

FLOOD RESILIENCY AND MITIGATION



2017 Update Report

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1. INTRODUCTION

The City of Calgary has undertaken significant work to increase Calgary's flood resilience and reduce the risks faced by Calgarians since the 2013 floods. The City continues to focus resources and efforts by:

- Investing in flood resilience and protection
- Increasing our understanding of flood risk
- Strengthening flood-related policies
- Partnering with others for a more flood resilient Calgary, and
- Communicating with Calgarians about their flood risk.

In the aftermath of the 2013 flood, The City formed an independent Expert Management Panel to develop recommendations to guide The City's flood resilience work. The panel released the *Expert Management Panel Report on River Flood Mitigation* in 2014 (PFC2014-0512) which outlined 27 recommendations that The City has worked to implement since 2014. Significant progress has been made on these recommendations and a full summary of progress to date can be found in Appendix A of this report. As of 2017, all recommendations are either underway or are complete (Figure 1).

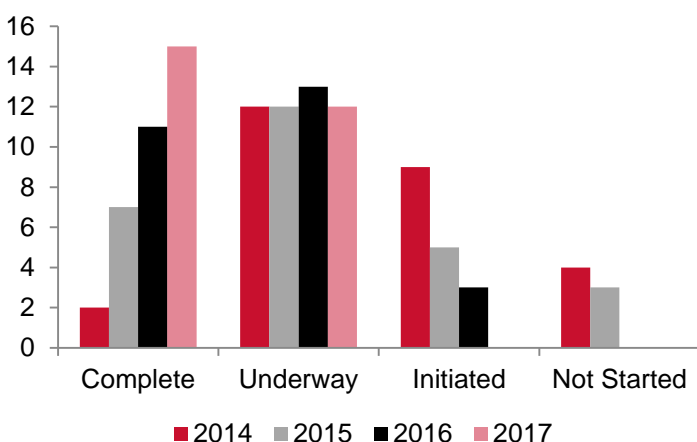


FIGURE 1: EXPERT MANAGEMENT PANEL RECOMMENDATIONS PROGRESS

stakeholders to achieve this goal. This report provides a summary of the work that was done in 2017, and identifies priorities for 2018.

Overall, citizen satisfaction with The City's work on flood mitigation remains high (Figure 2), and continue to believe that protection from river flooding is important (Figure 3). The City recognizes this and flood mitigation is one of The City's top strategic priorities.

As part of this work, The City completed a comprehensive Flood Mitigation Measures Assessment (FMMA, UCS2017-0266) in 2016. The FMMA results serve as the framework for The City's long-term flood mitigation and resilience strategy. City Council endorsed The City's strategy, and identified flood mitigation as a top strategic priority for The City of Calgary.

Building flood resiliency is a shared responsibility among The City, other orders of government, community partners, and citizens. The City continues to actively work with

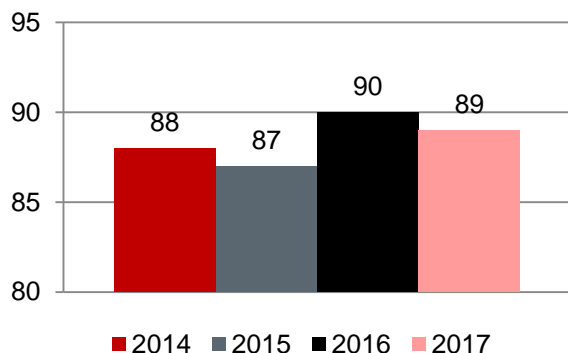


FIGURE 2: PERCENTAGE OF CITIZENS THAT ARE SATISFIED WITH THE JOB THE CITY IS DOING IN PROVIDING PROTECTION FROM RIVER FLOODING

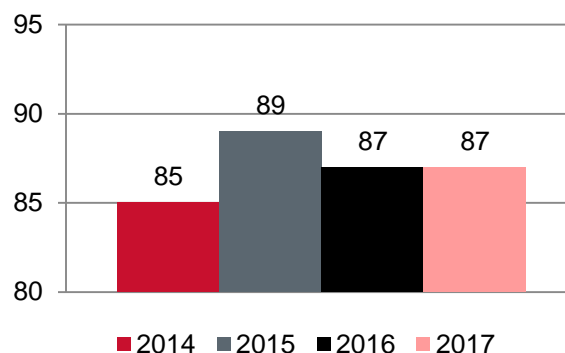


FIGURE 3: PERCENTAGE OF CITIZENS THAT BELIEVE PROTECTION FROM RIVER FLOODING IS IMPORTANT

The City is dedicated to implementing the Government of Alberta's Water for Life Strategy through its water management framework that ensures reliable and resilient water servicing for Calgary and regional customers. This report provides a summary of the activities undertaken by The City of Calgary's Flood Mitigation program in 2017 to address the fourth goal of the integrated watershed management framework that focuses building flood resiliency in Calgary. Working with the Province and regional partners, The City aims to protect the water supply, use water wisely, keep rivers healthy and build resiliency to flooding (Figure 4). Updates on the other three goals are addressed in a separate report to the Standing Policy Committee on Utilities and Corporate Services (2017 Watershed Planning Update, UCS2018-0093).

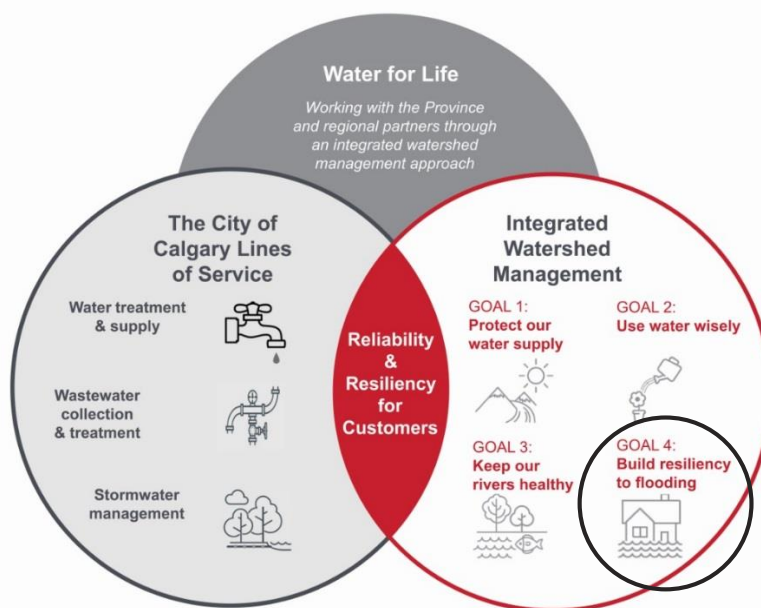


FIGURE 4: INTEGRATED WATERSHED MANAGEMENT FRAMEWORK

2. SUMMARY OF 2017 ACTIVITIES

2.1 2017 SEASONAL CONDITIONS

The City of Calgary monitors snowpack conditions year round. From May to July conditions are monitored 24 hours a day, 7 days a week, when Calgary's flood risk is at its highest. For the spring of 2017, the snowpack in the Bow and Elbow basin was average to slightly above average. Snowmelt started in mid-May and continued through mid-June. Above normal temperatures during snowmelt resulted in a much higher than average run-off to the Bow River, though conditions on the Elbow River remained normal. The resulting peak flow through Calgary on the Bow River was 453 m³/s on June 11 – well above the typical average flow. For safety, a boating advisory was issued by The City of Calgary between June 1 and June 19. However, no emergency response activities were required in 2017.

During the summer, above average temperatures and much lower than average precipitation resulted in flows in both the Bow and Elbow dropping significantly, remaining just above the drought advisory phase for much of the late summer. While flows remained above trigger conditions in Calgary, The City initiated an internal drought advisory from August 29 to October 2 because of regional water shortages and above average irrigation demands. During this period, The City's Water Oversight Committee and internal business units worked collaboratively to prepare actions to reduce water consumption in the event conditions worsened. However, public advisories to reduce consumption were not required and impacts to the general public were minimal.

2.2 FLOOD READINESS

In addition to monitoring Calgary's flood risk, The City of Calgary holds an annual Flood Readiness Campaign every year from May 15 to July 15. The Flood Readiness Campaign is designed to help educate citizens about river flooding and be prepared for a potential flood. The campaign's goals are to:

- Develop a greater understanding of what The City does to prepare for river flooding
- Help citizens understand how flooding occurs
- Show citizens how to prepare for and mitigate against flooding
- Help citizens stay informed of river conditions and flood risk during flood season.

As part of The City's campaign in 2017, a number of activities were undertaken to inform citizens and increase reach with providing flood risk information. These included:

- Overhauling The City of Calgary's flood portal at Calgary.ca/floodinfo
- Working with Community Associations, Councillors, and Provincial Members of the Legislative Assembly (MLAs) to share messaging with citizens via social and print media
- Information booths at The City's Disaster Alley and at community events
- General local media coverage, resulting in 21 articles and related media stories.

In 2017, City staff visited residents in the Mission area, who are at the highest risk of evacuation should flooding occur on the Elbow River. Residents received information packages that included information to help them be more prepared for a future flood event and evacuation order. Staff also responded to questions and concerns raised by residents at the door. Copies of the Flood Readiness Guide were delivered to targeted households that are at the highest risk of flooding. The guide provides information on understanding flooding, preparing for emergencies including flooding, and how to stay informed during May to July, when flood risk is highest.



THE CITY OF CALGARY'S FLOOD READINESS GUIDE IS AVAILABLE ONLINE AT WWW.CALGARY.CA/FLOODINFO

3. FLOOD MITIGATION MEASURES ASSESSMENT

The City completed a comprehensive Flood Mitigation Measures Assessment (FMMA) in 2016. In 2017, the results of the FMMA were presented to City Council. The assessment found that a combination of watershed, community, and property-level mitigation measures will provide a flexible and adaptable flood mitigation program that provides the most cost-beneficial flood resilience for Calgary (Figure 5). The FMMA also identified that non-structural mitigation measures will provide additional benefit. The recommendations from the FMMA reflect The City's principles and priorities for flood mitigation, including:

- Maintaining public safety and operation of critical infrastructure
- Ensuring sustainable water management amidst climate uncertainty
- Cost-beneficial investments
- Maintaining adaptability and flexibility
- Providing an equitable level of protection on both rivers, and
- Working with communities to ensure receptivity and shared responsibility to reduce flood risk.

Based on the findings of the FMMA, a report was approved by City Council on 2017 April 10, which recommended that City Council direct Administration to:

1. Work with Council to advocate for an upstream reservoir and continuation of the Provincial-TransAlta operational agreement for the Bow River
2. Continue supporting the development of the Springbank Off-stream Reservoir on the Elbow River by the Province
3. Develop an implementation and funding plan for community level flood mitigation and report back to Council through the SPC on Utilities and Corporate Services or the Priorities and Finance Committee by Q2 2017
4. Explore the development of a property level mitigation program
5. In alignment with Provincial mapping and policy updates, conduct further investigation on land use policy and building regulations for areas prone to flooding, and
6. Work with City Council to confirm and communicate to other orders of government that flood mitigation is a top strategic priority for The City of Calgary.

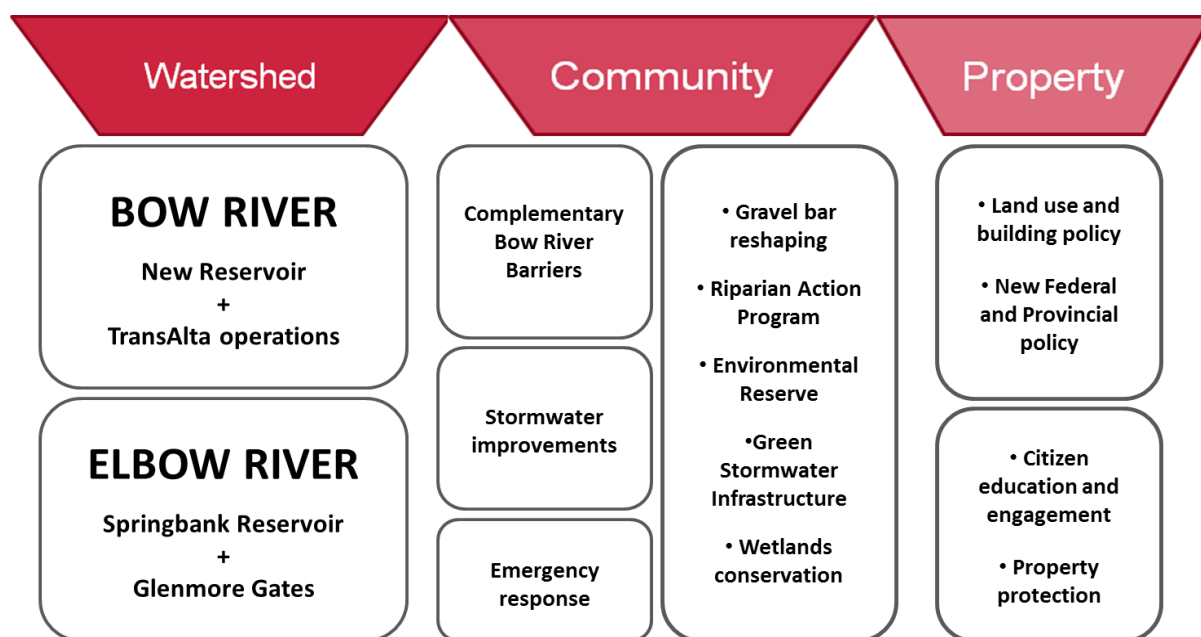


FIGURE 5: FLOOD MITIGATION MEASURES ASSESSMENT RECOMMENDED APPROACH

Based on the FMMA, a combination of upstream mitigation and community level structural mitigation is being pursued. This approach provides adaptability and flexibility in our ability to manage flood risk. Initial planning and design for barriers located in Calgary's downtown and in Sunnyside-Hillhurst, Bowness and Pearce Estate-Inglewood has been initiated. These projects will provide flood mitigation benefit while upstream measures on the Bow River are being pursued by the Province, and are designed to be scaled to address future climate uncertainty. These barriers will also work with recommended future upstream structural mitigation to further reduce flood risk once all components are in place.

4. DEVELOPMENTS IN 2017

4.1 WATERSHED MITIGATION – ELBOW RIVER

The Springbank Off-Stream Reservoir (SR1) project was announced by the Province in 2015 and will consist of a reservoir approximately 18.5 kilometers upstream of the Glenmore Dam that will temporarily store water during a flood and release water slowly back into the Elbow River. Studies have confirmed that SR1 is the best location for an upstream reservoir to mitigate flood risk for Calgary and other communities downstream. SR1 is critical to building flood resiliency on the Elbow River for Calgary.



UPGRADES AT THE GLENMORE DAM INCLUDE REPLACING THESE STOP LOGS WITH AUTOMATED STEEL GATES FOR IMPROVED WATER STORAGE AND FLOOD MITIGATION CONTROL.

The FMMA identified that current work to upgrade the gates on the Glenmore Dam, combined with construction of the SR1 upstream of Calgary, will provide flood mitigation similar to a 2013 event on the Elbow River. Community-level structural mitigation is not recommended on the Elbow River, as it would cause significant disruption to communities and private properties, and require significant land acquisition to accomplish.

On 2016 June 23, the Canadian Environmental Assessment Agency (CEAA) announced that a federal environmental

assessment for SR1 would be undertaken. Alberta Transportation submitted the environmental assessment report to CEAA on 2017 October 17, which CEAA subsequently referred back to Alberta Transportation by CEAA for additional information on 2017 November 20. Work is underway by Alberta Transportation to provide the additional information requested.

As part of SR1's environmental assessment, The City was invited to participate on the CEAA's Technical Working Group for SR1. The City of Calgary will work with Provincial and Federal counterparts, as well as local stakeholders to review information, and provide advice throughout the environmental assessment process. The Technical Working Group first met on 2017 November 8.

During 2017, The City continued its infrastructure upgrades to the Glenmore Dam. The Glenmore Dam has been key part of Calgary's drinking water infrastructure system since the early 1930s. 85 years of continual service and the ever increasing demands of a growing city means the time has come for an extensive upgrade. These improvements will not only extend the life of the Dam, but will help manage our drinking water supply and give us the ability to better control low and high river flows.

The first phase of the project involved moving the water and gas utility lines, which ran across the top of the dam, to a new tunnel excavated underneath the Elbow River. Work has now begun on Phase II, which includes a new bridge deck with better access for maintenance and pathway users, concrete work on the face of the dam, and a new steel gate and hoist system. While the normal maximum operating levels of the reservoir remains the same, the new gate system will provide greater flexibility to manage reservoir storage during low flows in the winter and high flows in the spring.

4.2 WATERSHED MITIGATION – BOW RIVER

In 2017, The City of Calgary continued to co-chair the Bow River Working Group (BRWG) with the Province to assess flood mitigation and water supply on the Bow River. The *Bow River Water Management Project final report* was released by the Province on 2017 August 11, and outlines the findings and recommendations from the BRWG process. The report identified a number of short, medium, and long term operational and infrastructure improvements to mitigate against flood impacts in Calgary.

The BRWG report recommended that a single new reservoir upstream of Calgary, combined with additional operational efficiencies at existing reservoirs will provide significant flood mitigation for Calgary. The efficiencies and modifications include negotiating a long-term watershed agreement with TransAlta, and extending the Ghost Reservoir flood operations agreement and drawdown rate. Once complete, these actions will work in combination with the community barriers being constructed by The City to provide mitigation to a flood event similar to 2013.

A proposed flood-focussed reservoir upstream of Calgary would have short-term water supply benefits for Calgary. Three locations for a new reservoir were identified, and feasibility studies are recommended to be completed within two years. The majority of reservoir scenarios to address drought were focussed on southern Alberta agricultural irrigation downstream of Calgary.

A Provincial study is underway to investigate the feasibility of drawing down the Ghost Reservoir more quickly for a more efficient flood response. As of 2018 January, the Province has begun follow-up work on the BRWG's short-term, "quick-win" mitigation recommendations. For recommendations related to large infrastructure recommendations such as upstream reservoirs, next steps have not yet been communicated by the Province. Work on a long-term solution requires Provincial commitment, and actions to move forward must be addressed collaboratively with stakeholders.

The City continues to stress to the Province that flood mitigation is one of its top strategic priorities. An upstream reservoir on the Bow River is a holistic water management solution for the watershed and is critical to Calgary's flood resilience, while also providing short-term water supply benefits.

4.3 COMMUNITY MITIGATION

The FMMA identified that new upstream infrastructure on both rivers and operational efficiencies, combined with the community-level flood barriers on the Bow River, are necessary to provide mitigation

to a flood event similar to 2013. Administration delivered a funding and implementation plan to City Council on 2017 June 26 to support design of four new community barriers in high flood risk locations:

- Downtown from Jaipur bridge to Reconciliation bridge
- Sunnyside-Hillhurst, from the Peace bridge to the existing community flood barrier
- Bowness, along Bow Crescent
- From the existing Inglewood flood wall to the south-eastern portion of Pearce Estate Park.

Initial planning and design for permanent flood barriers in Calgary's downtown as well as in the communities of Sunnyside-Hillhurst, Bowness, Pearce Estate-Inglewood has been initiated. These barriers will provide flood mitigation benefit while upstream measures are pursued by the Province.



THE WEST EAU CLAIRE BARRIER IS PART OF THE CITY'S EAU CLAIRE PUBLIC REALM PROJECT AND WILL BE INTEGRATED WITH THE EXISTING PARK AREA. IT IS A CRITICAL COMPONENT TO THE DOWNTOWN'S FLOOD RESILIENCE.

The downtown barrier is critical to Calgary's flood resilience as nearly half of the downtown is at risk should a significant flood event occur. It will integrate into The City's Eau Claire Public Realm initiative, which includes the West Eau Claire flood barrier currently under construction. When the downtown barrier is complete, it will connect to both the West Eau Claire flood barrier and the Centre Street lower deck flood barrier and serve as a single piece of flood mitigation infrastructure for all of the downtown.

The four barriers are designed to be scaled to address future climate uncertainty, and work with upstream operational efficiencies and recommended upstream reservoir on the Bow River to further reduce flood risk once all components are in place. Starting in 2018, The City will work with the communities where barriers will be located.

In September 2017, The City submitted proposals to Alberta Environment and Parks (AEP) Alberta Community Resilience Program (ACRP) for the four community flood barriers. Funding assistance from AEP for these projects is pending service level negotiations with the Province. More information regarding the ACRP and ACRP-funded projects can be found in Appendix B.

In addition, the Upper Plateau Separation project for the community of Sunnyside-Hillhurst, which provides further mitigation for the community, was approved in the FMMA and the Funding and Implementation Plan, and was submitted to ACRP in 2017 September for funding consideration.

Two gravel bars along the Elbow River in the community of Mission and five gravel bars on the Bow River at Centre Street Bridge, 10th Street Bridge, Crowchild Trail, Carburn Park, and Inglewood were also identified in the FMMA. These projects will help further reduce Calgary's flood risk by removing obstructions to the rivers' flow. The City is currently working to identify funding for these projects. Work on the Mission Island, Scollen Bridge and Centre Street gravel bars began in 2017 and is expected to continue throughout 2018.

5. ALBERTA COMMUNITY RESILIENCE PROGRAM

On 2015 October 26, AEP committed \$150M over 10 years to The City of Calgary through the ACRP for community-level flood mitigation projects. The City of Calgary has received funding from the ACRP for projects since 2014, and \$40.3M has been provided to The City to date. All ten ACRP-supported projects are currently in design or under construction, and once completed, are expected to reduce Calgary's flood risk by as much as 30 per cent. A summary of The City's current ACRP projects can be found in Appendix B.

In September 2017, The City submitted ACRP proposals to AEP for four community flood barriers, the Upper Plateau Separation project in Hillhurst-Sunnyside, and the 9th Avenue Bridge replacement project, which provides critical emergency access to the community of Inglewood. These projects are pending AEP approval and service level negotiations with the Province.

6. PROPERTY MITIGATION, POLICY AND MAPPING

Non-structural flood mitigation measures such as land use planning and policy changes are being explored in greater detail by The City. Such measures can provide significant reduction in Calgary's overall flood risk over the long term, as well as increasing resilience to climate change impacts. In 2014, changes to the Municipal Development Plan (MDP) and Land Use Bylaw (LUB) were made to provide guidance and better regulate development within the Flood Hazard Area (FHA, Figure 6). Starting in 2017 The City of Calgary established an internal City-wide working group led by Calgary Growth Strategies, to explore potential changes to The City's existing land use and building regulations to further increase Calgary's flood resilience.

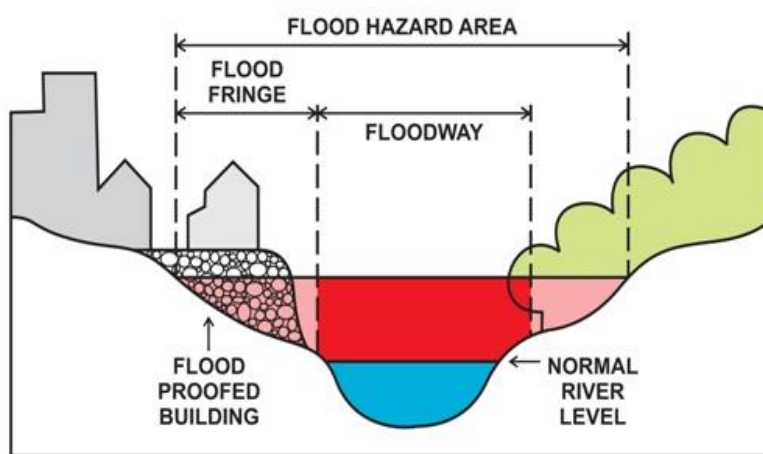


FIGURE 6: DIAGRAM OF THE FLOOD HAZARD AREA. NEW FLOOD HAZARD AREA MAPS FROM THE PROVINCE COULD INCREASE THE OVERALL SIZE OF THE FLOODWAY IN THE FUTURE. DEVELOPMENT IN THE FLOODWAY IS NOT PERMITTED. (SOURCE: [HTTP://AEP.ALBERTA.CA/WATER/PROGRAMS-AND-SERVICES/FLOOD-HAZARD-](http://AEP.ALBERTA.CA/WATER/PROGRAMS-AND-SERVICES/FLOOD-HAZARD-)

As part of this work in 2017, The City began reviewing the effectiveness of those initial approved non-structural measures. In 2018, The City will continue to review the effectiveness of these measures, recommend improvements where needed and analyze possible new policy and building regulation measures to improve flood resiliency. Potential policies for developed and greenfield areas that are being assessed include:

- Land use bylaw amendments, guidelines or policies that will reduce damages in flood risk zones over time.
- Education, communication and notification tools to increase property owners' and residents' awareness of their flood risk and mitigation opportunities.
- Regulating land use or occupancy types permitted in flood risk areas.

This project will include citizen engagement, as well as discussions with Provincial counterparts to understand the implications of policy and mapping changes and the availability of Provincial relief programs such as Disaster Recovery for citizens. As part of this work, The City is analyzing flood risk data to see how this information can be used to improve communicating flood risk to Calgarians and to inform land development policies in areas with increased flood risk. Work is also ongoing to make The City's existing inundation mapping more accessible and easier to understand for citizens, and will continue to improve accessibility to this information throughout 2018.

A key component that will inform The City's future land use planning or flood plain development policy is the Province's release of updated Flood Hazard Area (FHA) regulatory maps. It is anticipated that new FHA maps will be publicly released in early 2018, and will have implications for any policy changes The City is considering. The Province has also initiated a process to update its Floodway regulations, and the Federal government continues to work on developing floodplain development guidelines for the country.

The City is communicating with both orders of government, including sitting on several federal Advisory Panels and Committees, and is taking all of these potential developments under consideration as it proceeds with any recommendations for policy changes as they relate to development or redevelopment in the flood plain. The flood mapping, policy and land use regulation work will continue throughout 2018.

7. STORMWATER FLOODING

As The City of Calgary has grown over the past 140 years, stormwater management standards have advanced to respond to ever changing weather patterns and our evolving knowledge. This has resulted in varying levels of drainage service in communities across Calgary. Communities developed prior to 1990 have the greatest need for stormwater infrastructure upgrades to meet current minimum servicing standards. The 2013 flood event also renewed focus on how The City manages river flooding and stormwater backup for communities in close proximity to the rivers.

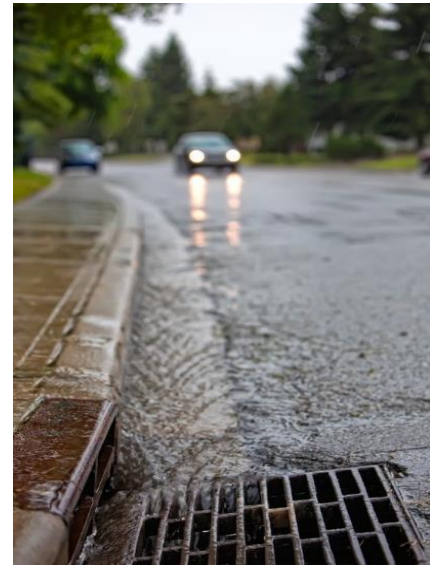
7.1 LOCALIZED FLOODING

Local stormwater flooding occurs in communities when drainage infrastructure cannot manage the volume of stormwater resulting from precipitation, or snow and ice melt. Localized flooding can also occur due to a restriction in the underground system or a surface grading issue. When communities are in close proximity to the river, these areas can be further impacted by adjacent river flood events. In 2017 March, The City worked to identify how resources can be best deployed during adverse weather in the summer, particularly for short duration-high intensity summer storms where there is flash flooding as well as immediate safety and property impacts.

For the 2017 season, The City focused on four key areas:

- Improving public messaging and communication regarding “normal” and “emergency” run off concerns to increase public awareness.
- Mapping problem areas to identify communities with the greatest risk and identify opportunities for improvement.
- Creating a response plan to summer storms that identified opportunities to share information, engage City partners, and improve record-keeping and reporting from the field.
- Addressing specific flooding issues in the area of communities of Deer Run and Lake Bonavista through the installation of temporary sand filled barriers. These neighbourhoods have been identified for study within the Community Drainage Improvement (CDI) program for future improvements.

Although The City strives to improve our response to localized flood events, they continue to be a challenge as rainfall events can be unpredictable. Communities with broader stormwater system issues will be addressed through the CDI program. Work done under the CDI program in 2017 is summarized in the section below and a list of current and future projects can be found in Appendix C.



LOCAL STORMWATER FLOODING CAN OCCUR QUICKLY AND UNPREDICTABLY.

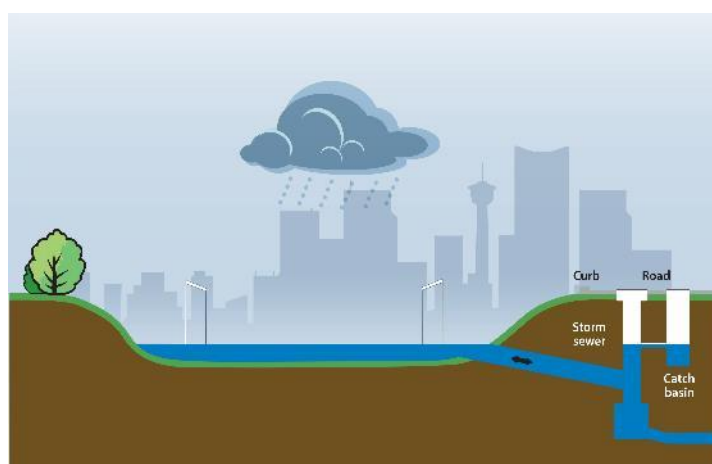
7.2 COMMUNITY DRAINAGE IMPROVEMENT PROGRAM

The CDI program invests in stormwater infrastructure improvements with a focus on established communities with the highest risk of local stormwater flooding. The Program prioritizes projects based on flood risk, potential impacts to the community and the cost-effectiveness of the proposed infrastructure upgrades. A drainage study is first completed for selected communities, which assesses flood risk and presents options for upgrades. Investment decisions are then evaluated based upon which

projects provide the greatest benefits to customers and communities. This is measured based on reduction to damages caused by local flooding as well as social, economic, and environmental impacts.

In 2017, a number of planning, design and construction activities were completed through the CDI program, including:

- Continuation of drainage studies for the communities of Renfrew and Macleod Trail, with completion expected in 2018. These studies will inform future CDI program investments.
- Design for stormwater projects in Sunnyside:
 - Stormwater pump station #1
 - Phase 2 improvements to stormwater pump station #2. Interim upgrades to pump station #2 were completed in 2017 and will support the Phase 2 upgrades for the project;
 - The Upper Plateau Separation project, which will reduce Sunnyside-Hillhurst's stormwater flooding risk by disconnecting their stormwater system from communities located above them in the upper plateau.
- Design for the Woodlands-Woodbine (WWCDI) projects, including Bebo Grove Pond, 24 Street SW Storm Diversion and Braeside Dry Pond.
- Completion of the 14.5 Street improvement project and interim upgrades to stormwater pump station #2 in Sunnyside-Hillhurst.
- Commencement of design for upgrades to outfall G20C in collaboration with Alberta Infrastructure. Work will continue through 2018 and is required to accommodate piped infrastructure under the future South West Ring Road at Sarcee Trail and Glenmore Trail. Once complete, this will complete CDI upgrades servicing the communities of Westgate and Christie Park.
- Completion of infrastructure upgrades in the communities of Christie Park and Sarcee Trail.



CROSS-SECTION OF A DRY POND. WATER COLLECTED IN A DRY POND DURING A RAINSTORM IS HELD UNDER THE STORMWATER PIPES HAVE THE CAPACITY TO DRAIN THE WATER AWAY. WHEN NOT IN USE, A DRY POND CAN BE USED FOR RECREATION OR LEISURE PURPOSES

Work done utilized value-engineering practices, flexible procurement, and leveraging of external funding to help drive cost efficiencies.

Infrastructure Canada committed \$2.1M through the New Building Canada Fund toward the construction of pump station #1 in Sunnyside in 2016 November, and ACRP announced an additional \$9.8M to support construction of pump stations #1 and #2 in 2017 April. The pump stations will function together as part of the overall community-wide drainage improvements occurring in Sunnyside-Hillhurst to remove

stormwater from the community and pump it back into the river. The City will continue to identify external funding opportunities for CDI projects and will continue to explore opportunities to enhance delivery of projects through the CDI program in 2018.

8. ACTIONS FOR 2018

One of The City's key actions for 2018 is initiating the implementation of the community level flood barriers. This will involve significant work with flood affected communities to gather input through public engagement where applicable, create detailed designs for each project and work with private land owners. Securing funding from the Province and Federal government to support these projects is a priority.

The City will continue to work closely with the Province on conducting further work to support the implementation of the BRWG Water Management Report recommendations, and development of upstream mitigation on the Bow and Elbow Rivers.

Planned Actions:

Flood mitigation and resilience

- Begin initial work to support the community level flood mitigation measures, including initial communications with communities, developing community engagement plans, initial design of the four barriers, and internal resourcing of this work.
- Work with Council to advocate for an upstream reservoir on the Bow River and support the development of the Springbank Off-stream Reservoir by the Province.
- Support and advocate for upstream Provincial projects through the Springbank Reservoir Technical Working Group, and the Bow River Working Group.
- Advocate for appropriate Provincial flood policy and Federal guidelines through engagement with the Province and participation in national floodplain guideline discussions.
- In alignment with Provincial flood mapping efforts and Federal floodplain guideline development, support Calgary Growth Strategies' work on reviewing and evaluating potential change to existing policy and building regulations for flood-affected areas.
- Deliver annual public flood awareness communications.
- Lead annual updates to flood emergency response procedures.
- Continue collaborating with the Province to support improved monitoring and river forecasting through discussions regarding a common forecasting platform.

Community Drainage Improvement (CDI) program

- Consider recommendations from planning studies currently in progress for the Renfrew and Macleod Trail CDI projects in the overall program's project prioritization.
- Initiate design of the Upper Plateau Separation project, which will reduce Sunnyside-Hillhurst's stormwater flooding risk by disconnecting their stormwater system from communities located

upslope in the upper plateau. Continue to identify external funding opportunities for this project.

- Proceed with construction of continued improvements to stormwater pump stations #1 and #2 in Sunnyside.
- Construction of drainage improvements for the Woodlands-Woodbine CDI projects, benefitting the communities of Woodlands, Woodbine, Braeside and Cedarbrae.
- Initiate the Deer Run and Lake Bonavista CDI study.
- Continue to explore opportunities to enhance delivery of drainage improvement projects through the CDI program in 2018.
- Report back to Council as part of the 2019-2022 Budget and planning process with an update on strategies for continued investment in the CDI program.

APPENDIX A – EXPERT MANAGEMENT PANEL RECOMMENDATIONS

1. INVESTING IN FLOOD PROTECTION

Recognizing the scale of impact caused by flooding, continued significant investments are needed for flood mitigation. Citizens believe that investment in flood mitigation is important and The City is working with all orders of government to explore opportunities and secure funding for investments in flood resilience. To date, The City has received \$40.3M from the Alberta Community Resilience Program (ACRP) for ten projects, and applied for an additional \$81.3M for six projects in 2017.

Investing in flood protection Expert Management Panel recommendation	Status	Timeline	2017 update
Prepare a time-phased plan to modify structures that constrain river flow during flood events, such as pathways and bridges. (4b)	Underway	Ongoing	Flood levels are currently considered as part of lifecycle project planning and implementation. Repair and reconstruction of bridges and pathways after 2013 were designed to withstand the 100+ year level flood, as are current bridge construction projects. This recommendation is linked to The City's Climate Change Adaptation Plan. Future construction or replacement of existing structures will be informed by future land use planning and development policy work.
Develop a comprehensive climate adaptation plan and implementation tools to reduce The City's infrastructure and operational vulnerabilities. (6d)	Underway	2018-2022	Internal engagement was conducted across the entire Corporation to identify actions that may be taken to adapt to a changing climate based on the vulnerabilities and risk assessment. Over 800 actions were identified Corporate-wide. Some of these actions have been included in business plans for 2018-2022.
Connect with the provincial body overseeing flood protection and loss reduction and support the Province's continuing analysis of flood mitigation options and implementation of appropriate measures through the watersheds. (6b)	Underway	Ongoing	The Bow River Water Management Report was released on 2017 August 11, and recommends a number of mitigation scenarios along the Bow River. In 2018, The City will continue to participate in the Bow River Working Group to identify ways to move the report's short, medium and long term recommendations forward. The City also continues to connect with Provincial counterparts through regular meetings on watershed level solutions to flood mitigation.

Increase the operating water storage capacity of the Glenmore Reservoir on the Elbow River through modifications to the Glenmore Dam. (3b)	Underway	2015-2020	The Glenmore Dam infrastructure improvement program includes a project to elevate the dam's gates to help control flooding and manage water supply. Work to support the construction of the gates has started, and the project is expected to be operational in 2020. The elevated gates will increase capacity at the Glenmore Reservoir and, operated in tandem with the proposed Springbank Reservoir, will provide mitigation for a 2013-level flood on the Elbow River.
Construct additional or higher flood barriers in key locations throughout the city and update temporary flood barrier plans to protect against higher flood levels. (3d)	Underway	2014-2026+	<p>Temporary barrier planning continues to be updated on an annual basis as part of The City's flood emergency response procedures.</p> <p>The Flood Mitigation Measures Assessment (FMMA) identifies four additional community level barriers to be constructed as part of The City's flood mitigation strategy. The City has started initial design for these barriers and will be reaching out to inform communities on the FMMA and barriers in their communities, and where applicable, seek input into barrier design prior to potential construction.</p>
Provide an annual update to City Council on progress related to the recommendations from the Expert Management Panel on River Flood Mitigation. (6f)	Complete	Ongoing	Annual updates are provided by Water Resources to Council's Standing Policy Committee on Utilities and Corporate Services.
Evaluate social, economic and environmental impacts of flood mitigation options. (6c)	Complete	2015-2016	A triple bottom line approach was used to assess possible flood mitigation measures as part of the FMMA. The Assessment determined that a combination of upstream mitigation, community level mitigation, and property level mitigation was the most cost-sustainable approach to reducing Calgary's flood risk. The recommendations generated from this assessment were approved by Council in April 2017 (UCS2017-0266)
In partnership with the Province, compare the three major capital works options for mitigating floods on the Elbow River. (3a)	Complete	2015-2016	The Springbank Off-stream Reservoir (SR1) was announced by the Province in 2015, and the Province has proceeded with this project, which is currently undergoing a federal environmental impact assessment. The City is participating on the Technical Advisory Committee for the Environmental Assessment of SR1 currently being undertaken by CEAA.
Establish a permanent team within The City to oversee flood preparedness and resilience. (6a)	Complete	2015-2016	Funding requests for a permanent team were approved in December 2014. The Watershed Planning Division was established in 2015, and supports this team.

2. UNDERSTANDING FLOOD RISK

There will always be a risk of river flooding and Calgary Emergency Management Association (CEMA) has identified flooding as Calgary's number one hazard and risk. The Expert Management Panel included several recommendations around understanding flood risk, which is one of The City's core strategies for building resiliency. In 2016 The City continued to conduct research, modeling, and monitoring to better understand Calgary's flood risk.

Understanding flood risk Expert Management Panel Recommendation	Status	Timeline	2017 update
Urge the Province to regularly review and update official flood hazard maps. (5b)	Underway	2018	The City is expecting the Province to release draft maps of the new Flood Hazard area (FHA) in early 2018. The Province has indicated municipalities will be engaged before maps are released. The City remains in contact with Alberta Environment and Parks and is monitoring the implications of new FHA mapping.
Develop a suite of watershed-scale climate models to capture various weather event scenarios, with input from regional partners, post-secondary institutions and other orders of government. (5d)	Underway	2022+	Projected trends in precipitation and temperature were developed for the 2050s and 2080s and were used to conduct a vulnerability and risk assessment to identify high risk climate scenarios for Calgary and region. Further climate analysis is required to support the update of design standards in preparation for changing climate conditions. The City is supporting research being conducted by the University of Saskatchewan to develop forecasting and climate modelling tools for our region. Opportunities may arise with the federal government and regional climate centers to provide this type of climate analysis in the future.
Collaborate with academic and other partners to develop computer models that identify groundwater movement in Calgary in relation to flood conditions. (5e)	Complete	2017	In 2016, The City completed two assessments on groundwater impacts relating to flooding, which were included in The City's updated Flood Damage Assessment.
Maintain a comprehensive flood risk database integrated with existing geographic information systems (GIS). (5c)	Complete	2015-2016	In 2016, The City produced a GIS based flood risk damage profiles at the community level. This data was created as part of The City's Flood Damage Assessment and has been incorporated into The City's GIS database.
Publish up-to-date, graduated flood maps for public information. (5a)	Complete	2015	Inundation maps prepared by The City for up to 100-year return periods have been posted to Calgary.ca/floodinfo and are available to the public. Work continues to make this information easier to access for Calgarians.

3. STRENGTHENING FLOOD-RELATED POLICIES

Land use policies, design standards, and flood-proofing building practices, when used alongside structural protection investments, can greatly enhance community resilience to flooding. The City remains committed to working closely with the Provincial and Federal governments on policy consultation regarding flood hazard area mapping, policy development, practices and regulations, and flood design levels.

Strengthening flood-related policies Expert Management Panel Recommendation	Status	Timeline	2017 update
Create graduated flood protection level requirements for City infrastructure. (1b)	Underway	Ongoing	Flood levels are currently considered as part of lifecycle project planning and implementation. For the Flood Mitigation Measures Assessment, a 1:200 level was used as reference. This recommendation is linked to the Climate Adaptation Program and CEMA's critical infrastructure strategy. A City-wide working group led by Calgary Growth Strategies has been established to explore land use and building regulation changes to increase Calgary's flood resiliency.
Expand the review of the Land Use Bylaw and other development regulations to update flood resiliency requirements for private property in flood risk areas. (1c)	Underway	2019	A City-wide working group led by Calgary Growth Strategies has been established to explore land use and building regulation changes to increase Calgary's flood resiliency.
Review The City's existing land-use planning documents and develop amendments, new guidelines or policies that will minimize development in the floodplain over time. (4a)	Underway	2019	The City is working on potential changes to floodplain development guidelines or policies as part of the City-wide working group currently led by Calgary Growth Strategies.
Perform a social, economic and environmental analysis to evaluate the need for a minimum flood protection level above the 1:100 flood for land-use planning and structural protection across Calgary. (1a)	Complete	2017	The FMMA completed in 2016 and 2017 analyzed a variety of scenarios up to a 1:200 flood event. The FMMA determined that protection to a 2013 event was the most cost-beneficial scenario, which was considered a 1:100 flood event. The City currently reviews all Area Structure Plans, Area Redevelopment Plans, building permits, and City projects to identify flood risks and structural requirements based on various flood protection levels.

4. PARTNERING FOR A FLOOD RESILIENT CALGARY

The City recognizes the important role partnerships play in implementing the Expert Management Panel's recommendations. The City depends on strong partnerships with the Province, other stakeholders such as TransAlta, flood-related organizations, citizens and communities upstream and downstream to build flood resiliency.

Partnering for a flood resilient Calgary Expert Management Panel Recommendation	Status	Timeline	2017 update
Pursue a common river forecasting platform with Alberta Environment and Parks (AEP) and TransAlta for faster and more accurate information and alerts about future flood events. (2a)	Underway	2019+	The City and AEP currently work together to share information to inform their respective forecasting platforms. The City received funds from the National Disaster Mitigation Program in 2017 to support this work, starting in 2018. The Province is currently prototyping several new forecasting platforms and The City has discussed potentially sharing a platform in the future. The City will work with the Province to identify common requirements as the Province develops its platform.
Strengthen partnerships with utility providers to improve resiliency of their infrastructure and operations, with first priority to energy supply and communication networks. (1d)	Complete	2017	The Flood Emergency Response Manual is updated annually to ensure maximum protection of critical city infrastructure and vulnerable communities. CEMA has developed a critical infrastructure strategy to support CI owners in their understanding of disaster risk and how to reduce their risk. CEMA has identified core utility providers and businesses as key stakeholders.
In partnership with Alberta Environment and Parks and TransAlta, expand the network of river and weather monitoring stations upstream of Calgary and protect stations from damage during flooding. (2b)	Complete*	2017	Since 2013, The City has repaired or replaced damaged monitoring stations and installed some new stations. *This recommendation is considered complete. However, as part of forecasting platform discussions (see 2a), future monitoring station installations by the Province would benefit The City of Calgary.
In partnership with the Province, develop a time-phased plan to remove buildings from areas with high flood risk, while minimizing the disruption to affected communities. (4c)	Complete*	2017	The voluntary Provincial buy-outs program is complete and the Province has begun demolition of properties. No further Provincial buy-outs are planned at this time. *This recommendation is considered complete but may be re-visited in the future, depending on potential future Provincial policy. Currently, the Province maintains ownership of the 19 properties in Calgary.
Continue to cooperate with TransAlta and the Province to increase flood storage on the Bow River through operation of existing TransAlta facilities. (3c)	Complete	2016	The Province and TransAlta have a 5-year agreement in place for Ghost Reservoir operations, ending in 2021. The Bow River Working Group has recognized the importance of this agreement for flood mitigation and identified extending the agreement as a "quick-win" opportunity.
Host a national flood risk workshop to share best practices & develop a networking group. (6e)	Complete	2015	The City hosted the 2015 Livable Cities Forum on Building Flood Resilient Communities in September 2015 in partnership with Canadian Water Resources Association and ICLEI Canada. The City is involved in national initiatives that bring together various stakeholders to share and develop new practices, mapping and guidelines to reduce flood risk.

5. COMMUNICATING WITH CALGARIANS

It is critical for The City to keep Calgarians informed, provide resources and engage with citizens when it comes to building flood resiliency. Since 2013, City staff has met regularly with citizens, community members, organizations, community action groups, flood task forces and media for engagement and to provide community-specific updates on flood mitigation and resilience strategies.

Communicating with Calgarians Expert Management Panel Recommendation	Status	Timeline	2017 update
Develop programs that support building owners to implement flood resiliency measures. (2e)	Underway	2019+	The City continues to support building and homeowners understand their flood risk through annual communication through its Flood Readiness Campaign. Further development of a formal program to educate and support owners has been considered and is dependent on resourcing at this time. Flood Impacted People and Property Project (FLIPPR) concluded as of 2016. The Flood Permit Grant Program co-administered with Red Cross to provide permits to homeowners not eligible for the Disaster Relief Program ended as part of FLIPPR conclusion.
Incorporate lessons learned from the 2013 flood to enhance communication channels to keep Calgarians informed of conditions that may lead to high river levels. (2c)	Complete	Ongoing	The City established a cross-corporate communications plan and flood readiness communications plan. Updates, information, and general communications are provided annual through The City's social media, local media and advertising, information sessions, and e-mail flood newsletter.
Expand the flood risk communication strategy and provide information and tools that empower Calgarians to make informed choices and better manage their personal flood risk. (2d)	Complete	2015-2016	The City established a cross-corporate communications plan and flood readiness communications plan, including providing information through annual open houses scheduled during flood season and regular newsletter and website updates.

APPENDIX B –CURRENT ACRP-SUPPORTED FLOOD MITIGATION PROJECTS

Project Name	Project Status	Project Description	Estimated Completion Date
Glenmore Dam Elevated Hoists	Underway	Installation of 2.5m high automated steel gates to replace the existing 1.5m manual stop log system to increase storage at the Glenmore Reservoir.	2020
Bonnybrook Wastewater Treatment Plant Flood Mitigation	Underway	Construction of a flood barrier on the eastern perimeter of the Bonnybrook Wastewater Treatment Plant, with groundwater and stormwater management enhancements to protect the plant from flooding.	2018
Heritage Drive Permanent Flood Barrier	Underway	Construction of an earth-filled berm along Glenmore Trail at Heritage Drive and Glendeer Circle SW (underneath Graves bridge) to prevent flooding of major infrastructure and roadways in the area.	2018
Centre Street Bridge Lower Deck Flood Barrier Improvements	Underway	Construction of removable flood barriers that will be installed in the lower deck of Centre Street Bridge to prevent flooding into Chinatown.	2018
West Eau Claire Flood Barrier	Underway	Construction of a flood barrier along the Bow River downstream of Eau Claire to the Peace Bridge.	2018
Sunnyside Pump station #1	Underway	Construction of a new, flood dedicated, two story pump station to dewater the community of Sunnyside during high water events for river and stormwater management.	2019
Sunnyside Pump station #2	Underway	Flood resilience improvements associated with an upgraded pump station in the community of Sunnyside.	2019
Roxboro Sanitary Liftstation Replacement	Underway	Flood resilience improvements associated with a replacement sanitary liftstation in the community of Roxboro.	2017
Stormwater Outfall Improvements	Underway	Resilience upgrades to fifteen stormwater outfalls to prevent potential back flooding into affected communities.	2018
Western Headworks Site Condition Improvements	Underway	Bank improvements in the area to allow operation of a nearby outfall gate to reduce flood risk for the community of Inglewood as well as the Calgary Zoo, Deerfoot Trail, and Pearce Estate Park. Additional improvements for emergency access for river emergencies.	2018
Upper Plateau Separation	In design	Partial separation of Hillhurst-Sunnyside's stormwater system from communities located above in the upper plateau catchment area.	2020
Downtown Flood Barrier	Applied September 2017	Construction of a permanent flood barrier from Jaipur Bridge to Reconciliation bridge.	2022
Sunnyside Flood Barrier	Applied September 2017	Construction of a permanent flood barrier in the community of Sunnyside.	2022
Bowness Barrier	Applied September 2017	Construction of a permanent flood barrier in the community of Bowness.	2024+
Pearce Estate Park Flood Barrier	Applied September 2017	Construction of a permanent flood barrier in Pearce Estate Park near the community of Inglewood.	2024+
9 th Avenue Bridge Replacement	Applied September 2017	Raising of the 9 th Avenue Bridge to prevent damage during high water events and maintain access for fire and emergency services for the community of Inglewood.	2020

APPENDIX C – COMMUNITY DRAINAGE IMPROVEMENT PROGRAM PRIORITIZATION LIST DECEMBER 2017

Project Name	Cost Estimate*	Benefit/Cost Ratio**	Project Status	Construction Start Date/ Business Cycle**
Christie Park Upgrades & Sarcee Trail (formerly Westgate)	\$3,845	20	Complete	2015-2018
North West Inner-City - 14.5 Street	\$444	15	Complete	2015-2018
Woodlands/Woodbine - Bebo Grove and 24 St SW (formerly Pond D)	\$22,143	9	Design	2015-2018
Woodlands/Woodbine - Braeside Dry Pond (formerly Pond A)	\$6,836	9	Design Complete -- Tendered	2015-2018
Woodlands/Woodbine - Local Improvements	\$6,558	6	Design	2019-2022
North West Inner-City - Pump Station #1 – Sunnyside ¹	\$9,992	4	Design	2015-2018
North West Inner-City - Pump Station #2 – Sunnyside ²	\$10,165	4	Interim Improvements Complete, Phase 2 in design	2015-2018
North West Inner-City - Upper Plateau Separation ²	\$36,900	7	Design	2019-2022
Westgate - Ditch Upgrade / G20C Outfall ³	\$4,809	1	Design	2015-2018
North West Inner-City - Kensington Close	\$2,200	13	to be funded	2019-2022
North West Inner-City - 7th Avenue	\$2,000	8	to be funded	2019-2022
North West Inner-City - 19th Street & 9th Avenue	\$2,100	8	to be funded	2019-2022
North West Inner-City - 19th Street & 6th Avenue	\$600	8	to be funded	2019-2022
North West Inner-City - South of Riley Park	\$11,200	6	to be funded	2019-2022 (Partial Scope)
North West Inner-City - Crescent Road	\$1,100	11	to be funded	Beyond 2022
North West Inner-City - Pump Station #4 - Hillhurst	\$11,700	8	to be funded	Beyond 2022
North West Inner-City - Pump Station #3 - Hillhurst	\$8,400	7	to be funded	Beyond 2022
Pineridge / Rundle Dry Pond B	\$4,175	6	to be funded	Beyond 2022
Palliser/Oakridge - Phase 2 and Phase 1	\$18,326	6	to be funded	Beyond 2022
Tuxedo/Mount Pleasant - Phase 2, Phase 1, and Local Improvements	\$14,196	5	to be funded	Beyond 2022
Pineridge / Rundle Storage Duct #2	\$2,824	5	to be funded	Beyond 2022
Shawnessy Stormwater Upgrades	\$20,197	3	to be funded	Beyond 2022
North West Inner-City - 10th Street	\$10,900	2	to be funded	Beyond 2022
North West Inner-City - 14th Street	\$14,900	2	to be funded	Beyond 2022
Palliser/Oakridge - Phase 3	\$11,247	2	to be funded	Beyond 2022
North West Inner-City - 17th Street & 23rd Avenue	\$3,800	2	to be funded	Beyond 2022
Oakmount Dry Pond (Oakmont Way Rev Report)	\$492	1	to be funded	Beyond 2022
Macleod Trail CDI Secondary Improvements ⁴	\$6,777	TBA	TBA	TBA
Total	\$248,826			

* - Cost estimates based on 2015 study estimates, except for projects underway or complete.

** - Benefit/Cost ratio is based on original project scope and costing (costing updated in 2015)

*** - Construction schedules are subject to change with the addition of new projects added to the list.

1 - with funding from the Alberta Community Resilience Program (ACRP) and the New Building Canada Fund

2 - with funding from the Alberta Community Resilience Program (ACRP)

3 - Alberta Transportation completing Westgate Ditch Upgrade via Southwest Ring Road. City to complete downstream outfall upgrades to accommodate ditch upgrade

4 - Study completed, projects identified in study to be sequenced and list reprioritized with existing projects.