Appendix H DRAINAGE AND STORMWATER MANAGEMENT REPORT

Drainage and Stormwater Management Report

Square One Drive Extension
Class EA & Preliminary Design

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City of Mississauga

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Sign-off Sheet

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Sign-off Sheet

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Abbreviations

BMP	Best Management Practice
CB	Catch Basin
CA	Conservation Authority
ESC	Erosion and Sediment Control
ET	Evapotranspiration
LID	Low Impact Development
MOECC	Ministry of Environment and Climate Change
OGS	Oil-Grit Separator
SWM	Stormwater Management
TSS	Total Suspended Solids

Glossary

Enhanced Quality Control	Enhanced protection corresponds to the end-of-pipe storage volumes required for the long-term average removal of 80% of suspended solids.
Evapotranspiration	The combined loss of water to the atmosphere from land and water surfaces by evaporation and from plants by transpiration.
Filtration	the technique of removing pollutants from runoff as it infiltrates through the soil.
Hydraulics	the branch of science and technology concerned with the conveyance of liquids through pipes and channels, especially as a source of mechanical force or control.
Hydrology	the branch of science concerned with the properties of the earth's water, especially its movement in relation to land.
Infiltration	The process by which water on the ground surface enters the soil
Low Impact Development	a stormwater management strategy that seeks to mitigate the impacts of increased runoff and stormwater pollution by managing runoff as close to its source as possible.
Quality Control	The “first-order” impacts of stormwater runoff are primarily related to suspended solids (SS), however, so the design of facilities is usually based on the long-term removal of SS from the stormwater discharge.
Quantity Control	Stormwater runoff peak flow control
Retention	Storage of stormwater without discharge to a pipe or other structure, typically the volume is infiltrated/exfiltrated or used on site
Return Period Storm	an estimate of the likelihood of a storm or flooding event to occur. For example, the term "100-year flood" means a flood that statistically has a 1-percent chance of occurring in any given year. Likewise, the term "100-year storm" means a

	rainfall event that statistically has this same 1-percent chance of occurring
Total Suspended Solids	the dry-weight of particles trapped by a filter. It is a water quality parameter used for example to assess the quality of wastewater after treatment in a wastewater treatment plant
Water Balance	Accounting of rainfall, infiltration, runoff, and evapotranspiration over some time period
Watercourse	an identifiable depression in the ground in which a flow of water regularly or continuously occurs (Conservation Authorities Act).
Watershed	an area or ridge of land that separates waters flowing to different rivers, basins, or seas

1.0 INTRODUCTION

Stantec Consulting Ltd. (Stantec) has been retained by the City of Mississauga (City) to complete a Class Environmental Assessment (Class EA) 'Schedule C' and preliminary design for the extension of Square One Drive in Mississauga from Confederation Parkway west to Rathburn Road West. The project study area (hereafter the 'Site') covers a road distance of approximately 250 m including the intersection of Square One Drive with Confederation Parkway and the proposed roundabout at Square One Drive and Rathburn Road West. The proposed extension will be a two-lane local road with a road width of approximately 9 m in addition to a boulevard and concrete sidewalk to the south and a boulevard and multi-use trail to the north. In addition to the works within the proposed Square One Drive Extension corridor, Rathburn Road West will be realigned from Confederation Parkway to near Hazineh Court to accommodate the proposed roundabout.

This Drainage and Stormwater Management (SWM) Report has been prepared to document the existing drainage, water quantity and quality conditions in the study area, evaluate the relative impacts of the preferred design on the receiving surface water systems, and recommend measures to mitigate the potential impacts.

The following materials were reviewed in the preparation of this report:

- *Geotechnical Investigation, proposed Square One Drive Extension*, City of Mississauga, On, prepared by GeoPro Consulting Limited, March 23, 2017 [Geotechnical Report];
- *City of Mississauga Development Requirements, City of Mississauga, September 2016 [City Design Manual];*
- *Credit Valley Conservation Stormwater Management Criteria*, Credit Valley Conservation Authority, 2012 [CVC SWM Criteria];
- *Appendix B, Landscape Design Guide for Low Impact Development,* prepared by Credit Valley Conservation Authority (CVC), 2012 [CVC LID Guidelines];
- *Low Impact Development Stormwater Management Planning and Design Guide,* prepared by CVC and Toronto and Region Conservation Authority (TRCA), 2010 [LID Guidelines];
- Functional Servicing Report, City Centre Lands, City of Misusages, Sernas Associates, May 2004; and
- *High-Rise Apartment Condominium Site Plan, Rathburn Road and Confederation Parkway, City of Mississauga, Stormwater Management Report,* The Conservatory Group, July 2011.

2.0 EXISTING CONDITIONS

2.1 GENERAL

Square One Drive is a minor collector road running northeast/southwest in the central portion of the City of Mississauga (Ward 4). The proposed extension of Square One Drive travels through mostly undeveloped land southwest of a condominium complex at 330/350 Rathburn Road. Near the west end of the Site, the proposed extension passes through Zonta Meadows Park. Near the southern edge of the right of way (ROW) for the proposed extension there is an existing Enersource building.

The proposed extension is 23.5 m wide and approximately 250 m in length and captures runoff from some additional areas where it intersects with Rathburn Road West for a total area of approximately 0.71 ha. The Site falls within the Mary Fix Creek Subwatershed of the Credit River and is under the jurisdiction of the Credit Valley Conservation Authority (CVC). SWM criteria for this project have been derived from the requirements of the CVC and the City of Mississauga.

The section of Rathburn Road West that is to be realigned is a four-lane road with sidewalks on both sides, a bicycle path to the south, a grassed boulevard to the north, and a grassed boulevard to the south in some sections. This section of Rathburn Road West, including both the current and the realigned road, paths, and boulevards has a total area of 1.98 ha.

2.2 EXISTING DRAINAGE

Under existing conditions, the Site generally drains from northeast to southwest. Stormwater flows overland through parkland and enters catch basins (CB) before flowing through storm sewers to a 1500 mm x 3000 mm concrete box culvert approximately 150 m to the southwest. Drainage from the Rathburn Road West is picked up by CBs in the road and is conveyed to the to the same 1500 mm x 3000 mm concrete box culvert near Schneider Court.

Existing drainage patterns were studied using orthoimagery of the Site and the following drawings and design sheets provided by the City of Mississauga (see **Appendix A**):

- Drawing no. G-38, Underground Services Storm Drainage, prepared by G.M. Sernas, 1992 [Rathburn Drainage Plan];
- Square One Drive, Drawing no. 57501-3-P01 prepared by AECOM, January 2007;
- Rathburn Road W., Drawing P-3, prepared by G.M. Sernas, 1986; and
- Storm Drainage Design Chart, The Woods North, by G.M. Sernas, 1985.

The existing drainage pattern is identified in the existing condition plan (**Figure 1**).

2.3 SOILS

A geotechnical investigation was conducted to obtain information on the existing subsurface conditions by means of five boreholes. Results show that the existing soil is predominantly clayey silt till (HSG type D). Sandy silt was encountered below a depth of 1.4 m at borehole no. 5. The boreholes were between 1.7 to 2.0 m deep due to spoon refusal on probable shale bedrock. Groundwater was encountered at a depth of 0.6 m and 0.9 m below ground surface at boreholes BH3 and BH4, respectively. These two boreholes are located within the proposed road right of way. The other three boreholes, which are located at both ends of the proposed road, were dry upon completion of drilling.

3.0 STORMWATER MANAGEMENT CRITERIA

Additional stormwater runoff from new pavement can impact receiving watercourses and cause flooding, erosion, and water quality impacts. Quantity and quality control measures to treat runoff should be considered for all new impervious areas and, where possible, existing surfaces. The following applicable SWM criteria are based on the City Design Manual and CVC SWM Criteria:

- **Quantity Control**: The 10-year post development flow must be controlled to the 2-year pre-development peak (City Design Manual Table, 2.01.03.03c);
- **Quality Control**: Implement Enhanced Level (80 % Total Suspended Solids (TSS) Removal) water quality control for all new developments;
- **Water Balance:** The CVC SWM Criteria Table 2-2 requires providing a minimum post-development recharge of the first 3 mm for any precipitation event. The subject Site is considered a Low Volume Groundwater Recharge Areas (LGRA), which does not impact a sensitive ecological feature, or require a subwatershed study, or EIR. A 3 mm per precipitation event must be captured and infiltrated;
- **Erosion and Sediment Control**: CVC Section 4.2 requires on-site detention of 5 mm as a minimum for this Site where conditions do not warrant the detailed analyses; and
- **Conveyance**: The storm sewer system should be designed to capture and convey runoff generated by the 10-year storm event. The minimum initial time of concentration is to be 15 minutes (City of Mississauga).

4.0 SQUARE ONE DRIVE EXTENSION PROPOSED CONDITIONS

4.1 SWM PLAN

The proposed extension will be a two-lane local road with a maximum pavement width of approximately 9 m (including on-street parking) in addition to a boulevard and concrete sidewalk to the south and a boulevard and multi-use trail to the north. The proposed work will increase the imperviousness within the right-of-way due to a change from grass to asphalt/concrete. A wide range of best management practices (BMPs) are available to mitigate the impacts of the increased imperviousness of the proposed road.

The SWM Plan will review and evaluate the available SWM alternatives and will develop a recommendation of the suitable SWM practices based on the capital cost, level of treatment, maintenance requirements, space constraints and site-specific conditions. A preliminary design will be provided for the preferred alternative to satisfy the SWM criteria as stated in Section 3.0.

4.1.1 Low Impact Development (LID)

LID is a SWM strategy that seeks to mitigate the impacts of increased runoff and stormwater pollution by managing runoff as close to its source as possible. LID comprises a set of site design strategies that minimize runoff and distributed, small scale structural practices that mimic natural or predevelopment hydrology through the processes of infiltration, evapotranspiration, harvesting, filtration and detention of stormwater. To protect the health of the Credit River watershed, the updated water management strategy calls for an immediate shift to more proactive and innovative stormwater management systems that include LID practices.

Studies show that implementing LID practices can have multiple positive environmental effects which help to mitigate potential negative impacts of climate change on groundwater levels, risk of flooding and stream channel erosion. Therefore, evaluation of the available SWM measures for the subject Site will include different types of the source treatment LID options as described below. Feasible LID measures will be implemented in the proposed SWM plan.

4.1.2 Available Measures

The available measures are generally classified into source, conveyance and end-of-pipe treatment alternatives.

- **Source Treatment Alternatives**: This alternative includes measures that treat precipitation where it falls, typically through infiltration or water reuse. Suitable source treatment for roads includes permeable pavement and engineered soil cells. Permeable pavement is generally not appropriate for this type of urban road due to concerns regarding maintenance requirements to prevent clogging of the permeable pathways through the pavement and due to potential groundwater contamination.

Engineered soil cells, such as Silva Cells® are modular support systems that provide a sturdy and permeable ground level decking that transfers surface loads to a compacted subbase 0.4 – 1.1 m below grade without compacting the near-surface soil layers. Because the near-surface layers remain uncompacted, void ratios remain high making the near surface layers useful for stormwater detention and infiltration. Engineered soil cells also provide suitable soil conditions for large tree growth. Engineered soil cells are recommended to provide water balance and erosion and sediment control for the proposed road.

- **Conveyance Treatment Alternatives:** This alternative includes measures which treat runoff as it flows from the source to the receiving watercourse. Conveyance treatment for roads includes enhanced roadside swales, dry grassed swales, pervious pipe and CB SHIELDS®.

    - Enhanced roadside swales should have a wide flat bottom that acts to slow and infiltrate road runoff. The established vegetation will further slow the flow and traps pollutants through filtering and nutrients uptake. Due to site constraints, no opportunities exist for a grassed swale.
    - Dry grassed swales with check dams on shallow grades can be effective in providing detention of stormwater and infiltration where soils permit. The boulevard areas adjacent to the road could be graded as shallow dry swales to detain and infiltrate the relatively clean water from the sidewalk. Since the native soil is predominantly clay, no opportunities exist for a dry grassed swale.
    - Pervious pipe systems are another conveyance control measure. The expected traffic volume indicates that extensive pre-treatment would be required to prevent clogging of the system with fine particles and to prevent ground water contamination. Also, clay is the predominant soil in this Site, which limits the potential effectiveness of this alternative. Therefore, pervious pipe system is not a recommended alternative for this site.
    - CB Shields® are devices that encourage sedimentation and reduce scour by intercepting influent stormwater and deflecting it toward the side of the CB. On their own, CB SHIELDS® have been demonstrated to provide 50-80% TSS removal. CB SHIELDS® are recommended as part of a quality control treatment train.

End-of-pipe Treatment Alternatives: This alternative includes wet ponds, Oil-Grit Separators (OGS) and stormwater filter devices like Jellyfish® Filters. Wet Ponds have been applied extensively for road works where the contributory drainage area exceeds 5.0 ha. Since the proposed site area is only 0.71 ha, which is less than the minimum requirement, wet ponds will not be used.

OGS units are generally applied to road drainage systems, either on their own or as part of a treatment train. OGS units provides treatment through sedimentation and oil-grit capture. The Jellyfish® Filter is a proprietary filtration system currently undergoing evaluation by the Ontario Ministry of the Environment and Climate Change (MOECC). Through a combination of filtration, sedimentation and oil-grit capture, the Jellyfish® Filter can be sized to provide >80% TSS removal. This system would be installed at the downstream end of the Site's storm sewer line either in a manhole or an underground vault structure. It requires removal of collected contaminants and filter washing a minimum of once per year and filter replacement every 2-5 years. Both OGS and Jellyfish Filters are suitable for this Site.

4.2 QUANTITY CONTROL

Because the Site lies within the Mary Fix Creek Subwatershed, it is required that the 10-year post development flow is controlled to the 2-year pre-development peak (City Design Manual, Table 2.01.03.03c).

Under existing conditions the Site has a weighted runoff coefficient of 0.33. The time of concentration has been found to be 11 minutes using the Bransby-Williams method and 14 minutes using the Uplands method; therefore, the City minimum of 15 minutes has been used. yielding a 2-year pre-development peak flow from the Site is 0.039 m^3/s (see **Appendix D**).

Under post-development conditions, the Site will have a runoff coefficient of 0.90 and a time of concentration of 15 minutes yielding a 10-year post-development runoff rate is 0.176 m^3/s.

Using an 80 mm orifice tube at the downstream end of the Site to connect the proposed storm sewers to MH50, and assuming that the system backs up to the top of lowest CB during the 10-year event (DCB 17), the discharge rate from the Site is 0.038 m^3/s. Using the modified rational method, 135 m^3 of detention storage is required upstream of the orifice tube. Several methods of quantity storage that may be appropriate for this Site are discussed below.

4.2.1 Underground Tank

An stormwater detention tank could be used to provide the required 141 m^3 of storage. In order to make full use of an underground tank, the top of the tank must be below the lowest CB in the system to prevent stormwater from spilling out of the CB. As such, any such system should be provided near the west end of the Site so that the tank can be installed at a minimum depth. Tank materials and styles that could be considered include:

- Concrete box tanks (e.g., StormTrap®);
- Plastic arch tanks (e.g., StormTech®); and
- Large-diameter HDPE pipe tank (e.g., Weholite).

4.2.2 Superpipe

The required storage could be provided through the use of oversized conveyance pipes. The total length of proposed storm sewer pipe on the site is 190 m. The pipes would, therefore need to be approximately 1050 mm ø which is much larger than required for the conveyance of stormwater from the site. Oversizing pipes to this extent is generally much more expensive than providing the same volume in an underground tank and is not recommended for this Site

4.2.3 Engineered Soil Cells

Engineered soil cells can serve multiple purposes including stormwater detention, retention, and quality improvement. Engineered soil cells can provide significant detention volumes in the void spaces within the soil. These systems can be designed to accept stormwater directly from CBs.

Section 2.01.03.02 of the City Design Manual states that:

> *With respect to optimizing the infrastructure if site grading and configuration allow, there may be the potential to replicate the stormwater quantity control storage typically provided by way of "superpipes" within the low impact development measures. If this is the case, the City would consider a "volumetric" credit if:*
>
> - *Engineering design demonstrates technical adequacy and sufficient storage such that pipe or surface storage are redundant, and;*
> - *A stormwater charge credit application is submitted which obliges the site tenant or property manager to maintain the infrastructure and also allows the City ability to inspect and enforce should there be any concerns particularly since the credit discussed here links back to flood resiliency.*

Subject to approval by the City, the use of engineered soil cells (e.g., Silva Cells®) could be used to achieve the detention storage required for flow attenuation.

4.2.4 Recommended Design

It is recommended that the required stormwater detention volume be provided primarily through an underground storage tank. As an example, a Weholite storage system (HDPE pipe tank) has been sized for this application. The tank would be approximately 2440 mm in diameter and 29 m long(see Appendix D for preliminary design report). It is proposed that this unit be located near the proposed roundabout (see Figure 2).

The size of the tank may be reduced through the use of engineered soil cells. It is recommended that this option be explored further with the City during detailed design. At that point it will be important to establish with the City the detention storage volume per m^3 of soil that will be accepted for quantity control.

4.3 QUALITY CONTROL

The study area currently does not include any water quality control measures to treat runoff before discharging into the storm sewer. The SWM criteria require the implementation of enhanced level water quality control (80% TSS removal) for all new developments.

CVC is adopting the City of Toronto Guidelines for OGS application. Essentially, OGS is recommended as a pre-treatment device or may be used as part of a multi-component (treatment train) approach to achieve Enhanced quality control. According to the City of Toronto Guidelines, OGS devices, operating alone at their original design capacities, are capable of achieving a TSS removal efficiency of 50%. The proposed Square One Drive Extension is located within a completely urbanized area; with limited opportunities of SWM practices that can be applied to achieve the required 80% TSS removal.

Two design alternatives have been proposed. The first consists of an OGS installed at the outlet of the Site's storm sewer piping along with CB Shield® on each CB. The second employs an inline filter unit installed at the outlet of the Site's storm sewer piping to meet the quality criterion. For both alternatives, the proposed Silva Cells will provide further treatment and enhance the performance of the proposed treatment train.

4.3.1 Alternative 1: CB Shields® and Oil-Grit Separator

An OGS unit would be located at the downstream end of the Site's storm sewer line and sized to provide 50% TSS removal. Additional treatment would be provided at each CB through the use of CB Shield® devices, which will provide 50-80% TSS removal. As an example, PCSWMM for Stormceptor software was used to size a Stormceptor OGS unit, **Table 1** below provides summary of the required OGS characteristics (see **Appendix A** for a full Stormceptor report). The combined TSS removal for the treatment train should exceed the Enhanced Level of target of 80%.

Table 1: Proposed OGS Characteristics

Area (ha)	Imp. (%)	Required TSS Removal (%)	Required Annual Runoff Volume (%)
0.71	90%	75%	91

4.3.2 Alternative 2: Jellyfish® Filter

An inline filter unit would be located at the downstream end of the Site's storm sewer line and sized to provide 80% TSS removal. As an example, a Jellyfish® Filter unit has been sized for the Site. **Table 2** below provides summary of the proposed Jellyfish characteristics. A detailed Jellyfish® sizing report is included in **Appendix A**.

Table 2: Proposed Jellyfish Filter Characteristics

Area (ha)	Imp. (%)	JF Type	TSS Removal (%)	Annual Runoff Volume (%)
0.71	90%	JF6-4-1	80%	90

4.4 WATER BALANCE

The CVC categorizes the Site area as being a "Low Volume Groundwater Recharge Area" and, therefore, requires a minimum of 3 mm per storm event to be captured and infiltrated. The Site includes approximately 0.71 ha of paved roadway which is unsuitable for infiltration without pre-treatment.

Soil Investigation results show that the existing soil is predominantly clayey silt till. Groundwater was encountered at a depth of 0.6 m and 0.9 m below ground surface at the two boreholes within the roadway area. Since the quality treatment of the runoff from the roadway will be accomplished with an inline treatment device installed in the storm sewer at the downstream end of the site, and due to the low permeability of the native soil and high ground water, infiltrating runoff from the road on-site is not feasible.

4.5 EROSION AND SEDIMENT CONTROL

CVC requires on-site detention of 5 mm as a minimum for this Site where conditions do not warrant the detailed analyses. The peak flow generated by the 5 mm storm event over the 0.71 ha drainage area was calculated as 0.01 m^3/s using PCSWMM software. The minimum allowable orifice size of 75 mm will release 0.02 m^3/s, which exceeds the peak flow generated by the 5-mm storm event. Accordingly, 5 mm storage detention cannot be met by controlling the outflow from the road areas. Therefore, technologies such as Silva Cells® should be considered during detailed design to achieve the erosion and sediment control targets by retaining and consuming the runoff generated by the 5-mm storm event through evapotranspiration (ET).

As an example of how Silva Cells could be implemented for this Site, retention of an equivalent of 5 mm rainfall event could be provided using Silva Cells® installed in the southern boulevard. A minimum of six trees would be planted along the southern boulevard. The total volume of planting soil is 90 m^3, which would provide a storage volume of 36 m^3, assuming 0.40 void ratio. The proposed Silva Cell system would capture and retain the first 12.5 mm of precipitation falling over the southern half of the roadway, which is equivalent to 5 mm over the total site area (0.71 ha). Example Erosion and Sediment Control Calculations are included in **Appendix B**.

5.0 RATHBURN ROAD WEST PROPOSED CONDITIONS

The proposed realignment of Rathburn Road West shifts the roadway south by a maximum of approximately 7 m. The width of the realigned roadway will be approximately the same as that of the current roadway. Landscaped areas south of the existing roadway that will be converted to paved lanes in the proposed condition will be offset by increases in landscaped areas north of the realigned roadway. As such, the imperviousness and existing drainage patterns in and around Rathburn Road West will be generally maintained under the proposed conditions.

5.1 QUANTITY CONTROL

The imperviousness and drainage area of the realigned Rathburn Road West will remain unchanged in the proposed condition; therefore, no quantity controls have been proposed.

5.2 QUALITY CONTROL

According to the Rathburn Drainage Plan, under existing conditions, the storm sewer under Rathburn Road West immediately east (downstream) of the intersection with the Square One Drive Extension receives drainage from 9.2 ha. The area of Rathburn Road West that is being realigned totals 1.98 ha. Since the storm sewer in this area conveys flows from a significantly larger area than is being realigned, it is not feasible to provide centralized quality treatment on the storm sewer under Rathburn Road West.

It is proposed that CB Shield® devices be installed on all catch basins of the realigned road to provide 50-80% TSS removal.

5.3 WATER BALANCE

The imperviousness and drainage area of the realigned Rathburn Road West will remain unchanged in the proposed condition; therefore, no water balance controls have been proposed.

5.4 EROSION AND SEDIMENT CONTROL

As with the Square One Drive Extension, it is proposed that erosion and sediment control requirements for the Rathburn Road West realignment (5 mm detention) be achieved through the use of engineered soil cells.

For example; minimum of 17 trees could be planted in Silva Cells® along the northern boulevard. The total volume of planting soil would be 255 m^3, which would provide a storage volume of 102 m^3, assuming 0.40 void ratio. The proposed Silva Cell system would capture and retain the first 9.7 mm of precipitation falling over the northern 24 m of the 40 m road right of way, which is equivalent to 5 mm over the total Rathburn Road West right of way area (1.98 ha). Erosion and Sediment Control Calculations are included in **Appendix B**.

6.0 CONVEYANCE

6.1 DESIGN CRITERIA

The existing drainage pattern shows that the Site drains towards the west into an existing 1500 mm x 3000 mm concrete box culvert which flows southeast. It is proposed that runoff from the Site will be conveyed via a proposed storm sewer system along Square One Drive and discharged into the 900 mm storm sewer line along Rathburn Road West. Approximately 100 m south of its intersection with Square One Drive, the 900 mm storm sewer empties into the existing 1500 mm x 3000 mm concrete box culvert.

Runoff from Rathburn Road West between Confederation Drive to Hazineh Court is collected in a storm sewer under Rathburn Road which empties into a 1500 mm x 3000 mm concrete box culvert near Schneider Court. The realignment of Rathburn Road West will result in the existing storm sewer being located underneath the proposed curb.

The design of the proposed storm water drainage system was based on the following design criteria, as per The City of Mississauga Guidelines:

- The storm sewer network should be designed with adequate capacity to accommodate runoff generated by the 10-year storm events, and 15 minutes initial time of concentration;
- Sewer must have an adequate gradient to maintain a velocity of 0.75 m/s minimum for circular concrete pipes and maximum velocity of 4.0 m/s;
- The storm sewers shall be located 1.5 m south or west of the centre line of the right of way;
- Maximum spacing of manholes shall be 120 m for sewers 600 mm or less in diameter and 170 m for sewers 675 mm or greater in diameter;
- The maximum area to be served by any catch basin shall be 2000 m^2 of paved area or 5000 m^2 of sodded area;
- Maximum spacing for catch basins shall be as follows:
    - Road grade @ 0.5% - 70 m
    - Road grade @ 0.5% to 3% - 90 m
    - Road grade greater than 3% - 70 m;
- Design flow calculations must be completed on City of Mississauga forms shown on City Standard Drawing No.'s 2112.020 and 2112.030, for this purpose; and
- Since the future buildings in the vicinity of the Site will not discharge into the proposed road storm sewers, hence the pipes will be placed with 1.2 m cover below the centre line of the road.

6.2 MINOR FLOW

Under existing conditions, the Site generally drains from northeast to southwest. Stormwater flows overland through parkland and enters CBs before flowing through storm sewers to a 1500 mm x 3000 mm concrete box culvert approximately 150 m to the southwest. Based on the Existing Underground Services, Storm Drainage drawing and storm sewer design sheets provided by the City, two alternatives were evaluated for the proposed outlet for the Square One Drive Extension.

The first alternative is to outlet into the existing 900 mm storm sewer on Rathburn Road West, which is currently flowing at 87% of full flow capacity during the 10-year event. **Table 3** below shows pipe capacities, existing condition and proposed condition peak flows (using a runoff coefficient of 0.90). The proposed junction point for the storm sewer from the Site is at existing MH 50 at the intersection of Rathburn Road West and Via Russo Court. It should be noted that the 10-year flow from the proposed road will be reduced by passing the flow into the proposed Silva cell tree boxes.

Table 3: Storm Sewer Networks Conditions

From MH	To MH	Pipe Diameter (mm)	Full Flow Capacity (m^3/s)	Flow From 10 Year Event					
				Existing Conditions			With Runoff from Site		
				Drainage Area (ha)	m^3/s	% Full	Drainage Area (ha)	m^3/s	% Full
51	50	825	1.335	7.73	1.094	82	7.73	1.094	82
50	7	900	1.459	9.16	1.272	87	9.87	1.307	90
7	4	3000 x 1500 (Box Culvert)	11.07	104.60	10.26	93	105.31	10.30	93

The second considered alternative is to discharge into the storm sewer running along Confederation Parkway, however, the addition of the 10-year flow from the Site would result in an expected flow of 0.29 m^3/s which exceeds the capacity of the pipe on Confederation Parkway of 0.21 m^3/s (expected flow in this pipe under existing conditions is 0.11 m^3/s). Therefore, Alternative 1 is recommended, and the proposed storm sewer for Square One Drive Extension is designed to discharge into the existing storm sewer along Rathburn Road West. The storm sewer design sheet is included in **Appendix C**.

It is noted that the Storm Sewer under Rathburn Road West is flowing nearly at capacity and will likely require upsizing in the future. An assessment of the extent of the improvements required is beyond the scope of this report; however, it is recommended that the City investigate this further during detailed design.

6.3 MAJOR FLOW

Under existing conditions, the Site drains overland to CBs that connect to 250 mm pipes that graduate to 300 mm pipes then feed directly into the 1500 mm x 3000 mm box culvert without using the storm sewer line running along Rathburn Road West. The proposed road slopes from a high point of 159.14 at the intersection with the Confederation Parkway, to a low point of 156.60 at the intersection with Rathburn Road West. Accordingly, the major flow will be conveyed via the proposed roadway as overland flow towards Rathburn Road West. The overland flow route on Rathburn Road West will be maintained.

7.0 SUMMARY

The proposed plan meets the SWM criteria as summarized below with the exception of the detention and infiltration of precipitation falling on the paved road area.

- **Water Quantity Control**: A stormwater detention system along with an orifice tube at the downstream end of the system will reduce the 10-year post development flow rate to the 2-year pre-development flow rate.
- **Water Quantity Control**: Either an OGS in conjunction with CB Shields® on all CBs or a Jellyfish® will be used to achieve the quality control target of 80 % TSS removal efficiency for the developed areas.
- **Water Balance**: Due to the low permeability of the native soil and high ground water, infiltrating runoff from the road on-site is not feasible.
- **Erosion and Sediment Control**: Engineered soil cells could be used to retain (then reuse) runoff generated by the 5-mm storm event.
- **Conveyance**: Based on evaluation of the available alternatives, it is recommended to connect the proposed storm sewer into the existing stormsewer along Rathburn Road West.

We trust the information provided will assist you in completing your review of the SWM plan for this study area. Should you require any additional information, please contact the undersigned.

Sincerely,
STANTEC CONSULTING LTD.

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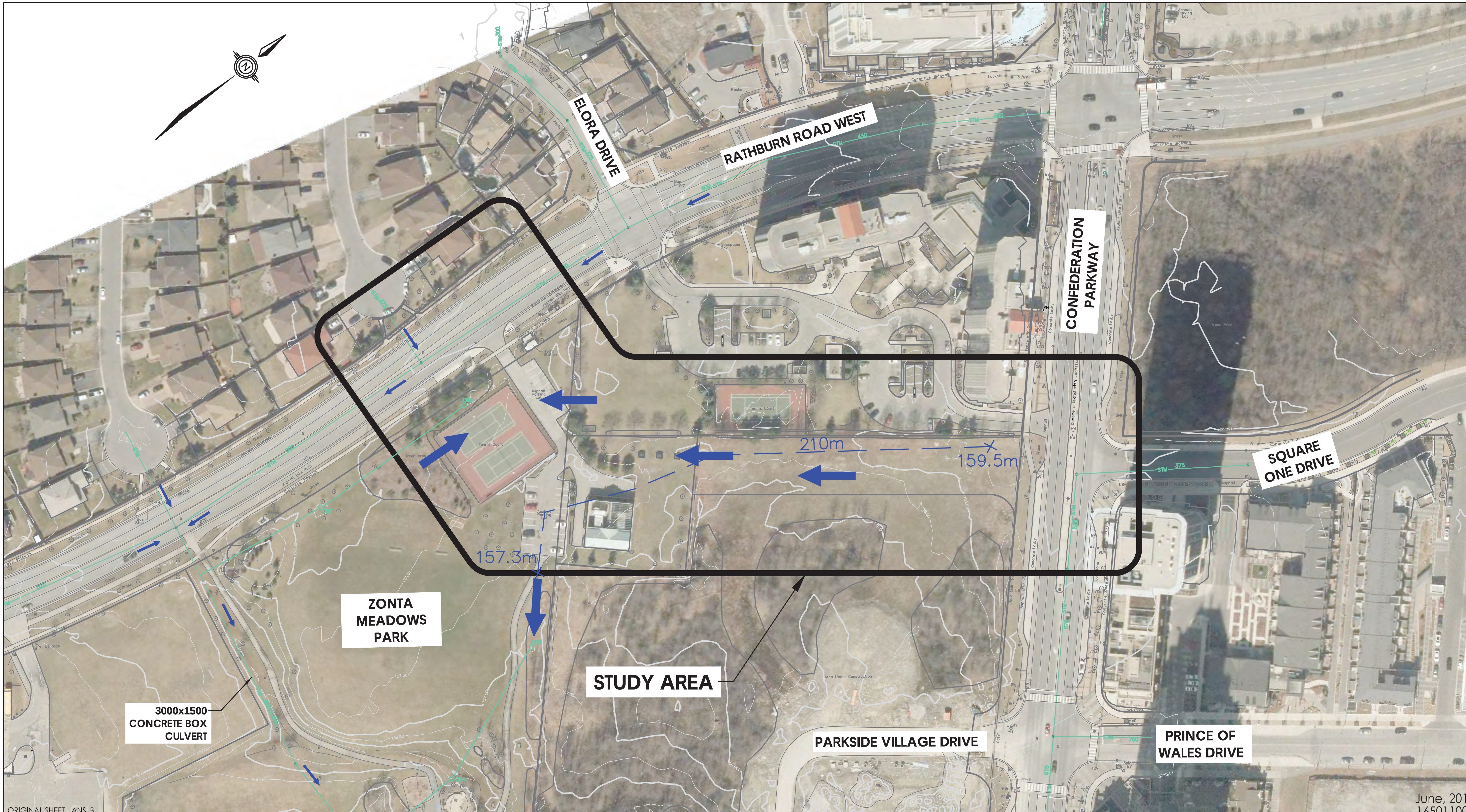

June, 2017
165011005

Stantec

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Markham ON
www.stantec.com

Legend

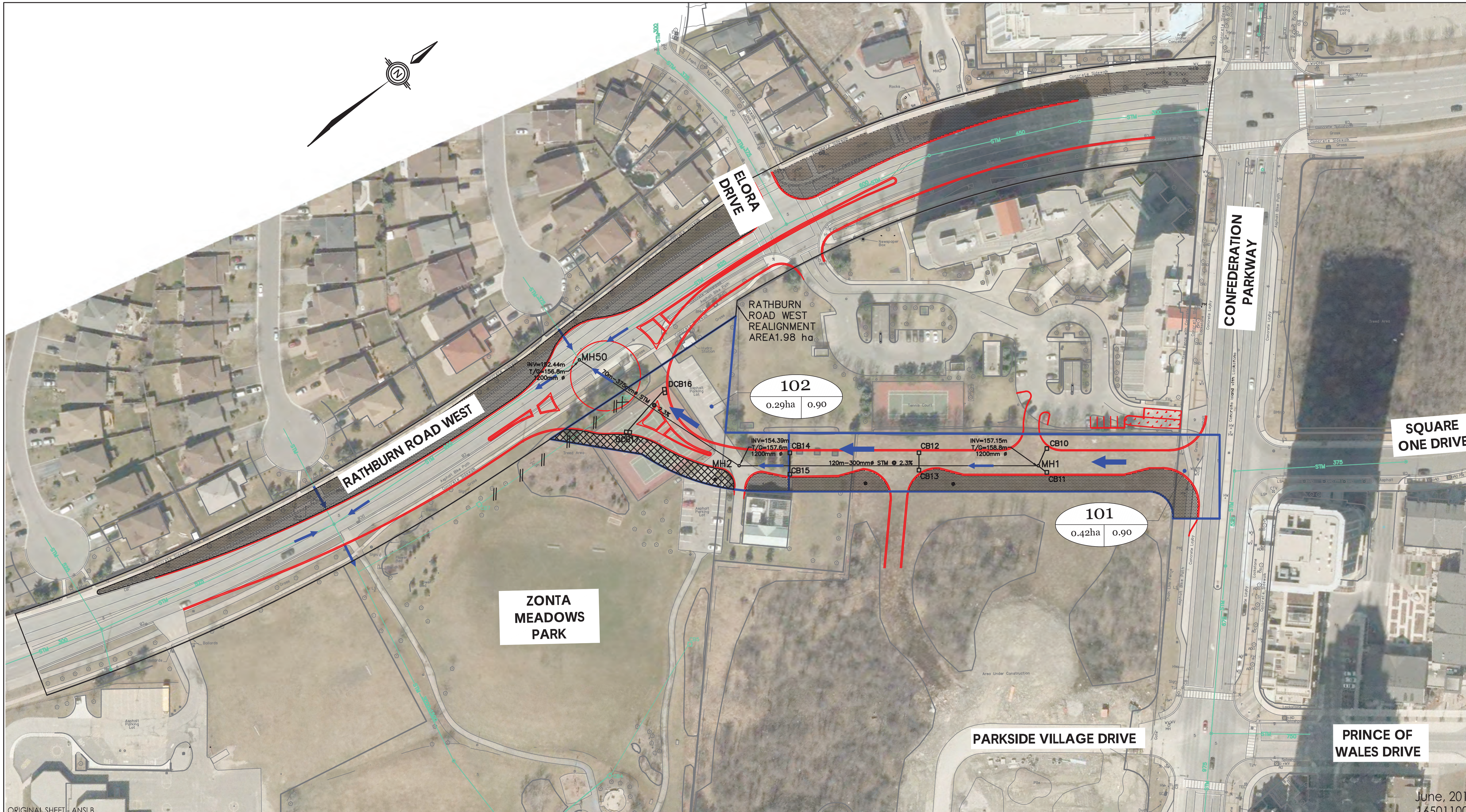
EXISTING STORM SEWER		MINOR FLOW		EXISTING CONTOURS	
EXISTING MANHOLE		MAJOR FLOW			
EXISTING CATCH BASIN		LONGEST FLOW PATH			

Client/Project
City of Mississauga
Square One Drive Extension Class EA

Figure No.
1

Title
Existing Drainage Conditions

Scale
1:1000



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2017/06/16 10:00 AM By: Rosales, Itzel

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Legend

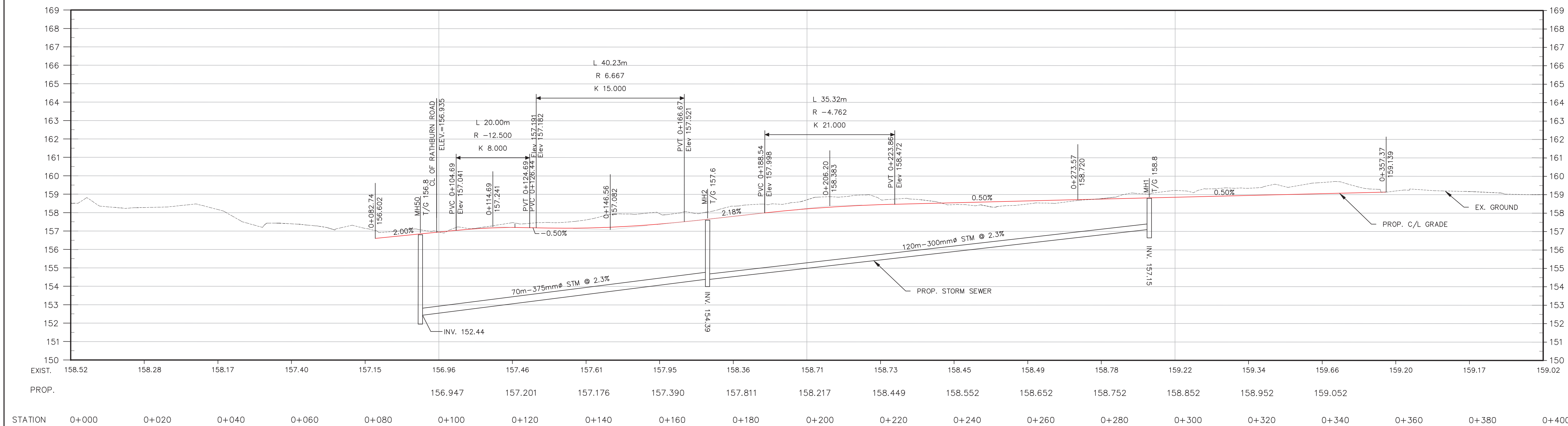
EXISTING STORM SEWER
EXISTING MANHOLE
EXISTING CATCH BASIN
EXISTING STORM SEWER TO BE REMOVED
PROPOSED ROAD
PROPOSED STORM SEWER
PROPOSED MANHOLE
PROPOSED CATCH BASIN
MINOR FLOW
MAJOR FLOW
CATCHMENT BOUNDARY
POTENTIAL SILVA CELL LOCATIONS
POTENTIAL TANK LOCATION
CATCHMENT ID 102
AREA (ha) 4.85ha
RUNOFF COEFFICIENT 0.38

Client/Project
City of Mississauga
Square One Drive Extension Class EA

Figure No.
2

Title
Stormwater Management Plan

Scale
1:1000



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June, 2017
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Client/Project
City of Mississauga
Square One Drive Extension Class EA

Figure No.
3

Title
Storm Sewer Profile

Scale
1:1000

APPENDICES

Appendix A QUALITY CONTROL

STANDARD OFFLINE
Jellyfish Filter Sizing Report

Project Information

Date	Thursday, April 20, 2017
Project Name	Square One Rd Ext
Project Number	revised area
Location	Mississauga

Jellyfish Filter Design Overview

This report provides information for the sizing and specification of the Jellyfish Filter. When designed properly in accordance to the guidelines detailed in the Jellyfish Filter Technical Manual, the Jellyfish Filter will exceed the performance and longevity of conventional horizontal bed and granular media filters.

*Please see **www.ImbriumSystems.com** for more information.*

Jellyfish Filter System Recommendation

The Jellyfish Filter model JF6-4-1 is recommended to meet the water quality objective by treating a flow of 22.7 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 18 years of TORONTO CENTRAL rainfall data for this site. This model has a sediment capacity of 256 kg, which meets or exceeds the estimated average annual sediment load.

Jellyfish Model	Number of High-Flo Cartridges	Number of Draindown Cartridges	Manhole Diameter (m)	Treatment Flow Rate (L/s)	Sediment Capacity (kg)
JF6-4-1	4	1	1.8	22.7	256

The Jellyfish Filter System

The patented Jellyfish Filter is an engineered stormwater quality treatment technology featuring unique membrane filtration in a compact stand-alone treatment system that removes a high level and wide variety of stormwater pollutants. Exceptional pollutant removal is achieved at high treatment flow rates with minimal head loss and low maintenance costs. Each lightweight Jellyfish Filter cartridge contains an extraordinarily large amount of membrane surface area, resulting in superior flow capacity and pollutant removal capacity.

Maintenance

Regular scheduled inspections and maintenance is necessary to assure proper functioning of the Jellyfish Filter. The maintenance interval is designed to be a minimum of 12 months, but this will vary depending on site loading conditions and upstream pretreatment measures. Quarterly inspections and inspections after all storms beyond the 5-year event are recommended until enough historical performance data has been logged to comfortably initiate an alternative inspection interval.

*Please see **www.ImbriumSystems.com** for more information.*

Thank you for the opportunity to present this information to you and your client.

Performance

Jellyfish efficiently captures a high level of Stormwater pollutants, including:

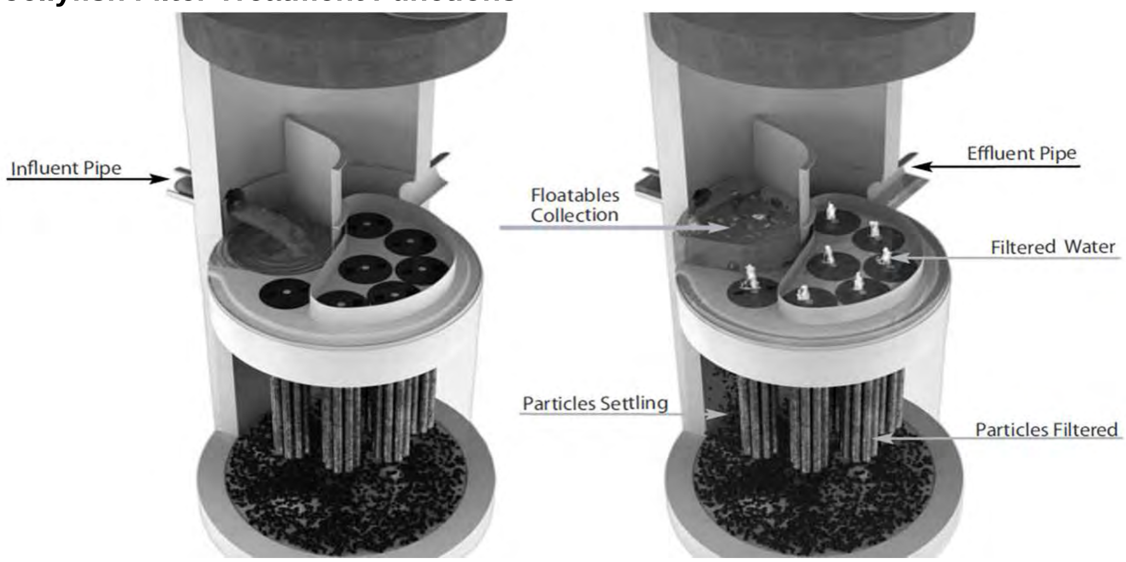
- ☑ 89% of the total suspended solids (TSS) load, including particles less than 5 microns
- ☑ 59% TP removal & 51% TN removal
- ☑ 90% Total Copper, 81% Total Lead, 70% Total Zinc
- ☑ Particulate-bound pollutants such as nutrients, toxic metals, hydrocarbons and bacteria
- ☑ Free oil, Floatable trash and debris

Field Proven Peformance

The Jellyfish filter has been field-tested on an urban site with 25 TARP qualifying rain events and field monitored according to the TARP field test protocol, demonstrating:

- A median TSS removal efficiency of 89%, and a median SSC removal of 99%;
- The ability to capture fine particles as indicated by an effluent d50 median of 3 microns for all monitotred storm events, and a median effluent turbidity of 5 NTUs;
- A median Total Phosphorus removal of 59%, and a median Total Nitrogen removal of 51%.

Jellyfish Filter Treatment Functions



Pre-treatment and Membrane Filtration

Jellyfish® Filter

Project Information

Date:	Thursday, April 20, 2017
Project Name:	Square One Rd Ext
Project Number:	revised area
Location:	Mississauga

Designer Information

Company:	Stantec
Contact:	Steffen Petelow
Phone #:	

Notes

Rainfall

Name:	TORONTO CENTRAL
State:	ON
ID:	100
Record:	1982 to 1999
Co-ords:	45°30'N, 90°30'W

Drainage Area

Total Area:	0.71 ha
Imperviousness:	100%

Upstream Detention

Peak Release Rate:	n/a
Pretreatment Credit:	n/a

Design System Requirements

Flow Loading	90% of the Average Annual Runoff based on 18 years of TORONTO CENTRAL rainfall data:	**19.3 L/s**
Sediment Loading	Treating 90% of the average annual runoff volume, 4232 m³, with a suspended sediment concentration of 60 mg/L.	**254 kg**

Recommendation

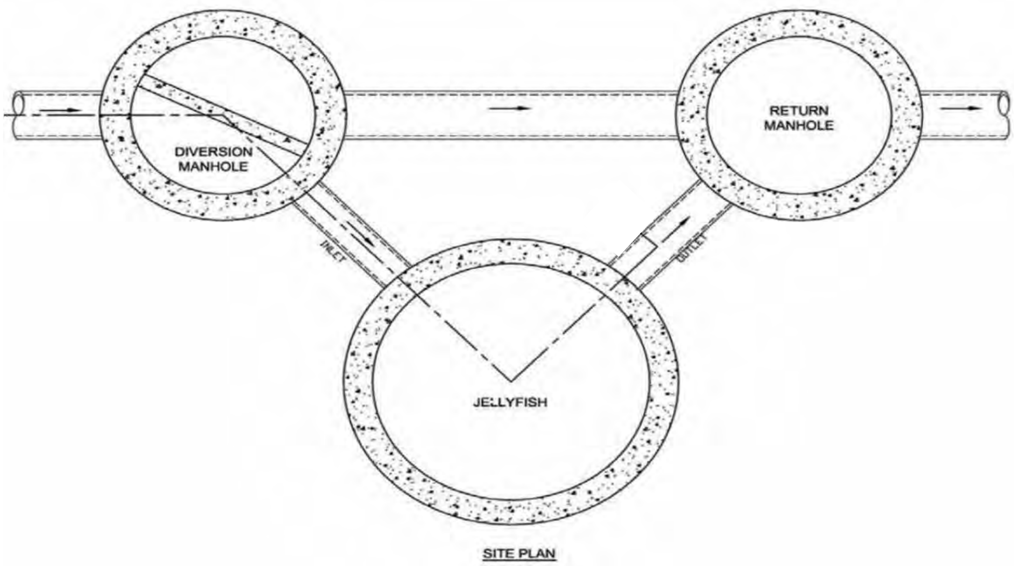
The Jellyfish Filter model JF6-4-1 is recommended to meet the water quality objective by treating a flow of 22.7 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 18 years of TORONTO CENTRAL rainfall data for this site. This model has a sediment capacity of 256 kg, which meets or exceeds the estimated average annual sediment load.

Jellyfish Model	Number of High-Flo Cartridges	Number of Draindown Cartridges	Manhole Diameter (m)	Wet Vol Below Deck (L)	Sump Storage (m³)	Oil Capacity (L)	Treatment Flow Rate (L/s)	Sediment Capacity (kg)
JF4-1-1	1	1	1.2	2313	0.34	379	7.6	85
JF4-2-1	2	1	1.2	2313	0.34	379	12.6	142
JF6-3-1	3	1	1.8	5205	0.79	848	17.7	199
JF6-4-1	**4**	**1**	**1.8**	**5205**	**0.79**	**848**	**22.7**	**256**
JF6-5-1	5	1	1.8	5205	0.79	848	27.8	313
JF6-6-1	6	1	1.8	5205	0.79	848	32.8	370
JF8-6-2	6	2	2.4	9252	1.42	1469	35.3	398
JF8-7-2	7	2	2.4	9252	1.42	1469	40.4	455
JF8-8-2	8	2	2.4	9252	1.42	1469	45.4	512
JF8-9-2	9	2	2.4	9252	1.42	1469	50.5	569
JF8-10-2	10	2	2.4	9252	1.42	1469	55.5	626
JF10-11-3	11	3	3.0	14456	2.21	2302	63.1	711
JF10-12-3	12	3	3.0	14456	2.21	2302	68.2	768
JF10-12-4	12	4	3.0	14456	2.21	2302	70.7	796
JF10-13-4	13	4	3.0	14456	2.21	2302	75.7	853
JF10-14-4	14	4	3.0	14456	2.21	2302	80.8	910
JF10-15-4	15	4	3.0	14456	2.21	2302	85.8	967
JF10-16-4	16	4	3.0	14456	2.21	2302	90.9	1024
JF10-17-4	17	4	3.0	14456	2.21	2302	95.9	1081
JF10-18-4	18	4	3.0	14456	2.21	2302	101	1138
JF10-19-4	19	4	3.0	14456	2.21	2302	106	1195
JF12-20-5	20	5	3.6	20820	3.2	2771	113.6	1280
JF12-21-5	21	5	3.6	20820	3.2	2771	118.7	1337
JF12-22-5	22	5	3.6	20820	3.2	2771	123.7	1394
JF12-23-5	23	5	3.6	20820	3.2	2771	128.8	1451
JF12-24-5	24	5	3.6	20820	3.2	2771	133.8	1508
JF12-25-5	25	5	3.6	20820	3.2	2771	138.9	1565
JF12-26-5	26	5	3.6	20820	3.2	2771	143.9	1622
JF12-27-5	27	5	3.6	20820	3.2	2771	149	1679

Jellyfish® Filter

Jellyfish Filter Design Notes

- Typically the Jellyfish Filter is designed in an offline configuration, as all stormwater filter systems will perform for a longer duration between required maintenance services when designed and applied in off-line configurations. Depending on the design parameters, an optional internal bypass may be incorporated into the Jellyfish Filter, however note the inspection and maintenance frequency should be expected to increase above that of an off-line system. Speak to your local representative for more information.



Jellyfish Filter Typical Layout

- Typically, 18 inches (457 mm) of driving head is designed into the system, calculated as the difference in elevation between the top of the diversion structure weir and the invert of the Jellyfish Filter outlet pipe. Alternative driving head values can be designed as 12 to 24 inches (305 to 610mm) depending on specific site requirements, requiring additional sizing and design assistance.
- Typically, the Jellyfish Filter is designed with the inlet pipe configured 6 inches (150 mm) above the outlet invert elevation. However, depending on site parameters this can vary to an optional configuration of the inlet pipe entering the unit below the outlet invert elevation.
- The Jellyfish Filter can accommodate multiple inlet pipes within certain restrictions.
- While the optional inlet below deck configuration offers 0 to 360 degree flexibility between the inlet and outlet pipe, typical systems conform to the following:

Model Diameter (m)	Minimum Angle Inlet / Outlet Pipes	Minimum Inlet Pipe Diameter (mm)	Minimum Outlet Pipe Diameter (mm)
1.2	62º	150	200
1.8	**59º**	**200**	**250**
2.4	52º	250	300
3.0	48º	300	450
3.6	40º	300	450

- The Jellyfish Filter can be built at all depths of cover generally associated with conventional stormwater conveyance systems. For sites that require minimal depth of cover for the stormwater infrastructure, the Jellyfish Filter can be applied in a shallow application using a hatch cover. The general minimum depth of cover is 36 inches (915 mm) from top of the underslab to outlet invert.
- If driving head caclulations account for water elevation during submerged conditions the Jellyfish Filter will function effectively under submerged condtions.
- Jellyfish Filter systems may incorporate grated inlets depending on system configuration.
- For sites with water quality treatment flow rates or mass loadings that exceed the design flow rate of the largest standard Jellyfish Filter manhole models, systems can be designed that hydraulically connect multiple Jellyfish Filters in series or alternatively Jellyfish Vault units can be designed.

STANDARD SPECIFICATION
STORMWATER QUALITY FILTER TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for construction and performance of an underground stormwater quality filter treatment device that removes pollutants from stormwater runoff through the unit operations of sedimentation, floatation, and membrane filtration.

1.2 REFERENCE STANDARDS

ASTM C 891:	Specification for Installation of Underground Precast Concrete Utility Structures
ASTM C 478:	Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 443:	Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM D 4101:	Specification for Copolymer steps construction

CAN/CSA-A257.4-M92
Joints for Circular Concrete Sewer and Culvert Pipe, Manhole Sections and Fittings Using Rubber Gaskets

CAN/CSA-A257.4-M92
Precast Reinforced Circular Concrete Manhole Sections, Catch Basins and Fittings

Canadian Highway Bridge Design Code

1.3 SHOP DRAWINGS

Shop drawings for the structure and performance are to be submitted with each order to the contractor. Contractor shall forward shop drawing submittal to the consulting engineer for approval. Shop drawings are to detail the structure's precast concrete components.

1.4 HANDLING AND STORAGE

Prevent damage to materials during storage and handling.

PART 2 – PRODUCTS

2.1 GENERAL

2.1.1 The device shall be cylindrical or rectangular and constructed from precast concrete riser and slab components or monolithic precast structure(s), installed to conform to ASTM C 891 and to any required state highway, municipal or local specifications.

2.1.2 Cartridge Deck The cylindrical concrete device shall include a fiberglass deck. The rectangular concrete device shall include a coated aluminum deck. In either instance, the insert shall be bolted and sealed watertight inside the precast concrete chamber. In each instance the insert shall serve as: (a) a horizontal divider between the lower treatment zone and the upper treated effluent zone; (b) a deck for attachment of filter cartridges such that the membrane filter elements of each cartridge extend into the lower treatment zone; (c) a platform for maintenance workers to service the filter cartridges; (d) a conduit for conveyance of treated water to the effluent pipe.

2.1.3 Membrane Filter Cartridges Filter cartridges shall be comprised of cylindrical membrane filter elements connected to a perforated head plate. The number of membrane filter elements per cartridge shall be eleven 2.75-inch (70-mm) diameter elements. The length of each filter element shall be a minimum 15 inches (381 mm). Each cartridge shall be fitted into the cartridge deck by insertion into a cartridge receptacle that is permanently mounted into the cartridge deck. Each cartridge shall be secured by a cartridge lid that is threaded onto the receptacle. The maximum treatment flow rate of a filter cartridge shall be controlled by an orifice in the cartridge lid and based on a design flux rate (surface loading rate) determined by the maximum treatment flow rate per unit of filtration membrane surface area. The maximum flux rate shall be 0.21 gpm/ft^2 (0.142 lps/m^2).

Each lightweight membrane filter cartridge shall allow for manual installation and removal. Each filter cartridge shall have filtration membrane surface area and dry installation weight as follows:

Filter Cartridge Length		Filtration Cartridge Membrane Surface Area		Filter Cartridge Dry Weight	
in	mm	ft^2	m^2	lbs	kg
15	381	106	9.8	10	4.5
27	686	190	17.7	14.5	6.6
40	1,016	282	26.2	19.5	8.9
54	1,372	381	35.4	25	11.4

2.1.4 Backwashing Cartridges The filter device shall have a weir extending above the cartridge deck that encloses the high flow rate filter cartridges when placed in their respective cartridge receptacles within the cartridge deck. The weir shall collect a pool of filtered water during inflow events that subsequently automatically backwashes the high flow rate cartridges each time the inflow event subsides. All filter cartridges shall allow for use of a manual backwashing or filtration membrane rinsing procedure to restore flow capacity and sediment capacity and extend cartridge service life.

2.1.5 Maintenance Access to Captured Pollutants The filter device shall contain an opening(s) that provides suitable maintenance access for removal of accumulated floatable pollutants and sediment.

2.1.6 Bend Structure The device shall be able to be used as a bend structure with minimum angles between inlet and outlet pipes of 90-degrees or less in the stormwater conveyance system.

2.1.7 Double-Wall Containment of Hydrocarbons The cylindrical precast concrete device shall provide double-wall containment for hydrocarbon spill capture by a combined means of an inner wall of fiberglass, to a minimum depth of 12 inches (305 mm) below the cartridge deck, and the precast vessel wall.

2.1.8 Baffle The filter device shall provide a baffle that extends from the underside of the cartridge deck to a minimum length equal to the length of the membrane filter elements. The baffle shall serve to protect the membrane filter elements from contamination by floatables. In the cylindrical device the baffle shall be a flexible continuous skirt secured to the fiberglass deck. In the rectangular device the baffle shall be a concrete or metal wall, secured to the precast chamber.

2.1.9 Sump The device shall include a minimum 24 inches (610 mm) of total sump depth below the bottom of the cartridges for sediment accumulation, unless otherwise specified in the shop drawings or by the design engineer.

2.2 PRECAST CONCRETE SECTIONS. All precast concrete components shall be manufactured to a minimum live load of HS-20 truck loading or greater based on local regulatory specifications, unless otherwise modified or specified by the design engineer.

2.3 JOINTS. All precast concrete manhole configuration joints shall use nitrile rubber gaskets and shall meet the requirements of ASTM C443, Specification C1619, Class D or engineer approved equal to ensure oil resistance. Mastic sealants or butyl tape are not an acceptable alternative.

2.4 GASKETS. Only profile neoprene or nitrile rubber gaskets in accordance to CSA A257.3-M92 will be accepted. Mastic sealants, butyl tape or Conseal CS-101 are not acceptable gasket materials.

2.5 FRAME AND COVER. Frame and covers must be manufactured from cast-iron and embossed with the name of the device manufacturer or the device brand name.

2.6 DOORS AND HATCHES. If provided shall meet designated loading requirements at a minimum for incidental traffic.

2.7 CONCRETE. All concrete components shall be manufactured according to local specifications and shall meet the requirements of ASTM C 478.

2.8 FIBERGLASS. The fiberglass portion of the water treatment device shall be constructed in accordance with the following standard: ASTM D-4097: Contact Molded Glass Fiber Reinforced Chemical Resistant Tanks.

2.9 STEPS. Steps shall be constructed according to ASTM D4101 of copolymer polypropylene, and be driven into preformed or pre-drilled holes after the concrete has cured, installed to conform to applicable sections of state, provincial and municipal building codes, highway, municipal or local specifications for the construction of such devices.

2.10 INSPECTION. All precast concrete sections shall be inspected to ensure that dimensions, appearance and quality of the product meet local municipal specifications and ASTM C 478.

PART 3 – PERFORMANCE

3.1 GENERAL

3.1.1 Function - The stormwater quality filter treatment device shall function to remove pollutants by the following unit treatment processes; sedimentation, floatation, and membrane filtration.

3.1.2 Pollutants - The stormwater quality filter treatment device shall remove oil, debris, trash, coarse and fine particulates (TSS), particulate-bound pollutants, metals and nutrients from stormwater during runoff events.

3.1.3 Bypass - The stormwater quality filter treatment device shall typically utilize an external bypass to divert excessive flows unless otherwise modified or specified by the design engineer.

3.1.4 Treatment Flux Rate (Surface Loading Rate) – The stormwater quality filter treatment device shall treat 100% of the required water quality treatment design flow based on a maximum treatment flux rate (surface loading rate) across the membrane filter cartridges of 0.21 gpm/ft^2 (0.142 lps/m^2).

3.2 FIELD TEST PERFORMANCE

At a minimum, the stormwater quality filter device shall have been field tested with a minimum 25 TARP qualifying storm events and field monitoring conducted according to the TARP field test protocol, and be NJCAT verified.

3.2.1 Suspended Solids Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median TSS removal efficiency of 85% and a minimum median SSC removal efficiency of 95%.

3.2.2 Runoff Volume – The stormwater quality filter treatment device shall be engineered, designed, and sized to treat a minimum of 90 percent of the annual runoff volume determined from use of a minimum 15-year rainfall data set.

3.2.3 Fine Particle Removal - The stormwater quality filter treatment device shall have demonstrated the ability to capture fine particles as indicated by a minimum median removal efficiency of 75% for the particle fraction less than 25 microns, an effluent d_{50} of 15 microns or lower for all monitored storm events.

3.2.4 Turbidity Reduction - The stormwater quality filter treatment device shall have demonstrated the ability to reduce the turbidity from influent from a range of 5 to 171 NTU to an effluent turbidity of 15 NTU or lower.

3.2.5 Nutrient (Total Phosphorus & Total Nitrogen) Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median Total Phosphorus removal of 55%, and a minimum median Total Nitrogen removal of 50%.

3.2.6 Metals (Total Zinc & Total Copper) Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median Total Zinc removal of 55%, and a minimum median Total Copper removal of 85%.

3.3 INSPECTION and MAINTENANCE

The manufacturer shall provide an Owner's Manual upon request.

3.3.1 FEATURES
The stormwater quality filter treatment device shall have the following features:

3.3.1.1 The membrane filter elements shall be designed to last a minimum one year under normal urban stormwater operation from a stable site prior to requiring maintenance or replacement.

3.3.1.2 Inspection which includes trash and floatables collection, sediment depth determination, and visible determination of backwash pool depth shall be easily conducted from grade.

3.3.1.3 Manual rinsing of the membrane filter elements or backflushing of the filter cartridges shall be possible to restore the flow capacity and sediment capacity of the filter cartridges and therefore extend cartridge service life.

3.3.1.4 The filter device shall have a minimum 24 inches (610 mm) of sediment storage depth below the cartridges.

3.3.1.5 Sediment removal from the filter treatment device shall be conducted using a standard maintenance truck and vacuum apparatus, and a minimum one point of entry to the sump that is unobstructed by filter cartridges.

3.3.1.6 Filter cartridges shall be easily maintained without the use of additional lifting equipment.

3.3.1.7 The membrane filter elements shall be easily removable and rinse-able with low pressure (< 50 psi) clean water to extend cartridge service life.

3.3.1.8 When required the membrane filter elements can be easily replaced to fully restore the flow capacity and sediment capacity of the filter cartridges.

3.3.2 REPLACEMENT FILTER CARTRIDGE ITEMS When replacement membrane filter elements and/or other parts are required, only membrane filter elements and parts approved by the manufacturer for use with the stormwater quality filter device shall be installed to ensure proper operation.

PART 4 – EXECUTION

4.1 INSTALLATION Contractor shall take appropriate action to protect all of the devices' internal components throughout the installation and construction process. No lifting shall be conducted or lifting mechanisms shall be connected to or come into contact with the stormwater quality treatment devices' deck or cartridge receptacles.

4.1.1 PRECAST DEVICE CONSTRUCTION SEQUENCE

The installation of a precast concrete device should conform to ASTM C 891 and to any state highway, municipal or local specifications for the construction of manholes. Selected sections of a general specification that are applicable are summarized below.

The precast concrete device is installed in sections in the following sequence:

- aggregate base
- base slab
- treatment chamber and cartridge deck riser section(s)
- bypass section
- connect inlet and outlet pipes
- riser section and/or transition slab (if required)
- maintenance riser section(s) (if required)
- frame and access cover

4.1. 2 The precast base should be placed level at the specified grade. The entire base should be in contact with the underlying compacted granular material. Subsequent sections, complete with joint seals, should be installed in accordance with the precast concrete manufacturer's recommendations.

4.1.3 Adjustment of the stormwater quality treatment device can be performed by lifting the upper sections free of the excavated area, re-leveling the base, and re-installing the sections. Damaged sections and gaskets should be repaired or replaced as necessary.

Once the stormwater quality treatment device has been constructed, any lift holes must be plugged watertight with mortar or non-shrink grout.

4.1.4 Inlet and Outlet Pipes Inlet and outlet pipes should be securely set into the device using approved pipe seals (flexible boot connections, where applicable) so that the structure is watertight.

4.1.5 Frame and Cover Installation Adjustment units (e.g. grade rings) should be installed to set the frame and cover at the required elevation. The adjustment units should be laid in a full bed of mortar with successive units being joined using sealant recommended by the manufacturer. Frames for the cover should be set in a full bed of mortar at the elevation specified.

4.3 MAINTENANCE ACCESS WALL
In some instances the Maintenance Access Wall, if provided, shall require an extension attachment and sealing to the precast wall and cartridge deck at the job site, rather than at the precast facility. In this instance, installation, attachment and sealing of these components shall be performed according to instructions provided by the manufacturer.

4.4 DEVICE PROTECTION PRIOR TO FILTER CARTRIDGE INSTALLATION
Filter cartridges shall not be installed until the project site is clean and free of debris, by the contractor. The project site includes any surface that contributes storm drainage to the treatment device. All impermeable surfaces shall be clean and free of dirt and debris. All catch basins, manholes and pipes shall be free of debris, dirt and sediments.

4.4.1 It is the contractor's full responsibility to properly protect the treatment device, and keep the device offline during construction.

4.4.1.1 The contractor may choose to plug both the inlet and outlet pipes to prevent stormwater from entering the device to fully protect the cartridges and system from construction debris and sediment.

4.4.1.2 The contractor must remove plugs to activate the device after the site has been fully stabilized post-construction, and device has been commissioned.

4.5 FILTER CARTRIDGE INSTALLATION

4.5.1 The Contractor shall confirm the project site and stormwater quality filter treatment device is clean and free of debris prior to pursuing cartridge installation. Filter cartridges and lids shall be installed in the cartridge deck only after the construction site is fully stabilized and the unit clean and free of debris by the contractor.

4.5.2 Contractor shall notify and coordinate with the manufacturer three weeks prior to requiring filter cartridges installed on site. Filter cartridges and lids, shall be delivered and installed to commission the stormwater quality filter treatment device.

END OF SECTION

Stormceptor Design Summary
PCSWMM for Stormceptor

Project Information

Date	3/30/2017
Project Name	Square One Road
Project Number	165011005
Location	Mississauga

Designer Information

Company	Stantec
Contact	Mustafa

Notes

N/A

Drainage Area

Total Area (ha)	0.71
Imperviousness (%)	90

The Stormceptor System model STC 750 achieves the water quality objective removing 75% TSS for a City of Toronto (clay, silt and sand) particle size distribution and 91% runoff volume.

Rainfall

Name	TORONTO CENTRAL
State	ON
ID	100
Years of Records	1982 to 1999
Latitude	45°30'N
Longitude	90°30'W

Water Quality Objective

TSS Removal (%)	50
Runoff Volume (%)	90

Upstream Storage

Storage (ha-m)	Discharge (L/s)
0	0

Stormceptor Sizing Summary

Stormceptor Model	TSS Removal %	Runoff Volume %
STC 300	66	79
STC 750	**75**	**91**
STC 1000	75	91
STC 1500	76	91
STC 2000	81	95
STC 3000	82	95
STC 4000	85	98
STC 5000	86	98
STC 6000	88	99
STC 9000	91	99
STC 10000	91	99
STC 14000	93	100

Particle Size Distribution

Removing silt particles from runoff ensures that the majority of the pollutants, such as hydrocarbons and heavy metals that adhere to fine particles, are not discharged into our natural water courses. The table below lists the particle size distribution used to define the annual TSS removal.

City of Toronto (clay, silt and sand)

Particle Size μm	Distribution %	Specific Gravity	Settling Velocity m/s		Particle Size μm	Distribution %	Specific Gravity	Settling Velocity m/s
10	20	2.65	0.0004					
30	10	2.65	0.0008					
50	10	2.65	0.0022					
95	20	2.65	0.0063					
265	20	2.65	0.0366					
1000	20	2.65	0.1691					

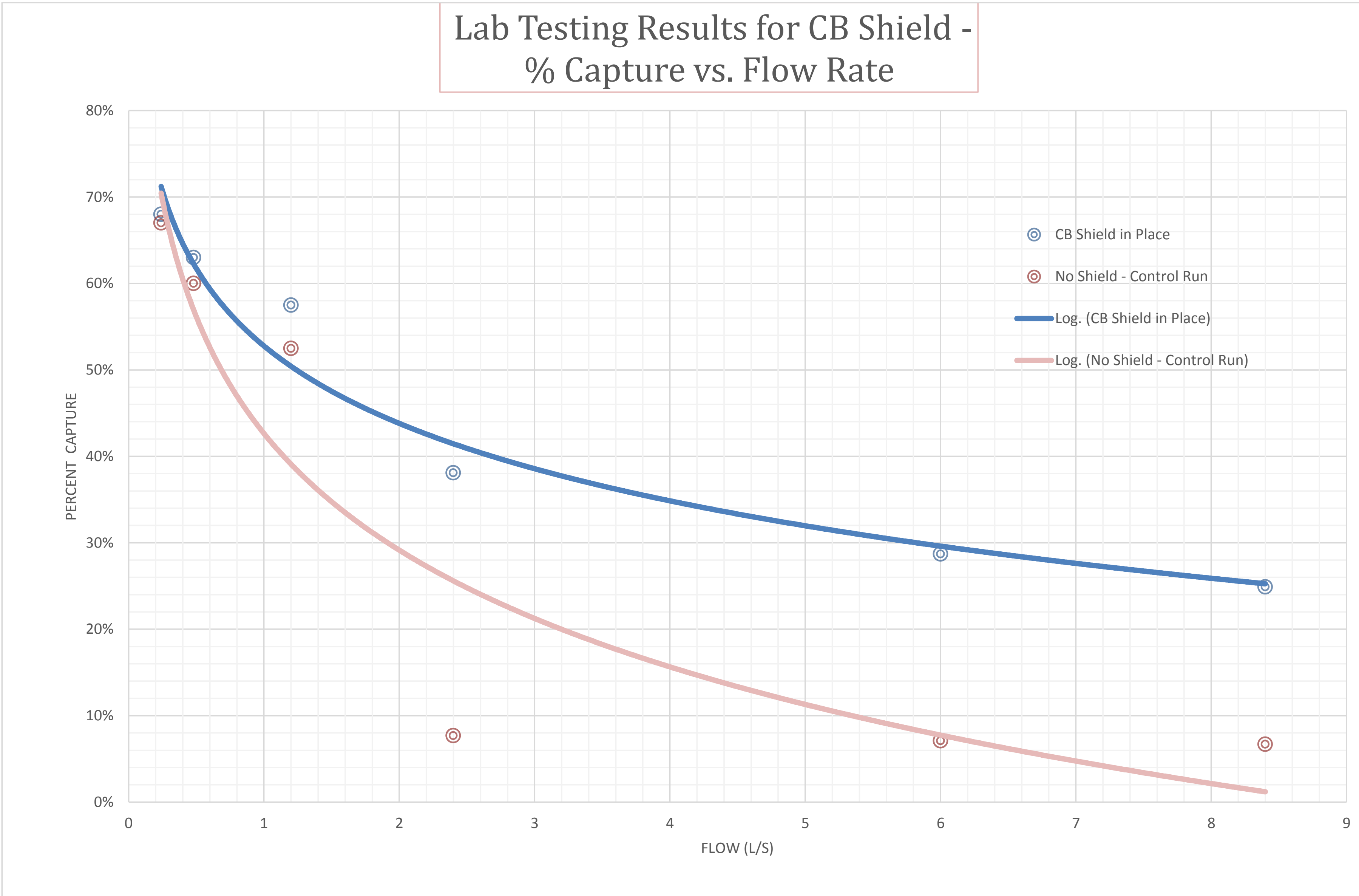
Stormceptor Design Notes

- Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor version 1.0
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal.
- Only the STC 300 is adaptable to function with a catch basin inlet and/or inline pipes.
- Only the Stormceptor models STC 750 to STC 6000 may accommodate multiple inlet pipes.
- Inlet and outlet invert elevation differences are as follows:

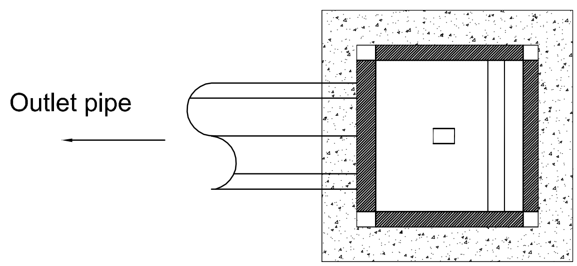
Inlet and Outlet Pipe Invert Elevations Differences

Inlet Pipe Configuration	STC 300	STC 750 to STC 6000	STC 9000 to STC 14000
Single inlet pipe	75 mm	25 mm	75 mm
Multiple inlet pipes	75 mm	75 mm	Only one inlet pipe.

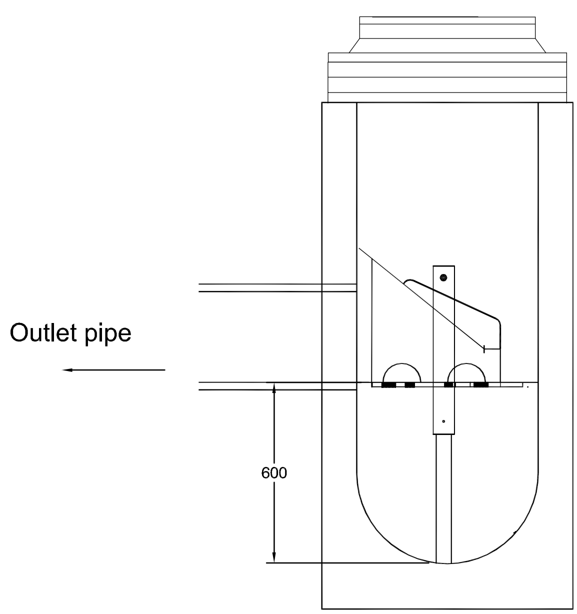
- Design estimates are based on stable site conditions only, after construction is completed.
- Design estimates assume that the storm drain is not submerged during zero flows. For submerged applications, please contact your local Stormceptor representative.
- Design estimates may be modified for specific spills controls. Please contact your local Stormceptor representative for further assistance.
- For pricing inquiries or assistance, please contact Imbrium Systems Inc., 1-800-565-4801.


Lab Testing Results for CB Shield - % Capture vs. Flow Rate
PERCENT CAPTURE
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
1
2
3
4
5
6
7
8
9
FLOW (L/S)
CB Shield in Place
No Shield - Control Run
Log. (CB Shield in Place)
Log. (No Shield - Control Run)

Notes
1. CB Shield can be installed at any time. In a non frozen condition.
2. The frame and cover should be well aligned with the catchbasin for proper installation
3. The catchbasin sump must be clean before installation
4. The grate should be at the same level as the standing water in the sump.



Top view



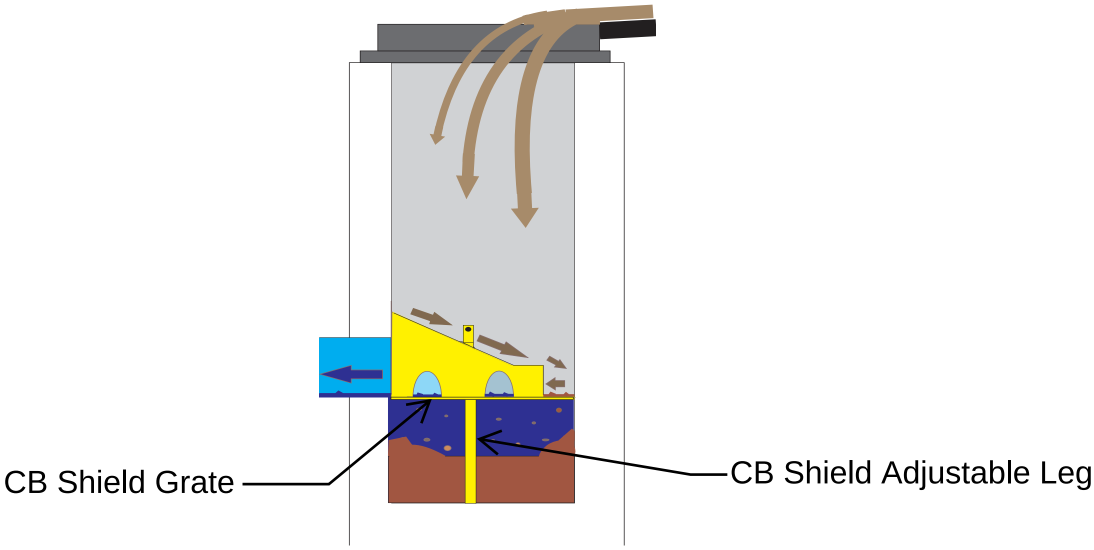
Profile view

CB Shield (600mm Sump)

CB Shield Operations Manual

Installing CB Shield

It is important the catch basin frame and cover is aligned properly with the catch basin below
If it is misaligned it may be difficult to install the CB Shield insert
Determine the depth of the sump (i.e. the distance from the invert of the outlet pipe to the bottom of the catch basin). If the catch basin is in service the sump depth will be the depth of the water. The grate section of the CB Shield insert should be the same elevation as the water depth in the sump.



Adjust the leg of the CB Shield to achieve the appropriate elevation
The CB Shield is lowered into place with the rope attached to the top of the leg. The high side of the sloped plate should face the wall with the outlet pipe. (The incoming water should be directed to the wall furthest from the outlet)
The flexible plastic skirt around the outer edges of the CB Shield insert may interfere with some misaligned frame and grates. If so a slice can be cut into the skirt with a utility knife at the point of interference.
Make sure the grate is at the desired level or remove CB Shield and re-adjust the leg length.

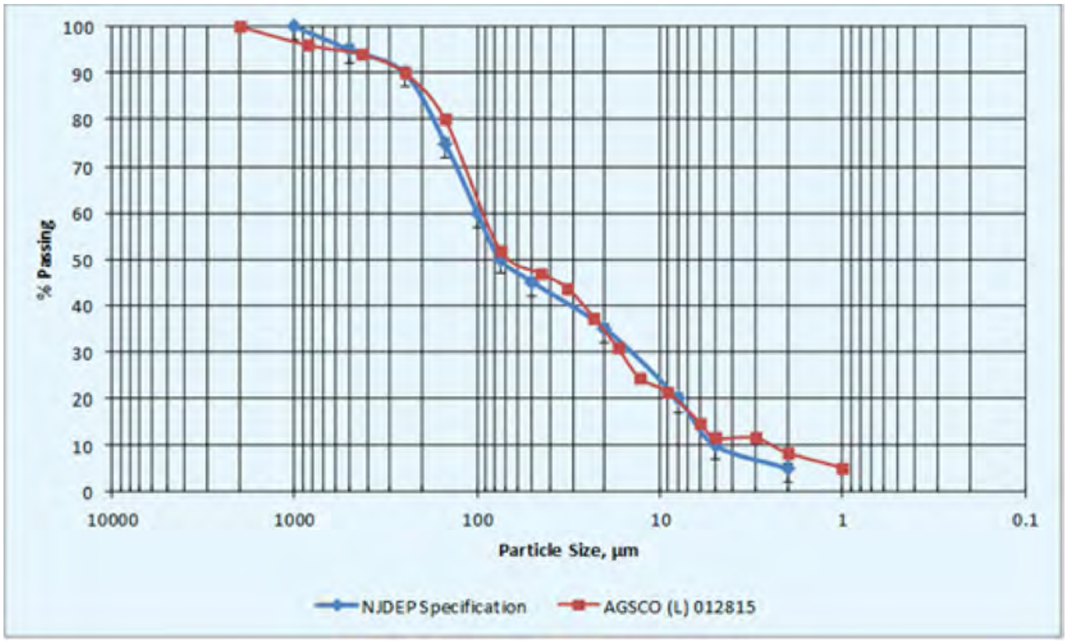
Inspecting a CB Shield Enhanced Catch Basin

Open grate
A lifting rope is attached to the top of the centered leg of the CB Shield insert. Lift and remove the insert.
Inspect CB Shield for any possible damage. Quite often leaves will accumulate on the grate. This can actually improve the Shield's ability to capture sediment and assist in preventing leave litter from being washed down stream.
Use a Sludge Judge to measure the sediment depth in 4 - 6 locations of the sump.
If the sediment depth is 300mm – 600mm deep it is recommended that the unit be cleaned.

Cleaning a CB Shield Enhanced Catch Basin

Open grate and remove CB Shield with lift rope.
Clean catch basin as usual with a Vacuum truck.
Clean CB Shield (if needed) and re-install into catch basin.
If there is any significant damage to a CB Shield please send a picture and its location to CB Shield Inc. (info@cbshield.com).

Graph of ETV Test Sediment PSD as prepared by Joe Costa of GHL, and forwarded in an email received from Joe Costa 24March2015.



Joe Costa indicates in his email that “this batch has a d50 of just under 75 µm and falls within the allowed variance at every specified particle size (though it is a close call at 1000 µm).”

Average Annual Sediment Removal Rates (%) using a CB Shield (based on ETV Sediment - 1 to 1000 micron Particle Size Distribution)						
Area to CB (ha)	**Imperviousness[1] (%)**					
	20%	35%	50%	65%	80%	100%
0.02	57%	57%	57%	57%	56%	56%
0.05	56%	56%	56%	55%	55%	54%
0.10	56%	55%	54%	53%	52%	51%
0.20	54%	53%	51%	49%	48%	46%
0.30	53%	50%	48%	46%	45%	43%
0.40	51%	48%	46%	44%	42%	40%
0.50	50%	47%	44%	42%	40%	38%
0.60	49%	45%	43%	40%	39%	36%

Notes:

1. Runoff Coefficient 'C' is approximately equal to 0.05 + 0.9*Impervious Fraction.
2. Above chart is based on long term continuous hydrologic analysis of Toronto, Ontario (Bloor St) rainfall data.
3. Assumes 0.6 m sump in CB and that maintenance is performed (i.e. CB cleaning) when required by sediment/pollutant build-up or otherwise.
4. See accompanying chart for suggested maintenance scheduling - AND - get CB Shield Inc. to monitor it for you in field.
5. Sediment/Pollutant removal rates based on third party certified laboratory testing using ETV sediment (PSD analysis available on request).
6. See additional discussion regarding scour protection from CB Shield during more infrequent runoff events.

Catch Basin Shield: Localized Sediment Control in Urban Environments

Pavneet Brar, Jennifer Drake, Ph.D., Stephen Braun

University of Toronto; Ontario Centres of Excellence

Context

Degradation of stormwater runoff quality has lead to implementation of **Treatment Train Approach** by many municipalities.

Source → Conveyance → End-of-Pipe

Many localized controls exist, but not all are implemented, due to:

- Perceived additional costs
- Unknown maintenance and long-term functionality
- Lack of credible verification protocols

An exploratory field study was conducted by the University of Toronto to evaluate the performance and feasibility of a catch basin insert, called **Catch Basin (CB)Shield**, under urban environments.

Objective: Ease the transition of CB Shields from testing stage to field-implementation stage.

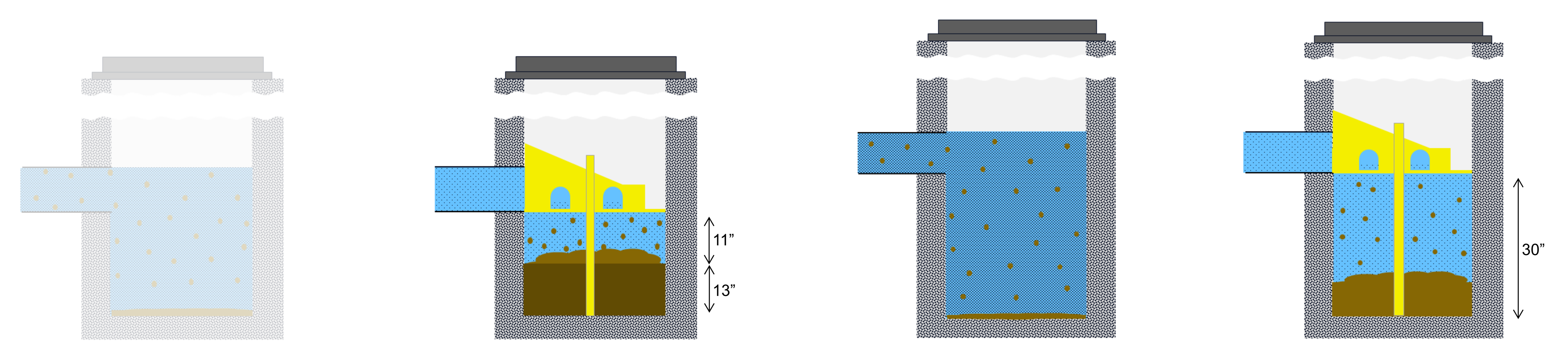
Discussion

Retaining more sediments in the sump is beneficial for *municipal infrastructure*, *local waterbodies*, and *aquatic habitats*. The use of localized controls, such as CB Shield, can be encouraged by:

- Establishing better communication between hierarchical operational entities
- Having clear dissemination of maintenance requirements and practices
- Promoting best management practices and novel technologies through pilot field testing

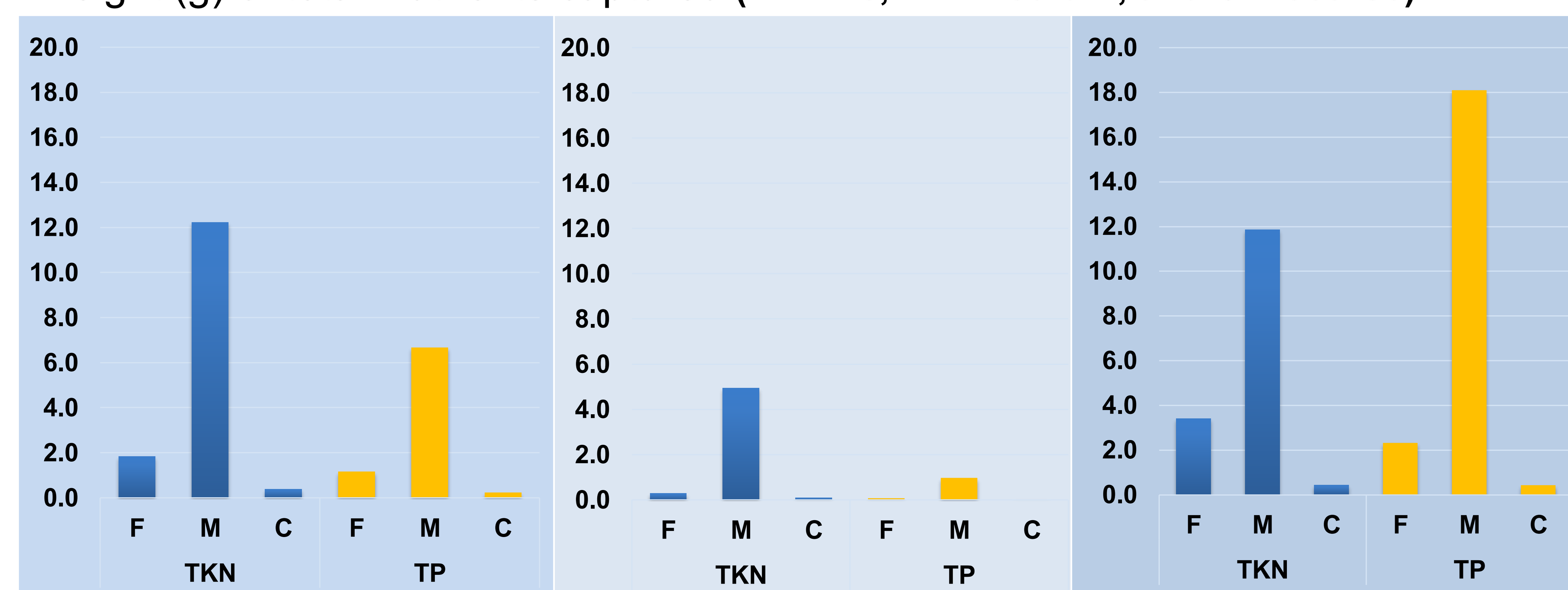
Annual Sediment Retention

Location 1: Sandford Fleming (SF) Building		Location 2: Graduate Student Union (GSU) Building	
Control	Shielded	Control	Shielded

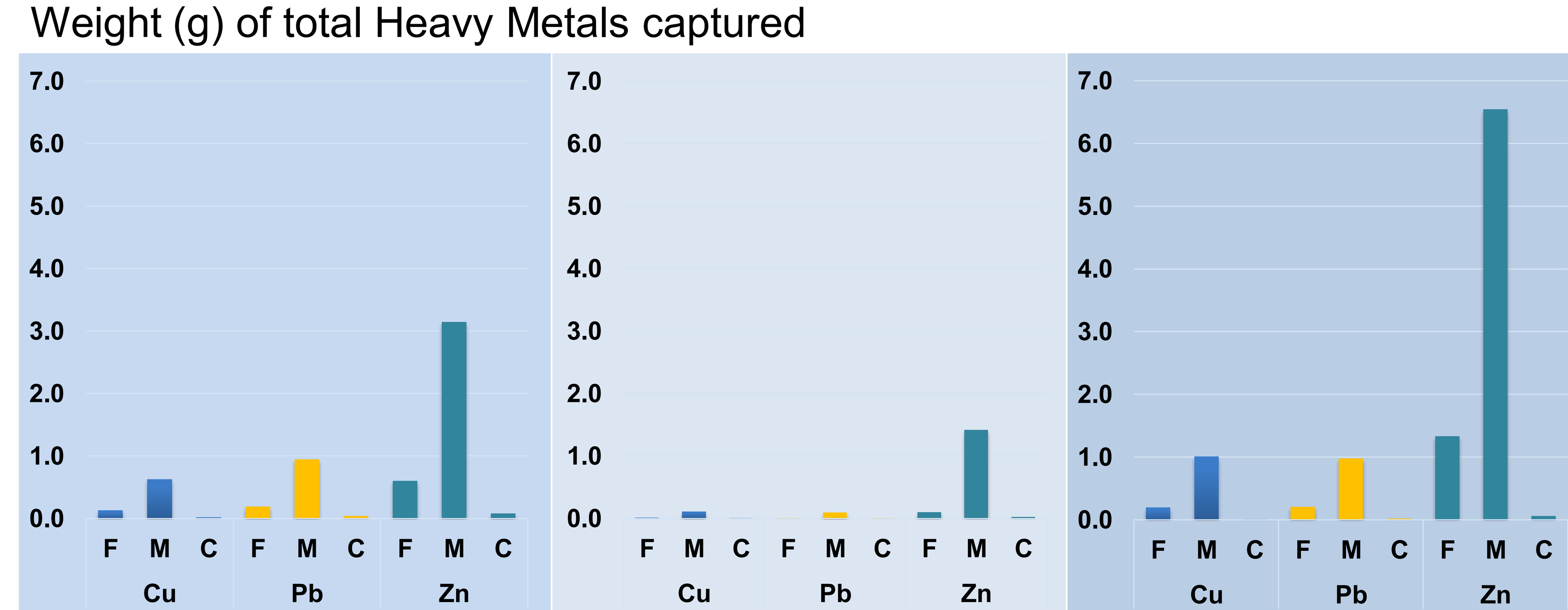


Catch basin disturbed during study; accidently cleaned out early by UofT Facilities Services	Catch basin not properly cleaned prior to study; older sediment deposited below 11" depth		
Dried sediment weight (kg) captured in the sumps			
	10.4	0.8	38.3
Volume (%) of the sump filled by sediment			
	9	1	25

Weight (g) of total Nutrients captured **(F = fine, M = medium, and C = coarse)**

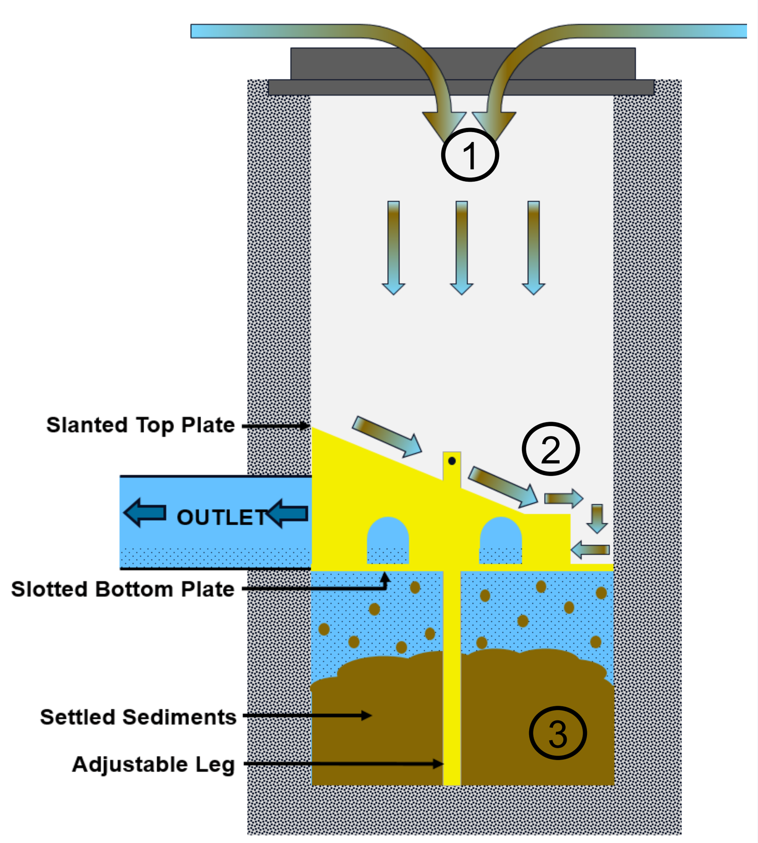


Weight (g) of total Heavy Metals captured



CB Shield

CB Shield can simply be placed in catch basins to improve their sediment retention capability.



1) Water enters through the catch basin frame on the top.
2) Water runs down the slanted plate and over the slotted grate.
3) The sump is not turbulent, so sediments and other material are able to settle out.

Methodology

Two locations at the University of Toronto are tested: at each location, there is a control and a retrofitted catch basin.

Conventional | Catch basin with CB Shield

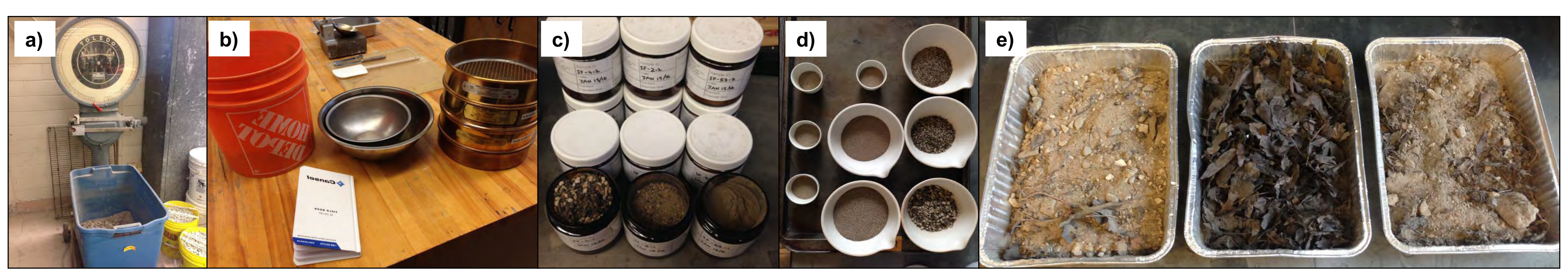
June to December 2015: Sumps sampled bi-weekly and tested for chemical, physical, and microbiological parameters.

December 2015: Complete catch basin clean out.

a) Cleanout using trashpump; b) Pail-and-shovel method for sediment; c) Rooftop drying; d) Filtering water; e) Indoor drying

Once only sediment remained, they were analyzed.

Chemical	Physical
• Total Nitrogen (TKN) • Total Phosphorus (TP) • Metals scan (Arsenic, Cadmium, Chromium, Copper, Lead, Manganese, Nickel, Selenium, Silver, and Zinc)	• Dry weight • Particle Size Distribution (Fine: <53μm , Medium: 53μm -2mm, Coarse: 2-4mm) • Organic Content



a) Weigh dry sediment; b) Particle size distribution using sieves; c) Samples for chemical analysis; d) Organic content using ignition; e) Dried sediment for SF shielded, GSU control, and GSU shielded, respectively

Appendix B EROSION AND SEDIMENT CONTROL

Erosion Control

Project Name :Square One Missussaga

Project No. : 165011005 **April 24, 2017**

Runoff from the south portion of the roadway will be captured via catchbasins which drain into the Silva Cells soil.

Total Site Area	0.71	ha
Targe Volume (based on retention of 5 mm over site area)	36	m^3

Available Retention Volume:

Total no. of trees within the boulevard	6	tree
Volume of planting soil per tree	15	m^3
Total volume of planting soil	90	m^3
Void ratio	0.4	
Total void volume	36	m^3

Captured Rainwater Volume

Half Road Width	11.5	m	
Total length of boulevard + sidewalk	250	m	
Total Area	2,875	m^2	
Capture event	12.5	mm	
Total rain volume captured by the trees	36	m^3	
Target volume	36	m^3	
% of target	101%		Ok

Erosion Control: Rathburn Road West

Project Name :Square One Missussaga

Project No. : 165011005 **June 19, 2017**

Runoff from the north portion of the roadway will be captured via catchbasins which drain into the Silva Cells soil.

Total Site Area	1.98	ha
Targe Volume (based on retention of 5 mm over site area)	99	m^3

Available Retention Volume:

Total no. of trees within the boulevard	17	trees
Volume of planting soil per tree	15	m^3
Total volume of planting soil	255	m^3
Void ratio	0.4	
Total void volume	102	m^3

Captured Rainwater Volume

Total ROW Width	40	m	
Captured ROW Width	24	m	
Total length of boulevard + sidewalk	425	m	
Total Area	10,158	m^2	
Capture event	9.7	mm	
Total rain volume captured by the trees	99	m^3	
Target volume	99	m^3	
% of target	100%		Ok

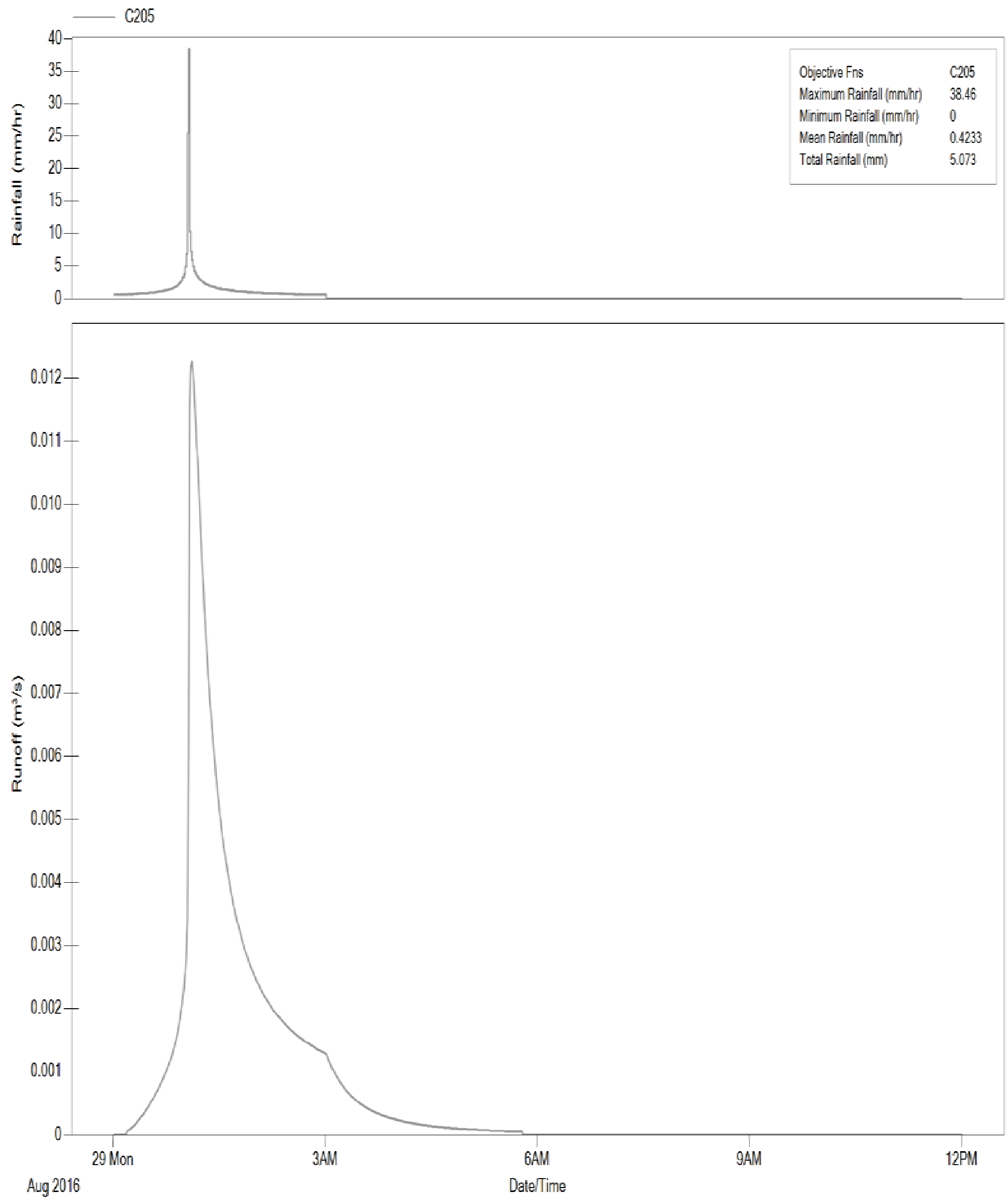
Erosion Control

Project Name :Square One Missussaga

Project No. April 24, 2017

CVC requires on-site detention of 5 mm to satisfy the erosion and sediment control requiremets
The peak flow generated by the 5 mm storm event over the 0.71 ha drainage area was calculated as 0.01 m3/s using PCSWMM software.
The minimum allowable orifice size of 75 mm will release 0.02 m^3/s, which exceeds the peak flow generated by the 5-mm storm event
Accordingly, 5 mm storage detention cannot be met by controlling the outflow from the road areas.

PCSWMM Model
Rainfall and Runoff Graphs



Rainfall

Runoff

PCSWMM Report

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.009)

Square One Dr Extension

WARNING 01: wet weather time step reduced to recording interval for Rain Gage 5mm

****

NOTE: The summary statistics displayed in this report are based on results found at every computational time step, not just on results from each reporting time step.

****

****

Analysis Options

****

Flow Units .... CMS

Process Models:

Rainfall/Runoff .... YES

RDII .... NO

Snowmelt .... NO

Groundwater .... NO

Flow Routing .... NO

Water Quality .... NO

Infiltration Method ...... CURVE_NUMBER

Starting Date AUG-29-2016 00:00:00

Ending Date AUG-29-2016 12:00:00

Antecedent Dry Days 0.0

Report Time Step 00:01:00

Wet Time Step 00:01:00

Dry Time Step 00:05:00

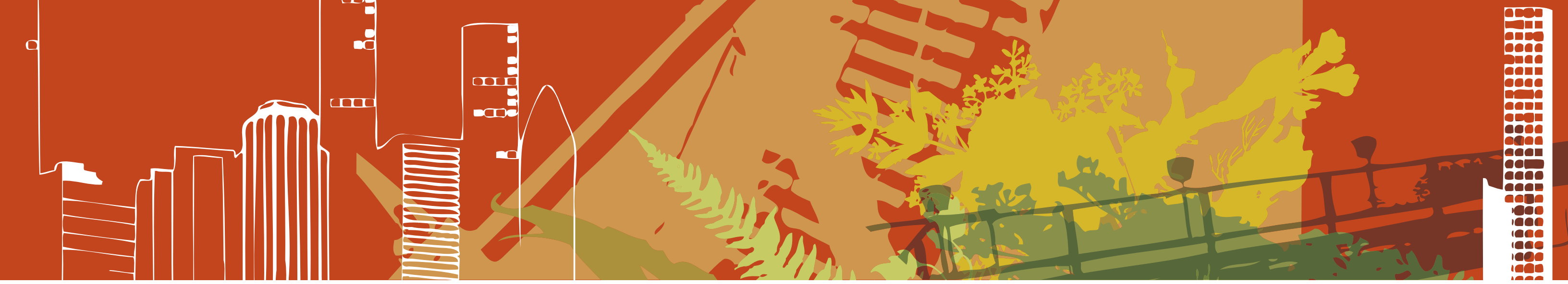
**************************	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
**************************	---------	-------
Total Precipitation	0.004	5.073
Evaporation Loss	0.000	0.000
Infiltration Loss	0.000	0.456
Surface Runoff	0.003	4.564
Final Storage	0.000	0.054
Continuity Error (%)	0.000	

**************************	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
**************************	---------	---------

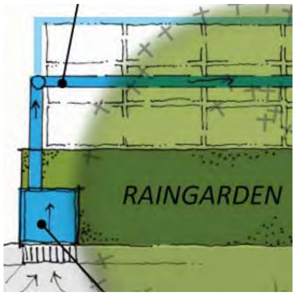
Dry Weather Inflow 0.000 0.000
Wet Weather Inflow 0.003 0.032
Groundwater Inflow 0.000 0.000
RDII Inflow 0.000 0.000
External Inflow 0.000 0.000
External Outflow 0.003 0.032
Flooding Loss 0.000 0.000
Evaporation Loss 0.000 0.000
Exfiltration Loss 0.000 0.000
Initial Stored Volume 0.000 0.000
Final Stored Volume 0.000 0.000
Continuity Error (%) 0.000

****
Subcatchment Runoff Summary
****

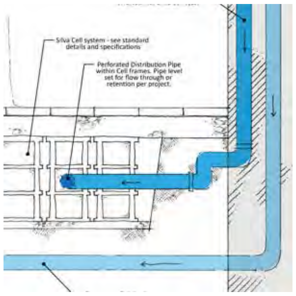
Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff CMS	Runoff Coeff
C205	5.07	0.00	0.00	0.46	4.56	0.03	0.01	0.900



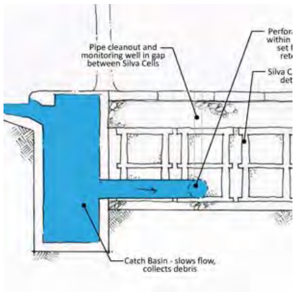
Stormwater and the Silva Cell System
SCHEMATICS



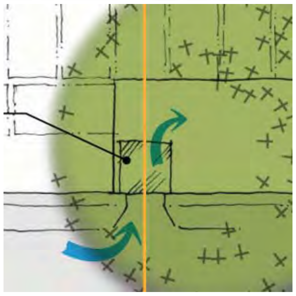
Raingarden Schematic -
Section View
Plan View



Rainleader Schematic -
Section View
Plan View



Catch Basin Schematic -
Section View
Plan View



Curb Cut Schematic -
Section View
Plan View

DeepRoot Urban Solutions

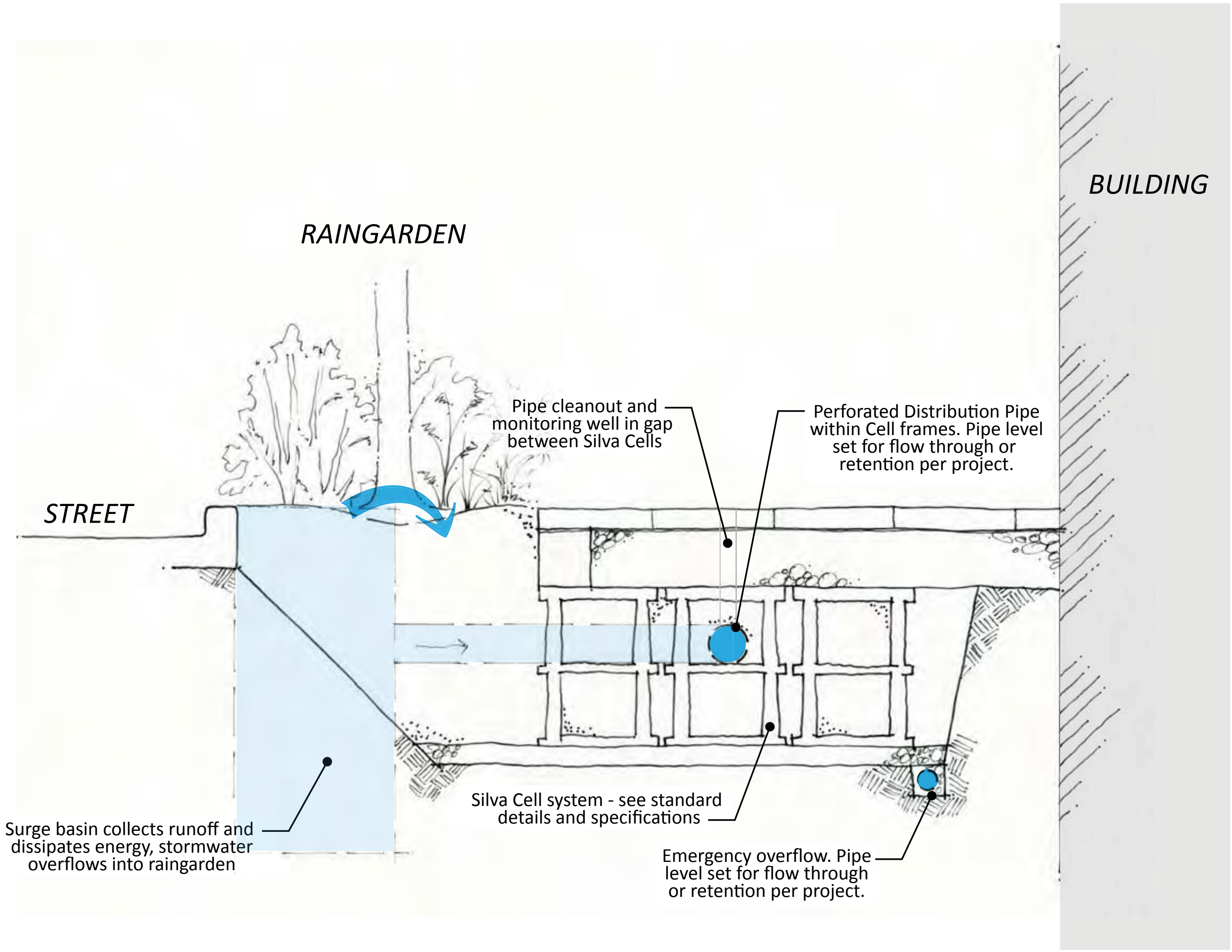
Updated 2/15/2011

Drawing is for schematic purposes only. Project designer must determine Silva Cell system and pipe sizing, location, overflow design, and slopes to meet project requirements.

Stormwater shall be pre-treated as needed prior to distribution through the Silva Cell system.

Please refer to the Silva Cell standard details and specifications for more information.

Back to Index



DeepRoot Urban Solutions

Stormwater and the Silva Cell System

Raingarden *Schematic*

Updated 2/15/2011

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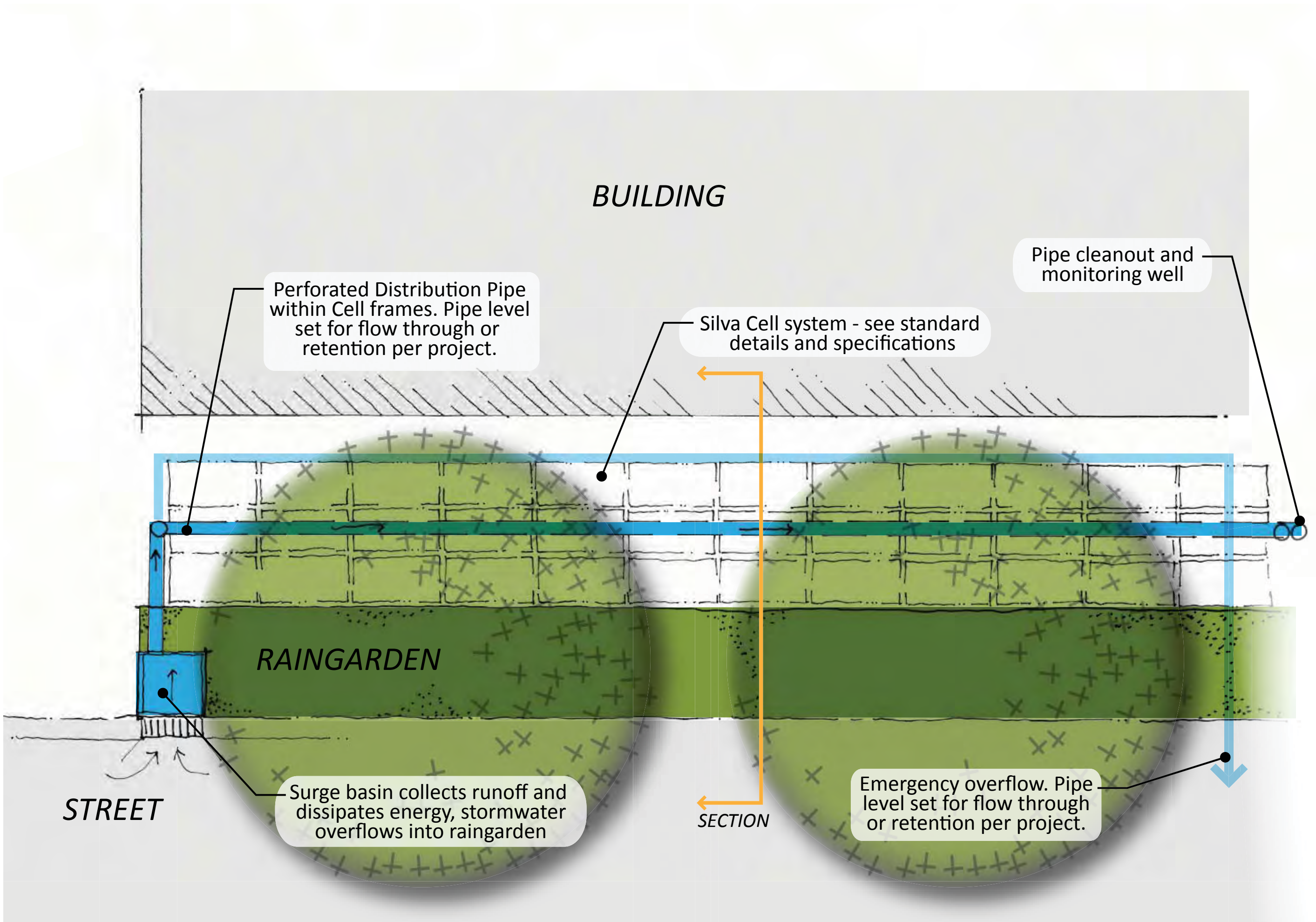

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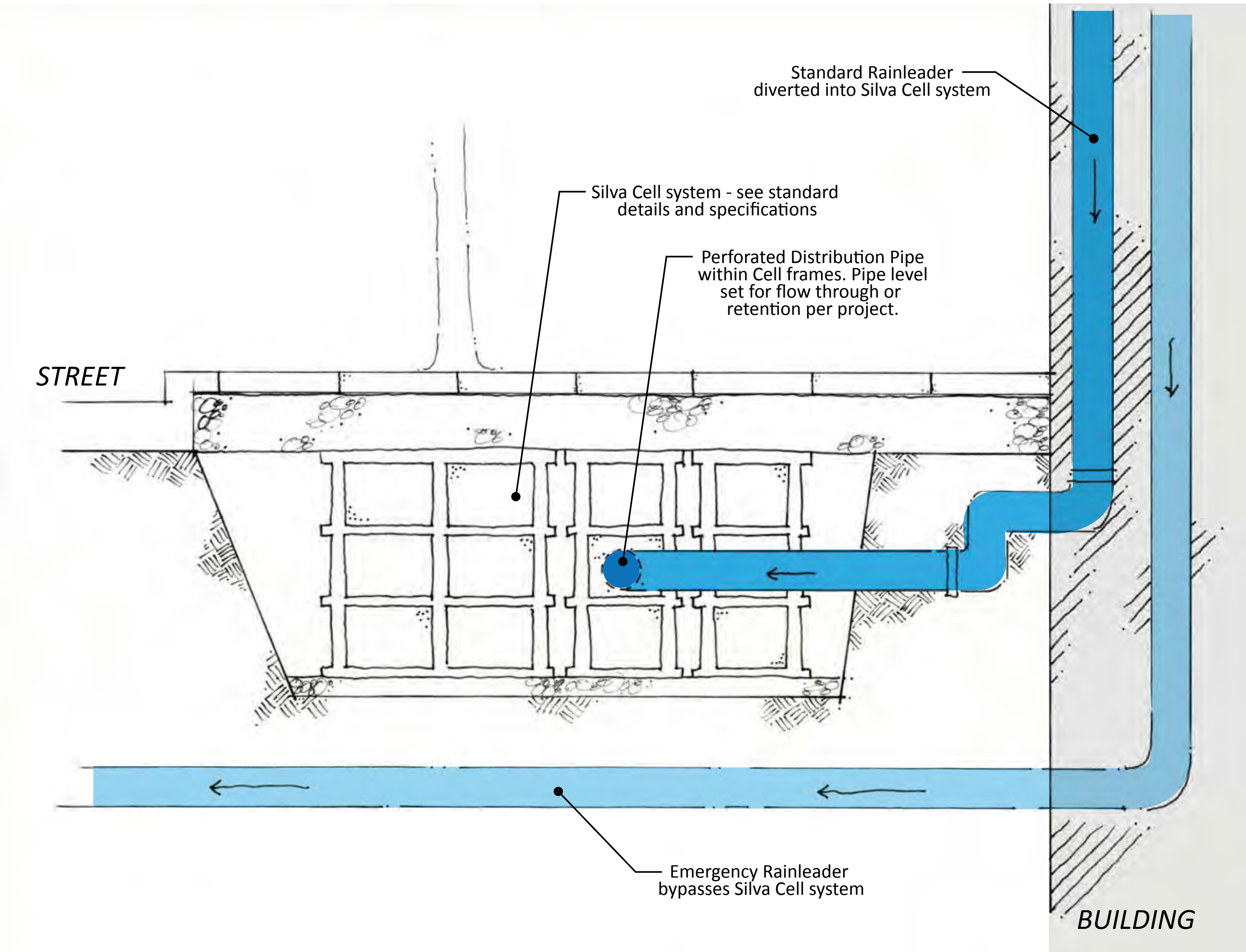

DeepRoot Urban Solutions

Stormwater and the Silva Cell System

Rainleader *Schematic*

Updated 2/15/2011

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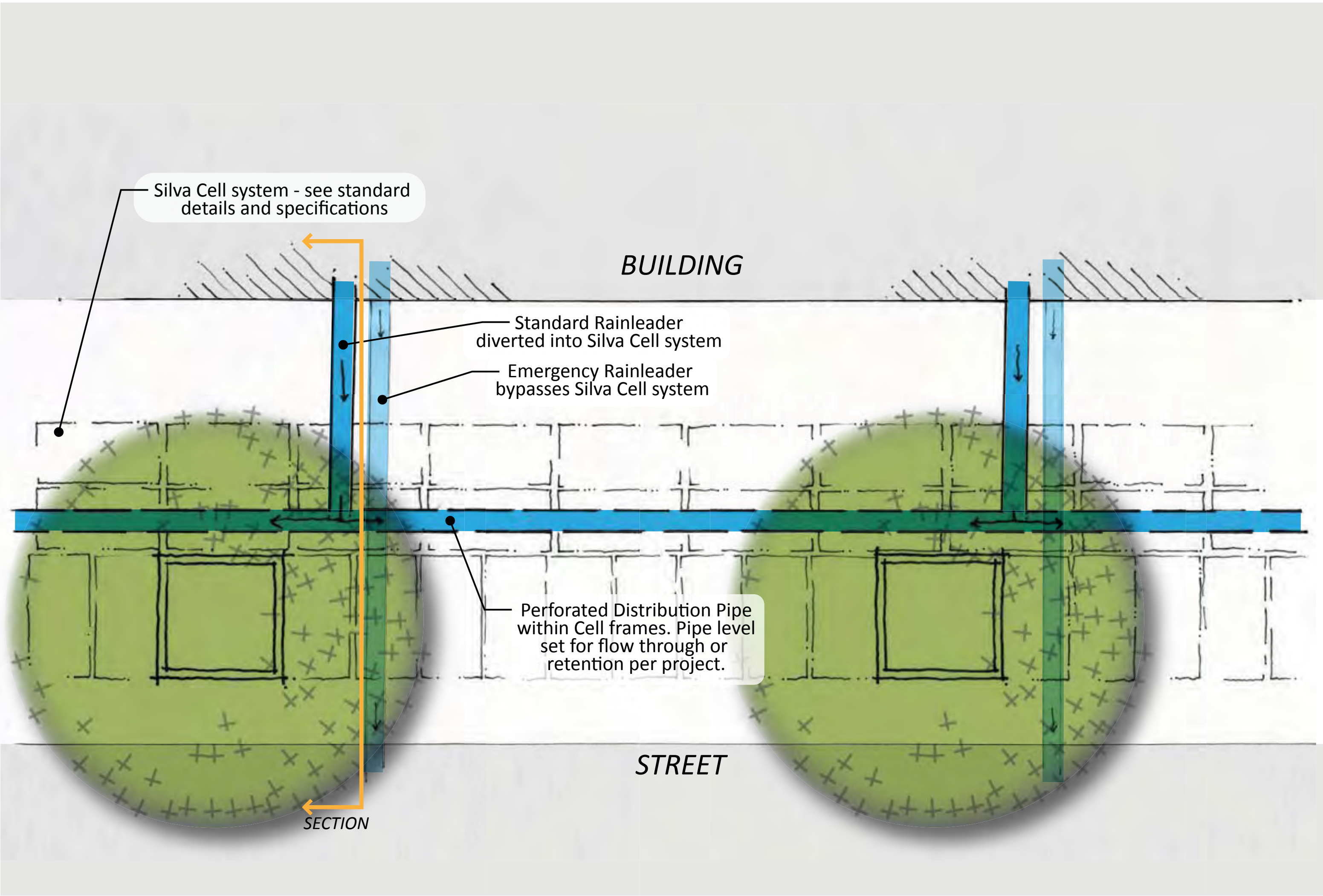

DeepRoot Urban Solutions

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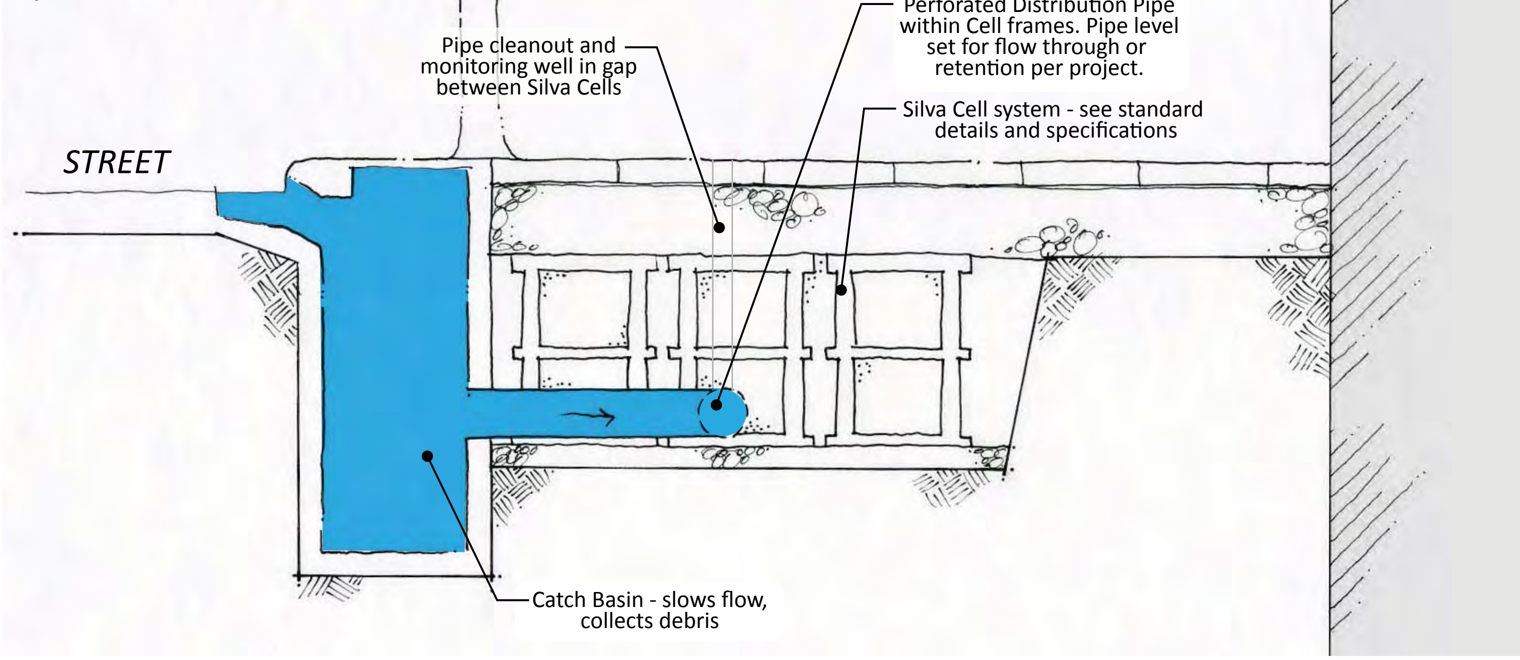

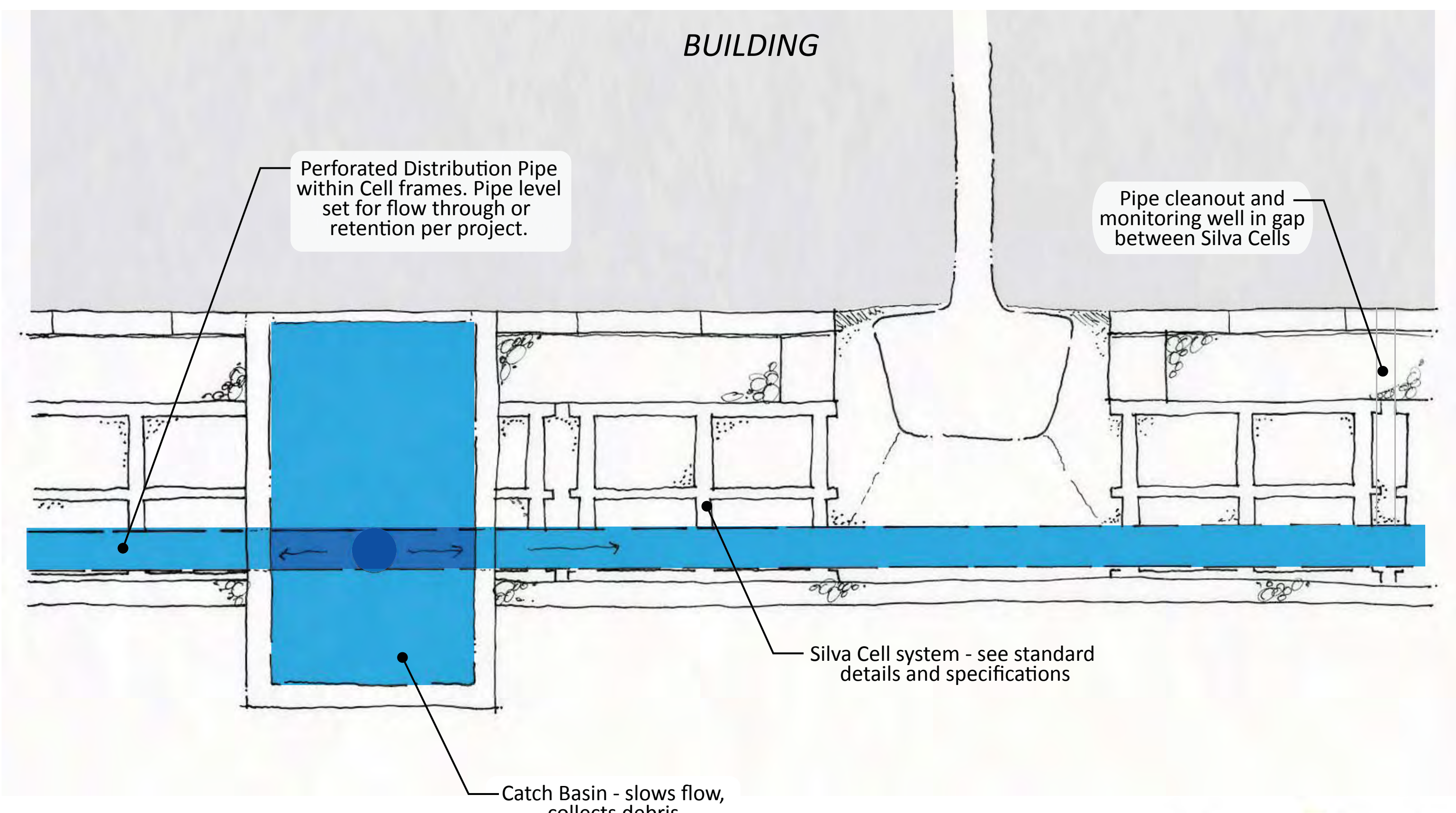

DeepRoot Urban Solutions

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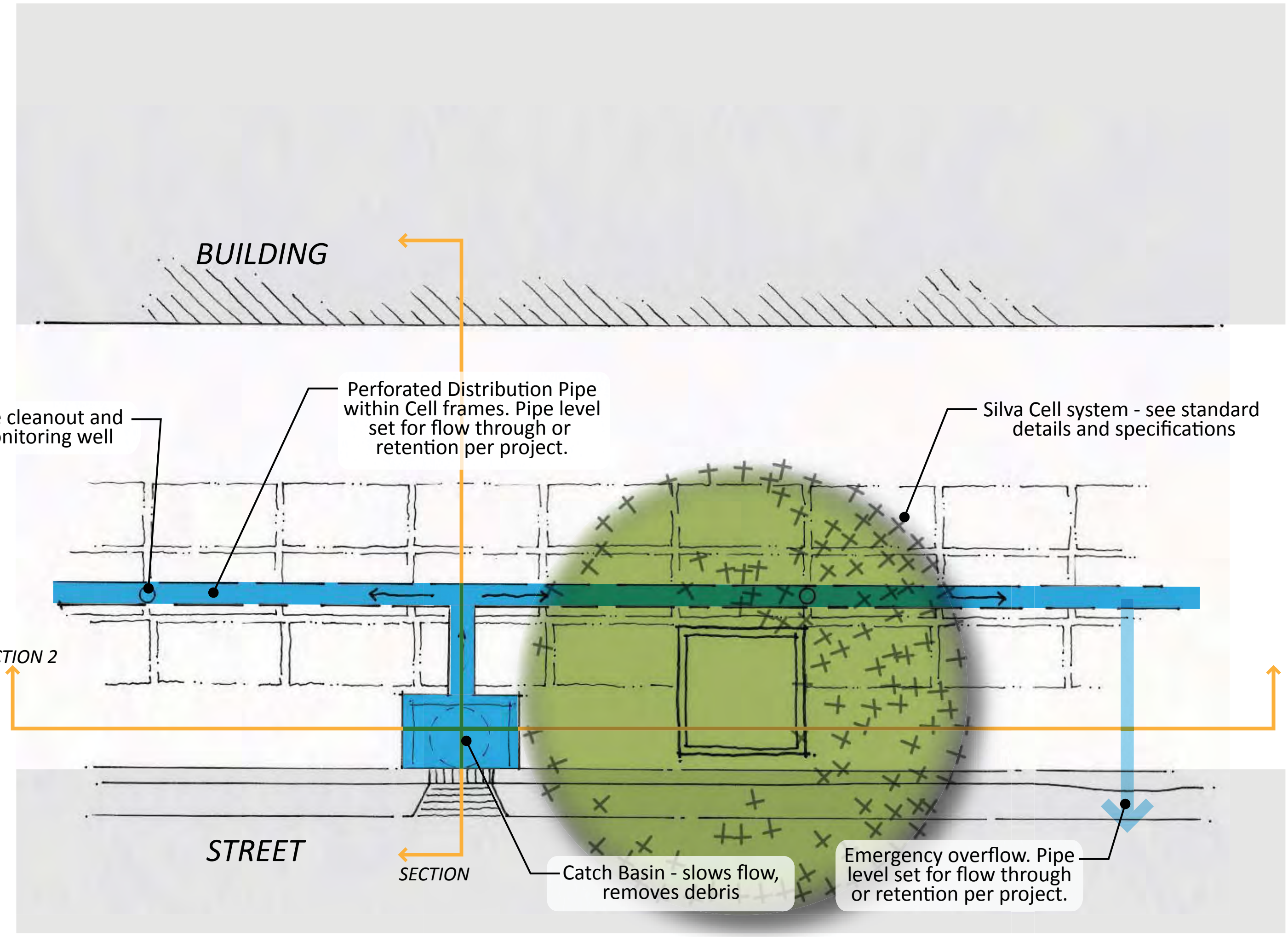

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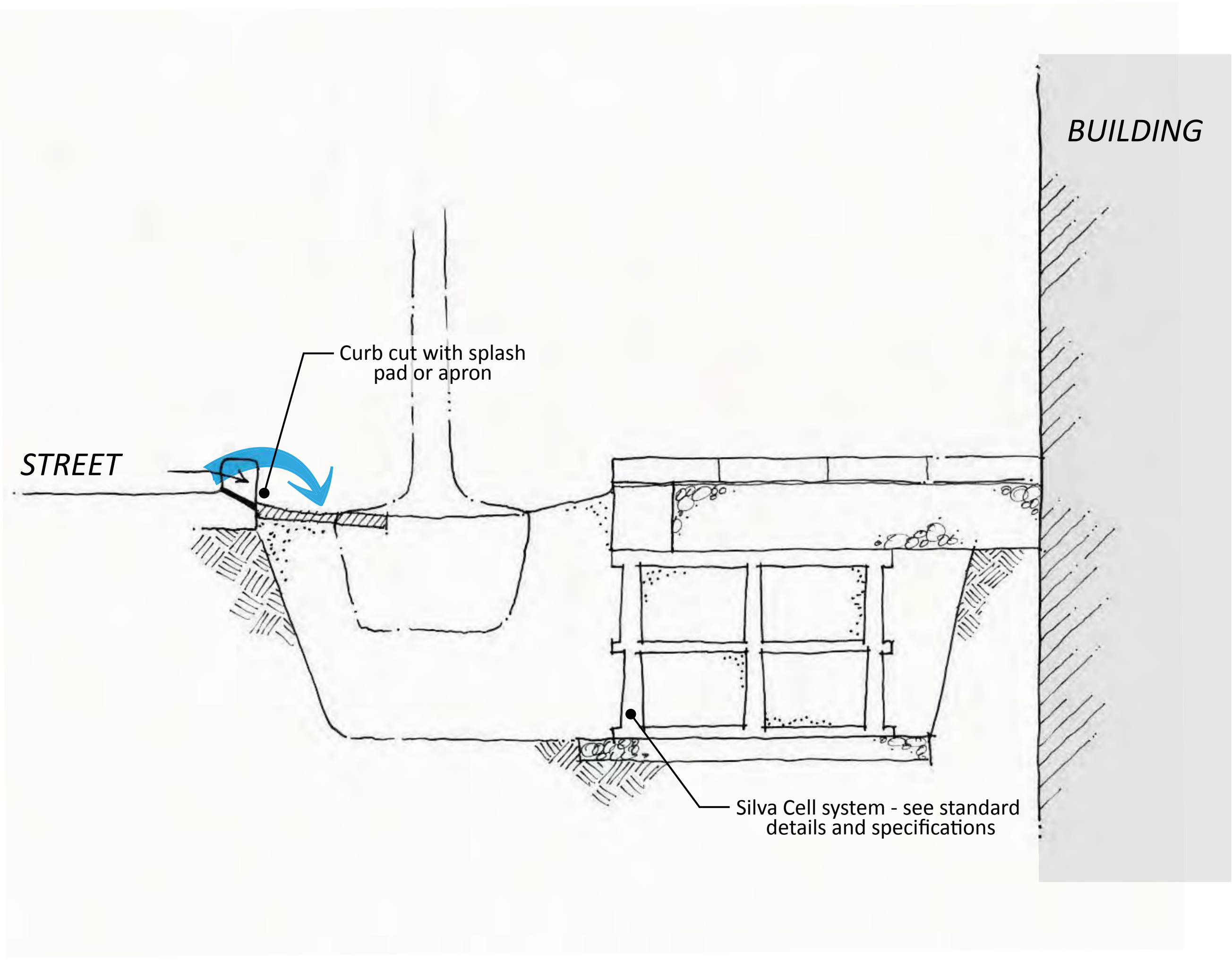

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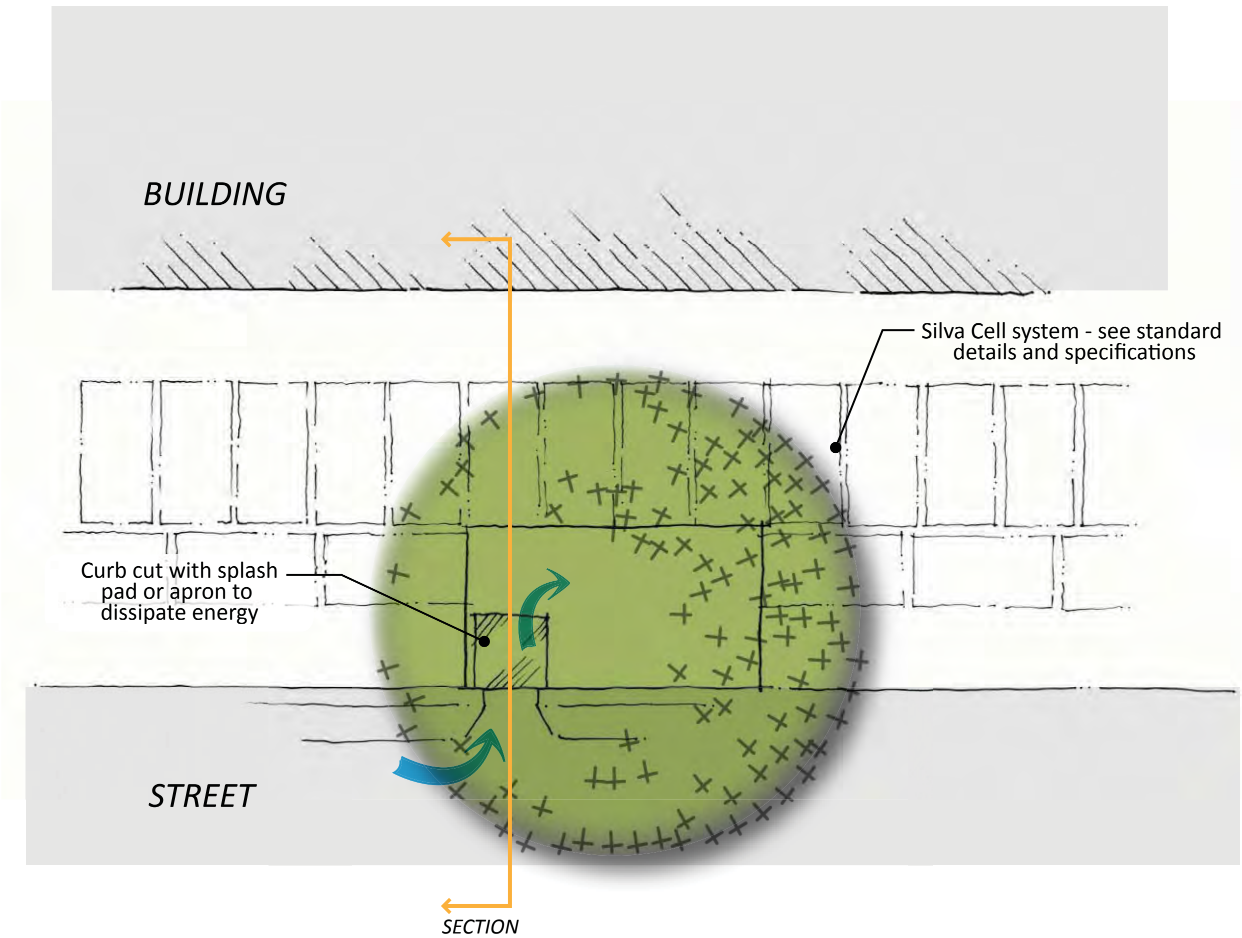

Appendix C STORMSEWER DESIGN SHEET

Storm Sewer Design Sheet
City of Mississauga

Rainfall Intensity = $\frac{A}{(Tc+B)^c}$

	10-YEAR	100-YEAR
A=	1010	1450
B=	4.6	4.9
c=	0.78	0.78
Starting Tc =	15 min	

Project: Square One Drive Extension
Project No: 165011005
Date: 21-Apr-17
Designed by: SP

Location of Secion	FROM MH	TO MH	10-YR AREA (ha)	10-YR RUNOFF COEFFICIENT "R"	10-YR "AR"	10-YR ACCUM. "AR"	10-YR RAINFALL INTENSITY (mm/hr)	10-YR ACCUM. FLOW (m^3/s)	LENGTH (m)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (m3/s)	FULL FLOW VELOCITY (m/s)	TIME OF CONCENTRATION (min)	ACC. TIME OF CONC. (min)
Square One	1	2	0.42	0.90	0.38	0.38	99.17	0.104	120.0	2.30	450	0.432	2.719	0.736	15.736
Square One	2	50	0.29	0.90	0.26	0.64	96.36	0.171	70.0	2.30	525	0.652	3.013	0.387	16.123

Appendix D QUANTITY CONTROL

Project: Square One Drive Extension
Project Number: 165011005
Project Location: Mississauga, ON
Date: 6/19/2017

Pre-Development 2-year Peak Flow

Storm	A	B	C
2-year	610	4.6	0.78

	Area	C
Impervious	0.09	0.9
Pervious	0.62	0.25
Total/Weighted Runoff Coefficient	0.71	0.33

Time of concentration	15.0	minutes
Rainfall Intensity	60	mm/hr

Rational Method

$$Q = 2.78 * C * i * a$$

C = Runoff Coefficient
i = Rainfall Intensity (mm/hr)
A = Contributing Area (ha)
Q = Flow (m^3/s)

Target Flow = **0.039** m^3/s (Existing conditions 2-year peak flow)

Post Development Conditions

Orifice Control:

Orifice Equation: $Q = C_d A(2gh)^{1/2}$

C_d	0.82	(Orifice tube)
Location	MH50	
Lowest CB Elevation	156.89	m
Orifice Size	80	mm
Orifice Invert	152.44	m
Centroid	152.48	m
Obvert	152.52	m
Head	4.41	m

Flow Area	0.005	m^2
Proposed Release Rate	**38**	L/s

Modified Rational Method Storage Calculation

Storm	A	B	C
10-year	1010	4.6	0.78

Area =	0.71	ha
Runoff Coefficient =	0.90	
Time of Conc =	15.0	min
Time Increment =	5.0	min
Design Release Rate =	0.038	m^3/s
Maximum Storage =	**135**	m^3

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (m^3/s)	Runoff Volume (m^3)	Volume Released (m^3)	Storage Required (m^3)
15.0	99.2	0.176	158.5	34.5	124.0
20.0	83.1	0.148	177.1	46.0	131.1
25.0	71.9	0.128	191.6	57.5	134.1
30.0	63.7	0.113	203.5	69.0	134.5
35.0	57.3	0.102	213.7	80.5	133.2
40.0	52.2	0.093	222.6	92.0	130.6
45.0	48.1	0.085	230.5	103.5	127.0
50.0	44.6	0.079	237.7	115.0	122.7
55.0	41.7	0.074	244.2	126.5	117.6
60.0	39.1	0.069	250.1	138.0	112.1
65.0	36.9	0.066	255.7	149.5	106.2
70.0	35.0	0.062	260.8	161.0	99.8
75.0	33.2	0.059	265.7	172.5	93.2
80.0	31.7	0.056	270.2	184.0	86.2
85.0	30.3	0.054	274.6	195.5	79.0
90.0	29.0	0.052	278.7	207.0	71.6
95.0	27.9	0.050	282.6	218.5	64.0
100.0	26.9	0.048	286.3	230.0	56.2
105.0	25.9	0.046	289.8	241.5	48.3
110.0	25.0	0.044	293.3	253.0	40.2
115.0	24.2	0.043	296.5	264.5	32.0

uponor

Weholite®

LIGHTWEIGHT PIPE SYSTEM

The lightweight pipe that takes a heavier load

Weholite® pipe is large diameter, profile wall pipe made from high-density polyethylene (HDPE) resin, which is manufactured to ASTM F-894. Designed for gravity and low-pressure applications, Weholite's raw material properties have been combined with patented structural wall technology to create a lightweight engineered pipe with superior loading capacity.

Lighter. Stronger. Chemical Resistant.

Weholite pipe is much lighter than similarly sized concrete pipe. Combine this with longer manufacturing lengths and Weholite allows you to achieve savings in labour and equipment

Weholite HDPE pipe will not corrode, tuberculate or support biological growth, making it the material of choice in wastewater and harsh chemical environments. It is inert to salt water and the chemicals likely to be present in sanitary sewage effluent.

Like all HDPE pipe, Weholite has a smooth ID that maintains its flow capability over time. The low Manning's roughness factor of 0.01 remains constant, even after years of use.

Easier to Transport. Easier to Install. Reliable Joints.

Weholite pipe is much easier to handle and install than heavier, rigid concrete or metallic pipe. This means potential cost savings during the construction process.

Weholite offers a variety of joining methods that meet or exceed your project's tightness requirements. Field fusion welding, Weholite Coupling Bands and Threaded Joints each meet the unique demands for the wide range of applications for which they are designed.

Cost Effective. Permanent.

Weholite pipe offers distinct chemical and physical advantages over FRP, concrete and cast or ductile iron pipe. It can be field bent to a radius 200 times the nominal pipe diameter eliminating many fittings required for directional changes in piping systems made from other materials. In addition, the flexibility of Weholite pipe makes it well suited for dynamic soils and areas prone to earthquakes.

Weholite is cost effective in both the short and long term. The fact that it is lightweight makes it easier to transport and install. The fact that it utilizes reliable joining methods means years of maintenance free use. The Plastics Pipe Institute conservatively estimates the service life for HDPE pipe to be 50-100 years.

The Weholite Advantage

- Lightweight
- Impact Resistant
- Corrosion Resistant
- Chemical Resistant
- Fatigue Resistant
- Reliable Joints
- Flexible
- Long Life
- Environmentally Friendly

Proven performance in many applications

Since its development, large diameter HDPE pipe has been used successfully in thousands of installations world-wide. Weholite has proven itself in both municipal and industrial applications including new pipeline and pipeline rehabilitation projects.

Weholite provides all the advantages of solid wall polyethylene pipe with substantial savings in weight for increased ease of installation and cost effectiveness.

Some of the successful applications of Weholite include:

- Biofilters
- Culverts
- Drainage Systems
- Gravity Sewers
- Hydroelectric
- Irrigation
- Municipal Low Pressure Projects
- Manholes
- Pipe Rehabilitation & Relining
- Sanitary Sewers
- Storage Tanks
- Storm Drains & Sewers
- Water Intakes
- Water Outfalls

Drainage & Roads

Uponor Infra provides Weholite drainage systems for virtually any requirement in civil construction including: culverts, culvert relining and drainage pipe for storm water drains, roadways and railroads. Weholite pipe has enhanced hydraulic flow and unparalleled chemical and abrasion resistance when measured against other materials. It is unbeatable when it comes to flexibility in unstable ground conditions.

Hydroelectric

Large diameter profile wall Weholite pipe is an ideal solution for hydroelectric applications such as turbine feed water supply and water diversion. It is lightweight, which makes transportation and installation easier. The flexibility of the pipe allows for large radius bends, which is important for water diversion where the terrain may control the area of installation.

Industry

Long-term reliable piping solutions are always in demand for a wide range of industrial applications. Large diameter profile wall Weholite offers resistance to corrosion, abrasion and chemicals that industry requires. Odorous compounds are released from many industrial processes, waste disposal and recycling. A Weholite biofiltration system is a simple, low cost technology that can reduce odour emissions by as much as 95%.

Weholite Tanks

Uponor Infra manufactures Weholite Tanks in a large array of sizes. All tanks can be outfitted with custom fabricated components suitable to the design requirements of each individual specific job. Weholite tanks are suitable for gravity plastic pipe systems, water storage, storm water systems, sewage systems and chemical storage.

Irrigation

Weholite HDPE pipe has proven to be an ideal solution in irrigation and low pressure water conveyance applications including: river and canal diversion, agricultural irrigation systems, underground irrigation systems, irrigation pipelines, water conservation and safety. The properties of Weholite including strength and durability ensure that your irrigation system will withstand the test of time.

Heating & Cooling

Weholite pipe has proven to be a strong, virtually leak-proof and chemically inert solution for use as a high volume water intake line for district cooling applications. It has distinct installation advantages due its light weight. In certain shallow depth marine applications the pipe can be assembled on shore in a continuous length, floated into position and then submerged as a continuous structure. Its resistance to both corrosion and zebra mussel fouling make it an ideal solution in lake and river applications.

Waste Water Systems

After more than 50 years use in sewer applications, polyethylene pipe has proven to be a reliable, long-term solution for sewer and wastewater systems. Weholite pipe has distinct advantages over other piping materials. Its resistance to abrasion and chemicals make it a lasting solution. Weholite pipe is also flexible and does not corrode or tuberculate over time.

Choose from a wide range of sizes

Weholite pipe is tough, flexible, lightweight, surge and chemical resistant. It offers installation economy and long service life. Available in a wide range of sizes from 18" to 132" in diameter, and standard pipe lengths of up to 50'. Special pipe lengths can be produced to meet almost any need.

Product Size Range

Item			Dimensions	
Size (inch)	Class	Spec	Avg. OD (inch)	Avg. ID* (inch)
18	160	F894	20.4	18.0
19.5	160	F894	22.2	19.5
21	160	F894	23.7	21.0
24	160	F894	27.1	24.0
27	160	F894	30.4	27.0
30	160	F894	33.7	30.0
33	160	F894	36.7	33.0
33	250	F894	37.5	33.0
36	160	F894	40.5	36.0
36	250	F894	40.5	36.0
40	160	F894	44.5	40.0
40	250	F894	45.0	40.0
42	160	F894	47.0	42.0
42	250	F894	47.3	42.0
48	160	F894	53.0	48.0
48	250	F894	53.5	48.0
54	160	F894	59.5	54.0
54	250	F894	60.2	54.0
60	160	F894	66.2	60.0
60	250	F894	66.9	60.0
66	160	F894	72.2	66.0
66	250	F894	73.6	66.0
72	160	F894	78.9	72.0
72	250	F894	80.3	72.0
78	160	F894	85.6	78.0
78	250	F894	86.3	78.0
84	160	F894	91.6	84.0
84	250	F894	92.9	84.0
90	160	F894	97.6	90.0
90	250	F894	98.9	90.0
90	400	F894	100.3	90.0
96	160	F894	104.3	96.0
96	250	F894	105.6	96.0
96	400	F894	107.0	96.0
108	160	F894	116.9	108.0
108	250	F894	118.3	108.0
108	400	F894	120.4	108.0
120	160	F894	129.6	120.0
120	250	F894	131.0	120.0
120	400	F894	133.8	120.0
132	160	F894	143.0	132.0
132	250	F894	144.4	132.0

Online Analysis Tool

The Uponor Infra online analysis calculator evaluates your selection of pipe size and grade to suit the hydraulic capacity, internal pressures, thermal factors and burial conditions of your application. Please visit our web site and use our online analysis tool to determine the best Weholite pipe size and class to suit your specific application.

Note: This dimensional table (page 6) for Weholite pipe contains a range of product sizes and stiffness classes. The specification associated with each of these items is ASTM F894. If the analysis using our online tools indicates that one of these lower stiffness items is suitable, the standard that will be indicated on all documentation is NONF894. The items comply in all respects with ASTM F894 except the waterway wall.

Fittings and custom configurations for any application

Uponor Infra provides a wide range of complimentary products to meet the requirements of just about any piping system.

Our comprehensive selection of factory fittings includes elbows (30, 45, 60 and 90 degree), headers, laterals, reducers and tees. You can choose from standard fittings or design custom fittings for your unique application.

We can custom manufacture piping assemblies to include branch connections commonly found in foul air and other industrial piping applications. Weholite can be easily fabricated into water storage tanks, inspection chambers and manholes for sewage applications. A wide range of sizes and designs are possible, with pipe connections suitable for any standard sewer pipe. Inspection chambers and manholes are available complete with an adjustment pipe for final height installation on site if desired. Covers are selected according to application and traffic load, and ladders can be fitted inside as required.

Product innovation and quality assurance

For over 50 years Uponor Infra has been a leader in the design, development, manufacturing and engineering support of polyethylene piping systems.

Extensive R&D in the early 1960's led us to produce 16" NPS polyethylene pipe at a time when many considered this size a technical impossibility. Today Uponor Infra produces 132" profile wall Weholite pipe for a wide range of applications.

All Uponor Infra products are manufactured from special, high strength resins with complete quality control maintained from raw material to finished pipe product. Uponor Infra produces Weholite to the exacting standards of its quality management system which is registered to ISO 9001:2008.

Our strict manufacturing specifications are verified daily, using precise dimensional controls and accelerated long term hydrostatic testing. Our continuous quality control process assures long-term pipe performance.

Since Weholite pipe is lightweight and flexible, it is easy to transport and install. Small misalignments of pipeline can be accommodated by bending the pipe itself. Long lengths of pipe can be ordered to reduce the number of joints and the associated time and expense of installation.

Simplified Material Handling

Light weight and long lengths reduce the material handling requirements at construction and storage sites. In addition, Weholite has high axial (or beam) stiffness that reduces the number of support points required to lift these long lengths of pipe. The durable PE material helps ensure that product damage due to handling is minimized.

Joining Options

Gravity Piping Systems

The Weholite Coupling Band has been designed to meet the requirements of your gravity piping system. Suitable for gravity wastewater, storm drainage and tank systems this mechanical coupling combines a high-strength, corrosion resistant stainless steel casing with a high-grade elastomeric seal to provide durable joining systems that exceeds the requirements of ASTM D3212

Low Internal Pressure Piping Systems

Field applied thermally fused extrusion welded connections are utilized for applications with low internal operating pressures. Fused joints offer reliable performance against leakage and result in a fully restrained system eliminating the requirement for thrust restraints.

Rehabilitation and Reline Systems

The unique Threaded Joint is a simple and reliable joining method providing an economic solution for slip lining applications. Weholite Threaded Joint facilitates the work of maintenance crews and contractors to rehabilitate pipe systems at the fraction of the cost of replacement.

Grouting Reline Pipe

Weholite's high axial stiffness and high resistance to the hydrostatic collapse pressure caused by grouting, simplifies the installation and grouting procedures when using this pipe to reline deteriorated highway culvert pipe. Relining offers substantial savings over replacement of distressed pipe and avoids traffic disruption.

Pipe Installation

The bedding and backfill requirements for Weholite pipe are the same as those used for all plastic pipe. ASTM standard D2321 that applies to PE and PVC plastic pipe installation, is appropriate for describing the process for placement of bedding, and backfill materials on a Weholite pipe installation. Where native materials are suitable, imported embedment materials may not be required.

Manhole Installation

Weholite manholes are designed in accordance with ASTM F1759. HDPE manholes when used with HDPE piping produce a sewage system that is virtually leak-free and is not subject to the corrosion experienced in many sanitary sewage systems. Weholite manholes may be provided with corrosion resistant OSHA ladders, and field cut to the required height.

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