

Detailed Implementation Plan for Flood Mitigation Recommendations

1. Exploring Mitigation Options

The Expert Management Panel noted that several possibilities for flood mitigation require a thorough assessment before a decision can be made on whether and how to undertake them. Mitigation options that involve significant investments in infrastructure, such as permanent barriers, need to be compared against each other and considered alongside options for reducing risk by amending land use policies in flood prone areas.

Implementing these recommendations requires exploring the technical feasibility and benefits of specific options, engaging citizens on their vision for the future of river valley lands and flood mitigation for particular neighbourhoods, and performing triple bottom line assessments to compare mitigation alternatives. In exploring options, The City seeks to implement solutions that minimize adverse effects on the community and allow for flexibility to adapt to a changing climate and watershed.

Three recommendations in Exploring Mitigation Options (1c/4a and 6c/1a) align with work underway for Stage Two of the Flood Hazard Area Policy and Land Use Bylaw Review Project being undertaken by City Wide Policy & Integration. The first stage included Council approval of amendments to the Land Use Bylaw and Municipal Development Plan on 2014 June 09. Stage Two requires a more extensive regulatory review to better manage development in the floodplain and create flood resiliency for private property.

Administration will require resources for Stage Two, to research, analyze, and hire consultants to conduct the following:

1. Examine flood vulnerability and the flood risk levels through a technical risk study within flood prone areas of Calgary. This will be achieved through the use of external consultants and in-house expertise. Administration will provide a Request for Proposal, terms of reference to the consultants, project coordination, and technical support. The outcomes of the study will consider how possible mitigation strategies will to respond to flood risk.
2. Retain a consultant to provide a triple bottom line review from a city-wide social, environmental and economic perspective.
3. Conduct extensive public engagement to gather citizen feedback. Engagement will be widespread, and will include consultation with internal and external subject matter experts, and professional organizations. The scope of engagement will greatly influence both the timeframe and resources needed to conclude this portion of the project.

These actions will help determine which solutions in which risk areas are optimal. The decisions resulting from these activities will impact implementation on a number of the recommendations in the *Investing in Resiliency* section.

Expert Management Panel Recommendation	Scope of work 2015-2018	Deliverable 2015-2018	Timeline
3a. In partnership with the Province, compare the three major capital works options for mitigating floods on the Elbow River: <ol style="list-style-type: none"> i. A diversion from the Elbow River to the Bow River, in accordance with the conclusions of the feasibility studies underway. ii. The Springbank off-stream diversion and storage site. 	The approach to implementing this recommendation has changed in light of the Province's announcement on 26 September 2014 that the Springbank dry reservoir will go ahead. Water Resources will continue to work toward collaborating with Alberta Environment & Sustainable Resource Development (AESRD) to look at whether the Glenmore Reservoir diversion tunnel and McLean Creek dry dam will proceed in conjunction with the Springbank dry reservoir. A triple bottom line analysis would inform the broader triple bottom line assessment to be carried out as part of 6c. This requires regular meetings with AESRD to share data and information, collaborate on a communications strategy, and engage with citizens. An	Elbow River capital works options have been compared according to a common triple bottom line methodology and stakeholders have been consulted. A preferred option has been identified.	2015-2016

Detailed Implementation Plan for Flood Mitigation Recommendations

<p>iii. The McLean Creek dry dam.</p>	<p>environmental review for McLean Creek is underway, and the final feasibility report on the Glenmore Reservoir Diversion Tunnel was received in July 2014.</p>	
<p>3b. Increase the operating water storage capacity of the Glenmore Reservoir on the Elbow River through modifications to the Glenmore Dam.</p>	<p>Life-cycle maintenance presents the opportunity to achieve some additional storage through necessary retrofits to the Glenmore Dam. Replacing the wooden stop log system with steel gates will allow mitigation of floods as large as a 1-40 year, greatly reducing downstream flood damage. The gates will also be able to carry ice loads, doubling the reservoir's winter water storage capacity. Funding from the Province has been requested to add elevated hoists which would permit the installation of higher gates, further increasing flood mitigation capacity.</p>	<p>Optimal water storage capacity is achieved in the Glenmore Reservoir as part of planned retrofits to existing infrastructure.</p> <p>2015-2017</p>
<p>3c. Continue to cooperate with TransAlta and the Province to increase flood storage on the Bow River through operation of existing TransAlta facilities.</p>	<p>In light of the Province's announcement on 26 September 2014 that the Province will negotiate a long-term agreement with TransAlta Utilities to ensure the Ghost Reservoir would be able to accommodate flood waters on the Bow River; Water Resources will continue to support this effort. Our efforts will include providing input into operational procedures on TransAlta's infrastructure network in the Bow watershed.</p>	<p>Operating decisions regarding flood water storage in TransAlta reservoirs are made with input from the Province and The City.</p> <p>2015-2016</p>
<p>6c. Evaluate social, economic and environmental impacts of flood mitigation options.</p> <p>1a. 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.</p>	<p>City Wide Policy & Integration and Water Resources will consider structural mitigation options (constructing major civil works (3a and 3b) and constructing additional flood barriers (3d)), and perform a triple bottom line (TBL) analysis to determine the optimal combination of solutions. The Province is undertaking a study that includes flood damage estimates in Calgary to be completed by the end of 2014, which will help inform the triple bottom line analysis undertaken by The City.</p> <p>The outcomes of the triple bottom line analysis will be used in the land use policy review (1c/4a), and to assess the need for a plan to remove buildings from flood risk areas (4c). Following assessments and decisions on structural and land use policy options, Water Resources will identify the flood protection level that will be achieved in each neighbourhood by implementing these measures. A gap analysis will identify whether adequate flood protection will be achieved across the city, or additional protective measures are necessary.</p>	<p>Structural mitigation options on the Elbow and the Bow have been assessed according to a triple bottom line analysis and the optimal capital investments have been identified. Areas where additional flood protection is warranted are identified and structural and land use measures are selected.</p> <p>2015-2017</p>
<p>1c. Expand the review of the Land Use Bylaw and other development regulations to update flood resiliency requirements for private property in flood risk areas.</p> <p>4a. 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.</p>	<p>As part of Stage Two Flood Hazard Area policy and Land Use Bylaw review, City Wide Policy & Integration will:</p> <ul style="list-style-type: none"> - Investigate the potential for expanding land use regulation for flood resiliency beyond the Flood Hazard Area. - Review and include flood resilience planning in key City policy and planning documents, and determine if new policies are required to ensure long-term management of the floodplain. <p>This requires determining flood risk levels through a risk analysis and widespread citizen engagement.</p>	<p>New policies adopted that guide appropriate development in flood risk areas.</p> <p>2015-2018</p>

Detailed Implementation Plan for Flood Mitigation Recommendations

2. Strengthening Partnerships

Relationship management is critical to the success of this implementation plan, particularly within the *Exploring Mitigation Options and Mapping, Forecasting and Modeling* sections. As such, The City will continue to build and maintain existing partnerships with the Province, TransAlta, the University of Calgary - Urban Alliance, and other organizations. In doing so, we will mitigate upstream impacts and infrastructure development risks, continually improving Calgary's resiliency to flood. To strengthen these partnerships, The City continues to hold regular meetings, provide data and analysis and participate in decision-making processes to improve flood resiliency.

Expert Management Panel Recommendation	Scope of work 2015-2018	Deliverable 2015-2018	Timeline
<p>1 d. Strengthen partnerships with utility providers to improve resiliency of their infrastructure and operations, with first priority to energy supply and communication networks.</p>	<p>Calgary Emergency Management Agency (CEMA) will continue to work with the utility providers (energy and communication suppliers) to increase resiliency of their infrastructure, operations and emergency planning. This includes ensuring that:</p> <ol style="list-style-type: none"> 1. Critical infrastructure owned and operated by utility provider is identified and mapped. 2. Emergency plans and contact lists are reviewed regularly and shared with CEMA. 3. CEMA will work with TransAlta to ensure participation in The City's annual flood exercises. 4. Real-time flows and facility operations information from TransAlta is shared with CEMA. 	<p>Improved emergency planning, critical infrastructure mapping, and information sharing between utility providers and CEMA.</p>	<p>2015 - 2016</p>
<p>6 b. 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.</p>	<p>Water Resources will maintain communication through formalized collaboration with the Province to assess flood mitigation options within and upstream of Calgary. Regular meetings include strategizing with the Province on flood policy and mitigation issues.</p>	<p>Water Resources is actively involved as a stakeholder in flood decisions from a capital and operational perspective on the Bow and Elbow Watersheds.</p>	<p>2015-2018+</p>
<p>6 e. Host a national flood risk management workshop to share best practices and develop an ongoing networking group.</p>	<p>Water Resources will plan a flood resiliency workshop in late 2015 or early 2016 focused on municipalities. This includes identifying workshop themes, key speakers, and pursuing funding and partners to collaborate on hosting a multi-day event.</p>	<p>Representatives from municipalities and experts across North America attend, and an ongoing national dialogue on best practices in urban flood resiliency is initiated.</p>	<p>2015</p>

Detailed Implementation Plan for Flood Mitigation Recommendations

3. Mapping, Forecasting and Modeling

Flood forecasts, mapping, and modeling are important components of flood preparedness and understanding risk. Strengthening knowledge in these areas can lead to improved response during an event, and better watershed management decisions in general. A better understanding of historical events, future climate scenarios, and groundwater influences can inform flood risk assessments, improve flood hazard maps, and inform design standards. This allows decision makers to address vulnerabilities and direct resources where needs are highest. The City's capacity to forecast floods, communicate flood risk to citizens, and anticipate future flood risk should be incorporated into resiliency projects under the *Exploring Mitigation Options and Investing in Resiliency* sections.

Expert Management Panel Recommendation	Scope of work 2015-2018	Deliverable 2015-2018	Timeline
2 a. Pursue a common river forecasting platform with Alberta Environment and Sustainable Resource Development (AESRD) and TransAlta for faster and more accurate information and alerts about future flood events.	Water Resources will examine the feasibility of a multi-model forecasting platform with AESRD and TransAlta that can use ensemble forecasts. This includes dedicating resources to explore the feasibility and a cost-share with AESRD and TransAlta for forecasting improvements.	Improved sharing of real-time forecasting and modeling outputs between organizations, resulting in faster and more accurate forecasts.	2015-2016
2 b. In partnership with AESRD and TransAlta, expand the network of river and weather monitoring stations upstream of Calgary and protect stations from damage during flooding.	Water Resources will contribute to an AESRD and TransAlta partnership to install additional hydrological and weather monitoring stations upstream of Calgary on the Bow and Elbow Rivers. This involves contributing one third of finances towards the new stations. At least eight locations identified by Water Resources, the Province, and TransAlta. New stations could include links to GIS, and specialized technology for better real-time forecasting. AESRD would likely operate the stations on behalf of Water Survey of Canada.	Eight additional monitoring stations are in place and resilient to effects of flooding.	2015-2016
5 a. Publish up-to-date, graduated flood maps for public information.	As part of the new maps project on calgary.ca, Infrastructure & Information Services will work with Water Resources to prepare updated, user-friendly graduated flood maps, which includes address search capability.	User-friendly, up-to-date, flood maps, searchable by address, published online.	2015
5 b. Urge the Province to regularly review and update official flood hazard maps.	To support conversations with the Province, The City will investigate the implications of publishing updated official flood hazard maps.	Province has updated flood hazard map for Calgary.	2017
5 c. Maintain a comprehensive flood risk database integrated with existing geographic information systems (GIS).	Water Resources will collaborate with Infrastructure and Information Services to include information from the 2013 flood as a layer to The City's GIS. This includes identifying and generating additional economic, social, and environmental data layers required.	Database is expanded to include flood-related information.	2015-2018
5 d. 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.	Environmental & Safety Management will collaborate with Water Resources and external partners to develop watershed-scale climate models for the region. These models should include detail at a regional scale, and examine the impacts of potential extreme weather events. Within 2015-2018, The City and partners will determine the project scope, elect the researchers, design the study, and pursue funding if necessary. This recommendation is related to UEP 2015-2018 Action Plan item: <i>H3.1 Collaborate with partners in the development of climate change models for the region to gain a broader perspective.</i>	A regional climate model is initiated that will improve our understanding of how climate change is impacting the local environment, and the size and frequency of extreme events within the watershed.	2015-2018

Detailed Implementation Plan for Flood Mitigation Recommendations

<p>5 e. Collaborate with academic and other partners to develop computer models that identify groundwater movement in Calgary in relation to flood conditions.</p>	<p>In conjunction with Recommendation 5a, Water Resources will work with partners including the University of Calgary to develop groundwater monitoring, maps or models that identify high groundwater flood-risk areas to understand the influence of groundwater flows during flooding. These models can be then used to assess the relative costs and risks of surface and groundwater impacts during floods, and provide this link to land use policy development (Recommendation 1c/4a).</p>	<p>Groundwater maps that complement flood inundation maps.</p> <p>2015-2018</p>
--	---	---

4. Citizen Awareness and Outreach

Administration will create a communications strategy to expand public awareness and knowledge of the high river flow season and the potential for flood events. Citizen engagement and safety will be a priority and broad outreach programs will be designed to encourage personal preparedness, business continuity and public safety. Easy-to-understand materials will be distributed through broad and targeted public awareness campaigns. Enhanced online tools and resources such as general and specific information, checklists, information videos, and property specific maps that outline flood risk areas will support awareness campaigns. The tools and resources developed will help property and business owners to understand their personal risks and needed actions to build civic resiliency when future flood events occur.

Expert Management Panel Recommendation	Scope of work 2015-2018	Deliverable 2015-2018	Timeline
<p>2 c. Incorporate lessons learned from the 2013 flood to enhance communication channels to keep Calgarians informed of conditions that may lead to high river levels.</p> <p>2 d. 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.</p>	<p>Customer Service & Communications will prepare a comprehensive communication strategic plan to support Calgarians in their personal flood preparedness. In developing the plan, Customer Service & Communications will consult with Water Resources and other business units and work together to share resources and create efficiencies in outreach delivery. Tools and resources will be developed to enrich Calgarians' understanding of the spring run-off season and the need to take precautions to mitigate property damage during water related events.</p> <p>Additionally, this communications plan will incorporate strategic alignment with the four stages of the emergency management cycle (preparedness, response, and recovery, mitigation) to keep Calgarians informed of conditions that may lead to high river levels. This will include working with CEMA and other supporting business units on how to improve the timing process of relaying information to Calgarians during an event, as well as improving inter-agency communication to shorten communication response times.</p>	<p>A comprehensive communication strategic plan is developed along with implementation timelines.</p> <p>Development, design and implementation of outreach programs for home, property and business owners.</p> <p>High water season and preparedness awareness campaigns are prepared.</p>	<p>2015 - 2016</p>
<p>2e. Develop programs that support building owners to implement flood resiliency measures.</p>	<p>Inspection & Permit Services will work with Customer Services & Communications and other supporting business units to build on The City's existing outreach programs for home owners, businesses, condo associations and building operators to implement flood resiliency measures. A gap analysis will be conducted to identify the needs of these groups and how new programs could address them.</p>	<p>A Flood Resiliency Program is in place to assist residential property and business owners and operators in their resiliency to flood events.</p>	<p>2016</p>

Detailed Implementation Plan for Flood Mitigation Recommendations

5. Investing in Resiliency

A broad, system-oriented outlook, based on the entire watershed must be taken to promote resiliency and accommodate change over the long term. Given that different areas will have varying levels of risk, a graduated approach to mitigation will be taken. The results of the work undertaken in *Exploring Mitigation Options* will contribute to decision-making in investing in flood resiliency for Calgary.

Implementing capital works, operational procedures, and land use policy changes will impact the decisions on additional flood resiliency measures. These decisions will influence the need for additional permanent barrier construction, and also determine the way forward on creating additional flood protection standards for City infrastructure. Assessing the viability of a time-phased plan to the potential removal of buildings from areas with high flood risk, while minimizing disruption to affected communities will be initiated in 2017, after analyzing the findings of the risk study, triple bottom line analysis, and citizen engagement conducted from 2015-2017.

Expert Management Panel Recommendation	Scope of work 2015-2018	Deliverable 2015-2018	Timeline
<p>1 b. Create graduated flood protection level requirements for City infrastructure.</p> <p>4 b. Prepare a time-phased plan to modify structures that constrain river flow during flood events, such as pathways and bridges.</p>	<p>Considering the land use and structural flood mitigation measures that will be implemented, Water Resources will consult with asset managers throughout The Corporation to identify graduated levels of flood protection depending on the function of City infrastructure. This includes an infrastructure inventory review, a policy evaluation on how flood protection is considered within City infrastructure planning, and a best practices analysis. If necessary, graduated design standards for specific locations or types of infrastructure will be developed through this collaboration.</p> <p>On a life-cycle basis for individual projects, The City evaluates design considerations relating to flood impacts. However, formalized standards that reduce the impact of bridges and pathways on river flood levels will be implemented through this process.</p>	<p>As necessary, standards for flood protection for City infrastructure have been developed depending on the infrastructure's function, and necessary modifications have been planned to allow space for the river to flow.</p>	<p>2015-2018 consultation</p> <p>2018+ implementation</p>
<p>3 d. Construct additional or higher flood barriers in key locations throughout the city and update temporary flood barrier plans to protect against higher flood levels.</p>	<p>Based on outcomes of the conceptual design study for raising flood barriers and the assessments of structural mitigation options (3a/6c), Water Resources will identify a construction sequence and funding for new permanent protective barriers within Calgary for communities and critical infrastructure. High-priority permanent barriers will be constructed prior to 2018 and others may be constructed if funding is provided by the Alberta Community Resilience Program. Water Resources will also evaluate the expansion of temporary flood barrier plans to include floods higher than the 1:100 year flood.</p>	<p>Permanent flood barriers, where appropriate, have been constructed.</p>	<p>2015-2018+</p>
<p>4 c. 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.</p>	<p>Starting in 2017, City Wide Policy & Integration will work with key business units to investigate the need for additional changes to land use in communities within areas identified as at risk. Determining the direction requires the results of the flood risk study, community consultation and evaluation of the TBL impacts, costs and benefits carried out in 1c/4a and 6c.</p>	<p>If required, a plan to remove specific buildings and manage the properties has been developed and adopted by the Province and City Council.</p>	<p>2017-2018+</p>
<p>6 d. Develop a comprehensive climate adaptation plan and implementation tools to reduce The City's infrastructure and operational</p>	<p>Environmental & Safety Management will work with asset managers throughout The City to implement the Corporate adaptation strategy under development. This includes identifying City assets that would benefit from a climate vulnerability assessment, and facilitate/support assessments and</p>	<p>Corporate climate adaptation plan is complete and implementation initiated. The national Public Infrastructure</p>	<p>2015-2018</p>

Detailed Implementation Plan for Flood Mitigation Recommendations

vulnerabilities.	resulting action. There is an opportunity to expand adaptation planning to operational and emergency management as well as business continuity planning. This recommendation is related to UEP 2015-2018 Action Plan item: H3.2. <i>Develop a comprehensive climate adaptation plan and implementation tools to reduce future impacts.</i>	Engineering Vulnerability Committee (PIEVC) protocol or other evaluations have been carried out for identified critical infrastructure.
------------------	--	---

6. Governance and Accountability

The implementation of river flood mitigation and resilience activities needs to be considered within the broader Corporate resiliency agenda. A future Corporate resiliency framework should include identification and analysis of acceptable levels of risk for The Corporation, and provide context for the Panel’s recommendations on river flood mitigation.

A dedicated team has been established in Water Resources that is responsible for coordinating and implementing the Panel’s recommendations that are led by Water Resources and providing coordination, where necessary, for the recommendations supported by Water Resources. This team will ensure work is completed in a timely manner, deliverables are met, and alignment with future Corporate resiliency is made.

Expert Management Panel Recommendation	Scope of work 2015-2018	Deliverable 2015-2018	Timeline
6 a. Establish a permanent team within The City to oversee flood preparedness and resilience.	A flood resiliency group in Water Resources was formed to coordinate and monitor the progress in implementing the Panel recommendations related to Water Resources. This work will align with a future Corporate resiliency framework.	A dedicated group is created within Water Resources to oversee flood resiliency and will align with a Corporate resiliency group to be established mid-2015.	2015 - 2016
6 f. Provide an annual update to City Council on progress related to the recommendations from the Expert Management Panel on River Flood Mitigation.	In Q2 2015, the first annual report on the progress of the Panel’s recommendations will be presented to Council, and it is envisioned that future reports will align with any Corporate resilience reporting.	Annual update in early May on progress of implementation plan.	2015- 2018+