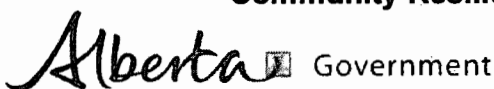


Community Resilience and Mitigation Assessment



Assessment Form
Resilience and Mitigation Branch

COMMUNITY RESILIENCE AND MITIGATION ASSESSMENT

Introduction

As part of the application process for the Alberta Community Resilience Program (ACRP), applicants are asked to submit a Community Resilience and Mitigation Assessment.

Disasters occur at the intersection of community vulnerability and natural hazards. Disaster mitigation is a multi-dimensional problem; while you can mitigate risk to a certain degree, you cannot eliminate it. Building resilience in Alberta is the shared responsibility of all Albertans.

A "resilient" community develops and adopts a comprehensive plan to manage community risk that identifies acceptable levels of impact, specifies appropriate measures to mitigate adverse impacts, and implements this plan in a manner that is adaptable, innovative, and highlights their shared accountability.

The goal of this assessment is to help communities develop a plan for long-term flood and drought mitigation through consideration of existing hazards, current vulnerabilities, and current and future mitigation elements within the community. This assessment will also support the community's existing emergency management program.

Name of Community:

Calgary, Alberta

Population:

1,230,915 (2015 census)

Assessment Components

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Section 1 Hazard and Risk Identification

1. Please list the natural water-related hazards facing your community

Please describe. E.g. River and overland flooding, stormwater management, erosion, drought. Please include degree of impact (frequency, duration), degree of damage (e.g. annual cost), etc.

The most significant natural water-related hazard facing Calgary is overland river flooding.

In 2013, Calgary experienced a flood along the Bow and Elbow rivers that resulted in over \$409 million damage to The City of Calgary's infrastructure alone. Devastating damage was also caused to 2,676 private homes and businesses, as parts of downtown and many residential areas were inundated by floodwaters along both rivers. At the time, the flood of 2013 was considered to be close to a 1:100 frequency event.

The February 2015 Provincial Flood Damage Assessment Study for The City of Calgary states that total damages including direct and indirect damages for a 1:100 year flood are estimated at \$1.815 billion for the Bow and Elbow rivers combined, with sewer backup damages included. Average annual damages for the Bow and Elbow rivers combined are estimated to be \$84,431,000 (\$54,320,000 for the Bow and \$30,111,000 for the Elbow). These costs include residential, commercial, and infrastructure damages.

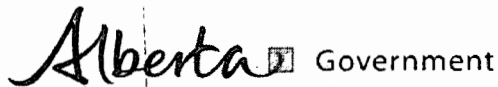
In an event, as experienced in 2013, sections of downtown and several residential areas are subject not only to overland flooding, but groundwater upwelling and stormwater inundation. Some areas along the Elbow River flood significantly during floods as low as 1:20 year events. This was evidenced in 2005 with a 1:10 event on the Bow River and 1:20 event on the Elbow River.

The impact of groundwater and stormwater on riverside communities when river levels are high is a key hazard. Under these conditions, communities adjacent to aquifers may experience significant flooding by groundwater and stormwater inundation. Many of the costs of the 2013 flood were due to groundwater and stormwater inundation.

Significant erosion can occur during high water and flood events along Calgary's riverbanks and escarpments. About 35 km of riverbanks were severely eroded along the Bow and Elbow rivers during the 2013 flood, adding significant sediment, soil and rocks to the Bow and Elbow rivers. The erosion impacted riparian health, fish habitat and infrastructure located on or near the riverbanks and in some cases presented a public safety concern. Erosion protection is required to protect outfalls, maintain stormwater service, maintain riparian functions, and help prevent overland flooding of communities and roadways. It will likely take until 2018 until we are able to repair all of the damage created by the 2013 flood.

Municipal drought is a water management challenge in the Calgary region. Drought occurs occasionally, as the city is situated in a prairie grassland environment which historically has naturally occurring cycles of drought. For most of our watershed, there is a 20-30 per cent chance of drier conditions occurring in any given year. The City of Calgary's Drought Management Plan (2011) cites growing evidence that suggests the severity of droughts in the Calgary region could get worse in the future. The plan found that despite higher water demand in the summer, competing irrigation and hydropower water management considerations, the

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most critical scenario for municipal drought would likely be from late winter through early spring.

Another water-related hazard is ice jams that can occur in the winter. Ice jams primarily cause groundwater seepage into basements. The City is studying ice formation on the Bow River, and an ice monitoring program is in place to assess potential impacts of ice build up on the river or infrastructure.

2. Please list the community values vulnerable to water-related hazards

Examples: Public safety, critical infrastructure, residential and commercial property, etc.

The City of Calgary has established flood mitigation strategies and emergency management procedures. However, as the flood of 2013 has shown, more upstream structural and non-structural mitigation options are needed to better protect citizens, community and business from future devastating floods. The first priority when dealing with water related hazard is protecting public health and safety. Second is protecting critical infrastructure, which includes access to public health facilities, energy facilities, water supply sources, water and wastewater systems, telecommunication assets, and Calgary's transportation systems (roads, bridges, and public transit infrastructure). Protection of the city's downtown area, which is the economic engine of Calgary and the location some critical municipal infrastructure, is crucial. Flood prone communities that include high and low density residential and commercial areas is also a significant community value.

Section 2 Mitigation Assessment

1. **What mitigation strategies currently exist in your community? Does the community have an established strategy or approach that describes how the hazards identified in Section One will be addressed?**

Examples: Land use controls and development bylaws, inter-municipal (regional) planning reports, existing structural measures – location, purpose, effectiveness, public engagement on procedures during emergencies, education, and awareness, etc.

The City of Calgary is moving towards a total watershed approach to address all water-related hazards and ensure the long-term resiliency of communities. As such, The City of Calgary has recently created a new division in Water Resources to address and manage this - Watershed Planning. This new division is made up of resource planning and policy, flood mitigation and resiliency, and river engineering. The mandate of this division is to consider all hazards and risks and make management decisions in a holistic way, considering implications on all facets of our watershed.

The City of Calgary has also developed a flood resiliency and mitigation plan that identifies many strategies related to river flood. The City also maintains related emergency management procedures. However, as the flood of 2013 has shown more upstream, structural and non-structural mitigation options are needed to better protect citizens, community and businesses from future devastating floods.

Please see Table 1 on page 9 - Overview of the mitigation measures for The City of Calgary. This table contains plans, strategies, programs, and bylaws aimed at building resiliency within our community.

2. **What outcomes do you want to achieve?**

The City of Calgary wants to become a resilient city taking a risk-based approach to all hazards. In this context, Calgary has a goal of becoming a flood resilient city, meaning that we would like a comprehensive suite of mitigation options available to protect Calgarians and our economy for the severe impacts of flooding. The City considers all hazards and demonstrating resiliency may be of assistance in securing future flood insurance coverage and contribute to lower insurance premiums.

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3. What other mitigation strategies could you implement to help you become a more resilient community?

Refer to the Provincial Flood Mitigation Studies and the Provincial Flood Damage Assessment Tool to help refine your options as you evaluate different strategies. Please identify any perceived limitations (assumptions), opportunities, and trade-offs.

- Flood Mitigation Studies

Attached, please see our 2014 Annual Report on Flood Resiliency and Mitigation. The plan includes actions identified within each of the five areas: strengthening flood related policies, investing in flood protection, understanding flood risk, communication with Calgarians and partnering for a flood resilient Calgary. Strategies have been or are being developed and undertaken within these five areas and opportunities that go beyond the strategies put forth in this application.

Should the Province develop upstream mitigation options on the Bow and Elbow Rivers that would mitigate to the current level of protection of 1:100, this would help Calgary become a more resilient community.

Section 3 Resilience Strategy**1. What specific projects support the community's resilience strategy and may be eligible for funding under the Alberta Community Resilience Program?**

Please provide a listing in order of priority and your Community's rationale for supporting this approach.

Attached please find the Proposed 2015 City of Calgary ACRP projects.

2. What community-led actions are being implemented, outside of ACRP, to prevent similar issues in the future?

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Examples may include land-use bylaws, regional planning studies, inter-municipal development strategies, working with non-government organizations on shared outcomes, protection of critical wetlands, etc.

The 2014 report from the Expert Management Panel on River Flood mitigation led to the development of Calgary's Flood Resiliency and Mitigation Plan. Included in the plan are five key areas, which address a full suite of actions (outside of ACRP eligible projects).

Strengthening flood-related policies - The City is expanding its review of the Land Use Bylaw and other development regulations to update flood resiliency requirements for private property in flood risk areas. The City is also reviewing the existing land-use planning documents and is looking to develop amendments, new guidelines or policies that will minimize development in the floodplain over time. A triple bottom line analysis is underway to evaluate the need for a minimum flood protection level above the 1:100 flood for land-use planning and structural protection across the city.

Partnering for a flood resilient Calgary - The City partners and works with various organizations on shared outcomes to move towards resiliency. Some examples include:

1. Led by WaterSmart, the 2014 Bow Basin Flood Mitigation Watershed Management Project, which The City of Calgary and other regional municipalities participated in, identified a number of solutions that align with and complement The City of Calgary's priorities for flood and drought management.
2. Other communities in the watershed, including Rocky View County and the Town of Cochrane (Environmental Action Committee) have been and continue to take initiatives to conserve and restore riparian areas at specific sites. Restoration of riparian areas upstream and downstream from Calgary complements planned riparian restoration activities within Calgary.
3. The Bow River Basin Council participated with The City of Calgary and other regional municipalities and stakeholders in WaterSmart's Bow Basin Flood Mitigation and Watershed Management Project. The project supports initiatives that restore natural river functions to slow and detain high river flows, including maintaining healthy riparian areas and bio-engineered bank protection.
4. As part of the implementation of the Bow Basin Watershed Management Plan (2012), municipalities and NGO's in the basin are working together with the BRBC to move recommendation forwards. A key component of the plan is to prevent further degradation of riparian areas and restore degraded riparian lands. The City of Calgary is in communication with the BRBC regarding the projects submitted to the ACRP and how watershed considerations can be included in their implementation.

The City of Calgary is also involved with the Elbow River Watershed Partnership, the Nose Creek Watershed Partnership, and the Ghost Watershed Alliance Society. Through these partnerships, The City works with stakeholders to help implement recommendations of the Bow Basin Watershed Management Plan, as well as more specific plans pertaining to the sub-basins.

Section 4 Watershed Assessment

A "No Adverse Impact" approach to floodplain management means that action taken by one community does not adversely impact other communities. Examples of positive actions include decreasing flood peaks, lowering flood velocities, decreasing erosion and sedimentation, or positively mitigating other impacts the community considers important.

1. How do the projects identified in Section 3 work together to improve your community's overall resilience to water-related natural event?

Consider redundancy, multi-functional infrastructure, damage reduction

A permanent flood barrier integrated into West Eau Claire's redevelopment of the pathway system will prevent flood infiltration into Calgary's downtown core, reducing the number of businesses that would experience damage or service disruption due to flooding up to a 1:75 event. The flood barrier would be built the same time as a new pathway redevelopment, making it an opportune time to create efficiencies during construction and take a cross-corporate approach, working with other business units.

Installation of a permanent berm at the Bonnybrook wastewater treatment plant will ensure plant function is not compromised and remains operational during a flood event. Continuity of plant operations will help protect other key pieces of municipal infrastructure that could be damaged or affected by flooding and protect downstream communities and the ecosystem health of the Bow River.

Resiliency upgrades to Bonnybrook wastewater treatment plant's stormwater outfalls and some lift stations throughout the city will reduce the likelihood of stormwater inundation at Bonnybrook and other parts of the city during riverine flooding. These upgrades will ensure that water can be pumped out of the lowest elevation areas, reducing damage to low-lying communities in the event of a flood.

2. How do the projects identified in Section 3 promote the overall resilience of the watershed to water-related natural events?

Consider upstream and downstream impacts, regional retention/detention, and environmental outcomes

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The permanent flood berm at Bonnybrook wastewater treatment plant and the relocation of stormwater outfalls are part of a larger program of flood resiliency for Bonnybrook WWTP. The berm will ensure that water leaving the plant meets provincial water quality standards, is not compromised during a flood event by unusually high wastewater volumes or interruption in plant operation which could negatively impact the health of the Bow River's ecosystem, or reduce water quality for communities downstream of Calgary.

The berm at West Eau Claire will prevent overland flooding into downtown. Geographically this benefits areas with high motor traffic, human activity, and Calgary's business centre. Overland flooding increases the amount of phosphorus, heavy metals, salts, debris, coliforms, and other pollutants that are carried into the river untreated. Berms to prevent flooding in these areas will help ensure that water leaving Calgary meets regulatory requirements and reduces adverse effects on downstream communities and aquatic habitats.

A new pump station in Sunnyside community and lift station resiliency upgrades will reduce the likelihood of stormwater inundation in low-lying communities during river flood events, which have a significant economic impact and can also cause increased risks to public health, downstream water quality issues, and damage to aquatic habitats.

Community Resilience and Mitigation Assessment

Table 1: Overview of the Mitigation Measures for The City of Calgary

Overview of the Mitigation Measures for The City of Calgary		
Activity	Description	Status
Emergency Management Plans		
Municipal Emergency Plan	This plan documents roles and responsibilities of Calgary Emergency Management Agency (CEMA) and agency members during an event. This document has several protected annexes with specific operational plans.	Established (undergoing a review)
Flood Emergency Response Manual	This strategic manual enables a coordinated response to flooding and allows the continuation of business services.	Established (updated annually)
Water Emergency Response Manual	This strategic manual enables a coordinated response to all water hazards and allows the continuation of business services.	Established (updated annually)
Comprehensive Emergency Management Model	Provides a framework to structure all emergency management activities. It illustrates that emergency management is a continuum that includes non-response activities (risk assessment, prevention, mitigation and preparedness) as well as response, recovery and rehabilitation.	Established
Water Management Planning		
Water Supply Master Plan	This strategic plan articulates The City's water supply risks and needs.	Established
Water Long Range Plan	A plan to look at The City's water infrastructure needs.	Established
Water Efficiency Plan	A plan for demand management strategies.	Established
Drought Management Plan	This plan outlines the risk and puts in place strategies to lessen the impact of climate change and water supply risks.	Established
Regional Servicing	Providing potable water to regional partners.	Established
Resiliency Planning		
Implementation Plan for the Expert Management Panel Recommendations on River Flooding Mitigation	Council approved implementation plan for the 27 recommendations outlined in the Expert Management Panel 2014 to 2018.	In-progress
Corporate Resiliency Strategy	The City will develop a Corporate Resiliency Strategy that outlines the hazards and applicable actions to become a more resilient city.	In-progress

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Corporate Workplace Continuity Planning	The City will develop Corporate Workplace business continuity plans to minimize disruptions in productivity and service delivery due to facility related emergency situations.	In-progress
River Flooding Mitigation and Monitoring		
River Forecasting and Monitoring program	A team of river engineers and technicians monitor, and map river conditions The City of Calgary.	Established
Permanent Barrier Study	To determine the best suite of potential mitigation options, The City is studying permanent barriers – the costs, benefits and placement location.	In-progress
River Morphology Study	How the river has changed since the 2013 flood? The City is looking at the effects of the flood.	In-progress
Flood Mitigation Options Analysis	Updating the Province's IBI Study results with current 2013 Hydrology and updating resulting to include social and environmental factors not included in the IBI work.	In-progress
Temporary Barrier Plan	This strategic plan outlines and prioritizes where temporary structures, barriers and berms will be placed during flood emergency of various sizes.	Established (updated 2015)
Policies and Bylaws		
Municipal Development Plan	A new MDP Section entitled 4.4 Flood Hazard Areas was adopted by Council on 2014 June 09 to enhance flood resiliency through land use planning measures. Section 4.4 provides high level direction to guide appropriate land use development in the Flood Hazard Area in concert with City policies and the Land Use Bylaw.	Updated 2014
Land Use Bylaw 1P2007 (Part 3, Division 3)	Aligning Floodway, Flood Fringe, and Overland Flow sections of Land Use Bylaw (LUB) 1P2007 with changes from the Province of Alberta.	Updated 2014
Emergency Management Bylaw	Outlines roles and responsibilities of the Emergency Management committee, CEMA, who can declare a State of Local Emergency, etc.	Established
Citizen and Business Awareness Campaigns and Programs		
Flood Readiness Campaign (May to July)	Annual public awareness campaign which runs from May	Established

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	to July		
Household Emergency Action Plan (HEAP)	General information and advice about emergencies and disasters	Established	
Important Documents bags	A plastic bag with a checklist printed on it to remind citizens which documents they should have copies of in their emergency kits	Established	
72-hour Kit Checklist	A checklist of suggested items to compile an emergency 72-hour kit	Established	
Business Continuity Guide	A booklet providing information to businesses about understanding risks and developing strategies to ensure continued operation during and after an emergency or disaster. E-tools are also available.	Established	
Community Preparedness Guide	A guide for communities to prepare for emergencies or disasters on a community-wide scale.	In- progress	
Flood Readiness Guide	A guide to protecting your family and property before, during and after a flood event.	Completed	
Emergency Preparedness Initiative of Calgary (EPIC)	A two-year Emergency Preparedness Initiative in partnership with the Calgary Chamber of Voluntary Organizations that will help ensure Calgary's nonprofit sector is prepared to effectively respond to emergencies	In-progress	
READYCalgary	A community preparedness program designed to inform, educate and build resiliency to the impacts of emergencies and disasters using an all-hazards approach.	Established	