

# **Bow River Water Management Project**

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**On Behalf of  
The Bow River Water Management Project Advisory  
Committee**

# Flood and Drought Mitigation: Purpose and Principles

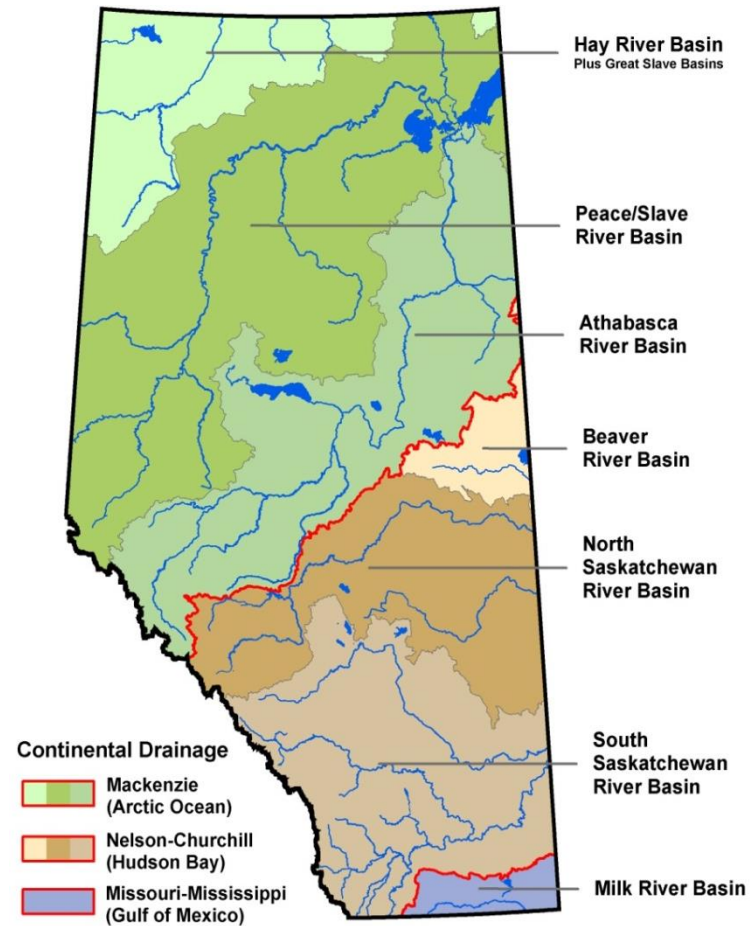
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**Flooding and Drought cannot be prevented, but we can be better prepared**

- **Preparedness, protection and resilience**
  - **Reduce risk**
- **Assess, select, coordinate and implement mitigation measures and policies**
- **Evaluate based on:**
  - **Understanding causes, risks and impacts**
  - **Social, environmental and economic cost-benefit analysis**

# Watershed Management: A Systems Approach

- Each river basin is a system
- Focus on river basins where flooding and drought risks are highest
- Implement best combination of upstream, local, individual and policy-based mitigation measures to protect against flooding events
- Enhance the ability to protect against drought



# Background

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- **The Bow River Working Group, a technical collaboration of water managers and users, was informally established in 2010.**
- **In late 2013 and early 2014 they worked together to identify and assess flood mitigation options in the Bow Basin. Their March 2014 *Bow Basin Flood Mitigation and Watershed Management Project* report put forward the most promising mitigation options including a number of operational changes for the TransAlta facilities in the upper Bow system.**
- **A separate report conducted by Amec Foster Wheeler in 2015 for Alberta Environment and Parks identified 11 potential flood storage schemes for the Bow River.**
- **This 2016 project is a continuation of both of these prior studies.**

# Vision and Mandate

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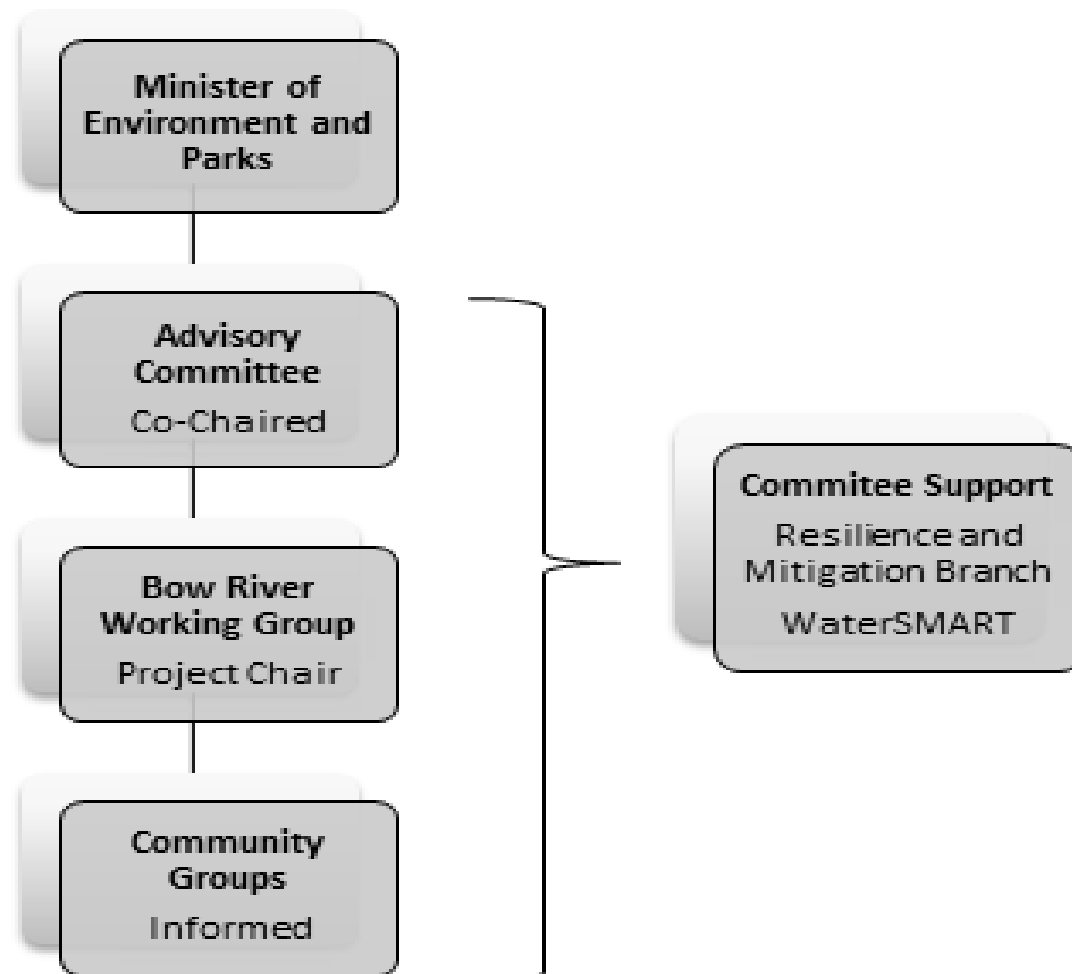
## **Vision:**

**To have a robust, strategic plan for water management in the Bow River Basin, from the headwaters to the confluence with the Oldman River and continuing through Medicine Hat.**

## **Mandate:**

**To provide the Government of Alberta with advice on opportunities to reduce future flood damage, improve the reliability of water supply, and protect the long-term health of the Bow River Basin. This advice will focus on screening flood and drought mitigation opportunities in the Bow River Basin, the resulting flow impacts downstream through the entire Bow River Basin, and consideration of the connected impacts on watershed health. This advice is to be provided to the Minister of Alberta Environment and Parks.**

# Governance Structure



# BRWG Participants

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## Government

- Alberta Environment and Parks
- Alberta Agriculture and Forestry
- Fisheries and Oceans Canada

## Municipalities

- Town of Canmore
- Municipal District of Bighorn
- Kananaskis Improvement District
- Town of Cochrane
- City of Calgary
- Rocky View County
- Municipal District of Foothills
- Medicine Hat
- Vulcan County
- Wheatland County
- Municipal District of Taber
- Cypress County
- Forty Mile Creek

## First Nations

- Siksika Nation
- Stoney Nakoda Nation

## Industry

- TransAlta
- Spray Lakes Sawmills

## Irrigation District

- Bow River Irrigation District
- Western Irrigation District
- Eastern Irrigation District

## WPACs and WSG

- Bow River Basin Council (BRBC)
- Ghost River Watershed Alliance
- Jumping Pound Creek Watershed Partnership
- South East Alberta Watershed Alliance (SEAWA)

## Environmental Non-Governmental Organizations

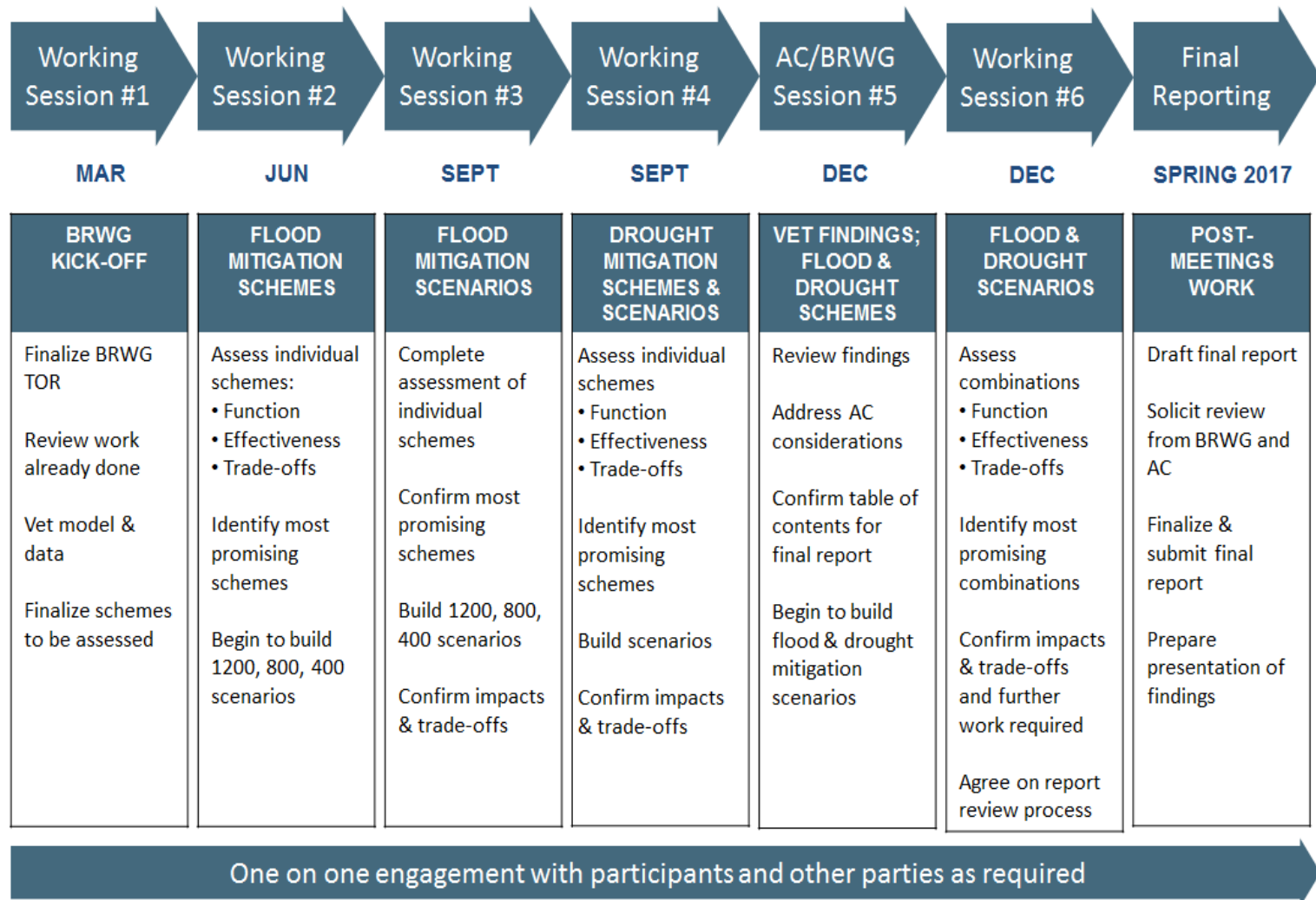
- Ducks Unlimited Canada
- Trout Unlimited Canada

## Other

- Calgary Regional Partnership
- Alberta WaterSMART



# Timeline





# The Final Report

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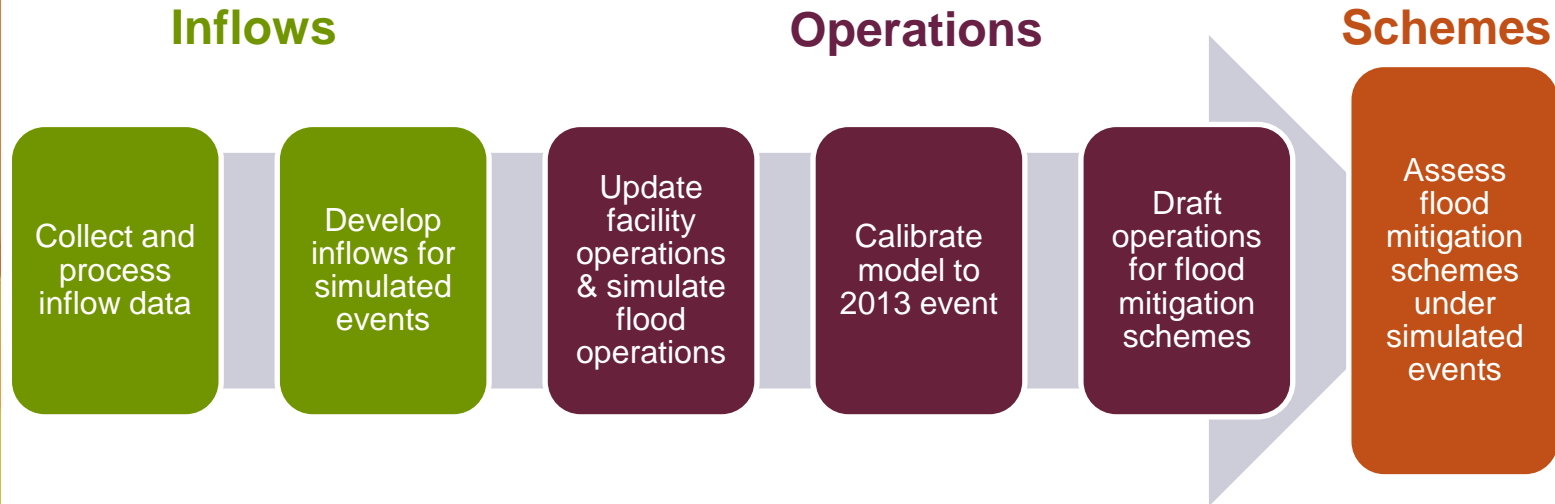
- **Will provide advice to GoA on flood and drought mitigation opportunities throughout the Bow Basin, the resulting flow impacts downstream through the entire Bow River Basin, and consideration of the related impacts on watershed health.**
- **This will influence how we produce a long term plan to reduce the economic, social and environmental costs of flood and drought in the Bow River Basin.**



# The Work of the Bow River Working Group (BRWG)

## Flood Mitigation

# Modelling Approach & Activity



- **BROM updated with new 2013 input flow records consistent with those used by TransAlta and GoA**
- **Time of travel updated to be consistent with TransAlta and GoA models**
- **Simulation of facility operations (normal and flood) refined with TransAlta**

# Modelled Inflows

## 4 different flood events

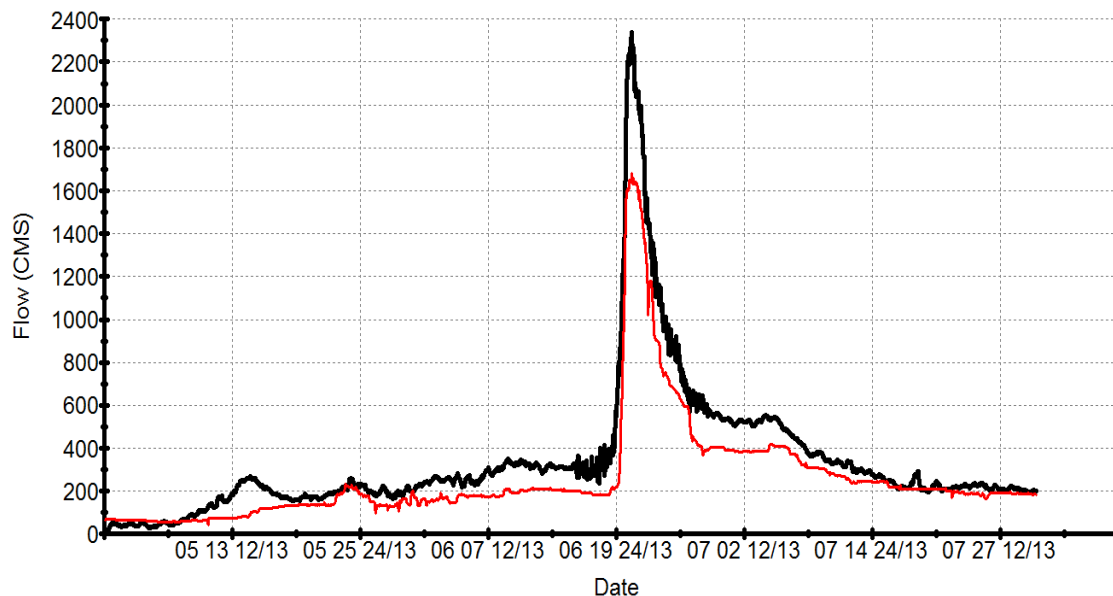
- 2013
- 3 scaled versions of 2005 and 2013 (details to follow)

All events run at an hourly time-step

- Flows represent hourly average flow

All events run from May 1 – July 31

Model input for all events is naturalized flow



## 2013 Event, Bow At Calgary

- Naturalized
- Actual (Observed)

## Peakflows (cms):

Observed  $\approx$  1800

Naturalized  $\approx$  2400

# Range of Simulated Flood Events

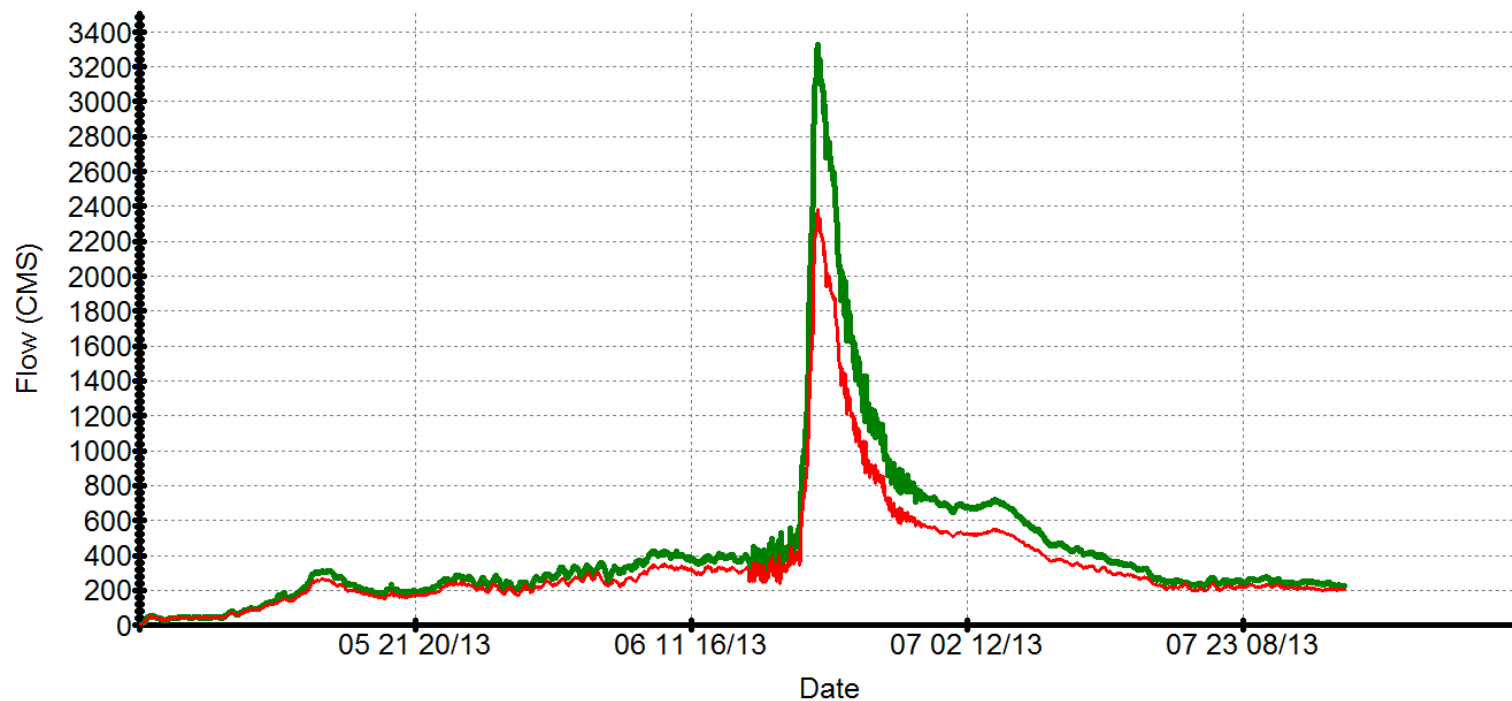
Range of Flood Characteristics vs. Set of Simulated Events to be Used in BRWG Screening Level Assessment								
Flood Characteristics	Naturalized Peak at Calgary			Hydrograph Shape			Inflow Location	
Simulated Flood Events	~2,000 cms	~2,400 cms	~3,300 cms	June volume @ Calgary (M m <sup>3</sup> )	Steep incline, single peak	Slower incline, multiple peaks	Central ranges	Front range and foothills
1. 2013 event				~1,500				
2. 2005 event scaled to ~2,000 cms peak at Calgary				~1,700				
3. 2005 event scaled to ~2,400 cms peak at Calgary				~2,050				
4. 2013 event scaled to ~3,300 cms peak at Calgary				~1,950				

# #1 and #4: 2013 and Scaled 2013

## 2013 Event – Bow At Calgary

— Naturalized Flow (Simulation 1)

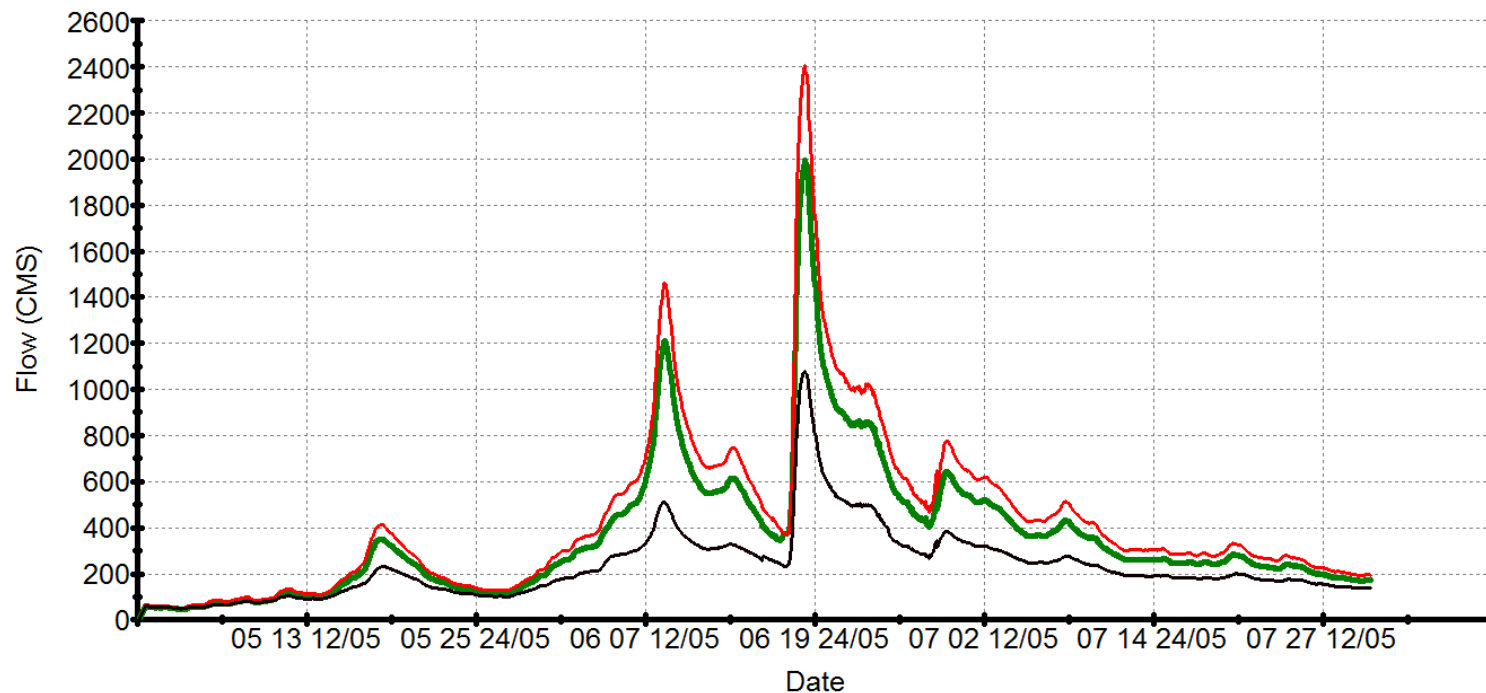
— Naturalized Peakflow Scaled to 3300 cms (Simulation 4)



# #2 and #3: Scaled 2005

## 2005 Event – Bow At Calgary

- Naturalized Flow
- Naturalized Peakflow Scaled to 2000 cms (Simulation 2)
- Naturalized Peakflow Scaled to 2400 cms (Simulation 3)





# Exploring flood mitigation schemes

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- **Objectives:**

- To develop scenarios of potential operational and infrastructure flood mitigation opportunities in the upper Bow River basin to reduce peak flow during a defined range of simulated flood events of approximately 1200, 800 and 400 cubic meters per second (cms) measured on the Bow River above the confluence with the Elbow River.
- impact on flow, as seen in the modelling

- **Additional considerations:**

- Communities
- Environment & Ecology
- Geotechnical
- Land Access & Use
- Project Cost & Efficiency
- Safety & Human Health
- Water Supply & Demand

# Working List of Flood Mitigation Schemes in the Upper Bow

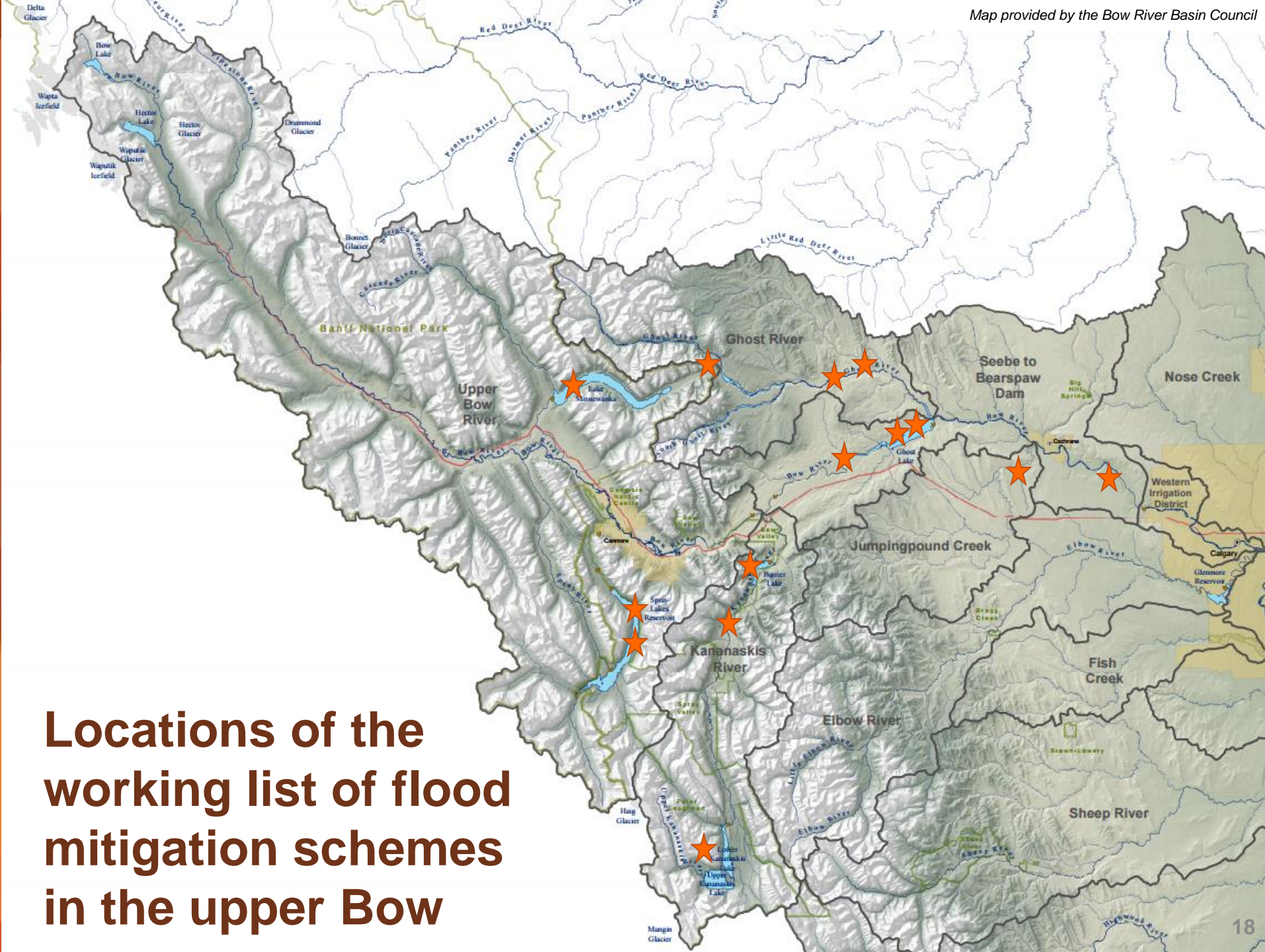
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|---|
| 1. Spray Lakes Reservoir flood operations                       |
| 2. Lake Minnewanka flood operations                             |
| 3. Upgrade Ghost River diversion to Lake Minnewanka             |
| 4. New dam on Ghost River upstream of Waiparous                 |
| 5. New dam on Waiparous creek upstream of confluence with Ghost |
| 6. Kananaskis Lakes Flood Operations                            |
| 7. New Dam on Kananaskis River                                  |
| 8. Barrier Lake flood operations                                |
| 9. New dam on Jumpingpound Creek                                |
| 10. New Glenbow dam on Bow River upstream of Bearspaw           |
| 11. New Morley dam on Bow River main stem upstream of Ghost     |
| 12. Ghost Reservoir flood operations (including 2016 agreement) |
| 13. Expand Ghost Reservoir                                      |
| 14. Expand Spray Reservoir                                      |

Legend:

Upgrade/expansion

Operations

New structure



**Locations of the working list of flood mitigation schemes in the upper Bow**

# Preliminary Findings: Flood Mitigation

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- **The more attractive schemes are located low on the main stem of the Bow River, not on the tributaries.**
- **Peak flows in the two smaller simulated flood events could likely be mitigated to the 1,200 and 800 cms targets.**
- **Peak flows in the larger simulated events could be reduced significantly, but likely not to the 1,200 and 800 cms targets without multiple expensive and difficult measures.**
- **There was convergence on a flood mitigation scenario Ghost flood operations with rapid drawdown capability, Barrier flood operations, and a new Glenbow dam.**
- **Alternatives to Glenbow dam included a new Morley dam or expansion of Ghost.**
- **To reach the 800 cms target, in addition to the above, the scenario would need to include either a second large facility on the main stem or multiple facilities on the tributaries.**



# Two step approach to the drought mitigation discussion

Flood mitigation	Mitigating the flood mitigation	Drought mitigation
<p>Assess individual flood mitigation schemes</p> <p>Build flood mitigation scenarios to achieve 1200cms/800cms at Calgary flow objectives</p>	<p>Estimate increased drought mitigation risk in 1200/800cms flood mitigation scenario compared to base case</p> <p>Identify schemes to mitigate the increased risk</p>	<p>Assess individual drought mitigation schemes</p> <p>Build drought mitigation scenarios to achieve 5-10% reduction in licence shortage objectives</p>
<p>Completed Sept 7 Confirm Dec 7</p>	<p>Completed Sept 8 Confirm Dec 7</p>	<p>Started Sept 8 Continue Dec 8</p>

# The Work of the Bow River Working Group (BRWG)

## Mitigating the Mitigation

# Exploring Drought mitigation schemes

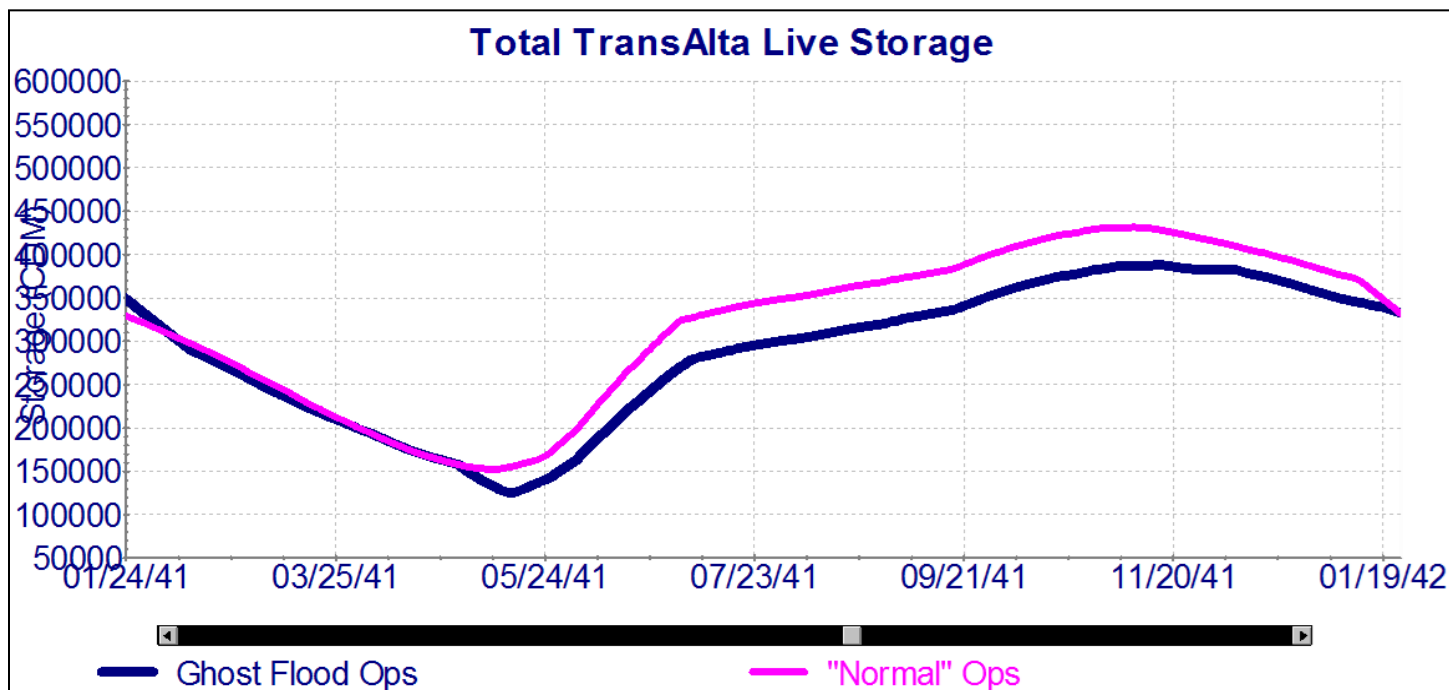
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- **Objectives:**
  - Estimate increased drought mitigation risk in 1200/800cms flood mitigation scenario compared to base case
  - Identify schemes to mitigate the increased risk
- **Additional considerations:**
  - Communities
  - Environment & Ecology
  - Geotechnical
  - Land Access & Use
  - Project Cost & Efficiency
  - Safety & Human Health
  - Water Supply & Demand



# Preliminary Findings: Mitigating the Mitigation

- Preliminary modelling results suggest risk of ~50,000 dam<sup>3</sup> less stored water in the Bow system due to flood scenario:



# Preliminary Findings: Mitigating the Mitigation

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- **“Mitigating the flood mitigation” should first include a series of relatively quick and cheap schemes that better use existing infrastructure:**
  - **increase winter storage in irrigation reservoirs**
  - **put in debris barrier at Carseland**
  - **fill irrigation district reservoirs earlier**
  - **upgrade McGregor to design full supply level (FSL)**
  - **increase Bow River Irrigation District (BRID) canal diversion**
  - **remove Western Irrigation District (WID) licence stage condition**
  - **revise Glenmore licence to use new capacity**
  - **and, possibly, make changes to enable faster drawdown of Ghost.**

# The Work of the Bow River Working Group (BRWG)

## Drought Mitigation

# Exploring Drought mitigation schemes

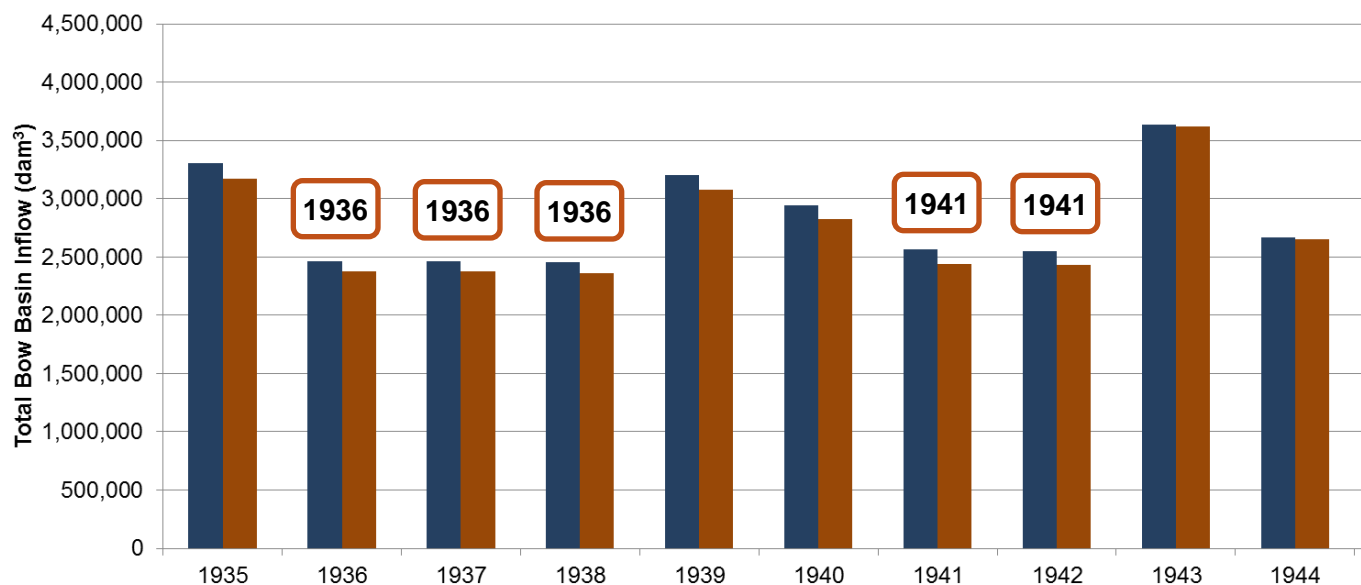
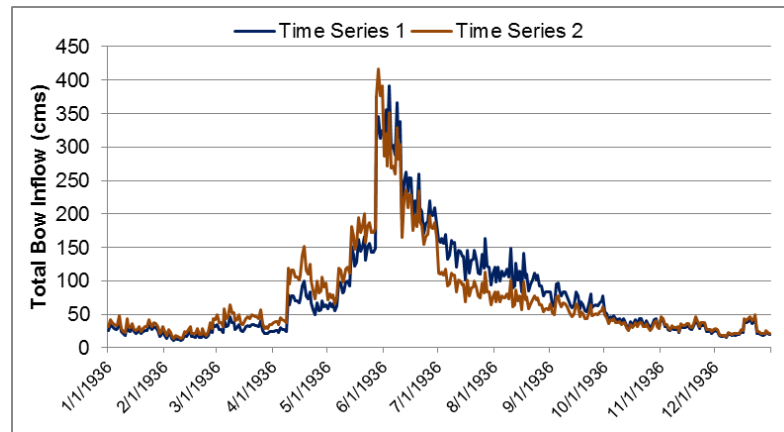
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- **Objectives:**
  - Reduce volume of licence shortages by at least 5% to 10% (relative to current operations) in the same time period, while maintaining the same apportionment contribution, and with improvement, or at minimum no reduction, in ecosystem health.
- **Additional considerations:**
  - Communities
  - Environment & Ecology
  - Geotechnical
  - Land Access & Use
  - Project Cost & Efficiency
  - Safety & Human Health
  - Water Supply & Demand

# Two simulated drought events and the actual historic record

## Two 10-year (cumulative) simulated time series of inflows:

- Time series 1: 1935 to 1944 with 1936 repeated 3 times and 1941 repeated 2 times
- Time series 2: the same time series scaled monthly using climate change scenarios data



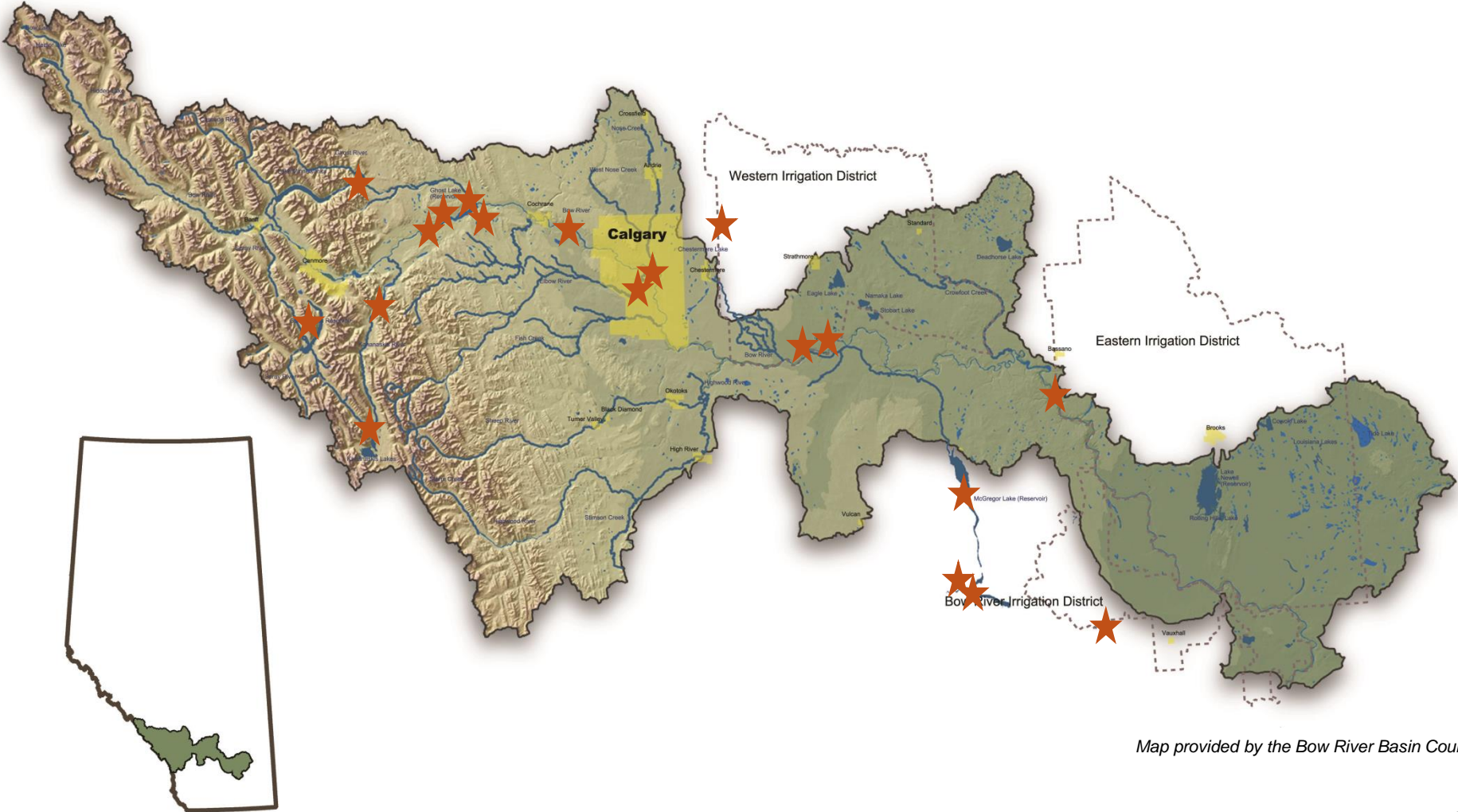
# Working list of drought mitigation schemes in the Bow River Basin

ID	Scheme
1	Raise full supply levels in Upper Kananaskis Lake
2	Restore Spray Reservoir to full design capacity
3	Increase Ghost Diversion to Minnewanka
4	New Dam on Kananaskis River
5	New dam on Bow River upstream of Ghost Reservoir (at Morley)
6	Increase Ghost drawdown rate
7	Expand Ghost Reservoir
8	New dam on Bow River upstream of Bearspaw
9	Long term watershed management agreement with TransAlta
10	Deadhorse Coulee
11	Changes to Glenmore Dam
12	Revision to WID licence to increase diversion at all river stages
13	Delacour Reservoir
14	Increase diversion rate of the Carseland Canal
15	Construct debris deflector at Carseland Canal intake
16	Build new storage low in Bow (Eyremore)
17	Operate McGregor Reservoir at the design FSL
18	Raise winter carryover in existing reservoirs (Travers, McGregor)
19	Fill ID reservoirs earlier (Travers)





# Working list of drought mitigation schemes in the Bow River Basin



Map provided by the Bow River Basin Council



# Preliminary Findings: Drought Mitigation

Preliminary modelling results suggest an order of magnitude change between historical license shortages and license shortages affected by climate change.

The range in reductions to reduce volume of licence shortages by at least 5% to 10% (relative to current operations) in the same time period, while maintaining the same apportionment contribution, and with improvement, or at minimum no reduction, in ecosystem health is from 6 to 138 thousand DAM<sup>3</sup>

	Total Shortage (KDAM <sup>3</sup> )	5% (KDAM <sup>3</sup> )	10% (KDAM <sup>3</sup> )
Drought 1	128	6	13
Drought 2	1,374	69	138

# Preliminary Findings: Drought Mitigation

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- **The most promising schemes to achieve further drought mitigation include:**
  - **new off-stream storage projects**
  - **using the potential new flood mitigation projects as multi-purpose facilities**
  - **and, if warranted, a large new on-stream project low in the Bow River Basin that would benefit both the Bow and the Oldman.**
- **As the flood mitigation scenarios and drought mitigation scenarios are built, it is vital that they be constantly evaluated together to understand the net impact on the water management system as a whole**

# Flood Mitigation + Drought Mitigation to reach a Water Management Strategy

<b>1. Flood mitigation</b>	<b>2. Mitigating the flood mitigation</b>	<b>3. Drought mitigation</b>	<b>4. Mitigating the drought mitigation</b>
<b>Flood mitigation scenario including specific schemes</b>	<b>List of schemes to mitigate the flood mitigation</b>	<b>Drought mitigation scenario including specific schemes</b>	<b>List of schemes to mitigate the drought mitigation</b>



# Questions

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