Collaborative Water Management to Build Resilience in the Red Deer River Basin in the Face of Climatic and Environmental Change

CWRA Alberta Branch Annual Conference, Red Deer

April 20, 2015

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Energy and Environment Solutions

Today's Presentation

- Overview of the SSRB Water Project
- Share with you what we've learned about the Red Deer Basin
- Consider what's next

The SSRB Water Project At A Glance

A collaborative project of southern Albertans to explore practical options for adapting to environmental and climatic change.

Water is fundamental to community sustainability and growth

How water is managed in the SSRB will become even more important in the face of changing climate and use of shared resources

This project will build on existing data, tools, capacity and knowledge to:

- Improve shared understanding of potential environmental and climatic impacts
- Develop and use a comprehensive river system model to explore opportunities in the Red Deer sub-basin
- Build and apply an integrated SSRB river system model to explore opportunities throughout the whole basin
- Introduce physically-based considerations and modeling capabilities

Increase capacity for water resource management throughout the SSRB

SSRB Water Project is Funded in Alberta

2 ½ year project ending Fall 2015

Funded by Alberta Innovates – Energy and Environment Solutions (AI-EES)

Executed by Alberta WaterSMART

Engaging external experts and resources throughout

Work will be conducted with stakeholders, by stakeholders

SSRB is a Complex System
Balancing Many Diverse Interests

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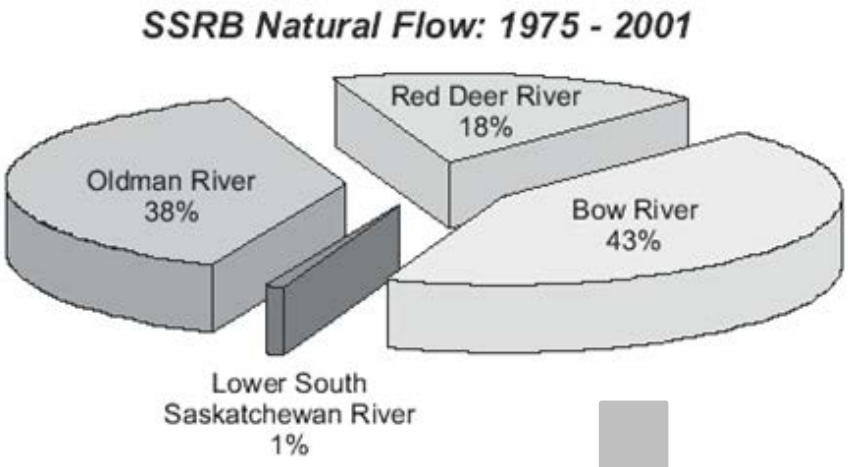

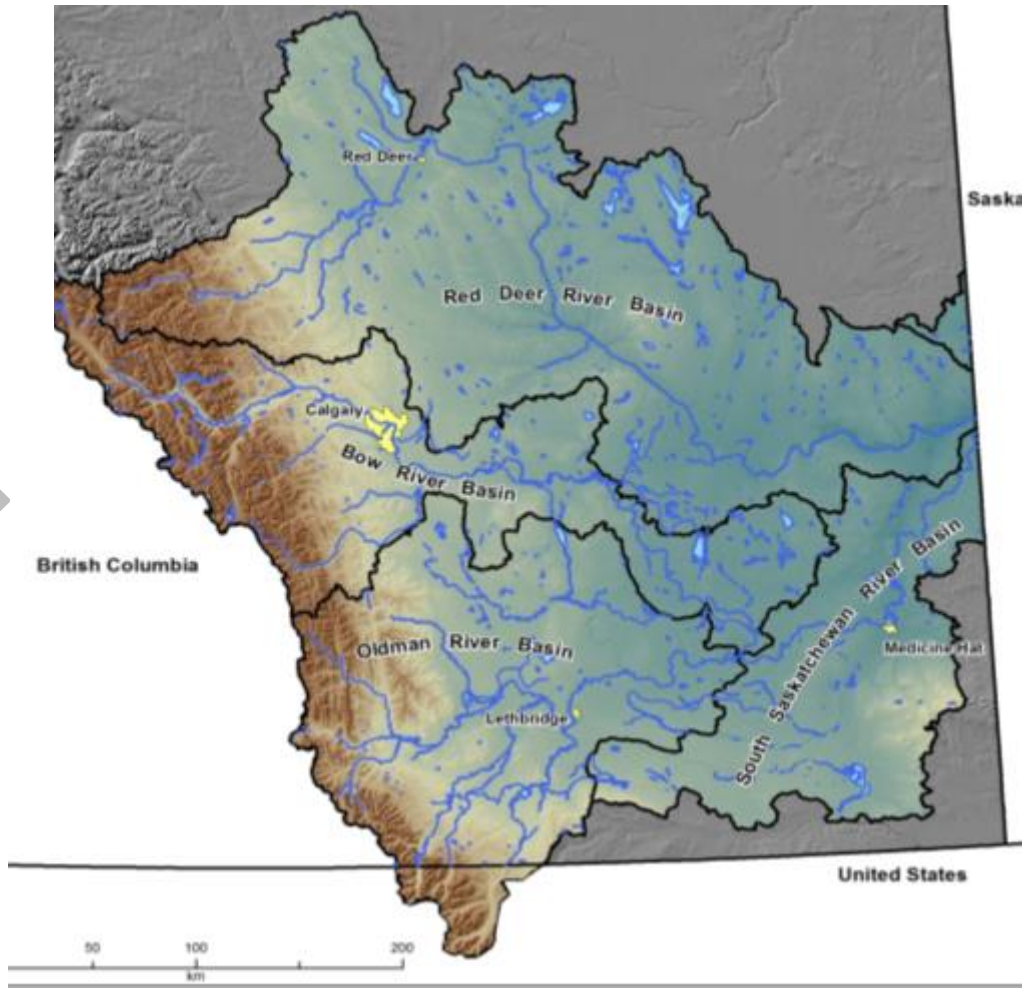

Three Problems with Water

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Too Much

Too Little

Too Dirty

History Demonstrates Extreme Climate Variability

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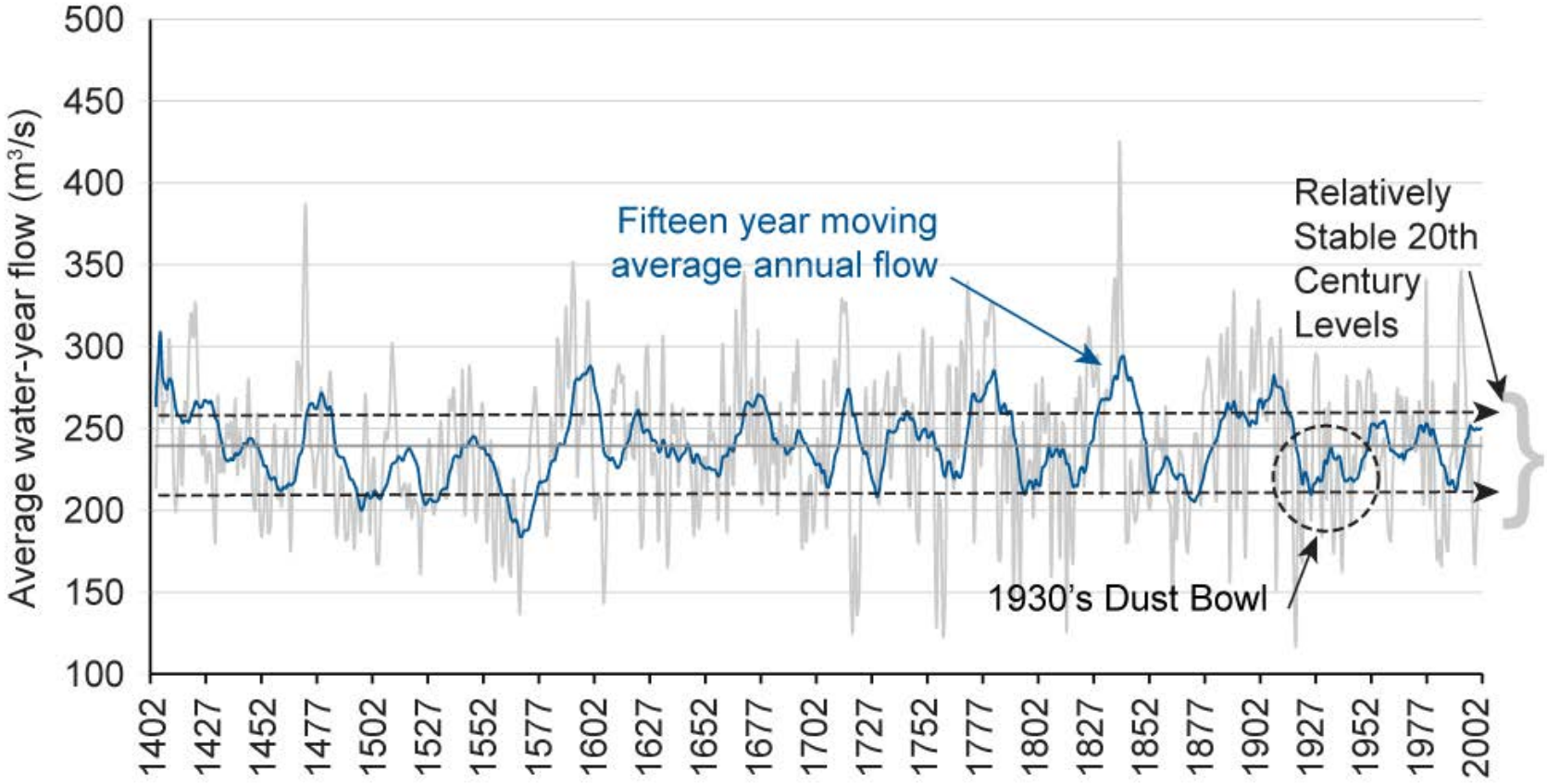
South Saskatchewan River Basin Flows (Bow + Oldman)



Historic and tree ring data indicate future flood/drought events could be far more severe than recent record

SSRB Experience: Provide a Strong Base of Data and Tools

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Alberta Environment and Sustainable Resource Development

- *Naturalized flow data*
- *Water Resource Management Model output*
- *Reservoir operations*
- *Flood mitigation ideas*

Alberta Agriculture and Rural Development

- *Irrigation Demand Model outputs*

Working Group Participants

- *Demand data*
- *Operations*
- *Land use and growth scenarios*
- *Environmental concerns and thresholds*

Interactive Facilitation Tool

PARC

- *Climate model output for future streamflow inputs*

ALCES Sustainable Landscapes, Sustainable Futures

- *Runoff and demand differences from land use changes*

…with performance measures reflecting basin interests from outputs….

…which produces meaningful outputs for discussion, and refinement of scenarios to reach shared or independent objectives.

SSRB Experience: Work Collaboratively To Identify Impacts and Opportunities

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1. Participants build the tools => **common understanding**
2. Participants use the tools => **trust and relationships** for **informed and transparent decision making**
3. Participants apply the tools to explore and evaluate opportunities => **proactive and implementable sustainable water management solutions**

The four sub basins in the SSRB have been modelled and analyzed for:

- Impacts from increasing water demands, droughts, floods, and climate variability
- Potential adaptation strategies and management opportunities while meeting growing demands.

Benefits and Outcomes from the Collaborative Modelling Process

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- **Decision Support**
  - Screening level identification of feasible adaptation, mitigation, and management options
  - Does not replace the need for regulatory requirements (e.g., environmental assessments, engineering feasibility)
- **Helps to translate science into policy and action**
- **Supports the political, social, and governance challenges associated with water management decisions**
  - Human nature barriers, not technical barriers
- **Group momentum and transparency can prevent 'paralysis by analysis'**
  - Trade-offs are identified and understood at a screening level
  - More politically palatable for governments to make decisions if there is regional understanding and evidence to justify and support decisions

Red Deer Working Group Participants

- Alberta Innovates Energy Environment Solutions
- Alberta WaterSMART
- City of Red Deer
- Ducks Unlimited Canada
- MEGlobal
- Mountain View County
- Natural Resources Conservation Board
- Nova Chemicals
- Prairie Adaptation Research Collaborative
- Red Deer River Municipal Users Group
- Red Deer River Watershed Alliance
- Special Areas Board
- Sundre Petroleum Operators Group
- Town of Drumheller
- Town of Sundre
- University of Lethbridge
- West Fraser Timber

Participation from: Alberta Environment Sustainable Resource Development; Alberta Agriculture & Rural Development; Alberta Tourism, Parks, and Recreation

Water Management in the Red Deer Basin: The Crux of the Discussion Is…

- Unique river basin in Alberta
- Water management infrastructure in place
- WCO and IOs in place
- Recent spotlight on flood mitigation
- Basin not closed to new allocations
- Range of growth opportunities
- Focus on maintaining environmental integrity

Key question: How can water management evolve and adapt as the **basin grows (increased water and land use)** and the **climate varies** to decrease risk to users and maintain a balance between growth and environmental interests?

Red Deer River Operational Model (RDROM)

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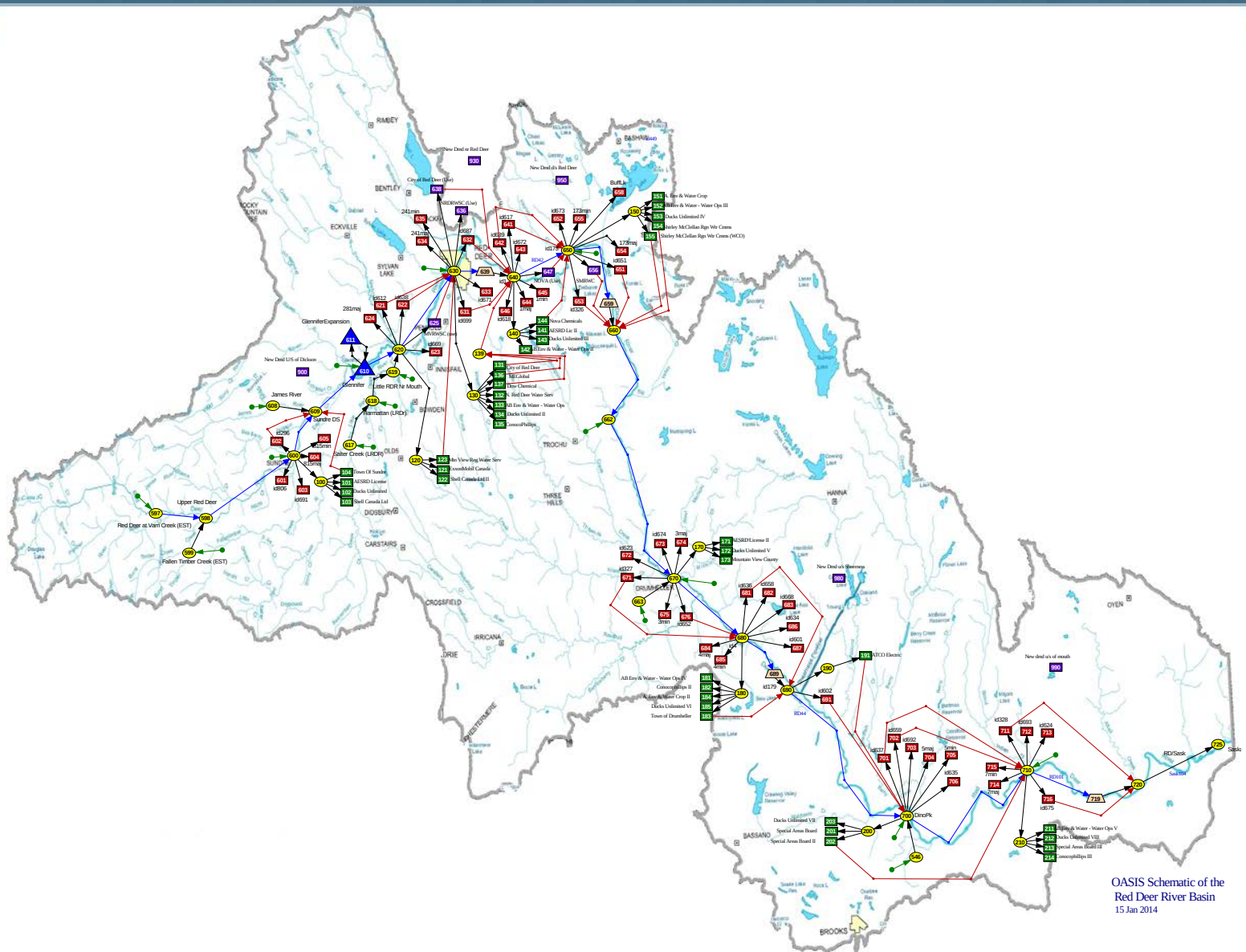

OASIS Schematic of the
Red Deer River Basin
15 Jan 2014

Climate Scenarios Showed Increase Stream Flow Variability

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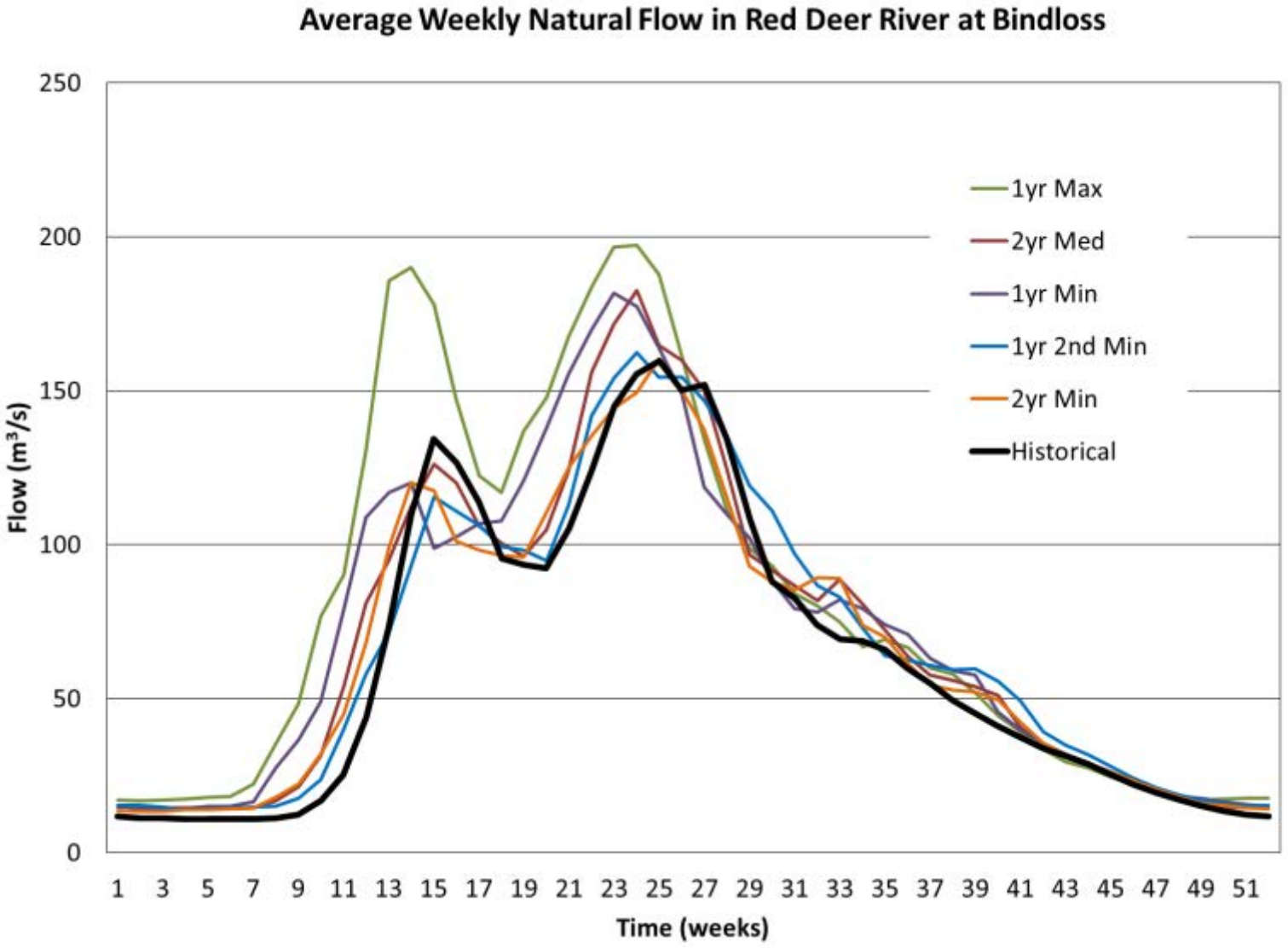


Land Use Scenarios Linked Land Use with Inflows and Demands

- ALCES modelling provided project participants with five land uses that could be assessed
- Four plausible land use scenarios were used in the land use to determine the changes to streamflow
  - The base case reflects current land use
  - Low, moderate and high reflect growth scenarios

	Base Case	Low	Moderate	High
Settlement	No change	50% BAU	100% BAU	150% BAU
Energy	No change	50% BAU	100% BAU	150% BAU
Crops	70,000 cdm	140,000 cdm	170,000 cdm	210,000 cdm
Wetlands	No reclamation	Reclaim 25% of wetlands lost	Reclaim 50% of wetlands lost	Reclaim all of wetlands lost
Fire/Logging	No change	1%/year	10%/decade	100% once
*BAU – Business as Usual				

Four Plausible Scenarios for the Basin

	Scenario 1 Current Conditions	Scenario 2 Medium Growth	Scenario 3 High Growth	Scenario 4 Extremely High Growth
Active Withdrawal (dam^3)	250,000	350,000	440,000	575,000
Total Allocation (dam^3)	335,000	435,000	525,000	655,000
Return Flows (m^3/s)	Current rates of return flow	Return flows scaled up with demands	Return flows scaled up with demands	Return flows scaled up with demands
TDLs (dam^3)	10,000	10,000	10,000	10,000
Wetlands	No change	10% more than today	10% more than today	10% more than today
Crops	No change	SAWSP + Acadia (85,000 dam^3)	SAWSP + Acadia (85,000 dam^3)	SAWSP + Acadia + 15,000 dam^3
Settlement	No change	4% of total growth in the BAU Scenario	Medium (100% BAU)	High (150% BAU)
Energy Development	No change	4% of total growth in the BAU Scenario	Low (50% BAU)	Medium (100% BAU)
Fire / Logging	No change	No change	No change	No change

Scenarios were used to test individual strategies and build combinations of strategies, but used the historical streamflow record as the climate scenarios didn't 'stress the system'

Most Promising Individual Water Management Strategies

Many strategy ideas related to infrastructure operations, managing demand, enhancing environmental flows, and for flood mitigation were all tested and vetted by participants.

The most promising individual water management strategies were shown to provide greatest benefits under conditions of climate variability (particularly drought) and in meeting increased water demands due to growth while considering potential environmental impacts and land use.

1. Implementation of functional flows
2. Dickson Dam operations to restore the WCO (downstream focus)
3. Dickson Dam operations to restore the WCO and new demands (downstream focus)
4. Additional storage
5. Local flood protection
6. Water conservation
7. Application of land use best management practices
8. Effective implementation of Alberta's Wetland Policy

Combination Water Management Strategies

	Scenario 1 Current Conditions	Scenario 2 Medium Growth	Scenario 3 High Growth	Scenario 4 Extremely High Growth
Active Withdrawal	250,000 dam^3	350,000 dam^3	440,000 dam^3	575,000 dam^3
Total Allocation	335,000 dam^3	435,000 dam^3	525,000 dam^3	655,000 dam^3
Combination Water Management Strategies	Current base + WCO met through Dickson operations + Functional flows	Current base + Conservation + Functional flows + Dickson operations to restore WCO and meet new demands AND/OR + Wetland Policy implementation + Execution of licence priorities and shortage sharing in extreme events	Current base + Conservation + Functional flows + Dickson operations to restore WCO and meet new demands + Additional storage (needed); e.g., Ardley (small) AND/OR + Wetland Policy implementation + Execution of licence priorities and shortage sharing in extreme events	Current base + Conservation + Functional flows + Dickson operations to restore WCO and meet new demands + Additional storage (needed); e.g., Ardley (large) AND/OR + Wetland Policy implementation + Execution of licence priorities and shortage sharing in extreme events

- Combination allow various levels of future economic growth in the basin (based on ALCES inflows)

Combination Water Management Strategies

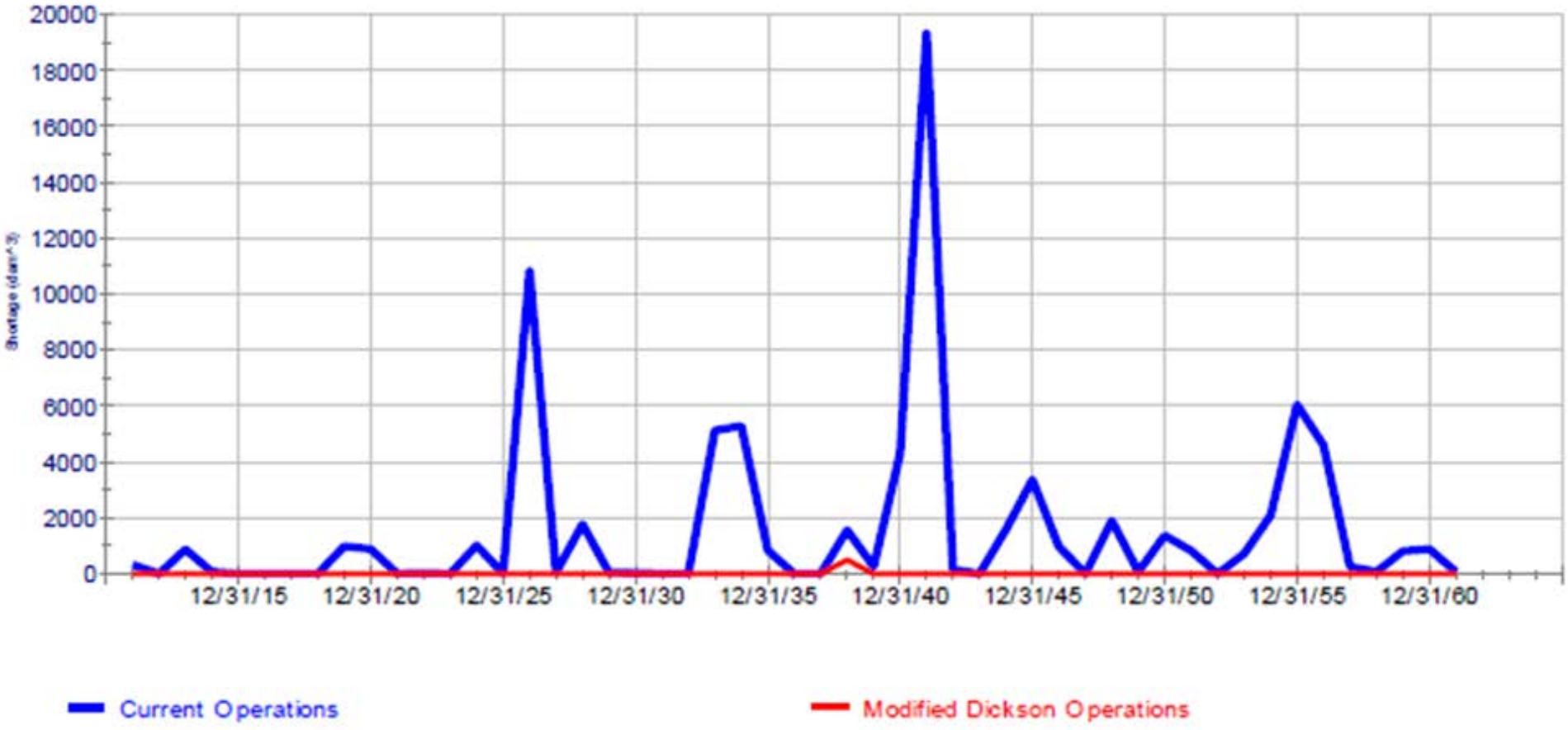
Percentage of time (modelled) where the WCO and active withdrawals in the basin scenarios are not met, and additional storage required to eliminate shortages

		Scenario 1	Scenario 2	Scenario 3	Scenario 4	
Problem	% time WCO not met	5.0%	6.2%	9.3%	11.0%	Current Infrastructure
	% time active withdrawals not met (Shortages)	5.3%	6.6%	12.1%	15.7%	
Solution Through Storage	Storage (dam^3)	0	0	58,000 dam^3	72,500 dam^3	Additional Storage

- Modelling suggests there is enough water and existing infrastructure to support substantial growth with consideration for maintaining environmental health
- High-growth scenarios (3 and 4) would require additional water storage to meet increased demands and maintain environmental integrity (trade-offs with creating additional storage)

Combination Water Management Strategies

Shortages in Scenario 2 to 'new demands' (Jr to the WCO) with current Dickson Dam operations (blue) and with modified Dickson Dam operations (red), 2015–2060



Summary of Findings in the Red Deer River Basin

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- The Red Deer Basin is well-positioned for future economic and population growth in terms of water availability.
- Climate variability projections from this work suggest streamflow in the basin will increase, however, the timing and magnitude of changes in streamflow may dictate whether additional water yields are available to meet increased demand.
- The basin will still be prone to droughts, and needs to build resilience to both wet and dry conditions.
- Land use important in watershed health and river management. However it's the associated increases in withdrawals and consumption due to municipal and industrial development activities that impact streamflow the most.
- The management strategies developed through this collaborative work can be used as a starting point for water managers to consider implementing, if warranted, to be proactive in managing future changes to water supply, water demand, and climate.

What Else Should Happen Next?

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1. Incorporate further environmental flows into the day to day operations of Dickson Dam

- Work with University of Lethbridge researchers, ESRD, and local fisheries biologists to refine operational opportunities for functional flows and embed them as part of standard operating practice

2. Confirm the storage strategy ("roadmap") for the Red Deer River Basin

- Determine potential operational changes to support additional growth
- Incorporate any additional storage into the overall basin water management planning
- Determine what the trigger(s) that will be used for looking at additional storage in the basin

3. Continue the systematic assessment and implementation of flood mitigation options

- Continue local mitigation measures through GoA programs such as the WRRP and advance the Room for the River process to scan all options

4. Advance related GoA programs that will help maintain a favourable water supply/demand balance

- Support Conservation, Efficiency, and Productivity (CEP) plan implementation and promote water conservation
- Ensure Best Management Practices (BMPs) are part of the application process for new water licences
- Effectively implement and enforce Alberta's Wetland Policy

5. Practice how the licence holders will manage through unprecedented times of shortage

- Confirm the existing regulations, policies, and tools already in place for drought management
- Simulate drought operations and how water would be used by licensees during times of severe drought to test procedures, agreements, and tools
- Create additional procedures and tools as needed

Integrated SSRB Modelling (South Saskatchewan River Operational Model [SSROM])

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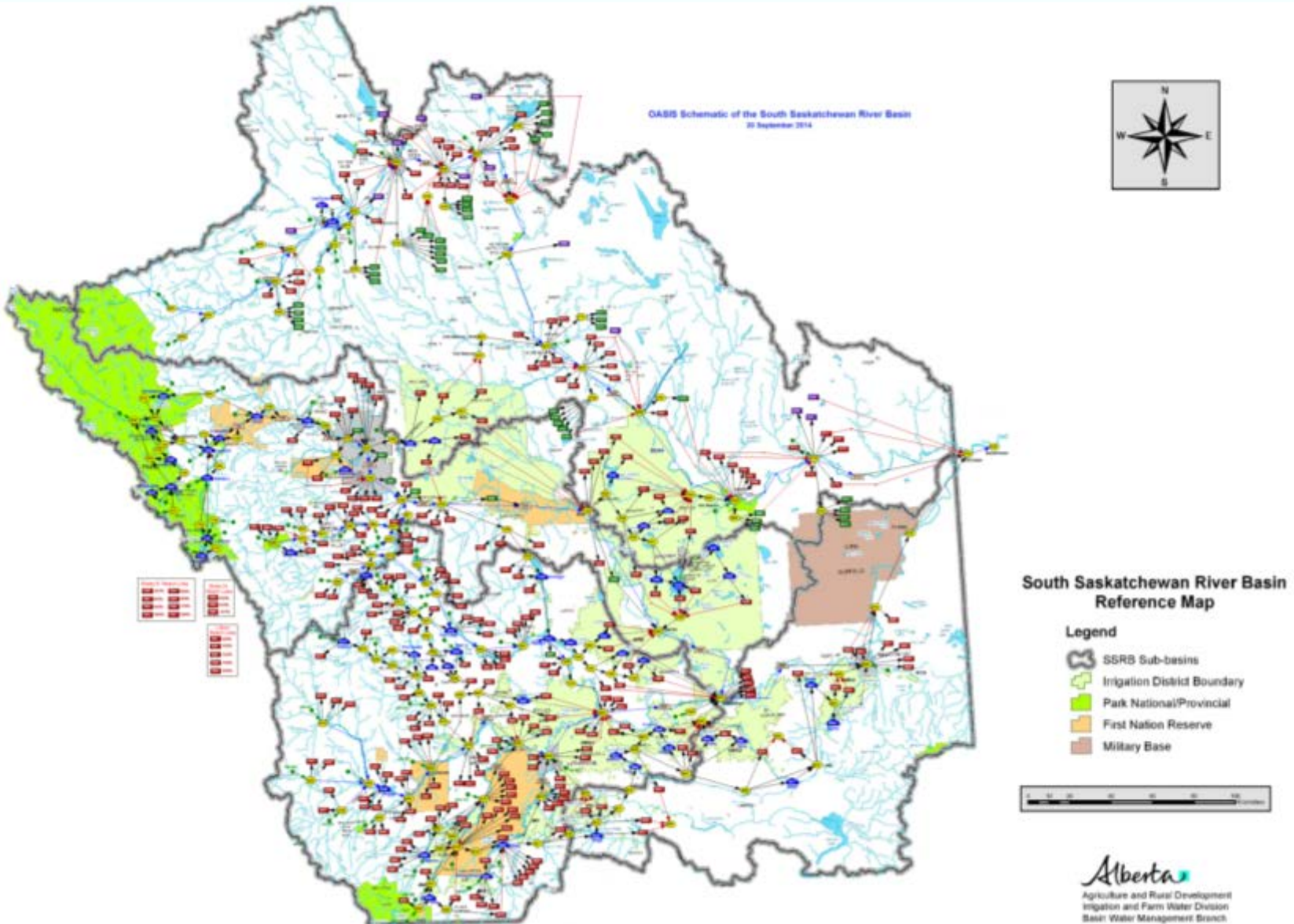

What We Hope to Produce

1. Greater shared knowledge of the SSRB water system, it's management, and potential environmental and climatic impacts
2. Specific recommendations for integrated river management opportunities in each sub-basin and across the SSRB basin
3. A credible set of adaptation strategies for each sub-basin and across the SSRB basin
4. A suite of tools and data to support ongoing adaptive river management

For more information:

Alberta WaterPortal

www.albertawater.com

Alberta WaterSMART

www.albertawatersmart.com

Email:

mike.nemeth@albertawatersmart.com