Storm Water Credit Cost Scenarios

1.0 Introduction

The costs for several onsite storm water management options were examined and the potential credits were estimated based on realistic options that a site may implement to improve the quality of their runoff, reduce the runoff quantity, or delay the flow from their property to the storm water system. The cost analysis showed that credits could be beneficial to larger properties that are required to implement onsite storm water management as part of the permitting approval process, but they may not provide sufficient financial incentive to encourage retrofitting of existing properties that are not required to meet the standards for new developments. The credits do help to recognize the increased costs borne by properties that manage the quantity and quality of their storm water runoff onsite.

Saskatoon's Storm Water Credit program proposal will aim to minimize the costs to applicants through an efficient application process with the following considerations:

- Storm Water credit application form.
- Specifications and design drawings.
    - Some measures will require design drawings and calculations completed by qualified designer (engineer or landscape architect).
- Confirmation that installation was as designed.
- Maintenance plan if applicable.
- Approved credits to be applicable for five years if the measure is maintained as per the plan, unless changes are made that would change the credit eligibility.
- Verification of eligibility for credits by a qualified engineer only in instances where calculations have not been provided by the supplier or have not previously been submitted and approved by the City as part of the permitting process.
- Renewal form and verification of maintenance for renewal after five years.
    - Some measures will require submission of annual maintenance records.
- Possible site inspection by City staff.

The maximum capital and ongoing maintenance cost savings to the City was estimated based on the assumption that all properties in a neighbourhood were to be pervious and retain 100% of their runoff onsite with no runoff to the storm water system in a 1-in-2 year storm. Runoff from streets and roads comprising about 20% of the neighbourhood area would flow to the storm water system. Based on these assumptions, the capital cost of a storm water management system could be reduced by up to 50% if all sites were to retain their runoff onsite. The cost of the system maintenance is expected to follow the same proportion. This analysis supports the concept of the 50% cap for the storm water credit proposal.

2.0 Storm Water Credit Examples

2.1 Property One: Office with Two Equivalent Runoff Units (ERUs)

Land Use	ERUs	Site Area (m²)	Building Area (m²)	Paved Area (m²)	Grass Area (m²)
Commercial Office	2	889	496	72	321

Storm Water Management: Above ground storage tank for water reuse

Assumptions/Notes:

- ERU's from building: 496 m² x 0.9 / 295.4 m² = 1.5 ERU's
- Storage tank size: 5 mm over the building area (496 m²) = 2,500 L
- Credit percentage: 5 mm x 2% = 10% for ERU's from building
- ERU credits: 10% x building ERU's (1.5) = 0.15 ERU's
- Overall credit percentage: 0.15 ERU / 2 ERU = 7.5 %
- Multiple tanks may be required to capture water at multiple downspouts.

Cost Assumptions for Company

Capital Costs	$1,600 - $2,200
Annual Maintenance Costs	$0 - $100
No Engineering Fee Required to Certify Application	$0

Storm Water Onsite Retention Credit						
	2019	**2020**	**2021**	**2022**	**2023**	**Five-Year Total**
Storm Water Fee (no credit)	$132.60	$159.60	$186.60	$213.60	$213.60	$906.00
7.5% Credit	$9.95	$11.97	$14.00	$16.02	$16.02	$67.96

2.2 Property Two: Gas Station with Seven ERUs

Land Use	ERUs	Site Area (m²)	Building Area (m²)	Paved Area (m²)	Grass Area (m²)
Gas Station	7	2,076	629	1,447	0

Storm Water Management: Oil and Grit Separator (OGS)

Assumptions/Notes:

- New development that requires OGS to meet development standards
- Information from OGS supplier provides information required by company for application
- OGS captures the entire site runoff with 80% total suspended solids (TSS) removal
- Overall credit percentage: 20%

Cost Assumptions for Company

Capital Costs	$15,000 - $50,000
Annual Maintenance Costs	$2,300
No Engineering Fee Required to Certify Application	$0
Administration Cost to Submit Maintenance Record (if requested)	$50 - $100

Water Quality Improvement Credit						
	2019	**2020**	**2021**	**2022**	**2023**	**Five-Year Total**
Storm Water Fee (no credit)	$464.10	$558.60	$653.10	$747.60	$747.60	$3,171.00
Credit	$92.82	$111.72	$130.62	$149.52	$149.52	$634.20

2.3 Property Three: Office Space with 12 ERUs

Land Use	ERUs	Site Area (m^2)	Building Area (m^2)	Paved Area (m^2)	Grass Area(m^2)
Commercial Office Space	12	4,210	1,250	1,967	76

Storm Water Management: Bioretention in parking lot

Assumptions/Notes:

- Installed during parking lot construction to direct flow into bioretention garden
- Designed with overflow beehive grate drain, no under drain system, and 200 mm of storage between surface and overflow drain
- ERU's from paved area: 1,967 m^2 x 0.9 / 295.4 m^2 = 6.7 ERU's
- Bioretention size = 4% of paved area = 80 m^2
- Water retained = 16,000 litres, equivalent to 8.5 mm runoff from paved area – bioretention area
- Credit percentage: 8.5 mm x 2% = 17% for ERU's from paved area
- ERU credits: 17% x paved ERU's (6.7) = 1.1 ERU's
- Overall credit percentage: 1.1 ERU / 12 ERU = 9.2 %

Cost Assumptions for Company

Capital Costs	$15,000 - $18,000
Annual Maintenance Costs	$750 - $1,800
Engineering Fee to Certify Application (If applicable)	$0 to $5,000

Storm Water Onsite Retention Credit						
	2019	**2020**	**2021**	**2022**	**2023**	**Five -Year Total**
Storm Water Fee (no credit)	$795.60	$957.60	$1,119.60	$1,281.60	$1,281.60	$5,436.00
Credit	$73.20	$88.10	$103.00	$117.91	$117.91	$500.12

2.4 Property Four: Car Lot with 32 ERUs

Land Use	ERUs	Site Area (m^2)	Building Area (m^2)	Paved Area (m^2)	Grass Area (m^2)
Commercial Car Lot	32	9,648	1,625	7,722	301

Storm Water Management: Parking lot peak flow detention with orifice control

Assumptions/Notes:

- Volume stored on parking lot with orifice for peak flow reduction
- Orifice installed during initial development
- 50% of the peak flow from a 1-in-2 year rain event is detained from entire site
- Overall credit percentage: 0.4 x 50% = 20%

Cost Assumptions for Company

Capital Costs (Assumes cost of onsite storage is part of parking lot grade design)	$200 - $1,000 for Orifice
Annual Maintenance Costs	$0 - $100
Engineering Fee to Certify Application (If applicable)	$0 - $5,000
Administration Cost to Submit Maintenance Record (if requested)	$0 - $50

Storm Water Peak Flow Reduction Credit						
	2019	**2020**	**2021**	**2022**	**2023**	**Five-Year Total**
Storm Water Fee (no credit)	$2,121.60	$2,553.60	$2,985.60	$3,417.60	$3,417.60	$14,496.00
Credit	$424.32	$510.72	$597.12	$683.52	$683.52	$2,899.20

2.5 Property Five: Commercial Mall with 100 ERUs

Land Use	ERUs	Site Area (m^2)	Building Area (m^2)	Paved Area (m^2)	Grass Area (m^2)
Commercial Mall/Retail	100	30,670	5,253	24,262	1,155

Storm Water Management: Parking lot peak flow detention with orifice control

Assumptions/Notes:

- Volume stored on parking lot with orifice for peak flow reduction
- Orifice installed during initial development
- 50% of the peak flow from a 1-in-2 year rain event is detained from entire site
- Overall credit percentage: 0.4 x 50% = 20%

Cost Assumptions for Company

Incremental Capital Costs	$500 - $1,500 for orifice
Annual Maintenance Costs	$0 - $200
Engineering Fee to Certify Application (If applicable)	$0 - $5,000
Administration Cost to Submit Maintenance Record (if requested)	$0 - $50

Storm Water Peak Flow Reduction Credit						
	2019	**2020**	**2021**	**2022**	**2023**	**Five-Year Total**
Storm Water Fee (no credit)	$6,630	$7,980	$9,330	$10,680	$10,680	$45,300
Credit	$1,326	$1,596	$1,866	$2,136	$2,136	$9,060

3.0 Cost Ranges For Storm Water Management Measures

3.1 Above Ground Storage Tank and Reuse (Retention)

This method is the same as a residential rain barrel, but sized to hold more water from a larger roof area. The volume required is simply rain depth x roof area. Operation will require the tank to be emptied, ideally used as irrigation on landscaping, between rain events. An automated irrigation system can be installed at additional cost, or the tank can be manually emptied.

This table provides cost estimates by tank material.

Tank Type Cost Chart ($/L, installation not included)			
Fiberglass	**Steel**	**Plastic**	**Concrete**
35,000 L and up	1,800 - 57,000 L	190 – 5,700 L	7,500 L and up
$ 0.60	$ 1.13	$ 0.64	$ 0.75

Capital Costs	$3-5/$m^2$ drainage area for 5 mm capture. $15-20/$m^2$ drainage area for 25 mm capture.
Annual Maintenance Costs	$100 - $500

Sources: WERF LID Cost estimation tools, adjusted to 2018 CAD$.

Assumptions/Notes: Tanks attach to downspouts and may be required at more than one location to cover the entire roof area. Retention credits require the water to be used for onsite irrigation. Basic maintenance involves cleaning inflow filters, disinfecting the tank every year, and ensuring tank is empty in the fall.

3.2 Oil and Grit Separators (Water Quality)

Oil and Grit Separators are installed inline with the storm sewer pipes to remove oil and grit before the water leaves the site. They require emptying and cleaning on approximately an annual basis, depending on loading. Costs increase with size of unit required.

Capital Costs:	$15,000 to $50,000+
Annual Maintenance Costs:	$1,500 to $5,000
Company Administration Cost to Submit Maintenance Record	$50 to $200

Sources: City of Saskatoon, Stormceptor

Assumptions/Notes: OGS must be sized for the site and anticipated pollutant level. The manufacturer will provide design advice at time of purchase.

3.3 Orifice Control and Parking Lot Detention (Peak Flow Reduction)

An orifice restricts the amount of flow entering the downstream system, while the parking lot floods in a shallow, planned fashion to hold back water until the peak flow has passed.

Capital Costs	Orifice is $200 to $1,000
Annual Maintenance Costs	Annual inspection and cleaning if necessary
Certification by Engineer	Included in purchase.

Sources: City of Saskatoon

Assumptions/Notes: Orifice sizing requires calculation of desired flow rates, and the required storage should be planned in the parking lot grading established before construction. The engineer responsible for site design will complete this work.

3.4 Orifice Control and Underground Storage (Peak Flow Reduction, Retention)

If it is undesirable to hold water above ground, storage may be provided in a buried storage system. Some infiltration may be possible, depending on the soil properties. This can provide some credit for retention, as well as the detention that is the primary objective.

Capital Costs including Installation	$800 to 1,000/$m^3$
Annual Maintenance Costs	Cleaning cost estimated to be 2% of capital cost
Certification by Engineer	Included in purchase.

Sources: Stormtrap® for Capital Cost, City of Saskatoon

Assumptions: Installed during initial development construction for proper grading and inlets.

3.5 Bioswales (Retention, Water Quality, and/or Detention)

Bioswales or Raingardens are landscaping features designed to retain, infiltrate, and treat runoff. They are deeper than typical flower beds, and are filled with layered media to increase the space available for water. Some water will be retained and used by the plants, while some of the retained water will infiltrate. With a connected underdrain, excess water can move through the soil which will act as a filter to remove TSS and other pollutants. This type of system will also delay peak flows, as water flows through the bioswale at a slower rate than it would move over the surface. The specific design will determine which types of credits will be awarded to bioswale installations.

Price is proportional to size. Maintenance costs will be slightly higher than conventional landscaping to allow for cleaning of the underdrain system and removal of trash and surface sediment.

Capital Costs (landscaping and design)	Median cost: $10/$m^2$ contributing area
Annual Maintenance Costs could include sedimentation removal and periodic regrading	$100 to $10,000+
Certification by Engineer	$1,000 to $5,000

Sources: WERF LID Cost estimation tools, adjusted to 2018 CAD$.

Assumptions/Notes: Design report required to estimate the credits in each category.

3.6 Cistern with Reuse (Retention)

This is the same concept as the tank, but underground. A pump is required to allow reuse of the water, which introduces higher maintenance costs. This method takes up nearly no surface space.

Capital Costs	$5 to $10/$m^2$ drainage area for 5 mm capture. $25 to $30/$m^2$ drainage area for 25 mm capture.
Annual Maintenance Costs	$500 to $750
Certification by Engineer	Included in purchase.

Sources: WERF LID Cost estimation tools, adjusted to 2018 CAD$.

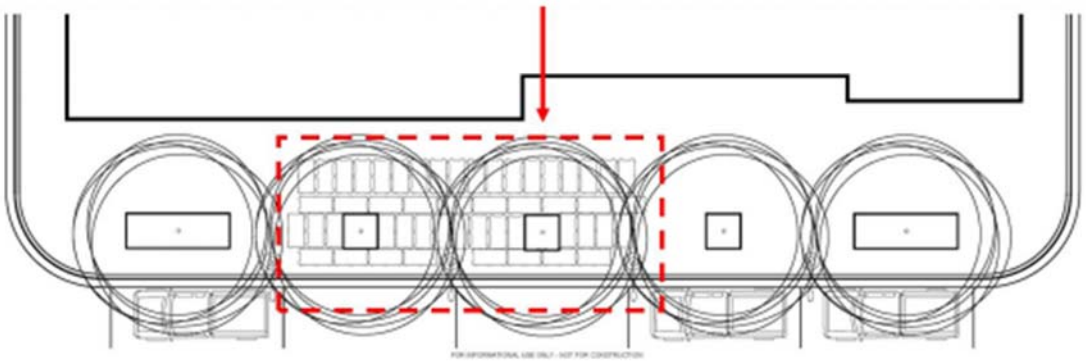
Assumptions: 5-25 mm of runoff captured.

3.7 Tree Box Bioretention (Retention, Water Quality, Detention)

A bioretention cell (e.g. Silva Cell) can be constructed primarily beneath a paved surface (e.g. parking lot) with an opening for a large tree to grow. This system can provide retention, water quality improvement, and detention benefits depending on the specific project design. The cell can be watered from above (permeable pavement or pavers) or connected via pipe from an adjacent catchbasin.

A canopy tree requires 28 m^3 of soil, while a smaller understory tree requires 17 m^3 of soil. Bioretention soil mixes have about 20% empty space available for water retention and/or treatment. Typically, the treatment area required is 4% of the impervious drainage area. See below for example.

- 12,750 ft^2 (1,185 m^2) impervious drainage area
- 4% sizing rule yields 510 ft^2 (47 m^2) treatment area needed for bioretention
- 510 ft^2/10 ft^2/Silva Cell (47m^2/1m^2/Silva Cell) = 51 Silva Cells
- 51 Silva Cells + 1 or 2 trees



Capital Costs	$15K to $18K per canopy tree $10K to $12K per understory tree
Annual Maintenance Costs for inlets/outlets and basic tree care	$200
Certification by Engineer	Included in purchase.

Sources:
https://www.deeproot.com/silvapdfs/resources/SC2/supporting/Silva_Cell_Fact_Sheet.pdf#chapter
https://www.deeproot.com/silvapdfs/resources/standardDetails/Layout_Instructions.pdf

Assumptions:
- Water filtered through the Silva Cell is assumed to decrease TSS by 85%. (Water Quality Improvement)
- Water held below the outlet elevation is assumed to be infiltrated and 20% of soil volume is assumed to remain saturated with water to be used by tree. (Retention)
- The peak flow of water discharge from silva cell will be delayed at least 30 minutes.

4.0 Non-Residential Properties By Number Of ERUs Paid

In 2018, there were 3,365 industrial, commercial, and institutional sites billed for annual storm water management charges. The following table shows the number of properties that were billed based on the number of ERUs that they pay.

2018 ERU Breakdown			
ERUs	**# of Sites**	**Percent**	**Cumulative**
2	900	26.7%	26.7%
3 - 5	722	21.5%	48.2%
6 - 10	629	18.7%	66.9%
11 - 15	324	9.6%	76.5%
16 - 20	232	6.9%	83.4%
21 - 30	222	6.6%	90.0%
31 - 40	118	3.5%	93.5%
41 - 50	56	1.7%	95.2%
51 - 60	31	0.9%	96.1%
61 - 70	29	0.9%	97.0%
71 - 80	21	0.6%	97.6%
81 - 90	14	0.4%	98.0%
91 - 100	67	2.0%	100.0%
TOTAL	**3,365**	**100%**	**100.0%**

5.0 Conclusion

The value of expected storm water credits based on the examples considered suggests that the two-thirds of industrial, commercial, and institutional properties that pay ten or less ERUs are unlikely to apply for storm water credits if their own administrative costs to apply are more than $500. The credits are expected to be more economically feasible for the 33.1% of properties that pay more than ten ERUs.

The storm water credits are not expected to influence properties to implement new onsite storm water management options that they were not planning to implement for other reasons. Discussions with other municipalities confirmed that their storm water credits have not influenced existing businesses to make changes to their properties that were not otherwise required.

The storm water credits will recognize a portion of the investments that companies make for capital costs and ongoing maintenance for onsite storm water management. These measures are important in reducing the risk of flooding for their own properties and neighbourhood properties, and in protecting the quality of water flowing to the storm water system and the Saskatchewan River.