLAND STREET EAST

STORM DRAINAGE AREA PLAN

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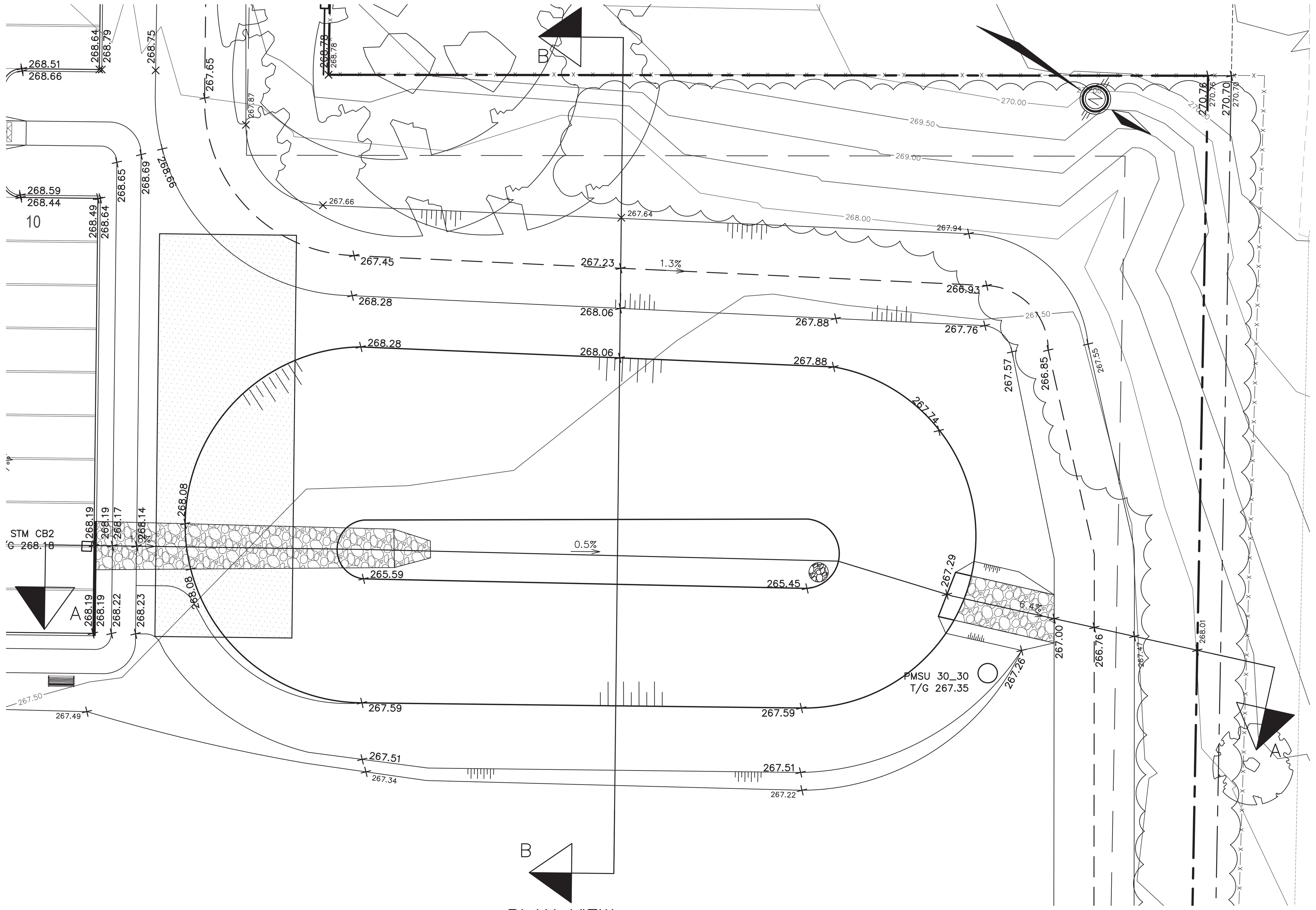


PLAN VIEW
1:200

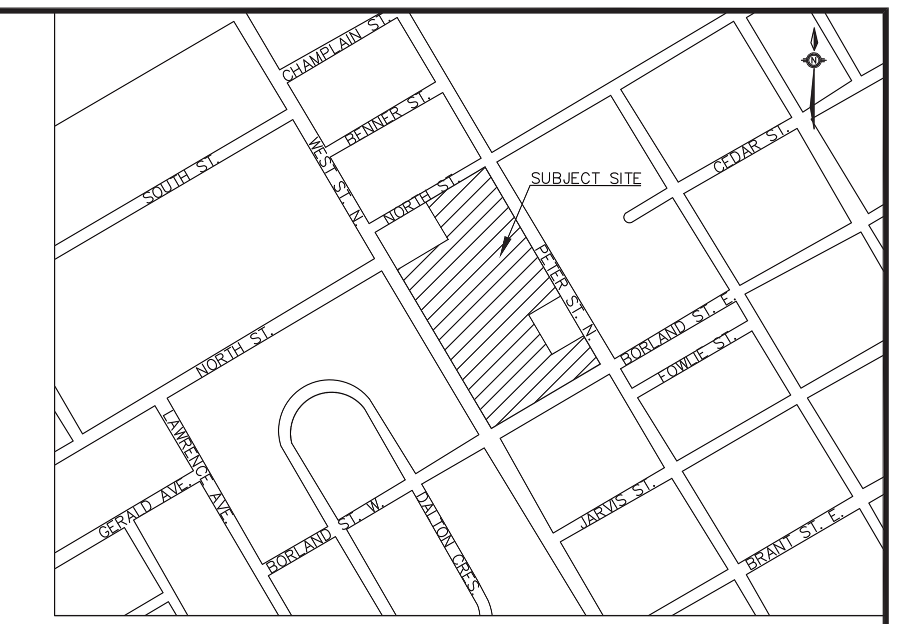
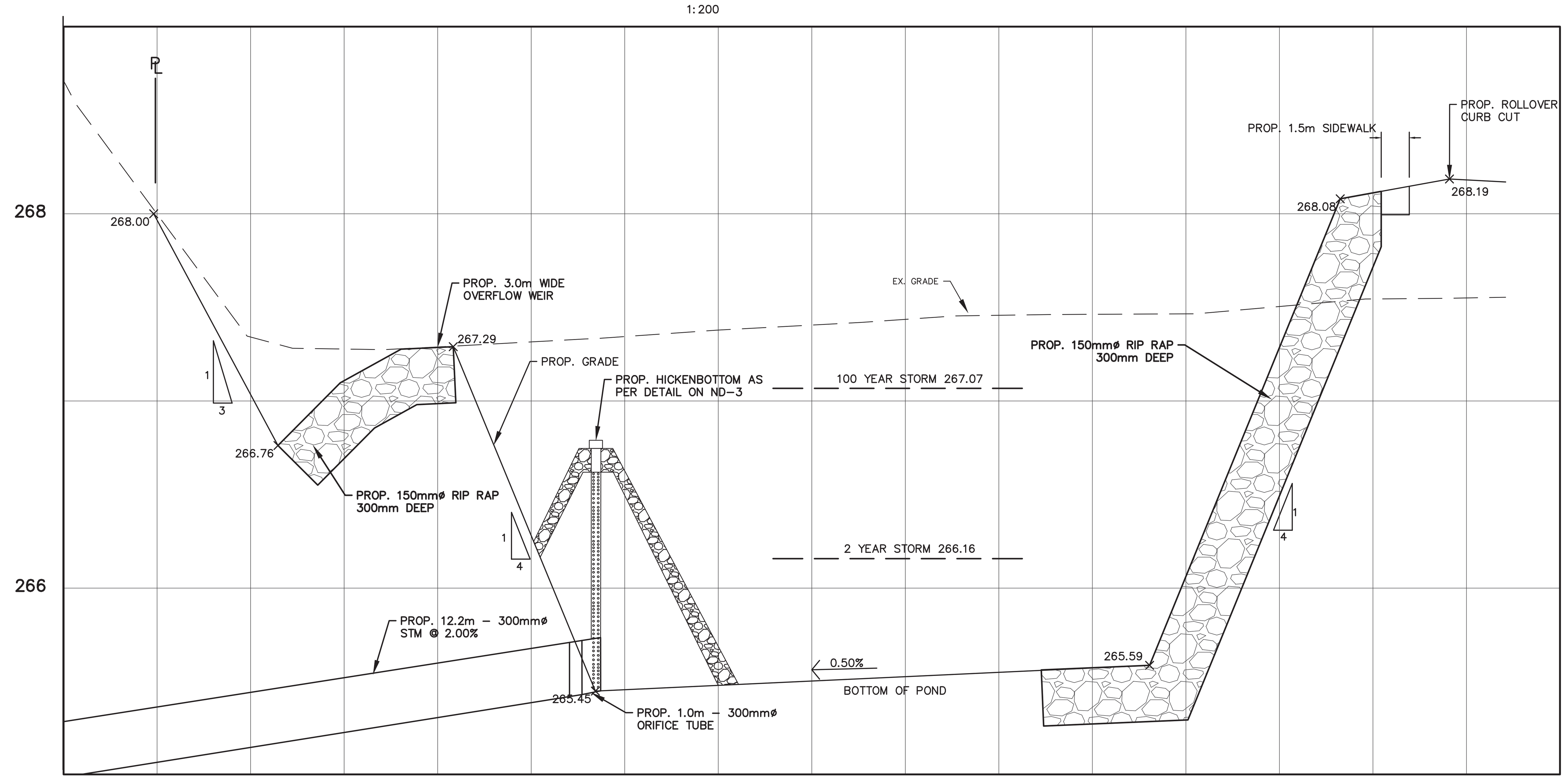
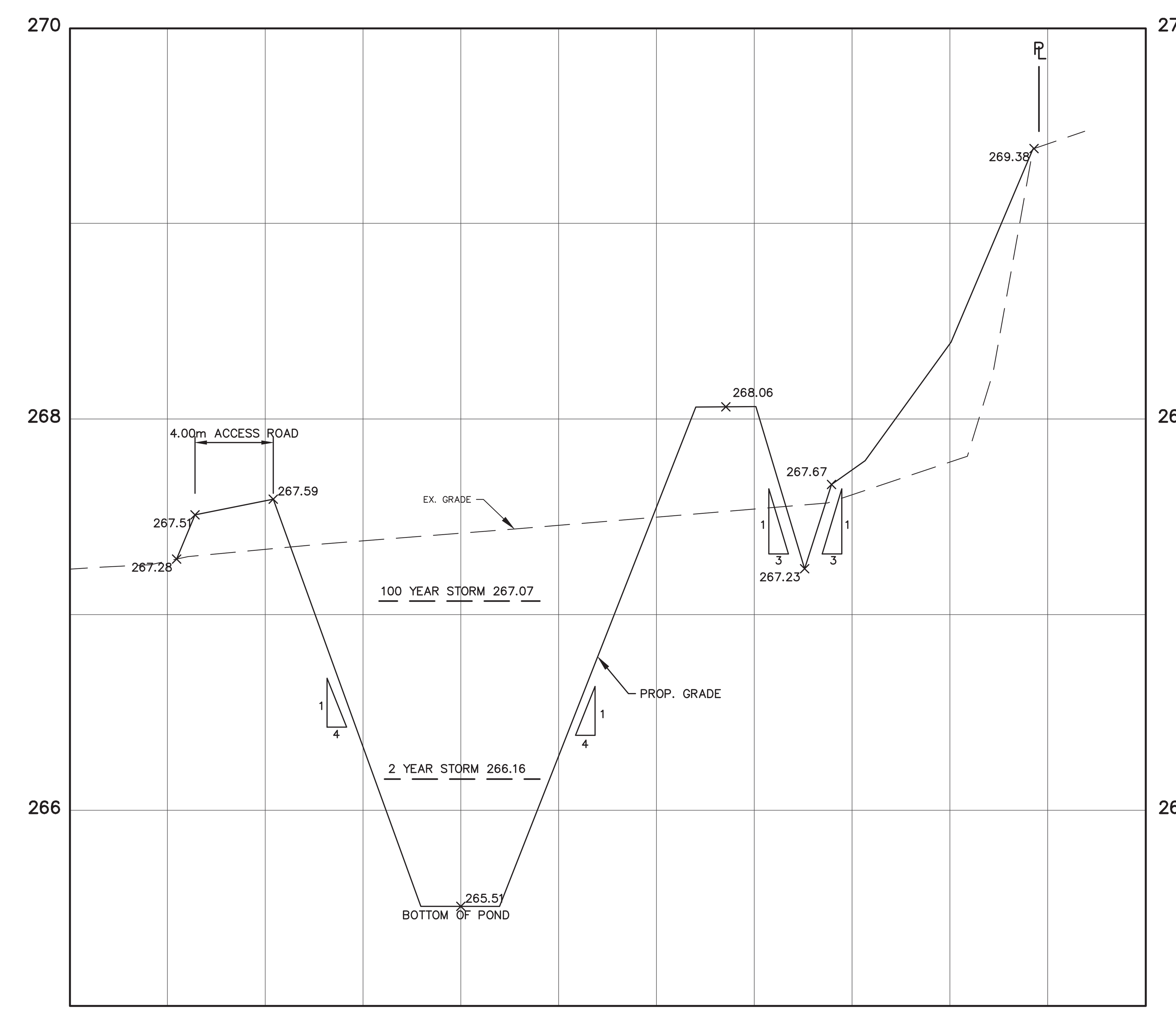


Table 3: SWM Pond Stage-Storage-Discharge

	2 Year Storm	5 Year Storm	10 Year Storm	25 Year Storm	50 Year Storm	100 Year Storm
Total Flow (m^3/s)	0.19	0.22	0.23	0.26	0.29	0.30
Elevation (m)	266.16	266.35	266.47	266.71	266.91	267.07
Total Storage (m^3)	130	193	238	340	444	535



SECTION A–A: POND LENGTH
HORIZONTAL SCALE 1:200
VERTICAL SCALE 1:20



SECTION B–B: POND WIDTH
HORIZONTAL SCALE 1:200
VERTICAL SCALE 1:20

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ORILLIA, 2 BORLAND STREET EAST

STORMWATER MANAGEMENT
POND DETAIL

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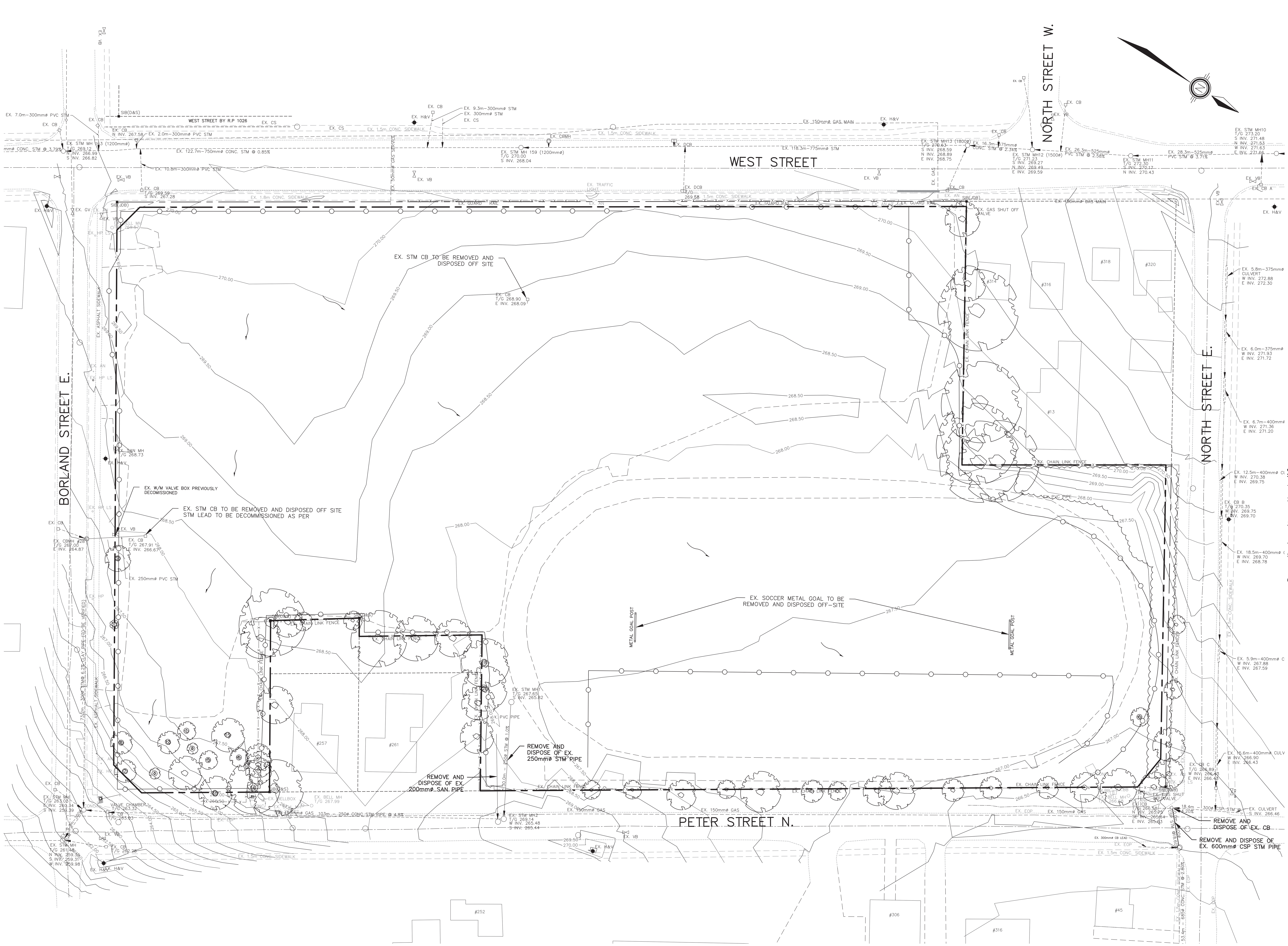

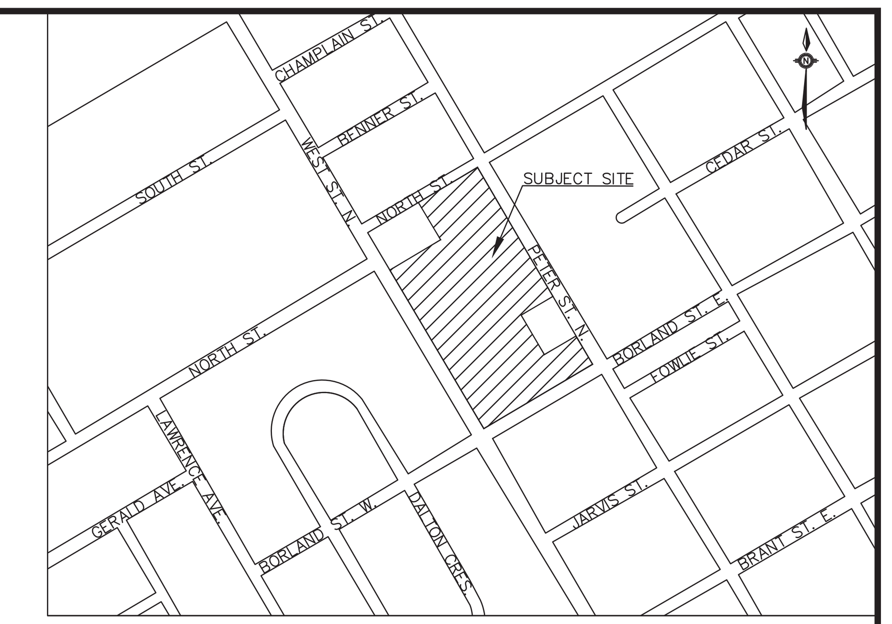

KEY MAP

NTS

LEGEND

- SILT FENCE
- TEMPORARY SWALE
- TEMPORARY ROCK CHECK DAM
- EX. CHAINLINK FENCE
- EX. BELL BOX
- EX. TREE

SEQUENCE OF CONSTRUCTION

1. ENGINEER TO BE NOTIFIED PRIOR TO INITIATION OF ANY ON SITE WORKS.
2. SILT FENCE AS PER BSD–23, CONSTRUCTION ACCESS MATS, SWALE, AND CHECK DAMS AS PER DETAILS ON EPR–1 ARE TO BE INSTALLED PRIOR TO THE COMMENCEMENT OF ANY WORKS ONSITE.
3. VEGETATION REMOVAL MAY COMMENCE AFTER ALL SILT FENCE IS INSTALLED AND APPROVED BY THE ENGINEER.
4. COMMENCE WITH EARTH WORKS AND SITE SERVICING.
5. EROSION CONTROL MEASURES TO BE MAINTAINED AS DIRECTED BY THE ENGINEER DURING THE CONSTRUCTION PERIOD. ADDITIONAL CONTROL MEASURES MAY BE REQUIRED AT THE DISCRETION OF THE ENGINEER.
6. ALL DISTURBED GROUND LEFT INACTIVE FOR MORE THAN 30 DAYS SHALL BE STABILIZED WITH SEED, SOD, MULCH OR OTHER ADEQUATE COVERING, AS INSTRUCTED BY THE ENGINEER.

NOTES FOR SEDIMENT & EROSION CONTROL

1. DISTURBED AREAS THAT HAVE FAILED TO HAVE STABLE GROUND COVER ESTABLISHED BY OCTOBER 30TH SHALL BE PROTECTED WITH A SILTATION CONTROL FENCE OR STRAW MULCH ETC. AND MAINTAINED BY THE CONTRACTOR UNTIL VEGETATION BECOMES ESTABLISHED IN THE SUBSEQUENT GROWING SEASON.
2. ANY DEWATERING WASTE SHALL BE DISCHARGED TO A VEGETATED AREA AT LEAST 30m FROM ANY WATERCOURSE AND FILTERED. FILTERING METHODS MUST BE APPROVED BY THE SITE ADMINISTRATOR.
3. SILT FENCE SHALL BE PUT IN PLACE PRIOR TO AND MAINTAINED DURING ALL GRADING. SILT FENCE TO BE INSPECTED PRIOR TO COMMENCEMENT OF EARTH GRADING ACTIVITIES. SILT FENCE TO BE INSPECTED AND REPAIRED OR REPLACED IF DAMAGED AS DIRECTED BY THE SITE ADMINISTRATOR.SILT CONTROLS TO BE INSPECTED ON A REGULAR BASIS AND AFTER EVERY RAIN EVENT. INSTALLATION SHALL BE TO THE MANUFACTURER'S RECOMMENDED SPECIFICATIONS.
4. THE CONTRACTOR SHALL BE PREPARED FOR UNEXPECTED CONDITIONS AND ACCORDINGLY HAVE STOCKPILED MATERIALS ON SITE FOR NECESSARY REPAIRS AS A RESULT OF FAILED OR INADEQUATE CONTROL MEASURES. ALL SEDIMENT AND EROSION CONTROL MEASURES SHALL BE INSPECTED AT LEAST ONCE A WEEK, AND AFTER EVERY RAINFALL EVENT.
5. MUD MATS AT ALL LOCATIONS WHERE CONSTRUCTION TRAFFIC ENTERS OR LEAVES THE SITE SHALL BE USED. 300mm OF 50mm – 100mm CLEAR LIMESTONE PLACED IN A GEOTEXTILE FABRIC SUITABLE FOR ALLOWING EX–FILTRATION OF WATER AND PREVENTING THE QUARRY STONE FROM BECOMING CONTAMINATED WITH THE SUBSTRATE SOIL (TERRAFIX 270R OR APPROVED EQUAL). TO BE FLANKED BY SILT FENCES AND VEGETATIVE BUFFERS FORM THE PROPERTY LINE TO THE START OF ANY ON–SITE ROADWAYS.
6. CONTRACTOR SHALL OBTAIN A CURRENT COPY AND BECOME FAMILIAR WITH OPSS 577, CONSTRUCTION SPECIFICATION FOR TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES AS WELL AS ALL APPLICABLE MUNICIPAL STANDARDS.
7. THE CONTRACTOR MAY CONSIDER ALTERNATIVE SEDIMENT AND EROSION CONTROL MEASURES. SUCH MEASURES SHOULD BE PRESENTED IN WRITING FOR APPROVAL OF THE SITE ADMINISTRATOR AND MUST BE APPROVED IN WRITING BY THE MUNICIPALITY AND CONSERVATION AUTHORITY.
8. THE TOPS OF ALL FILTER FABRIC MUST BE A MINIMUM OF 1.0 METRES ABOVE THE GROUND LEVEL AND ATTACHED TO THE FENCE WITH A CONTINUOUS STEEL WIRE. ALTERNATIVELY, THE FILTER FABRIC MUST BE FOLDED OVER THE TOP OF THE FENCE AND ATTACHED TO THE FENCE WITH WIRE LOOPED THROUGH THE FABRIC ON BOTH SIDES OF THE FENCE. FILTER FABRIC IS TO BE TERRAFIX 270R OR EQUIVALENT.
9. ALL DISTURBED GROUND LEFT FOR MORE THAN 30 DAYS SHALL BE STABILIZED BY SEEDING, SODDING, MULCHING, OR COVERING OR OTHER EQUIVALENT CONTROL MEASURES. THIS PERIOD OF INACTIVITY SHALL BE AT THE DISCRETION OF THE TOWN OF STAYNER'S MANAGER OF ENGINEERING BUT SHALL NOT EXCEED THIRTY DAYS OR SUCH LONGER PERIOD DEEMED ADVISABLE BY THE TOWN OF STAYNER'S MANAGER OF ENGINEERING.
10. CONTRACTOR RESPONSIBLE FOR MUD TRACKING, PREVENTION, AND MAINTENANCE ON SURROUNDING ROADS.

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ORILLIA, 2 BORLAND STREET EAST

ENVIRONMENTAL PROTECTION AND REMOVALS PLAN

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