Draft Meeting Summary

Athabasca River Basin (ARB) Initiative

Working Group meeting #1

Date September 22, 2016

Time 8:30am to 4:00pm

Location Executive Royal Hotel West, Edmonton

Attendees

Allé-Ando Yapo, Teck Resources Ltd.
Alexander Zehnder, Alberta Innovates, Energy and Environment Solutions (AI–EES)
Andrew Paul, Alberta Environment and Parks (AEP)
Anil Gupta, AEP
Anita Selinger, Suncor
Axel Anderson, fRI Research/Alberta Agriculture and Forestry (AAF)
Brian Yee, AEP, Transboundary Waters
Carmen de la Chevrotière, AEP – Transboundary Waters
Cathy Maniego, AEP
Christine Brown, Shell
Dallas Johnson, AI–EES
Dan Cardinal, Métis Nation Region 1
Dan Moore, AFPA/ANC
Donna Kanarek, Al-Pac
Ellyn Davidson, CPAWS
Fred Kuzmic, Shell
Fred Wrona, AEP
German Rojas, AEP
Janice Linehan, Suncor
Jason Ponto, Athabasca Watershed Council (AWC)
Jessica Watson, West Central Forage Association
Jim Sellers, Athabasca University
Lauren Makowecki, AEP
Linda Jefferson, ATCO
Marek Janowicz, DFO
Mark Sinclair, Peavine Métis Settlement
Martin Van Olst, Environment and Climate Change Canada (ECCC)
Meghan Payne, Lesser Slave Watershed Council (LSWC)
Molly Fyten, Lac La Biche County
Murray Tenove, AAF
Narayan Shrestha, Athabasca University
Patrick Marriott, Alberta Energy Regulator (AER)
Quentin Syryda, Al-Pac
Thorsten Hebben, AEP
Wayne Crosby, AEP
Barb McCord, Alberta WaterSMART
Claire Jackson, Alberta WaterSMART
Danielle Marcotte, Alberta WaterSMART
Devin Cairns, Alberta WaterSMART
Mike Nemeth, Alberta WaterSMART
Ryan MacDonald, Alberta WaterSMART
Denise Di Santo, Alberta WaterSMART

Meeting objectives

1 Review the Terms of Reference for the ARB Initiative Working Group.
2 Review basin issues and challenges as gathered and heard to date.
3 Confirm model is representative of the watershed “today”.
4 Help to build the modelling platform and use model to explore potential basin issues and opportunities.
5 Discuss and refine Performance Measures (PMs).

Current action items

Action		Responsible	Due	Status
1	Project team to follow up on which tributaries should be considered for adding into model to align with water quality monitoring	WaterSMART	October 14	New
2	Project team to check on other environmental flows that should be in the model, and look at the licenced one near Hinton.	WaterSMART	End of October	New
3	Project team to follow up with licensees to confirm water use in model.	WaterSMART	Early November	New
4	When checking licence use with licensees, determine if it is necessary to ungroup certain high volume licences	WaterSMART	Mid-November	New
5	Pull registrations – confirm that the volumes on different reaches of the river are within margin of error of modelling and determine if they should be added as a demand.	WaterSMART	Mid-November	New
6	Pull environmental management licences, where possible look at actual use versus allocated use demand patterns and actual return versus allocated return patterns.	WaterSMART	Mid-November	New
7	Project team to look at forecast for downstream industrial use and compare that to current modelled licence use in the lower Athabasca.	WaterSMART	End of October	New
8	Project team to follow up on list of suggested PMs to build for the next Working Group meeting	WaterSMART	Before the Dec 1 meeting	New
9	Send out Doodle Poll and book meeting for Nov or early December (meeting #2)	WaterSMART	October 7	Complete
10	Draft meeting summary and send to participants with slides from meeting	WaterSMART	October 7	Complete
11	Send out Doodle Poll and book meeting for January (meeting #3)	WaterSMART	October 14	New

Discussion points

1 Opening remarks

Mike Nemeth convened the meeting at 8:45 a.m., welcomed everyone and acknowledged that the meeting was convened on Treaty 6 land. Participants then introduced themselves, noting their affiliation and interest in the basin and the project.

Mike reviewed the objectives of today, and emphasized that this is the first step in Athabasca River Basin (ARB) Initiative, which is focused on providing a basin wide understanding of the water issues and opportunities in the ARB, and developing a Roadmap for sustainable water management throughout the ARB. Mike then reviewed WaterSMART's unique mandate and mission – to improve water management in Alberta, and export ideas outside Alberta, through project development and execution such as the ARB Initiative which focus on collaboration, and communication.

Mike reviewed the strong link between climate variability and water, and the direct, significant impact on water resources that climate change will have. He underscored the importance of focusing early on adaptation, which will require understanding the converging demands in watersheds like the ARB, and devising strategies to balance the demands in the face of climate and environmental change.

The ARB Initiative is a basin-wide collaborative effort to inform decision making and create a common understanding of the issues and opportunities across the ARB for proactive water management. The Initiative will build on existing data, tools, capacity, and knowledge to:

- Provide an integrated modelling tool to inform water and natural resource management plans, approaches, and decision making
- Provide accessible and transparent information on basin water management
- Build a common understanding and trust across the basin
- Identify strategies for adapting to future water challenges
- Identify critical gaps in data, science, processes and policy for effective water management

The current scope of the ARB Initiative reflects the approach to examine the Slave River system in "manageable chunks". The scope of this work does not include the entire extent of the ARB in Saskatchewan, and does not explicitly consider the Peace–Athabasca Delta (PAD) in Alberta. The long-term scope, however, integrates the Athabasca–Peace–Slave systems, spanning British Columbia, Alberta and Saskatchewan, including the PAD. The questions asked and work done in the ARB Initiative will feed information on water flowing into the PAD from the Athabasca system, and changes to those flows over time, and with change in climate and on the landscape.

The ARB Initiative hopes to:

1. Bring together the people that know the watershed
2. Provide a strong base of data and tools – credible, vetted, and reliable:
    - Input data from best available sources
    - Produce an interactive model of surface water quantity to build a Roadmap for sustainable management of surface water resources in the ARB
    - Use Performance Measures (PMs) reflecting basin interests – visuals that show status of an interest to a participant
3. Work collaboratively

The ARB Initiative is not just a modelling project; it is not a Government of Alberta (GoA) initiative (though the GoA's support indicates that they see the value in the Initiative) and is not Consultation, or replacing the duty to consult. The ARB Initiative is an iterative, collaborative process with the intent of

providing the ARB water community with a common understanding, and a chance to inform decision making.

The target result for this Working Group meeting is to share information, discuss the issues and opportunities that may be explored using modelling tools, and suggest changes/improvements to the integrated model to achieve the best possible representation of water quantity in the basin. The goal of future meetings will be to build levels of adaptation (mitigation/management strategies) into a Roadmap for water management in the ARB (similar to the structure of a Roadmap done for the South Saskatchewan River Basin (SSRB)). The broader outcome of the ARB Initiative is to build greater shared knowledge of the ARB water system, examine potential land use and climate change impacts on the basin, and develop useable management and adaptation strategies that balance the basin's interests and needs.

Responses to questions based on discussion from the group:

- Will the models and the data be made available after the work is done, and where will the work reside?
- Response: yes, all the modelling and data will be publicly available. Where this work will reside after the current scope of work has yet to be determined. Discussions with AEP and other parties are underway to determine where the model and the associated data will be permanently housed, and how the model might be available for operational use. A desired outcome of these watershed initiatives is that participants (e.g., governments, industry, municipal groups, First Nations, Métis communities) use the tools once they're developed. Making them available and accessible is important but is a long term challenge.
    - Ongoing discussions about "homes" for models:
        - Models from previous modelling work carried out in the SSRB are currently made available through the University of Lethbridge servers.
        - There is potential that Athabasca University may act as storage hub.
        - WPACs and GoA have also been discussed as potential options.
- Will all the meetings be held in Edmonton?
- Response: yes, the plan is to host all the meetings in Edmonton. For logistics for people from around the basin and for many of the folks that come in from Calgary and Edmonton it seems to strike a balance between logistics and resources.
- How is the modelling going to fit together? Is groundwater being modelled?
- Response: Groundwater will not be explicitly modelled using a 3D groundwater model but modelling outputs could be compared to outputs from existing groundwater models and eventually can be linked with a groundwater model if desired. The Raven hydrological framework will be used to provide streamflow as an output. Streamflow will be fed into the OASIS river system model (called the Athabasca River Operational Model or AROM), which will generate output to reflect interests as expressed by the Working Group in the form of performance measures (PMs).
- How are water licences shown in the modelling work?
- Response: Water licences are shown as demands in AROM that will be explained later this morning.

- Has the work that was done in southern Alberta been able to be updated and used?
- Response: Mike explained that the work that was started in the SSRB has been on-going and revisited constantly since it started in 2010. Currently there is a Bow River Working Group project that is led by AEP and facilitated by WaterSMART to look at flood and drought mitigation in the Bow River mainstem.

Mike explained that there is lots of information being presented and the slides will be sent out with the meeting summary. Some of the material will be reviewed in future meetings, and this process is meant to be iterative.

2 Review ARB Initiative Working Group Terms of Reference

Denise Di Santo led the discussion on the Draft Working Group Terms of Reference (ToR), and asked for further feedback/comments/revisions.

Section 1 Background:

- Suggested that the term Indigenous be *globally* replaced with "First Nations and Métis".
- Suggested to include reasons/rationale for working group meetings.

Section 3 Project Principles:

- Suggested that "inclusive" be added to second bullet point; second comment noted it should read "inclusive *within* Alberta."
- Confirmed that minimum flow requirements in 3.6 are mandated/regulatory (e.g., 87 cubic meters per second (cms)).

Section 5 Scope:

- Suggested that water quality as it's related to water quantity is modelled should be added to the ToR.
- Concern expressed about excluding the PAD; questioned the rationale.
    - Mike reminded the group that this Initiative covers the whole ARB, and is meant to look at water across the basin, not just the lower portion or the outlet. The work done and questions asked of the models will be able to show changes in flow going into the PAD region from changes in flow from the Athabasca. There may be PMs that can be used to indicate changes from flow to things like Walleye recruitment in the PAD.
    - Mike reiterated that in order to make the scope manageable the focus would be on completing Athabasca River basin, and then the Peace River to be able to look at the PAD and Slave system as a whole.
- Follow-up suggestion to ensure that the PAD is considered is to perhaps derive a PM related to flow/PAD changes.
- There was a question on if additional tributaries in the lower Athabasca could be added to align with current water quality monitoring. It was confirmed that it is possible to add tributaries to scope at this stage.

ACTION: Project team to follow up on which tributaries should be considered for adding into model to align with water quality monitoring

- Suggested that ToR stipulate "no legal obligations".

- Suggestion that 5.2 state explicitly basin landscape changes and climatic changes over time – can be modelled together.
- A comment that the concept of modelling uncertainty seems to be absent; should be added to ToR and explicitly discussed.
- A question was asked around who was going to own ARB Initiative results. Concern was expressed about the risk that a great tool may be developed and not used as envisioned after the process is over.
- Denise concluded discussion with request for additional comments to Claire, Mike, or herself in person, or by email.

Comments/revisions will be incorporated in the ToR using tracked changes, and revised version will be sent to working group for review. Comments back from the second draft that will be send out will be reviewed at the next Working Group meeting where the ToR will be finalized.

3 Integrated model overview

The integrated model components and preliminary modelling work done to date was presented, including landscape simulation in ALCES, hydrological modelling in Raven, and river system modelling (including water use (demands)) in the river system model (Athabasca River Operation Model or AROM) built on the OASIS modelling platform. Data needs and modelling assumptions and limitations were also presented and discussed.

The integrated model has four components:

- Regional Climate Models: simulates future climate conditions for the Athabasca River Basin
- Landscape Simulation Model (ALCES Online): simulates anthropogenic and natural land change
- Hydrological Model (Raven): simulates hydrological processes and changes those processes have on streamflow
- River System Model (AROM): simulates river management, including human and environmental demand, and infrastructure operations

A few highlights of ALCES Online for landscape simulations include:

- Roughly 200 landscape and footprint types
- Publicly available data (e.g., ABMI, AltaLIS, AAFC, NHN, AER, AEP, CanVec, LUF, Cities, Geo Discover, Open Street Map)
- 100 m spatial resolution
- Annual temporal resolution
- Web-based simulator
- Driven by explicit assumptions and data:
    - Working Group knowledge
    - Land Use Framework
    - Alberta Energy Regulator
    - Detailed Forest Management Plans
    - Municipal Plans

Raven is broken into five sub-models based on regional topographic, soil, and vegetative characteristics:

- Headwaters (steep topography, glaciers, shallow soils)
- Foothills (moderate topography, completely forested/harvested, deep soils
- Prairie (flat topography, agriculturally dominated, deep soils)
- Lesser Slave (moderate topography, large reservoir (Lesser Slake Lake), mostly forested/harvested)
- Boreal Plain (flat topography, peatland and wetland systems (very complex), forested)

Comments/questions are as follows:

- Are water quality and groundwater/surface water interactions modelled?
  Response: The models are *accounting* for those components, not explicitly modelling them.
- Question: Can Raven act as a standalone model?
  Response: Yes, it is fully functioning hydrological model, but is being, and can be integrated with other modelling tools.
- Comment: AROM name is already in use.
  Response: There is a Athabasca River Model (ARM), which is has been used for numerous oil sands EIAs as well as for investigation of potential water release scenarios as it includes steady-state, two-dimensional, vertically averaged, dispersion model based on analytical solutions to river dispersion equations. Outputs from AROM could feed into ARM. They are not the same model or the same name.
- Comment: Is groundwater an input to the model? How will this reflect climate variability in the model?
  Response: Daily air temperature and precipitation will be output by the Regional Climate Models, this is an input to Raven which will model the effects of evapotranspiration, soil moisture, etc. Raven allows water to enter groundwater reserves; however, it treats groundwater as a "bath tub". Raven will simulate groundwater discharge to streamflow; however there will be no 3D groundwater modelling.
- Comment: Important to note that model doesn't include sediment transport.
  Response: yes, that is correct, it doesn't, but it can be linked with models that exist that do model sediment transport.
- Question: Why was Raven chosen over SWAT?
  Response: The sub surface dynamics are complex in this basin. It was determined that the Raven model is flexible enough to allow us to integrate the relevant hydrological processes, there is ongoing work with model developers at the University of Waterloo and hydrologists at the University of Alberta to understand and simulate these dynamics more fully. Also, Raven offers several advantages over other modelling tools, and is recognized by local hydrologists as being genuinely customizable for Canadian landscapes. It is being widely applied in Canada, and has a large group of professionals and researchers contributing to it. The model is extremely fast, so offers the ability to simulate scenarios in a live setting. Speed also has advantages for model calibration and uncertainty analysis. The model is easily integrated with other tools because of flexibility and access to the core model development team.
- Question: In climate change scenarios will a daily hydrograph be synthesized?
  Response: yes, daily streamflow will be simulated as we will be using daily temperature and precipitation inputs from climate scenarios, which will simulate a daily hydrograph as an output.
- Question: As you're modelling, do you run base case (water demand/"business as usual") as well as scenarios?

Response: Yes, base case will be simulated as current state of water use in the basin, and will be discussed later today if we should use actual use or allocated use.

- Question: What is the minimum and maximum size of the HRUs?
  Response: HRUs were based on sub-basins (split in headwaters), elevation, landscape composition, surficial geology, and groundwater flow direction. Sizes are smaller in the headwaters where there are greater topographical changes, to larger in the Boreal Plain region.
- Question: In previous projects, were there big differences in data between Saskatchewan and Alberta?
  Response: Previous work has not used data from Saskatchewan, but yes, for this work with data around landscape and soils information, Saskatchewan data are very coarse. The modelling that will be done in Saskatchewan is less complex, and there is not a lot of development in the area contributing to the Clearwater.
- Question: Does the model look at or use river cross-section data?
  Response: Rating curves that show a relationship between flow and elevation at a point on the river can be used to develop PMs if there is an interest at a particular point in the river. Hydraulic modelling is outside the scope of work for this project.
  Comment: There are very detailed surveys of the rivers in the lower Athabasca.
- Question: Is the model able to track flow (quantities) – is a water management application just outside of what the model gives us?
- Response: Yes, the model tracks flow. The model provides an interface for landscape/climate change and how those changes affect flow. AROM is based on the OASIS platform so inputs (inflow/storage–reservoirs lakes) and outputs (demands (water licences) and return flows) are tracked. We will look to the Working Group to improve/refine/change model inputs (e.g., are there operational rules we need to consider? What should the demand structure look like?).
- Question: Is the model calibrated for each sub-basin?
  Response: The model is calibrated based on the 5 sub-models that Ryan presented (headwaters, foothills, prairie, lesser slave and the boreal plain.
- Question: How is hydraulic routing handled?
  Response: It's handled through routing in the hydrologic model. We have a range of routing routines available and are currently applying a Muskingum routine.
- Question: How are environmental flows modelled?
  Response: Environmental flows are modelled as target flows in the model that has the highest priority for the model to meet that flow.
- Comment: There is a minimum flow on the mainstem of the upper Athabasca near Hinton of 14 cubic meters per second (cms) from an older senior licence (maybe a pulp mill licence?)

ACTION: Project team to check on other environmental flows that should be in the model, and look at the licenced one near Hinton.

- Question: Can you model ice conditions?
  Response: This is something we have discussed internally. We are working on how to do it within the scope of this project as it will be important on the Peace and PAD discussions as well. We are open to ideas on best approach to incorporate ice conditions in the hydrologic model. Current thinking is a PM will be built that identifies the conditions under which ice jams form, and the model can be used to determine the frequency with which those conditions are met under changes in climate.

Danielle presented the rationale for demand grouping. The rational for grouping the demands (water use) in the following way was to capture large-scale dynamics of basin water demands, increase model utility in terms of speed and flexibility, and attempt to be representative of how the system would likely be operated, rather than strict licence priority. Grouping categories are First Nation/Métis, low volume licences, high volume licences, and temporary diversion licences (TDLs).

Water is distributed in the model based on the following order:

- First Nation/Métis licences
- Low volume:
    - municipal licences
    - environmental management licences
    - commercial/industrial licences
    - agricultural/irrigation/other licences
- High volume licences (order within group defined by date)
- Temporary diversion licences (TDLs)

Allocated versus actual use was also modelled, and how the patterns of use are implemented into the model.

Comments/questions are as follows:

- Comment: There has been extensive hydrodynamic modelling on the lower Athabasca and the Slave that can be referenced if necessary.
- Question: How would multiple projects from a single company be grouped (e.g., Suncor licences for different projects/sites with different licence priorities)?
  Response: The groupings are done by type of use and water source. If those projects are all pulling from the same source and are listed under the same company they would be grouped as one node. Within that node the priority would be defined by the oldest licence date (unless majority of the volume came from a more junior licences in which case the junior licence date would assign priority).
- Comment: Consider modelling actual use instead of full allocations (e.g., some oil sands projects currently only use 10-15% of their allocated water licence quantity).
  Response: Yes, we have both actual reported use and licenced allocation in the model and can use either one in scenarios, whichever the Working Group prefers.
- Question: If one licence holder has multiple licences with different priorities are they grouped in the model?
  Response: Licensees with more than one licence will be grouped in the same node if the licences are in the same geographical location. If a licensee has many licences and considerable distance between source/diversion point, they will have different licences in different nodes.

ACTION: When checking licence use with licensees, determine if it is necessary to ungroup certain high volume licences

- Question: Why aren't you using the AEP system (WRMM) for managing allocation?

Response: WRMM is a regulatory tool that is used in southern and central Alberta; it does not exist for the Athabasca. Rather than trying to reflect licence priority, we are trying to represent the system in a way that water could be or would be managed in times of limited water supply (i.e., people have priority). By having the model distribute water in this way it is easier to track the few shortages in the basin and represent those as 'basin shortages' with an understanding that licence priority may dictate who gets water and who doesn't if there was not enough water in the system. The intent is not to build a regulatory tool, but to assess how water use affects water management and what management opportunities there are to address changes in demand or supply.

- Question: If allocations are grouped then is there still a geographic aspect to the model?
  Response: Yes, they are grouped by geographic extent and by water use type. AROM model is aspatial, however licences are grouped based on proximity to each other and their relative location to other licence groupings (upstream vs downstream) is accounted for.
- Question: Demands related to use by things like vegetation don't show up in licences, how does the modelling account for that?
  Response: Vegetation/crop demands are accounted for in Raven, so those 'demands' are taken out of the system through hydrological processes and reflected in the subsequent streamflow we look at in AROM.
- Question: How are voluntary licence registrations accounted for (the *Water Act* exempts farmers)?
  Response: These licences are not being ignored, however they represent a very small portion of the demand therefore they are well within the margin of error.

ACTION: Pull registrations – confirm that the volumes on different reaches of the river are within margin of error of modelling and determine if they should be added as a demand.

- Question: TDLs by nature only last one year and are therefore prone to demand surges and wains, how will these be accounted for? (e.g., fracking in foothills)
  Response: TDLs are accounted for; there is an on/off switch that corresponds to these licences. There is also a scaling factor in the model so that TDLs can be increased or decreased to simulate the surges and wains.
- Comment: Some users may be small with respect to the total flows at the mouth of the Athabasca; however they may still be worth looking at geographically.
  Response: yes, that is correct, which is why grouping the licences geographically by the source they withdraw from, allows the model to look at impacts on certain tributaries.
- Comment: Priority grouping isn't assigned based on a particular use. Environmental management licences often end up with "screwy numbers" (e.g., Ducks Unlimited structures), where the allocated use are not actual water withdrawals, but evaporative losses, and in many cases are not used or are under used from what is allocated. So if allocated use is being modelled as a demand it is likely pulling more water from the river than these environmental management licences tend actually use.

ACTION: Pull environmental management licences, where possible look at actual use versus allocated use demand patterns and actual return versus allocated return patterns.

- Note: Actual use data is not available for all licences; when actual use in unavailable full

allocated use is assumed.

- Question: For allocated use pattern, couldn't you get more information from detail in licences rather than assuming it follows the actual use information?
  Response: the pattern of actual use was applied as a starting point for the modelling rather than a static use number. It is assumed that licences with reported data would follow their licence requirements in terms of timing of withdrawals, so the actual use pattern was used. It is a monthly pattern, so higher level than the licences would tell us anyway. That level of detail could be added if it were needed, but not sure in the scope of the project it would be an effective use of resources to go after that data as it is unlikely to change outcomes from the model in terms of water supply/demand balance.

Modelling Reminders:

- The goal of this modelling work is to provide a useful and representative integrated model at appropriate spatial and temporal scales in order to allow for informed and meaningful discussion.
- AROM is a screening level tool used to screen surface water quantity opportunities.
- AROM simulates the entire ARB system, it is not meant to simulate small-scale dynamics.
- The intent is to build the model *with* the working group, the best available data and knowledge as expressed by the group will be included. Model assumptions, limitations, and uncertainties will be documented and understood.

4 Confirm model is representative of today's watershed

Breakout Groups Session 1

Participants broke into three groups to help build the modelling platform. The objectives of the working session were to:

- Review model inputs, datasets, and assumptions, and to identify any missing data or model updates needed
- Use the model to look at basin issues and opportunities to help confirm model is representative of the watershed today
- Refine and suggest additional performance measures (PMs)

The text below reflects highlights presented in the readouts as well as points from the flip charts.

Table 1 (Modeller: Ryan MacDonald/Scribe: Denise Di Santo)

Highlights:

- The group explored AROM showing demands in the system, including the water balance concept which included looking at scale for modelling and vetting tributaries in the Appendix.
- How do instream flow rules (e.g., as in the South Saskatchewan River) apply and how does this relate to demand as percentage of natural flow, when considering balancing inputs and outputs to the system?
- Comparisons to naturalized streamflow on the mainstem of the Athabasca River could be (at a minimum) used as a PM.

- What other water bodies are of interest besides mainstem Athabasca and listed tributaries? Can we model lakes and which lakes to include? Criteria to choose the lakes, such as size? Which lake areas? Species at Risk may be part of the criteria for choosing lakes to simulate?
- It was suggested to verify infrastructure in the system; e.g., weirs on Paddle River, Fickle Lake, Lesser Slave Lake.
- There needs to be a check done for node 603 (licence) to verify licence holder – is this a temporary diversion licence (TDL)?
- The reality is that licenced allocation volume is an indicator of water use, not actual use, and conditions are attached for use and timing of use. This should be represented in the model if possible.
- There could be consideration for actual use patterns as there are often conditions attached to licences and these may show as patterns, depending on type of use for the water (e.g., municipal return flow as opposed to industry). This is applied in the model.
- The 1970–2070 project timeline was reiterated as the time frame in which the model could be run.
- For baseline demands to run the model – the group considered using actual use vs. allocation of the licence.
- Use percentage of total allocation could be used as scenario tied to a PM.
- Shortages as a PM would need to consider:
  - Amount of shortage
  - seasonal patterns
  - geographic area where shortages occur
  - how this affects amounts required or sought for instream flow needs (IFN)
  - The IFN desktop method was suggested as a means to determine IFN across the basin
- Watershed outflow requirements might be considered to show how those requirements might be met, or not, with changes flows PM identified: outflow as a percentage of natural outflow (outflow = contribution to Lake Athabasca).
- PM identified: streamflow as a percentage of natural flow.

Table 2 (Modeller: Danielle Marcotte/Scribe: Claire Jackson)

Throughout the discussion one main discussion point was that PMs must speak to different stakeholder needs and truly match stakeholder interests.

Highlights:

- The group started by exploring AROM and looking at the demands in the system. It was discussed that where it is known the actual water use of the licence holder is entered into the model, where the actual use is not know the full water allocation demand is entered into the model.
- There was a comment that the actual use demand for a licensee with three licences seems to be overstated. This demand is currently entered into the model as an average of the actual use, as shown in publicly available records, over the last five years. It was noted that with technical improvements at the facilities their actual water use was decreasing steadily and would continue to decrease into the future. Additionally, they will have one more facility coming online that will change the demand. There was a great deal of discussion regarding how to ensure that the large

industrial demands are accurately reflected.

Action: Project team to follow up with licensees to confirm water use in model.

- During the P2FC work industry developed an estimate of actual industrial water demand; this demand represented a sum of all of the industrial demands in the Lower Athabasca. This was done so that individual industrial water users would not need to release their water use forecasts to the public. It may be worth looking at this forecast.

Action: Project team to look at forecast for downstream industrial use and compare that to current modelled licence use in the lower Athabasca.

- For Suncor, and likely for other industrial users, the most accurate representation of water use would be to use the water use pattern from last year rather than a five year average.
- Suncor noted that they may be able to come up with a representative pattern for their water use now and into the future. This will depend on Suncor internal processes. Follow up with Anita Selinger regarding the Suncor demands and how they should be represented in AROM.

There was some discussion regarding the naturalized dataset and how this data set was calibrated.

- Which use data were used for the calibration?
  - The reported actual use data was added back into the streamflow records to simulate a naturalized streamflow. The full allocation volume was not used, only the actual reported data. The process to naturalize streamflow also accounted for time; so, if a licence was allocated in 1990, the flow record was adjusted based on the use after 1990. However, it is important to note that we used the 5 year averages from available actual use data and for locations where actual use data were not available, we used the full allocation volume.
- When the current demands are implemented into the system to generate the simulated streamflow, is time accounted for? For example, Suncor wasn't producing in 1970, was their demand removed in that year, or was it removed only from the point where the demand started onwards?
  - All the demands are removed from the system for all years of the simulation. So in 1970 the Suncor demand was withdrawn from the system even though Suncor wasn't producing in 1970. This is because we are not simulating what actually happened in 1970; we are just saying if we experience a streamflow similar to that of 1970 today, how would the system behave? The model aims to simulate potential scenarios; it does not try to recreate history.
- The group looked at the flows downstream of Lesser Slave Lake and compared simulated flows to observed flows. It was noted that the simulated flows did not match the observed flows as well as some of the other flows show in the earlier presentation.
  - When the flows downstream of the Lesser Slave Lake were naturalized was the weir considered, and if so was the timing of the weir considered? The weir was built in 1984.
  - Additionally, the stream downstream of the weir has been straightened out, was that considered?
  - The incremental inflow downstream of the weir on Lesser Slave is not affected by the weir, these are inflows from the tributaries. We simply used gauge records; therefore, did not attempt to account for a change in the hydraulics.

    - The group suggested that a plot of the water into Lesser Slave Lake versus the water out of the lake would be a valuable visual for the working group.
    - Yaw Okyere at AEP has done a lot of work modelling the Lesser Slave Lake, he has managed to calibrate his models accurately and would be a good resource to touch base with.
- The demands at the Teck Cardinal River mine were discussed. These demands appear to be higher than actual use. This facility should have very low demands as it is used as a water management facility.
    - Follow up with Allé-Ando Yapo regarding demands at the Teck Cardinal River mine
- Minimum flow and the LARP Surface Water Quantity Framework were discussed. The group wondered how often the rules in the Water Quantity Framework were being met?
    - Suggested performance measure: How often are rules in the Water Quality Framework being met?
- There was some discussion regarding how the minimum flow of 87 cms is modelled? Is it modelled such that all users in the lower Athabasca are cut off it this flow is not met? This minimum flow should be modelled so that it doesn't cut off any upstream users and it only applies to newer mines.
- There is also a minimum flow of 6 cms downstream of Lesser Slave Lake, this minimum flow was introduced in 2009. This minimum flow should be modelled such that it doesn't cut off users, if the flow is too low more water would be released from Lesser Slave Lake before users are shorted water. In this case, since the weir is fixed, they would siphon water out of the lake to maintain the min flow downstream.
- Al-Pac diligently watches the dissolved oxygen (DO) on the Athabasca; a suggested performance measure would be to look at the DO as it relates to flow on the Athabasca at Al-Pac.
    - Follow up with Donna or Quentin at Al-Pac, they have an existing calculation for DO versus water quantity.
- It is important to note that in the basin some years might be dry in one area, and wet in others. Can this spatial difference be represented in the model? Will it be reflected when the climate change scenarios are run?
    - This will be represented in the regional climate model outputs, which then feed precipitation and air temperature data to the RAVEN hydrological model through different spatial patterns.

Table 3 (Modeller: Devin Cairns/Scribe: Mike Nemeth)

Highlights:

- The group started by exploring AROM and looking at the demands in the system. It was discussed that where it is known the actual water use of the licence holder is entered into the model, where the actual use is not know the full water allocation demand is entered into the model.
- It would be helpful if names could be placed on the nodes where possible so that users can see which nodes are which for the demands.
- It would also be helpful to have a specific example of how the nodes are grouped. For example, if a node is an industry node, which industries are in there and how many licences does each one have? An example may look like the following:

- Industry:
  - Industry A, licences 1, 2, 3, 4
  - Industry B, licence 1
  - Industry C, licences 1, 2

Action: Project team to clarify the information is in demand nodes in AROM so it is clearer to the Group.

- There was discussion on using a GIS layer that AEP has developed with stream orders and TDLs, the idea being that TDLs could be managed based on the stream of water they are withdrawing from based on stream order. The project team should follow up with Ahmad Asnaashari/Andy Paul regarding a GIS layer with TDL and stream orders to manage TDL shutoffs
- Ice cover and DO around the Alberta Newsprint Company (ANC) site can be an issue that would be of interest to build a PM around. The project team should follow up with Dan Moore on a PM regarding high/low flow concerns for ANC with respect to flooding, and DO concerns if flows are too low (under ice).
- A PM was suggested that could be used as an interim apportionment PM on 1:50,000 rivers from Saskatchewan (e.g., EBF + 50% of "remaining" flow). Follow up with Carmen de la Chevrotière on this.
- Alberta can consume 2 billion m^3 in Slave system before it goes into the NWT. A 'pseudo apportionment PM' could be EBF + 50% at Embarras. This would only really be needed if the 2 billion m^3 limit is reached, but is something to look at as an indicator of use in the Athabasca and beyond as this work moves to look at the full Slave River system.
- It is important that changes in water management on this system are not going to "save the grayling in Pembina" on their own. Many of the water issues in the basin involve more than just meeting a flow target. Meeting a flow target is part of the discussion that might be used to help in efforts, such as grayling populations in the Pembina, but is not the full story on its own. Management includes considerations such as water quality (temperature, sediment, contaminants). It is a good start though.
- Is there a PM, or something, to show if we are +/- 5% of simulated versus observed? There was discussion that rather than being a PM this might be something that the modelling team can show as part of the model documentation in terms of how well Raven simulates compared to historical. 5% is also likely well within modelling error and gauge record error, so need to keep that in perspective.
- A PM was suggested around how often under climate change or other changes in the system under a future simulation will flow reach or drop below 7Q10 at point sources (e.g., pulp mills). Need to follow up with the group to determine which site(s) would be useful, and how this would help in building knowledge that could support water management.

5	**Assess basin issues and opportunities and refine performance measures (PMs)**

Claire provided an overview of the issues, interests, and opportunities around water management in the ARB that had been heard and documented to date based on a desktop study prior to this meeting. The goal in providing this information is to identify the key issues, interests, and opportunities to ensure it is captured when modelling changes in landscape and climate in the ARB. This info was sent to the Working Group in the spring of 2016.

Publically accessible and available information and data gathered from online sources through searches on relevant government, industry, and organization websites on previously stated water issues, interests, and opportunities in the ARB. The issues and interests of various perspective types in the basin grouped into broad categories, such as water quality, water quantity, flora and fauna, as well as many others, as they relate to the watershed. This is not a complete list, so if something is missing please bring it to our attention. Issues and interests that are within the current scope of the ARB Initiative are identified, as well as what part of the integrated modelling tool can be used to look at them.

On the slides (sent out with this document) Claire provided an overview of the basin issues and interests as gathered and heard to date, and what may be addressed in the scope of this work.

Claire then reminded the group of PMs, and that they are any visual that shows the status of an interest to a Working Group participant (e.g., fish species, navigation, streamflow), and will be used to show the direction and magnitude of change for any interest from the group (e.g., change in flow due to climate or landscape change, and how that impacts fish spawning). Claire also reviewed the list of currently drafted and conceptualized PMs. This information was also sent out to the Working Group in the spring of 2016.

Breakout Groups Session 2

Participants broke into three groups to use the model to explore basin issues and opportunities. The objectives of the working session were to:

- Use AROM to explore the basin and identify potential opportunities
- Discuss how the working group will assess opportunities using the model
- List opportunities to explore using the models in the working group meeting
- Refine and suggest additional PMs

The text below reflects the main topics presented in the readouts as well as points from the flip charts are attached and form part of these meeting notes.

Table 1 (Modeller: Ryan MacDonald/Scribe: Denise Di Santo)

There was a brief discussion of existing data to inform the potential opportunities. Water quality scope was asked about, beyond water temperature and dissolved oxygen (DO). It was recognized that these two parameters were currently in scope.

Highlights:

- In terms of nutrient loading, it was offered that empirical data exists for phosphorus and nitrogen. If this can be integrated at this stage of the work the project team will work on doing that.
- Point source (data) exists from the pulp and paper industry; this may supplement DO estimates from the model.
    - Consider a PM related to change in seasonal flow over time due to changes in climate and land cover. Summer flows, winter flows, and shifts (timing and magnitude) in spring freshet

might trigger adaptive management considerations.

- Surface Water Quantity Framework – it was suggested to consider criteria that are outlined in the Framework.
  - Yes, AROM does model the rules for flow conditions and withdrawals in the Lower Athabasca River, which includes that minimum flow target of 87 cms that has been talked about today.
- Aboriginal Base Flows (ABF)/maximum flows were discussed, and if there is interest in modelling these it should be modelled in context of:
  - Relationship to navigation
  - Change in flow
  - Change in lake levels
  - Change in fish spawning
  - Change in forest cover/loss/retained (e.g., fire suppression)
- Percentage of natural flow relative to measured flow should be compared; are there commonalities or patterns across the basin? Impacts should be considered in sub basins as well as the mainstem.
- Environmental Base Flow (EBF) percentage of natural flow vs. a quantifiable term such as 87 cms (consider for basin-wide, not just at Fort McMurray, where 87 cms might only apply) would be a good PM to build into the work in some capacity.
- Ice cover could be considered in flow modelling as empirical data exist; examine ice formation relationship.
  As discussed earlier, the current thinking is a PM will be built that identifies the conditions under which ice jams form, and the model can be used to determine the frequency with which those conditions are met under changes in climate.
- Also look at how disturbance footprints in one area of the basin compare with disturbed areas in other sub basin areas; how do these differ (e.g., widespread forest fires, development)?
- Fish Sustainability Index (FSI):
  - Are there existing datasets to inform current conditions of fish habitat?
  - River 2D sites may be available from government sources for fish habitat areas (project team can follow up on this).

Table 2 (Modeller: Danielle Marcotte/Scribe: Claire Jackson)

Highlights:

- There are a number of tributaries in the TOR that do not have gauge stations on them. Some of these tributaries are of specific interest to the group as they have been struggling with monitoring them or with trying to find information about them for some time. How will tributaries without gauge stations be modelled and calibrated?
- A suggested PM that will be of value to this work is the temperature and temperature fluctuations on the main stem of the Athabasca.
  - This PM is particularly important for cold water fish species such as grayling, bull trout and Athabasca rainbow. When the PM is designed these fish species should be kept in mind.
  - The seasonality of the temperatures, specifically the time of year of the peak high temperatures, will be important with relation to fish spawning. Do we see a significant shift

in timing of peak stream temperature? If so, how does this shift coincide (or not) with fish timing windows?

- Another important PM is the Exceedance of Q80 and Q95 of naturalized mean annual discharge. This represents a minimum environmental flow cut-off value. So when simulated streamflow is below the Q80/Q95 of naturalized flow we get an exceedance in the PM. Q80 and Q95 represent the values at which 20% and 5% of the time, respectively, the mean annual discharge will be higher in a normal distribution.
  - These will be important at point of diversion (of demands), gauges downstream of demands, and in more sensitive areas (e.g., grayling). Can be applied to the Upper Athabasca.
- A PM reflecting annual shortages is of interest. The group notes that it would be their preference to see shortages annually as opposed to seeing the sum or the shortage over the entire modelling timespan.
- The group discussed coal mine demands in the headwaters and how they are reflected geographically. Coal mines usually draw right from headwaters, often off of small tributaries – is it important that this is accurate in the model, as opposed to showing the coal mines drawing from the main stem? This may be important as it would allow for a discussion regarding the health and demands of tributaries
- There was a great deal of discussion regarding the daily time step seen in the model. At some locations it will be important to look at the variability in flow on an hourly time step (i.e. peak flows during flooding). RAVEN, the hydrologic model, is able to simulate hourly flows therefore we would be able to develop this as a PM.
  - Flood frequency was noted as a valuable PM. It was discussed that in order to have a PM showing flood frequency, flood flows would need to be known at specific locations on the rivers. It may be worthwhile to follow up with municipalities to determine if they have these sorts of flood flow numbers.
- A telling PM that could be developed and used when the climate change scenarios are modelled would be glacial contribution to flow on an annual basis.
- Another PM that may be interesting to look at when climate change scenarios are modelled will be the change in seasonality of flows. This could be looked at by showing at what date freshet starts every year.
- Over time the group felt that it would be interesting to look at demand growth and see how this affects shortages.

Table 3 (Modeller: Devin Cairns/Scribe: Mike Nemeth)

Highlights:

- Wetland loss/retention was discussed as something of interest to the group and if it were able to be represented in the model. It was discussed that ALCES will be able to simulate changes in landscape, including wetland loss, retention, and even restoring of wetlands. This will then feed into Raven to simulate how those changes will influence hydrology, and subsequent streamflow.
- The question was asked if there is a pre-development baseline in ALCES? There is, however it was decided this wasn't needed as part of the scope of work as it would be unrealistic to think that the basin would go back to pre-development conditions. If there is an existing pre-development scenario in ALCES for the whole province we could look at maybe running that as a

baseline to see how changes in landscape over the last ~50-80 years has changed streamflow.

- The conceptualized Walleye recruitment PM would be good to have. It could show one aspect of linking flows in the Athabasca to the PAD. This PM is not simple to implement, but would be a good link and of interest from a fisheries perspective.
- Could PMs be built for percent change of natural flow at Embarras and percent change of natural flow for each of the five "zones" in the hydrological model set up (e.g., foothills, mountains)?
- It would be good to compare groundwater (user defined) outflows from the integrated model with more detailed groundwater modelling that has been done in the basin – need to consider scale and do it by region. Project team should follow up with Suncor (JP) on this. This would be a good sanity check.
- Need to look at ice in some capacity – ice jams, under-ice flows – huge factor on Peace River and the PAD. Ice jamming around Athabasca and Fort McMurray are also of concern. Current thinking is a PM will be built that identifies the conditions under which ice jams form, and the model can be used to determine the frequency with which those conditions are met under changes in climate.
- A PM was suggested to show if the following riverine components were being maintained around basin:
  - biology (could use walleye recruitment)
  - water quality (DO)
  - morphology (fairly easy if system is free-flowing)
  - connectivity (lakes, side streams, wetlands, PAD). Connect with Andy Paul on this PM.
- The riverine components PM would be good look at, but it should be done in the context of addressing what we can, and acknowledging what we can't.
- Being able to see the difference in percent contribution from different sources over time (e.g., snowmelt, glacier, baseflow) would be useful, especially under changing conditions. Could a percent contribution graph or PM for river output for change in glacier/snow/baseflow be developed to look at changes in flow from Raven?
- There was discussion on what the end point should be for flow considerations. It was suggested that Old Fort could be used instead of Embarras. The river forks after Embarras, so there was discussion if this would be useful at this stage of the work. Project team should follow up with German Rojas regarding endpoint at Old Fort, not Embarras (AEP water quality sampling station at Old Fort).
- In terms of landscape change and impact on hydrology, the recent fires around the Fort McMurray area would be interesting to look at. If we took the spatial extent of the burned area and ran that change in ALCES, it would be interesting to look at how that changes the hydrology (potential change in runoff from burned areas in the fire).
- A question was asked about if we had information on forest management plans in the upper Athabasca. There has been on-going communication with the Land Use Framework branch at AEP to get that sort of information and so landscape simulations are based on current plans. The project team will follow up with Aaron Petty on the forest management plans in the upper ARB areas, and confirm if we have it for the lower portion of the basin. If not, discussions with AAF and forestry sector can be arranged.

6	**Next Steps and Close**

Mike Nemeth made a few summary remarks, noting how valuable today's discussion was. The slides and

meeting summary will be circulated to participants for information and comment, and the project team will follow up with individuals on specific discussion points. Participants were encouraged to contact the project team with ideas and suggestions for the project, model inputs, and data.

Mike will send out invites for the next working group meeting, planned for end of November/early December. That meeting will follow up on today's discussion, focused on exploring water management strategies in the basin and identifying practical options.

Mike acknowledged today's excellent contributions and thanked everyone for their support, enthusiasm and input, and adjourned the meeting at 4:00 p.m.

ALBERTA
waterSMART
Water Management Solutions

Sustainable Water Management in the Athabasca River Basin Initiative (ARB Initiative)

Working Group meeting #1
September 22, 2016

Welcome and introductions

Introduce yourself to the group by telling us:

- Your name
- Affiliation
- Where you are geographically in the basin
- 1 interest or opportunity you hope to explore in the basin through this work

Today's Agenda		
8:30	**Welcome, Introductions, and Opening remarks**	**Mike**
9:30	Refine draft Terms of Reference for ARB WG	Denise
10:15	Break	-
10:30	Introduction to integrated model components	Ryan, Devin, Danielle
11:45	Lunch	-
12:30	Breakout groups: Help to build the modelling platform	Breakout Groups
1:40	Readouts to plenary	
1:55	Break	-
2:10	Review basin issues and opportunities as gathered and heard to date	Claire
2:25	Breakout Groups: Use model to explore potential basin issues and opportunities	Breakout Groups
3:40	Readouts to plenary	Group Representatives
3:55	Calendar check, next steps, and close	Mike

Keep in mind…

- There is lots of info here….slides will be send out after today
- Everything here is publically available
- Can ask questions as we go through the slides and during the working sessions today
- Some of the material will be reviewed in future meetings
- This process is meant to be iterative - it is on going work
    - A draft model is built that represents the system based on available data and information to date
    - Your job is to tell us what needs to be changed to make it the best representation of the basin as possible - this is why we are coming to the WG now to be involved in developing the model

About Alberta WaterSMART

OUR MISSION

We are committed to improving water management through better technologies and practices, for the social, economic and environmental benefit of current and future Albertans, and sharing our solutions with Canada and the World.

ACHIEVED THROUGH

Project development and execution
Identifying opportunities and innovative solutions to work toward a vision of improved water management

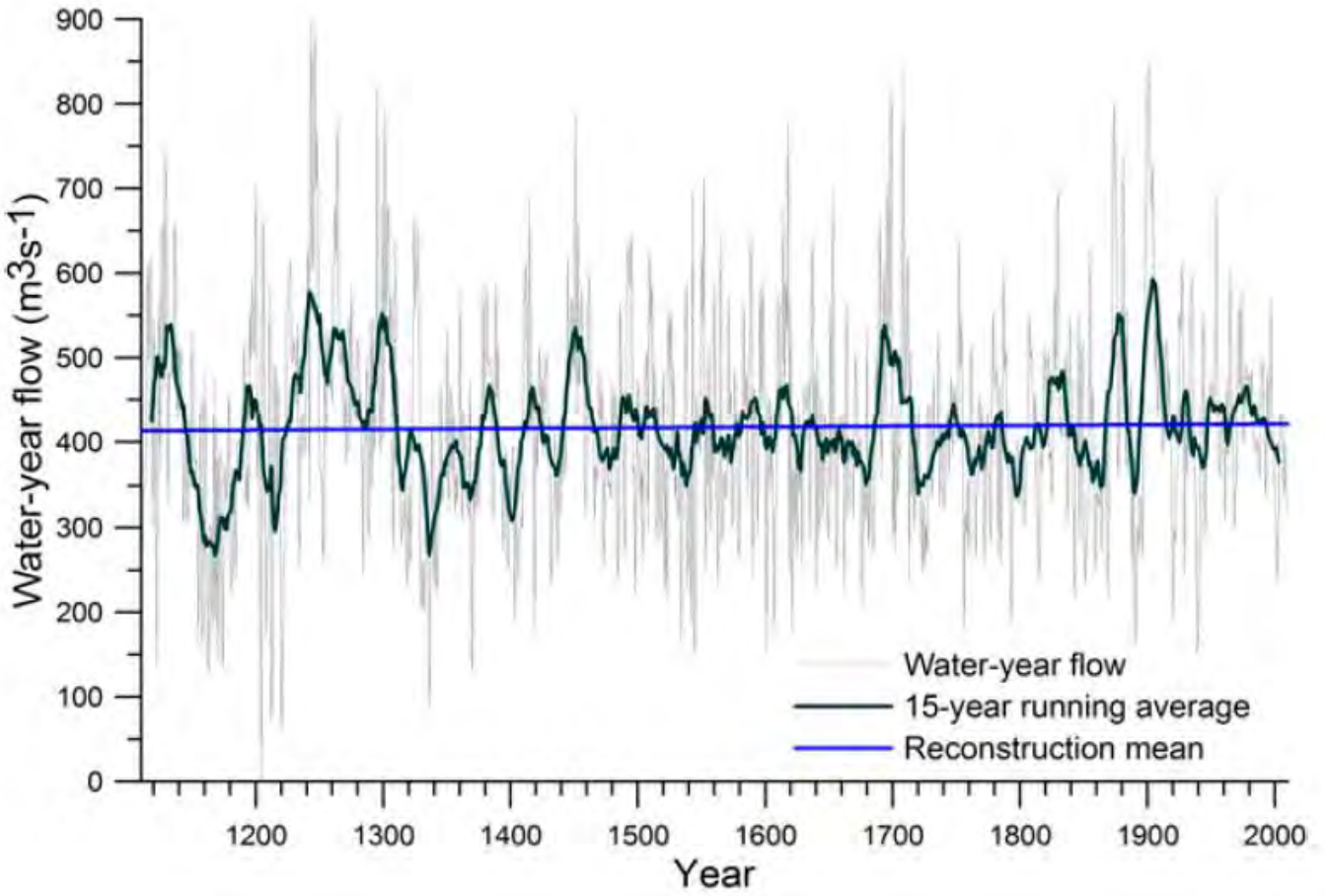
Collaboration and communication
Valuing collaboration and engagement by bringing diverse individuals and organizations together, to work toward common goals and accommodating multiple interests

Water strategy
Conducting effective projects on water strategy for corporations, consortiums and other organizations

Supported by people knowledgeable in all aspects of water management at local, regional, and global levels

History demonstrates extreme climate variability

Athabasca River at Athabasca, 1111-2010[1]



Reinforcing the importance of adapting and building resilience now, before more extreme events

[1]David J. Sauchyn, Jeannine-Marie St-Jacques, and Brian H. Luckman 2015, Long-term reliability of the Athabasca River (Alberta, Canada) as the water source for oil sands mining, Proceedings of the National Academy of Sciences of the United States of America , DOI 10.1073/pnas.1509726112

Water in Alberta: focus on adaptation

"The strong link between climate change and water has contributed to the view that if mitigation is about carbon, then adaptation is about water."
–Alberta Climate Dialogue 2014

Mitigation

is about **greenhouse gas**

is **global**

is a **trigger**

takes time

Adaptation

is about **water**

must be **local**

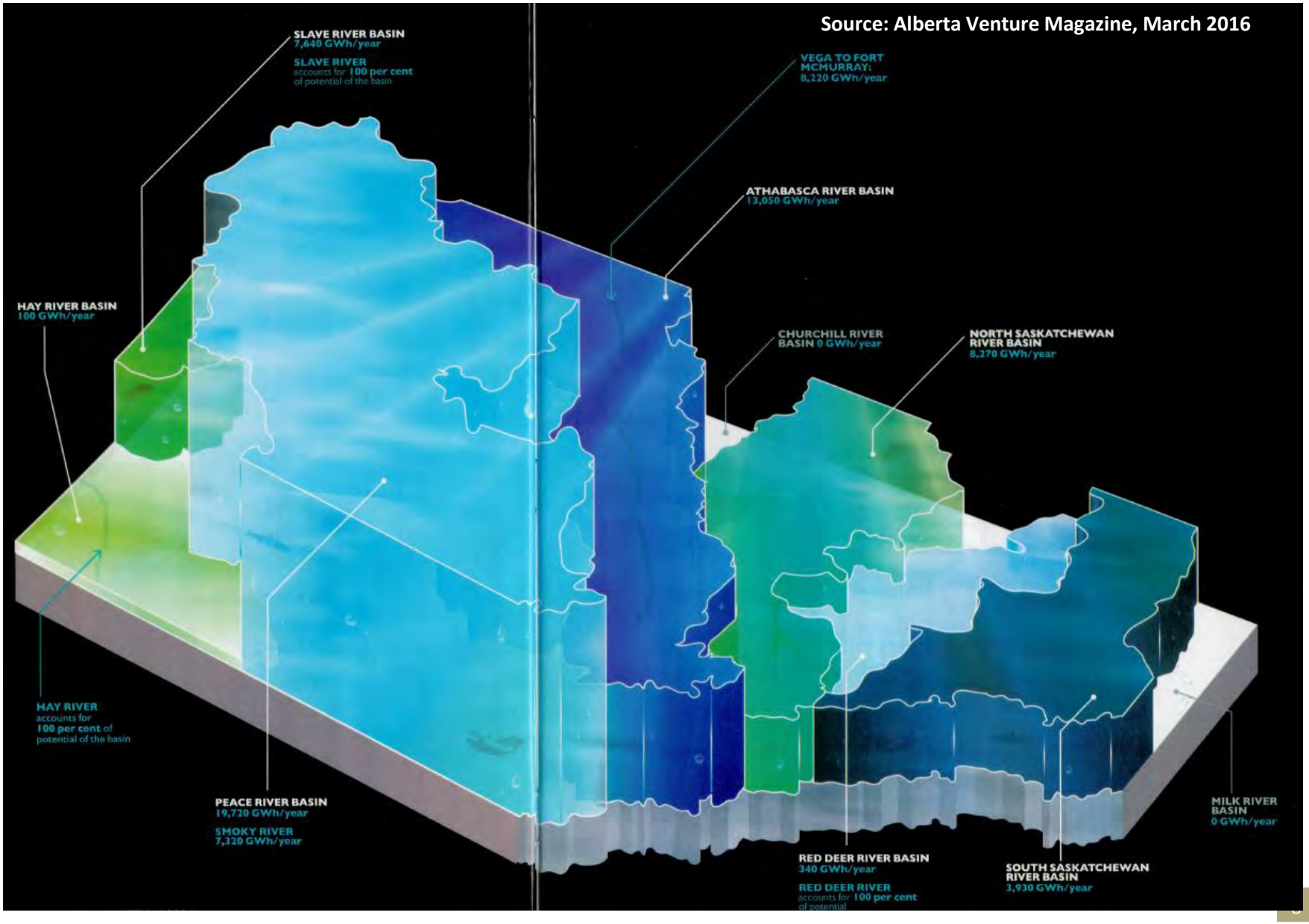
is about **action**

is **needed now**

Climate change will have a direct, significant impact on water resources

Alberta can and needs to focus on adaptation

Hydropower potential in Alberta



Pressures in the Athabasca River Basin

There are people working on and talking about how to keep this dynamic watershed healthy

Water for People

Water for Food

Water for recreation and transportation

Water for Industry

Water for the Environment

Examples of 'What if…' questions

Working group participants decide on the issues and opportunities they would like to explore using the modelling tools

- What if precipitation occurs as rain in the spring rather than snow?
- What if current population centers were to double or triple in size?
- What actions will improve water navigability?
- What if we experience the drought of the century?
- What opportunities might potential hydropower facilities provide for water management?
- What landscape changes might mitigate floods and droughts or make them worse? How much difference would such changes make?

→ What are my community's water concerns?

Perspective

A person's perspective is based on where they have been, where they are, and where they want to go.
Everyone's perspective is different, and they are all correct!

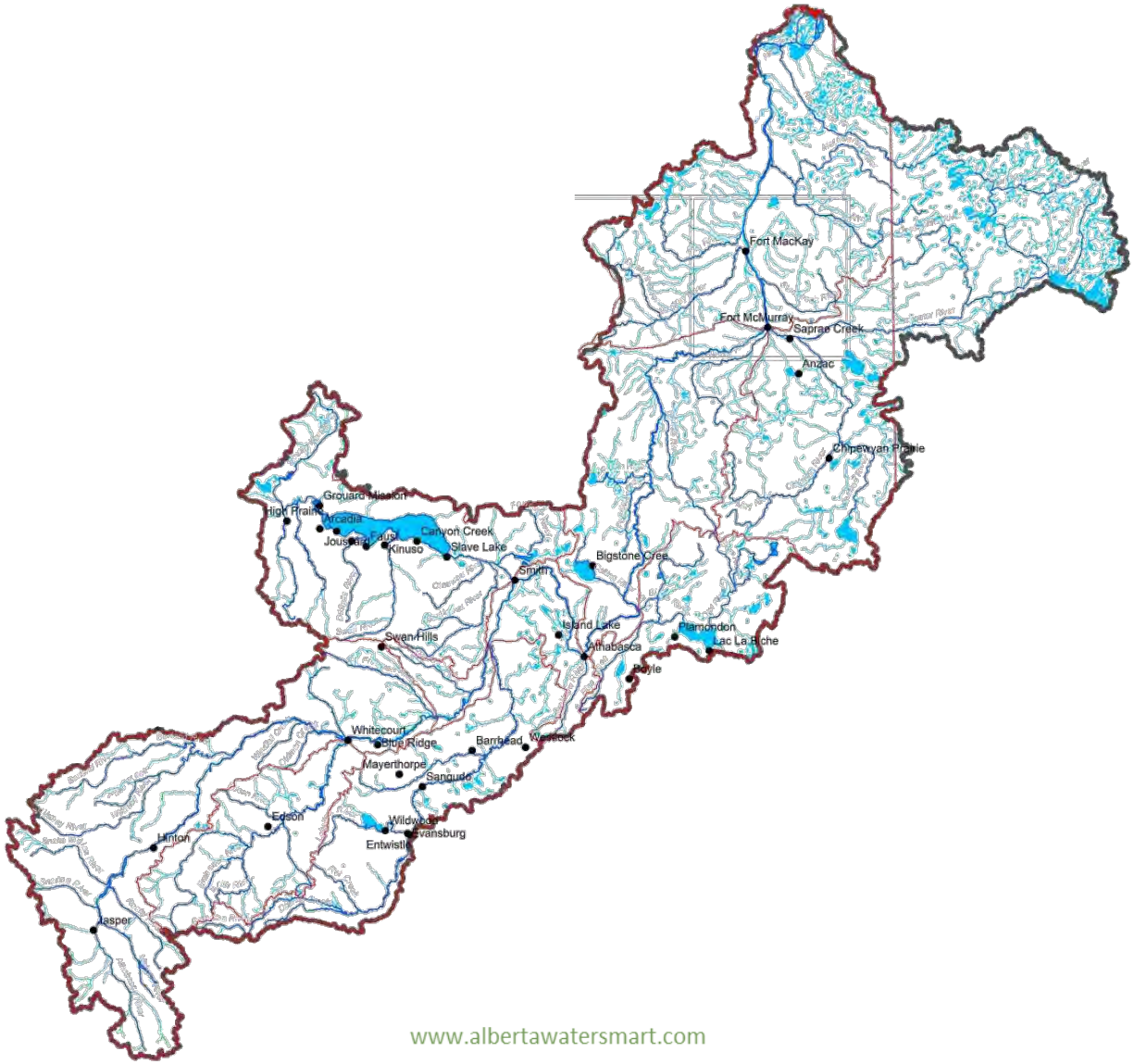
Athabasca River Basin Initiative

A basin wide collaborative effort to inform decision making and create a common understanding of the issues and opportunities across the Athabasca Basin for proactive water management.

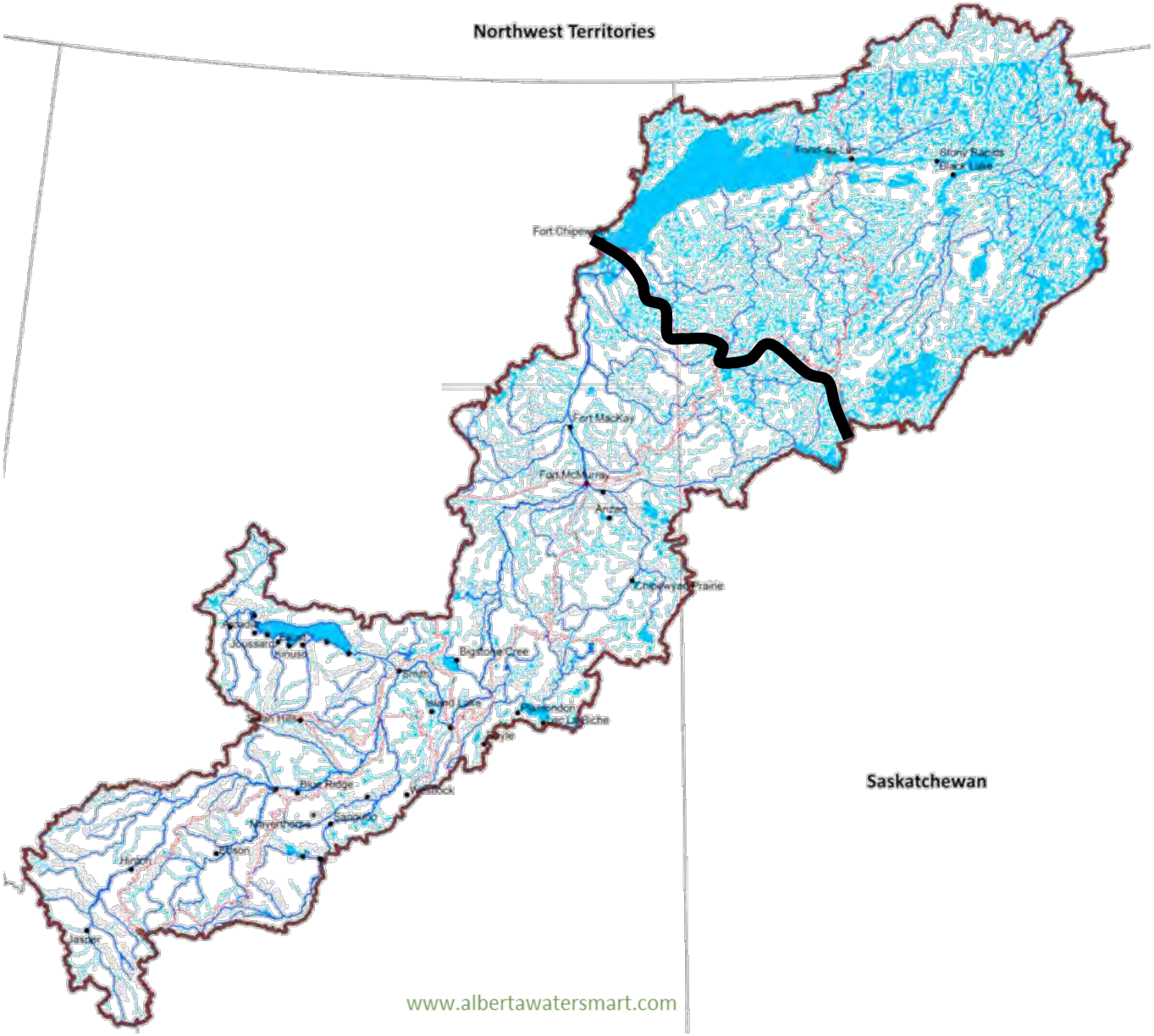
This initiative will build on existing data, tools, capacity and knowledge to:

- Provide **integrated modelling tool** to inform water and natural resource management plans, approaches and decision making
- Provide **accessible and transparent information** on basin water management
- Build a **common understanding and trust** across the basin
- Identify **strategies for adapting** to future water challenges
- Identify critical **gaps in data, science, processes and policy** for effective water management

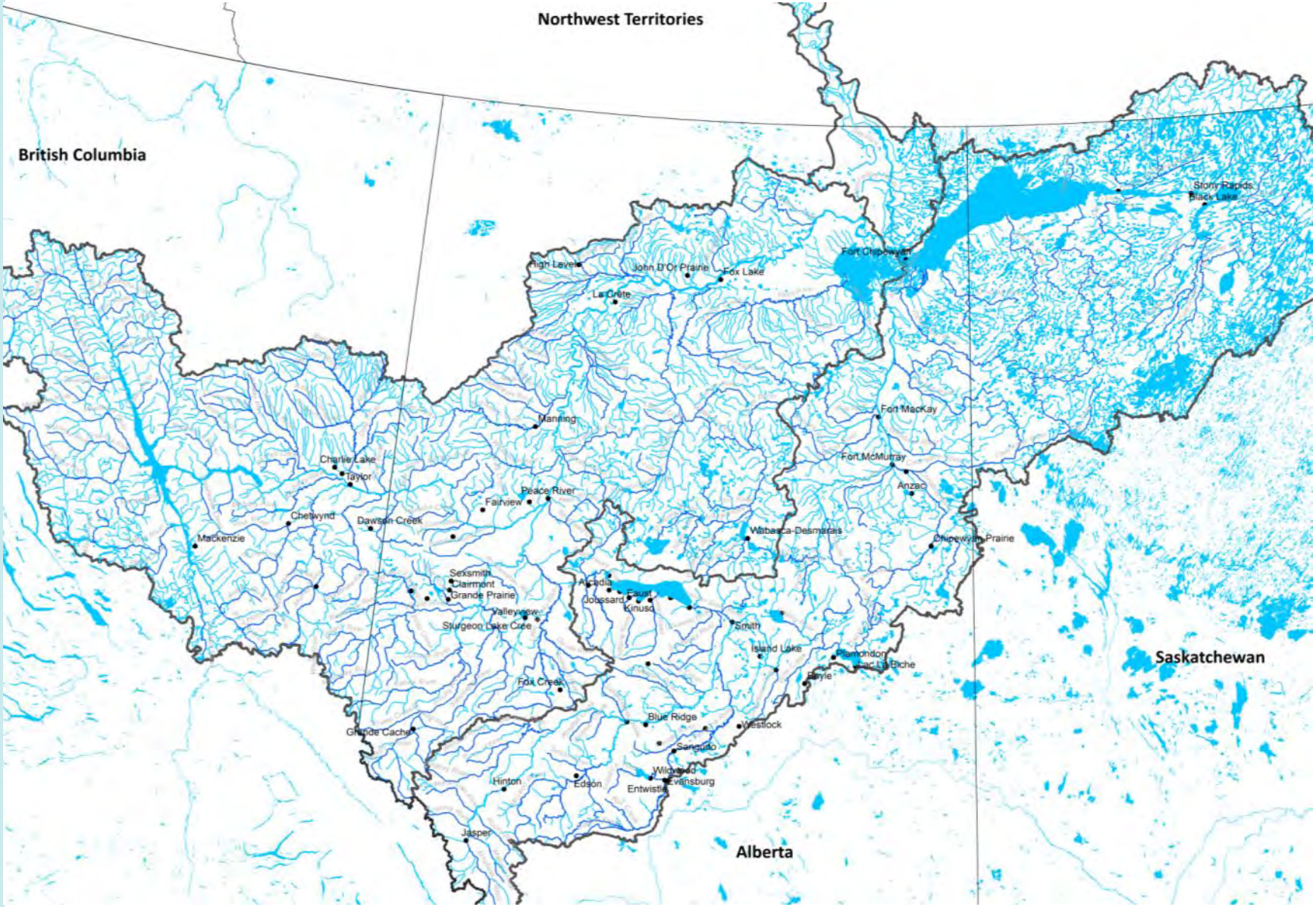
Current scope



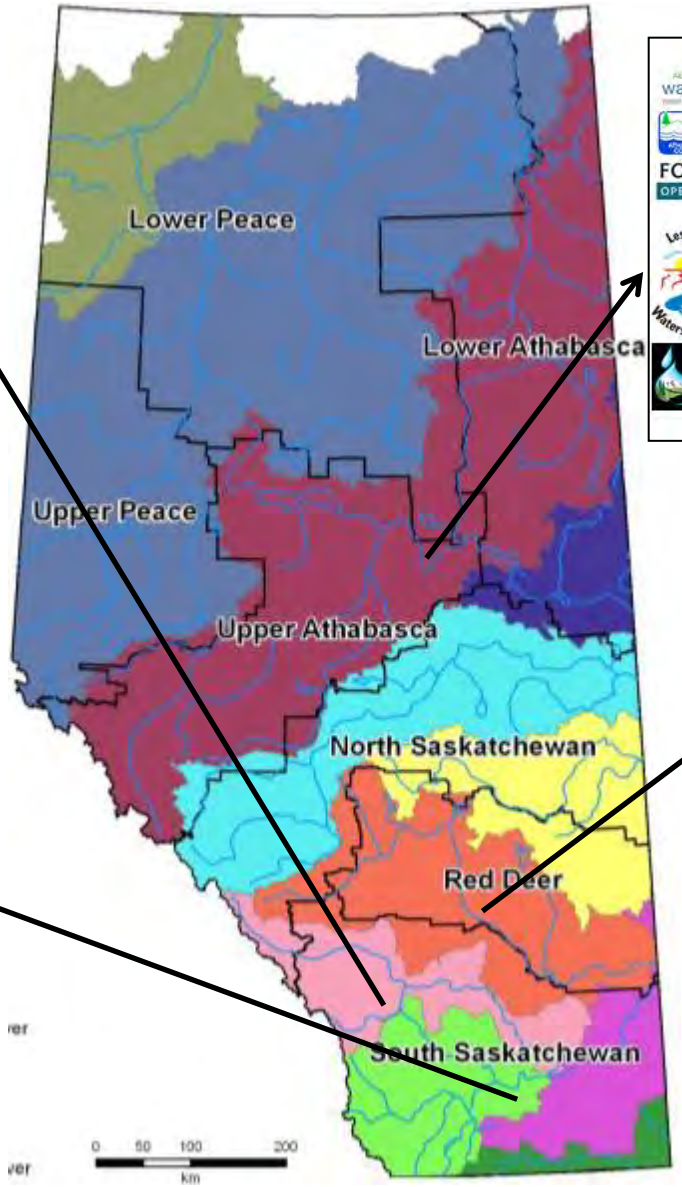
Current scope



Scope looking forward



1. Bring together the people that know the watershed the best



Participation from:

Alberta Agriculture and Forestry

Alberta Environment and Parks

2. Provide a strong base of data and tools

Input data from best available sources…

Alberta Environment and Parks

- *Naturalized flow data*
- *Allocation and licence data*
- *Infrastructure operations*

PARC

- *Climate variability data*

ALCES Sustainable Landscapes. Sustainable Futures.

- *Landscape simulations*

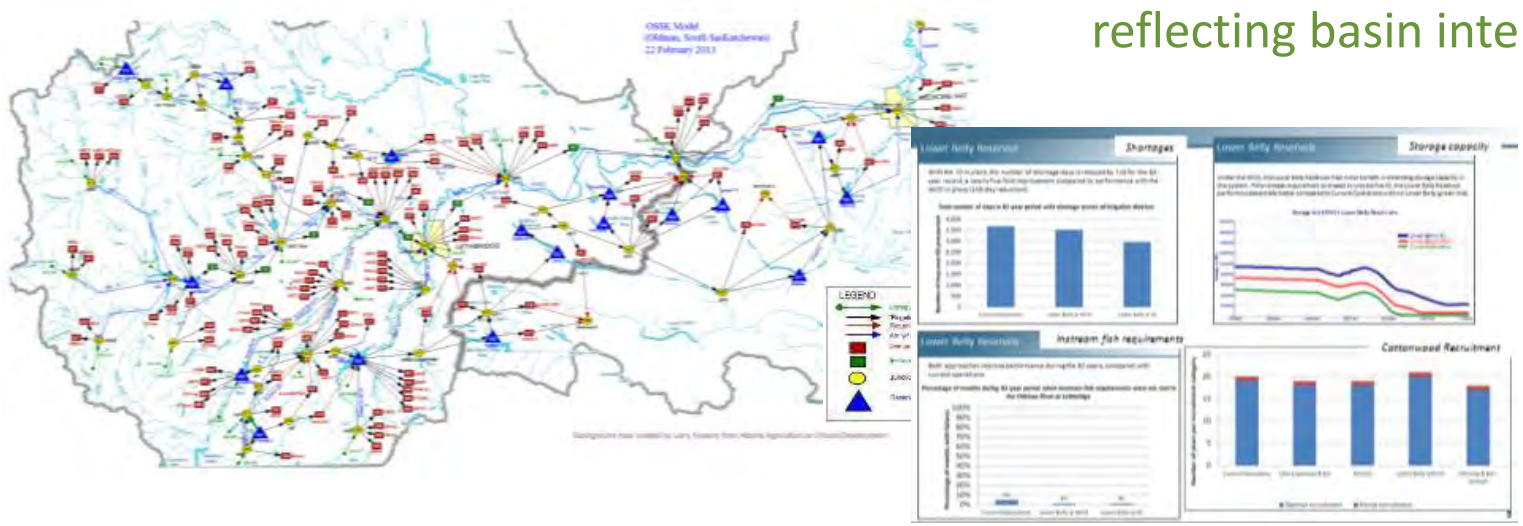
Working Group Participants

- *Actual Use data*
- *Operations*
- *Issues, concerns and management opportunities*

…interactive model of surface water quantity for each sub basin…

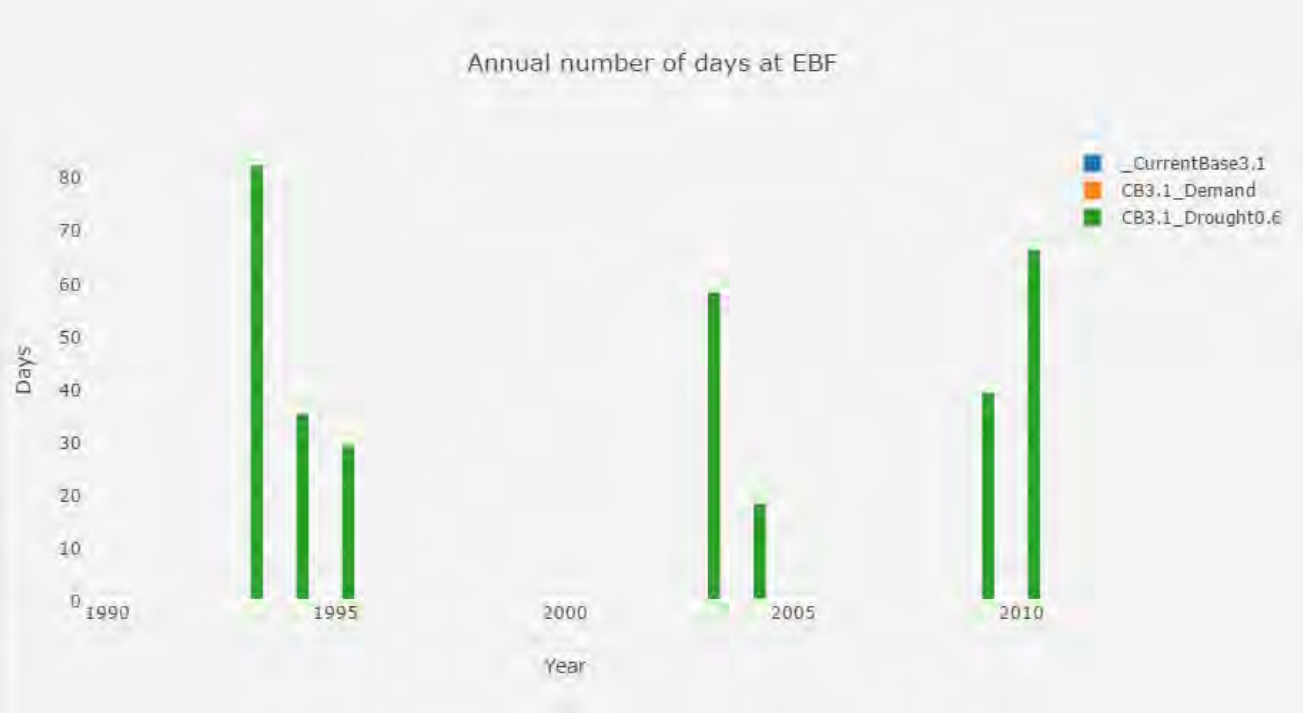
-historic data and future projections of climate variability

…with performance measures reflecting basin interests



Performance Measures (PMs)

- Performance Measure= any visual that **shows the status of an interest to a Working Group participant** (e.g., fish species, navigation, streamflow)
- Used to look at the relative difference in for a particular interest between model runs (scenarios)(e.g., change in flow due to climate or landscape change, and how that impacts fish spawning).
- PMs will be used to **show the direction and magnitude of change** on an interest, develop and refine opportunities in the model.



3. Work collaboratively

Identify impacts and opportunities – live modelling sessions

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

In S. Alberta, this process assessed:

- Impacts from increasing water demands, droughts, floods, and climate variability
- Adaptation strategies and management opportunities to meet growing demand for water and environmental interests

Working Group meetings…

- **Design Performance Measures (PMs)
  - PM design is the most intellectually demanding part of the process
  - Understanding how people use objectives to guide their behavior is critical to the process and obtaining representative outcomes
- **Gain an understanding of data and methods (before opportunities are evaluated)
  - Agreement is found with reason behind it
  - Gives the parties a chance to hear other perspectives
- **Develop integrated model
- Develop opportunities
- Evaluate opportunities in Working Group meetings

**** indicates what we will be doing today**

What happens during model development

Participants get a better understanding of basin wide issues

Participants begin to understand the model uncertainties

A foundation for fact-based discussions is established

Whole basin perceptions form

Process is iterative over multiple Working Group meetings.

What happens at a meeting like this…

Several opportunities (e.g., strategies, alternatives, opportunities to manage water or land differently) evaluated in advance and at the meeting

Participants describe from their perspective pros and cons (tradeoffs) about each and every opportunity

New opportunities are designed and tested

Between modelling sessions opportunities are refined

Iterative process that allows for informed discussion on tradeoffs

A system-scale approach can mitigate some of the social and environmental risks associated with natural and anthropogenic change.

A system-scale approach can help to identify changes in the watershed to meet future basin interests

Process also allows participants and decision-makers to visualize tradeoffs and understand the rewards and risks associated with decisions over time.

Athabasca River Basin Initiative

This Initiative is:

- **Not just a modelling project**. It's a collaborative process for the entire water community that uses models to see the Basin as a system.

The models are important; balance the need to have a perfect model with having a good model that represents the system, and allows informed and meaningful discussion. Discussion > innovation.

- **Not a GoA initiative**. The intent of the Initiative is to inform and support policy and planning work at all scales by communities and organizations, not create policy or plans.

Participants, including GoA agencies, are all recipients of project outcomes and benefits of the watershed model.

- **Not consultation, or replacing the duty to consult**. This work is to provide the ARB water community with a common understanding, and a voice in terms of potential approaches for water management, adaptation, and mitigation strategies for their watershed.

This work is being conducted without prejudice meaning that participants are not precluded from future options or actions they may wish to seek.

South Saskatchewan River Basin (SSRB) Adaptation Roadmap

Increasing degrees of adaptive capacity →

Already In Progress	Level 1	Level 2	Level 3
• Achieve CEP Plan targets • Assign and transfer water allocations • Share water within IDs • Upgrade critical water management infrastructure • Release functional flows (Oldman) • Build flood defence berms where necessary • Institute Ghost Reservoir flood operations agreement • Develop large scale flood mitigation facility on the Elbow • Replace Glenmore stop logs with operable gates	• Institute a long term watershed management agreement with TransAlta for the Bow • Raise winter carryover in irrigation serving reservoirs • Further shortage sharing within and between IDs • Develop shortage sharing frameworks by basin • Restrict greenfield development in the floodplain	• Redesign operations of all upstream Bow reservoirs for water supply purposes • Expand and balance Chin Reservoir (Oldman) • Build new SAWSP and Acadia off stream storage	• Build new storage low in the Bow basin (~Eyremore)
	• Increase St Mary operating FSL by 1M • Effectively implement Alberta's wetland policy • Improve and resource forecasting • **Adjust Dickson Dam operations (for WCO, supply, functional flows)** • **Advance conveyance opportunities (Room for the River)** • Advance natural detention opportunities (Room for the River) • Apply land use best management practices • Promote further municipal conservation	• Pursue more extensive relocation and buyouts in floodplain • Build series of new off stream storage in the Oldman basin • Build series of new offstream storage in the Red Deer basin	• Build new off stream storage in the WID (~Bruce Lake) • Build new on stream storage in the Southern Tributaries (~Kimball) • Build new on stream storage low in the Red Deer basin (~Ardley) • Reduce minimum flows through municipalities as an exceptional measure

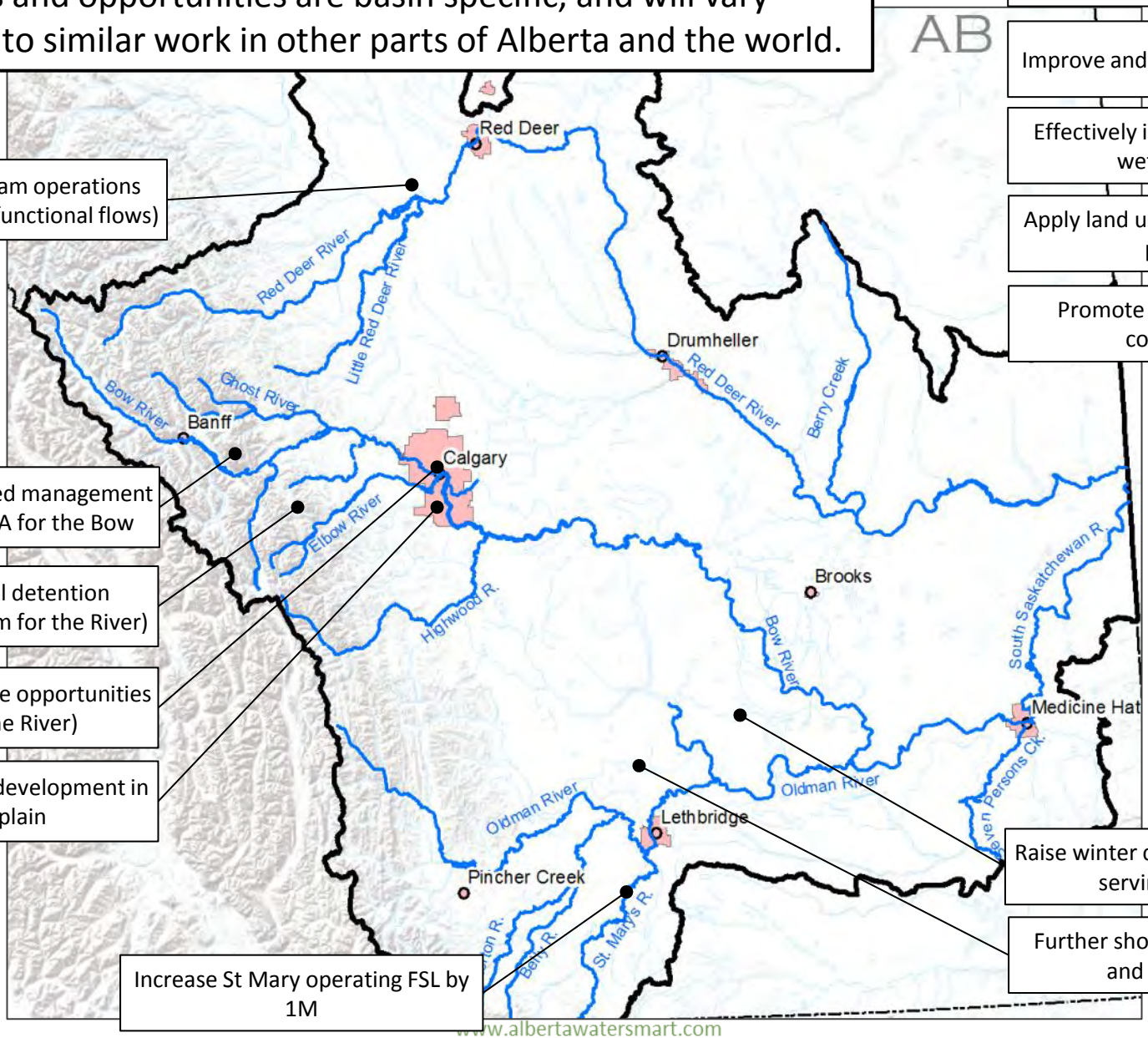
Blue highlights the most promising strategies within a level

SSRB Adaptation Roadmap Level 1

Challenges and opportunities are basin specific, and will vary compared to similar work in other parts of Alberta and the world.

SSRB wide

- Develop shortage sharing frameworks by basin
- Improve and resource forecasting
- Effectively implement Alberta's wetland policy
- Apply land use best management practices
- Promote further municipal conservation



- Adjust Dickson Dam operations (for WCO, supply, functional flows)
- Long term watershed management agreement with TA for the Bow
- Advance natural detention opportunities (Room for the River)
- Advance conveyance opportunities (Room for the River)
- Restrict greenfield development in the floodplain
- Increase St Mary operating FSL by 1M
- Raise winter carryover in irrigation serving reservoirs
- Further shortage sharing within and between IDs

ARB Water Management

Recognizing past and current work

This Initiative recognizes the work completed and underway… including:

- Northern Rivers Basin Study
- Phase 2 Framework committee (P2FC) and Surface Water Quantity Management Framework
- Lower Athabasca Regional Plan and related frameworks
- Athabasca River Basin flood mitigation study
- State of the Basin reports

What's missing:

A basin wide collaborative effort to inform decision making and create a common understanding of the issues and opportunities across the Athabasca Basin for proactive water management.

Athabasca River Basin Initiative

Key outcomes for this scope of work of the ARB Initiative

- Improved common understanding of water resource issues and opportunities from a basin perspective
- A 'Roadmap' that provides useable management and adaptation strategies, and balances the basin's interests and needs

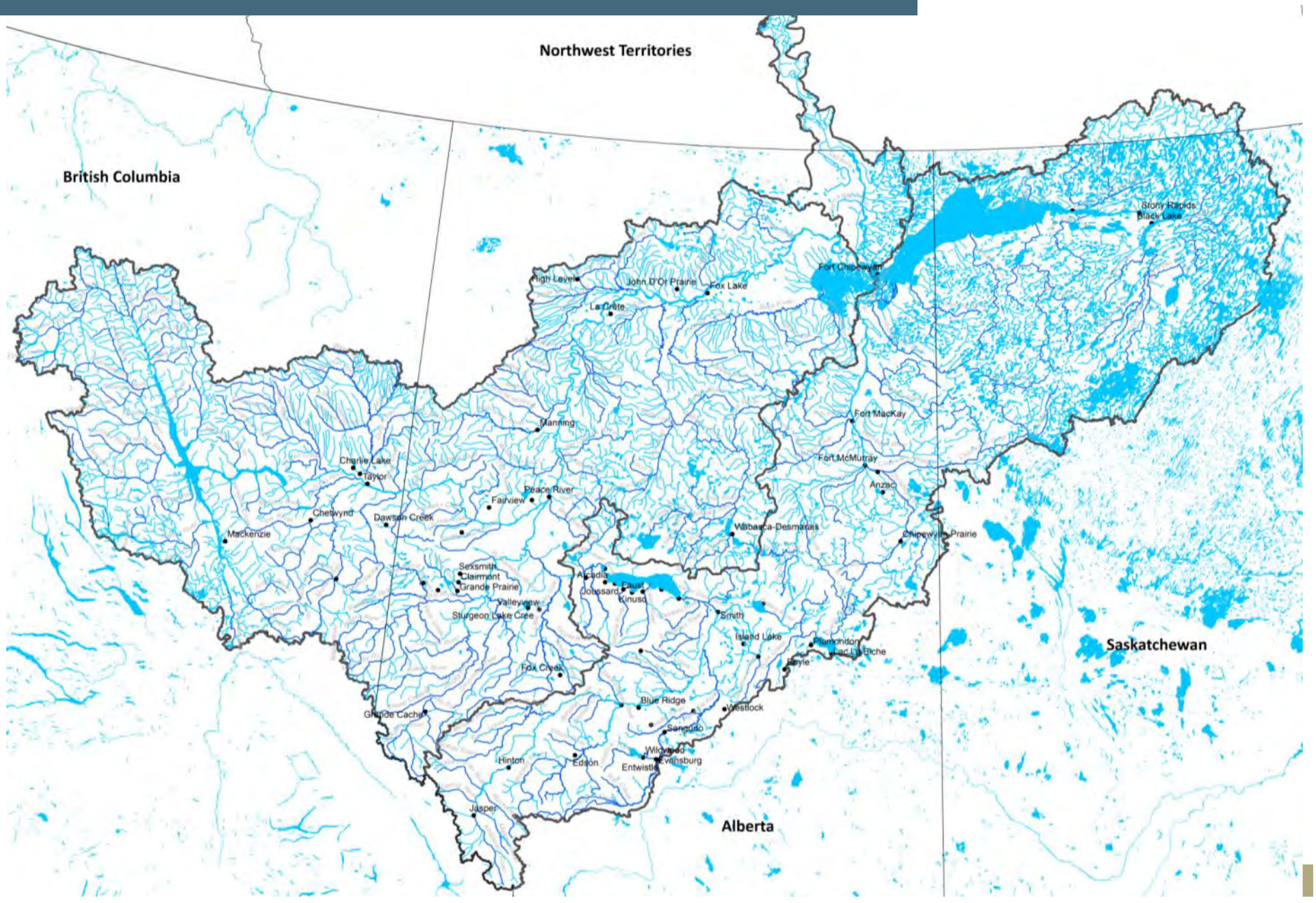
Core funding for this scope of work provided by AI-EES

- Matching funds contributed from several participant groups and organizations from various sectors (May 2016 to December 2018)
- Funding to date from: AEP, AI-EES, ATCO, Shell, Suncor

Longer Term Considerations

- Continue this work into the whole Slave River system approach (Athabasca, Peace, Peace-Athabasca Delta (PAD), Slave)
- Work toward a Water Management Plan for the Athabasca Basin

Water management in Northern Alberta
(Athabasca, Peace, and Slave Basins)



Timelines

Working Session #1	Working Session #2	Working Session #3	Working Session #4	Working Session #5	Working Session #6	Working Session #7	Working Session #8
Sep 2016	Nov 2016	Jan 2017	Mar 2017	May 2017	Sep 2017	Nov 2017	Mar 2018
Introduction to the process and tool	**Water management opportunities**	**Strategies in response to changes in climate**	**Strategies in response to landscape change**	**Integrated modelling, explore & vet strategies #1**	**Integrated modelling, explore & vet strategies #2**	**Refine mitigation, adaptation & management strategies**	**Final vetting & confirming of strategies**
Refine the Terms of Reference for the working group Review basin issues and challenges as gathered and heard to date Introduce and vet model Refine Performance Measures	Explore opportunities to address current issues Develop water management strategies under 'today's' conditions	Understand potential future impacts to streamflow from changes in climate Explore opportunities to address impacts Refine/ develop strategies in response to changes in climate	Understand potential future impacts to streamflow from landscape change Explore opportunities to address impacts Refine/ develop strategies in response to changes in landscape	For each strategy identified assess with an integrated model: • Specify startegy purpose • Model it • Assess results • Identify trade-offs • Identify most promising strategies • Park less promising	Refine most promising strategies Explore combinations of most promising strategies Assess combinations Identify most promising combinations	Refine most promising strategies and combinations Identify associated trade-offs	Finalize most promising combinations Confirm table of contents for final report Agree on report review process

From Apr-Dec 2018: Draft final report, solicit review from participants, finalize, submit, & distribute final report, prepare presentation of findings, and make presentations on work

Working Group participants

When is this work taking place?

- Participating in ~8 Working Group Meetings between September 2016 and March 2018

Who is participating?

Potential Working Group (WG) participants include:

- Indigenous representatives of First Nations and Métis
- Federal and Provincial Governments and related agencies (e.g., Alberta Environment and Parks (AEP), Agriculture and Forestry, AER, DFO, etc.)
- Municipalities (e.g., Jasper, Hinton, Whitecourt, Athabasca, RMWB)
- Watershed Planning and Advisory Councils (WPACS); (i.e. , Athabasca Watershed Council, Lesser Slave Watershed Council)
- ENGOs/NGOs (e.g., Ducks Unlimited, Trout Unlimited, Alberta Wilderness Association, CPAWS)
- Industry (e.g., coal, agriculture, oil and gas, forestry, oil sands, utility companies)

What will participants do/share?

- Interests/ideas for water management in the basin (e.g., mitigation, adaptation, and management strategies)
- Perspectives on challenges and opportunities
- Expertise
- Quantitative and qualitative data and information if available
- Active participation

Today's Agenda		
8:30	Welcome, Introductions, and Opening remarks	Mike
9:30	**Refine draft Terms of Reference for ARB WG**	**Denise**
10:15	Break	-
10:30	Introduction to integrated model components	Ryan, Devin, Danielle
11:45	Lunch	-
12:30	Breakout groups: Help to build the modelling platform	Breakout Groups
1:40	Readouts to plenary	
1:55	Break	-
2:10	Review basin issues and opportunities as gathered and heard to date	Claire
2:25	Breakout Groups: Use model to explore potential basin issues and opportunities	Breakout Groups
3:40	Readouts to plenary	Group Representatives
3:55	Calendar check, next steps, and close	Mike

ARB Initiative Working Group
Terms of Reference

TOR: Background, Vision, Mandate & Goals

Background

Project Vision

Mandate

Goals

Any other revisions or comments at this time?

TOR: details for reference

1.0 Background

The ARB Initiative is a basin wide collaborative effort to create a common understanding of the issues and opportunities and inform decision making across the Athabasca Basin for proactive water management. This Initiative will build on existing data, tools, capacity and knowledge to:

- Provide integrated modelling tool to inform water and natural resource management plans, approaches and decision making;
- Provide accessible and transparent information on basin water management;
- Build a common understanding and trust across the basin;
- Identify strategies for adapting to current an future water challenges; and
- Identify critical gaps in data, science, processes and policy for effective water management.

The ARB Initiative is NOT:

- **A modelling project**. It is a stakeholder engagement project that uses integrated models to engage the entire water community. The models are important, the intention is to balance the need to have a 'perfect' model, with the need to have a good model that is representative of the system and allows meaningful stakeholder engagement and discussion. Discussion facilitated by modelling is where the innovation in this work comes from.
- **A GoA initiative**. The intent of the work is to inform and support policy and planning work, not create GoA policy or plans. GoA is not the only recipient of project outcomes; participants and the water community of the ARB can benefit from this work too.
- **Consultation, or replacing the ``duty to consult``**. This work is to provide the ARB water community with a voice in terms of what they would like to see for water management, adaptation, and mitigation strategies for their watershed. There is no separate and distinct consultation process as this is not consultation. We welcome participation from all Indigenous Communities if they so choose.

TOR: details for reference

2.0 Vision

To have a robust, strategic, proactive approach for water management in the ARB ('ARB Roadmap'), from the headwaters to the confluence with Lake Athabasca that provides practical and implementable management and adaptation strategies, balances the basin's interests and needs, and provides an improved common understanding of water resource issues and opportunities from a basin perspective.

3.0 Project Principles

- Cause no significant, measurable environmental harm.
- Uphold an open and transparent process.
- Include interests and needs, as expressed by participants, from across the basin.
- Make data, findings, and materials from the Working Group, including the final report, available and assumed to be considered public domain.
- Support the long term population/economic growth forecasts.
- Maintain municipal, Aboriginal, and environmental minimum flow requirements.
- Meet Alberta's annual apportionment and bilateral commitments to neighboring provinces and territories.
- Recognize that Alberta's legal water priority system, the Water Act and all other regulatory frameworks (e.g., LARP, SWQMP) are assumed to remain the guiding legal and regulatory authority.
- Achieve Alberta's policy goals as laid out in Water for Life Strategy.

TOR: details for reference

4.0 Goals

- Connect climate, land and water issues to better understand the range of potential effects of climatic and landscape changes on streamflow throughout the ARB.
- Build and apply an integrated modelling tool (climatological, hydrological, landscape, and river system simulation tools) with the WG to support basin wide understanding and exploration of water management, mitigation, and adaptation strategies.
- Test the integrated modelling tool and develop performance measures with the Working Group participants.
- Build trust surrounding multi-stakeholder engagement in the basin, for participants, not only to be heard, but also to genuinely inform decision-making.
- Ensure Traditional Knowledge and other input from Indigenous groups is integrated into the project.
- Enable and facilitate innovation: the innovation associated with such collaborative processes is often seen when participants, who may initially have had conflicting perspectives, seek and offer solutions to meet the needs of other parties.

TOR: Scope, Ingoing Assumptions, Working Group Deliverables, & Workplan

Scope

- Items in-scope
- Items out-of-scope

Ingoing Assumptions

Working Group Deliverables

Workplan

Any other revisions or comments at this time?

TOR: details for reference

5.0 Scope

- The Athabasca River Basin (ARB) will be regarded and simulated as an integrated ecosystem, from headwaters and tributaries to Embarrass Airport, just before Lake Athabasca. Due consideration will be given to growth and change of the water uses along its course, as well as potential future effects of changes in climate, landscape, and natural disturbance.
- The current scope of collaborative modelling will focus on surface water river management, basin landscape, and climatic change, as per Phase 3 funding allocations and timelines.
- Flow quantity in the Athabasca River main stem, and the major tributaries (Appendix A) based on budget and data availability:
- Out of Scope:
  - Lake Athabasca;
  - Peace-Athabasca Delta;
  - Feasibility or environmental assessment of mitigation, adaptation or management strategies;
  - Water Quality modelling;
  - Groundwater modelling;
  - Development of GoA policy or plans; and
  - Cost-benefit analysis of mitigation, adaptation or management strategies.

TOR: details for reference

Ingoing Assumptions

- The current Water Act, and all other regulatory frameworks are assumed to remain the guiding legal and regulatory authority.
- The data, findings and materials from the Working Group will be considered public domain. The final report will be considered public domain.

TOR: timelines

Working Session #1	Working Session #2	Working Session #3	Working Session #4	Working Session #5	Working Session #6	Working Session #7	Working Session #8
Sep 2016	Nov 2016	Jan 2017	Mar 2017	May 2017	Sep 2017	Nov 2017	Mar 2018
Introduction to the process and tool	**Water management opportunities**	**Strategies in response to changes in climate**	**Strategies in response to landscape change**	**Integrated modelling, explore & vet strategies #1**	**Integrated modelling, explore & vet strategies #2**	**Refine mitigation, adaptation & management strategies**	**Final vetting & confirming of strategies**
Refine the Terms of Reference for the working group Review basin issues and challenges as gathered and heard to date Introduce and vet model Refine Performance Measures	Explore opportunities to address current issues Develop water management strategies under 'today's' conditions	Understand potential future impacts to streamflow from changes in climate Explore opportunities to address impacts Refine/ develop strategies in response to changes in climate	Understand potential future impacts to streamflow from landscape change Explore opportunities to address impacts Refine/ develop strategies in response to changes in landscape	For each strategy identified assess with an integrated model: • Specify startegy purpose • Model it • Assess results • Identify trade-offs • Identify most promising strategies • Park less promising	Refine most promising strategies Explore combinations of most promising strategies Assess combinations Identify most promising combinations	Refine most promising strategies and combinations Identify associated trade-offs	Finalize most promising combinations Confirm table of contents for final report Agree on report review process

From Apr-Dec 2018: Draft final report, solicit review from participants, finalize, submit, & distribute final report, prepare presentation of findings, and make presentations on work

TOR: Expected Benefits, Project Organization, Meeting Process, & Annexes

Expected Benefits

Project Organization

Meeting Process

Annexes

Any other revisions or comments at this time?

TOR: details for reference

6.0 Working Group Deliverables

- A roadmap for sustainable water management in the ARB (ARB Roadmap) from the headwaters to the confluence with Lake Athabasca that provides useable management and adaptation strategies and balances the basin's interests and needs

- An improved common understanding of water resource issues and opportunities from a basin perspective

TOR: details for reference

7.0 Workplan

The meeting process for all Working Group meetings will include the following:

- Proposed meeting dates will be set at the first meeting of the Working Group meeting and confirmed at least three weeks in advance.

- Chatham House Rule will be applied to the Working Group meetings: *When a meeting, or part thereof, is held under the Chatham House Rule, participants are free to use the information received, but neither the identity nor the affiliation of the speaker(s), nor that of any other participant, may be revealed.*

- Meeting summaries will be prepared and distributed to members for review before being considered final.

TOR: details for reference

8.0 Expected Benefits

- Inform and support participant (e.g., GoA, industry, municipalities) policy and planning work. Policy and plans will not be created. The scenarios developed through this project will be valuable to communities and and organizations, including GoA, as future developments or changes in the **B**asin are considered and planned.
- Recipients of this work include all water users and broader water communities in the **B**asin who can use the products (tools and processes) after the work is complete.
- There is never a guarantee with any work that GoA will use the outcomes, but their support indicates their intent to do so. The GoA supports this project and encourages participation.
- It is the hope and expectation of all that are involved, including GoA, that outcomes from this work will be used to further the development and ongoing improvement of regional plans, sub-regional plans, and environmental management frameworks for the ARB.
- Support decision making for organizations across the **Basin** (e.g., support cumulative effects assessments, basin water management plans, environmental assessments, regional planning, and ongoing state of the watershed reporting).
- Identify, at a screening level, feasible adaptation, mitigation, and management options. Trade-offs of each are identified and understood at a screening level.
- Help to translate science into policy and action.
- Support the political, social, and governance challenges associated with water management decisions.
- Develop broad regional understanding and science-based evidence, which may help facilitate informed decision making within government.

TOR: details for reference

9.0 Project Participants and Roles

Working Group

Criteria for Working Group Participation

- Broad spectrum of perspectives is represented.
- Significant water license holder, significant future or current need for water, possess important knowledge and technical skills needed for project to succeed, managerial knowledge needed for implementation, and/or vested interest in sustainable water management in the ARB.

Expectations of Working Group Participants

- Working group members are asked to volunteer their time to attend up to 8 full day working group meetings in 2016-2018 and to complete some additional work (primarily data provision and document review) in between meetings.
- Every participant brings commitment to results.
- Every participant is committed to project principles, including collaboration
- Every participant at a minimum will be self-supported.
  - Some participants may be supporting the work with financial and in-kind contributions, and some participants may be self-supporting with in-kind contributions.
- Every participant attends the meetings or sends an informed alternate
  - Efforts to inform alternates of the project's work can be made outside of Working Group meetings in order to ensure maximum productivity with Working Group meeting.

TOR: details for reference

Working Group participant role and responsibilities

- Bring interests/ideas for water management in the basin (e.g., mitigation, adaptation, and management strategies), and their unique perspective on challenges and opportunities, and their expertise.
- Provide quantitative and qualitative data and information if available and can be shared.
- Actively participate in Working Group meetings.
- Assemble data and assure quality assurance/quality control (QA/QC) data for accuracy.
- Develop agreement on data in the models and performance indicators.
- Develop scenarios for model runs (i.e. revise, refine, improve).
- Discuss social/community implications of scenarios (e.g. recreation, assured water supply, etc.).
- Potentially participate in a Technical Team (e.g. Data and Modelling, Economic and Financial Implications and Estimates, Environmental Impacts, Opportunities, Communications, etc.).
- Support preparation and approval of final report.

Decision-making

- The ARB Initiative is a collaborative, integrative approach to water management to provide a common understanding of water resource issues and opportunities from a basin perspective, rather than from a consensus based decision-making model.
- WaterSMART works to ensure all voices at the table **are** heard and various perspectives are considered.

TOR: details for reference

Logistics and Administrative Committee (LAC)

The LAC will focus on:

- Issue resolution and associated strategic guidance on:
  - Opportunities that may change scope of original workplan
  - Budget changes from original workplan as needed;
- Advancing the discussions on the 'home' for the tools and work (e.g., WPACs, GoA)
- Providing feedback based on updates on Working Group activities provided in LAC meetings/calls, including deliverables and contractual obligations;
- Reviewing updates budget and advise on changes based on direction the work takes from Working Group meetings; and
- Scoping support and funding structure for additional work.

Alberta WaterSMART (WaterSMART)

- WaterSMART is an independent third party that is leading and facilitating the process. WaterSMART is responsible for overall project accountability to the funding agencies, as well as project leadership, coordination/management, banker functions, contract management, and administrative processes.

TOR : Next steps…

- Project Team will make revisions to Draft TOR based on previously submitted, and today's comments
- Revised TOR document will be sent to Working Group for review
- Project Team will revise draft TOR based on comments
- Working Group Session #2 will include brief review and finalization of TOR

Today's Agenda		
8:30	Welcome, Introductions, and Opening remarks	Mike
9:30	Refine draft Terms of Reference for ARB WG	Denise
10:15	Break	-
10:30	**Introduction to integrated model components**	**Ryan, Devin, Danielle**
11:45	Lunch	-
12:30	Breakout groups: Help to build the modelling platform	Breakout Groups
1:40	Readouts to plenary	
1:55	Break	-
2:10	Review basin issues and opportunities as gathered and heard to date	Claire
2:25	Breakout Groups: Use model to explore potential basin issues and opportunities	Breakout Groups
3:40	Readouts to plenary	Group Representatives
3:55	Calendar check, next steps, and close	Mike

For the modelling work…

The integrated model offers several advantages for this type of process:

1. Short run time: From clicking “Run” to results is < 20 minutes and can be iterative

2. Operating rules are input in a “plain-English” coding language

3. Easily modifiable “on-the-fly”: New operations, redeveloped schemes, or refined objectives can usually be quickly implemented and tested to allow for rapid progress

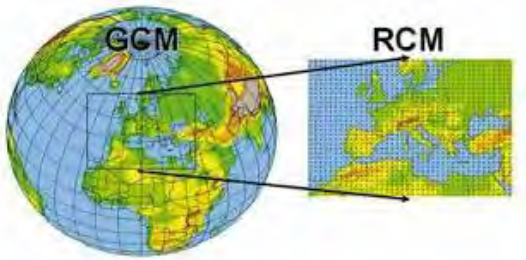
4. Dynamic and visual output tools

Keep in mind…

- There is lots of info here….slides will be send out after today
- Can ask questions as we go through the slides and during the working sessions today
- Some of the material will be reviewed in future meetings
- This process is meant to be iterative - it is on going work
    - A draft model is built that represents the system based on available data and information to date
    - Your job is to tell us what needs to be changed to make it the best representation of the basin as possible - this is why we are coming to the WG now to be involved in developing the model

Integrated model

Regional Climate Models: simulates future climate conditions for the Athabasca River Basin



Outputs: future daily precipitation and air temperature

Hydrological Model: simulates hydrological processes, and changes those processes have on streamflow

Outputs: changes to streamflow based on changes to climate and landscape

Landscape Simulation Model: simulates anthropogenic and natural land change

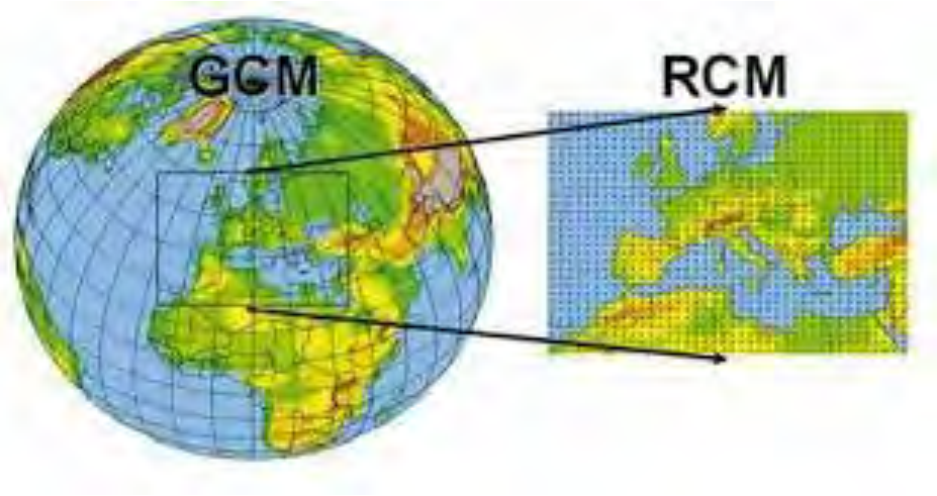
ALCES

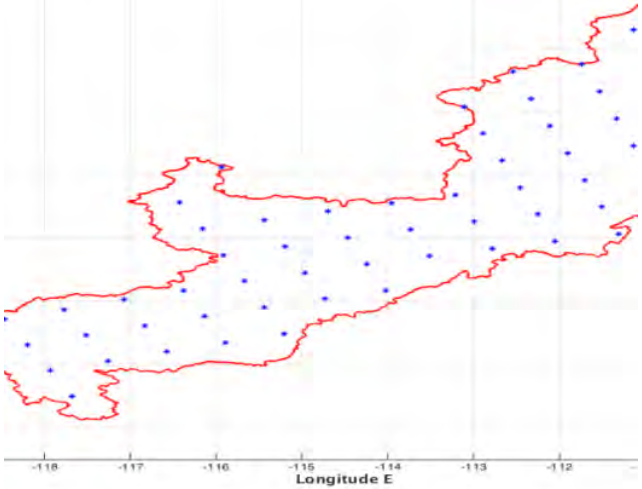
Outputs: changes in landscape composition from various scenarios

River System Model (AROM): simulates river management, including human and environmental demand, and infrastructure operations

Outputs: Changes to streamflow, impacts on human and environmental demands

Climate change simulation





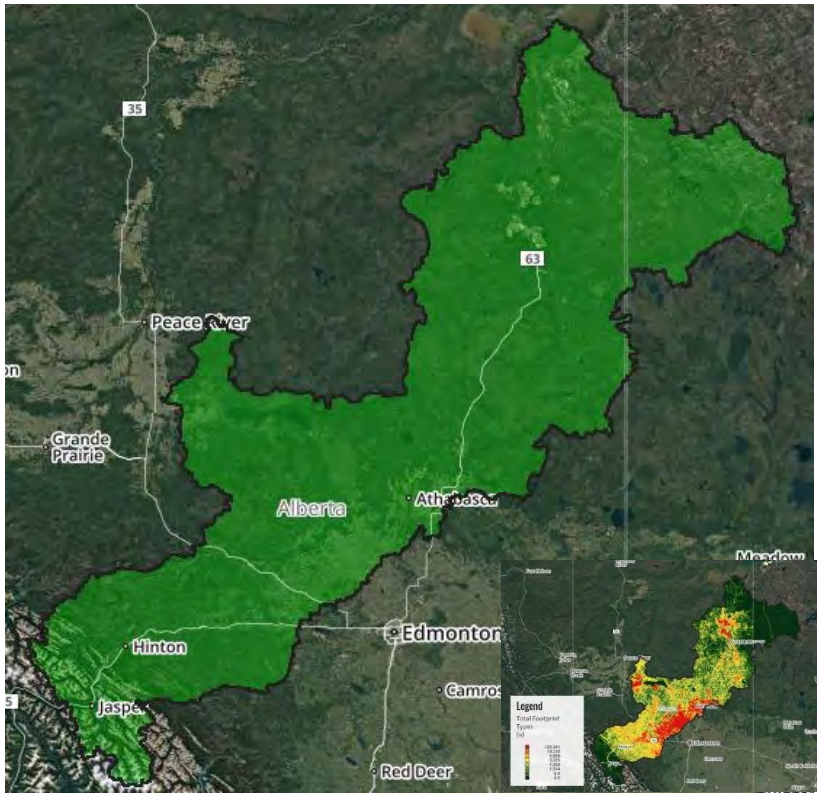
3 Regional Climate Models (RCM):

- CRCM4_cesm2 - CanRCM4 RCM
  - hot-wet extreme.
- CRCM_cgcm3
  - median conditions
- ECP2_gfdl
  - cold-dry extreme

- Downscaled to a daily time step for air temperature and precipitation out to 2070
- Bias corrected to local conditions
- Used as input to the hydrological model for future climate simulations
- Preserves climate signal in RCM output

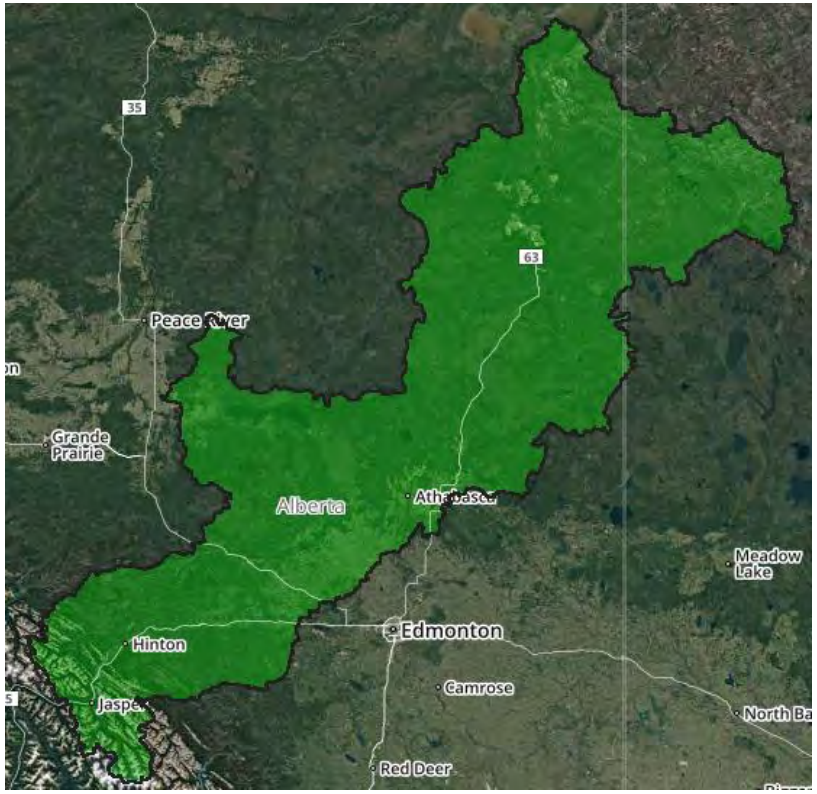
Landscape simulation

ALCES Online



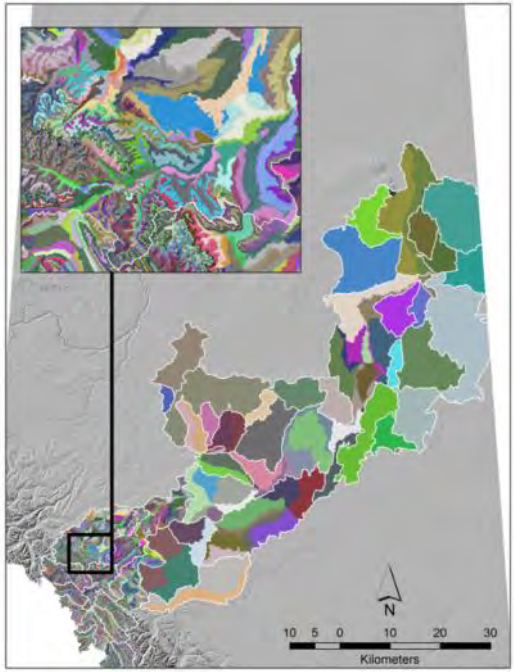
- ~ 200 landscape and footprint types
  - Publicly available data (e.g. ABMI, AltaLIS, AAFC, NHN, AER, AEP, CanVec, LUF, Cities, Geo Discover, Open Street Map)
- 100 m spatial resolution
- Annual temporal resolution
- Web-based simulator
- Driven by explicit assumptions and data:
  - Working Group knowledge
  - Land Use Framework
  - Alberta Energy Regulator
  - Detailed Forest Management Plans
  - Municipal Plans

Landscape and hydrologic model coupling



ALCES used to build Hydrologic Response Units (HRUs) ~10,000

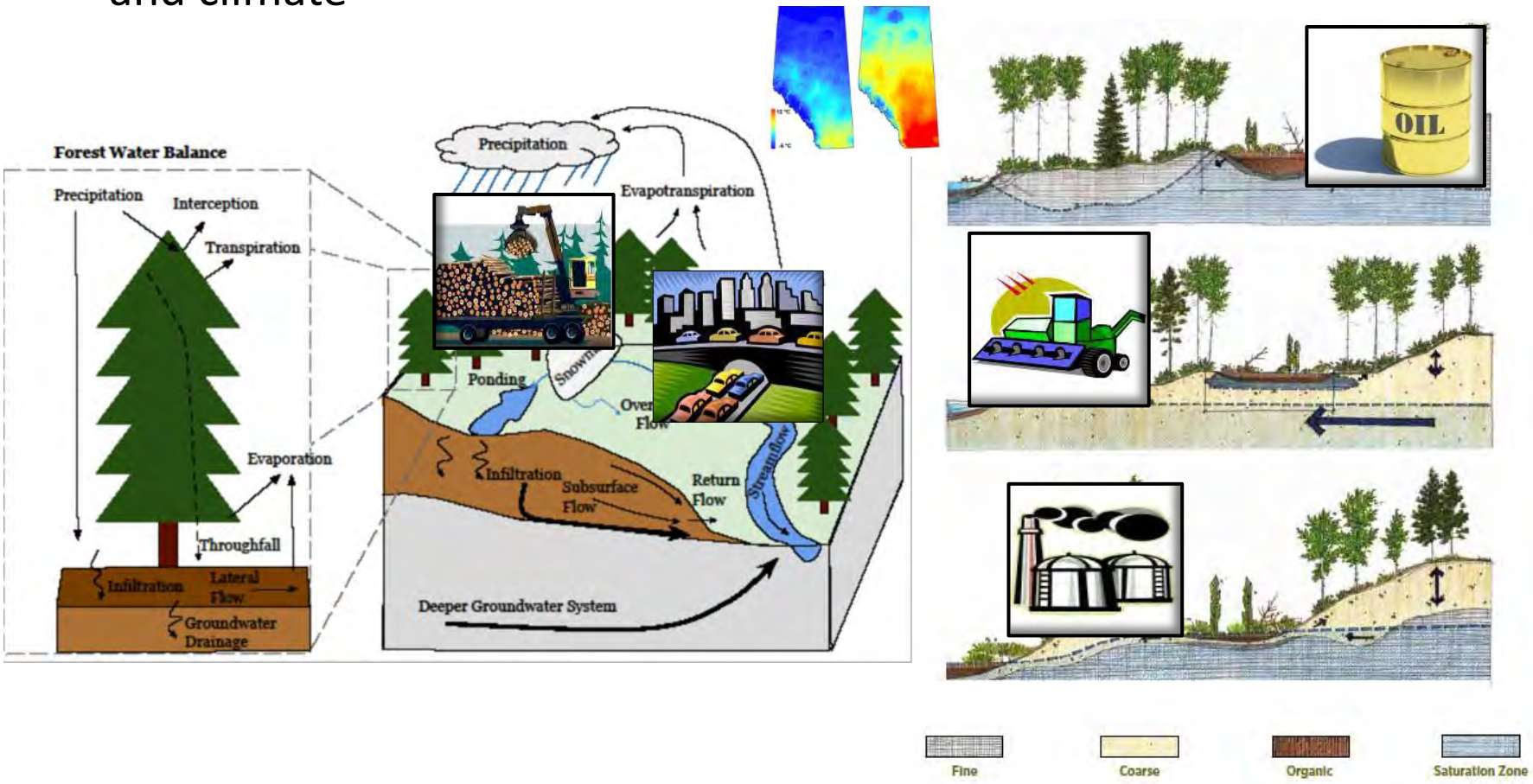
- Sub-basin (split in headwaters)
- Elevation
- Landscape composition
- Surficial geology
- Groundwater flow direction



Raven parameters – describe how hydrologic processes relate to the physical landscape

Hydrological simulation – Raven hydrological model

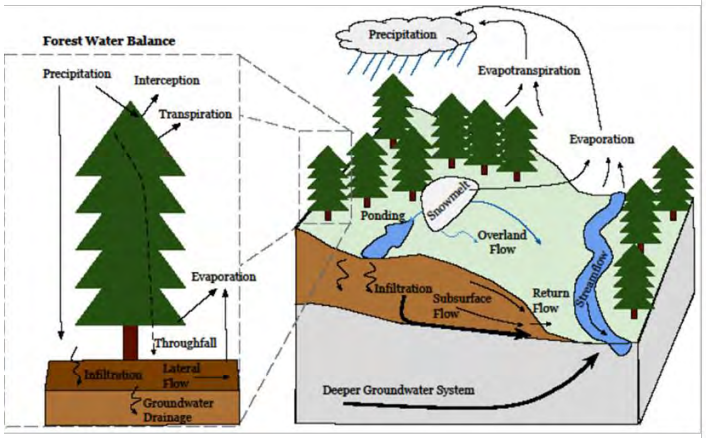
- A customizable model used to simulate streamflow for the whole basin
- Used to simulate hydrologic response to changes in landscape and climate

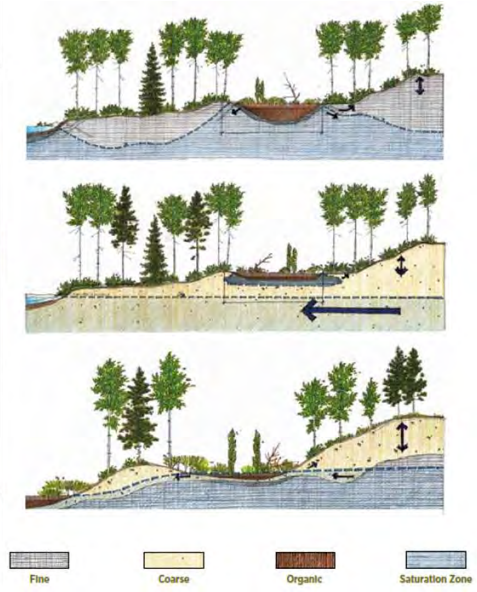


Devito et al. 2012

Data needs for hydrological modelling

- Data
  - Streamflow (Water Survey Canada)
  - Weather and Climate (Environment Canada and RCMs)
  - Surficial geology (Alberta Geological Survey)
  - Soils (CanSIS)
  - Landscape (ALCES Online)
- Model parameters (e.g., rate of infiltration) are based on literature and expert knowledge

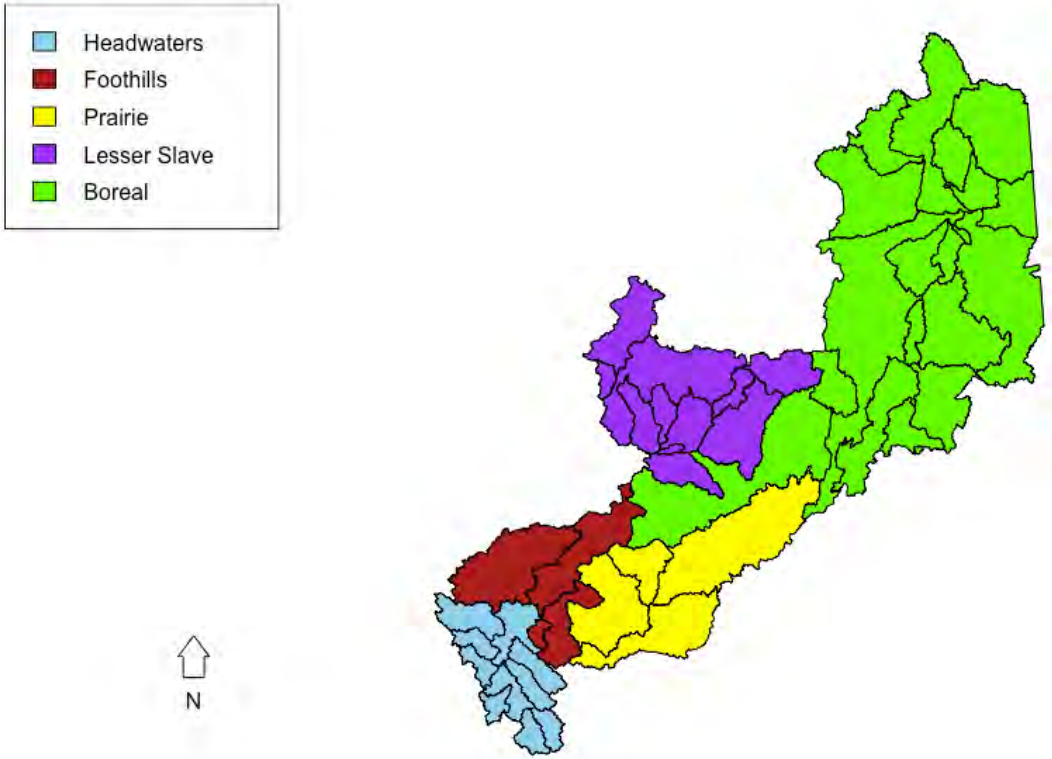




Hydrologic simulation - Raven

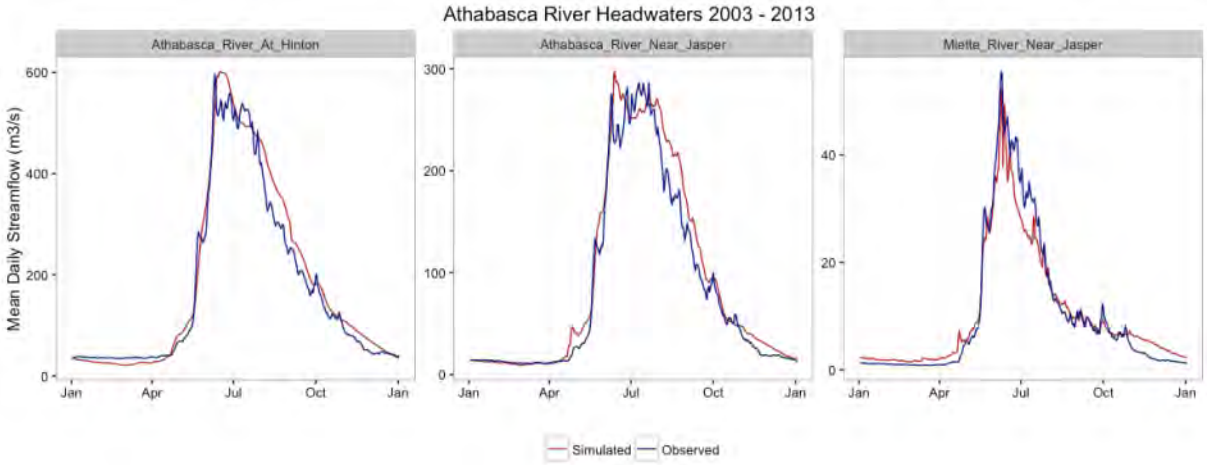
Five sub-models

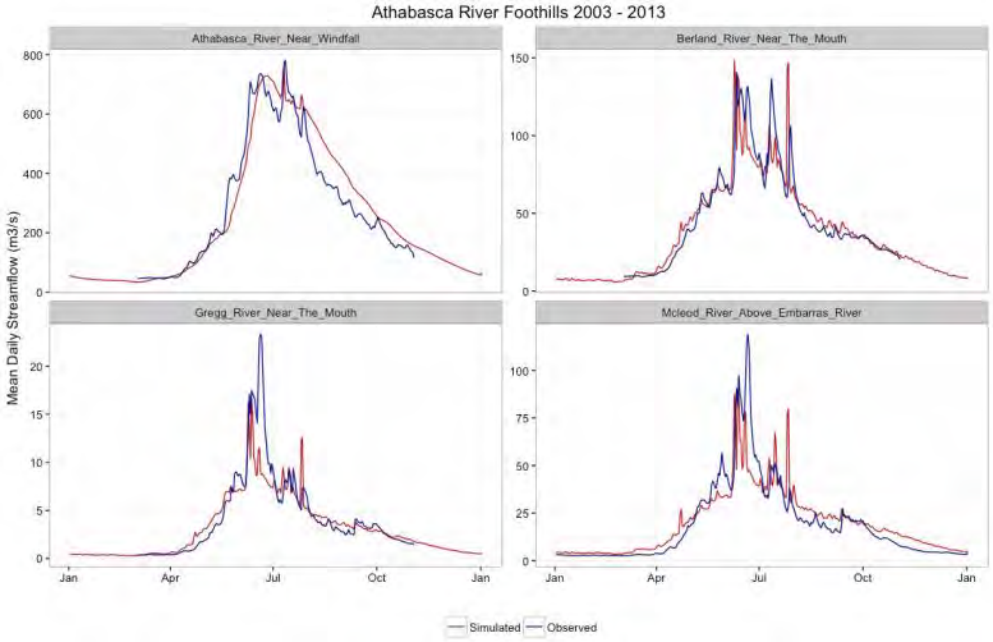
- Headwaters
  - Steep topography
  - Glaciers
  - Shallow soils
- Foothills
  - Moderate topography
  - Completely forested/harvested
  - Deep soils
- Prairie
  - Flat topography
  - Agriculturally dominated
  - Deep soils
- Lesser Slave
  - Moderate topography
  - Large reservoir
  - Mostly forested/harvested
- Boreal Plain
  - Flat topography
  - Peatland and wetland systems (very complex)
  - Forested



Hydrologic modelling results… thus far…

An ongoing effort to build and calibrate models

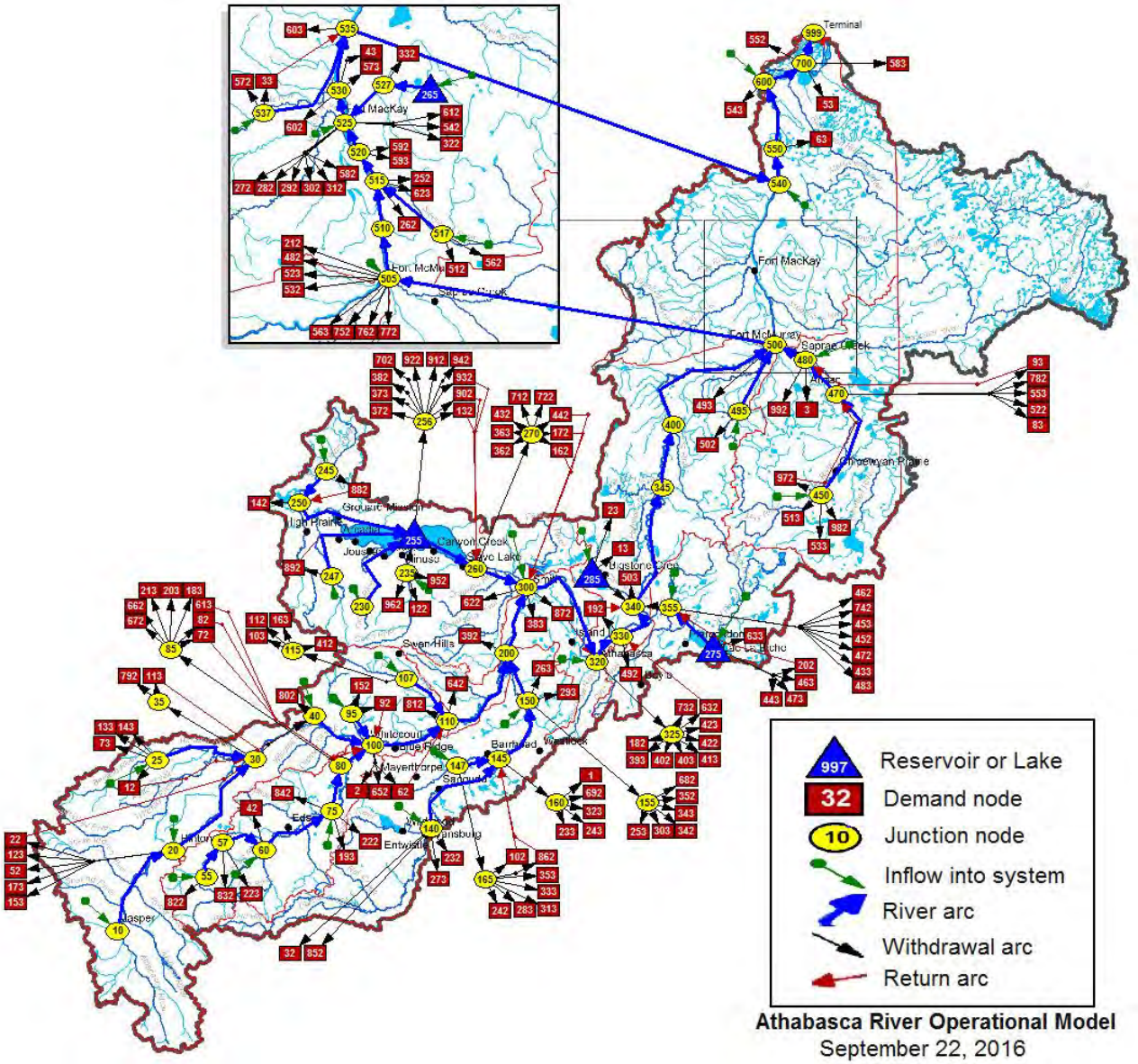




Monthly stats

- Athabasca at Hinton
  - NS = 0.93
- Athabasca at Jasper
  - NS = 0.93
- Athabasca near Windfall
  - NS = 0.89
- Miette River
  - NS = 0.91
- Berland River
  - NS = 0.82
- Gregg River
  - NS = 0.76
- McLeod River
  - NS = 0.76

River system simulation – Athabasca River Operational Model (AROM)



What the AROM is…and is not…

The AROM:

- Is a mass balance model
- Can be used as a screening model for surface water quantity opportunities
- Uses a daily time step for a historic flow record (currently using 1990 to 2010) – will look at future time periods as well
- Operating rule driven
- Long term simulation – all floods and droughts and normal flows in the historic record can be simulated at once
- Allows testing new infrastructure and operational opportunities at a screening level
- Allows for participant driven development of opportunities and combinations
- Is a multi-objective model – many Performance Measures besides streamflow are evaluated including water shortages, environmental values, etc.

The AROM is not:

- Hydrodynamic model or physical hydrologic model – but it is informed by them
- Water quality model – but much is inferred through quantity

Data needed for AROM

Inflows:

- Daily streamflow – currently using Water Surve Canada (WSC) gauge records
  - Naturalized by adding in water use
  - Incremental
- Will use hydrologic model

Demands:

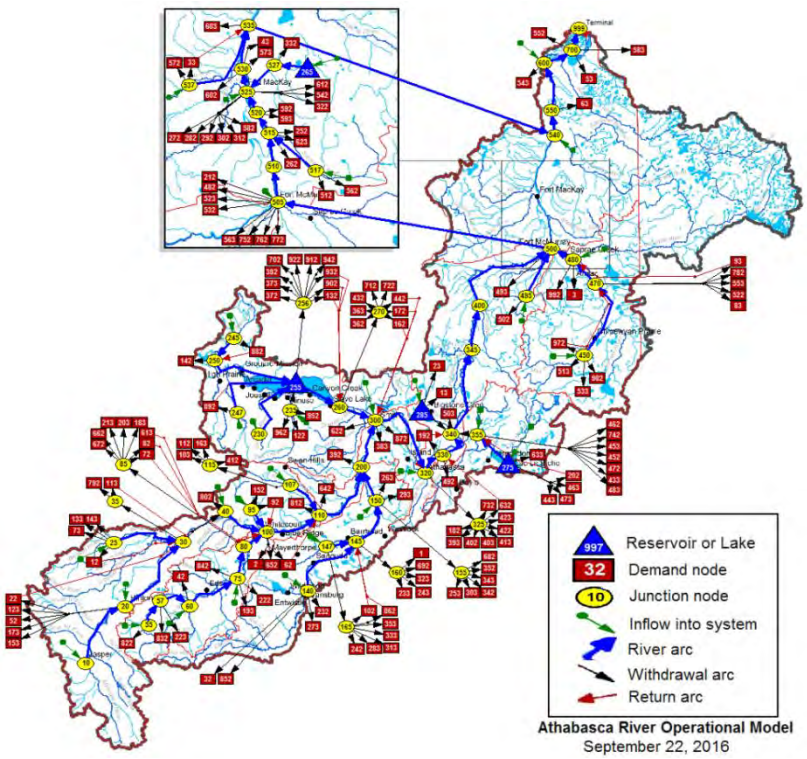
- Water allocation and actual use data are extracted from the AEP water licence database

Reservoirs:

- Bathymetry (Old)
- Stage-discharge curves
- Operational rules (none currently)

Current Assumptions:

- 87 cubic meters per second (cms) min flow downstream of Ft McMurray (Surface Water Quantity Management Framework for the Lower Athabasca River, 2015)
- 6 cms min flow at Lesser Slave River (pers. comm. A. Asnaashari)
- More to integrate



Rationale for demand grouping

- To capture large-scale dynamics of basin water demands
- Increase model utility in terms of speed and flexibility
- Representative of how the system would likely be operated, rather than strict licence priority

Want feedback on this in breakout groups – this is a starting point

Categorizing licences for water distribution in the model

Indigenous licences

- Represented individually (i.e., not grouped)

Low volume licences

- All licences less than 1M cubic meters
- Grouped by type and water source
  - municipal, environmental management, commercial/industrial, and agriculture/irrigation

High volume licences

- All licences above 1M cubic meters, as well as other large users participating in the Working Group
- Approximately 90% of the total allocation volume.
- Grouped by licensee and water source

Temporary diversion licences (TDLs)

- Grouped by type and water source
- Can turn them on or off in the model

Licenced allocation groups in the model for discussion

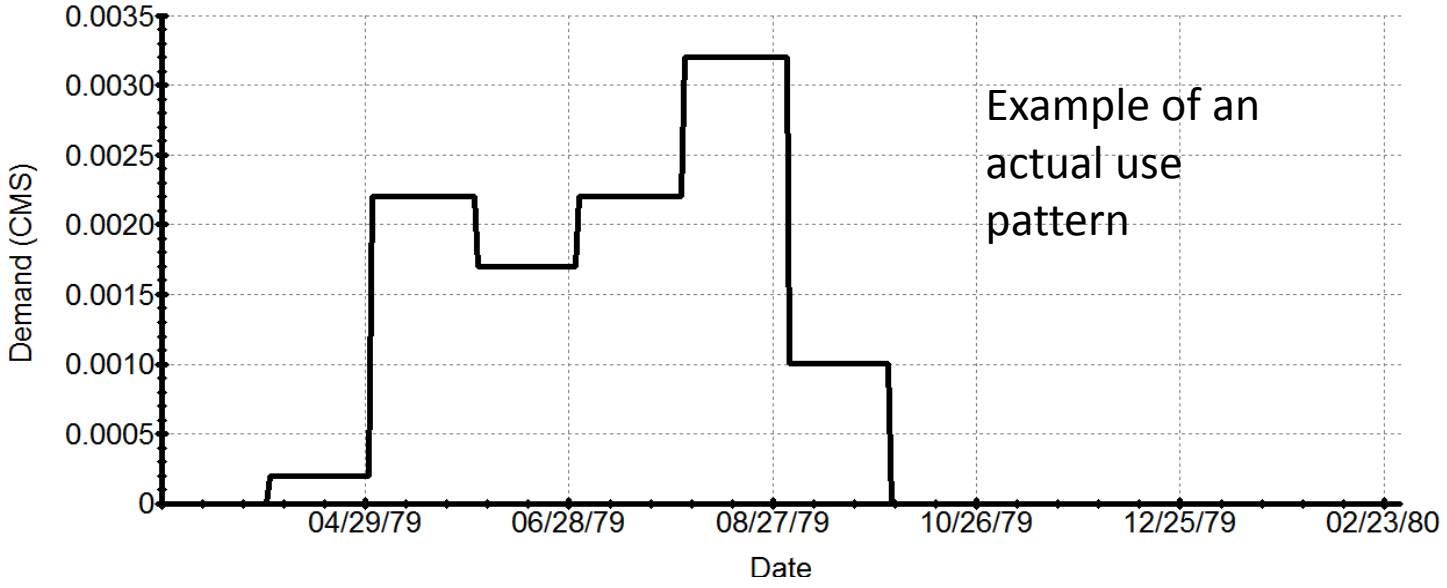
Water is distributed in the model based on the following order:

- Indigenous licences
- Low volume:
  - municipal licences
  - environmental management licences
  - commercial/industrial licences
  - agricultural/irrigation/other licences
- High volume licences (order within group defined by date)
- Temporary diversion licences (TDLs)

Actual use demand patterns

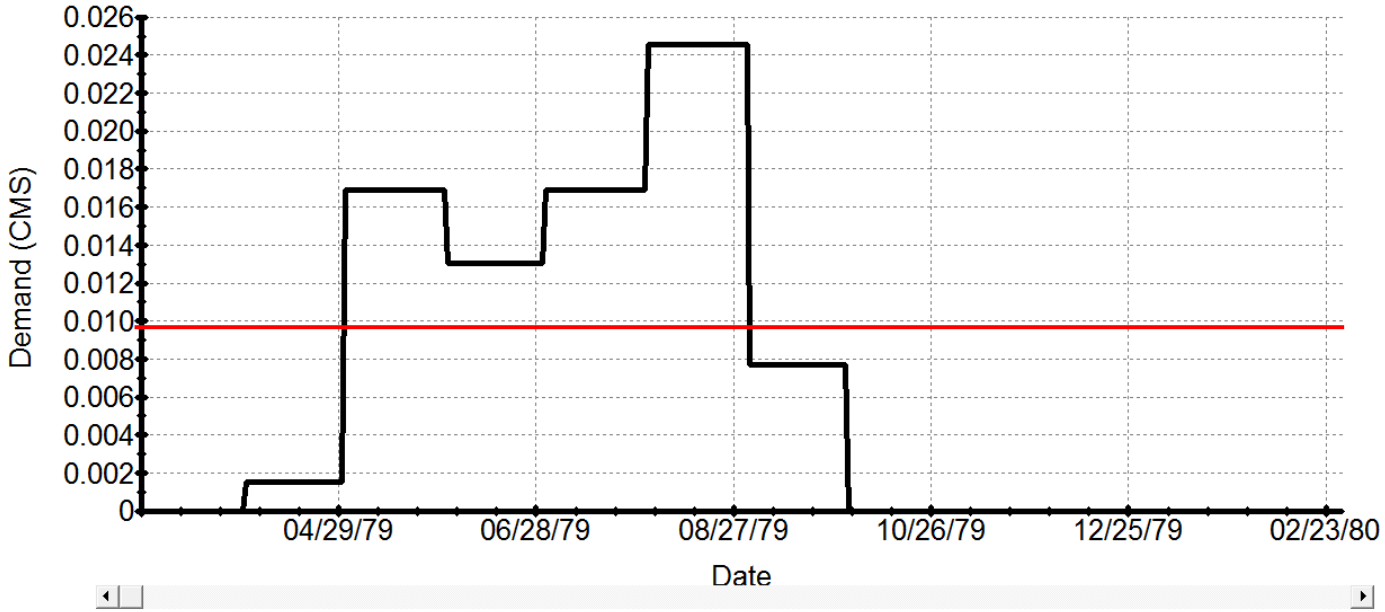
- Most recent 5-year average of reported data to AEP aggregated by demand node to a monthly time step

- Reported actual use for 399 licences of the 1,191 incorporated in the system (33.5%)
  - 98% of the high volume licences (by volume)
  - 88% of all licences (by volume)



Allocated use demand patterns

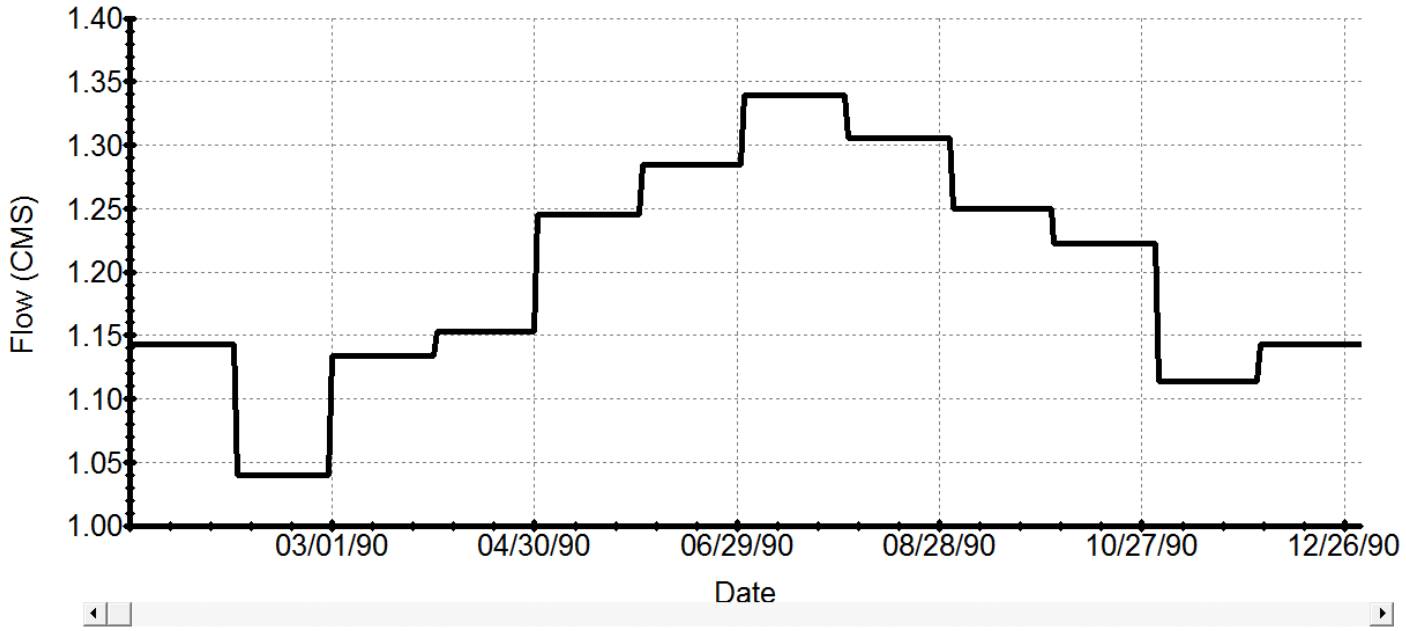
- Full allocation volume scaled in proportion to monthly actual use pattern
- For licences with no reported use, an average annual allocation value is used



Average annual allocation (red) and annual allocation scaled by month (black)

Actual return patterns

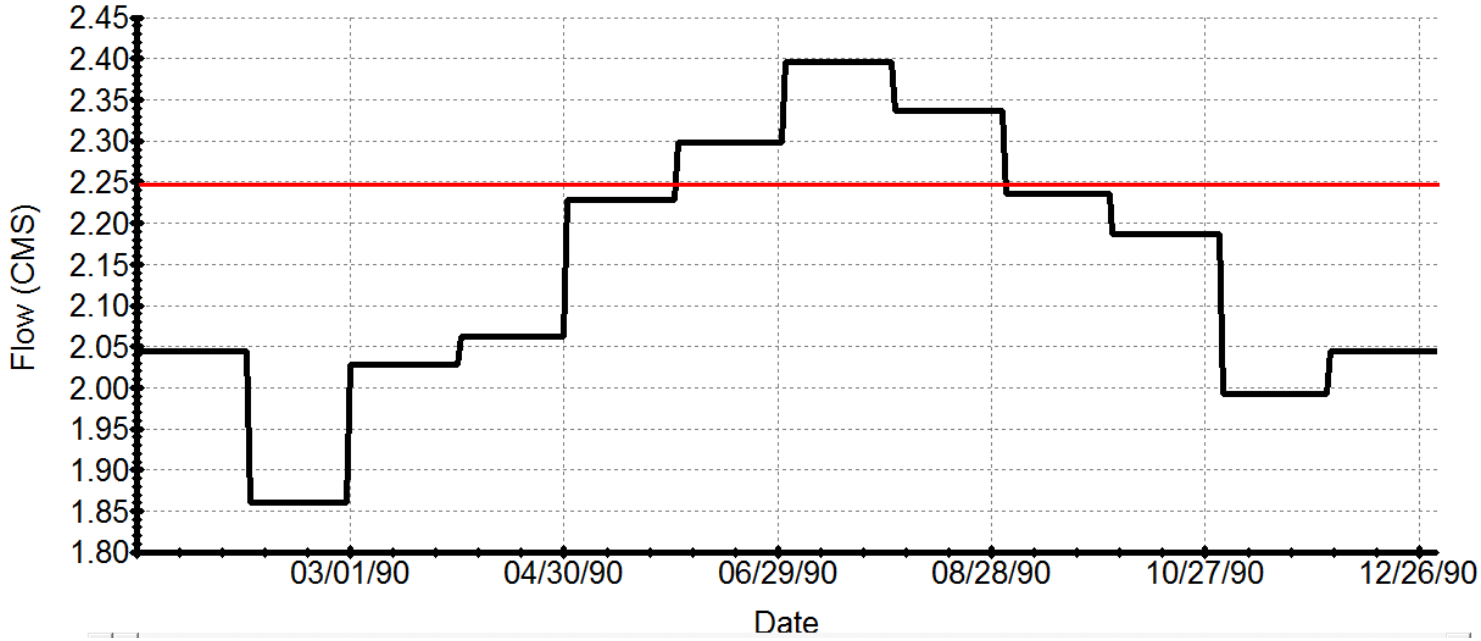
- Most recent 5-year average of reported data AEP aggregated by node to a monthly time step
- Reported actual return data for 49 licences (97% of return by volume)
- This monthly pattern is expressed as a percentage of the demand



Actual return flow

Allocated return patterns

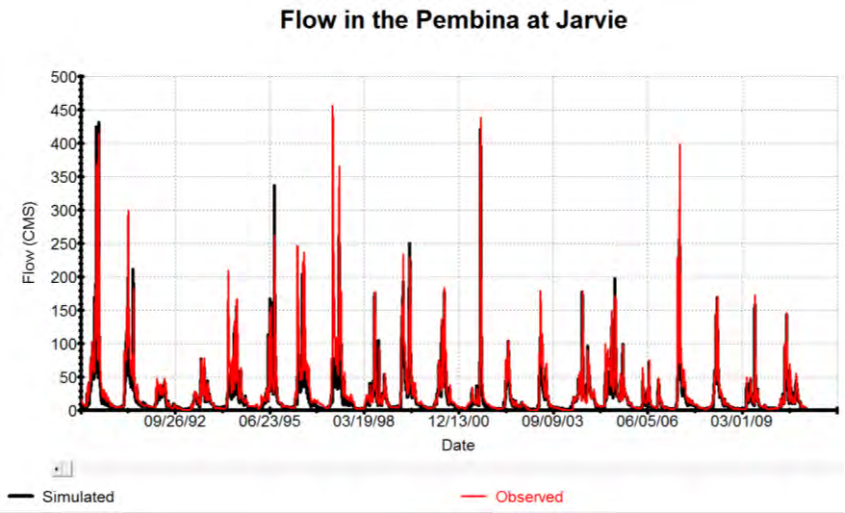
- Full allocated return volume scaled in proportion to monthly actual return pattern
- For licences with no reported use, an average annual allocation value is used
- Expressed as a percentage of the demands

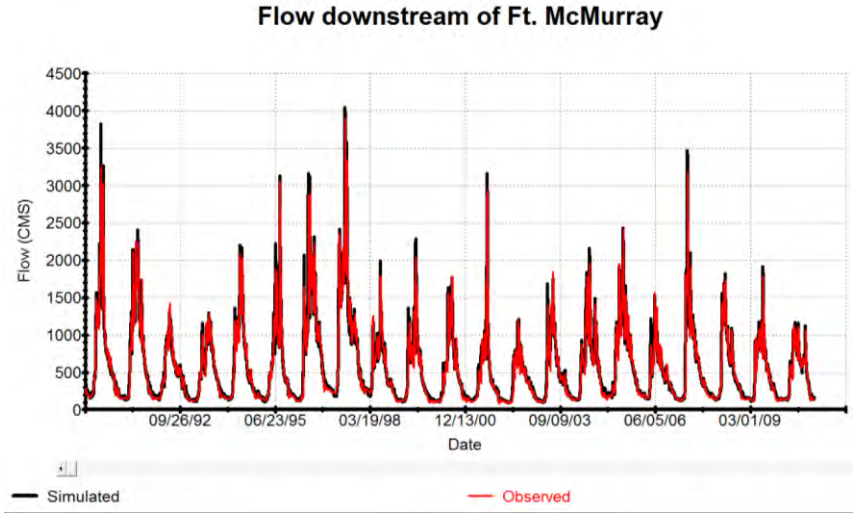


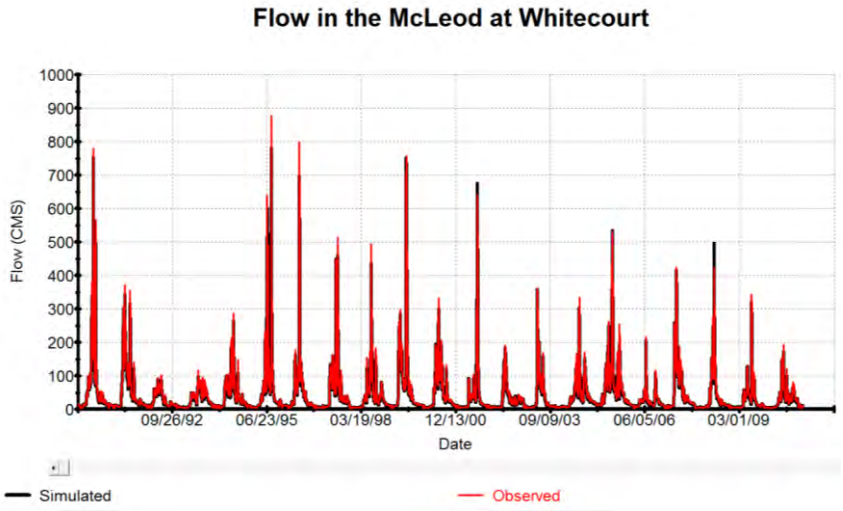
Average annual allocated return (red) and annual allocated return scaled by month (black)

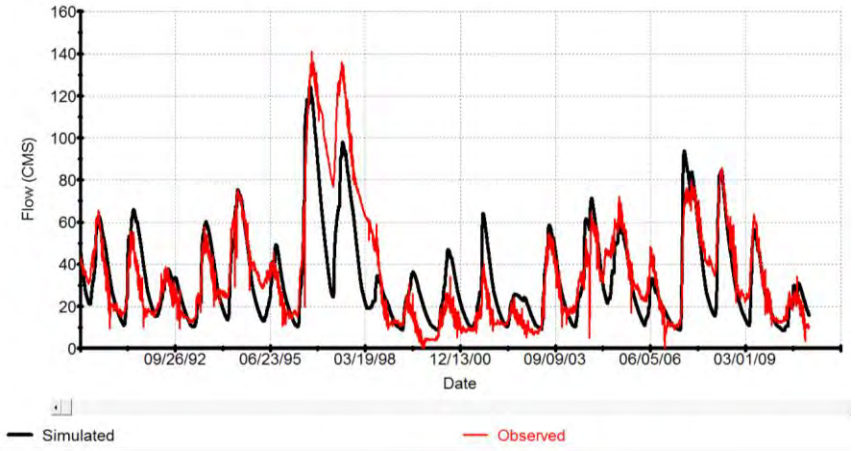
Initial model verification

Primarily to evaluate implementation of time lags



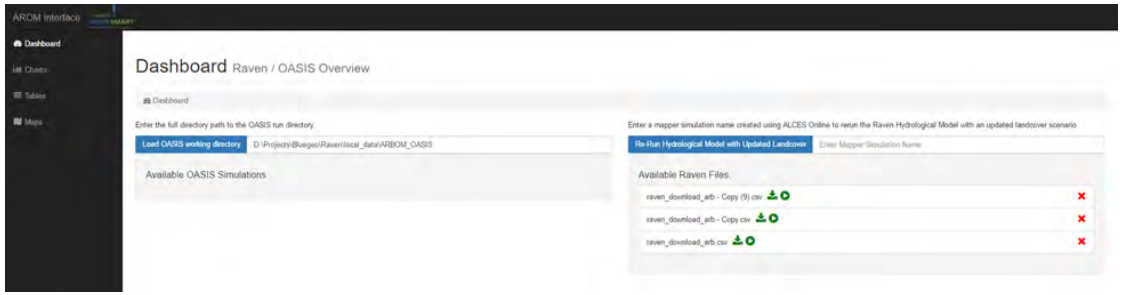


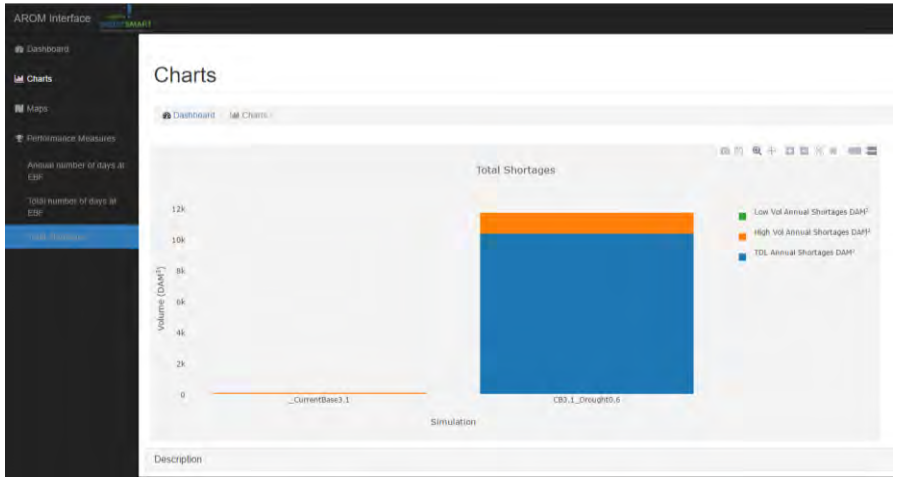




ALCES, Raven, AROM interface

- Dashboard – provides an interface for linking models and visualizing outputs
- Used to link outputs from landscape simulations with hydrological model
- Runs hydrological model (~ 5 min) and provides outputs for AROM
- Imports AROM runs to show PMs





To remember

- "All models are wrong, but some are useful" – George Box

- Goal is to provide a useful and representative integrated model at appropriate spatial and temporal scales
  - Climate and landscape change
  - Hydrologic processes
  - Water management

- This integrated model is used to screen surface water quantity opportunities

  e.g., water supply, water demand, infrastructure

- Building the model with the Working Group
  - Incorporating the best available data with knowledge from this group (and others)
  - Assumptions, uncertainty and limitations are well understood

Today's Agenda		
8:30	Welcome, Introductions, and Opening remarks	Mike
9:30	Refine draft Terms of Reference for ARB WG	Denise
10:15	Break	-
10:30	Introduction to integrated model components	Ryan, Devin, Danielle
11:45	Lunch	-
12:30	**Breakout groups: Help to build the modelling platform**	**Breakout Groups**
1:40	Readouts to plenary	
1:55	Break	-
2:10	Review basin issues and opportunities as gathered and heard to date	Claire
2:25	Breakout Groups: Use model to explore potential basin issues and opportunities	Breakout Groups
3:40	Readouts to plenary	Group Representatives
3:55	Calendar check, next steps, and close	Mike

Breakout Group: help to build the modelling platform

Objectives:

- Take a tour of the draft model
- Identify any required data & model refinements
- Confirm model set up is representative of the watershed today
- Refine and suggest additional Performance Measures

Table 1: Denise and Ryan

Table 2: Claire and Danielle

Table 3: Mike and Devin

- ➢ Feel free to move between tables
- ➢ Scribes will record notes on flip charts

A volunteer from each table needs to provide a brief readout back to the full group

Today's Agenda		
8:30	Welcome, Introductions, and Opening remarks	Mike
9:30	Refine draft Terms of Reference for ARB WG	Denise
10:15	Break	-
10:30	Introduction to integrated model components	Ryan, Devin, Danielle
11:45	Lunch	-
12:30	Breakout groups: Help to build the modelling platform	Breakout Groups
1:40	Readouts to plenary	
1:55	Break	-
2:10	**Review basin issues and opportunities as gathered and heard to date**	**Claire**
2:25	Breakout Groups: Use model to explore potential basin issues and opportunities	Breakout Groups
3:40	Readouts to plenary	Group Representatives
3:55	Calendar check, next steps, and close	Mike

Issues, interests, and opportunities in the ARB

The goal in providing this information is to identify the key issues, interests, and opportunities to ensure it is captured when modelling changes in landscape and climate in the ARB. This info was sent to the Working Group in the spring of 2016.

Information and data gathered

- Publically accessible and available information and data gathered from online sources through searches on relevant government, industry, and organization websites on previously stated water issues, interests, and opportunities in the ARB.

Issues and interests grouped

- The issues and interests of various perspective types in the basin grouped into broad categories, such as water quality, water quantity, flora and fauna, as well as many others, as they relate to the watershed.
- Not a complete list, so if something is missing please bring it to our attention.

Issues and interests within scope identified

- Issues and interests that are within the current scope of the ARB Initiative are identified, as well as what part of the integrated modelling tool can be used to look at them.

The following slides provide an overview of the basin issues and interests as gathered and heard to date, and what may be addressed in the scope of this work.

Examples of issues that can be looked at with the integrated modelling tool

Category	Issues/Interests/Opportunities that can be looked at in the current scope of work	Part of the model used to look at issue
Water Quantity	Changes in water quantity due to **climate change**, landscape changes and industrial development.	Raven, ALCES, and OASIS
	Data gaps and limitations in terms of water use and flow variation prevent proper understanding of water resources in LAR.	OASIS
	Water storage- re-evaluation of water storage options on and off-stream.	OASIS
	Declining water levels are inhibiting boat transportation, resulting in sandbars and sediment being drawn out during water intake and how do changes in river dredging practices play into this?	WG Discussion
	Cumulative effects from decreased flows.	Raven, ALCES, and OASIS
	Set precautionary water withdrawal limits to limit impact on water-based recreation and navigational uses of the Athabasca River.	WG Discussion
	How are seasonal and annual flows changing, and how are longer climate cycles (e.g., 60 years) expected to change flow conditions?	Climate scenarios and Raven

Examples of issues that can be looked at with the integrated modelling tool

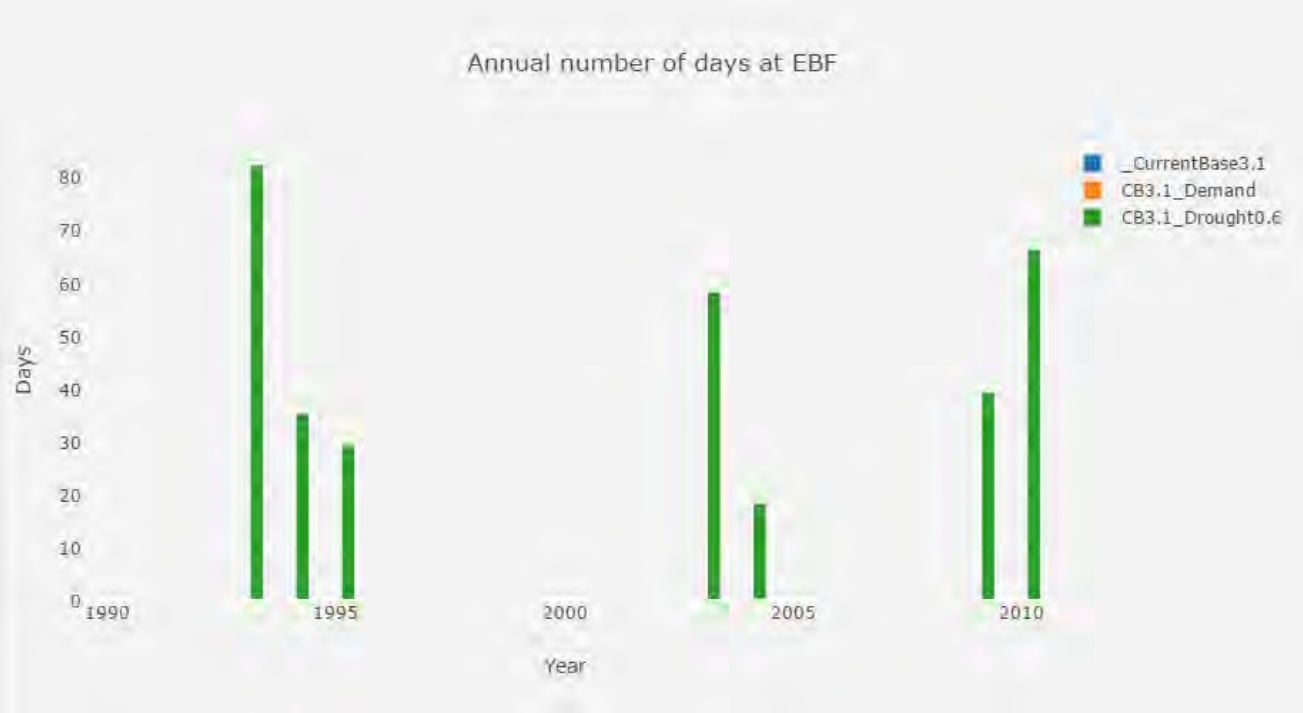
Category	Issues/Interests/Opportunities that can be looked at in the current scope of work	Part of the model used to look at issue
Change in flood patterns	**Forest disturbance** could lead to increased volatility in water flows (i.e., flood and drought).	ALCES and Raven
	Development has increased the amount of flash flooding in Lesser Slave Lake area.	ALCES and Raven
	Lack of flooding has resulted in increased willow growth and island formation.	WG Discussion
Priority Allocation	What are the current **surface water allocations** and how often with potential changes could they prevent the ability to meet minimum surface water flows required to maintain healthy aquatic environment?	OASIS
	Are Treaty rights impacted by current allocations, and how does that change under future scenarios?	Climate scenarios and OASIS
Flora and fauna	Wetland retention	ALCES and Raven
	Changes in soil moisture regimes	Raven
	Fish populations are suffering from lower water levels which are causing a decline in fish and waterfowl populations, impacts traditional use.	This would be a PM .
Climate and Land Use Change	How are or will **changes in snowpack** change seasonal and annual flows?	Climate scenarios and Raven.

Examples of issues that can be looked at with the integrated modelling tool

Category	Issues/Interests/Opportunities that can be looked at in the current scope of work	Part of the model used to look at issue
Water Management	Establish an **Ecosystem Base Flow (EBF)** in the Athabasca River (threshold to 87m3/s, which is based on the winter period 1 in 100 low flow statistic for mean weekly flows over the current period of record).	This is a PM and can be evaluated in OASIS.
	Establish an "Indigenous Base Flow" (ABF) to set the minimum water level/flow required for Treaty Rights and traditional uses.	This is a PM and can be evaluated in OASIS.
	Properly manage hydroelectricity production, recognizing that maximizing hydroelectricity productions often fails the need for the Crown to seek balance in competing values.	This is a PM and can be evaluated in OASIS.
	Consider **how to meet the Water Management framework** by either building the required storage amount over time or through equivalent means, such as: **water sharing agreements**, technological improvements in water use efficiency, curtailing production, and alternate **drought response measures**.	OASIS
	Consider the water aspects in developing a system of Ecosystem Management that also considers Traditional Knowledge and Use.	Captured in a PM and WG Discussion
Economic	**Development of hydropower facilities** – due to increased economic development and the NDP Government's climate change plan for Alberta, there is potential for damming the Athabasca for hydropower facilities.	OASIS
	Impacts of dams – there are concerns surrounding forced relocation, loss of homes and personal property, decreased availability and resources for hunting, food gathering and fishing areas, as well as loss of trap lines.	This could be a PM.

Performance Measures (PMs)

- Performance Measure= any visual that shows the status of an interest to a Working Group participant (e.g., fish species, navigation, streamflow)
- Used to look at the relative difference in for a particular interest between model runs (scenarios)(e.g., change in flow due to climate or landscape change, and how that impacts fish spawning).
- PMs will be used to show the direction and magnitude of change on an interest, develop and refine opportunities in the model.



PMs that were conceptualized (or drafted)

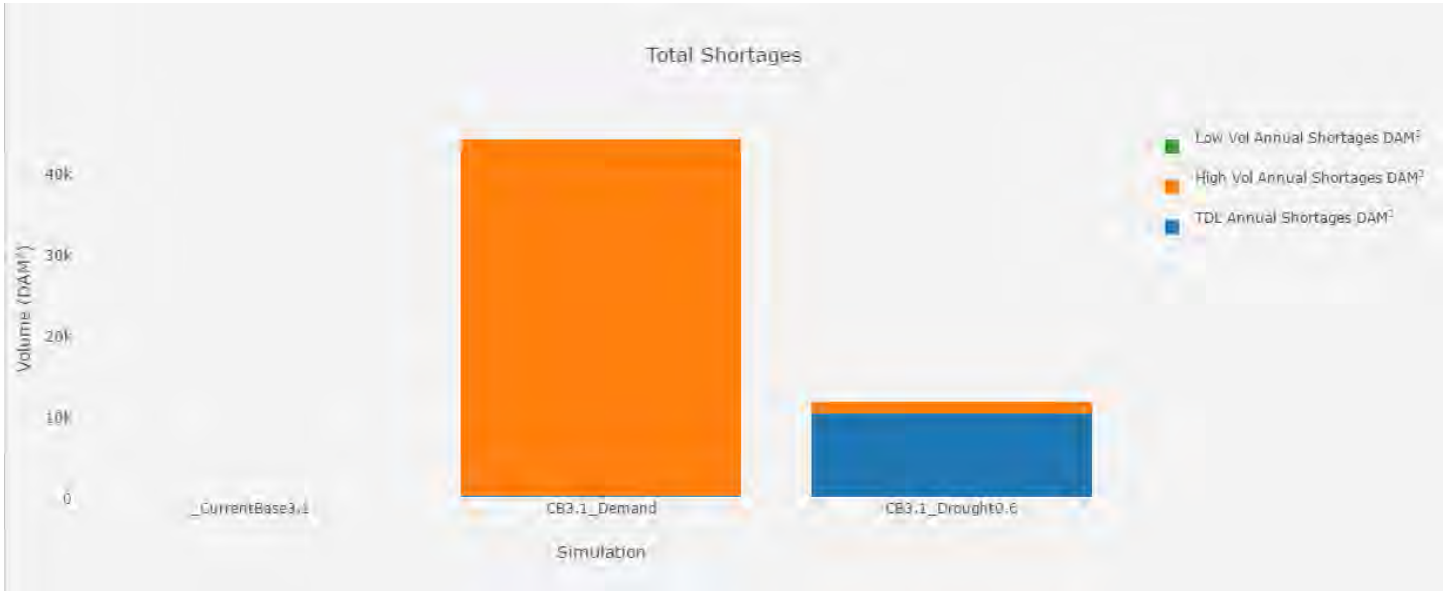
Water quality
- Stream temperature
- Dissolved Oxygen (DO)

Climate / landscape change
- Changes in flow patterns
- Drought
- Wetland area
- Linear feature density

Water management
- Potential surface water use
- Navigational suitability
- **Ecosystem Baseflow (EBF)**
- Net upstream water use
- **Water shortages**

Flora and fauna
- Walleye population reduction and population viability
- Fish Sustainability Index (FSI) for a range of species

Proposed flood concerns
- Flooding of populated areas



Today's Agenda		
8:30	Welcome, Introductions, and Opening remarks	Mike
9:30	Refine draft Terms of Reference for ARB WG	Denise
10:15	Break	-
10:30	Introduction to integrated model components	Ryan, Devin, Danielle
11:45	Lunch	-
12:30	Breakout groups: Help to build the modelling platform	Breakout Groups
1:40	Readouts to plenary	
1:55	Break	-
2:10	Review basin issues and opportunities as gathered and heard to date	Claire
2:25	**Breakout Groups: Use model to explore potential basin issues and opportunities**	**Breakout Groups**
3:40	Readouts to plenary	Group Representatives
3:55	Calendar check, next steps, and close	Mike

Breakout Group: Use model to explore issues and opportunities

Objectives:

- Use the model to explore basin wide issues and identify potential opportunities
- Discuss how the WG will assess opportunities using the model
- List opportunities to explore using the model in the next WG meeting
- Refine and suggest additional PMs

➢ Feel free to move between tables

➢ Scribes will record notes on flip charts

Table 1: Denise and Ryan

Table 2: Claire and Danielle

Table 3: Mike and Devin

A volunteer from each table needs to provide a brief readout back to the full group

Today's Agenda		
8:30	Welcome, Introductions, and Opening remarks	Mike
9:30	Refine draft Terms of Reference for ARB WG	Denise
10:15	Break	-
10:30	Introduction to integrated model components	Ryan, Devin, Danielle
11:45	Lunch	-
12:30	Breakout groups: Help to build the modelling platform	Breakout Groups
1:40	Readouts to plenary	
1:55	Break	-
2:10	Review basin issues and opportunities as gathered and heard to date	Claire
2:25	Breakout Groups: Use model to explore potential basin issues and opportunities	Breakout Groups
3:40	Readouts to plenary	Group Representatives
3:55	**Calendar check, next steps, and close**	**Mike**

Are November 29, 30, or December 1 possible?

November Meeting:
Exploring water management strategies in the basin as it is today

Are January 24, 25, 26th possible?

January Meeting:
Refining and exploring opportunities under projected changes in climate

Final Reminders

This work is focused on identifying practical options for adapting to change throughout the ARB

- WaterSMART to draft meeting summary and distribute to Working Group members for review
- Follow up with individuals regarding key datasets required to refine modelling tool, or questions from today's meeting
- Ongoing modelling work between now and next meeting
- Meeting invites for the next 2 meetings will be sent out
- Please contact us if you have any thoughts, questions, comments!

Thank you for all your support and participation!

Thank you

ALBERTA
waterSMART
Water Management Solutions

www.albertawatersmart.com

Water: the key to our sustainable future

ALBERTA
waterSMART
Water Management Solutions

For more information:

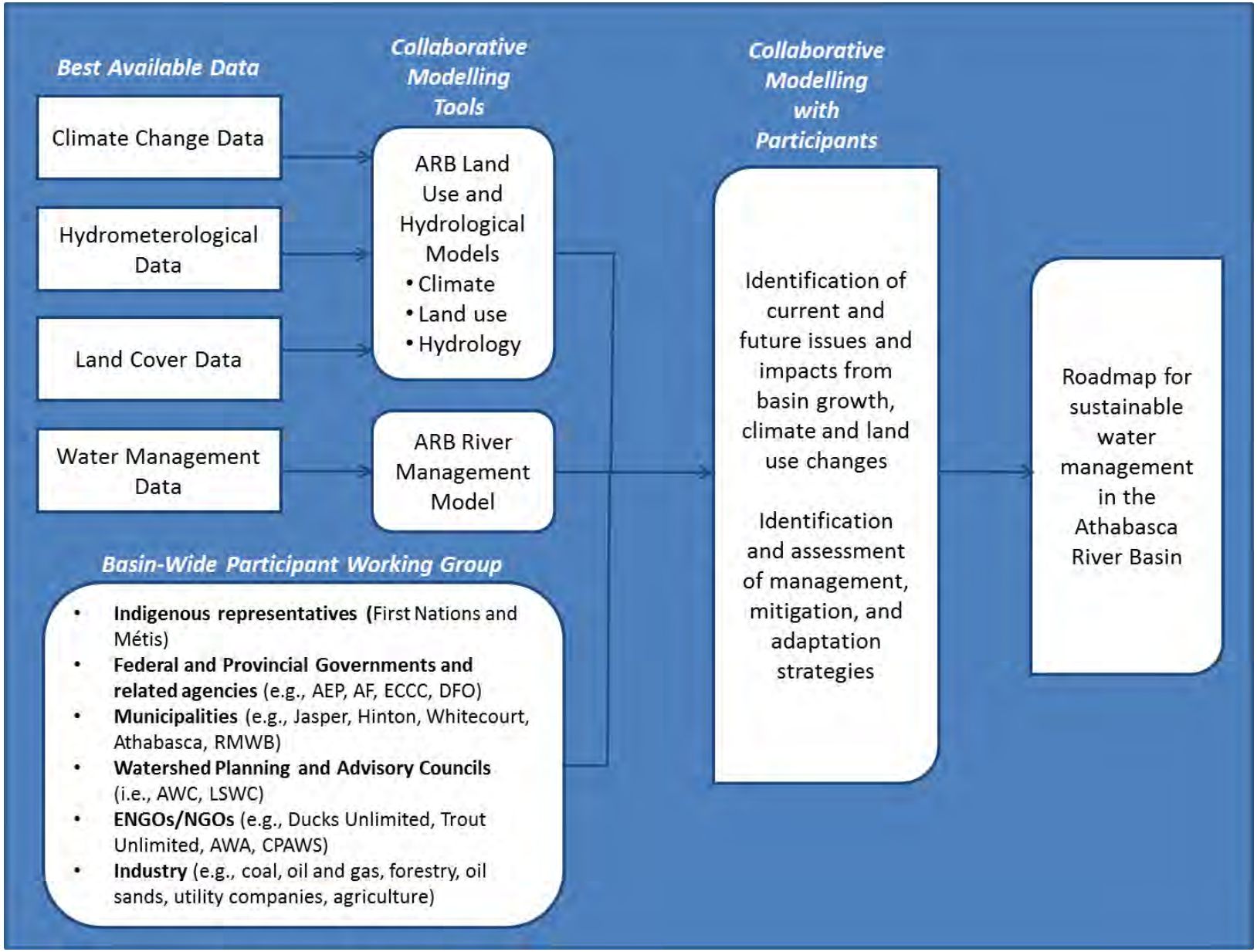
Alberta WaterPortal
www.albertawater.com

Alberta WaterSMART
www.albertawatersmart.com

Email:
mike.nemeth@albertawatersmart.com

Reference Slides

How it all fits together…



Inflows into AROM

- Currently using Water Survey Canada (WSC) data that have been naturalized
- Naturalized inflows = adding water use back into streamflow dataset
- Incremental inflows = Differences in flow from upstream to downstream
  - E.g. Streamflow at Hinton = WSC gauge record at Hinton – WSC gauge record at Jasper
  - Time lags have also been calculated to determine the lag from upstream to downstream