

FLOOD RESILIENCY AND MITIGATION



2015 UPDATE REPORT



Table of Contents

1. INTRODUCTION	3
2. FLOOD RESILIENCY AND MITIGATION FRAMEWORK	4
3. GOAL #4: BUILD RESILIENCY TO FLOODING	5
3.1 Understanding flood risk	5
3.2 Investing in flood protection.....	7
3.3 Strengthening flood-related policies	10
3.4 Partnering for a flood resilient Calgary	11
3.5 Communicating with Calgarians.....	12
4. RISK ASSESSMENT	14
5. RECOMMENDATIONS/NEXT STEPS.....	15

1. INTRODUCTION

The City is committed to making Calgary a safe, flood resilient community. The 2013 floods caused significant social disruption and unprecedented economic damages. To better prepare for and make Calgary more resilient to future events, The City is implementing the 27 recommendations from the 2014 Expert Management Panel Report on River Flood Mitigation.

We recognize that building resiliency to flooding is not something that can be achieved overnight and requires long-term commitment. We also know that resiliency can only be achieved by a collaborative approach with many business units across The Corporation, other orders of government and community partners and citizens. Building flood resiliency for Calgary also needs to be undertaken in the context of the entire watershed.

The City of Calgary takes an integrated watershed management approach to protecting public health, conserving our water resources, and supporting the needs of a growing city (Figure 1.0). The work related to building flood resiliency is a significant part of this approach.



Figure 1.0. Integrated Watershed Management Goals

The Flood Resiliency and Mitigation 2015 Update addresses the fourth goal, *Build Resiliency to Flooding*.

An update of the status of the three other goals, *Protect our Water Supply*, *Use Water Wisely*, and *Keep our Rivers Clean*, and stormwater flooding as it relates to the fourth goal of *Build Resiliency to Flooding* is further discussed in a separate report (Watershed Management Planning Update 2015, UCS2016-0167) to the Standing Policy Committee on Utilities and Corporate Services.

2. FLOOD RESILIENCY AND MITIGATION FRAMEWORK

The Flood Resiliency and Mitigation 2015 Update highlights progress since the 2014 Annual Report and is based on the recommendations from the Expert Management Panel Report on River Flood Mitigation. Figure 2.0 provides a framework that summarizes the 27 recommendations of the Expert Management Panel and other corporate activities underway to improve Calgary’s flood resiliency.



Figure 2.0. Flood Resiliency and Mitigation Strategic Framework

This report summarizes progress made in 2015 as well as relevant current updates within the five key performance areas outlined in the flood resiliency and mitigation plan:

- Understanding flood risk;
- Investing in flood protection;
- Strengthening flood-related policies;
- Partnering for a flood resilient Calgary; and
- Communicating with Calgarians.

As the flood resiliency and mitigation program progresses and more data and information becomes available, The City will continue to develop and refine targets, key performance

indicators, programs and evaluation to ensure activities deliver on expected outcomes.

Water Resources is responsible for leading 16 of the 27 Expert Panel Recommendations, and is involved as a stakeholder in the remaining recommendations. Water Resources continues to work with other business units including Calgary Growth Strategies, Calgary Emergency Management Agency, Calgary Neighbourhoods, Inspections and Permit Services, and Customer Service and Communications to support where needed and track the implementation of the Expert Management Panel’s recommendations.

Since 2014, all but three recommendations have been initiated, are underway or are complete (Figure 2.1). When prioritized against all other recommendations, the remaining recommendations are dependent on other work that first needs to be completed. These specific recommendations can be found within the various key performance areas.

Expert Management Panel Recommendations Progress

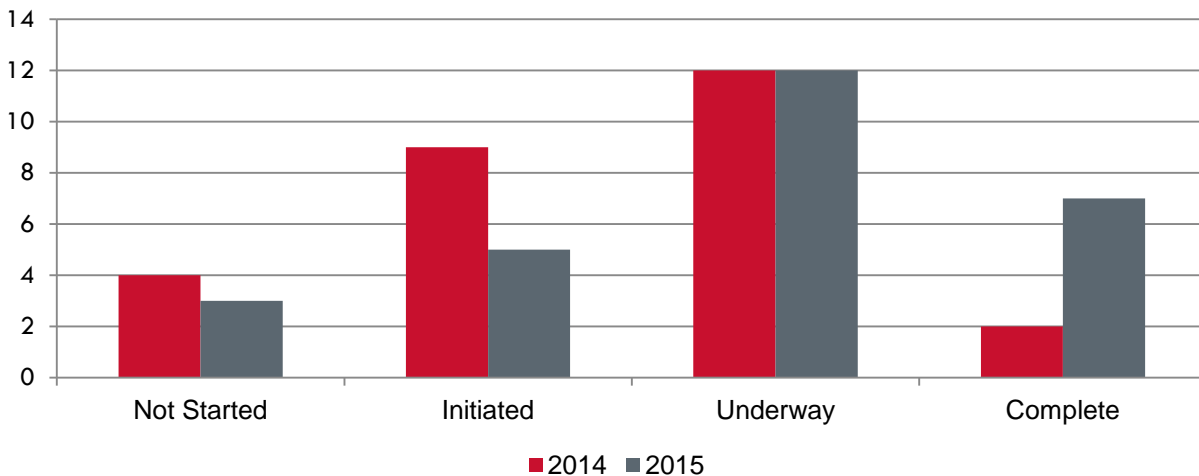


Figure 2.1. Progress on the 27 Expert Management Panel Recommendations

3. GOAL #4: BUILD RESILIENCY TO FLOODING

Building resiliency to flooding remains a priority for The City and the community. Highlights of progress and planned activities aligned with our goal are presented in this report by key performance area. The City remains committed to implementing the 27 recommendations from the Expert Management Panel and moving Calgary toward a flood resilient future.

3.1 UNDERSTANDING FLOOD RISK

There will always be a risk of river flooding and CEMA has identified flood as number one risk to Calgary in 2014 and 2015. The City uses a risk management framework (Figure 3.0) to constantly identify, assess and understand the risks to ensure the best flood mitigation decisions are made. The City uses a range of tools to understand, prepare for and mitigate this risk – from river monitoring, forecasting models, updated flood mapping and river morphology

studies to developing climate change models, community risk assessments and damage model assessments.



Table 3.1 shows the progress to date on the Expert Management Panel's recommendations related to Understanding Calgary's Flood Risk. In 2015, The City updated its flood inundation maps, which identifies the land areas expected to flood under different return frequencies. The updates reflect changes in our waterways since 2013 and show that the total land area now anticipated to be inundated during a 1:100 (one percent probability) flood event has increased within many communities. The updated maps are publicly available and will be used by Water Resources and Community

Planning to provide advisory comments on planning applications in flood hazard areas. The updated maps are also used for emergency response planning, infrastructure design and will inform the on-going work the Province is undertaking to update the Provincial flood hazard maps, expected to be complete in 2017.

In early 2015, the Province released their Flood Damage Assessment Study that described flood damages for Calgary under a range of flood return frequencies between a 1:2 and 1:1000 flood event. Once the post-2013 hydrology was available, The City refined the Province's study with the new data, refined groundwater criteria, and included social and environmental impacts. Damages are currently being finalized and it is estimated that annualized costs attributed to flooding have more than doubled from the original study to approximately \$170M, or \$17B in total damages over 100 years. This more accurate damage assessment provides a better understanding of Calgary's flood risk exposure, more precise cost benefit analyses and justifies significant investments for flood mitigation.

In addition, The City expects to complete its river morphology study in 2016, which identifies changes in river flow since the 2013 flood. This study will identify subsequent risks due to changes in the flow of the Bow and Elbow Rivers. First steps have also been taken to assess and model the effects of climate change on Calgary's flood risk and further work on understanding groundwater is underway.



Figure 3.1. Measuring river levels

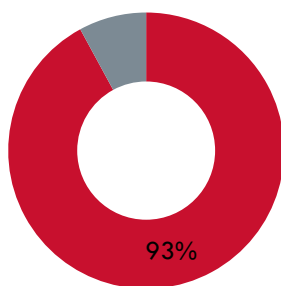
Table 3.1. Expert Management Panel Recommendations - Understanding Flood Risk

Expert Management Panel Recommendation	Status	Timeline
Publish up-to-date, graduated flood maps for public information. (5a)	Completed	2015
Urge the Province to regularly review and update official flood hazard maps. (5b)	Underway	2017
Maintain a comprehensive flood risk database integrated with existing geographic information systems. (5c)	Not started	2015-2018
Develop a suite of watershed-scale climate models to capture various weather event scenarios, with input from regional partners, post secondary institutions and other levels of government. (5d)	Underway	2015-2018
Collaborate with academic and other partners to develop computer models that identify groundwater movement in Calgary in relation to flood conditions. (5e)	Underway	2015-2018

3.2 INVESTING IN FLOOD PROTECTION

By understanding the risk, The City recognizes the significant scale of impact and the considerable investments needed for flood mitigation (Table 3.4). Provincial and federal funding is essential at this investment level and The City continues to try to secure funding through all orders of government.

Citizens that believe The City should invest more or the same in protection from river flooding



*0% change from 2014

Figure 3.2. Citizen satisfaction survey results on investment level for river flooding

Citizens believe that investment in flood mitigation is important (Figure 3.2) and The City is continually working with all orders of government to secure funding for flood mitigation as well as exploring alternative options for funding flood mitigation.

In 2015 October, the Province announced a commitment to develop Springbank off-stream reservoir. Based on current information, Springbank off-stream reservoir, operated in tandem with Glenmore Dam and its new gates (anticipated to be complete in early 2019) should protect to a 2013-size event. The City is currently working as part of the technical advisory group with the Province and their consultant to ensure optimization of flood protection.

Starting in March 2016, The City is co-chairing the Bow River Advisory Committee with the Province and participating on the Bow River Working Group to explore flood mitigation opportunities upstream on the

Bow River. The objective is to provide the Government of Alberta with strategic advice on opportunities to reduce future flood damage, improve reliability of water supply and protect the long-term health of the Bow River Basin.

Recognizing the risk exposure and need for significant investment, Administration continues to work with all orders of government to explore funding opportunities. In 2015 October, the Province announced an allocation of \$150M, over the next 10 years, for flood resiliency measures for Calgary through the Alberta Community Resiliency Program (ACRP). To date, The City has received a commitment of \$27.7M through the ACRP for six flood mitigation projects including the elevated hoists at Glenmore Dam, stormwater outfall repairs, and permanent barriers for Heritage Drive, Centre Street lower bridge deck, Bonnybrook Wastewater Treatment Plant and West Eau Claire Park (Table 3.2).

Table 3.2. City of Calgary Projects funded through Alberta Community Resilience Program

Project	Description	Funds Awarded (\$ millions)	Expected Completion
Glenmore Dam Elevated Hoists	Installation of an elevated hoist system to increase storage in the reservoir for water supply and flood mitigation.	7.60	2019
Bonnybrook Wastewater Treatment Plant Flood Protection	Construction of a flood protection berm along the eastern perimeter of the plant, with groundwater and stormwater management enhancements to protect the plant from flooding.	11.46	2017
Heritage Drive Permanent Barrier	Construction of a permanent barrier along Glenmore Trail at Heritage Drive to provide flood protection up to a 100-year event.	3.96	2017
Centre Street Bridge Lower Deck Permanent Barrier	Construction of a permanent barrier on the lower deck of Centre Street Bridge to provide flood protection up to a 200-year event.	1.53	2017
West Eau Claire Park Flood Protection	Construction of a permanent barrier at West Eau Claire park to provide flood protection to a 200-year event.	1.38	2017
Stormwater Outfall Gate Improvements	Resilience upgrades to 15 outfalls located in 12 communities across Calgary.	1.80	2017

To determine the best suite of mitigation options for Calgary, Administration is undertaking a Flood Mitigation Measures Assessment in 2016. The assessment will use a triple bottom line approach to assess the flood mitigation measures and consider feedback and input from the community. Once the analysis is complete, the suite of recommended options and implementation plan will be delivered to Council in 2017.

The assessment will consider the long-term options, such as upstream mitigation, but also balance the need for short-term action and medium-term options. All potential mitigation measures, including upstream and local infrastructure, operational strategies, land use and building policy options, riparian solutions as well as others will be analysed for both the Bow and Elbow rivers in 2016. Table 3.3 identifies the high level mitigation measures that will be considered in the assessment.

Table 3.3. Flood Mitigation Measures Assessment Summary

Timeframe	City of Calgary	Provincial/Federal Government
Short Term (underway or <3 years)	<ul style="list-style-type: none"> -Emergency response plans -Citizen Awareness and Education programs -Technical studies (river morphology study, permanent barrier study) -Mapping, modeling -Existing land use policies -Local barriers 	<ul style="list-style-type: none"> -Operations of reservoirs (e.g. Provincial agreement with TransAlta Utilities) -Flood Hazard Mapping
Medium Term (4-10 years)	<ul style="list-style-type: none"> -Glenmore Gates (2019 expected) -Bonnybrook berm (2017 expected) -Riparian Areas -Fish compensation -Local barriers -Land use policies 	<ul style="list-style-type: none"> -Flood Insurance policy changes -Building Code amendments -National flood policy -Provincial flood policy
Long Term (10+ years)	<ul style="list-style-type: none"> -Land use policies and planning -Local Barriers -Future measures 	<ul style="list-style-type: none"> -Springbank Off-Stream Reservoir on the Elbow River -Upstream storage on the Bow River

Part of achieving flood resiliency for Calgary is considering the investments made in its overall flood preparedness to enhance response to future flood events, including:

- Completing comprehensive updates to its Flood Emergency Reference Manual (FERM)
- Significantly increasing staff training for emergency response
- Doubling the amount of emergency response material in The City's inventory

In addition to investments in flood preparedness, The City has also repaired all critical erosions sites and enhanced resilience at these sites, repaired or replaced all pedestrian bridges destroyed in 2013, and is conducting ongoing work to identify, repair, and upgrade various stormwater lift stations, sanitary lift stations, and stormwater outfalls throughout Calgary. All of

the investments made by The City in 2015 ensure that the damage from an event similar to 2013 is minimized.

Table 3.4. Expert Management Panel Recommendations - Investing in Flood Protection

Expert Management Panel Recommendation	Status	Timeline
Create graduated flood protection level requirements for City infrastructure. (1b)	Initiated	2015-2018 consultation
In partnership with the Province, compare the three major capital works options for mitigating floods on the Elbow River. (3a)	Complete	2015-2016
Increase the operating water storage capacity of the Glenmore Reservoir on the Elbow River through modifications to the Glenmore Dam. (3b)	Underway	2015-2017
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	2015-2018+
Prepare a time-phased plan to modify structures that constrain river flow during flood events, such as pathways and bridges. (4b)	Not started	2018+ implementation
Establish a permanent team within The City to oversee flood preparedness and resilience. (6a)	Complete	2015 - 2016
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	2015-2018+
Evaluate social, economic and environmental impacts of flood mitigation options. (6c)	Underway	2015-2017
Develop a comprehensive climate adaptation plan and implementation tools to reduce The City's infrastructure and operational vulnerabilities. (6d)	Underway	2015-2018
Provide an annual update to City Council on progress related to the recommendations from the Expert Management Panel on River Flood Mitigation. (6f)	Complete	Annual

3.3 STRENGTHENING FLOOD-RELATED POLICIES

Ensuring that Calgary becomes a more flood-resilient city requires examining policies for land use and infrastructure design alongside structural protection investments. The City is committed to working closely with the Province on policy consultation regarding flood hazard area policies, practices and regulations, flood design levels and Special Policy Areas (SPAs) over the course of 2016 and 2017.

The City anticipates that the Province will increase provincial floodplain standards beyond the current 100-year protection level once the flood hazard mapping is updated. With the potential development of upstream mitigation it is also expected that the Province will explore the use of SPAs, allowing for some discretionary development in areas of heightened flood risk within

Calgary. The City’s Flood Mitigation Measures Assessment will be used to inform future protection standards and land use planning throughout Calgary (Table 3.5).

Since 2015, the Federal government has been working to develop national floodplain guidelines. The City participated in workshops hosted by Public Safety Canada and Natural Resources Canada. The City will continue to participate in federal workshops and other opportunities for engagement in 2016 to analyse and provide feedback on how national guidelines could affect The City of Calgary’s emergency response, operations, regulated flood protection levels and the risk faced by citizens.

The potential application of SPAs, provincial floodplain standards, and national floodplain guidelines will influence The City’s future mitigation investments and potential policy changes beyond the amendments made to the Municipal Development Plan and Land Use Bylaw in 2014. Administration understands the need to have solutions in place as soon as possible, and is considering multiple likely scenarios as part of its Flood Mitigation Measures Assessment. This ensures The City will be able to meet service levels and minimize residual risk in all potential scenarios.

Table 3.5. Expert Management Panel Recommendations - Strengthening Flood-Related Policies

Expert Management Panel Recommendation	Status	Timeline
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)	Underway	2015-2017
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)	Initiated	2015-2018
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)	Initiated	2015-2018+

3.4 PARTNERING FOR A FLOOD RESILIENT CALGARY

The City’s flood resilience work is dependent on strong partnerships with the Province, other stakeholders such as TransAlta Utilities, flood-related organizations, citizens and communities upstream and downstream of Calgary. Table 3.6 emphasizes the importance of partnerships in achieving flood resilience in Calgary.

In 2015, The City strengthened these relationships by continuing its strategic work with the Province through regular meetings, as well as participation on the Springbank off-stream reservoir technical committee, co-chairing the Bow River Advisory Committee and participation on the Bow River Working Group, which will evaluate additional mitigation options for the Bow River upstream of Calgary. The City also partnered with the Province and Calgary Rivers

Community Action Group to host the Flood Readiness open houses for 2015 and will do the same in 2016.

In 2015, the operational agreement between the Province and TransAlta for the operation of the Ghost Reservoir lowered levels during flood season to minimize the risk of a flood on the Bow River. The Province and TransAlta are currently discussing a new agreement for operating the Ghost Reservoir to reduce Calgary’s flood risk during flood season.

In addition to working with the Province, The City hosted over 170 delegates and presenters at the 2015 Livable Cities Forum on Building Flood Resilient Communities based on the recommendation from the Expert Management Panel to host a national flood risk management event to share best practices and develop an ongoing network group. As a result of the Forum, a steering committee has been formed to establish a national network to address municipal flood resilience priorities across Canada.

Table 3.6. Expert Management Panel Recommendations- Partnering for a Flood Resilient Calgary

Expert Management Panel Recommendation	Status	Timeline
Strengthen partnerships with utility providers to improve resiliency of their infrastructure and operations, with first priority to energy supply and communication networks. (1d)	Underway	2015 – 2018
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)	Initiated	2015-2018
In partnership with AEP and TransAlta, expand the network of river and weather monitoring stations upstream of Calgary and protect stations from damage during flooding. (2b)	Initiated	2015-2018
Continue to cooperate with TransAlta and the Province to increase flood storage on the Bow River through operation of existing TransAlta facilities. (3c)	Underway	2015-2016
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)	Not Started	2017-2018+
Host a national flood risk management workshop to share best practices and develop an ongoing networking group. (6e)	Complete	2015

3.5 COMMUNICATING WITH CALGARIANS

To build civic flood resiliency, The City expanded the way it shares information and communicates with citizens with respect to flooding. In 2015, The City created a targeted public awareness campaign, called Flood Readiness, to increase citizen understanding, preparedness and opportunities to stay informed (Table 3.7). The City has used multiple methods to connect with citizens, including open houses, one-on-one meetings, videos and continued distribution of

the Flood Readiness subscriber based newsletter, providing updates on river levels, upcoming events, and flood mitigation work.

In addition, City staff met frequently with citizens, community members, organizations, community action groups, a flood task force and media to provide community specific updates including overall mitigation strategies. The City, through the Calgary Emergency Management Agency, also launched READYCalgary to help inform, educate, and build resiliency to the impacts of emergencies and disasters in Calgary communities. READYCalgary has worked with 16 communities to date.



Figure 3.3. Flood Readiness Information Session, May 2015

As part of its work to support flood-impacted homeowners, The City's Flood Impacted People and Property Recovery (FLIPPR) project reported in 2015 that 100% of properties damaged in 2013 are either completed or currently in the recovery process. The Flood Grant Permit Program also provided \$20,000 to homeowners not eligible for Disaster Recovery Program funds in 2015. It is expected that 2016 will be the final year for the program.

From the learnings, interactions and shared understanding gained throughout 2015, The City developed a comprehensive corporate flood communication plan, which further expands the way we share information and communicate with citizens. The plan will provide citizens with year-round information on flood readiness and how to prepare for all types of flooding.

Administration's Water Oversight Committee is a team of Directors representing various City departments that monitors and co-ordinates cross-department flood preparedness and oversees communication initiatives to prepare citizens for flood and drought season. This is the second year this committee has been active.

The City has planned significant community and stakeholder engagement work occurring in 2016. This work will be used to help determine future investment decisions related to flood mitigation and resiliency and will be part of the Flood Mitigation Measures Assessment. Input from the public will be gathered through:

- Community Advisory Group (March-November) – a group of 21 participants from flood-impacted and non-flood impacted communities, businesses, flood-focused community groups, watershed organization to provide input into optimizing options to meet community needs, review mitigation measures and examine trade-offs and liaise with respective organizations.

- Public Survey (March-April) – gauge citizens opinions and values on how the floodplain should be used through a telephone survey. Information will be used to inform the triple bottom line criteria in assessing the various flood mitigation measures.
- Community and stakeholder feedback (September-October) – engage communities and stakeholder groups (i.e., businesses, development industry, social agencies, etc.) to provide feedback on flood mitigation measures.

Table 3.7. Expert Management Panel Recommendations - Communicating with Calgarians

Expert Management Panel Recommendation	Status	Timeline
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	2015-2016
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
Develop programs that support building owners to implement flood resiliency measures. (2e)	Underway	2017

4. RISK ASSESSMENT

Calgary is one of Canada’s economic engines and our people, critical infrastructure, property, and economy must be protected from flood impacts. Lack of sufficient flood mitigation funding will increase costs to all Albertans, create significant impacts due to damage, and could worsen the risks associated with the current economic climate.

- The City continues to prioritize its mitigation projects where the need is most urgent and has received a Provincial allocation of \$150M over ten years for investment in flood mitigation measures. The City is also playing an active role in trying to secure federal funding for flood resiliency and mitigation work to limit its overall risk exposure to flood.

Implementation of flood mitigation measures within Calgary depends on decisions made by the Province, such as design and construction of the Springbank off-stream storage reservoir, upstream mitigation options on the Bow River, updated provincial flood hazard mapping, changes to provincial floodplain standards and policy; and operation of TransAlta Utilities’ facilities. Failure to coordinate with Provincial activity could result in significant service delivery, financial, and reputational risks for The City.

- This risk is being mitigated through participation on the Province’s technical and strategic stakeholder committees, and ongoing communication with other partners.

Potential risk exists that the Province does not proceed with its upstream mitigation plans, placing additional responsibility on The City to plan and fund mitigation.

- Upon completion of the Flood Mitigation Measures Assessment, The City intends to develop long-term plans for mitigation considering scenarios both with and without provincial upstream mitigation.

Flood mitigation is a complex issue and long-term process and The City must be prepared for flooding in the interim before major investments in protection are implemented.

- The City has stockpiled riverbank-protection and temporary barrier materials, repaired critical erosion sites, and refined its emergency response procedures. To ensure that citizens and businesses are prepared, The City improved and expanded its flood preparedness communication tools. Through partnerships, The City has provided support to businesses and community agencies to prepare for, respond to, and recover from flooding.

5. RECOMMENDATIONS/NEXT STEPS

While complex and interrelated, assessing the social, environmental and economic costs and benefits of flood mitigation options is a critical component of the work within this program. A comprehensive triple bottom line approach is being taken to ensure that the social and environmental costs of mitigation are understood, in addition to more traditional economic costs.

The triple bottom line approach will be used to create a prioritized list of investments and actions and will inform The City's long-term flood resilience planning both with and without upstream mitigation from the Province. The suite of recommended measures and implementation plan will be delivered to Council in 2017 for approval and will inform the flood mitigation infrastructure list that will align with the ACRP and other funding opportunities being explored.

Data related to Calgary's flood resilience and citizen perceptions of flood will continue to be collected in 2016 to gather information that will potentially inform future baseline trends on Calgary's flood resiliency and mitigation work.

Proposed Actions for 2016:

- Complete the triple bottom line analysis of flood mitigation measures for Calgary and develop prioritized list of recommendations for Council in 2017
- Complete comprehensive engagement on flood mitigation measures through The City's Community Advisory Group and citizen and stakeholder engagement
- Continue work with the Province through the Springbank Reservoir Technical committee, Bow River Advisory Group, and the Bow River Working Group
- Continue participation in national floodplain guideline discussions