

STORM WATER UTILITY

2019 Annual Report



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EXECUTIVE SUMMARY

The Storm Water Utility funds storm water management and flood protection services including ongoing operations and maintenance of assets with an estimated replacement value of \$2.6 billion. The Utility also monitors and stabilizes the East Riverbank to protect strategic public infrastructure. In 2019, the Storm Water Utility had revenues of \$11.3 million, with \$10.5 million for operating expenses which includes \$7.3 million transferred to Capital and Infrastructures Reserves. Approximately \$0.75 million was transferred to the Storm Water Stabilization Reserve.

In 2019 progress was made implementing the *Storm Water Utility Business Plan*, with the following highlights:

- Secured \$21.6 million in Government of Canada funding for a \$54.0 million Flood Control Strategy to increase storm water infrastructure over nine years for ten areas prone to flooding.
- Completed the *Flood Control Strategy Greenhouse Gas (GHG) Emissions Assessment* report as part of requirements for the Government of Canada Disaster Mitigation and Adaptation Fund agreement.
- Constructed a full-size multipurpose sports field at Aden Bowman Collegiate to provide more flexibility in design and construction of the dry storm pond within W.W. Ashley District Park and continued access to a high quality sports field. Advanced the design for W.W. Ashley Dry Pond as the first Flood Control Strategy project.
- Fully implemented the Storm Water Management Credit program which came into effect on January 1, 2019, for Industrial, Commercial and Institutional (ICI) properties that manage rainfall runoff onsite. The website for the program was finalized with “Frequently Asked Questions”, a fillable application form, a user friendly credit calculator, an inspection and maintenance template, and a comprehensive guidance manual.
- Completed the current profiles for all right-of-ways in the Montgomery Place neighbourhood as the basis for the Master Drainage Plan.
- Completed the Caen Street, Lancaster Boulevard, and Dundonald Avenue ditch design for future construction.
- Assessed 97 storm sewer outfalls and completed the *2019 Outfall Evaluation* report.
- Completed visual inspections of the City’s storm water retention ponds and prepared the *2019 Storm Pond System Assessment*. A total of 28 wet ponds and eight dry ponds were evaluated.
- Progressed the *State of Storm Water Infrastructure Report* based on assessments completed for culverts and storm water pipes, and with 2019 condition assessment updates for storm water ponds and outfalls.
- Delivered flyers to 29 flood risk areas that included a checklists for flood prevention, and the City’s future plan to mitigate flooding in the top ten flood risk areas of Saskatoon.

- Conducted an inventory that cataloged standpipe piezometers, vibrating wire piezometers, and slope inclinometers that are located along the East Riverbank.
- A total of 12 km of storm water sewers were flushed and the condition assessed.
- Oversaw riverbank slope stability monitoring projects, 3D slope stability modeling, and geotechnical analysis of the slope by Eastlake Avenue.

In 2019, Saskatoon experienced seven localized rainfall events with estimated return periods of “two to five years”. Rainfall on July 14, 2019, included a 1-in-25 year storm followed by a 1-in-2 year storm, caused flooding and eligible residents whose properties were damaged during this event could receive financial assistance under the Provincial Disaster Assistance Program.

1.0 OVERVIEW

1.1 Introduction

The Storm Water Utility provides storm water management and flood protection through funding the storm water system's operations and maintenance, asset preservation, capacity enhancements, and drainage inspections. The Utility also monitors and mitigates damage to strategic public infrastructure caused by riverbank slumping.

Storm water services are provided to residential and to ICI properties. In 2019, storm water charges were applied to approximately 66,000 single-family residential properties and 4,700 multi-family residential and ICI properties including City-owned properties.

Saskatoon's storm water infrastructure includes 23,078 manholes and catch basins, 964 km of linear infrastructure such as storm sewer pipes and culverts, 36 storm ponds, and other drainage infrastructure with a replacement value of approximately \$2.6 billion.

1.2 Strategic Linkages

Our Vision

The City of Saskatoon is a leader in storm water design and asset management. We effectively collaborate with citizens and partners to utilize storm water as a resource and mitigate the risk of flooding.

Our Mission

The Storm Water Utility provides safe, efficient, and cost-effective storm water management to Saskatoon citizens through teamwork and innovation. We develop proactive strategies that ensure the effective long-term performance of our storm water systems, supported by sustainable, accountable, and responsive funding structures. Storm water management charges entrusted by citizens are used as effectively as possible to minimize storm water and snow melt impacts.

Our Corporate Values

- Trust
- Integrity
- Respect
- Courage
- Safety
- People

Leadership Commitments

- Reliable and Responsible Service
- Strong Management and Fiscal Responsibility
- Effective Communication, Openness and Accountability
- Innovation and Creativity

2.0 OUR STORM WATER UTILITY TEAM

The Storm Water Utility is part of the Saskatoon Water Division in the Utilities & Environment Department. The Utility had two full-time employees and two engineering interns in 2019. The Utility also pays for services provided by the following divisions:

Saskatoon Water's Engineering & Planning section is responsible for overseeing the Storm Water Utility and providing storm water engineering expertise. Saskatoon Water provides the following storm water management services:

- Flood Control Strategy
- Rainfall monitoring
- Assessing runoff factors of multi-residential and ICI properties for billing purposes
- Engineering support for drainage projects
- Community liaison for storm water issues
- Modelling storm system capacity relative to varying levels of rainfall volume and intensity
- Planning and design of storm water infrastructure for new land development

Water & Waste Operations (WWO) provides the ongoing day-to-day operations and maintenance of storm water ponds, outfalls, and below ground storm water drainage infrastructure.

Roadways, Fleet, & Support (RFS) maintains above ground drainage, including culverts, and completes a fall street sweep.

Technical Services (previously Major Projects & Preservation) tracks the inventory, completes condition assessment, and oversees asset preservation for storm sewer infrastructure.

Construction & Design operates the "Connection Desk" and provides project management services, including survey work and inspection, for storm water infrastructure construction projects.

Community Standards provides drainage inspections, drainage advice to residents and developers, [Drainage Bylaw](#) updates, and *Drainage Bylaw* enforcement.

Sustainability (previously Environmental & Corporate Initiatives) provides leadership in activities that contribute to storm water practices that protect our watershed and natural resources.

Communications & Public Engagement assists in initiatives to enhance citizen awareness and engagement to improve flood resiliency.

Corporate Revenue provides storm water billing and collection services.

Finance (previously Transportation & Utilities Business Administration) provides accounting and administrative support.

3.0 OUR INFRASTRUCTURE

Table 1 to the right summarizes the City's storm water infrastructure with a replacement value of \$2.6 billion.

The Storm Water Utility's **minor system** consists of piping, manholes, catch basins, and outfall structures that are able to convey runoff from more frequent, lower intensity storm events (up to a "1-in-2-year" storm). The system includes 964 km of linear infrastructure such as storm sewer pipes and culverts, 9,422 manholes, 13,656 catch basins, 2,934 service connections, 114 outfalls, and minor ditches.

The **major system** consists of overland street drainage, eight dry ponds, 28 wet ponds (including three natural ponds and two constructed wetlands), major ditches, swales, and any other land that is required to convey runoff from less frequent, higher intensity storms that produce runoff in excess of what the minor system typically handles.

Table 1: Storm Water Inventory

Asset	Type	2019 Inventory	
Sewer Mains	Collectors	675	km
	Trunks	71	km
Manholes	Collectors	8,929	ea.
	Trunks	493	ea.
Force mains		4	km
Service Connections		2,934	ea.
Catch Basins	Collectors	13,163	ea.
	Trunks	493	ea.
Leads	Collectors	151	km
	Trunks	7	km
Dry Ponds		8	ea.
Wet Ponds		28	ea.
Culverts		12	km
Outfalls		114	ea.
Sub-drainage		44	km
Oil & Grit Separators		1	ea.
Lift Stations		2	ea.
Replacement value		\$ 2.6	B



John Avant Storm Water Pond in Erindale

4.0 OUR RESULTS

4.1 Surface Flooding

Annual Rainfall

Seven rainfall gauges were regularly monitored between April 1, 2019, and September 30, 2019, with a summary of Saskatoon's 2019 rainfall season provided in the [2019 Annual Rainfall Report](#). Overall, Saskatoon had an average rainfall year with 258 mm of rainfall accumulating compared to the 264 mm historical average and 569 mm record high in 2010. A summary of the rainfall events in 2019 for Saskatoon can be found below in Table 2.

Seven rainfall events with an estimated return period of two years or greater were recorded at City rain gauges in 2019. The highest return rain event (1-in-25-year) was recorded at the Acadia rain gauge early in the morning on July 14 and a second rain event was recorded in the evening on the same day. Eligible residents who experienced flood damage on July 14 were able to receive financial assistance under the Provincial Disaster Assistance Program. Idylwyld Drive closed on July 19 due to flooding.



July 14, Early Drive, Saskatoon

Table 2: Rain Events in 2019

Date	Rain Event Statistics	Acadia	Attridge	City Hall	Light and Power	Shaw Centre	Wastewater Treatment Plant	Woodlawn
June 21-22, 2019	Accumulation (mm)	51	35	38	43	35	39	38
	Duration (minutes)	1395	1380	1385	1390	1120	1360	1365
	Return Period (yr.)	2	< 2	2	2	< 2	2	2
July 8, 2019	Accumulation (mm)	3.8	0.6	2.8	9.8	0	9.6	0.2
	Duration (minutes)	25	10	10	25	0	20	5
	Return Period (yr.)	< 2	< 2	< 2	< 2	< 2	2	< 2
July 14, 2019	Accumulation (mm)	32	15	23	16	14	10	15
	Duration (minutes)	32	45	30	40	50	55	55
	Return Period (yr.)	25	2	5	2	2	< 2	2
July 14, 2019	Accumulation (mm)	18	7	11	18	5	2	7
	Duration (minutes)	100	95	95	95	95	95	90
	Return Period (yr.)	2	< 2	< 2	5	< 2	< 2	< 2
July 19, 2019	Accumulation (mm)	21	20	12	13	7	20	28
	Duration (minutes)	320	300	290	315	200	305	290
	Return Period (yr.)	< 2	< 2	< 2	< 2	< 2	2	5
July 24, 2019	Accumulation (mm)	1	8	16	1	10	19	14
	Duration (minutes)	10	15	20	15	10	20	15
	Return Period (yr.)	< 2	< 2	2	< 2	2	5	2
August 25, 2019	Accumulation (mm)	10	14	8	19	3	9	4
	Duration (minutes)	35	40	50	30	55	45	60
	Return Period (yr.)	< 2	2	< 2	5	< 2	< 2	< 2

Flood Control Strategy

In January 2019, a comprehensive Flood Control Strategy for \$54 million was submitted to the Government of Canada's Disaster Mitigation and Adaptation Fund funding agreement for the Flood Control Strategy. The Disaster Mitigation and Adaptation Fund agreement was approved pending the Indigenous Group consultation and GHG Emissions Assessment Report. Saskatoon Water completed consultations with Indigenous Groups and initiated the GHG assessment report. The GHG Emissions report was audited as a requirement of ISO 14064-2 in December 2019, and is expected to be finalized and submitted to the Government of Canada in early 2020.

The majority of work completed in 2019 for the Flood Control Strategy included progressing the W.W. Ashley Dry Storm Water Pond design. A public engagement event was held at J.S. Wood Library in July 2019. A second public engagement event will be held in the neighbourhood once the design is finalized and construction is scheduled.



W.W. Ashley District Park Preliminary Design

In early 2019, the City completed an agreement with Saskatoon Public Schools Board to construct a full size multi-purpose sports field at Aden Bowman Collegiate, as an alternative to constructing a full-size field within the dry storm pond at W.W. Ashley District Park. This approach is expected to provide cost savings, new green space available for community use, less disruption for sports field users during construction, and improved parking. The new Aden Bowman Sports Field was designed and constructed in 2019 with

minor construction detailing scheduled to be completed in early 2020. The field is expected to be program ready by fall 2020.



Aden Bowman Collegiate Sports Field Drawing

*There will always be a chance of
basement flooding, no matter what
municipalities or private
homeowners do to reduce the risk.*

Institute for Catastrophic Loss Reduction

Home Flood Protection Program

In 2018, the Storm Water Utility partnered with the Intact Centre for Climate Adaptation at the University of Waterloo and SGI CANADA to pilot the Home Flood Protection Program. The program offered free online resources with best practices to make homes more flood resilient, with 633 unique website visits. The second component of the program was Home Flood Protection Assessments. Trained inspectors provided 113 Saskatoon homeowners with a confidential 45 point visual inspection of features inside and outside the home, a 35 point maintenance review, and a customized written report covering their top opportunities to reduce flood risk.



Home Flood Protection Program Signage

In 2019, the evaluation of the program was completed. Most feedback about the pilot program was positive. Some citizens stated they had completed all flood protection measures provided by the third party inspection. Based on their research, Intact Centre for Climate Adaptation prepared a handout, “Three Steps to Cost-Effective Basement Flood Protection” (See Appendix Two.)

4.2 Maintenance and Operations

Citizen Inquiries

In 2019, the Customer Care Centre responded to approximately 900 inquiries from citizens in regards to culvert, drainage, storm sewer, and storm water flooding issues. The Storm Water Utility group responded to an additional 61 citizen inquiries.

Roadways, Fleet, & Support Fall Sweep

Similar to 2018, the 2019 fall Street Sweep program utilized a tree density and flood risk approach rather than the neighbourhood boundaries approach. A total of 127 km of streets were swept, with 2,030 t of debris collected. From 2018 to 2019, sweeping efficiency went up from 14 to 19 tonnes per linear kilometer swept. By designing the program based on higher tree density, increased debris captured during the sweep provides better flood risk reduction per kilometer swept.

Water & Waste Operations Maintenance

WWO operates and maintains below-ground storm water infrastructure, including sewer mains, manholes, and connections. Table 3 below summarizes WWO's 2019 storm water related maintenance activities, including flushing and televising storm water sewers, and cleaning and inspecting infrastructure.

WWO also manages the spring melt in Montgomery Place by removing snow accumulating in ditches in late winter and thawing frozen culverts and catch basins at high-risk locations once melting conditions (temperatures) commence.

Table 3: WWO's Storm Water Infrastructure

Activity	2018	2019	Units
Flushing Storm Sewers	21,661	8,905	Meters
Storm Sewer Meters	6,611	1,861	Meters
# of Passes	133	116	Each
Televis Storm Sewers	21,661	20,157	Meters
Catch Basin Leads	281	138	Each
Inspect Storm Manholes	1,273	582	Each
Inspect CBs	749	301	Each
Outfalls	66	400	Each
Storm Ponds	62	69	Each
Clean CBs	13,357	25,380	Each
Repair Storm Manholes	156	116	Each
Repair CBs	181	117	Each
Grout MHs/CBs	10	1	Each

Table Definitions

- "Storm Sewer Meters" refers to the storm segment meters flushed.
- "Flushing Storm Sewers" includes multiple passes by the flusher hose in the same segment.
- "Catch Basin Leads" is the number of leads flushed or cleaned.
- "Outfalls" is the number of total times outfalls inspected and/or cleaned.
- "Storm Ponds" is the number of trips made to maintain storm ponds.

A total of 291 storm sewers, manholes, and catch basins were repaired or replaced in 2019, a 35% decrease relative to 2018. Figure 1 below displays the 2019 WWO repairs and replacements of storm water infrastructure compared to the previous five years.

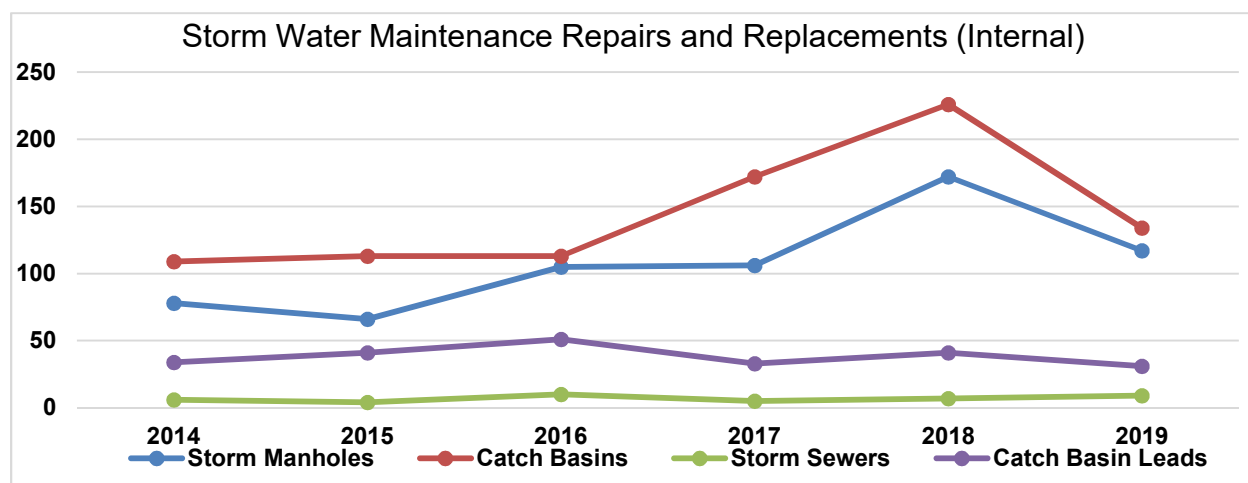


Figure 1: Storm Water Maintenance Comparison for Five Years

4.3 Storm Water Asset Management

External Storm Sewer Inspection, Cleaning, and Lining

In 2019, the Storm Water Utility funded the cleaning and inspection of approximately 12 km of storm sewers. Over 145 km of storm pipes in total have been inspected to date (19% of total system), and 97 km of these have been rated (13% of total system).

The inspected storm sewers were rated using a three-point scale:

- A: No structural problem evident
- C: Sewer main showing deterioration
- F: Physical condition has failed



Storm Sewer Inspection

The rating for 145 km of inspected sewer mains can be viewed in Figure 2 below:

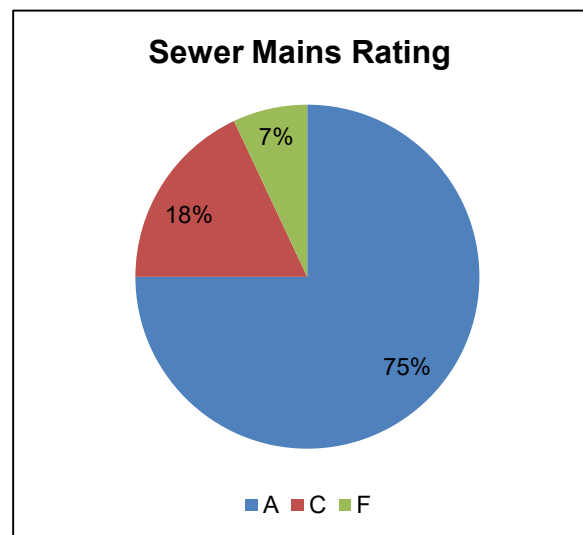


Figure 2: Storm Sewer Main Rating

Outfalls

Saskatoon Water identified 17 outfall maintenance items in the *2019 Outfall Assessment Report* that were to be completed. In 2019, the outfalls identified as having sediment and overgrowth issues generally have been resolved by WWO. All high priority maintenance items were completed.



Storm Water Outfall

Drainage Projects

- **Melville Street (Stonebridge):** In 2018, the Utility assessed design options for improving drainage near Melville Street/Portage Avenue. In 2019, four options were reviewed in detail and a preferred option determined. The preferred option of extending the existing storm pipe under the CN rail tracks and discharging into the Cartwright Storm Pond progressed during 2019. However due to the complexity of access, boring under the CN tracks and requirement for an easement agreement for the existing storm pipe, the design process has taken longer than expected.

The final design is expected to be completed in 2020 with construction for improved drainage to be completed in coordination with roadway reconstruction projects in 2021.

- **Lashyn Cove (Arbour Creek):** Flooding has occurred several times at the drainage low point within Lashyn Cove causing significant basement flooding damage. In 2019, Saskatoon Water designed a concrete-grass combination swale to improve surface drainage. The concrete-grass combination was constructed in 2019 and the detailed landscaping will be completed in late spring or early summer of 2020.



Lashyn Cove Swale Construction - 2019

- **Montgomery Place Culverts and Ditch Drainage:** Frozen culverts and other drainage issues resulted in ponding during spring snow melt. In 2019, 26 work requests were made to the Customer Care Centre in regards to culverts and drainage in Montgomery Place, which was down from 52 in 2018.



Montgomery Place Spring Melt

Saskatoon Water initiated the design of ditch reconstruction and shallow storm sewer installation in Montgomery with the intent for construction in 2020. The project area for proposed 2020 work includes the following:

- Caen Street from Dundonald Avenue to Currie Avenue
- Lancaster Boulevard from Caen Street to Dieppe Street
- Dundonald Avenue from Caen Street to Dieppe Street

A cost savings strategy to include water main replacement, lead-line and fiber connection replacement, and road reconstruction with the ditch reconstruction and shallow storm sewer installation is planned to be completed as a single large-scale project.

4.4 Bylaws and Enforcement

The Storm Water Utility funds a dedicated drainage inspector position and partially funds three other positions in the Community Standards Bylaw Compliance Section. The drainage inspector helps citizens and developers ensure compliance to Saskatoon's [Drainage Bylaw](#) through a model of education and enforcement. In 2019, Community Standard's Bylaw Enforcement Network software tracked 117 property drainage-related complaints, down from 143 in 2018. Table 4 displays the number of drainage related complaints in 2019 compared to 2018.

Table 4: Drainage Related Complaints

Complaint Type	2018	2019
Lot Grading Concerns	15	24
Sump Pump Discharge	14	23
Drainage Advice and Education	60	19
Lot Grading Plan Requests and Questions	6	12
Rear Property Line Drainage	-	9
Eaves Trough and Downspouts	10	9
ROW Closure Approvals	5	6
Side Yard Drainage Concerns	-	3
Garden/Garage Suite Plan Approvals	-	3
Commercial Property Development	8	3
Retaining Wall Concerns	3	2
Ground Water Issues	-	2
Infill Development	15	1
Condo Development	5	-
Detached Garage Flooding	2	-
Garage Pad Elevations	-	1



Driveway Crossing

The Storm Water Utility provided funding for a capital project led by Community Standards to improve Drainage Bylaw compliance. Completed and in-progress initiatives under this project are described below.

4.4.1 Drainage Regulation Completed Initiatives

- **Lot Grading Database/Landing Page:** The City's GIS group launched the lot grading web page which provides citizens with easy on-line access to their lot grading plans. This database is accessible from the Saskatoon.ca lot grading landing page: <https://www.saskatoon.ca/business-development/development-regulation/lot-drainage>. Information will continue to be added to the page as it is developed.
- **POSSE Caveat System:** A process has been developed using the warning features in Posse to consistently align lot grading types with proposed house types. POSSE is a powerful workflow engine that automates, integrates, monitors, and enforces business process rules. Building Permit Applications featuring walk-out basement style homes will only be approved on walk-out lots identified in POSSE as being suitable. A new process ensures that new walk-out lots are added as future neighbourhood servicing progresses.
- **Drainage Regulation and Compliance Open House:** An engagement session hosted several stakeholders, including builders, developers, and architectural firms. The feedback was considered in the development of the Drainage

Homeowner's Manual and will continue to influence the development of the Phase 2 initiatives.

4.4.2 Current Initiatives

- **Lot Grading/Drainage Homeowner's Manual:** The initial draft of the manual has been completed with images showing appropriate lot grading methods. This manual provides a comprehensive set of guidelines in "plain-language" aimed at ensuring that an appropriate lot grade process is followed. The manual is expected to be posted on Saskatoon.ca in early 2020.
- **Rear Property Line Elevation Control:** A new residential lot grading audit of rear property line elevations was completed using GPS survey equipment. The audit focused on "D style lots" in five new subdivisions around the city with limited housing development to evaluate properties at the 'rough graded stage'. Compliance was determined using a tolerance of ± 25 mm from the desired grade (100 mm below the design grade). The audit determined the grading compliance to be 22% overall. The audit also showed a significant number of properties exceeded ± 150 mm from the desired grade. These results are indicative of future drainage problems. The audit emphasizes the need for rear property line elevation control by means of concrete swales or inspection.
- **Commercial/Multi-Family Lot Grading Inspection:** A visual site grading audit was completed on 33 commercial and 22 multi-family properties that were developed within the past ten years, and focused on properties in the Marquis Industrial neighbourhood while the multi-family audit evaluated properties from a variety of newer developments across the city. The properties were audited for compliance with approved site grading plans. This audit determined site grading compliance to be 51% and 68% respectively. The audit emphasizes the importance of developing an inspection process to ensure compliance to approved site grading plans. Development of this process will continue in 2020.
- **Infill Development Grading:** This initiative will include the development of a process to approve infill lot grading plans during the Building Permit Application process. It will also include the development of an inspection process to ensure compliance with the approved plan according to the Neighbourhood Level Infill Development Strategy.
- **Park Development Guidelines:** Preliminary discussions have been initiated regarding the incorporation of infrastructure to accommodate drainage from lots adjacent to parks. This may involve additions to the Park Development Guidelines or revisions to the Standard Construction Specifications.
- **Garage Pad Elevations:** Preliminary discussions have been initiated regarding methods to regulate the elevations of both attached and detached garage pads. This may include additions to the New Neighbourhood Design and Development Standards Manual and/or the specification of garage pad elevations on lot grading plans.

4.5 Riverbank Slope Stability

The Storm Water Utility funds riverbank slope stability monitoring due to the impact of snow melt and rainfall on groundwater levels and erosion. The City's goal is to manage the east riverbank slope stability more proactively for increased efficiency and lower long-term costs.

Slope Monitoring

Saskatoon Water staff visually monitored east riverbank sites near 16th Street and 11th Street, with monitoring being more frequent when risk of slope movement was higher. Storm Water personnel have also completed piezometer readings of groundwater levels.

Contracts awarded in 2017 for the following work were continued and completed in 2019:

- **East Riverbank Spring Reconnaissance:** The final year of a three-year contract was completed with Golder Associates for slope inclinometer readings, a visual review, risk rating, and recommended actions for 22 east riverbank sites. Saskatoon Water summarized results and met with WWO and RFS to plan next steps for the recommended actions.
- **Nutana Slope Instrumentation Monitoring:** An optional third year extension of a two-year contract was completed with Golder Associates to survey and report on various instrumentation readings between 11th Street and Saskatchewan Crescent. Two monitoring reports were completed, and results were provided to area residents. No significant slope movement was observed.



Nutana Slope Area

Instrumentation Monitoring

In 2019, Saskatoon Water conducted its first inventory of standpipe piezometers, vibrating wire piezometers, and slope inclinometers that are located along the East Riverbank. These instruments are planned to be monitored in future years. There were 44 open standpipe piezometers, two vibrating wire piezometers, and seven slope inclinometers.

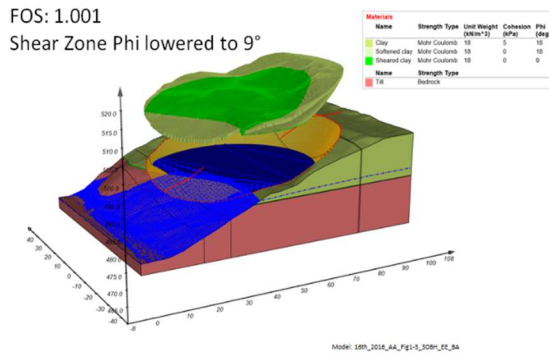
Saskatoon Water created a *Piezometer Inspection Report* in 2019 that contains the location and details on all inspected instruments.



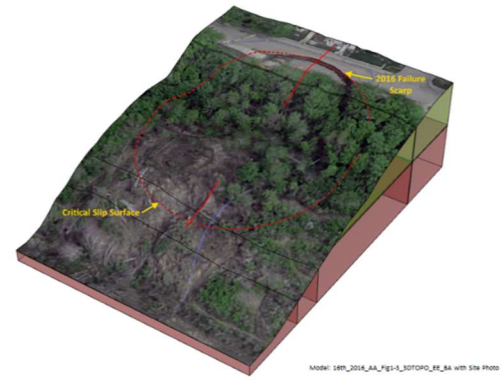
Piezometer Used to Measure Groundwater

Saskatoon Riverbank Stability Modeling

The 3D model, created in 2018, continued to be updated with new and revised information in 2019 and was utilized to review ground and ground water conditions and their impacts on slope stability along the east riverbank.



Riverbank Stability 3D Modelling



Riverbank Slope Instability Aerial View

Riverbank Development Regulations

During 2018 and 2019 members of the Storm Water Team worked closely with the Building Standards and Planning & Development Divisions to develop the Riverbank Development Regulations. In December 2019, City Council approved the bylaw amendment which included the Riverbank Slope Overlay District which applies appropriate development standards and regulations to avoid or minimize potential impacts of slope instability and subsidence on development, and to prevent injury and minimize property damage related to publicly and privately-owned properties adjacent to the South Saskatchewan River.

Meewasin Trail Extensions

Meewasin has two projects to extend the existing trail north from the Circle Drive North Bridge on the east side of the river to connect with Chief Mistawasis Bridge and to extend the trail on the west bank from the Saskatoon Sanatorium site to the Circle Drive South Bridge. Geotechnical and design representatives from the Storm Water Team provided advice to ensure that should the projects progress, they fit with the City's existing infrastructure.

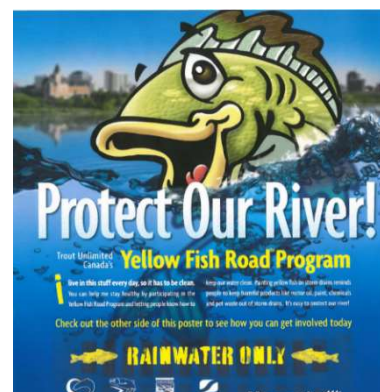
4.6 Community Awareness and Engagement

Home Flood Protection Program: Flyers delivered to 29 flood zones in Saskatoon included a checklist for flood prevention and a summary of the City's future plan to mitigate flooding in the top ten flood prone areas of Saskatoon.

Montgomery Place Drainage: Flyers were delivered to Montgomery Place residents to increase awareness on what to expect from the City for drainage maintenance, actions for citizens to maintain drainage, and drainage requirements for driveway crossings.

Nutana Slope: Two flyers were distributed to residents near the Nutana Slope to inform them of instrumentation monitoring results. A "Notice to Residents" was also delivered to provide information on what to expect from the City and what citizens can do to reduce risk from slumping.

Yellow Fish Road™ Program: The Storm Water Utility, in collaboration with Sustainability and WWO, supported the Partners for the Saskatchewan River Basin and Meewasin in delivering the “Yellow Fish Road™ Program” to make students and citizens aware that water goes through the storm water system untreated to the Saskatchewan River. In 2019, 12 schools/groups and 407 students and teachers participated in Yellow Fish Road™. Yellow fish were painted on 504 storm drains in 11 neighbourhoods, and 1,266 door hangers were distributed.



Yellow Fish Road™ Program Flyer

In 2019, the City expanded the partnership with Partners for the Saskatchewan River Basin to develop educational materials about the sanitary sewer system, under the title Prevent Irritable Sewer Syndrome, for future distribution to students and teachers in conjunction with the Yellow Fish Road™ program.

Storm Water Charges: Bill inserts were prepared to provide information to ICI property owners about the storm water management charges including information about changes to rates from 2019 to 2022 and the Storm Water Management Credit Program.



Students Painted Storm Drains around River Heights

Saskatoon.ca Website Updates: Changes were made to Saskatoon.ca to update citizens about the Storm Water Management Credit Program.

4.7 Storm Water Ponds

Wet and dry storm ponds in Saskatoon were inspected in 2019 and the *2019 Storm Pond System Assessment* was completed. A total of 23 ponds were found to be in good condition, and 13 in fair condition. Common issues found were erosion and cattail overgrowth.

Storm Water Ponds and Recreational Use: The Utility collaborated with Community Development and other divisions to review policies for recreational use of storm water ponds, and the design for new welcome signs. Existing pond welcome signs were replaced and new signs were installed in ponds without signs. Warning Signs were reviewed in 2018, and new ones were put up in 2019.



Blairmore SC Wet Pond

4.8 Storm Water and the Environment

Storm Water Quality Monitoring

Saskatoon Water monitors 12 major outfalls for storm water quality. These outfalls are sampled and tested for total coliforms and E.coli every alternate week.

In 2019, the Storm Water Utility continued its partnership with the University of Saskatchewan (U of S) for storm water quality testing and analysis that had been established with a Natural Sciences and Engineering Research Council of Canada grant. The City followed up with additional detailed testing in response to the U of S report, and a remediation plan with a funding strategy was developed to address the water quality issue identified.

A monitoring program also tracks immediate and long-term changes in water quality and quantity for the Northeast Swale. A monitor measures basic water quality parameters and monthly water samples provide for more detailed analysis. Annual reporting includes trend analysis of samples, and comparisons to guidelines and historical data.



Northeast Swale Monitoring

Green Infrastructure Strategy

The Storm Water Utility participated in the Green Infrastructure Strategy with Sustainability, Planning and Development, other divisions, and Meewasin, and contributed \$120,000 towards its development in 2019. Green storm water infrastructure, such as swales and storm water ponds, are an important part of the green network. Green storm water infrastructure will be incorporated in future neighbourhood planning to contribute to the green network and to improve storm water quality entering the South Saskatchewan River. The strategy will also help to reposition storm water as an important resource.



Swale in Aspen Ridge

Climate Change

In 2019, work progressed on the two-year project with the University of Saskatchewan and Concordia University to update Saskatoon's rainfall Intensity, Duration, Frequency curves to take into account rainfall over the last 30 years, and the risks associated with climate change for use in developing future storm water infrastructure standards for new neighbourhoods. In 2019, analysis was completed on risks of intense rain events, and the cost of different standards for varying rainfall risk levels. The project will be completed in 2020.

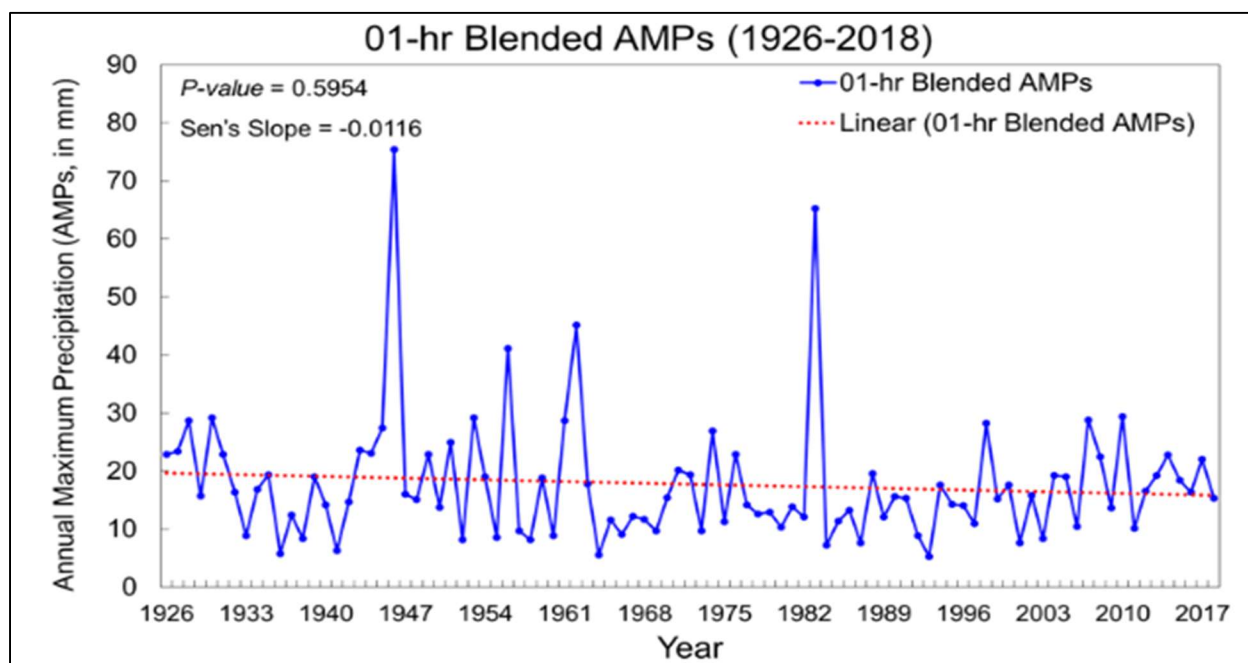


Figure 3: Annual Maximum Precipitation by Year

The Storm Water Utility and the Sustainability Division participated in Public Sector Digests' municipal case studies and webinar about the use of data to prepare for climate change. The U of S also presented results at a national conference.

Understanding flood risks, flood damage and the cost of infrastructure for different risk levels will provide for more informed decisions about optimal resource allocation for new storm water management infrastructure.

Floating Treatment Wetland Pilot Project

The Storm Water Utility collaborated with the Sustainability Division, the South Saskatchewan River Watershed Stewards, and Meewasin on a Floating Treatment Wetland Pilot Project for the Evergreen Storm Water Pond. The project will test the platform design, the robustness of various native plant species, and the soil used for plant growth. Signage was developed to inform people about how the wetland benefits storm water quality. The project is expected to attract students on educational field trips. A grant approved from RBC Royal Bank will help expand the project with additional wetland islands and a monitoring program starting in 2020.



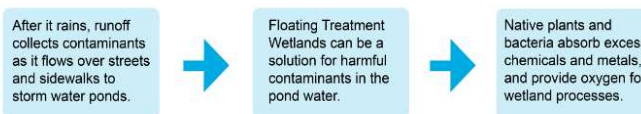
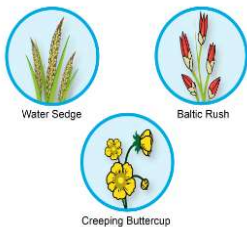
Educational Field Trip about Floating Wetland

Floating Treatment Wetland

Welcome to Saskatoon's first floating wetland designed to naturally filter pollutants and improve storm water pond quality.

Floating Treatment Wetlands create a terrestrial habitat in aquatic environments and imitate how natural wetlands purify water. Native aquatic plant roots below the water line provide habitat for microscopic bacteria that do the work of cleansing the water.

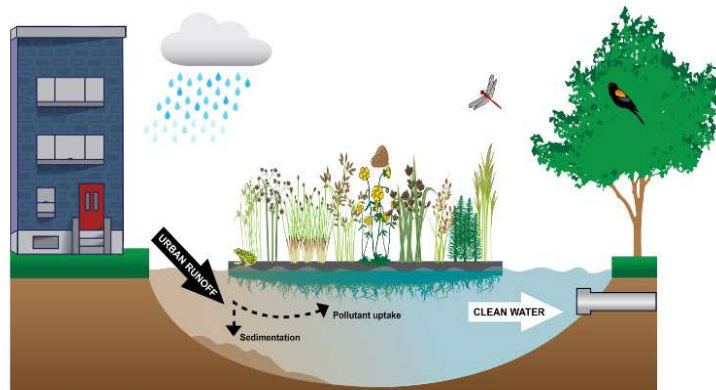
These Floating Treatment Wetlands were planted with locally sourced native aquatic plant species including sedges, rushes, and aquatic flowering plants.



Floating Treatment Wetlands can improve the quality of water entering the South Saskatchewan River.

Did you know?

Most runoff flows through the City's storm water system of catch basins and pipes directly into our river.



Please enjoy nature watching from a safe distance and do your best to not disturb the animals.

Floating Wetland Signage

South Saskatchewan River Watershed Stewards

City of Saskatoon
Meewasin

4.9 Utility Billing

Equivalent Runoff Unit Assessment Updates

In 2019, the Storm Water Utility finished a reassessment of all ICI and multi-residential storm utility properties. Approximately 800 of the 7,000 total ICI and multi-residential properties reviewed experienced a change to their utility bill. The cumulative increase of 2,382 new Equivalent Runoff Units (ERU) which will result in an increase of over \$600,000 in revenue for the Storm Water Utility from 2019 to 2022.

Storm Water Management Credit Program

The [Storm Water Management Credit Program](#) took effect January 1, 2019, providing the opportunity for a reduction in Storm Water Management Charges for ICI and multi-residential property owners who have implemented onsite storm water management measures. Properties are eligible for a credit in the three categories up to a maximum total combined credit of 50%. The details of the three categories are provided in Table 5 below.

Table 5: Storm Water Management Credit Categories

Category	Evaluation Criteria	Total Credit (50% Maximum)
Water Quality Improvements	Based on the percentage of storm water directed through a quality control infrastructure that meets the minimum standard of 80% total suspended solids (TSS) removal for particles sizes 50 micron or larger.	Up to 20%
Peak Flow Reduction	Based on the proportion of storm water for a standard 1-in-2 year rain event held onsite and released slowly to the City's storm water system. The credit is equal to 0.4 multiplied by the peak flow reduction percentage up to 75%.	Up to 30%
Onsite Retention (Runoff Volume Reduction)	Based on 2% per millimeter of storm water up to 25 mm that is retained onsite and not released to the City's storm water system.	Up to 50%

The Storm Water Utility worked with an advisory committee of developers and business leaders to finalize the website with Frequently Asked Questions, a fillable application form, a user friendly credit calculation calculator, an inspection and maintenance template, and a comprehensive guidance manual. Information about the credit was sent with all 2019 ICI Storm Water Utility bills. Two property owners applied for and were approved for credits in 2019.

4.10 Continuous Improvement Highlights

The Storm Water Utility has undertaken Continuous Improvement to increase service levels, improve efficiencies, and reduce costs in 2019:

- In 2019, the Government of Canada approved \$21.6 million towards \$54.0 million in eligible costs between 2019 and 2028 for nine projects that will reduce flood damage for over 300 properties. Most of the projects will incorporate new dry ponds in parks in older areas where run-off from intense storms has nowhere else to go. The project will help the City adapt to the risk of more intense storms associated with climate change.
- Parks, Recreation and Community Development, and the Storm Water Utility partnered with the Saskatoon School Board to construct a multi-purpose sport field at Aden Bowman Collegiate for use by the community as well as students. Soccer teams and other sport field users will have continued access to a high quality sport field when a new dry pond is constructed in W.W. Ashley District Park to reduce the risk of neighbourhood flooding.
- Cost-effective research was leveraged through a new partnership with the U of S to research the water quality of storm water run-off in outfalls. The research results will be used to remediate a source of potential contamination.
- The audit and update to individual ERU assessments will result in an increase of more than \$600,000 in revenue for the Storm Water Utility from 2019 to 2022.

5.0 OUR FINANCES

The Storm Water Utility is funded on a user-pay principal with charges reasonably proportional to storm water runoff generated according to property size and surface imperviousness (green space is charged less than buildings and pavement). A single family residential dwelling is deemed to produce one ERU of storm water which forms the unit for charging other property types. The Storm Water Management Charge for single residential properties in 2019 was \$5.53 per month (\$66.30 annually).

Commercial properties can generate significantly more storm water than residential properties; therefore they are charged multiple ERUs from a minimum of two annual ERUs (\$132.60) to a maximum of 100 ERUs (\$6,630) in 2019.

After intense rain events caused sewer backups in 2005, a temporary Flood Protection Program (FPP) was established with a \$36.00 annual (\$3.00 monthly) charge on all water meters. The charge was increased to \$54.00 annually (\$4.50 monthly) in 2009. In 2018, City Council approved an increase to the ERU rate of \$13.50 per year from 2019 to 2022, and the phase out of the temporary FPP charge by \$13.50 per year, ending December 31, 2021. Figure 4 below displays the ERU and FPP rates for single family residential properties from 2018 to 2022, with the total charges not changing.

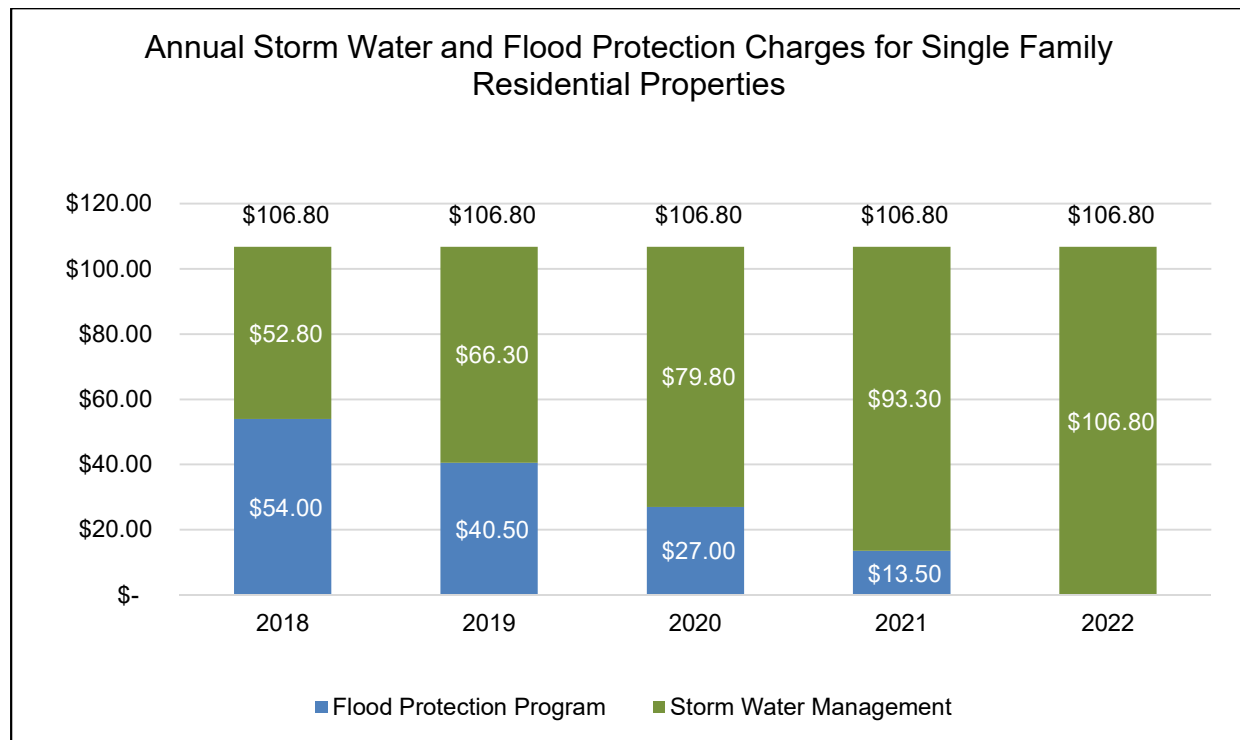


Figure 4: Annual Storm Water and Flood Protection Charges by Year

5.1 Revenues

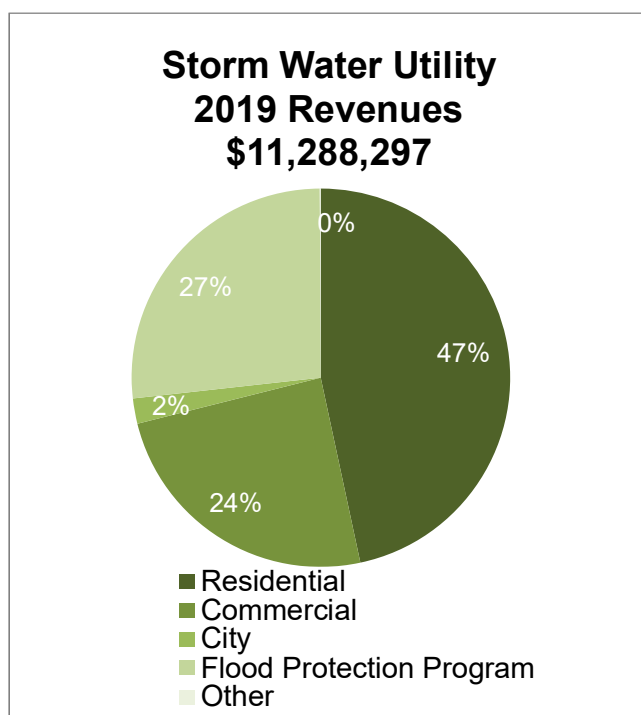


Figure 5: 2019 Revenues by Category

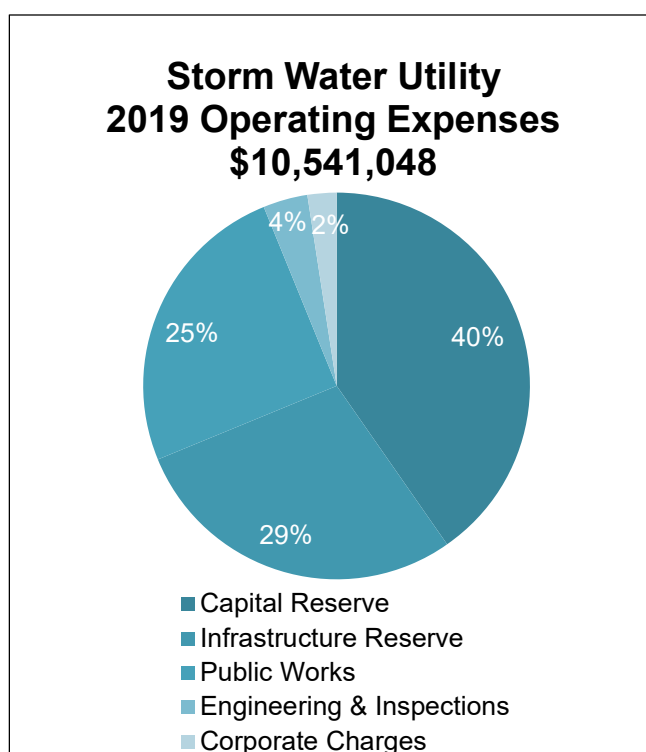
because of reassessments completed and properties previously annexed to the City of Saskatoon.

In 2019, total Storm Water Utility revenues including the temporary FPP were \$11.3 million, an increase of 7.3% from 2018. Storm Water Management revenues of \$8.3 million based on ERUs included \$2.8 million from ICI properties (33% of revenues and 5% of customers), and \$5.3 million from residential properties (64% of revenues and 95% of customers). Revenue from City-owned properties was \$244,000. Figure 5 displays the revenues in percentage by category.

The 2019 revenue from the temporary FPP of \$3.0 million was directed to the Infrastructure Reserve for the Flood Control Strategy.

Variances: Actual total Storm Water Utility revenues were \$140,900 (1.3%) higher than budgeted in 2019, partly

5.2 Operating Expenditures



The Storm Water Utility's 2019 operating expenditures were \$3.3 million, and \$7.3 million was allocated to Capital and Infrastructure reserves. The operating surplus of \$0.7 million was allocated to the Stabilization Reserve.

WWO and RFS expended \$2.6 million to operate and maintain the storm water system including handling citizen drainage calls, keeping storm drains clear, replacing and repairing the infrastructure, and sweeping streets in the fall.

Administration costs (corporate charges) of \$0.26 million included billing services by the Revenue Division, financial and administration services from Finance, and insurance.

Engineering and inspections, including overall utility management, accounted for \$0.39 million. Figure 6 displays the operating expenses in percentage by category.

Variances: Operating expenditures in 2019 were \$606,000 (5.4%) lower than budgeted because of staff vacancies and rain events were less widespread than average years.

Table 6 displays the actual 2019 Operating Revenues and Expenditures compared to the 2019 budgeted and 2018 actual amounts.

Table 6: 2019 Storm Water Operating Revenues and Expenditures

Storm Water Utility Operating Revenues and Expenditures			
	2019 Actual	2019 Budget	2018 Actual
Revenues			
Storm Water Charges	\$ 8,268,880	\$ 8,109,900	\$ 6,533,554
Flood Protection Program (FPP)	\$ 3,008,341	\$ 3,025,527	\$ 3,974,419
Late Charges	11,077	12,000	12,032
Total Revenues	\$ 11,288,299	\$ 11,147,427	\$ 10,520,005
Expenses			
Engineering & Inspections Operations	\$ 390,896	\$ 564,500	\$ 313,022
Maintenance (Public Works)	1,890,492	2,069,800	2,305,701
Drainage (Public Works)	755,411	990,900	692,750
Customer Billing (Revenue Branch)	117,569	127,900	123,481
Corporate Services (Business Administration)	52,840	51,800	51,800
Licenses & Insurance	87,300	87,300	68,100
Interest Expense/(Revenue)	(14,700)	(23,200)	(23,400)
Provision to Capital Reserve	4,252,900	4,252,900	2,727,800
Provision to Infrastructure Reserve	3,008,341	3,025,527	3,974,420
Total Operating Expenses	\$ 10,541,048	\$ 11,147,427	\$ 10,233,674
Revenue Less Expenses	\$ 747,250	\$ -	\$ 286,331

Note: The FPP charges prior to 2019 went to the Infrastructure Reserve to repay the accumulated debt for the super pipes which had been installed to reduce the risk of sanitary sewer backups during intense rain events. The 2018 statements have been restated to include the FPP revenues for transparency. These revenues did not previously flow through the Storm Water Utility.

5.3 Storm Water Stabilization Reserve

The Storm Water Stabilization Reserve has been established to provide for normal fluctuations in storm water expenses as a result of differences in weather conditions that impact requirements for storm water maintenance services. The balance ensures that funding is available in the event of a widespread severe rain event. The \$2.8 million balance at the end of 2019 was \$747,000 more than in 2018 due to the 2019 operating surplus. The difference can be seen in Table 7 below.

Table 7: 2019 Change in Stabilization Reserves

Change in Storm Water Stabilization Reserve (\$1000s)			
Stabilization Reserve Beginning of Year	\$ 2,056	\$ 1,753	\$ 1,460
Balance From Year	\$ 747	\$ 303	\$ 293
Storm Stabilization Reserve End of Year	\$ 2,803	\$ 2,056	\$ 1,753

5.4 Capital Funding

In 2019, capital reserve funding was \$3.0 million. In addition to revenue allocated from the Storm Water Operations, \$41,750 of an approved grant of \$105,000 was received from the Government of Canada's National Disaster Mitigation Program to update the City's Intensity, Duration, Frequency curves and identify potential implications of climate change for the City's storm water infrastructure.

5.5 Capital Expenditures

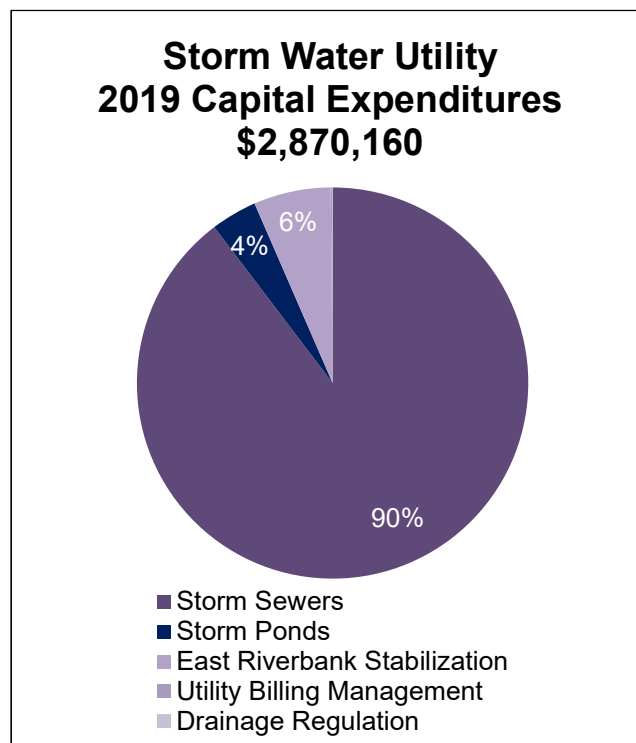


Figure 7: 2019 Capital Expenditures by Category

In 2019, Storm Water Utility capital expenditures were approximately \$2.9 million. Approximately 90% of capital expenditures was for storm sewer network management, asset preservation, and capacity building (\$2.6 million), primarily the Aden Bowman Collegiate sports field and drainage projects.

East Riverbank Stabilization expenditures of \$182,700 primarily included the in-house geotechnical engineer salary, the 3D slope stability modelling, geotechnical investigation at Eastlake, and other riverbank monitoring costs.

Storm pond preservation expenditures were \$109,600, and included inspections and reporting, ice testing/ Ground Penetrating Radar (GPR) testing and updated pond signage.

Utility billing expenditures of \$3,500 included the review and update of ICI properties' storm water management charges. This capital project was closed in 2019, and in the future, similar expenses will be part of the Operating Budget. Figure 7 displays the capital expenditure in percentage by category.

Work on the Community Standard's drainage regulation project, which was previously funded as a capital project continued in 2019.

Variances: Actual 2019 capital expenditures were \$4.8 million less than budgeted with the following significant contributing factors:

- Actual expenditures for the East Riverbank Stabilization project were \$898,000 less than budget because no slope remediation projects were completed in 2019. A balance of up to \$3.0 million will be maintained in the East Riverbank Stabilization Capital Project to ensure funding is available if there is an emergency slope failure which impacts strategic public infrastructure. The unexpended balance at the end of 2019 was \$2.2 million.
- Storm Water Sewer expenditures were \$3.5 million less than the budget, mostly because of the delay in constructing the W.W. Ashley Storm Water Pond and related infrastructure.
- Storm Water Pond preservation expenditures were less than budgeted because there was no pond dredging in 2019.

Table 8 displays the actual 2019 Storm Water Capital Expenditures compared to the 2019 budgeted and 2018 actual amounts.

Table 8: 2019 Storm Water Capital Expenditures from Capital Reserve Fund

Storm Water Capital Expenditures from Capital Reserve Funds (Net of External Funding) (\$1000s)			
	2019 Actual	2019 Budget	2018 Actual
Storm Trunk and Collection Sewers	\$ 2,573	\$ 6,064	\$ 1,015
Storm Water Pond Preservation	110	450	275
Utility Billing Management	3	-	39
East Riverbank Stabilization	183	1,081	364
Drainage Regulation	1	-	-
Watershed Mgmt and Assessment Program	-	120	-
Total Capital Expenditures	\$ 2,870	\$ 7,715	\$ 1,693

Note: The 2019 Capital Budget includes \$5,065 from the Storm Water Capital Reserve and an additional \$2,650 from the Water & Sewer Infrastructure Reserve (Flood Protection Program revenues which are included in the Storm Trunk and Collection Sewers).

At the end of 2019, ongoing capital projects extending over more than one year had unspent capital balances of \$8.6 million.

5.6 Storm Water Capital Reserve

The Storm Water Capital Reserve provides funding for future large scale capital projects. The capital reserve at the end of 2019 was \$1.0 million.

In 2019, a few capital projects from previous years were closed, with unspent balances returned and overages deducted from the capital reserve, with a net addition of \$0.8 million. Table 9 displays the comparison of 2019 Capital Reserves End of Year to those of 2017 and 2018.

Table 9: 2019 Change in Storm Water Capital Reserve

Change in Storm Water Capital Reserve (\$1000s)			
	2019	2018	2017
Capital Reserve Beginning of Year	\$ 1,857	\$ 2,008	\$ 1,721
Provision to Capital Reserve	4,253	2,728	2,696
Capital Budget	(5,065)	(2,989)	(2,424)
Closures Returned to Capital Reserve	8	109	15
Capital Reserve End of Year	\$ 1,052	\$ 1,857	\$ 2,008

5.7 Storm Water Utility Benchmarking

The 2019, Storm Water Utility compared its utility rates to 11 other cities with utilities across Canada. Saskatoon's overall charges including Storm Water Management (\$66.30) and Flood Protection¹ (\$40.50) were \$106.80, which is the third lowest compared to the 11 other comparison cities. The combined Storm Water Management and Flood Protection charge compared to fees in other prairie cities is shown in Figure 8. Winnipeg has no storm water utility fees.

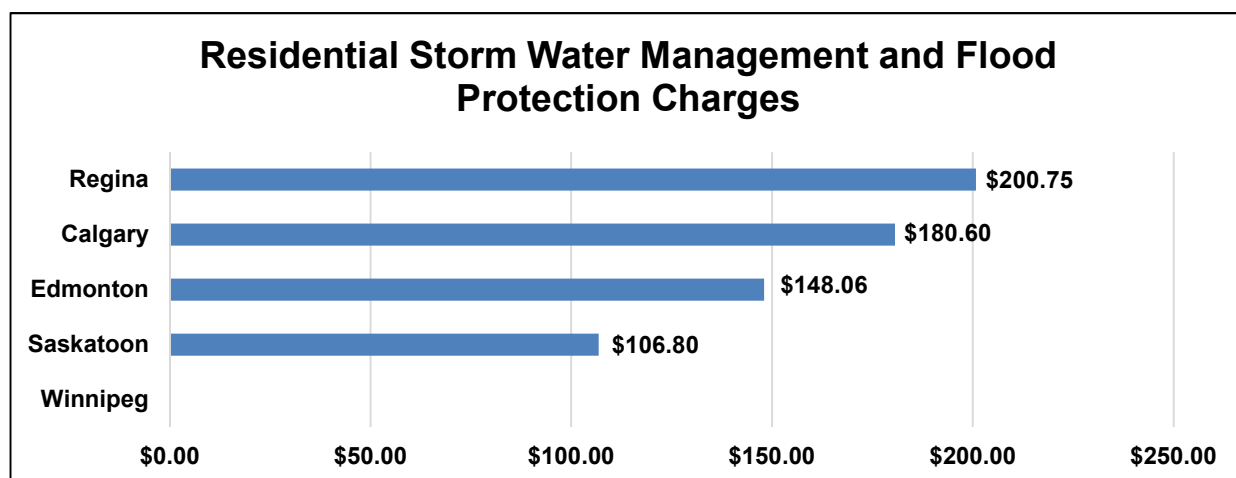


Figure 8: 2019 Residential Storm Water Management and Flood Protection Charges

¹ Prior to 2019, the "Flood Protection Program" levy was charged to fund projects that mitigate damage from sanitary sewer backups during intense rain events.

Non-residential properties are more difficult to compare as storm water utility programs ranged from flat rates for all customers to charges for all customers based on area size and imperviousness. Saskatoon's maximum annual storm water charge was \$6,630 in 2019 for non-residential properties. Saskatoon had the fourth highest charge out of 11 cities for non-residential properties, based on a completely impervious surface with a property area of 4,515 m². Annual storm water charges for a typical large shopping centre ranged from \$102 fixed rate charge in Sherwood Park to \$2,208.60 in Kitchener which has no maximum cap. The comparison 2019 annual minimum and maximum Storm Water Management and Flood Protection Charges is shown in Figure 9.

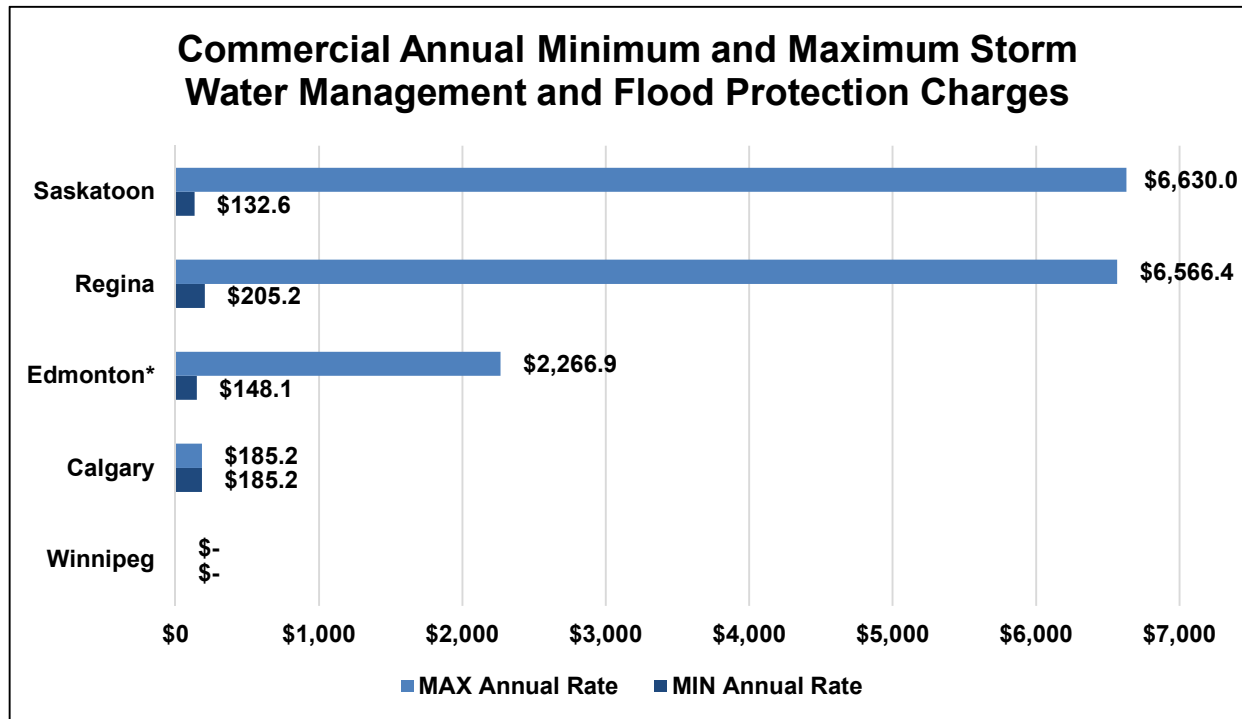


Figure 9: 2019 Commercial Annual Minimum and Maximum Storm Water Management and Flood Protection Charges

6.0 OUR CHALLENGES

Storm water management has continuing and expected future challenges which are summarized below.

Climate Change: Climate change adds to the potential of more frequent, higher intensity rain events, and increased demands on the storm water infrastructure.

Age and Condition of Existing Infrastructure: Water infrastructure has a limited life expectancy and over time pipes, culverts and other infrastructure must be repaired or replaced. Some of Saskatoon's water infrastructure dates back to the early 1900s.

Historical Design Standards: Limited standards for storm water infrastructure were in place when Saskatoon neighbourhoods began to develop. In 1989, new storm water standards for new neighbourhoods were established to handle "1-in-100 year" storms. Surface flooding during high intensity storms continues to be an issue for many low lying areas in older areas of the City.

Fluctuating Groundwater Levels: Higher groundwater levels have changed drainage patterns as water is unable to seep into the ground. The groundwater levels impact neighbourhood drainage and contribute to East Riverbank slumping and slope failure.

Infill Development: Cumulative impacts of infill development are placing higher demands on our water-related infrastructure. Infill reduces greenspace and increases surface runoff.

Citizen Expectations: Citizens have high expectations for storm water drainage that minimizes ponding on their streets and on properties. Flooding happens relatively rarely, but when it does happen, it can impact many properties at once. Citizens expect quick reactions by the City to their areas.

Drainage Bylaw Enforcement: Neighbourhood storm water drainage is negatively impacted by properties developed contrary to approved design standards or drainage paths that are not maintained. Inspections when development occurs are necessary to minimize future problems.

Regulatory Requirements: Evolving federal and provincial regulations have the potential to impact discharges to the river, and may require future investments to improve the quality of storm water runoff.

Inflow and Infiltration to the Sanitary Sewer: Extraneous inflow and infiltration of snowmelt and rainfall to the sanitary system increases risk of sanitary sewer back-up during rain events and creates unnecessary costs for treatment and capacity upgrades for the Wastewater Treatment Plant.

Costs for Businesses: Storm water charges for some businesses will more than double between 2018 and 2022, which may generate negative feedback. Actions that

businesses can take to reduce their storm water run-off generally have high capital costs relative to the annual reduction in storm water management charges.

7.0 CONCLUSION

Several initiatives that the Storm Water Utility undertook in 2019 will be further developed in 2020 and future years including the following:

- Implementing the nine-year Flood Control Strategy to reduce flood risk in areas that have a long history of frequent flooding, starting with the construction of W.W Ashley Dry Pond. The design work for the 24th Street and 3rd Avenue project is scheduled to be completed in 2020, with the intent to construct in 2021. The Churchill Dry Storm Water Pond design is scheduled to be completed in 2021 with construction expected to start in 2022.
- Implementing a Master Drainage Plan for the Montgomery Place neighbourhood, starting with the reconstruction of the Caen Street/Dundonald Avenue drainage system
- Continuing the storm water pipe lining program to extend the life of storm water infrastructure and improving drainage for two areas with ongoing drainage issues in collaboration with Technical Services (formally Major Projects and Preservation)
- Completing a State of Storm Water Infrastructure Report based on assessments completed for culverts and storm water pipes, and with 2019 condition assessment updates for storm water ponds and outfalls
- Further leveraging resources through partnerships with the University of Saskatchewan for research about storm water quality and the impact of climate change risks on storm water
- Promoting the Storm Water Management Credit Program

The Storm Water Team is committed to working collaboratively with other divisions towards making Saskatoon a more flood resilient city.

8.0 APPENDICIES

Appendix One: Definitions

Catch Basins: Used to convey storm water from the ground surface, usually on a street or parking lot, to the storm water collection system. Collector catch basins are located on collector mains and trunk catch basins are located on trunk manholes.

Culverts: Used to channel water under roads, railways, or embankments. Culverts have open inlets and outlets, usually transporting water from one ditch to another.

Dredging: The process of removing sedimentation (mud), weeds, and rubbish from pond bottoms.

Equivalent Runoff Unit (ERU): A measurement unit for runoff that is used for storm water management fees. One ERU is based on an average single family residential property's areas and types of surfaces (i.e. amount of grass, hard surface, etc.).

Floating Treatment Wetland: Floating treatment wetlands, or islands, are artificial platforms that allow aquatic plants to grow in water that is typically too deep for them. Their roots spread through the floating islands and down into the water creating dense columns of roots with lots of surface area.

Force Mains: Pressurized mains from 100 mm to 900 mm in diameter which connect storm water pumping stations and lift stations to the gravity collection system.

Leads: Pipes connecting catch basins to the storm collection system which range in diameter from 100 mm to 900 mm. Collector leads are located on collector storm mains. Trunk leads are located on trunk storm mains.

Lift Stations: Move storm water from lower to higher elevations, particularly where the elevation of the source is not sufficient for gravity flow and/or when the use of gravity conveyance will result in excessive excavation depths and high sewer construction costs.

Lining: A layer of material installed in a sewer main to improve performance and extend the lifespan.

Manholes: Chambers used to access sewer mains for maintenance and inspection purposes.

Oil and Grit Separators: A variation of the traditional settling tanks designed to capture sediments and trapped hydrocarbons (oils) in storm water runoff. Oil and grit separators replace conventional manholes.

Outfalls: The discharge point of the storm sewer system to the river, they include the following three categories:

- Local – Expel water from relatively smaller local areas than the collector or trunk outfalls

- Collector – Connect to the storm sewer system through collector mains
- Trunk – Connect to the storm sewer system through trunk mains

Piezometers: Devices used to measure pressure or depth of groundwater at a specific point.

POSSE: A government software system that automates and simplifies complex workflows.

Return Period: The estimated average time between equivalent rain events based on rainfall intensity and duration. A rain event with a two year return period has a 50% probability of occurring in any year. A rain event with a 100 year return period has a 1% probability of occurring in any year.

Runoff: Rain and snowmelt draining from land, buildings, or other surfaces.

Service Connections: Connect drainage systems from customer properties to storm mains in the street.

Sewer Mains: Principal pipes in a system that distribute water or collect storm water and waste water, and include the following two categories:

- Collector – Sewer mains that are less than 1,350 mm in diameter
- Trunk – Sewer mains that are more than 1,350 mm in diameter

Slope Inclinometer: Geotechnical instruments used to measure horizontal displacements along various points on a borehole to detect slope movement.

Standpipes: Plastic pipes with perforated holes at the base used to measure groundwater level.

Storm Water Ponds: Manmade basins that control excess storm water during and after heavy rainfall events and provide water quality improvement for runoff. **Dry Ponds** normally do not have water - they detain runoff during intense rain events and then gradually release the water back into the storm sewer system. **Wet ponds** permanently retain water throughout the year.

Sub-Drainage: Perforated pipes located in the slope along the riverbank used to collect ground water and remove it from the slope. This decreases the groundwater level in the slope and helps to stabilize the slope.

Sump Pumps: Remove water that has accumulated in a water-collecting sump basin, commonly found in the basements of homes

Vibrating Wire Piezometers: Used to provide accurate pore-water pressure readings in soils to measure groundwater levels.

Appendix Two: “Three Steps to Cost-Effective Basement Flood Protection” Handout




THREE STEPS TO COST-EFFECTIVE BASEMENT FLOOD PROTECTION




Complete these 3 steps to reduce your risk of basement flooding and lower the cost of cleanup if flooding occurs. For items listed under step 3 check with your municipality about any permit requirements and the availability of flood protection subsidies.

Step 1: Maintain What You've Got at Least Twice per Year


**Do-It-Yourself
for \$0**




Remove Debris from Nearest Storm Drain




Clean Out Eaves Troughs



Maintain Plumbing, Fixtures and Appliances



Test Your Sump Pump



Clean Out Your Backwater Valve

Step 2: Complete Simple Upgrades

**Do-It-Yourself
for Under \$250**



Install Window Wall Covers



Extend Downspouts and Sump Discharge Pipes at Least 2m from Foundation



Store Valuables and Hazardous Materials in Watertight Containers or Remove from Basement




Remove Obstructions to Basement Floor Drain




Install and Maintain Flood Alarms

Step 3: Complete More Complex Upgrades


**Work with a
Contractor for
Over \$250**



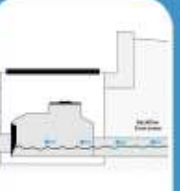
Install Window Walls that Sit 10-15 cm Above Ground and Upgrade to Water Resistant Windows




Disconnect Downspouts, Cap Foundation Drains, and Extend Downspouts to Direct Water at Least 2m from Foundation



Correct Grading to Direct Water at Least 2m Away from Foundation



Install Backwater Valve



Install Backup Sump Pump and Battery

Note: Not all actions will be applicable to each home. Completing these steps does not guarantee the prevention of basement flooding.

INTACT CENTRE
ON CLIMATE ADAPTATION

For Additional Resources Visit:
www.HomeFloodProtect.ca



Appendix Three: “Home Flood Prevention” Handout

Your city is hard at work on flood prevention.

If you’ve ever experienced flood damage, you know how devastating it can be. The good news is that Saskatoon has asked for and received \$21.6 million in federal funding to implement our nine-year **\$54-million Flood Protection Plan**. Work has begun to protect as many people and properties as soon as we can!

We’d protect every home if we could.

Keeping Saskatoon running smoothly takes a vast underground network of water and sewer pipes, power and natural gas lines, phone and other communication cables—it’s like a whole other city under the city! This makes upgrading storm water infrastructure complex and costly.

Our Flood Protection Plan is examining how we can improve 10 of our city’s most flood-prone areas—and we’ll be looking to these communities for input when we’re ready.

- 3rd Ave & 24th St
- Ave W & 21st St
- Cairns Ave & Ruth St
- Cumberland Ave & 14th St
- Cumberland Ave & Main St
- Dufferin Ave & 1st St
(includes Broadway Ave & Taylor St)
- Dufferin Ave & Cascade St
- Early Dr & Tucker Cres
- J.A. MacDonald Rd & McCully Cres
- York Ave & Ruth St



✉ Sign up for Flood Protection Plan **email updates** and we’ll keep you in the loop: saskatoon.ca/floodplan

Flood Prevention CHECKLIST

- ☐ Remove any debris from storm drains
- ☐ Clean out eavestroughs
- ☐ Test sump pump and have a battery backup
- ☐ Install flood alarms (they’re inexpensive and can save you a lot of money and stress)
- ☐ Keep valuables off basement floor, or in waterproof containers
- ☐ Check for and fix any leaks from plumbing or appliances
- ☐ Install or clean out backwater valve
- ☐ Waterproof windows and doors
- ☐ Fill any cracks in basement walls
- ☐ Extend downspouts and sump discharge pipes at least 2 m from foundation
- ☐ Correct grading around your home to direct water at least 2 m away from foundation
- ☐ Ask your insurance agent about coverage options for water damage

You’ll find more tips at:
saskatoon.ca/floodprotect

Thanks for doing your part to keep Saskatoon safe and dry!

 **City of Saskatoon**
Customer Care Centre
☎ **306-975-2476**