

**Southern Alberta Flood Recovery Task Force
Flood Mitigation Measures for the Bow River,
Elbow River and Oldman River Basins
Volume 3 - Stakeholder Engagement Report**

Submitted to:

Alberta Flood Recovery Task Force
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CW2174



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1.0 PURPOSE OF STAKEHOLDER ENGAGEMENT

The Southern Alberta Flood Recovery Task Force (SAFRTF) is responsible for developing a coordinated, strategic flood mitigation plan for the provincial government that will be linked to water management plans for southern Alberta. The study will:

- Review and evaluate the viability of submitted mitigation proposals compiled from sources such as the SAFRTF, affected municipalities and provincial government departments, and identify possible alternatives for flood mitigation;
- Develop selection criteria and evaluate potential flood mitigation options for each river basin; and
- Identify how the proposed flood mitigation methods could enhance existing water management strategies within each of the assigned river basins, conduct stakeholder engagement, and develop conceptual design plans for recommended options.

AMEC Environment & Infrastructure, a division of AMEC Americas Ltd. (AMEC), is assisting the SAFRTF in developing a plan for the Bow River, Elbow River and Oldman River basins. As part of this effort, AMEC has identified and contacted a number of stakeholders to understand:

- What happened in their community or area of interest as a result of the various flooding events;
- How they responded to the flooding; and
- What could or should be done in the future to prevent or reduce flooding, and improve response to flooding if prevention is not possible.

Information provided has aided AMEC's identification and evaluation of flood mitigation and water management options for the three river basins.

2.0 STAKEHOLDER IDENTIFICATION

The engagement team prepared a list of stakeholders based on the urban, rural and Aboriginal communities affected by flooding in the three river basins and the counties/municipal districts (MDs) in which the river basins lie, as well as other organizations with interests that may have been affected by flooding. As part of the Stakeholder Engagement Plan, AMEC identified how these stakeholders could contribute to the data being collected. Stakeholders for this study can be grouped as follows:

- Professional partners;
- Provincial and federal government departments;
- Communities, counties, and MDs;
- First Nations; and
- Environmental non-government organizations (ENGOS).



Cities and towns with their own governments were identified as being separate entities from the counties/MDs they are part of and were included as individual stakeholders. Unincorporated communities (such as Bragg Creek) without their own governance structure are governed by the county/MD in which they are located.

It was decided that a questionnaire would be the best way to collect consistent information for all the stakeholders. Once identified, stakeholders were grouped by how directly they were affected by the 2013 flood event and other significant flood events. The method of interview suggested for each stakeholder related to the level of impact:

- High impact – in-person meeting to fill out the questionnaire;
- Medium impact – phone interview to fill out the questionnaire; and
- Low impact – e-mailed the questionnaire to be completed and returned.

Contact information was obtained for each stakeholder:

- General managers were identified for the irrigation districts (IDs);
- Chief administrative officers were identified for communities, counties and MDs; and
- Consultation contacts identified for First Nations.

The SAFRTF provided contact names for the government departments. Contacts for the ENGOs were determined from their websites.

Although the ENGOs do not own lands or operate water systems, they represent preservation and conservation interests and, in some instances, projects within the river basins. In many cases, they also provide advice to the provincial government.

Table 2.1 provides a list of the 37 stakeholders, the river basin in which they are located, and information on the method of engagement used (further discussed in **Section 4.0**). **Figure 2.1** shows where they are located in southern Alberta.

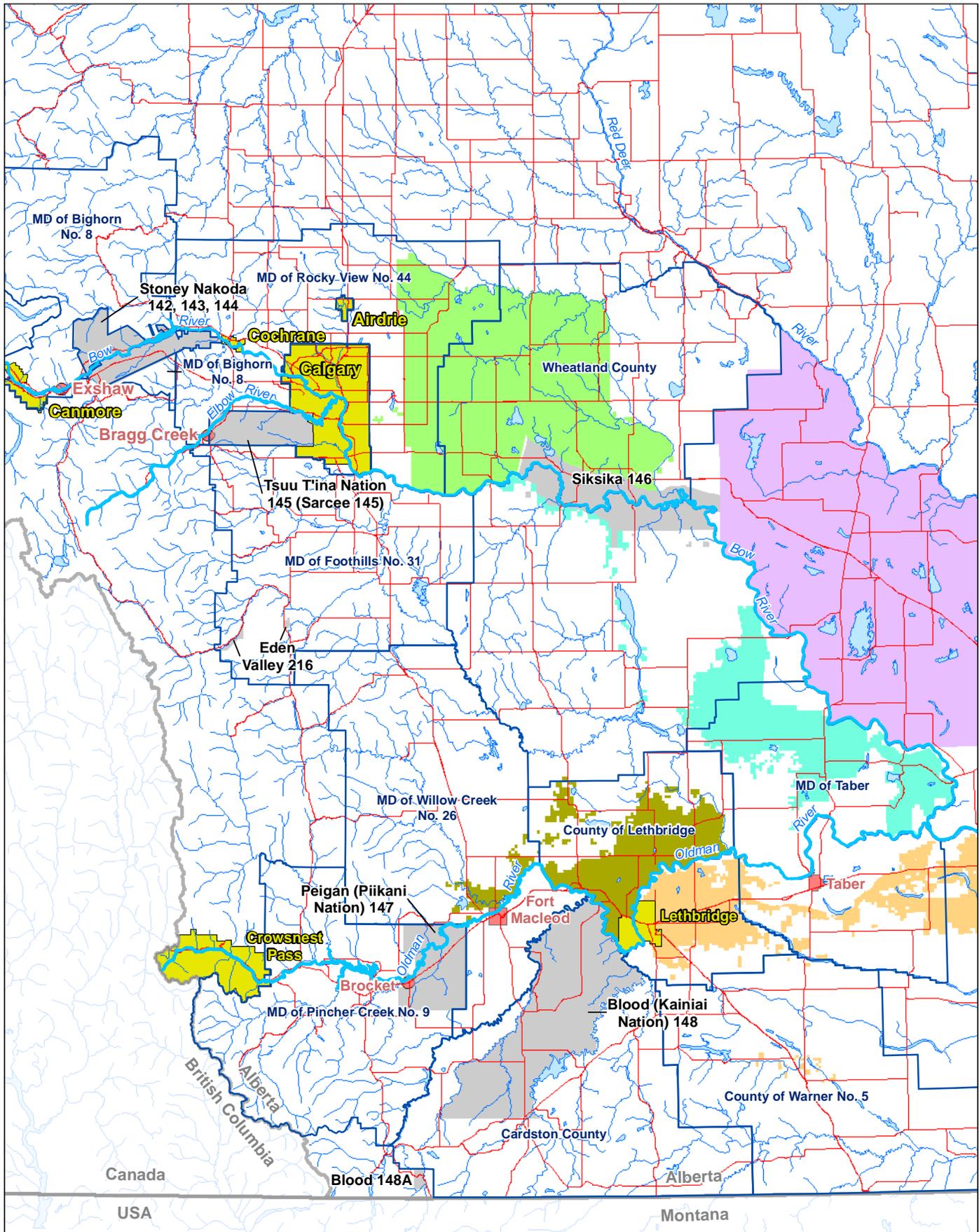
Table 2.1
Stakeholders for the Flood Mitigation Study

Stakeholder	Stakeholder Type	River Basin	Interview Type	Questionnaire Completed
Bow River Irrigation District (BRID)	Professional Partner	Bow	In Person	Yes ¹
Eastern Irrigation District (EID)	Professional Partner	Bow	In Person	Yes ¹
Western Irrigation District (WID)	Professional Partner	Bow	In Person	Yes ¹
Lethbridge Northern Irrigation District (LNID)	Professional Partner	Oldman	Phone	Yes
St. Mary River Irrigation District (SMID)	Professional Partner	Oldman	Phone	Yes
Alberta Agriculture & Rural Development	Government	All	Phone	Yes

Stakeholder	Stakeholder Type	River Basin	Interview Type	Questionnaire Completed
Alberta Environment & Sustainable Resource Development (ESRD)	Government	All	In Person	Yes
Alberta Transportation	Government	All	In Person	Yes
Alberta Tourism, Parks & Recreation	Government	Bow, Elbow	In Person	Yes ²
Parks Canada	Government	Bow	In Person ³	Yes
Bighorn No. 8 (MD)	County/MD	Bow	In Person ³	Yes
Cardston (County)	County/MD	Oldman	E-mail	No
Foothills No. 31 (MD)	County/MD	Oldman	Phone	Yes
Kananaskis Improvement District	Improvement District	Bow, Elbow	In Person	Yes ²
Lethbridge (County)	County/MD	Oldman	In Person	Yes
Pincher Creek No. 9 (MD)	County/MD	Oldman	E-mail	Yes
Rocky View (County)	County/MD	Bow, Elbow	In Person	Yes
Taber (MD)	County/MD	Oldman	Phone	Yes
Warner No. 5 (County)	County/MD	Oldman	E-mail	No
Wheatland (County)	County/MD	Bow	E-mail	No
Willow Creek No. 26 (MD)	County/MD	Oldman	E-mail	Yes
Airdrie (City)	Community	Bow	Phone	Yes
Calgary (City)	Community	Bow, Elbow	In Person	Yes
Canmore (Town)	Community	Bow	In Person	Yes
Cochrane (Town)	Community	Bow	In Person	Yes
Crowsnest Pass (Municipality)	Community	Oldman	Phone	Yes
Lethbridge (City)	Community	Oldman	In Person	Yes
Kainai Nation (Blood Tribe)	First Nation	Oldman	In Person	In Progress ⁴
Piikani Nation	First Nation	Oldman	In Person	Draft ⁵
Siksika Nation	First Nation	Bow	In Person ³	Draft ⁵
Stoney Nakoda Nation	First Nation	Bow	In Person	Draft ⁵
Tsuu T'ina Nation	First Nation	Elbow	In Person	In Progress ⁴
Bow River Basin Council	ENGO	Bow	Phone	Yes
CPAWS – Southern Alberta	ENGO	All	Phone	No
Ducks Unlimited	ENGO	All	Phone	No
Oldman Watershed Council	ENGO	Oldman	Phone	Yes
Trout Unlimited – Bow River	ENGO	Bow	Phone	Yes

Notes:

1. One meeting was held with the BRID, EID and WID to fill out a single questionnaire.
2. One meeting was held with Alberta Tourism, Kananaskis Improvement District and Kananaskis Emergency Services to fill out a single questionnaire.
3. Stakeholders filled out the e-mailed questionnaire provided in January. AMEC followed up to ask if they wished to have an in-person meeting; stakeholders were happy with their responses and declined a meeting.
4. Contact has been made with the Kainai and Tsuu T'ina First Nations but a meeting to fill out the questionnaire has not yet occurred. No information on flooding on their reserves has been received.
5. The Siksika, Stoney Nakoda and Piikani First Nations are currently reviewing their draft questionnaire responses. AMEC has received the draft questionnaire responses, and these drafts were used to provide the information found in this report.



Sources: GeoBase®, Spatial Data Warehouse Ltd.

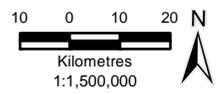
Legend

- Provincial/International Boundary
- Other Community
- Lethbridge Northern Irrigation District
- Reserve Land
- Lake
- County or Municipal District
- Bow River Irrigation District
- St. Mary River Irrigation District
- Bow, Elbow, and Oldman River
- River
- Stakeholder Community
- Eastern Irrigation District
- Western Irrigation District
- Highway



PDF: Fig2.1 Consultation Overview
14-03-14
DATE: March 2014
PROJECT: CW2174
PROJECTION/DATUM: 10TM/NAD83
ANALYST: NH

Alberta Flood Recovery Task Force
Flood Mitigation Study



Stakeholders in the Study Area

Figure 2.1

A meeting was also held with TransAlta Corporation (TAC; a professional partner) in 2013, before the questionnaires were available. The purpose of this meeting was to gather data on their operations.

3.0 CONSULTATION PROCESS

In-person meetings, phone calls and e-mails with stakeholders were used to:

- Collect information about their experiences with historical and recent flooding;
- Collect information about their plans regarding future flood mitigation; and
- Identify measures that would contribute to both flood mitigation and water management in the river basins being studied.

Basic information about the project was provided in a brochure, and a questionnaire was used to guide discussions to ensure the process and questions asked were consistent across stakeholders to the greatest possible extent.

3.1 Notification

Stakeholders were initially contacted by phone on 20 December 2013 to inform them of the study and request their input by questionnaire. These calls were followed up with an e-mail introducing the study, and providing copies of the brochure and questionnaire. The e-mail noted that follow-up contact would occur in January 2014.

In addition to the contacts by AMEC, the SAFRTF engagement team sent out the draft questionnaire to the flood coordinators in various communities, requesting that it be filled out and returned to AMEC.

In January, all stakeholders were again contacted either by phone or e-mail. Meetings were arranged for most of those designated as high impact and phone calls arranged for those designated as medium impact. Those designated as low impact were again sent the questionnaire to complete.

3.2 Engagement Format

A brochure was designed to provide basic information about the study, and to provide contacts for further information. A copy of the brochure is provided in **Appendix A**.

A questionnaire was developed as a template for guiding information collection during the in-person meetings and phone calls (**Appendix B**). Three slightly different versions of the questionnaire were developed for the three general types of stakeholders to assist in focusing on the data to be collected:

- Community – for Aboriginal and non-Aboriginal communities, counties, and MDs;
- Government – for government departments and professional partners; and

- ENGO – for ENGOs.

In-person meetings were attended by two people from the engagement team (a facilitator and a note taker) and one from the technical team. A member of the SAFRTF was also in attendance at most of the meetings.

Phone calls were conducted by one person from the engagement team and one from the technical team. The SAFRTF was not represented on the calls.

In some instances, the draft questionnaire distributed by the SAFRTF was filled out by the flood coordinator for the community or someone other than the contact person identified by AMEC. In these cases, the AMEC-identified stakeholder was contacted and asked to review the completed questionnaire to ensure that the information provided was correct and complete. Some stakeholders participated in a follow-up phone call, while others were happy with the questionnaire responses submitted.

4.0 RESULTS

Of the 20 stakeholders designated as high impact, 16 meetings were held and/or completed questionnaires have been received; three questionnaires are in draft form, and one meeting to complete the questionnaires is still to be arranged. Of the 12 stakeholders designated as medium impact, all but two (unreachable) were interviewed by phone. Of the five stakeholders designated as low impact, two returned the e-mailed questionnaire. In total, five of the 36 stakeholders did not respond to AMEC's requests for information. Assuming that meetings will be set up with Tsuu T'ina Nation, this represents a completion rate of 87% (**Table 2.1**).

Given the areas of interest of the stakeholders (e.g., community answers relate to their communities, and other answers relate to broader areas), the following sections typically summarize the responses received by geographic area.

In general, the information presented in the following sections is organized by river basin, starting with general comments and then upstream to downstream on the Bow, Elbow and Oldman rivers (and noted tributaries). Stakeholders associated with each of the river basins are listed in **Table 4.1**.

Table 4.1
Stakeholders by River Basin

Bow River Basin	Elbow River Basin
<ul style="list-style-type: none"> • Bow River Basin Council • Trout Unlimited • Parks Canada • Alberta Tourism, Parks & Recreation • Kananaskis Improvement District • Canmore • MD of Bighorn • Stoney Nakoda Nation • Rocky View County • Cochrane • Airdrie • Calgary • BRID • WID • Wheatland County * • Siksika Nation • EID 	<ul style="list-style-type: none"> • Alberta Tourism, Parks & Recreation • Kananaskis Improvement District • Tsuu T'ina Nation * • Rocky View County • Calgary
Oldman River Basin	All Basins
<ul style="list-style-type: none"> • Oldman Watershed Council • MD of Foothills (High River) • MD of Willow Creek (Willow Creek) • Municipality of Crowsnest Pass (Crowsnest River) • MD of Pincher Creek (Pincher Creek) • Cardston County * (St. Mary, Belly and Waterton Rivers) • Kainai Nation (Blood Tribe) * (St. Mary and Belly Rivers) • SMRID (St. Mary, Belly and Waterton Rivers) • County of Warner * (St. Mary River) • Piikani Nation (Oldman River) • LNID (Oldman River) • Lethbridge (Oldman River) • Lethbridge County (Oldman River) • MD of Taber (Oldman River) 	<ul style="list-style-type: none"> • Alberta Agriculture & Rural Development • ESRD • Alberta Transportation • CPAWS – Southern Alberta * • Ducks Unlimited *

Notes:

* No questionnaire received from these stakeholders.

As secondary data were not collected as part of the stakeholder engagement program, information on the areas of concern for stakeholders who did not respond to the questionnaire has not been included in the following sections (information from secondary data collection is presented in the technical report). For example, none of the stakeholders along the St. Mary and

Belly rivers responded to AMEC's request for information, so the only information presented for this area is from the SMRID.

Unless otherwise noted, all information relates to 2013 flooding.

4.1 What Happened and Flood Effects

This section describes what happened in the communities and stakeholder areas of interest during recent flood events. It also describes the nature and magnitude of effects in the various areas.

Flooding has occurred in different years for different communities. For agricultural lands and infrastructure, 2010 was the worst flood. In terms of provincial infrastructure (roads, bridges, etc.), 1995, 2005, 2010, and 2013 were flood years with extensive damage. The most widespread flooding occurred in 2005 and 2013 in the Bow and Elbow river basins. In the Oldman Basin, the 1995 flood was considered the worst in recent history.

Flood years as noted by the stakeholders are provided in **Table 4.2**.

**Table 4.2
 Flood Years**

Area	1995	2005	2008	2010	2011	2012	2013	Other
Bow and Elbow River Basins								
Parks Canada								Annually
Kananaskis	X	X					X	Annually
Canmore						X	X	
MD of Bighorn		X					X	
Stoney Nakoda Nation		X					X *	
Rocky View County		X	X				X	
Cochrane							X	
Airdrie		X						
Calgary	X	X				X	X	Other years
Siksika Nation		X	X	X *	X *		X	1998
BRID, WID and EID		X		X *	X *		X	
Oldman River Basin								
MD of Foothills		X					X	
MD of Willow Creek	X	X					X	
Municipality of Crowsnest Pass							X	
MD of Pincher Creek	X	X		X			X	
Kainai Nation	X						X	1964, 1974, 1985, 2002
SMRID				X	X			
Piikani Nation	X	X		X			X	2002 *
LNID							X	
Lethbridge		X		X			X	1955
County of Lethbridge	X				X		X	
MD of Taber	X	X		X	X		X	

Note:

* Overland rather than river flooding.

General comments from stakeholders about flooding that apply to all three river basins include:

- Flooding has positive effects on aquatic communities. When a river floods, sediments full of nutrients move, which fertilizes the floodplain and strengthens the ecosystem.
- If aging infrastructure was kept up to date, would flood effects have been different?
- No bridges were lost during the 2013 flood; what was damaged was the road/bridge approaches.
- In the Bow and Elbow river basins, there was far more debris in the flow in 2013 than in 1995.
- Concerned about effects of erosion on water quality and fish habitat.



- Concerned about aquifer, well water and stormwater pond contamination.

4.1.1 Bow River Basin

General comments from stakeholders about flooding in the Bow River Basin:

- Lots of debris, inorganic and organic.
- Lots of bank erosion along the Bow River.
- West of Calgary, flood impacts were from the mountain creeks rather than the Bow River itself.
- Flooding in 2013 was generally river flooding. Flooding in 2010 and 2011 was overland flooding.
- There are too many developments (many very expensive) in floodplains.

Table 4.3 provides information on effects in specific areas in the Bow River Basin, as described by stakeholders. The community questionnaire contained a table called “What Happened”, which provided a list of events to check off:

- River overflowed banks;
- Obstacles/constrictions caused river to overflow banks;
- Sediment and debris flows;
- River bank erosion;
- Storm sewers overflowed; and
- Sewers backed up.

Where this section was completed by the stakeholder, the events checked off have been included in this table as the first bullet point for the stakeholder.

Table 4.3
What Happened in the Bow River Basin

Area	What Happened
Canmore	<ul style="list-style-type: none"> • What happened: sediment and debris flows, river bank erosion, storm sewers overflowed, sewers backed up. • Some minor erosion along the pathways near the dykes on the Bow River. • Most damage was caused by sediment and debris flows in the nine mountain creeks.
Kananaskis Area	<ul style="list-style-type: none"> • Many highways in the area were affected – 1A, 22, 8, 66, everything in Kananaskis Country. • Mud and rock debris on Highway 1; major highway bridge by Canmore was washed out. • Backcountry trails and bridges washed out, campgrounds and day use areas (about 100) flooded or washed out. Peter Lougheed Visitor



Area	What Happened
	<p>Centre was damaged.</p> <ul style="list-style-type: none"> • Parks water treatment plants, wells and associated infrastructure were affected. • Major damage to Kananaskis Golf Course.
Stoney Nakoda Nation	<ul style="list-style-type: none"> • What happened: river [creeks] overflowed banks, obstacles/constrictions caused river to overflow banks, sediment and debris flows, river bank erosion, sewers [septic tanks and cisterns] backed up. • Flooding was from spring runoff from mountain creeks, not the Bow River. Creeks contained large amounts of debris. • On-reserve roads flooded and bridges were damaged by creeks, isolating some residents (helicopter evacuation required in some cases) and affecting access to the Morley water treatment plant. • Creek bank erosion at Benjamin, Jacobs, Chiniki and Little creeks. • Septic tanks and cisterns were inundated and contaminated with overland water from creeks. • Loss of communication during the flood. • More than 800 homes across the Big Horn, Morley and Eden Valley reserves were affected.
Kananaskis to Calgary	<ul style="list-style-type: none"> • What happened in MD of Bighorn: river [and creeks] overflowed banks, obstacles/constrictions caused river [and creeks] to overflow banks, sediment and debris flows, river bank erosion, storm sewers overflowed, sewers backed up. • What happened in Rocky View County: river overflowed banks, obstacles/constrictions caused river to overflow banks, sediment and debris flows, river bank erosion, storm sewers overflowed, sewers backed up. • Kananaskis River and many creeks overflowed their banks, as well as the Bow River. The Ghost River overflowed its banks at Benchlands. • Sediment and debris flows from mountain creeks affected Canmore.
Cochrane	<ul style="list-style-type: none"> • Effects on park areas, pathways, some bridges and intake of the water treatment plant. • No effects on houses, infrastructure or roads. • Jumping Pound Creek channel changed significantly because of debris; bridge across the creek was affected. Some individual homes outside of Cochrane along the creek were affected. • In the Big Hill area, some pathways were washed out and there were minor impacts on houses. • Continuous monitoring of water treatment plan required additional staff and extra time. • Cochrane Lake has issues in 2012 and 2013 because it's a closed basin.
Airdrie	<ul style="list-style-type: none"> • In 2005, Nose Creek flowed into the fringe area and covered some parkland areas. • No houses or infrastructure were affected. • Higher water level and sanitary flow than the City was able to handle.
Calgary	<ul style="list-style-type: none"> • What happened: river overflowed banks, obstacles/constrictions caused river to overflow banks, sediment and debris flows, river bank erosion, storm sewers overflowed, sewers backed up. • Major overflow of the Bow River into neighbourhoods and downtown



Area	What Happened
	<p>area, making many areas impassable.</p> <ul style="list-style-type: none"> • Major backflow from the Elbow River into downtown Calgary as river could not flow into the Bow River at their confluence (because of velocity of Bow River waters). • Fish Creek Park trails and boat launch were damaged. • Sam Livingston Fish Hatchery sustained a lot of damage.
Siksika Nation	<ul style="list-style-type: none"> • What happened: river overflowed banks, obstacles/constrictions caused river to overflow banks, sediment and debris flows, river bank erosion, storm sewers overflowed, sewers backed up. • River overflowed its banks for the full length of the Bow River through the reserve. • No flooding downstream of the Bassano Dam, but the water backed up and flooded reserve lands upstream of the dam. • Approaches on the Highway 547 bridge (provides access to the reserve) were washed out. Bow River channel moved 60 m east at the river crossing. • Hidden Valley Resort was completely flooded.
Calgary to Confluence with South Saskatchewan	<ul style="list-style-type: none"> • Johnson's Island day use area and boat launch were damaged, as were the McKinnon Flats boat launch area and Policemen's Flat. • Highway 842 near Cluny was damaged. • Crowfoot Ferry Crossing infrastructure was severely damaged and the ferry may not reopen.
IDs	<ul style="list-style-type: none"> • Little Bow diversion canal was damaged, as well as 52 km of bridges (damaged or washed out), mostly relating to spill from the Highwood. • Harvie Passage was destroyed, but no effect on operation of the Western Headworks Canal weir (gates were kept closed to prevent the diversion canal from being overwhelmed by flood waters, and to prevent damage to the gates from debris). • In 1995, the flood damaged the Western Headworks Canal (minimal damage in 2005). • Damage along the Shepard Diversion Canal (Inglewood fencing). • Some damage at the Carseland weir (fuse plug blew out, causing major scouring of the river bottom at the fuse plug site). • Some minor damage to the Bassano Dam (adjacent concrete erosion control was washed out; damage to the mechanical hinges on the dam gates, build-up of debris against the dam gates). • Carseland head gates have had debris issues 3 times in the past 10 years. • No damage in WID. • 2010 flood affected drop structures, flow meters, culverts and crossings in the EID system. • 2005 flood washed out the main BRID canal. • Not a lot of flood mitigation measures in place; systems are designed for irrigation, not flooding.



4.1.2 Elbow River Basin

Table 4.4 provides information on effects in specific areas of the Elbow River Basin, as described by the stakeholders. The community questionnaire contained a table called “what happened”, which provided a list of events to check off:

- River overflowed banks;
- Obstacles/constrictions caused river to overflow banks;
- Sediment and debris flows;
- River bank erosion;
- Storm sewers overflowed; and
- Sewers backed up.

Where this section was completed by the stakeholder, the events checked off have been included in this table as the first bullet point for the stakeholder.

Table 4.4
What Happened in the Elbow River Basin

Area	What Happened
Kananaskis Area to Bragg Creek	<ul style="list-style-type: none"> • What happened: river overflowed banks, obstacles/constrictions caused river to overflow banks, sediment and debris flows, river bank erosion, storm sewers overflowed, sewers backed up. • Lots of damage to infrastructure and parks – backcountry trails and bridges, campgrounds, day use areas. • Evan Thomas Creek floodway now three times the width it was prior to the 2013 flood event. • Highways 66, 22, 8 and 758 were affected by flooding. • Allan Bill Pond was rebuilt after 2005 flood, but was completely wiped out in 2013.
Bragg Creek Area	<ul style="list-style-type: none"> • What happened: river overflowed banks, obstacles/constrictions caused river to overflow banks, sediment and debris flows, river bank erosion, storm sewers overflowed, sewers backed up. • Flooding all along the Elbow River banks in the flood fringe. • Land that was part of residential properties became part of the river channel. • Mountain River Estates water well intake pipe has lost connectivity with the river (the river channel has moved). • Wetlands and sloughs were flooded; no place for runoff to go. • Bridge to Hawkeye Estates over Bragg Creek was overtopped.
Calgary	<ul style="list-style-type: none"> • What happened: river overflowed banks, obstacles/constrictions caused river to overflow banks, sediment and debris flows, river bank erosion, storm sewers overflowed, sewers backed up. • River overflowed its banks all along the Elbow River throughout Calgary, making many neighbourhoods impassable. • Because of high velocity in the Bow River, the Elbow River was unable to flow into it. This caused the Elbow River to back up and flood the downtown area.

4.1.3 Oldman River Basin

General comments about flooding in the Oldman River Basin include:

- City of Lethbridge has suffered less damage from river flooding than other communities because it has not allowed urban development in the floodplains since 1955 (only recreational facilities).
- There has been regular overland flooding in low-lying urban areas from heavy rainfalls (not related to river flow).

In the Bow and Elbow river basins, much of the flooding was on the mainstems of these rivers. However, in the Oldman River Basin, there was flooding along many of the larger tributaries, not just along the Oldman River. Comments from stakeholders in this section (who filled out a questionnaire) have therefore been organized by waterway:

- Little Bow River and High Rivers – MD of Foothills;
- Willow Creek – MD of Willow Creek;
- Crowsnest River – Municipality of Crowsnest Pass;
- Belly and Waterton rivers – Kainai Nation;
- Pincher Creek – MD of Pincher Creek; and
- Oldman River – Lethbridge, Lethbridge County, MD of Taber, Piikani Nation.

As the IDs span multiple rivers, their general comments have been grouped separately. Specific comments have been included under the appropriate waterway.

Table 4.5 provides information on effects in specific areas in the Oldman River Basin, as described by stakeholders. The community questionnaire contained a table called “what happened”, which provided a list of events to check off:

- River overflowed banks;
- Obstacles/constrictions caused river to overflow banks;
- Sediment and debris flows;
- River bank erosion;
- Storm sewers overflowed; and
- Sewers backed up.

Where this section was completed by the stakeholder, the events checked off have been included in this table as the first bullet point for the stakeholder.



Table 4.5
What Happened in the Oldman River Basin

Area	What Happened
Little Bow River	<ul style="list-style-type: none"> • Damage to private infrastructure. • Canal was severely damaged; water diversion was not possible. • Some farms and ranches were flooded along the river. Concerns about debris and manure washing into the river from farms and feedlots along the river. • Thirteen crossings washed out above and below the Twin Valley Reservoir because of excess water from the Highwood River.
Willow Creek	<ul style="list-style-type: none"> • Pine Coulee has had minor damage three times since 2005. In 2003, there was damage to the diversion weir area. • Creek overflowed its banks; same properties damaged during all three floods (1995, 2005, 2013).
Crowsnest River	<ul style="list-style-type: none"> • Most damage was on the tributaries entering the Crowsnest River. • Some residential damage along Lyons Creek (backflow from creek water unable to pass under the CPR bridge). • Byron Creek changed course. • Some damage in Bush Town (south of CPR tracks in Coleman). • Lost walking bridge. • Major tree damage along banks. • Some damage around Blairmore. • A forest fire in 2004 has reduced the ability of the area to hold back excess water.
Pincher Creek	<ul style="list-style-type: none"> • Main impacts were on municipal and provincial roads and bridges on Pincher Creek and its tributaries. • Flooding in Pincher Creek area, Indian Farm Creek at Therriault Dam.
Belly River (Kainai Nation)	<ul style="list-style-type: none"> • 2013 was less severe than other events. • Flooding at various locations along the Belly River on the western boundary of the reserve (Little Chicago area, lower Standoff, Old Agency area) and the north end (Band Ranch area, Weasel Fat Flats, Fort Whoop-Up area). • Bank erosion on the Belly River threatened homes, roads, water treatment facility at Standoff. • Residents were stranded and could not because roads were washed out. • Sewer backups flooded basements. • Livestock were lost. • Disruption of power from downed poles in river valley. • In 1964, homes were lost along the Belly River, major roads and bridges were washed out, and livestock was lost. • In 1974, homes were lost, roads and bridges were washed out, basements were flooded by sewer backups. • In 1985, major roads were washed out and homes flooded. • In 1995, Homes were flooded, roads were washed out and livestock were lost. • In 2002, the Belly River flooded Highway 2 at Standoff, major roads and bridges were washed out (residents stranded), and livestock were lost. • In March 2014, they have already had flooding of roads in coulees.
Belly River/Waterton River (Other)	<ul style="list-style-type: none"> • Hiking trails closed and trails washed out in Waterton National Park. • Main road to Cameron Lake washed out in several places.



Area	What Happened
Oldman River (Piikani Nation)	<ul style="list-style-type: none"> • In 1995, there was flooding along the entire length of the Oldman River through the reserve. • In 2013, water was 2/3 of the 1995 flood level in the same area. • Lost north abutment of Summerview Bridge in 1995 and the full bridge in 2013. • 1995 event was caused by Pincher Creek, 2013 event was caused by the Castle River flowing into the Oldman Reservoir.
Oldman River (Fort MacLeod)	<ul style="list-style-type: none"> • Highway 2 bridge closed after the 2013 flood because of erosion around pilings at north end. • Two crossings on the Oldman River were affected. • Infrastructure in Fort MacLeod damaged during several flood events, potentially because of water releases from the dam. • In 1995, the Highway 2 bridge north of Fort MacLeod was affected (built in 1994). • Preliminary design for new bridge and road alignment on Highway 3 would have been underwater in the 1995 flood, so the alignment was redesigned before the bridge was built.
Oldman River (Lethbridge)	<ul style="list-style-type: none"> • Golf course, campground, parkland and Paradise Canyon were affected by flooding. • There was sediment and debris in the river, but not enough to restrict flow. • Some basements were flooded (from surface drainage). • Consistent overland flooding; road infrastructure and stormwater drain pipes sometimes not able to accommodate it. • Two bridges linking east and west Lethbridge were closed during the 1995 flood (water level too high). • In 1995, Highway 3 bridge sustained considerable damage, as did recreation facilities in the river valley. Minor damage to the wastewater treatment plant (still operational).
Oldman River (Other)	<ul style="list-style-type: none"> • Large amount of debris in the Oldman Reservoir. • Damage to municipal infrastructure and in the Oldman River Valley (MD of Taber). Water plants not affected. • Flooding in the Beaver Mines area, Highway 3 bridges by Brocket. • Cattle were moved out near the Highway 3 crossing. • In 1995, the river valley was full of water; significant flooding of homes from stormwater and sewer backups; erosion of river banks. • In 1995, some damage to the banks near Taber.
IDs	<ul style="list-style-type: none"> • Little damage to irrigation infrastructure, but excess water in irrigation canals and storage reservoirs caused serious concerns about dam failure. • Significant erosion and slumping damage in irrigation canals (SMRID). • Damage to headworks diversion canal from the Oldman River to Keho Lake. • Some irrigation farmers pumped their excess water into the irrigation canals, causing overflow further downstream. • Water backed up under the railway track beside Highway 3 northwest of Coalhurst. • More damage in 2010 and 2011 – overland flooding inundated roads, irrigation canals and equipment, pumping stations, municipal infrastructure, farmsteads and farmland throughout the area south of the Oldman and South Saskatchewan rivers.

4.1.4 Damages

In many cases, the full cost of damages from the 2013 flood is not yet available. The estimates provided below are very generalized estimates for physical damage only, and do not take into account the social and economic costs of the flooding (e.g., time for cleanup, loss of business). They also don't take into account structures that were not badly damaged, but are generally old and need to be replaced or rehabilitated.

Cost categories provided in the questionnaire were:

- Exceeding \$1 billion;
- \$500 million to \$1 billion;
- \$100 to \$500 million;
- \$10 to \$100 million;
- \$1 to \$10 million; and
- Less than \$1 million.

Table 4.6 shows the damage estimates, as provided by the stakeholders.

Table 4.6
Cost of Damages for 2013 Flooding

Stakeholder	Approximate Costs
Across All Three Basins	
Alberta Agriculture	No estimate available
Alberta Transportation	\$100 million for all basins (not just Bow, Elbow and Oldman)
ESRD	\$150 million (still getting estimates)
Bow and Elbow River Basins	
Bow River Basin Council	No estimate available
Trout Unlimited	N/A
Parks Canada	No estimate available
Alberta Tourism, Kananaskis Emergency Services, Kananaskis Improvement District	\$60 million in Kananaskis \$15 million in Fish Creek Park \$5 million for rest of Southern Alberta (Carseland day use, parks on Oldman River)
Canmore	\$10 to \$100 million
MD of Bighorn	\$10 to \$100 million
Stoney Nakoda Nation	No estimate available
Rocky View County	\$10 million (does not include businesses and residences)
Cochrane	\$2 million
Airdrie	Minimal
Calgary	\$100 to \$500 million
Siksika Nation	\$100 to \$500 million

Stakeholder	Approximate Costs
BRID	No estimate available
WID	No estimate available
EID	No estimate available
Oldman River Basin	
Oldman Watershed Council	N/A
MD of Foothills	<\$50 million
MD of Willow Creek	\$1 to \$10 million
Municipality of Crowsnest Pass	\$2.5 million
MD of Pincher Creek	\$1 to \$10 million
Kainai Nation	\$500 million to \$1 billion (for all flooding)
SMRID	No estimate available
Piikani Nation	\$4 million
LNID	No estimate available
Lethbridge	<\$1 million for 2013 \$1 to \$10 million for 1995
Lethbridge County	\$1 to \$10 million for 2013 \$1+ million for 2011
MD of Taber	\$2.5 million

Note:

N/A = not applicable.

Some stakeholders provided information on the severity of damage in their communities. This information is presented in **Table 4.7**.

Table 4.7
Severity of Damage to Stakeholder Communities in 2013

Stakeholder	Water Supply, Water Treatment, Sewage Disposal	Electrical Supply	Telecommunications	Municipal Roads & Bridges	Provincial Roads & Bridges	Rail & Life Rail Transit	Landfills	Public Services	Private Residences	Private Businesses	Motor Vehicles	Other *
Bow and Elbow River Basins												
Canmore	4	3	1	3	4	4		3	4	3	1	4
MD of Bighorn	4	3	3	1	4	4		4	4	2-3	4	4
Stoney Nakoda Nation	3	4	4	4	4	4		4	4	4		
Rocky View County	4	4	2	2	4			2	4	4	4	
Calgary	1	2	1	3	3	3	2	3	4	4	4	
Siksika Nation	4	1	1	2	4				4	2	2	4
Oldman River Basin												
MD of Willow Creek			1	2						3		4
MD of Pincher Creek	2			4	4				3	2		
Piikani Nation	4			2	3			4	4	1	2	



Stakeholder	Water Supply, Water Treatment, Sewage Disposal	Electrical Supply	Telecommunications	Municipal Roads & Bridges	Provincial Roads & Bridges	Rail & Lite Rail Transit	Landfills	Public Services	Private Residences	Private Businesses	Motor Vehicles	Other *
Lethbridge	1									2		
Lethbridge County	3			2								

Note:

Stakeholders were asked to rate severity from 1 (low) to 4 (high). No rating means that particular type of damage did not occur in 2013.

1. The Other category included things like campgrounds, gas utilities, community buildings and infrastructure.
2. The Kainai Nation ranked severity based on all flooding, not just 2013.

Stakeholders had a number of suggestions for how damages could have been reduced. These suggestions are covered below under the potential mitigation measures discussions.

4.2 Mitigation Measures

Comments from stakeholders about future mitigation measures that apply to all three river basins included:

- Need to look at the overall water management system, not just protection of specific sites.
- Water management plans have been written in the past, but nothing has been done about them. Need to act on plans regionally, even if effects were local.
- Assess competing interests between IDs and communities regarding operation of irrigation systems for flood and drought protection.
- Challenge to design mitigation measures that still meet the mandate for recreation and ecological areas.
- Goal of mitigation should be to find upstream methods to buffer a large surge.
- Structural options are important, but also need to look at non-structural options that could be more useful. May need to look at multiple options together. More natural ways could be less expensive.
- Need to consider downstream effects of any mitigation measures implemented. Coordinate local and regional mitigation plans.
- Need to make people aware of the reason for land use policies that prevent building in floodways and flood fringes. When we don't have floods, people move closer to the rivers, but they need to be aware they are still in a floodway – even if it hasn't flooded recently. Need to remove structures in affected flood fringes (and floodways), not restore them.
- Update the flood fringe and flood zone mapping in the province (many channels have changed).

- It can be hard to plan for flood mitigation as watercourses may change every flood.
- Improve conveyance – design bridges with wider spans to accommodate increased river flows, and use larger culverts. If bridges are lost, need to redesign not just replace.
- Protect bridges by guiding the water through the bridge using spurs.
- River banks need trees for stabilization (riprap is often not successful). Use natural riparian solutions in river valleys.
- Need better weather forecasting and warning systems, especially for mountain creeks.
- Establish a system to predict river height at key locations (such as bridges) to assist with assessing the potential damage.
- Find way to translate flow to an elevation rise in the river.
- Monitor the river regularly for new levels.
- Install debris catchment structures in areas where debris is an issue, and ensure the structures are maintained.
- Dry dams are more costly to maintain than wet dams.
- Need to look at effects of flooding on the economic supply chain.
- Need to consider the cost of mitigation versus the cost of damage – at what point are there diminishing returns?
- How much are you willing to spend to protect against a 1% risk that most people will only see once in their lifetime?
- Improve drainage and stormwater runoff systems in urban areas.
- Inspect dams and bridges regularly for safety and maintenance.
- Easier to move dirt and rock than steel and concrete. Breaching a road is a faster/cheaper option than losing a bridge.
- Roads and bridges will always be vulnerable; this can't be avoided.
- Allow disaster recovery funds to be used to upgrade damaged infrastructure, or make it easier to upgrade infrastructure to current standards rather than just replacing it.
- First Nations lack funding to improve mitigation and infrastructure on the reserves.
- Mitigation measures need to consider effects on water quality.
- Concerned about groundwater invading other areas – saturated septic systems, road washouts, isolated livestock on little islands.

As part of the questionnaire, stakeholders were asked if they had specific types of mitigation measures in place, and how effective they were. These mitigation types were:

- Permanent berms at strategic locations;
- Dam/weir/reservoir to manage flows;
- Land classification policies and zoning;
- Emergency response plan; and

- Other.

Their responses to this information have been included in the following sections, along with other comments and suggestions from the stakeholders.

4.2.1 Bow River Basin

General comments from stakeholders about current mitigation measures in the Bow River Basin include:

- Mitigation measures in place (e.g., berms, dykes, armouring, rip rap) were effective, but were not enough to protect from the intensity of the 2013 flood.
- Bridges repaired in 2005 to higher engineering standards survived the 2013 flood; rebuilding costs were well spent.
- Reservoirs were effective in reducing the peak flow, but there were concerns about reducing reservoir levels too far and potentially creating water shortages.

General comments from stakeholders about potential future mitigation measures in the Bow River Basin include:

- Build a dry reservoir upstream on the Bow River.
- Regular awareness for residents of potential flood effects (people get complacent when there hasn't been flooding for a while).

Table 4.8 provides information on mitigation measures from stakeholders for the Bow River Basin – what is already in place, how effective it was, and suggestions for future mitigation measures.

Table 4.8
Current and Potential Mitigation Measures in the Bow River Basin

Area	Current Mitigation	Effectiveness	Potential Measures
Canmore	<ul style="list-style-type: none"> Land classification in the Bow River floodway. 	<ul style="list-style-type: none"> Fair. 	<ul style="list-style-type: none"> Install a debris net. Develop a detailed hazard and risk assessment, and implement appropriate active and passive mitigation measures, particularly for the mountain creeks. Conduct study to determine if current infrastructure should be enhanced to provide more than 1:100-year event protection. Install dyking around the golf course (currently underway). Change land use policy on building in the floodway and fringe.
	<ul style="list-style-type: none"> Permanent berms at strategic locations. 	<ul style="list-style-type: none"> Good. 	
	<ul style="list-style-type: none"> Emergency response plan. 	<ul style="list-style-type: none"> Good. 	
	<ul style="list-style-type: none"> Deflection berm in Stoneworks Creek. 	<ul style="list-style-type: none"> Berm failed, leading to overland flooding. 	
	<ul style="list-style-type: none"> Bank armoring at Cougar Creek. 	<ul style="list-style-type: none"> Failed. 	
	<ul style="list-style-type: none"> Manmade pond on Three Sister's Creek. 	<ul style="list-style-type: none"> Collected sediment that could have caused extensive damage downstream. 	
Kananaskis Area	<ul style="list-style-type: none"> Clean debris from highway culverts yearly. 	<ul style="list-style-type: none"> Fair. 	<ul style="list-style-type: none"> Increase size and capacity of culverts. Review management of, and potential alterations to, existing reservoirs/dams.
	<ul style="list-style-type: none"> Dykes at the Kananaskis Golf Course. Tee boxes and greens were elevated. 	<ul style="list-style-type: none"> Dykes were not high enough to hold back the water. Cut down the amount of damage. 	
	<ul style="list-style-type: none"> Mitigation structures along both sides of the Bow River (armouring, riprap, berms). 	<ul style="list-style-type: none"> Some was effective, some was compromised. 	
	<ul style="list-style-type: none"> Armouring on the Kananaskis River. 	<ul style="list-style-type: none"> Held up fairly well. 	
	<ul style="list-style-type: none"> Kananaskis River has gravel traps. 	<ul style="list-style-type: none"> Fair. Traps were mostly full before flooding as they have not been maintained since being installed in 2009. 	



Area	Current Mitigation	Effectiveness	Potential Measures
Stoney Nakoda Nation	<ul style="list-style-type: none"> No specific mitigation identified. 		<ul style="list-style-type: none"> Flood Prevention Strategy/Memorandum of Understanding with government re: housing and roads (currently in draft). Emergency Response Plan. Larger culverts on roads. Build roads at higher elevations near waterways.
Kananaskis to Calgary	<ul style="list-style-type: none"> TAC diversion channel on the Ghost River. 	<ul style="list-style-type: none"> Diversion berm destroyed. 	<ul style="list-style-type: none"> Clear stormwater drainage systems under Highway 1. Build a berm around the Exshaw lift station and potentially back-flow preventers in the sewer mainlines. Relocate the communication lines for the MD of Bighorn office. Better culverts for Jura Creek under Highway 1A and better crossing for Grotto Creek at Highway 1A. Improve CPR crossing of Exshaw Creek. Elevate Exshaw homes in certain locations, prohibit full basements, have retaining walls. Buffers upstream of water supply, water treatment and sewage disposal facilities. Better emergency response plan.
	<ul style="list-style-type: none"> Berm at Benchlands. 	<ul style="list-style-type: none"> Poor. Silt and gravel from the destroyed berm likely caused damage downstream. 	
	<ul style="list-style-type: none"> Berms and armoured banks in place at strategic locations along waterways. 	<ul style="list-style-type: none"> Much of the armouring washed away (for the third time). 	
	<ul style="list-style-type: none"> MD of Bighorn: <ul style="list-style-type: none"> Permanent berms at strategic locations Dam/weir/reservoir to manage flows Land classification policies and zoning Emergency response plan 	<ul style="list-style-type: none"> MD of Bighorn: <ul style="list-style-type: none"> Poor Poor Fair Good 	
<ul style="list-style-type: none"> Rocky View County: <ul style="list-style-type: none"> Permanent berms at strategic locations Land classification policies and zoning Emergency response plan 	<ul style="list-style-type: none"> Rocky View County: <ul style="list-style-type: none"> Poor Good Fair 		



Area	Current Mitigation	Effectiveness	Potential Measures
Cochrane	<ul style="list-style-type: none"> Sandbags along Jumping Pound Creek. 	<ul style="list-style-type: none"> Very good. 	<ul style="list-style-type: none"> Erosion control – change pathways from shale to asphalt; use more resistant materials. Permanent berm along Jumping Pound Creek (so sandbagging is not necessary).
	<ul style="list-style-type: none"> Land use policy for flood fringe. 	<ul style="list-style-type: none"> Very good. 	
Airdrie	<ul style="list-style-type: none"> Land use policy for flood fringe. 	<ul style="list-style-type: none"> Very good. 	
Calgary	<ul style="list-style-type: none"> Levees and dyking along river in downtown area. 	<ul style="list-style-type: none"> Worked as planned, but unable to accommodate the level of the 2013 flood (attenuated effects from 1:500-year event to 1:100-year event). 	<ul style="list-style-type: none"> Review emergency response plan for lessons learned – always room for improvement.
	<ul style="list-style-type: none"> Land use policy for floodway. 	<ul style="list-style-type: none"> Very good in newer areas where policy is now in effect. 	
	<ul style="list-style-type: none"> Emergency response plan. 	<ul style="list-style-type: none"> Good. 	
	<ul style="list-style-type: none"> Fish Creek Park has stormwater retention ponds. 	<ul style="list-style-type: none"> Seemed to be effective. Although the 2013 event was larger, there was less damage than during 2005 (before the ponds were created). 	
Siksika Nation	<ul style="list-style-type: none"> Permanent berms at strategic locations. 	<ul style="list-style-type: none"> Poor. 	<ul style="list-style-type: none"> Relocate water treatment site away from river. Move homes from the flood plain. Elevate bridge on reserve. Need alternative fresh water sources for times of emergency.
	<ul style="list-style-type: none"> Land classification policies and zoning. 	<ul style="list-style-type: none"> Poor. 	
	<ul style="list-style-type: none"> Emergency response plan. 	<ul style="list-style-type: none"> Fair. 	



Area	Current Mitigation	Effectiveness	Potential Measures
IDs	<ul style="list-style-type: none"> Infrastructure designed with flooding in mind. 		<ul style="list-style-type: none"> Need to ensure that all structures are designed to handle flooding; if a spillway is destroyed, it could affect irrigation for 3 to 5 years.
	<ul style="list-style-type: none"> Flow and volume gauges. 	<ul style="list-style-type: none"> Good until lost (difficult to assess volumes and flow). 	<ul style="list-style-type: none"> Use dams to reduce peak flows; dams should be for multiple uses (e.g., flood protection and water management). Better management of upstream flow volumes. Need stormwater management plans that utilize existing irrigation infrastructure and possibly new wetlands. Increasing storage capacity and adding spillways would allow spill from reservoirs without compromising the future water supply. Add storage reservoirs specifically for flood control.
	<ul style="list-style-type: none"> Carseland weir. 		<ul style="list-style-type: none"> Revise dyke. Find a way to keep debris out of the head gates area.
	<ul style="list-style-type: none"> Bassano Dam built for 1:100-year flood. 	<ul style="list-style-type: none"> Good. 	<ul style="list-style-type: none"> Upgrade spillway or add an additional spillway.
	<ul style="list-style-type: none"> Travers Dam. 	<ul style="list-style-type: none"> Operated at or above capacity during flood. 	<ul style="list-style-type: none"> Add an additional spillway.

4.2.2 Elbow River Basin

Table 4.9 provides information on mitigation measures from stakeholders for the Elbow River Basin – what is already in place, how effective it was, and suggestions for future mitigation measures.

Table 4.9
Current and Potential Mitigation Measures in the Elbow River Basin

Area	Current Mitigation	Effectiveness	Potential Measures
Kananaskis Area to Bragg Creek	<ul style="list-style-type: none"> Evan Thomas Creek has gravel traps. 	<ul style="list-style-type: none"> Fair. Traps were mostly full before flooding as they have not been maintained since being installed in 2009. 	<ul style="list-style-type: none"> No potential measures identified.
	<ul style="list-style-type: none"> Berms at Evan Thomas Creek. 	<ul style="list-style-type: none"> Berm failed; creek went back to its original course around the downstream water treatment plant. 	
	<ul style="list-style-type: none"> Measures in place were effective for what they were designed to protect, but the 2013 flood was bigger. 	<ul style="list-style-type: none"> Effective at some specific sites, but not necessarily as a system. Could have been extended to protect more. 	
Bragg Creek	<ul style="list-style-type: none"> Land classification policies and zoning. 	<ul style="list-style-type: none"> Effective for new areas (no building in the fringe), but does not help for structures built before the zoning was put in place. 	<ul style="list-style-type: none"> Need more upstream buffering.
	<ul style="list-style-type: none"> Berms and armoured banks in place, often on sides of road. 	<ul style="list-style-type: none"> Armouring on side of highway washed away for the third time. 	
	<ul style="list-style-type: none"> Land use policy for no development in the flood fringe. 	<ul style="list-style-type: none"> Effective for the areas it was in place (still some areas where structures were built before the policy). 	
Calgary	<ul style="list-style-type: none"> Dyking along the Elbow River. 	<ul style="list-style-type: none"> Current dyking was not sufficient to eliminate risk of flooding below the Glenmore Dam. 	<ul style="list-style-type: none"> Phased approach to warnings. Need to understand preparedness – critical infrastructure, emergency response, mitigation.
	<ul style="list-style-type: none"> Land classification policies and zoning for no development in the flood fringe. 	<ul style="list-style-type: none"> Effective where it is in place. However, most development along the Elbow predates the policy. 	

4.2.3 Oldman River Basin

General comments from stakeholders about current mitigation measures in the Oldman River Basin include:

- Concern about effectiveness of the Oldman and St. Mary River dams and reservoirs for flood protection (designed for irrigation/drought).

General comments from stakeholders about potential future mitigation measures in the Oldman River Basin include:

- Establish a system to predict river height at key locations (such as bridges) to assist with assessing potential damage.
- Assess competing interests between IDs and communities regarding operation of irrigation systems for flood and drought protection.

Table 4.10 provides information on mitigation measures from stakeholders for the Oldman River Basin – what is already in place, how effective it was, and suggestions for future mitigation measures.



Table 4.10
Current and Potential Mitigation Measures in the Oldman River Basin

Area	Current Mitigation	Effectiveness	Potential Measures
Chain Lakes	<ul style="list-style-type: none"> No specific mitigation identified. 		<ul style="list-style-type: none"> Building a new spillway to increase capacity to prevent overtopping of the south dam. However, this means water will flow downstream at higher velocity in flood events.
Little Bow River	<ul style="list-style-type: none"> No specific mitigation identified. 		<ul style="list-style-type: none"> Controlled diversions to the Little Bow River.
Pine Coulee	<ul style="list-style-type: none"> No specific mitigation identified. 		<ul style="list-style-type: none"> Need to do some investigation; may not be able to handle another flood.
Willow Creek	<ul style="list-style-type: none"> Land classification policies and zoning. 	<ul style="list-style-type: none"> Good. 	<ul style="list-style-type: none"> Better land use policies for no building in floodplain areas.
	<ul style="list-style-type: none"> Emergency response plan. 	<ul style="list-style-type: none"> Good. 	
	<ul style="list-style-type: none"> Twin Valley Dam. 	<ul style="list-style-type: none"> Very good (prevented Willow Creek and downstream communities from flooding). 	
Crowsnest River	<ul style="list-style-type: none"> Riprap along some sections of the river. 	<ul style="list-style-type: none"> Good – saved some areas from damage. 	<ul style="list-style-type: none"> Increase size of CPR bridge over Lyons Creek to prevent residential flooding upstream of the bridge. Better emergency response plan. Plan to deal with raised river bed. Looking at natural ways to deal with overland flooding, such as tree planting.
	<ul style="list-style-type: none"> Log dam upstream of the municipality. 		
Pincher Creek	<ul style="list-style-type: none"> Permanent berms at strategic locations. 	<ul style="list-style-type: none"> Fair 	<ul style="list-style-type: none"> Improve the land use policy to prevent building in floodplains.
	<ul style="list-style-type: none"> Dam/weir/reservoir to manage flows. 	<ul style="list-style-type: none"> Good. 	
	<ul style="list-style-type: none"> Land classification policies and zoning. 	<ul style="list-style-type: none"> Fair. 	
	<ul style="list-style-type: none"> Emergency response plan. 	<ul style="list-style-type: none"> Fair. 	



Belly River (Kainai Nation) *	<ul style="list-style-type: none"> Permanent berms at strategic locations. 	<ul style="list-style-type: none"> Poor. 	<ul style="list-style-type: none"> More river bank protection (e.g., trees) along the river banks to reduce erosion. Ensure good water quality for residents. Need a more comprehensive and organized emergency response plan to understand location of housing, roads, access, first responders, potential response time. Build berms around homes along the river bank to minimize damage and increase occupant safety. Rebuilt roads and bridges, where necessary, to current standards. Ensure that all areas are accessible for first responders in the event of an emergency. Improve reliability of roads through coulees (build up roads and install larger culverts). Improve reliability of access to facilities on the reserve. Better management of the canal and reservoir system – work with the IDs and ESRD re: releasing water into the coulees (in particular, Bullhorn Dam on Fox Lake).
	<ul style="list-style-type: none"> Land classification policies and zoning. 	<ul style="list-style-type: none"> Poor. No new housing is permitted in the Belly River valley, but there are no policies to move residences out of the valley. 	
	<ul style="list-style-type: none"> Emergency response plan. 	<ul style="list-style-type: none"> Fair 	
	<ul style="list-style-type: none"> Water wells moved to higher ground (wastewater treatment facility still in the river valley). 		
	<ul style="list-style-type: none"> Kainai check the snow pack in the mountains to help predict water levels. Also check water levels at the irrigation system dams. 		



Oldman River (Piikani Nation)	• Land classification policies and zoning.	• Good.	<ul style="list-style-type: none"> • Install storm sewers. • Use rock armour in river to protect wells. • Relocate CY Ranch buildings and corrals. • River erosion control to protect water supply and treatment facilities. • Emergency plan for each department.
	• Emergency response plan.	• Good.	
	• Mutual aid with Pincher Creek.	• Advance warning allowed for evacuation where needed.	
	• After 1995 flood, moved the water control building to above the 1995 flood level.	• Very good.	
	• Warning system – has four levels.	• Good.	
	• Enhancements to culverts and corrugated spiral pipe.	• Worked well where installed, but increased flow has created problems further downstream.	
Oldman River (Lethbridge)	• Permanent berms at strategic locations.	• Effective in 1995.	<ul style="list-style-type: none"> • Prefer not to use berms so that flood areas will drain quickly. • Improve surface drainage. • Encourage homeowners to floodproof their homes. • No cost-effective option to remove remaining residences from floodprone areas. • Increase size of berms at water plant and harden electrical systems so operations can be restored more quickly. • Berms around private businesses in floodprone areas. • Still more improvements in surface drainage to be made.
	• Dam/weir/reservoir to manage flows.	• Good.	
	• Land classification policies and zoning for no industrial or urban development in the river valley.	• Good.	
	• Emergency response plan.	• Good.	
	• Changes to landscape adjacent to coulees.	• Effective.	
	• Improved surface drainage in some areas to prevent basement flooding.	• Effective.	



Oldman River (Other)	<ul style="list-style-type: none"> • Communications plan. 	<ul style="list-style-type: none"> • Lethbridge County was unable to contact the government emergency response during the 2013 flood event. • MD of Taber integrated flood response into their disaster plan. 	<ul style="list-style-type: none"> • Installation of groins at strategic locations along the river to stop bank erosion. • Relocation of affected wells.
	<ul style="list-style-type: none"> • Purchased assets to assist with flooding (MD of Taber). 	<ul style="list-style-type: none"> • Effective. 	
	<ul style="list-style-type: none"> • Land classification policies and zoning for no residents or communities in river valleys. 	<ul style="list-style-type: none"> • Good. 	
IDs	<ul style="list-style-type: none"> • Used irrigation canals to partially alleviate potential flood damage. 	<ul style="list-style-type: none"> • Effective, but in combination with overland flow, created significant pressure on the canal system. 	<ul style="list-style-type: none"> • Additional emergency spillways may be required to discharge flood waters from key canal systems back to the Oldman River (although this could potentially affect downstream communities like Medicine Hat). • Undertaking the Southern Regional Stormwater Management Study to assess long-term drainage requirements. • Master Drainage Plan being completed will include flood management options. • Educate landowners of effects of pumping excess field water into irrigation canals. • Promote use of local solutions by farmers (e.g., retention ponds). • Store water in more locations. • Construct emergency spillways.
	<ul style="list-style-type: none"> • Water management operations. 	<ul style="list-style-type: none"> • Provided accurate assessment of potential flood impacts, and warnings to residents about potential problem areas. 	

Note:

* The Kainai Nation discussed mitigation in terms of all flooding, not just 2013.

4.3 Response to Flood (During and After)

General comments from stakeholders about flood response across all basins include:

- Need for better and more coordinated emergency response systems and communications, particularly at a regional level;
- Create regional spots for storing emergency equipment that can be shared among nearby communities;
- Provide more lead time of potential flood events – better forecasting;
- Need for better education of residents in floodprone areas of what to do in a flood; and
- Flooding has positive effects on aquatic systems. Concern is effect of activities undertaken after the flood.

General suggestions from stakeholders for improvements to flood response across all basins include:

- Funding is currently available to replace what was there (through the Disaster Recovery Program). Funding for upgrading infrastructure to protect for future flooding must be secured from other sources. Need to be able to improve infrastructure, not just replace what was there before.
- Momentum is good for response right after the emergency, but eventually slows down. Need to have “emergency clauses” in procedures relating to permitting, *Water Act*, etc. so that repair work can be done more quickly. May also need different guidelines/principles during emergency events (e.g., for entering homes to rescue pets).
- Many stakeholders commented that communication was an issue – forecasting information and contacts for emergency response. Applies to communication between the different levels of government, as well as coordination of efforts between levels of government and different organizations/communities. In many areas, cell phones did not function during emergency response.
- There is a need for more accurate forecasting, and earlier warning of potential flood events.
- Communities need to develop, test and implement emergency plans, and consider roles and responsibilities of those who will be involved.
- In many cases, people did not want to evacuate. Sometimes those who would not evacuate had to be rescued.

Some stakeholders provided details on the types of response they had to recent flood events. This information is provided in **Table 4.11**.

**Table 4.11
 Community-Specific Flood Responses**

Stakeholder	Advance Warning to Administration/ Emergency Services	Warning to Community Residents	Emergency Response Plan in Place	Emergency Health Services	Restricted Access to Flood areas	Property Protection	Volunteers Sandbagging/ Building Berms	Evacuation to Higher Ground	Temporary Food & Shelter Provided	Volunteer Cleanup of Damaged Areas	Volunteer Donations	Other
Bow and Elbow River Basins												
Canmore	X	X	X		X	X		X	X	X	X	X
MD of Bighorn	X	X	X		X	X	X	X	X	X	X	X
Stoney Nakoda Nation				X	X			X	X	X	X	X
Rocky View County		X	X	X	X			X	X	X	X	
Calgary	X	X	X	X	X	X	X	X	X	X	X	
Oldman River Basin												
MD of Willow Creek		X	X					X	X	X	X	
MD of Pincher Creek	X	X	X		X			X	X			
Kainai Nation*	X	X	X	X	X	X	X	X	X	X	X	
Piikani Nation	X	X	X	X	X			X	X	X	X	
Lethbridge	X	X	X	X	X	X	X	X	X		X	X
Lethbridge County	X	X	X	X	X			X				

Note:

* The Kainai Nation discussed responses in terms of all flooding, not just 2013.

4.3.1 Bow River Basin

General comments from stakeholders about flood response in the Bow River Basin include:

- Need to understand preparedness – critical infrastructure, emergency response, mitigation. What are the priorities?
- Need an overall flood (re)action plan for structures along the Bow River.
- Need to understand ramifications of responses before implementing them (e.g., excavating roads, rerouting river flow).

General suggestions from stakeholders for improvements to flood response in the Bow River Basin include:

- Need collaborative approach towards determining the amount of water to be released from the various storage facilities along the Bow River before a flood event to ensure they have room for water storage during flooding.
- Wait until after spring flooding to raise water levels in reservoirs (for drought management).



Table 4.12 provides information from stakeholders on flood response in the Bow River Basin, and suggested changes for future flood response.

**Table 4.12
 Flood Response in the Bow River Basin**

Area	Flood Response	Changes for Future Responses
Alberta Transportation	<ul style="list-style-type: none"> • Used maintenance contractors as first responders for flooding impacts on their infrastructure, which allowed them to respond very quickly. • Watched water levels and closed roads proactively when the waters hit defined levels at bridges and other areas. • Response was very well coordinated and effective. 	
Alberta Agriculture		<ul style="list-style-type: none"> • Held a post-event debriefing to discuss lessons learned for future flood preparation. • Need increased storage and spill capacity for better response. • Improve access to information and communication.
Bow River Basin Council	<ul style="list-style-type: none"> • Initiated a recovery program for clean-up of the flooded areas. 	
Parks Canada	<ul style="list-style-type: none"> • Set up an incident command structure. 	
Canmore	<ul style="list-style-type: none"> • Emergency services were notified to monitor essential areas with known bank degradation. • Warned residents via social media and house to house. • Minor sandbagging; also imported a large volume of heavy rock for temporary berms. 	<ul style="list-style-type: none"> • More training with non-emergency municipal staff. • Improve early warning. • Better personal emergency preparedness. • Reliable communication.
Kananaskis Area	<ul style="list-style-type: none"> • Declared a state of local emergency, established an emergency operations centre, called in extra resources. • Notified and evacuated 1,200 people with the help of the RCMP and army. • Kananaskis Country Interdepartmental Consultative Committee (KCICC) effectively coordinated the response. Changes made after 2005 made a difference. 	



Area	Flood Response	Changes for Future Responses
Stoney Nakoda Nation	<ul style="list-style-type: none"> No emergency plan was in place; no plan for notifying residents. Red Cross managed emergency health services and the shelter. 	<ul style="list-style-type: none"> Need a flood prevention strategy. Need an emergency response plan for all potential emergencies (not just flooding). Better coordination of damage assessments.
Kananaskis to Calgary (MD of Bighorn)	<ul style="list-style-type: none"> Firefighters notified people door to door where evacuation was required. 	<ul style="list-style-type: none"> Implement notification of residences more quickly. Be more prepared for drainage issues. More timely assistance from the provincial government.
Kananaskis to Calgary (Rocky View County)	<ul style="list-style-type: none"> No warning received from provincial government, only from residents. Coordinated response with City of Calgary; also had a site in Bragg Creek. Notified residents via media, social media and emergency management system. Some door-to-door warnings. Red Cross assisted with shelter. 	<ul style="list-style-type: none"> Revise emergency plan. Clarify lines of communication during and after emergency events.
Cochrane	<ul style="list-style-type: none"> Bearspaw Dam reduced water flow (2,400 cms coming in, 1,700 going out). Established an emergency centre; provided sandbags when needed. Activated communication system and alerted people to stay away from affected areas. 	
Airdrie	<ul style="list-style-type: none"> No flooding in 2013, but supported other communities with flooding. Very little done for 2005 flood. 	



Area	Flood Response	Changes for Future Responses
Calgary	<ul style="list-style-type: none"> • Emergency response plan worked well (practiced at least three times/year). Plan was updated after 2005 flood. • All emergency services coordinated through the Emergency Operations Centre. • Warning to residents via loud speakers, media, social media, Alberta Emergency Response Warning System. • Emergency shelters – used lifeguards for first aid providers when first responders were overwhelmed. • Evacuations – people who had never been evacuated before listened to the warnings and evacuated. Those who had been flooded before often stayed, and many had to be rescued. 	<ul style="list-style-type: none"> • Need earlier notification for residents.
Siksika Nation	<ul style="list-style-type: none"> • Army was called in to assist (to ensure that the Crowfoot Ferry was not swept downstream). 	
IDs	<ul style="list-style-type: none"> • Closed gates in Calgary. • Carseland – gates left minimally open when plugged with debris. • No communication from the Provincial Emergency Response Centre or River Forecast Centres during the flood. • Over-reliance on electronic equipment and systems, and the upstream gauges that failed. • Bow River ID had no cell phone service during the flood. No manual backup response plan. • EID did not have good advance warning because of destroyed gauges upstream. Information provided was very inaccurate. • Diverted water went into the river downstream if no storage in the reservoir. 	<ul style="list-style-type: none"> • Earlier warning of residents. • Better coordination of departments and volunteers. • Community awareness – education of risk for those living in the floodplain. • Need better upstream management.

4.3.2 Elbow River Basin

Table 4.13 provides information from stakeholders on flood response in the Elbow River Basin, and suggested changes for future flood response.

Table 4.13
Flood Response in the Elbow River Basin

Area	Flood Response	Changes for Future Responses
Kananaskis Area to Bragg Creek	<ul style="list-style-type: none"> See Kananaskis Area under the Bow River Basin (response coordinated for entire Kananaskis area). 	
Bragg Creek and Area	<ul style="list-style-type: none"> See also Rocky View County under the Bow River Basin. Evacuation was difficult (some people were not interested in leaving). Red Cross assisted with shelters at Springbank High School and Banded Peak School. No time for property protection. Redwood Meadows used Bragg Creek emergency water. 	<ul style="list-style-type: none"> Revise emergency plan. Clarify lines of communication during and after emergency events.
Calgary	<ul style="list-style-type: none"> See also Calgary under the Bow River Basin. Reduced water level in Glenmore Reservoir to allow retention of more flood water. 	

4.3.3 Oldman River Basin

General comments from stakeholders about flood response in the Oldman River Basin include:

- Most communities were as prepared as they could be for flood response. Able to provide assistance to High River and other affected communities.

General suggestions from stakeholders for improvements to flood response in the Oldman River Basin include:

- Be more prepared – stockpile sandbags and sand; have an emergency response plan in place; implement flood mitigation measures before the next flood.
- Flood cost recovery should be better defined.

Table 4.14 provides information from stakeholders on flood response in the Oldman River Basin, and suggested changes for future flood response.

Table 4.14
Flood Response in the Oldman River Basin

Area	Flood Response	Changes for Future Responses
Little Bow	<ul style="list-style-type: none"> • Had no warning. • Closed damaged roads and bridges. 	<ul style="list-style-type: none"> • Improve warning system.
Willow Creek	<ul style="list-style-type: none"> • Warning to residents. • Evacuated small number of people. • Provided temporary food and shelter for small number of people. 	<ul style="list-style-type: none"> • Alternate form of communication (Telus and wireless were down).
Crowsnest River	<ul style="list-style-type: none"> • Municipality of Crowsnest Pass declared a state of emergency. 	<ul style="list-style-type: none"> • Proceed with preparations and response sooner (not left to the last minute). • Update emergency plan from lessons learned.
Pincher Creek	<ul style="list-style-type: none"> • Advance warning to Pincher Creek Community Emergency Management Agency. • Warning to residents. 	<ul style="list-style-type: none"> • Earlier notification.
Belly River (Kainai Nation) *	<ul style="list-style-type: none"> • Advance warning from the provincial government. • Warning to residents using local radio, phone calls, door-to-door in low-lying areas. Posted all emergency phone numbers. • Received assistance from the Red Cross. • Brought in sand for sand bagging (sand bagging provided by individuals and the community). • Residents from low-lying areas evacuated to school gyms and community halls. • Organized crews for cleanup. • Families brought food to the emergency shelters. • Moved livestock out of the river valleys. 	<ul style="list-style-type: none"> • Prepare a more comprehensive community plan (including emergency response plan; no funding available). • Need a warning system for when roads are flooded and access is interrupted (no funding available).
Oldman River (Piikani Nation)	<ul style="list-style-type: none"> • Used vacuum truck at lift station to keep the flow down. • Water wells kept open until they would have flooded. 	<ul style="list-style-type: none"> • More involvement by key departments (not just emergency management). • More advance warning.
Oldman River (Lethbridge)	<ul style="list-style-type: none"> • Received advance warning. • Warning to residents, sometimes door to door. • Restricted access to flooded areas. • Little sandbagging; didn't want to trap water behind berms. 	<ul style="list-style-type: none"> • Improve warning system for residents. • Debrief identified some improvements to implement. • Listen to the people on the ground; they know what's going on.

Area	Flood Response	Changes for Future Responses
Oldman River (Other)	<ul style="list-style-type: none"> • Received advance warning. • Activated disaster plan. • Warning to resident coordinated through the Emergency Operations Centre. Some door-to-door visits (river valley evacuations), schools were contacted. Also used media, website, social media and joint news conferences. • Removed key assets from floodway (had enough time to prepare). • Restricted access to flooded areas. • Dispersed pumps and equipment where required (MD of Taber). 	
IDs	<ul style="list-style-type: none"> • Warned potentially affected residents about impending flood. • Pumped out flooded reservoirs and areas where infrastructure was affected. • Worked closely with MDs and counties. 	

Note:

* The Kainai Nation discussed mitigation in terms of all flooding, not just 2013.

4.4 Flood Studies

Many of the stakeholders had access to reports prepared after previous floods. In most cases, the reports (or information from them) were provided to AMEC for use in this study.

Since the 2013 flood, a number of communities and government departments have been undertaking flood-related studies of the following types:

- Lessons learned;
- Community-specific mitigation measures;
- Flood hazards and risk assessments;
- Drainage assessments and master drainage plans;
- Emergency response planning;
- Dam safety review; and
- Flood and drought water management strategies.

4.5 Other Water Management Concerns

Stakeholders were asked if they had any other water management (or other) concerns or issues that they would like brought forward. **Table 4.15** provides a summary of these comments.

Table 4.15
Other Water Management Concerns and Comments

Stakeholder	Other Water Management Concerns
Alberta Agriculture	<ul style="list-style-type: none"> • Ensure that response to the 2013 flood does not change operations and management of the irrigation water supply infrastructure as managing for droughts is also very important.
Alberta Transportation	<ul style="list-style-type: none"> • Public expectations have been raised that mitigation being looked at will take the risk to 0, rather than just being reduced.
ESRD	<ul style="list-style-type: none"> • Hard to manage for both floods and drought. • Current dams have been designed for drought mitigation; can't expect them to mitigate for floods. • Need to provide more education to the public on how flood and drought management structures operate so they better understand how the structures are managed in extreme events.
Oldman Watershed Council	<ul style="list-style-type: none"> • Concerned about lack of clear policies and information.
IDs	<ul style="list-style-type: none"> • Dams are operated differently for flood control and water supply management. Keeping reservoirs low in case of flooding increases the risk that there will not be enough water available for irrigation. • Drought mitigation and overall water management should be considered along with the flood mitigation options. • Communicate effectively so people can make good, informed decisions.
Canmore	<ul style="list-style-type: none"> • Inflow and infiltration of the water and wastewater systems because of the extremely high water table.
Stoney Nakoda Nation	<ul style="list-style-type: none"> • Lack of funding to do appropriate assessments.
Rocky View County	<ul style="list-style-type: none"> • Water supply is an issue; need a license to draw water, and it's a long process to get a new license. • Need to integrate water storage into the flood mitigation plan.
Cochrane	<ul style="list-style-type: none"> • Need better coordination between the hydro dams and downstream users. • Ice movement and jams on the river due to increased use of hydro dams in winter can be an issue.
Calgary	<ul style="list-style-type: none"> • Manage watersheds, not just floods. • City's emergency plan would be a good model for other communities.
MD of Pincher Creek	<ul style="list-style-type: none"> • Need to protect headwaters. • Concerned about timelines for infrastructure restoration.
Kainai Nation	<ul style="list-style-type: none"> • Limited funding is available for maintenance, emergency response and improvements (e.g., planning, mitigation). • It can take years after a flood to recover from the financial repercussions. • Concerned about potential failure of the Waterton Dam (surpassed its 50-year lifespan). • Need clarity on responsibility for road maintenance (Kainai or provincial government) – Kanai receives funding to maintain only 800 km of their 12,000 km of roads. • Need to provide safe drinking water to all community members (need funding).



Stakeholder	Other Water Management Concerns
Piikani Nation	<ul style="list-style-type: none"> • Need to know the catchment area for Beaver and Pincher creeks. Floods on local creeks create problem in other areas. • Can be challenging to get reimbursed for expenses incurred during an emergency. • Challenged with limited funding available for planning.
Lethbridge County	<ul style="list-style-type: none"> • Need to improve irrigation drainage infrastructure and be able to spill extra water in heavy rain or flood events.
MD of Taber	<ul style="list-style-type: none"> • Look at long-term solutions. • Need an integrated approach.

5.0 SUMMARY

A few key themes on mitigation and flood response emerged from consultation with stakeholders. These are summarized below.

- We need to plan water management of both droughts and floods. Much of the existing infrastructure is designed for drought management, but has the potential to be used for some flood management as well.
- The government needs to coordinate potential mitigation measures from an overall perspective, rather than having each community or area planning their own mitigation strategies. Although individual strategies are good, they need to fit into the overall water management scheme.
- Need to look at both structural and non-structural options for flood prevention. Large structures such as dams and dykes/berms would be good in the bigger picture. However, other options such as planting trees on banks to prevent erosion and changing land use policies to remove structures from floodways would also add to flood prevention.
- Funding for repair of structures such as bridges and roads should allow for improvements to design so the structure can better withstand future flooding. No point in rebuilding a structure that won't withstand the next flood.
- Better flood mapping is required to assist communities with their land use classification policies and zoning relating to flooding. It would also assist communities in better understanding potential flood zones.
- Need for improved forecasting to ensure that communities have enough time to prepare for flood events. Gauges need to withstand higher levels of flooding, and forecasts need to be more accurate. It would be helpful for forecasts to provide information on potential river height increases, not just increased velocity.
- Lines of communication between the government and communities is critical, especially during the emergency. Need to have clear lines of communication and alternate methods of contact if the normal lines of communication are unavailable.
- Citizens in potential flood areas need to be educated on how to prepare for a flood, and how their reactions in a flood may affect others around them and downstream. Also need to

provide more education to the public on how flood and drought management structures operate so they better understand how the structures are managed in extreme events.

- The City of Lethbridge implemented a land use policy after the 1955 flood event that has limited development in the river valley to recreational uses. Because of this, they have had little flood-related damage, which confirms the effectiveness of this type of policy.
- After the 2005 flood event, the City of Calgary made major changes to their emergency response plan, and have practiced implementing the plan on a regular basis. Flooding in Calgary during the 2013 event was severe, but the City very effectively managed their response and damages were much less because of the Emergency Response Plan. Their plan would be a good model for other communities to consider.

6.0 USE OF INFORMATION

Information collected through the stakeholder engagement program was compiled and provided to the AMEC design team. Along with information collected from secondary data sources, stakeholder input has provided the design team with a big picture of flooding in the Bow, Elbow and Oldman river basins so that AMEC can better recommend options that will be beneficial in all areas, rather than just specific communities. The community-specific information on flooding will also allow the design team to suggest effective mitigation options for flood protection in particular areas.

7.0 NEXT STEPS

Collecting information on flooding effects and response as well as mitigation measures is just the first step in the process of providing better flood protection for communities and rural areas in Southern Alberta.

To date, information has been collected and some potential mitigation options recommended for the provincial government SAFRTF to consider. It will be up to the government to determine which options they would like to look at in more detail.

Once this decision is made, AMEC suggests that a larger engagement program be undertaken to provide stakeholders and the general public with information on the potential flood mitigation options that would affect them, and provide the opportunity for further input into the selection and design of the final options.

It is anticipated that engagement will occur throughout the process, right through construction of the final mitigation measures chosen.



8.0 CLOSURE

This report has been prepared for the exclusive use of the SAFRTF. This report is based on, and limited by, the interpretation of data, circumstances, and conditions available at the time of completion of the work as referenced throughout the report. It has been prepared in accordance with generally accepted engineering practices. No other warranty, express or implied, is made.

Yours truly,

AMEC Environment & Infrastructure

A handwritten signature in cursive script that reads "C McArthur".

Cheryl McArthur, B.A.
Human Environment Specialist

Reviewed by:

A handwritten signature in cursive script that reads "Bruce Ramsay".

Bruce Ramsay, MNRM
Principal, Human Environment Team Lead



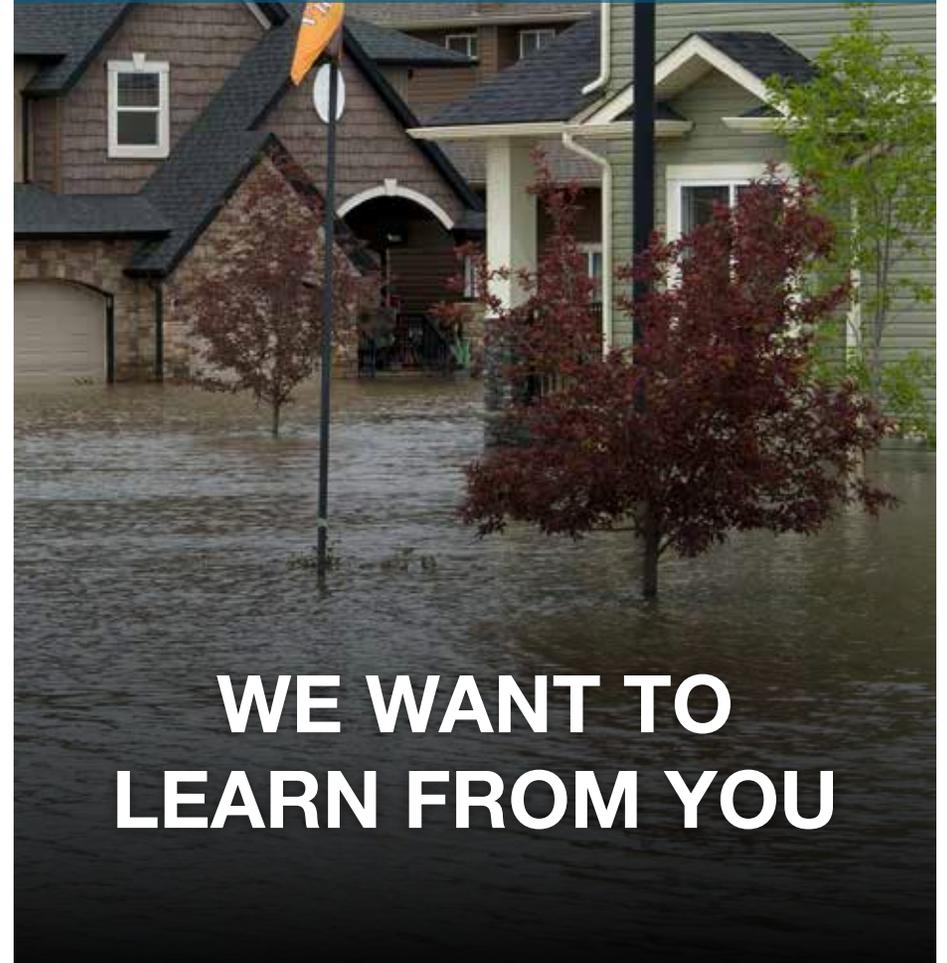
Appendix A

Brochure



Southern Alberta 2013 Floods

The Provincial Recovery Framework
Southern Alberta Flood Mitigation Study
Flood Recovery Task Force



**WE WANT TO
LEARN FROM YOU**

What happened in your community?



- River flooding?
- Debris flows?
- Sewer backup?

How can we reduce or prevent future flooding?

What was the impact to your community?



- To residences?
- To businesses?
- To your infrastructure and services?

How could those impacts be reduced?

How did you respond?



- Advance warning?
- Response coordination?
- Access to flooded areas?
- Evacuation?
- Emergency health services?
- Shelters?

What could have been done better by you and others?

We want to hear from you

The Government of Alberta Flood Recovery Plan includes the completion of a Flood Mitigation Plan. Your experiences and ideas will help build an effective and economical Flood Mitigation Plan to protect Albertans in the future.

Please participate.



Contacts

Flood Info Line

310-4455 - toll-free in Alberta
1-866-825-4455 out-of-province
8 am - 6 pm MDT (Mon-Fri)
9 am - 5 pm MDT (Sat-Sun)

AMEC Environment & Infrastructure

403-387-1707
consultation.calgary@amec.com



Appendix B

Questionnaires

Southern Alberta Flood Recovery Task Force

Flood Mitigation Study

Questionnaire

Southern Alberta urban and rural municipalities and residents as well as First Nation lands and residents located in proximity to the Bow, Elbow and Oldman rivers and tributaries have experienced record flooding in recent years (1995, 2005 and 2013) that has caused minor to significant adverse physical, economic and social effects.

The Southern Alberta Flood Recovery Task Force, supported by AMEC Environment & Infrastructure and AECOM, is undertaking the Southern Alberta Flood Mitigation Study and want your input to better understand what happened to communities, regions and First Nations lands along the Bow, Elbow and Oldman Rivers, how communities responded to the flooding, and what could or should be done in the future to prevent or reduce flooding and improve response to flooding if prevention is not possible.

Your response to the following questions will provide valuable information to AMEC in identification and evaluation of flood prevention, mitigation and response.

Interview Type: _____

Date: _____

Name of urban or rural municipality, community or First Nation: _____

Questionnaire completed by: _____

Have you been contacted by a government agency or consultant for information relating to how the recent flooding affected your community? ____ Yes ____ No

If yes, please provide a summary of who contacted you and what information you provided.

Have your municipal or First Nation lands, infrastructure, services, businesses and/or residents been directly affected by flooding? ____ Yes ____ No

In what year or years? _____

WHAT HAPPENED IN YOUR COMMUNITY?

Please answer these questions if flooding occurred in your community.

1. What happened? (check all that apply from list below)

- River overflowed banks
 Obstacles or constrictions caused the river to overflow banks
 Sediment and debris flows
 River bank erosion
 Storm sewers overflowed
 Sanitary sewers backed up

If the river overflowed its banks, at which locations did this happen?

2. What flood prevention and mitigation measures, if any, were in place at the time of the flooding?

Present/ Not Present	Effectiveness Good/Fair/Poor	Preventive Measure
		Permanent earth or aggregate berms at strategic locations
		Dam, weir or reservoir on river or tributary to manage flows
		Land classification policies and zoning to limit or eliminate development in flood plains
		Emergency response plan in event of a flood
		Other – provide details:

How effective were these measures?

Did any of the existing measures have any effect elsewhere?

3. What suggestions do you have for measures to reduce or prevent flooding in the future?

**Do you think that any potential mitigation measures may have effects elsewhere?
Adverse or beneficial?**

**Do you have any reports about your past experiences during the 2013 or earlier
floods? If yes, would you be willing to share them with us?**

4. Are you undertaking any studies or actions now?

WHAT WAS THE EFFECT ON YOUR COMMUNITY OR REGION?

**5. What was the scale/extent of the flooding in your municipality, community, region
or First Nation lands?**

- Damage estimated to exceed \$1 billion
- Damage estimated at between \$500 million and \$1 billion
- Damage estimated at between \$100 million and \$500 million
- Damage estimated at \$10 million to \$100 million
- Damage estimated at \$1 million to \$10 million
- Damage estimated to be less than \$1 million

**6. Indicate where damage was most severe and least severe in your community on a
scale of 1 to 4 (with 4 representing most severe).**

Yes/No	Level of Severity (1 = Low, 4 = High)	Damage To
		Water supply, water treatment and sewage disposal facilities
		Electrical supply
		Telecommunications
		Municipal roads and bridges
		Provincial roads and bridges
		Rail and light rail transit lines
		Landfills
		Public services (administration, hospitals, schools, emergency services)
		Private residences (single family homes, multi-family units)
		Private businesses
		Motor vehicles

Yes/No	Level of Severity (1 = Low, 4 = High)	Damage To
Other (please describe)		

7. How could the level of damages been reduced?

Damaged Asset	Way to Reduce Damage
Water supply, water treatment and sewage disposal facilities	
Electrical supply	
Telecommunications	
Municipal roads and bridges	
Provincial roads and bridges	
Rail and light rail transit lines	
Landfills	
Public services (administration, hospitals, schools, emergency services)	
Private residences (single family homes, multi-family units)	
Private businesses	
Motor vehicles	

HOW DID YOU RESPOND TO THE FLOODING?

8. How did your municipality, community or First Nation attempt to manage the flooding and related effects?

_____ Advance warning to community administration and emergency services
If yes, how was the advance warning provided?

_____ Warning to community residents
If yes, how was warning to residents provided? (horn sounding, severe weather notice on local TV and radio or other means)

_____ An emergency response plan was in place and activated by a response team
 _____ Emergency health services
 _____ Access to flooded areas was restricted
 _____ Property protection – from water and from people

- _____ Municipal and citizen volunteers sandbagging or building earth berms to protect property
 - _____ Residents were evacuated to a facility(s) on higher ground
 - _____ Temporary food and shelter provided
 - _____ Citizens and other volunteers participated in the cleanup of damaged homes and property
 - _____ Citizens and volunteers collected donations of money, food and clothing
 - _____ Other – provide details:
-

9. How could the response have been handled better?

By the community?

By others?

10. Do you have any other water management issues or concerns you would like to share with us?

Thank you for your participation in this survey. If you have any questions or would like further information on this study, please contact:

Cheryl McArthur
AMEC Environment & Infrastructure
consultation.calgary@amec.com
403-387-1707

Personal information is protected under authority of the Freedom of Information and Protection of Privacy Act, and is used solely for the purpose of evaluating and improving the Project assessment. Individuals will not be identified in any public documents or names used for any purpose other than this project.

Southern Alberta Flood Recovery Task Force

Flood Mitigation Study

Questionnaire

Southern Alberta urban and rural municipalities and residents as well as First Nation lands and residents located in proximity to the Bow, Elbow and Oldman rivers and tributaries have experienced record flooding in recent years (1995, 2005 and 2013) that has caused minor to significant adverse physical, economic and social effects.

The Southern Alberta Flood Recovery Task Force, supported by AMEC Environment & Infrastructure and AECOM, is undertaking the Southern Alberta Flood Mitigation Study and want your input to better understand what happened to communities, regions and First Nations lands along the Bow, Elbow and Oldman Rivers, how communities responded to the flooding, and what could or should be done in the future to prevent or reduce flooding and improve response to flooding if prevention is not possible.

Your response to the following questions will provide valuable information to AMEC in identification and evaluation of flood prevention, mitigation and response.

Government Department: _____

Questionnaire completed by: _____

Have you been contacted by a government agency or consultant for information relating to how the recent flooding affected your facilities or resources?

_____ Yes _____ No

If yes, please provide a summary of who contacted you and what information you provided.

Have your facilities or resources been directly affected by flooding?

_____ Yes _____ No

In what year or years? _____

WHAT HAPPENED IN YOUR REGION?

Please answer these questions if flooding occurred that affected your facilities or resources.

1. **What happened during flooding that affected facilities or resources in your area of responsibility?**

2. **Were their flood prevention and mitigation measures in place that affected how the flooding impacted your facilities or resources?**

How effective were these measures?

Did any of the existing measures have any effect elsewhere?

3. **What suggestions do you have for measures to reduce or prevent flooding in the future?**

Do you think that any potential mitigation measures may have effects elsewhere? Adverse or beneficial?

Do you have any reports about your past experiences during the 2013 or earlier floods? If yes, would you be willing to share them with us?

4. **Are you undertaking any studies or actions now?**

WHAT WAS THE EFFECT ON YOUR REGION?

5. **What was the nature and level of effect on your facilities or resources?**

6. **What was the cost estimate for the damages?**

7. How could the level of damages been reduced?

HOW DID YOU RESPOND TO THE FLOODING?

8. How did you respond to the flood – during and after?

9. How could the response have been handled better – by you or others?

10. Do you have any other water management issues or concerns you would like to share with us?

Thank you for your participation in this survey. If you have any questions or would like further information on this study, please contact:

Cheryl McArthur
AMEC Environment & Infrastructure
consultation.calgary@amec.com
403-387-1707

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Southern Alberta Floor Recovery Task Force

Flood Mitigation Study

Questionnaire

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Irrigation District: _____

Questionnaire completed by: _____

Have you been contacted by a government agency or consultant for information relating to how the recent flooding affected your systems?

_____ Yes _____ No

If yes, please provide a summary of who contacted you and what information you provided.

Have your systems been directly affected by flooding?

_____ Yes _____ No

In what year or years? _____

WHAT HAPPENED IN YOUR REGION?

Please answer these questions if flooding occurred in your region.

1. **What happened during flooding that affected your systems?**

2. **Were their flood prevention and mitigation measures in place that affected how the flooding impacted your systems?**

How effective were these measures?

Did any of the existing measures have any effect elsewhere?

3. **What suggestions do you have for measures to reduce or prevent flooding in the future?**

Do you think that any potential mitigation measures may have effects elsewhere? Adverse or beneficial?

Do you have any reports about your past experiences during the 2013 or earlier floods? If yes, would you be willing to share them with us?

4. **Are you undertaking any studies or actions now?**

WHAT WAS THE EFFECT ON YOUR REGION?

5. **What was the nature and level of effect on your systems?**

6. **How could the level of damages been reduced?**

HOW DID YOU RESPOND TO THE FLOODING?

7. How did you respond to the flood – during and after?

8. How could the response have been handled better – by you or by others?

9. Do you have any other water management issues or concerns you would like to share with us?

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Organization: _____

Questionnaire completed by: _____

Have you been contacted by a government agency or consultant for information relating to how the recent flooding affected your particular area of interest?

_____ Yes _____ No

If yes, please provide a summary of who contacted you and what information you provided.

Has your particular area of interest been directly affected by flooding?

_____ Yes _____ No

In what year or years? _____

WHAT HAPPENED IN YOUR AREA OF INTEREST?

Please answer these questions if flooding occurred in your particular area of interest.

1. **What happened during flooding that affected your area of interest?**

2. **Were their flood prevention and mitigation measures in place that affected how the flooding impacted your area of interest?**

How effective were these measures?

Did any of the existing measures have any effect elsewhere?

3. **What suggestions do you have for measures to reduce or prevent flooding in the future?**

Do you think that any potential mitigation measures may have effects elsewhere? Adverse or beneficial?

Do you have any reports about your past experiences during the 2013 or earlier floods? If yes, would you be willing to share them with us?

4. **Are you undertaking any studies or actions now?**

WHAT WAS THE EFFECT ON YOUR AREA OF INTEREST?

5. **What was the nature and level of effect on your area of interest?**

6. **How could the level of damages been reduced?**

HOW DID YOU RESPOND TO THE FLOODING?

7. How did you respond to the flood – during and after?

8. How could the response have been handled better – by you or by others?

9. Do you have any other water management issues or concerns you would like to share with us?

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