Draft Meeting Summary

Athabasca River Basin (ARB) Initiative

ALBERTA waterSMART
Water Management Solutions

Working Group meeting #8

Date March 14, 2018

Time 9:00 a.m. to 4:00 p.m.

Location Executive Royal Hotel, West Edmonton

Attendees

Andrew Wilson, Alberta Environment & Parks (AEP)
Brian Yee, AEP
Dallas Johnson, Alberta Innovates
Dan Moore, Alberta Newsprint Company
German Rojas, AEP
Gillian Donald, McMurray Métis (MNA Local 1931)
Jessica Watson, West Central Forest Association
Jim Sellers, Athabasca University
JoAnne Volk, Repsol Oil and Gas Canada Ltd.
Kelly Scott, ATCO
Lauren Makowecki, AEP
Michael Seneka, AEP
Murray Tenove, Alberta Agriculture and Forestry
Pat Marriott, Alberta Energy Regulator
Prit Kotecha, Suncor
Riley Beauchamp, West Fraser – Hinton
Soumendra Bhanja, Athabasca University
Waylon Heavy Runner, Land Use Secretariat
Xinzhong Du, Athabasca University
Yapo Alle-Ando, Teck Resources
Zahidul Islam, AEP
Claire Jackson, Alberta WaterSMART
Denise Di Santo, Alberta WaterSMART
Meghan Van Ham, Alberta WaterSMART
Mike Nemeth, Alberta WaterSMART
Ryan MacDonald, Alberta WaterSMART
Kim Sanderson, Alberta WaterSMART

Meeting objectives

- Review and refine updated strategies and the Roadmap
- Review recommendations and actionable steps
- Confirm next steps and final communication and documentation plans

Action items

Action		Responsible	Due	Status
1	Check the on-stream storage results to see if supplementing lower flows appears in the results and if not, explain.	Project team	March 23	
2	Follow up with the AFPA to get more information about current forestry BMPs and update the forestry strategy.	Project team	May 2018	
3	Follow up with Ducks Unlimited Canada to get more details on their wetland BMPs project.	Project team	March 23	Done
4	Review the detailed flip chart notes for specific suggestions and consider how best to address address IFN verbiage, inclusion of aspects out of scope (quality, biodiversity), and review challenges for accuracy in the report.	Project team	April 20	

Action		Responsible	Due	Status
5	Follow up with the AWC regarding possible joint outreach as the WPACs meet with their own members or host other events.	Mike	April 27	

Mike Nemeth convened the meeting of the ARB Working Group (WG) at 9:11 a.m. Those present introduced themselves.

Discussion points

1 Opening remarks

Mike reviewed the agenda and objectives for the day. He encouraged participants to speak freely, noting that nothing will be attributed in the meeting record. He reminded the group of the scope and the collaborative nature of the project, and briefly reviewed the process and timelines. The goal of this work is a Roadmap with strategies and actionable steps developed by the group, and a recommended path forward to support sustainable water management in the ARB. He presented the list of the 12 current strategies that will be further discussed and refined at today's meeting. Additional feedback can be accepted until April 6th.

2 Plenary Session 1: The basin today, learnings and basin challenges

Megan Van Ham presented content that has been developed to date on the basin as a whole; this will be part of the final report and seen as the basin story, or the basin as it is today. Part one will look at the size and diversity of the basin, the range of challenges, and key learnings from this project. She asked participants to suggest any additional information that should be included. Her presentation first described the "fact-based" content on geography, hydrology, land uses, and water management legislation, policy and practices. She then briefly reviewed the eight challenges that emerged during the WG discussion.

Comments

- Communications continue on the Wetland Policy and this should be added to the list as policy content.
- Use the term "Indigenous" rights rather than "treaty" rights, as reflected in Section 35 of the Constitution.

Megan presented information on each of the eight learnings that came out of this work. The intent is to provide a good base of information and increase information sharing. For each learning a commonly held perception was noted, along with information that could be used to support or refute the perception. WG members were asked to comment on each one and the project team responded.

1. Where does water in the ARB come from?

Perception: The water in the Athabasca River and its tributaries comes from multiple sources, mainly glaciers, melting snow and rainfall.

- This perception is supported by information arising from this project.

2. Where does the water in the ARB go?

Perception: Industry withdraws and consumes a large portion of the water in the Athabasca River and its tributaries every year.

- Project work indicates that industrial use is about 4% of the average annual flow.

Comments:

- The terms "withdrawal" and "consumption" suggest that water is leaving the basin, whereas for most of these uses, there is a high return flow, so consumption is actually less than 4%.
- While return flow is a big part of some licences, water for the largest industrial uses (including oil sands mining) is not returned. Allocation is not the same as withdrawal and actual use. There are also challenges accounting for things like evaporation.
- Agriculture and irrigation are very small users, but represent a more consumptive use.
- Some licences are less of a diversion and more a hold-up of water (e.g., Ducks Unlimited), which can amount to some evaporative losses.
- A single graph showing curves for a full year could be shown, but the problem with this approach is scale; use is a very small line on the graph.

Response:

- We can more clearly define terms to indicate what is withdrawn, what is used and what is returned.

3. What will climate change likely mean for water supply in the ARB?

Perception: Climate change will mean typically less precipitation (snow and rain) each year and warmer temperatures causing earlier melting of glaciers and snow. All of this means less water supply in most years.

- Project work generally shows a different perception in terms of volume; not much change in the long run, with increased annual flow for the short term (up to 40 years) before flows start to decrease. The timing of flow is expected to change with higher flow in the spring and winter, with less flow in the summer.

Comments:

- It's not so much that there will be less supply but rather the timing of the melt changes so there is less water in the summer. The total annual volume of precipitation would not change.
- Snow and rain should be shown separately.
- Text that focuses specifically on the headwaters should be added.
- A summary of the analysis for each learning would be helpful to readers and make clear what emerged from this work.

Response:

- Snow and rain can be shown separately and we can look at text on headwaters. A new box that summarizes findings can be prepared.

4. How might rapidly melting glaciers impact long term water supply in the ARB?

Perception: Glaciers worldwide are melting faster now than historically due to warmer air temperatures from climate change. We expect the glaciers in the Athabasca River Basin are similarly retreating therefore we expect that we will run out of glacier water supply at some point soon.

- Glacier contribution to stream flows is important. Future climate change is likely to lead to increased melting so glaciers are expected to contribute less flow over the next 100 years.

Comments:

- The explanation speaks to glacier volume but not necessarily to change in flows. The glacier supply will not run out in the next 100 years but the volume remaining in glacier storage will be less over time.
- For this and the previous learning, we need to tell the story together so the implications – the "so what" – is clearly explained. There may be times in the year when we have less than expected flows, and we need to plan for that now.

Response:

- We are saying we will see higher melt in 50 years, which will then start to drop off; over 100 years we may be where we are today in terms of flow but with much less water stored in glaciers. We can describe this more clearly.

5. How might changes in land use affect water supply in the ARB?

Perception: Changes in how land is used and what covers the land can significantly change the amount of water that flows in the rivers in the Athabasca River Basin

- Here, we wanted to recognize dynamics that are well documented. Graphs show a baseline and what happens if there is a major change in land cover (e.g., fire). The impacts are most easily seen at the local level; at the scale of the mainstem and the basin, the same changes are not apparent.

Comments:

- The last two paragraphs on this slide may be correct but they are not very helpful as they don't fully explain what the issue is. We should more fully describe the impacts on smaller local areas, then we can present the overall conclusion.
- This text largely describes urbanization type effects, which are local. Another part of the story is that sometimes there is a tendency to blame any extreme event on human activity, and this is not accurate.
- Maybe we need to flip this to say land uses do have an impact on a smaller scale. A lot of the strategies won't affect the mainstem or the basin as a whole, but may affect the tributaries and more local regions. We don't want to lose sight of local issues.
- This is why the Province is doing sub-regional planning – to understand changes on a smaller scale.

Response:

- We don't want to say that what you do on the land doesn't matter when you look at the whole basin, but that could be the conclusion readers reach. We can focus this discussion to consider the importance of local land use decision and their impacts, and be more direct in the conclusions.

6. Does converting land into farmland or increasing irrigation have greater potential effect on surface water quality or quantity?

Perception: Developing new farmland will cause water quality problems due to sediment and nutrient runoff. Increasing irrigation will create higher water demand leading to water quantity problems.

- If more land is developed for agriculture or is irrigated, the model suggests there will not be a substantial effect on surface water quantity at the scale assessed, but potential water quality impacts should be minimized (i.e., no new net impact to the existing issues around sediment and nutrient runoff should be expected in new farmland were developed or irrigated in the ARB).

Comments:

- We should make clear that this was the opinion of the group, since we did not model water quality and thus have no hard data.

Response:

- We will be clear in the text that the report reflects model results as well as expert opinion of the working group.

7. Will using alternatives to fresh water in SAGD facilities make a noticeable difference in flow in the Athabasca River?

Perception: SAGD facilities currently use a lot of fresh water in their operations and asking industry to change to alternative processes or non-fresh water sources will result in less water being diverted from the Athabasca River or its tributaries.

- Very few freshwater licences are held by SAGD facilities. The modelling simulation showed no detectable difference in flow in the mainstem by using alternatives to freshwater in currently licensed SAGD facilities.

Comments:

- Does SAGD also include all in-situ facilities or just SAGD? It might be better to use the term "in-situ" rather than SAGD.
- Most facilities that use freshwater are using groundwater rather than surface water.

Response:

- We will confirm what is included in SAGD and change to in-situ if appropriate. This work only looks at surface water so that will be made clear.

8. Can shutting off water licence withdrawals improve navigation on the Athabasca River?

Perception: Industrial water withdrawals are high. If they are shut off, higher flows would substantially help navigation in the lower basin.

- The SWQMF supports minimum flow targets. Project results show that flow could be increased by shutting off withdrawals during open water season, but not by much. Four alternatives to minimum flow targets were explored, as the slide shows.

Comments:

- The four alternatives are really potential strategies. In the strategy section, there are other alternatives to increase flow, including off-stream storage. I think these alternatives, which present a limited view, should appear in the section on strategies.
- What do these learnings and perception slides tell us overall? Could this information be summarized into one slide?

Response:

- We will look at the best way to tell the story so it is internally consistent and coherent. Most of this work has focused on the strategies we might put in place. Some of the learnings are part of that and some are supplementary. How we position this section is key so people don't just say "Oh we only learned these eight things."

Overall Basin Story

The basin story will provide context for the project findings. Then the report will look at the strategies and the recommendations. Megan asked the group if any additional basin facts are needed, if the challenges are clearly explained, and if other learnings should be highlighted in this section.

Comments:

- It would be hard to summarize perceptions on one slide. Perceptions reflect the concerns of people in the basin about the sustainability of the river, and some of this material came across as defensive. Maybe it would be better to present as "concerns" rather than "perceptions."
- Work was done to evaluate the concerns, including the development of performance measures. The concerns and PMs produced to address them should appear early in the report. The perceptions or "myths" should appear much later or as an appendix.
- There is nothing about groundwater, which we all know is linked to surface water.

Response:

- We can bring in the discussion of PMs earlier and can also clarify what is meant by perceptions if that word continues to be used. A perception is how a person sees something, and that is based on their past, their experience, and their beliefs. Perspectives aren't wrong, they are just different. We all agree surface and groundwater are linked, but the scope for this project was surface water. We've had some discussions about groundwater but were not able to address it directly.

3 Breakout Groups: Refinement of updated strategies

Mike provided context for the breakout group work by describing the current strategies and where and how they might be applied in the basin. The group was asked to consider if showing the strategies graphically in this way is worthwhile. The breakout groups went through the summary slides and worked to refine the updated strategies. Participants were asked to consider:

- Is the strategy well described?
- Are all perspectives reflected?
- Is the information complete?
- Is the information communicated effectively?

The intent today was not to change the strategies rather to finalize and clearly communicate them. The strategies will inform the recommendations and actionable steps.

When the breakout activity was completed, facilitators provided a short summary of their group's discussion and a few key points for each of the strategies considered at each table.

For additional details on discussions captured on the flip charts in each breakout group, please see more detailed notes appended to the end of this meeting summary.

Table 1 (facilitator: Claire)

Strategy 1: Effluent reuse

- Interim guidance for some sectors already exists: "The Interim Guidance to Authorise Reuse of Municipal and Industrial Wastewater" (December 2015), and there are many examples of work underway in different sectors. One driver is the Draft Water Conservation Policy for Upstream Oil and Gas Operations (October 2016), which encourages upstream oil and gas operators to explore alternate water sources before using high quality non-saline water for operations.
- One trade-off related to this strategy is that benefits depend on time and location (e.g., where the water comes from and where it is returned to). Many large users take from the mainstem while TDLs tend to come from tributaries.
- Challenges are costly infrastructure, risk of a company that reuses water relying on another company for its supply, and developing a policy for the entire province when conditions are so different in southern and northern basins.
- A potential action is to create incentives for water reuse (e.g., opportunity for a company to report through a sustainability index).

Strategy 2: Water conservation

- Language in this strategy should align with that in Water for Life, which talks about reducing water use intensity rather than an absolute decrease. However, if a 10% decrease is not achieved, the benefits seen in the modelling will not occur.
- One challenge is that the technology costs to achieve further conservation could be very high, and even if new technologies are available they are not always economically feasible to use.
- Data gaps for the seven major water using sectors make it hard to measure increased conservation and to encourage more conservation.

Strategy 6: Environmental flows

- It would be beneficial to look at this strategy in conjunction with other strategies, such as storage and improving IFNs.
- The Modified Desktop Method being developed will make it mandatory to consider environmental flows when new licences are allocated.
- If IFNs were made more senior than existing licenses there would likely be pushback from senior licence holders. Water supply certainty would be another challenge, senior licence holders may be worried that their licence would be cut off.

Strategy 7: Navigational flows

- The documentation for this strategy should make it clear that navigational flows are not met naturally.
- It would be helpful to look at this strategy in conjunction with others, such as off-stream storage.
- A big gap is the lack of understanding of the navigational challenges faced by communities and where they are experiencing pinch points. Data are already being collected on navigational pinch points through an Indigenous navigation app.

Table 2 (facilitator: Megan)

Strategy 3: On-stream storage

- Having on-stream storage would create more flexibility to deal with changing flows due to climate change.

- The operating objectives for an on-stream project should include both basin objectives and hydropower generation objectives; the balance of these two is key in supporting water management while still having an economically viable project.
- The trade-offs should note that introducing on-stream storage could have the unintended consequence of de-incentivizing industrial, municipal and agricultural improvements in water efficiency practices. That said, having both the certainty from on-stream storage and improvements in water efficiency together might make Alberta industries that much more competitive.

Action 1: The project team will check the on-stream storage results to see if supplementing lower flows appears in the results and if not, explain.

Strategy 4: Off-stream storage

- A lot of off-stream storage is already available in the oil sands area, so we should consider what opportunities these sites provide for supplementing low flows in tributaries, as long as water quality standards are met.
- A challenge is how to build and operate off-stream storage sites to minimize impacts to natural flows.

Strategy 5: Existing infrastructure

- There was insufficient time to discuss this strategy.

Strategy 12: Oil sands mining reclamation (agreed to change this title to Extraction reclamation)

- Reclamation should be a key focus for, and should be guided through, sub-regional plans; it is a local scale issue that needs to consider the land disturbances and reclamation at that scale.
- This strategy is closely related to the land-based strategies (wetlands, forestry, conservation, connectivity) and that link should be explicitly stated. The modelling from those strategies can provide the logic to support this strategy even though it was not directly modelled.

Table 3 (facilitator: Mike)

Strategy 8: Land conservation

- Map of CPAWS20 and CPAWS50 areas should be added to the final report.
- What lands are being conserved under the scenarios being simulated? Agricultural land may be physically restored and conserved, but this is not socially or economically feasible.
- This is not an effective surface water management strategy when looking strictly at streamflow.
- A key challenge is managing fire in conserved areas.

Strategy 9: Forestry

- Need to talk about the smaller watersheds first and highlight their importance.
- This seems more like a watershed health and sustainability strategy than a surface water management strategy, especially when looking at benefits on the local scale.
- Although forestry has an impact on streamflow, BMPs have been implemented in the sector. The current text makes it sound as if that is not happening.
- Additional clarity is needed in the strategy text about what the model says, the trade-offs and how the information should be interpreted.

Action 2: The project team will follow up with the AFPA to get more information about current forestry BMPs and update the forestry strategy.

Strategy 10: Wetlands

- Increase in peak flows should also reflect a decrease in base flows as a trade-off (i.e., water on the landscape).
- There is a suite of benefits to retaining wetlands, but not many related to flow.
- Explanation of modelling results needs to be clarified.

Action 3: The project team will follow up with Ducks Unlimited Canada to get more details on their wetland BMPs project.

Strategy 11: Linear connectivity

- Is this strategy economically viable? This is important at smaller scales.
- This is a useful strategy for watershed health, but it does not appear to directly benefit water supply in rivers.
- Flow interruption and habitat fragmentation were not modelled or understood fully for this strategy, so it likely understates the value of the strategy in terms of water quality and quantity.

Additional comments and suggestions from this table:

- Need to state the IFN assumptions for the IFN PM (regulatory vs. a PM to measure a flow target). State that the Desktop Method is being used and that the IFNs are not regulatory in nature – where it came from, where it is, etc. Add in verbiage around aiming for flows to be close to natural conditions. Follow up with Andy Paul regarding the best way to look at this PM when land use results in more water in the stream, even though it is deviating from the natural condition.
- Inclusion or not of water quality, biodiversity – seems many times the strategies talk more about the aspects that are out of scope than what was modelled. Need to frame the strategies to make sure they are strategies and frame discussion as the strategies relate to surface water management and modelling results.
- Challenges for all the strategies need to be reviewed and not mixed up with trade-offs.

Action 4: The project team will review the detailed flip chart notes for specific suggestions and consider how best to address IFN verbiage, inclusion of aspects out of scope (quality, biodiversity), and review challenges for accuracy in the report.

4 Plenary Session 2: Discussion of recommendations for sustainable water management and actionable steps

Claire Jackson noted that the project team inventoried the strategies, reviewed the original challenges and actions listed under the strategies, and identified common themes. Using that analysis, they then developed six draft recommendations. Each recommendation has associated proposed actions, corresponding strategies and challenges. Claire presented this work and asked the group for feedback.

1. **Conserve or better manage what is happening on the landscape** to reduce negative impacts on river flow and water quality.

Comments:

- I support the recommendation but we need to make sure the thinking for the recommendations flows from the modelling and analysis. We should distinguish between what the model shows and WG comments.
- There might be a disconnect between the model results and what we know in the way the numbers been applied. Moving to a more natural state should not result in an IFN "violation."
- Would "improve management" be better language than "better manage"?
- Under actions, maybe we should look at connecting the two land use processes (UARP and LARP) and inform those conservation plans rather than having a new basin plan.
- Wetlands are a key component to water storage. Can we make a direct connection from wetlands conservation to water management at key times of the year? Connecting conservation of wetlands and seasonal flows is maybe not fully realized from the model results.
- I don't see a connection between things like erosion and water quality. Need to be more specific with respect to water quality, sediment, and nutrient transport.

Response:

- Part of the challenge is how to talk about land practices in a way that is relevant and useful in a discussion of water management. The connection between wetlands conservation and water management is real, but whether the science is fully articulated is a challenge. We have identified this as a key gap, so maybe that connection can simply be made in words.

2. Establish minimum flows for watershed health to address specific environmental needs and provide certainty to industry and the public as to the amount and nature of remaining water available for use.

Comments:

- We should move away from the words "minimum flows." The idea is to mimic the natural hydrograph; e.g., percentage of flow
- In the action, an approved water management plan is a very specific, onerous process that requires Cabinet approval. This may not be what we want. Originally an approved water management plan was specifically described in the *Water Act*. Cabinet-approved plans are needed to authorize water transfers, but this is not so much an issue in the ARB. The ALSA now allows for other options that may be more appropriate here and would enable better integration with other elements. Regional plans under ALSA are simpler. Decision makers still have to consider regional plans as well as official water management plans.
- Most regional plans and their frameworks are at a level of setting triggers to enable a closer look if trends are on the wrong trajectory, as opposed to having operational limits.
- The action is more than just looking at the Desktop Method. A number of things have to be balanced, so it's not as simple as the action sounds.
- We need some flexibility to deal with situations that weren't anticipated when existing rules were developed years ago. The Desktop Method is already a consideration
- If flow data are available, they can be run through the Desktop Method and numbers can be calculated. The issue is more related to how acceptable the numbers are to people. The Desktop Method is regarded as quite conservative and protective.
- Focus this recommendation on putting these flows in place and communicating them.

Response:

- We can shift the focus away from formal mechanisms to finding ways to implement and communicate about environmental flows.

3. Establish multi-purpose objectives for new on- or off-stream projects to understand and inform how future storage could support basin flow needs.

Comments:

- If an energy company puts in an off-stream storage pond to use for fracking, would it have to go through more review? The intent would be not to support basin flow but take water in during the spring freshet rather than later. If a review is needed, who would do it?
- The action should also include off-stream storage.
- This is a major challenge. There are many possible configurations and it's hard to come up with all of them in advance. We could list some things to consider when creating a proposal, but it's impossible to have something proponents have to design to. The Hatch report (2010) might provide a starting point to identify potential sites. If someone were to develop at those sites, there could be a broad list of considerations or some specific objectives for the site.

Response:

- Do we need to specify a certain size of storage? Where do we draw the line so not every single project has to go through a review? It might be more function rather than size. Identified sites (Hatch report) could be used as a guide for sites and considerations downstream from them. This recommendation will be revised.

4. Increase communication to the active water community and education to the general public to support sustainable water management.

Comments:

- This will become repetitive and quickly lose meaning. Change wording in action 1 from "when" to "how." This might be more practical.
  - Do people find out when new IFNs are implemented on a licence? The intent was to raise awareness so that if an IFN is implemented, everyone can find out about it.
- I think we are moving in that direction already.

Response:

- Revise with details and information on methodology to be provided at a reasonable level.

5. Address most critical gaps in data, processes, policy, and knowledge related to sustainable water management. (Claire also highlighted gaps the project team viewed as most critical.)

Comments:

- In the policy gaps, change the language regarding water management plans as previously discussed.
- Communication of IFNs should be noted as a gap.
- What is meant by "hydrologically sensitive" areas?
  - These are areas that are significant in terms of generating water.
- We should have sustainability measures related to maintaining heritage and other high use sites that are important to Aboriginal communities. This information should be part of this process and

has not been so far. Communications is part of it, but it goes beyond that for Aboriginal people as per constitutional rights (Section 35).

- Different audiences would rank gaps differently; e.g., measuring winter flows is a big challenge for regulators and represents a large gap.
- A water reuse policy is a priority within AEP, but reaching consensus is not easy. It means having to deal with regulatory systems that did not contemplate such direction so new instruments must be created. Also, the water supply differs from south to north in Alberta, so developing a broader provincial policy in this area becomes a real challenge.
- As discussed earlier, regional planning is more appropriate and achievable than a water management plan for the basin.

Response:

- We have an opportunity to identify where gaps exist in processes and policies and a chance to say what areas need more effort, resources, etc. to close some of these gaps. Even if we don't prioritize gaps, we still want to reflect support for the people who are working to fill them. The circles will be removed from the gaps slide and we can state what the group noted as critical gaps, rather than putting them as priorities. The language will be revised, including a clearer definition of hydrologically sensitive areas.

6. Continue to develop the means to **share, capture and apply traditional knowledge** to sustainable water management.

Comments:

- In the action, change TEK to "traditional knowledge." Indigenous communities should be consulted when applying TK. Also, rather than refer to treaty rights, the language should say "Indigenous rights as reflected in Section 35 of the Constitution."

Summary Comments

- Where do we address other big challenges such as meeting AFX or seasonal variations? Earlier we talked about options to meet AFX, so those could potentially be turned into a recommendation.

Response:

- The project team looked at specific challenges and common themes then moved them around to try and deal with as many as possible. Another path might be to go back and see which of the current recommendations will help manage that seasonal fluctuation. We are missing a recommendation on how to increase adaptive capacity of the ARB to deal with climate change. Are there other areas in addition to AFX and adaptive capacity to manage seasonal and annual variations? We want to make sure the key points are captured so if people think of other potential recommendations, they should advise the project team. The project team will rework the recommendations and send back to the group for comment.

5	Plenary Session 3: Discussion on finishing the roadmap and what happens next

Megan described plans for finishing the project and how the WG can continue to be involved. The goal is to have a report that is 90% done by end of May. It is proposed that Alberta WaterSMART be noted as the author of the report, but all organizations that have participated would be listed and acknowledged for their input and contributed expertise. The WG agreed with this approach. Each organization will be given an opportunity to indicate if they want to be shown as a project participant.

The draft report will be sent to everyone for their comments and will be posted on the WaterPortal in June. The team will take feedback and continue to refine through the summer and will be making presentations to various groups. The final report and presentation are expected to be in the public domain by September. The team also wants to determine the best way to make the data and results more widely available, noting that the intent is not to replace other data tools.

Discussion:

- Could WaterSMART host the data and model online?
  - We could set up a list of data sets used but data will be time stamped and not kept current.
- There is some concern about results that show clear cuts and draining wetlands are good things for water management. Some context should be provided before results are shared.
  - Agreed. When we talk about process and concerns that have come out in terms of analysis vs. method, we will make sure the process is clearly described. There will be a mix of results from the model and commentary from the WG, so we need to make sure the text is clear.
- In communicating about this work, the short "elevator speech" will be a key marking strategy. We need to have a few (three?) simple key messages that can be shared succinctly and clearly. And maybe we should not use the terms "strategies" or "recommendations" but rather "concepts" to help people see that perhaps several paths forward could be beneficial.
  - We haven't yet been able to take the 12 strategies down to a specific three, for example, that should be implemented first. The WG hasn't come to that point so it might be hard to be that definitive.

Megan closed by reiterating that, in addition to a document with the basin story, strategies, and recommendations, we have also created a good common understanding with a solid model, a scientific fact base, and a successful collaborative forum. The investment of time and money has been substantial, but what happens after the report is published? How does the WG envision continuing this kind of work?

Discussion:

- A lot of work has been done on riparian areas and linear connectivity. It would be good to link this project with WPAC work.
- Will we have a modelling program that people can experiment with? There are education opportunities and a video could be done to show how to use the model to enable uptake by writers and the media. This is a very specific tool, not just a report, which makes it very valuable.
  - The intent is to create a tool for people to use and further explore water issues in the basin.
- Will there be more formal presentations to the AEP executive, WPACs and other key stakeholders?
  - For the work in southern Alberta, there was a presentation to AEP and to many individual stakeholder groups. For this project, we have communicated findings to some senior managers and plan to reach out to those at the ADM level. The project team will work to set this up.

- It would be good to engage with those involved in the response to the World Heritage Committee regarding the heritage status of Wood Buffalo National Park. Multiple jurisdictions in Canada are involved. A presentation to the Mackenzie River Basin Board might also be useful.
- In the south, there was a strong sense of urgency to deal with water management issues. Have we identified a similar sense of urgency in this basin over the last two years?
  - It's not necessarily a sense of urgency. Rather we want to be able to understand where we are and where we don't want to go and be proactive about what we do and don't want to see happen.
- Perceptions exist in other parts of Canada that oil sands use a lot of water. This work could help others better understand the ARB. Also, the PAD has been ignored for decades, but is now and this could affect the reputation of Alberta and others. Now is a good time to contribute to solving these problems. A lot of work is underway that wasn't in place ten years ago.
- We need to make sure we know who the stakeholders are (e.g., people who need to know what's changing with IFNs). Some communities are not represented. Who is accountable and who might look at this problem on their own after our work is done?
- If we want developers to consider the things we've been talking about, we need to communicate it to them now so they don't have any excuses. Communication channels could include the land use framework process, WPACs, and regulators. We should develop a checklist of key audiences before we begin to roll this work out further.

6 Next Steps and Close

Mike reiterated the process to wrap up the project, noting immediate next steps. As usual, the meeting summary will be circulated shortly and materials are on the ARB website. The project team will contact participants regarding the willingness of their organization to be shown as a project participant. It was suggested that WPACs be approached, particularly the Athabasca Watershed Council, about doing joint outreach as the WPACs meet with their own members or host other events.

Action: Mike Nemeth to follow up with the AWC regarding possible joint outreach as the WPACs meet with their own members or host other events.

Mike acknowledged the funders of this project and thanked all participants for their ongoing involvement and commitment to the work. One participant commended the project team for their management of this initiative, ensuring good use of time and showing results between meetings.

The meeting adjourned at 3:30 p.m.

Additonal flip chart notes from breakout tables

Table 1: Claire's Breakout Group Flip Chart Notes

General:
- A participant noted that it would be helpful to distinguish between the conclusions drawn from the modelling and the conclusions drawn from the group feedback and thinking.
- Is there an opportunity to consider the cumulative benefits of strategies by modelling strategies together?

Strategy 1: Effluent Reuse
- This strategy discusses reuse as a consideration, as opposed to recycling; a participant noted that recycling is often defined as reusing water for a single use by one user whereas reuse is defined as a second water user reusing discharged water from another user.

What has already happened with this strategy:
- The Oil Sands Leadership Initiative (OSLI), the precursor to COSIA, completed an economic analysis of the possibility of water reuse within the oil sands. The analysis found that due to the long distances between the oil sands sites water reuse in the oil sands would be uneconomic.
- There is interim guidance issued for reuse "The Interim Guidance to Authorise Reuse of Municipal and Industrial Wastewater" (December 2015).
- A driver that is being put in place to encourage water reuse is the Draft Water Conservation Policy for Upstream Oil and Gas Operations (October 2016); which encourages upstream oil and gas operators to explore alternate water sources before using high quality non saline water for operations.

Actions:
- Create incentives for water reuse, an incentive for a company may be reporting through a sustainability index.

Trade-off:
- The benefits seen in this strategy are dependent on time and location. For example, if water that was originally pulled from the main steam Athabasca was reused instead of fresh water from a tributary there would be benefits to the tributary, however if water that was originally pulled from the main steam of the Athabasca was reused instead of pulling fresh water from that Athabasca then there would be no change to net change to surface water quantity.

Challenges:
- Infrastructure cost could present a challenge.
- For companies that are reusing water there is a risk in relying on another company for water supply.
- It is challenging to develop a province-wide water reuse policy; the conditions in the ARB are much more flexible than they are in the southern Alberta, therefore the same water reuse policy may not be applicable in the ARB and the SSRB.

Benefits:

- Water reuse may create an economic incentive for effluent suppliers as it may save on water treatment.

Strategy 2: Water Conservation

- A 10% flat decrease in water use does not allow for growth; the Water for Life Strategy discusses a decrease in water use intensity as opposed to a flat decrease, the language in this strategy should be updated to reflect this.
    - Note that if a 10% decrease is not achieved, the benefits, as reflected in the model, will not be realised.
- Increasing water rates is not possible under current legislation and policy

Challenges:

- The cost of new technologies to achieve further water conservation could be very high; furthermore, if new technologies are available they are not always economically feasible to use.
- Regarding the CEP plans, gaps in the data surrounding water use and water use changes for the seven major water users in the province make it hard to measure increased conservation and hard to encourage greater conservation.

Strategy 6: Environmental Flows

- It would be beneficial to be able to look at this strategy along with other strategies, such as storage.

What's already happening with this strategy:

- The modified desktop method that is currently being developed will make it mandatory to consider environmental flows when allocating new licences.

Challenges:

- If this strategy were to look at implementing environmental flows as licences more senior to current allocations there would be push back from licence holders.
- Water supply certainty

Strategy 7: Navigational Flows

- In the write up for this strategy it would be helpful to state upfront that naturally these flows aren't met.
- It would be beneficial to be able to look at this strategy along with other strategies, such as off stream storage.

Action:

- Develop a better understanding of navigation challenges experienced by communities, this would allow for a better understanding of how to approach this strategy; where are communities experiencing pinch points?

What's already happening with this strategy:

- Data are being collected through communities regarding the navigational pinch points through an indigenous navigation app that allows communities to report on pinch points.

Table 2: Megan's Breakout Group Flip Chart Notes

On-stream storage – suggestions

- Change in river sedimentation pattern is listed as a trade-off from having an on-stream structure. However, the structure may also present a potential means to help manage increased sedimentation that is happening anyway because of climate change and land uses. Sedimentation can be a significant dam decommissioning challenge.
- The slide/report should state the climate change adaptation benefit that comes from having operated on-stream storage that can help manage through shifts in hydrology that will likely result in longer, drier summers. Storage and flow augmentation can help manage supply for licensed demands and environmental needs.
- ACTION: Need to check the on-stream storage results to check if supplementation of lower flows is seen in the results and explain if not, why not (will depend ion the operating rules).
- The purpose (operating objectives) for an on-stream project should include both basin objectives and hydropower generation objectives; the balance of these two is key in supporting water management while still having an economically viable project.
- Update the slide to show that the two recent hydro project applications have been withdrawn.
- It should be noted in the trade-offs that introducing on-stream storage could have the unintended trade-off of de-incentivizing industrial, municipal and agricultural improvements in water efficiency practices. That said, having both the certainty from on-stream storage and improvements in water efficiency, together might make Alberta industries that much more competitive.
- Look at the strategy overall, in terms of management of water quantity (flow), this strategy would offer the greatest benefit.
- A challenge in implementing on-stream storage is establishing a shared vision of what the structure would do; objectives can often be conflicting and the facility would need to create a revenue stream to be economically viable.
- On-stream storage should create flexibility for water management.

Off-stream storage – suggestions

- The position of the star suggests that the implementation may be easier than it actually would be; these could likely still be large projects.
- Oil sands tailings ponds (and possibly other industrial water storage) are off-stream storage sites already holding large amount of water. They could be looked at as an opportunity; both the storage facility and the water it holds. As companies design their operations and reclamation plans, these assets could be viewed as opportunities to be leveraged for water management. Some of this language was included in the Treat and release of Oil Sands water strategy – it should be resurrected here. There may be opportunities to supplement low flows in tributaries through these releases, if water quality standards are met.
- Operationally, the off-stream storage should divert water during high flows to minimize the impact on the flow regime of the source river.
- Generally, it is assumed that the impact to the natural flow regime of the source river will be impacted less by off-stream storage than on-stream storage.
- Off-stream storage in some ways makes sense given the typical hydrograph of the basin, i.e. very high flows in spring followed by low late summer flows.

- The appetite for on-stream (and off-stream) projects is heavily influenced by the political leaning of the governing party and the subsequent policy direction. There appears to be far greater willingness to discuss on-stream dams and reservoirs today than there was even 5 years ago.

(Oil sands) mining reclamation

- Reclamation should be a key focus for and should be guided through sub-regional plans; it is a local scale issue that needs to consider the land disturbances and reclamation at the local scale.
- This reclamation piece ties to the land based strategies (Wetlands, Conservation, Connectivity etc.). That link should be explicitly stated. The modelling from those strategies can provide the logic to support this strategy even though it was not directly modelled.
- A key question is: what is the timeline for implementing/realizing the implementation plans? This typically depends on the life of the project and the rate of development (driven by market forces). The earlier the reclamation is done, typically, the greater the assurance that it will actually happen. Waiting until the end of the project risks the company no longer being active therefore not completing the reclamation work and typically costs more as the company carries the liability longer. Progressive reclamation i.e. starting early and staging reclamation investment, is becoming more common; it allows companies to reach natural certification sooner.
- This should not be relevant to the “energy” industry; it should include the “extraction” industry including oil sands, coal, aggregates etc.
- The benefits description should be more specific; it is unclear what “re-naturalizing’ the hydrograph means. In many instance, reclamation does not put the land back to the state before development but instead puts it to a certified natural state. The nature of this state can vary tremendously and would not necessarily result in going back to the pre-development hydrograph.

General comments:
The matrix with stars was a useful tool for discussion but may be less useful now. It draws focus to exactly where on the axis a strategy is positioned. This may not be a productive discussion. If we continue to show the matrix, we must be clear on what was used to determine a strategy’s placement on the matrix.

Table 3: Mike's Breakout Group Flipchart Notes

Strategy 8: Land Conservation

- Map of CPAWS20 and CPAWS50 areas should be added to the final report
- What lands are being conserved under the scenarios being simulated? Agricultural land may be physically restored and conserved, but this is not feasible socially or economically.
- Not effective as a surface water management strategy when strictly looking at streamflow
- Challenge: managing fire in conserved areas

Strategy 9: Forestry Practices

- The wording still reads like forestry BMPs are not being done. Mike to check in with Dan and AFPA for a review of this one. It should still highlight forestry has an impact on streamflow
- Trade-off needs to change – lower harvest levels, need to be compensated by innovation and changes to how fibre is managed in supply chain. Changes require time.
- Is this a surface water management strategy? – more of a watershed health and sustainability strategy, and certainly more at a local scale in terms of the benefits
- Make it simple with clear statements like "disturb more forest to make PMs green" – but this would be the inverse of what the strategy is trying to portray. If this is how it was modelled then state how it was modelled and then the tradeoffs (e.g., trade-off with sedimentation)
- Need to talk about the smaller watersheds first and highlight their importance
- What are you managing forests for -> increase flow? Sediment? What are the promising BMPs? Answering these questions might help frame this strategy.

Strategy 10: Wetlands

- An increase in peak flows should also show a decrease in base flow (another trade-off). These would both be a function of less water being held on the land with wetland loss.
- Inverse modelling of this is still confusing – keep it simple: more flow produced with less wetlands, but there is now less control over rapid runoff response or the volume of runoff
- There is a suite of benefits for retaining wetlands, but not many around flow
- DUC is working on a national boreal forest wetland BMPs project, which should be highlighted and the Project team should contact DUC as they were unable to attend today.

Strategy 11: Linear Connectivity

- Challenges need to be changed as they are benefits in the slides right now
- What is the cost of doing this strategy? Is it economically viable. Doesn't seem like it would be done for managing flow in large rivers like the Athabasca. However, this is important at smaller spatial scales.
- It is difficult to control human activity and habits on the landscape, so linear feature reclamation would need to be done with access management in mind
- A policy framework should be developed for this strategy
- Water supply in rivers is not a primary benefit from this strategy, but the strategy itself is still useful for watershed health
- Flow interruption and habitat fragmentation were not modelled or understood fully for this strategy, so it likely understates the value of strategy (water quality and quantity)

- Need to state the IFN assumptions for the IFN PM (regulatory vs. a PM to measure a flow target). State that the Desktop Method is being used and that the IFNs are not regulatory in nature – where it came from, where it is, etc. Add in verbiage around aiming for flows to be close to natural conditions. Follow up with Andy Paul regarding the best way to look at this PM when land use results in more water in the stream, even though it is deviating from the natural condition.
- Inclusion or not of water quality, biodiversity – seems many times the strategies talk to more about the aspects that are out of scope than what was modelled. Need to frame the strategies to make sure they are strategies and discussion as they relate to surface water management and modelling results.
- Challenges for all the strategies need to be reviewed and not mixed up with tradeoffs.

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Water Management Solutions

Sustainable Water Management in the Athabasca River Basin Initiative

(ARB Initiative)

Working Group meeting #8
March 14, 2018

Welcome
Introductions
House keeping

Today’s discussion

9:00	**Welcome, introductions, and opening remarks**	**Mike**
9:20	Plenary session 1: basin overview • Reminder of the basin today, learnings and basin challenges	Megan
10:05	Break	All
10:45	Breakout groups: refinement of updated strategies • Participants to rotate through 3 tables and all strategies to provide feedback and additional changes to strategies • Document additional comments • Recap of strategy refinements from breakout groups	All
12:35	Lunch	-
1:20	Plenary session 2: discussion of recommendations for sustainable water management and actionable steps	Claire
2:20	Break	All
2:35	Plenary session 3: discussion on finishing the Roadmap and what happens next • Mechanics of finishing the Roadmap and communication plans • How to move the Roadmap forward	Megan
3:35	Next steps, and close • Next steps to finalize the Roadmap document • Communication and project close out plans	Mike

Chatham House Rule

"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."

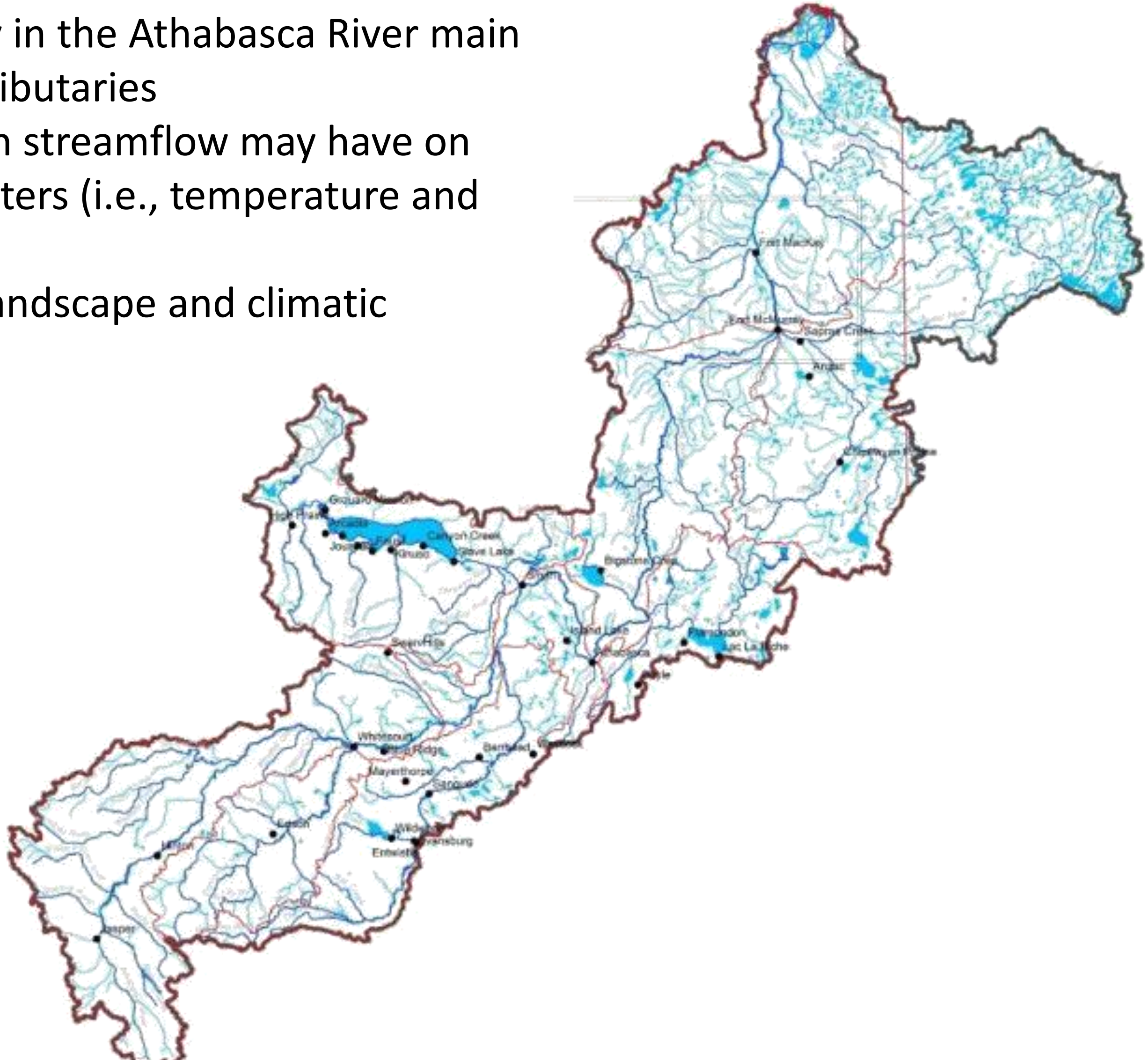
Be bold, be innovative, speak openly……focus on addressing the challenge, not the blame

Keep in mind…

- Slides and meeting summary will be sent out after today's meeting.
- Materials and information presented can be shared publically- all meeting material available on the project website (visit www.albertawatersmart.com or Google "ARB Initiative").
- Please ask questions as we go through the slides and during the working sessions.
- This is the final group meeting.
- Communication plans for the final product will be part of today's discussion.

Scope

- Surface water quantity in the Athabasca River main stem, and the major tributaries
- Implications changes in streamflow may have on certain quality parameters (i.e., temperature and dissolved oxygen)
- Implications of basin landscape and climatic change on streamflow

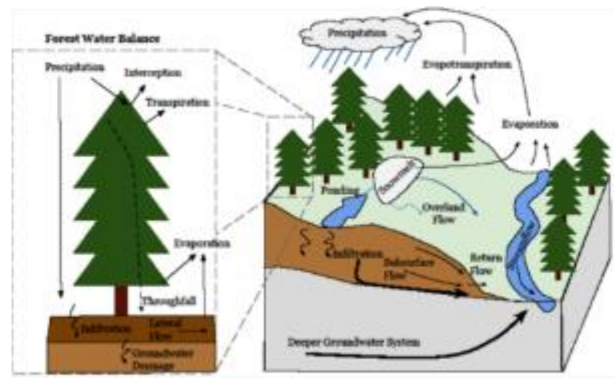


Collaborative water management creates informed discussions that can move toward action

1. Bring together an inclusive basin-wide working group

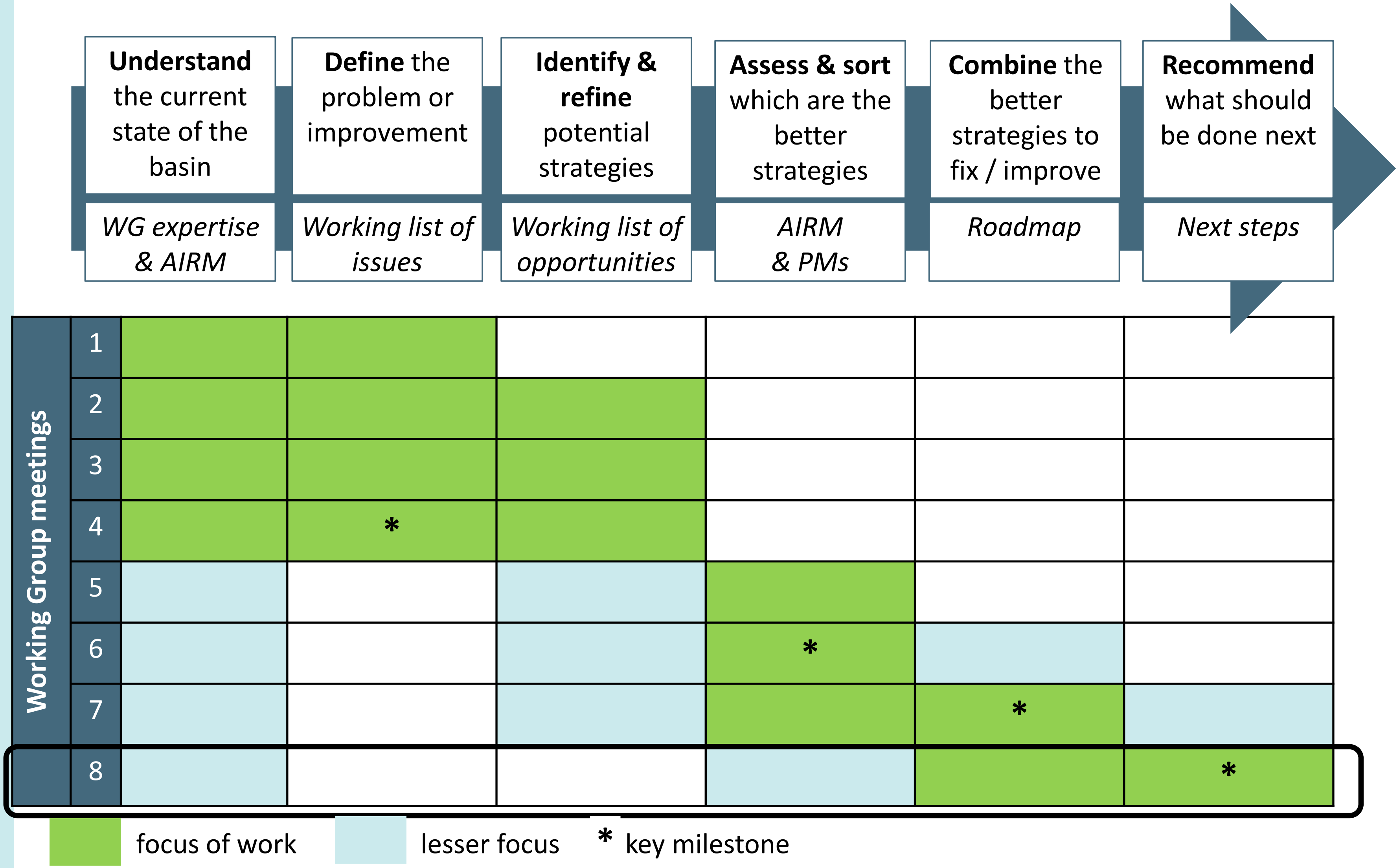
First Nations, Métis Regions, Métis Locals, and Métis Settlements

2. Provide a strong base of data and tools



3. Work collaboratively to identify challenges and opportunities

Collaborative process to develop the ARB Roadmap



Goal for this work is a Roadmap for sustainable water management in the ARB

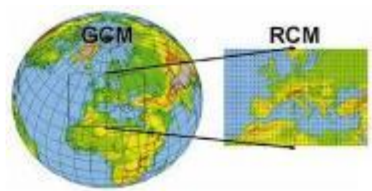
A Roadmap is:

- a set of strategies with practical actions
- developed by an inclusive basin-wide working group using collaborative modelling and dialogue
- a recommended or potential path toward sustainable water management in a basin
- intended to inform future planning and management efforts as they relate to water

- **Screens** and **sorts** strategies; does not prioritize projects
- Identifies **gaps** and **recommends next steps**; does not layout an Implementation Plan
- Reflective of **collaborative findings**; not Consultation or a decision making body
- A **guiding** document; not a basin Plan

Athabasca Integrated River Model (AIRM)

Input: opportunities (e.g., changes in demand/water use, flow targets, infrastructure changes, land use and landscape change, changes in climate, etc.) and expertise.



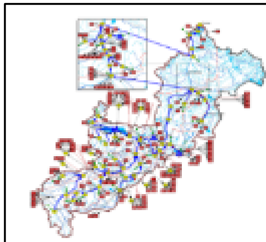
Output: future daily precipitation and air temperature

Raven

ALCES

Outputs: changes in landscape composition from various scenarios

Outputs: changes to streamflow based on changes to climate and landscape, changes in snowpack, soil moisture, etc.



Outputs: Changes to streamflow and PMs that show effects of strategies on the system

Current strategies for sustainable water management in the ARB

1. **Effluent reuse**: Enable reuse of industrial or municipal effluent to reduce reliance on freshwater
2. **Water conservation**: Continue to achieve water conservation and efficiency improvements with regional development
3. **On-stream storage**: Explore new on-stream multi-purpose storage options
4. **Off-stream storage**: Develop new off-stream storage sites to meet multiple basin water management objectives
5. **Existing infrastructure**: Alter existing water storage infrastructure and operations to meet multiple basin water management objectives
6. **Environmental flows**: Establish IFNs for all tributaries in the basin as a precautionary water management measure
7. **Navigational flows**: Implement minimum flows to improve navigation in the lower Athabasca basin
8. **Land conservation**: Increase the quantity and improve the condition of conserved and restored land across the basin
9. **Forestry practices**: Support practices in Forest Management Agreements (FMAs) that minimize hydrologic change
10. **Wetlands**: Avoid further wetland loss and promote more wetland restoration
11. **Linear Connectivity**: Reclaim linear features and reduce future linear disturbances in watersheds
12. **Oil sands mining reclamation**: Continue to set and meet high standards of reclamation of energy footprint to maintain or improve hydrological functions in a watershed

Numbering does not indicate a priority or ranking of the strategies.
Numbering is only there for referencing.

Reminders for today

We want to hear all perspectives on each strategy, not draw a consensus on each.

All comments and opinions will be captured. Diverse and dissenting opinions will be captured and included (without attribution).

There is a lot to get through today, we will have regular breaks, and will need to stay on time allow time for discussion in each plenary and the breakouts.

Feedback also accepted in writing today or via email by April 6th at the latest.

Today's discussion

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Basin story: What is it and why do we need it?

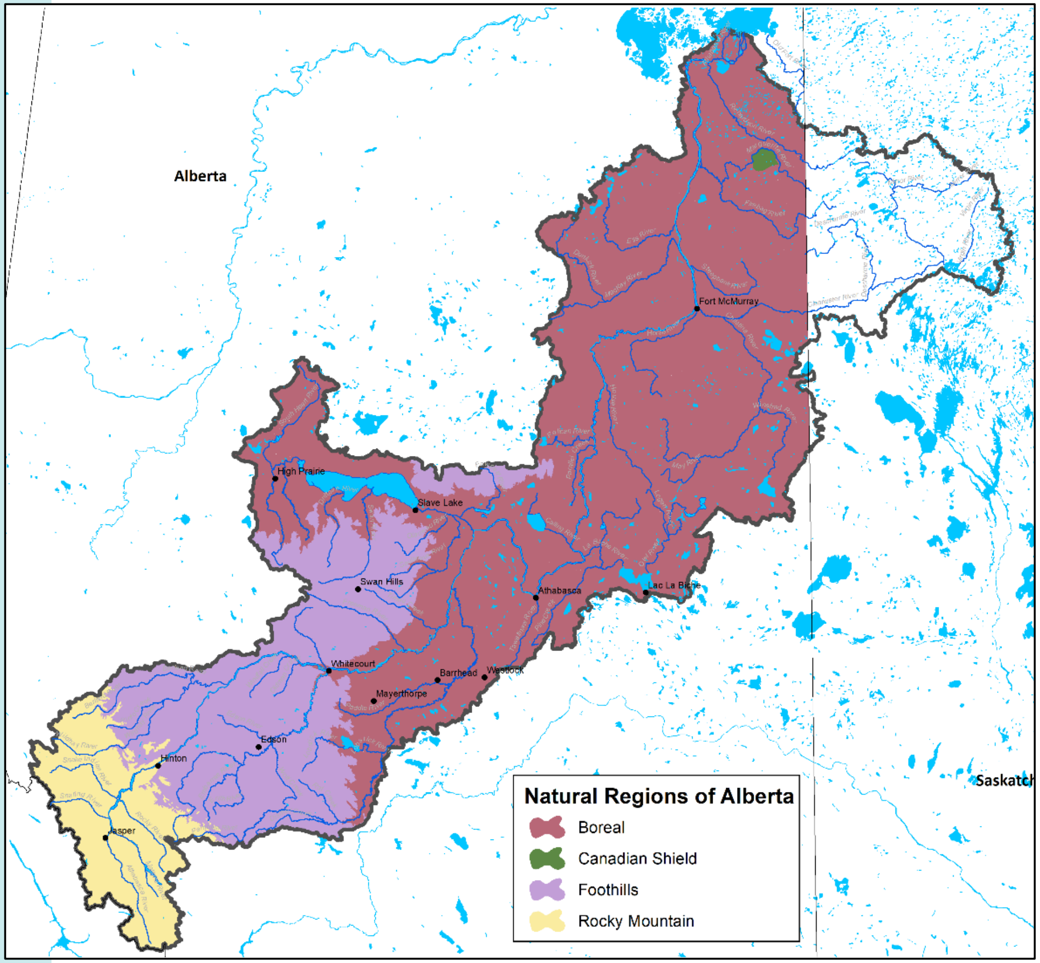
WHAT Common understanding of the basin:

- Reflecting its size and diversity
- Recognizing its range of challenges
- Identifying some key learnings

WHY Provides the basin context for the report's findings

- One of the mandates of this project was to build the shared knowledge of the ARB

Geography: Four natural regions



Drains ~165,000 km^2

Covers ~25% of Alberta

4 natural regions:

- **Rocky Mountain** steep topography, high elevations, large glaciers and high winter snowpack, widespread coniferous forest
- **Foothills** interface between the Rocky Mountains and Boreal, variable topography with undulating terrain
- **Boreal Forest** relatively flat topography, with mosaic of lakes, interspersed uplands, and extensive wetlands
- **Canadian Shield** exposed bedrock and hummocky topography, some bogs and fens

Hydrology: Generally a snowmelt dominated regime

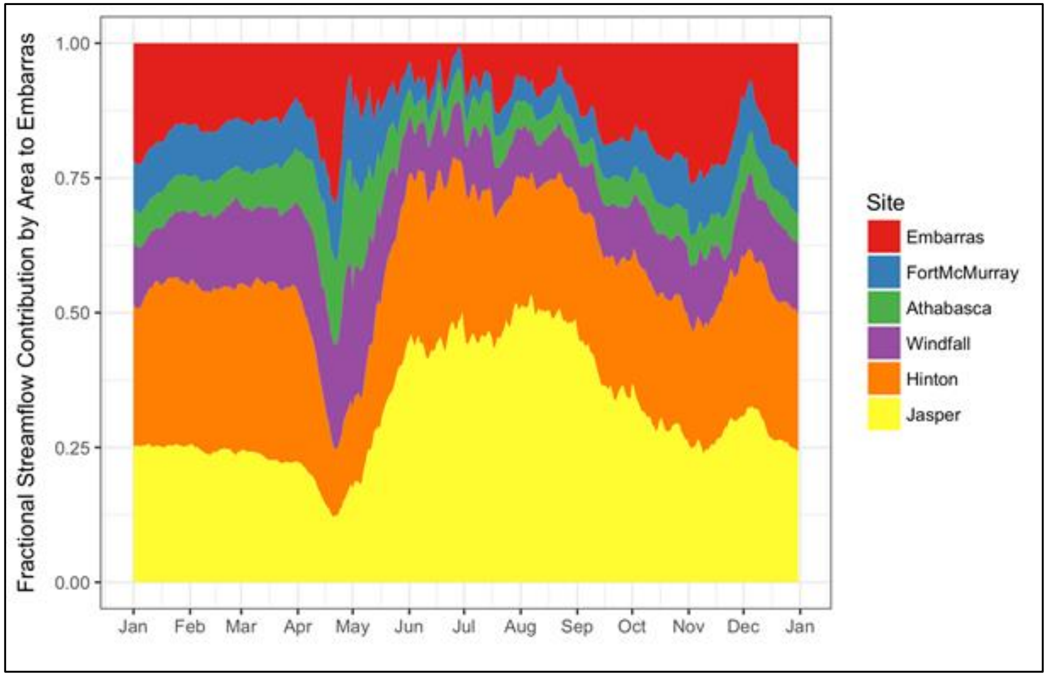
Streamflow is low during the cold winter months, peaks during the spring due to snowmelt, and tapers off into the fall as the winter snowpack becomes depleted

During the late summer and fall, streamflow periodically increases due to large summer precipitation events

The Athabasca River is supplemented during the late summer by glacier melt

~58% of the Athabasca River streamflow by area occurs upstream of Hinton, ~38% occurs upstream of Jasper

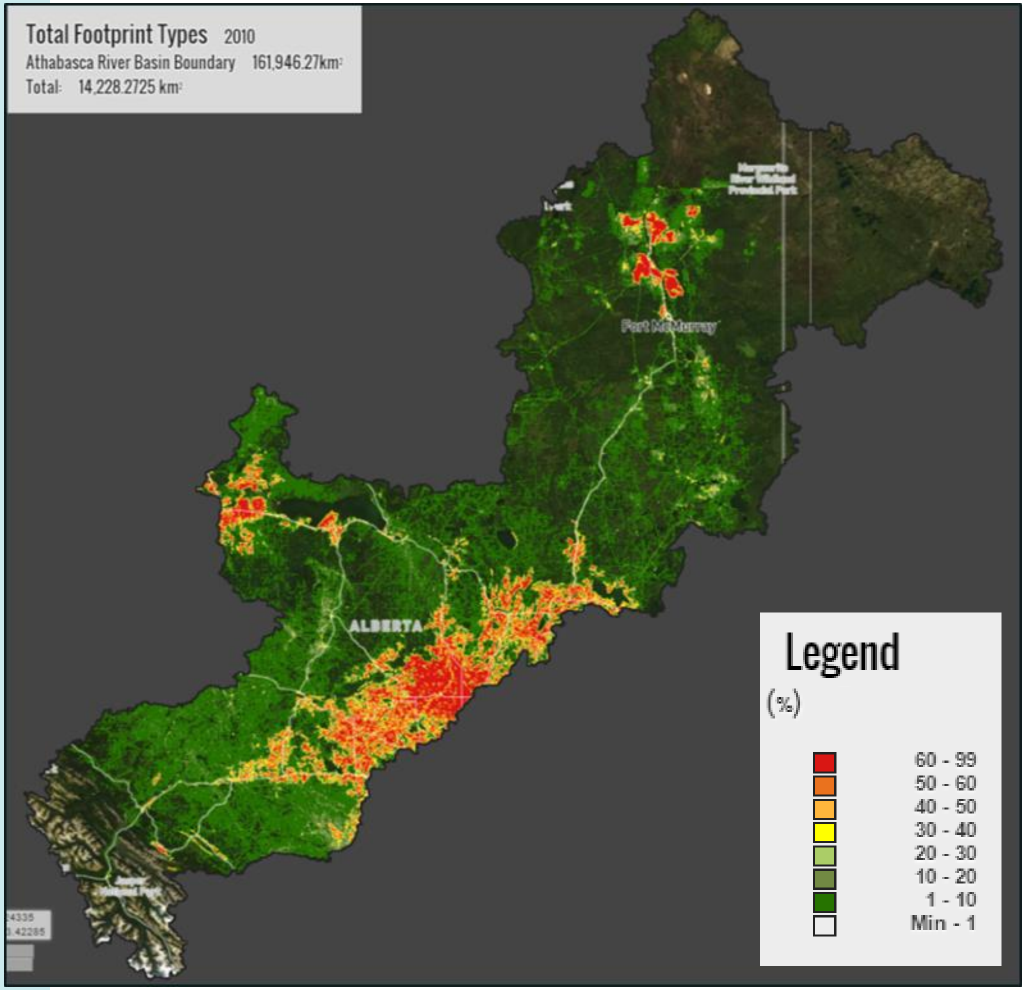
On a per-area basis, much of the water in the Athabasca River is generated in its headwaters, at high elevations in the Rocky Mountains



Fractional streamflow contributions for various points-of-interest on the Athabasca River mainstem

Draft for discussion

Human activity: Many land uses throughout the basin



Agriculture – largest overall land use by area

Forestry – distributed through the basin within FMA boundaries

Oil & gas development – largest area footprint in the lower basin

Roads, seismic, power, rail – highest density and pressure in upper basin

Traditional uses – throughout the basin

Draft for discussion

Water management: Legislation, policy, practices

Water Act, proclaimed in 1999

Water for Life: Alberta's Strategy for Sustainability, published in 2003

Lower Athabasca Regional Plan (LARP), completed in 2012

- The Groundwater Management Framework, released in 2012
- The Tailings Management Framework, released in 2015
- The Surface Water Quantity Management Framework (SWQMF), released in 2015

The Upper Athabasca Regional Plan, in early stages of development

The Mackenzie River Basin Transboundary Master Agreement, signed in 1997

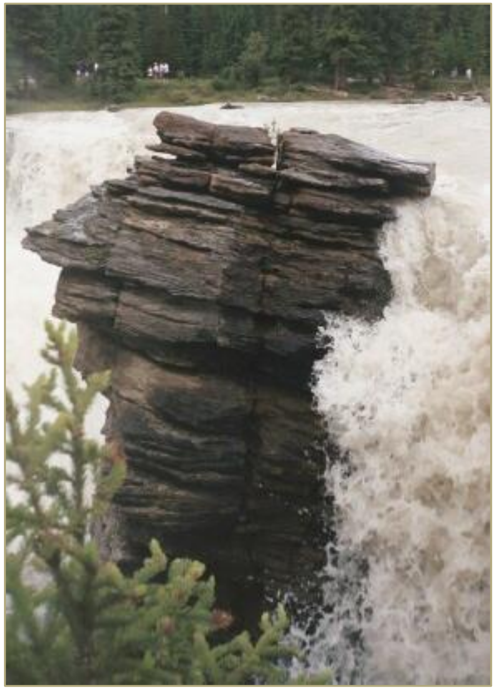
Alberta and Northwest Territories bilateral water management agreement, 2015

Draft Water Conservation Policy, released in 2016

Forestry Management Agreements (FMAs), various dates

Water challenges facing the ARB

- Maintaining or improving ecosystem health
- Providing water supply certainty for development
- Minimizing the effect of development footprint on basin hydrology
- Ensuring sufficient flow for navigation
- Limiting damage from floods or extreme events
- Maintaining or improving the health of the Peace Athabasca Delta (PAD)
- Addressing concerns around treaty rights
- Accessing data and knowledge in the basin around water
- Maintaining or improving water quality
- Understanding the renewable energy potential of the basin



Water challenges facing the ARB: What we heard in Sharing Sessions

Draft for discussion

Greatest concerns are water quality, ecosystem health, water quantity

Gaps in information / community understanding regarding

- changes in water and land environment
- changes in lake levels
- fishery and wildlife health

Some community-based monitoring currently in place

- in partnership with private companies (e.g., consulting firms and oil and gas companies)
- creates more trust in data and information sharing

Concern: Navigation and transportation disruption (quantity)

- adequate water levels for water course transportation
- winter road disruption (flooded/melted) due to released reservoir water –and potentially under warmer, wetter conditions
- can impact access to food and supplies

Concern: Access to clean drinking water (quality)

- external source water supply transported into communities
- lack of trust in water supply for consumption (e.g., Fort Chipewyan: cancer amongst community perceived to be linked to water)

Concern: Fishing and trapping losses (ecosystem)

- species loss or absence of insects, birds, fish
- commercial fishery closure
- game organ meats unsafe for consumption

Learning: Where does the water in the ARB come from?

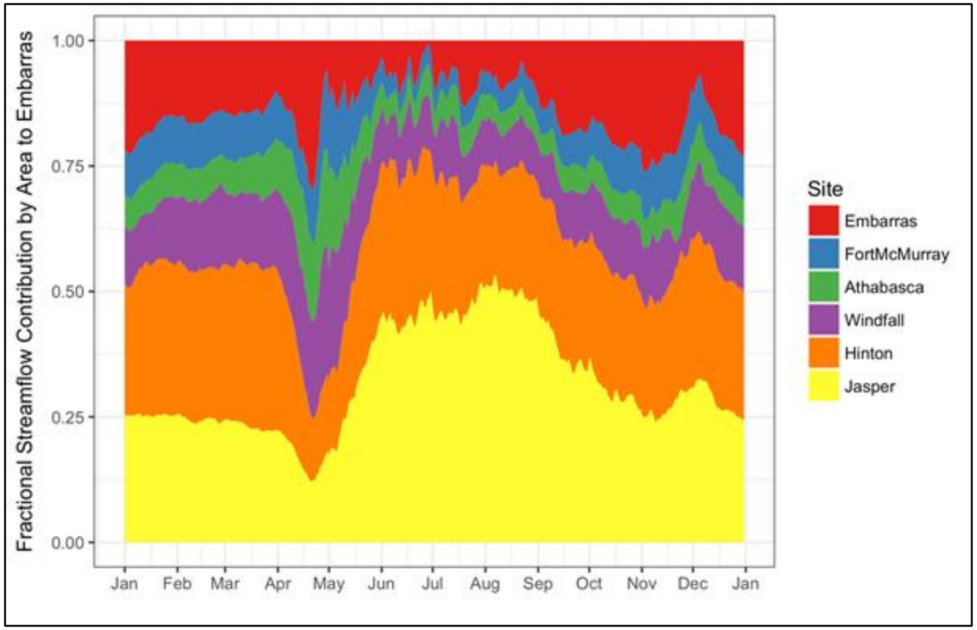
Commonly held perceptions: The water in the Athabasca River and its tributaries comes from multiple sources, mainly glaciers, melting snow and rainfall.

Streamflow peaks in spring due to snowmelt and tapers off in fall as the winter snowpack becomes depleted

During the late summer and fall, streamflow periodically increases due to large summer precipitation events

The Athabasca River is supplemented during the late summer by glacier melt

On a per-area basis, much of the water in the Athabasca River is generated in its headwaters, at high elevations in the Rocky Mountains



Fractional streamflow contributions for various points-of-interest on the Athabasca River mainstem

Learning: Where does the water in the ARB go?

Commonly held perceptions: Industry withdraws and consumes a large portion of the water in the Athabasca River and its tributaries every year.

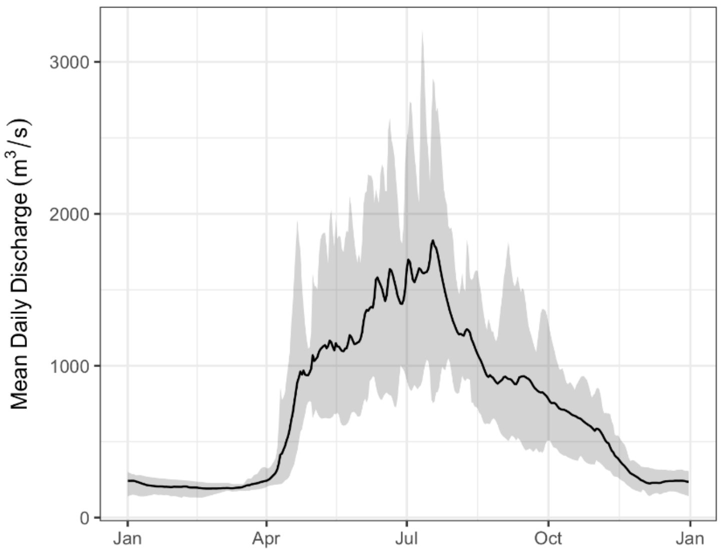
Natural uses include evaporation, transpiration, infiltration, and percolation.

Human uses are, for the most part, managed through a system of water diversion licences.

Summary of water licenses held in the Athabasca River Basin by allocation volume and type of user

Type	# of Licences	Volume	% by volume
High Volume	57	733,428,757 m^3	88%
First Nation	8	838,000 m^3	
Other high volume	49	732,590,757 m^3	
Municipal	9	36,892,202 m^3	
Environmental Management	3	11,103,400 m^3	
Commercial & Industrial	36	682,795,155 m^3	
Agricultural & Irrigation	1	1,800,000 m^3	
Low Volume	651	32,116,155 m^3	3.8%
Municipal	51	9,017,936 m^3	
Environmental Management	64	9,090,616 m^3	
Commercial & Industrial	303	10,477,726 m^3	
Agricultural & Irrigation	233	3,529,876 m^3	
TDLs	336	68,800,806 m^3	8.2%
TOTAL	1045	834,345,718 m^3	100%

Daily average streamflow (1971 – 2015) for the Athabasca River at Embarras (WSC: 07DD001)



This suggests that of the annual flow at Embarrass (~19.5 billion m^3):

- Licences (~834 million m^3) would account for ~4%
    - 83% goes to industrial uses, therefore ~3.5%
    - 0.6% goes to agricultural uses, therefore ~0.03%
    - 5.5% goes to municipal uses, therefore ~0.24%

Learning: What will climate change likely mean for water supply in the ARB?

Draft for discussion

Commonly held perceptions: Climate change will mean typically less precipitation (snow and rain) each year and warmer temperatures causing earlier melting of glaciers and snow. All of this means less water supply in most years.

Repeated decadal droughts are relatively common in the ARB

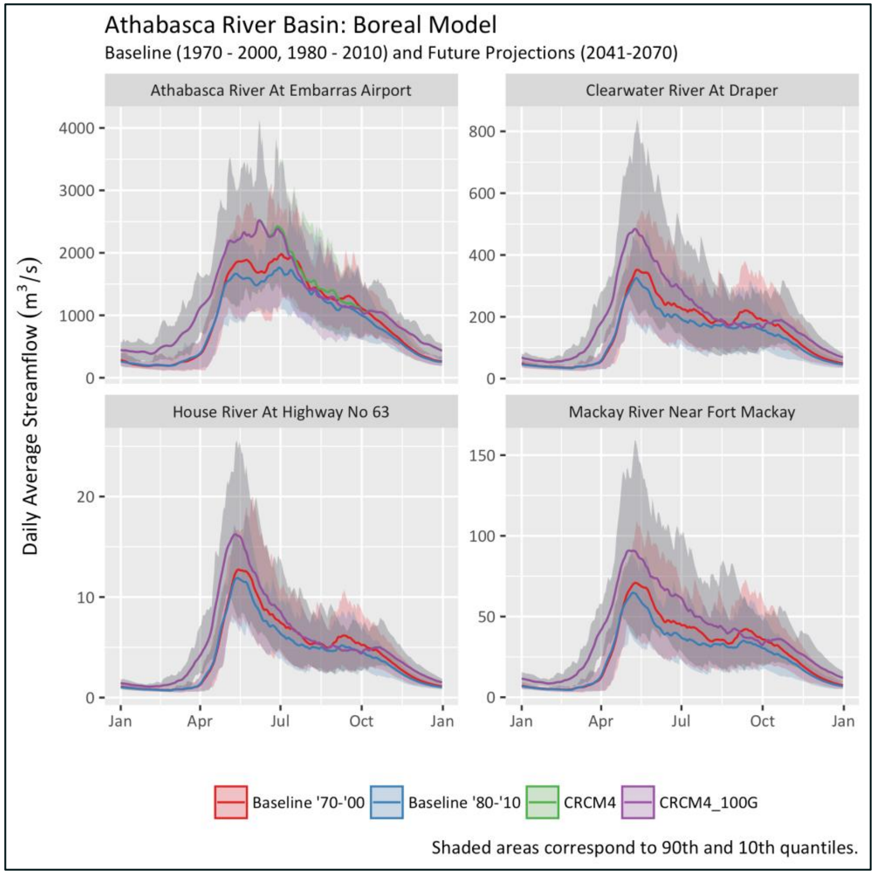
The potential future climate scenarios evaluated through this study suggest:

- precipitation will likely increase across much of the ARB, with the exception of the headwaters in winter
- air temperature is likely to increase

Earlier spring snowmelt

Higher freshets from higher spring precipitation

Lower summer flows



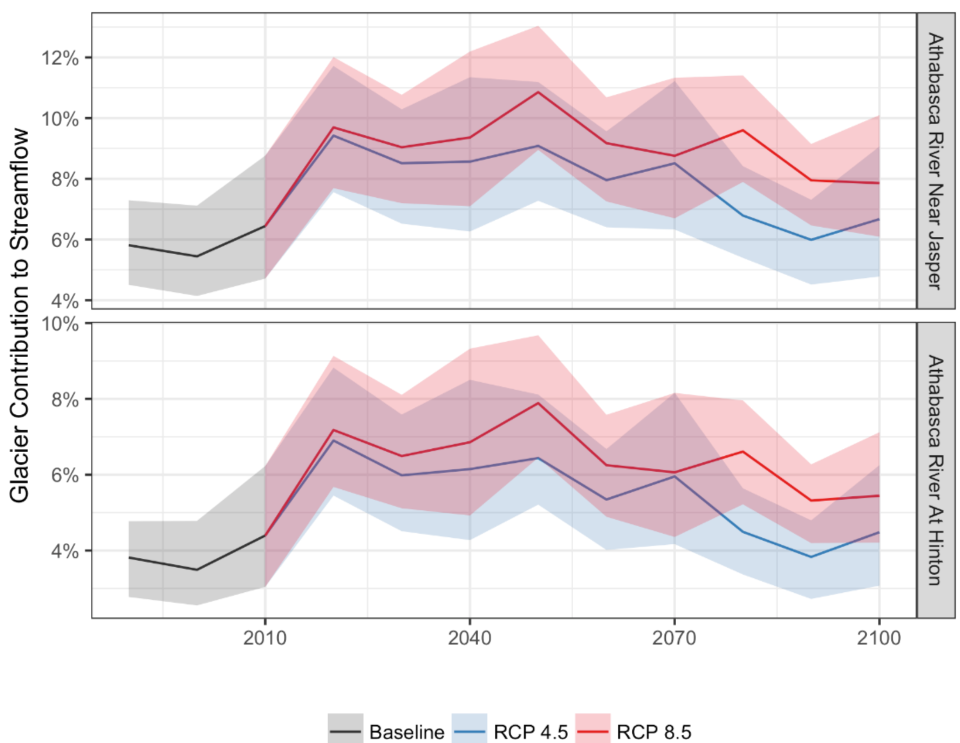
Average daily streamflow for 30 year periods in the headwaters

Learning: How might rapidly melting glaciers impact long term water supply in the ARB?

Draft for discussion

Commonly held perceptions: Glaciers worldwide are melting faster now than historically due to warmer air temperatures from climate change. We expect the glaciers in the Athabasca River Basin are similarly retreating therefore we expect that we will run out of glacier water supply at some point soon.

Simulated glacier contribution to total annual streamflow in the Athabasca River at Jasper and Hinton from 1980 to 2100 under two potential future climate change scenarios



Shaded areas represent 10% and 90% quantiles.

Glaciers provide an important late-season source of water for the Athabasca River

Future changes in climate are likely to result in higher glacial contribution to streamflow over the medium term (next 50 years or so) from higher ice melt

Over the long-term (in the next 100 years), glaciers will contribute less and less to streamflow in the Athabasca as glacier ice recedes substantially

Learning: How might changes in land use affect water supply in the ARB?

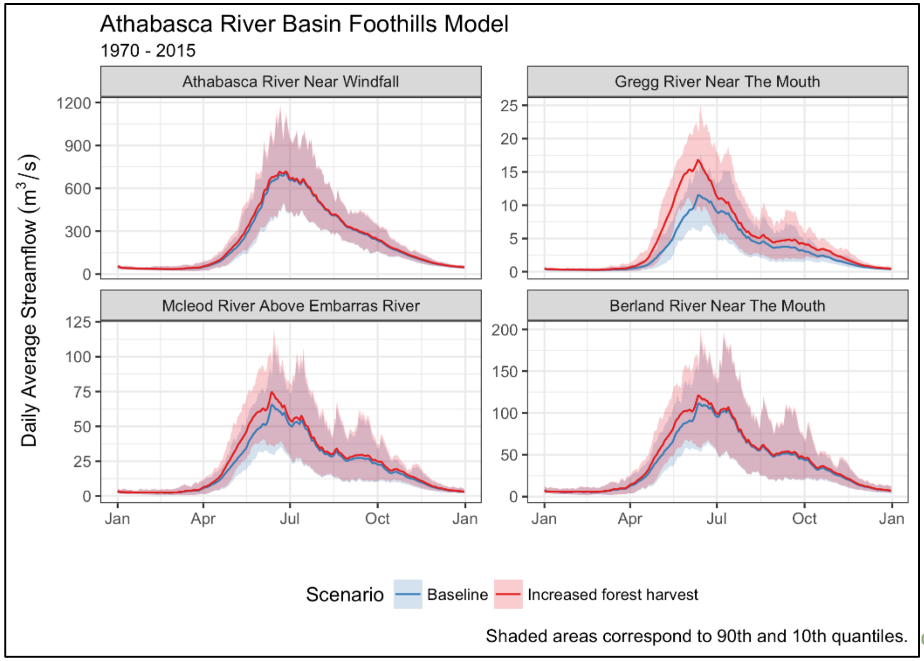
Draft for discussion

Commonly held perceptions: Changes in how land is used and what covers the land can significantly change the amount of water that flows in the rivers in the Athabasca River Basin.

If surfaces are hardened e.g. changed from grass to pavement, less water infiltrates the soil and more water drains off the area.

If trees and shrubs are removed, less snow is intercepted, less water is lost to evapotranspiration, and snow melts and drains faster.

If waterbodies are intersected by linear features including trails, seismic lines and cut lines, natural drainage patterns are changed resulting in water typically running off the landscape faster.



Each of these dynamics and the many other and often more complex hydrological dynamics are typically most easily evidenced locally in small areas.

Over the scale of a basin as large as the ARB, it is difficult to see significant effect on streamflow.

Daily average streamflow at four locations under baseline (1970 -2015) and under 50% higher forest harvest

com

Learning: Does converting land into farmland or increasing irrigation have greater potential effect on surface water quality or quantity?

Draft for discussion

Commonly held perceptions: Developing new farmland will cause water quality problems due to sediment and nutrient runoff. Increasing irrigation will create higher water demand leading to water quantity problems.

Developing new farmland

Modelled 30% increase in agricultural area

Results suggest this would not have a substantial effect on surface water quantity at the scale assessed

Need to minimize effects on water quantity at smaller spatial scales and to limit effects of agriculture on water quality due to increased sediment and nutrient runoff

Increasing irrigation

Modelled increased water demand at existing licences in agricultural area

Results suggest this would not have a substantial effect on surface water quantity at the scale assessed

The main consideration is likely the impact of runoff into river systems due to increased sediment and nutrient loading

If new farmland were developed or irrigated in the ARB, it should have no new net impact to the existing issues around sediment and nutrient runoff

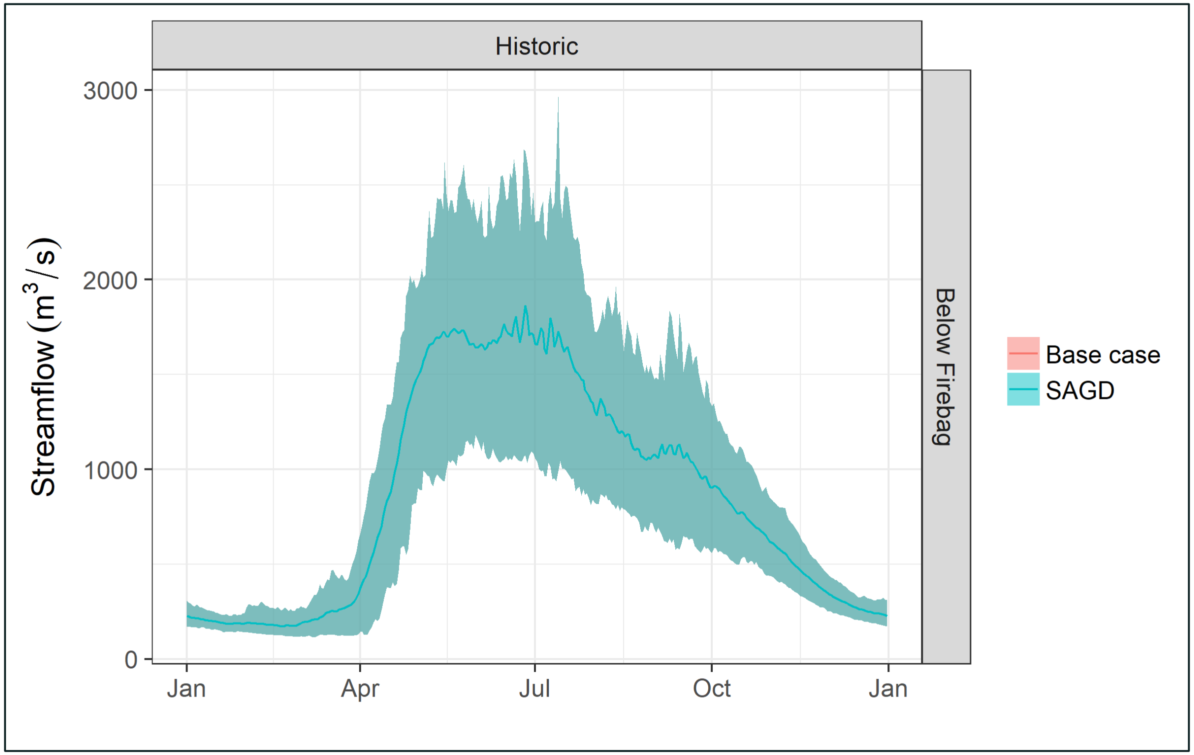
Learning: Will using alternatives to freshwater in SAGD facilities make a noticeable difference in flow in the Athabasca River?

Draft for discussion

Commonly held perceptions: SAGD facilities currently use a lot of fresh water in their operations and asking industry to change to alternative processes or non-fresh water sources will result in less water being diverted from the Athabasca River or its tributaries.

Very few SAGD facilities hold licences to divert fresh water and of them, very few, if any, actively draw from freshwater sources

Modelling simulation showed no detectable difference in flow in the mainstem by using alternatives to freshwater use in currently licenced SAGD facilities



Comparison of average daily streamflow for the Athabasca River below Firebag during base case and removing SAGD withdrawal.

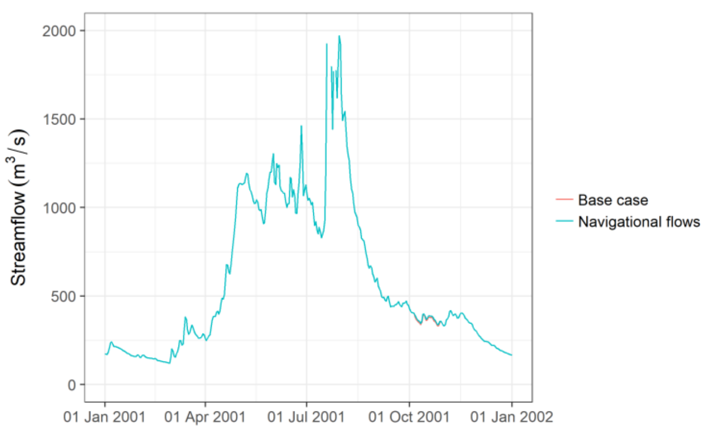
Learning: Can shutting off water licence withdrawals improve navigation on the Athabasca River?

Draft for discussion

Commonly held perceptions: Industrial water withdrawals are high. If they are shutoff, higher flows would substantially help navigation in the lower basin.

SWQMF supports minimum flow targets in the Lower Athabasca by limiting total oil sands withdrawals to 4.4 m^3/s during low flow periods (<87 m^3/s at Fort McMurray)

2010 'As Long as the River Flows' report suggested 400 m^3/s minimum extreme flow (AXF) and ~1,600 m^3/s ideal flow (ABF) to support Aboriginal navigation and access in the lower basin



- Modelled targeting 400 m3/s downstream of the Firebag River, between April 16 and October 28 by shorting any upstream licences
- Results showed generally increased flow during the open water season but not by very much
- The 400 m^3/s target remained often not met

Potential alternatives to a minimum flow might include:

- Construction of instream structures to increase water depth in specific locations
- Construction of a dam and reservoir upstream to store and release water for navigation
- Better understanding of navigation channels and their changes through time; may lead to suggestions for channel management including targeted dredging
- Investment in alternate transportation; water craft, road navigation

Basin Story: Provides the context for the project findings

Should additional basin facts be included?

Are the challenges well represented?

Are there other learnings that should be highlighted?

Today’s discussion

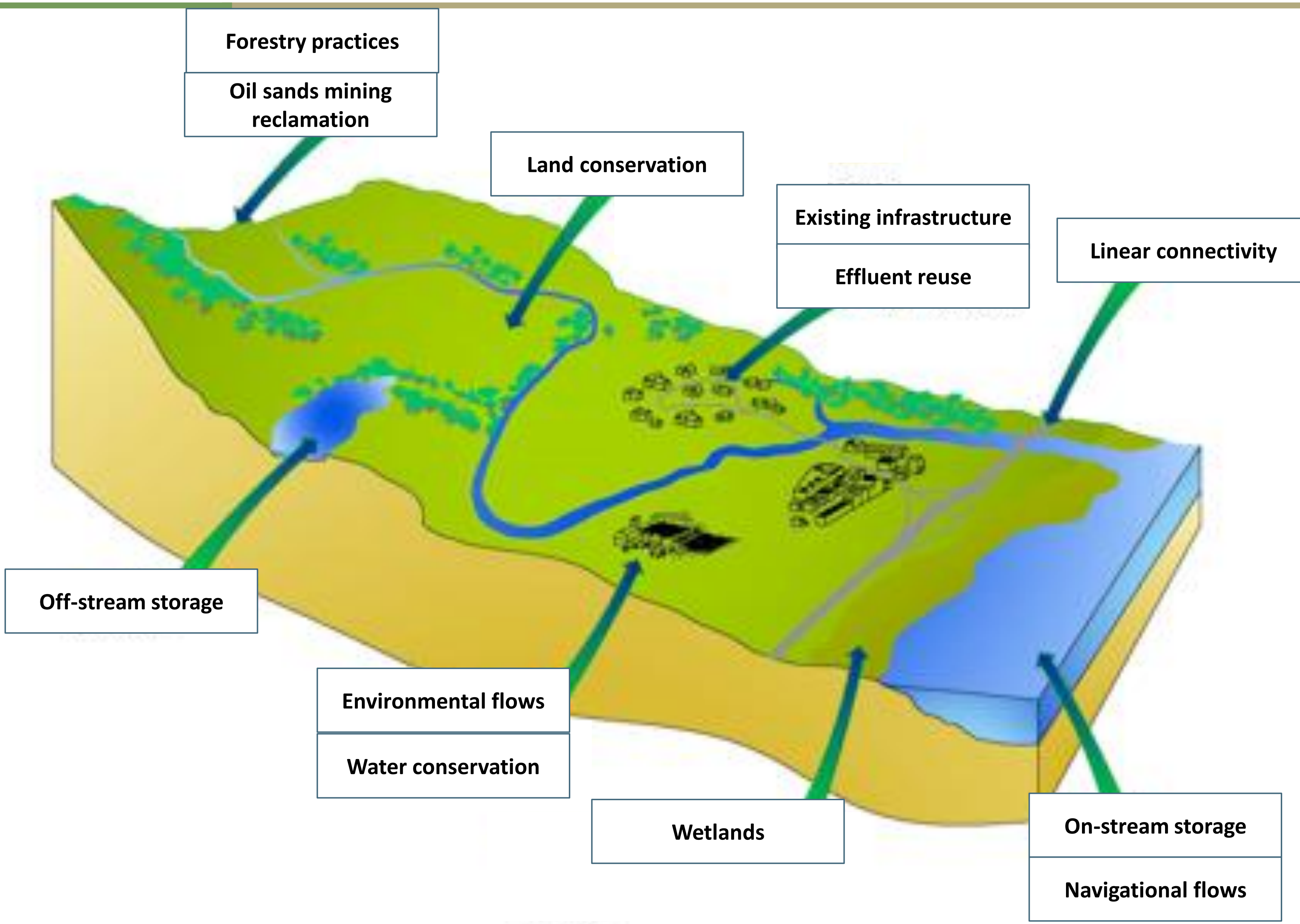
9:00	Welcome, introductions, and opening remarks	Mike
9:20	Plenary session 1: basin overview • Reminder of the basin today, learnings and basin challenges	Megan
10:05	Break	All
10:45	**Breakout groups: refinement of updated strategies** • **Participants to rotate through 3 tables and all strategies to provide feedback and additional changes to strategies** • **Document additional comments** • **Recap of strategy refinements from breakout groups**	**All**
12:35	Lunch	-
1:20	Plenary session 2: discussion of recommendations for sustainable water management and actionable steps	Claire
2:20	Break	All
2:35	Plenary session 3: discussion on finishing the Roadmap and what happens next • Mechanics of finishing the Roadmap and communication plans • How to move the Roadmap forward	Megan
3:35	Next steps, and close • Next steps to finalize the Roadmap document • Communication and project close out plans	Mike

Current strategies for sustainable water management in the ARB

1. **Effluent reuse**: Enable reuse of industrial or municipal effluent to reduce reliance on freshwater
2. **Water conservation**: Continue to achieve water conservation and efficiency improvements with regional development
3. **On-stream storage**: Explore new on-stream multi-purpose storage options
4. **Off-stream storage**: Develop new off-stream storage sites to meet multiple basin water management objectives
5. **Existing infrastructure**: Alter existing water storage infrastructure and operations to meet multiple basin water management objectives
6. **Environmental flows**: Establish IFNs for all tributaries in the basin as a precautionary water management measure
7. **Navigational flows**: Implement minimum flows to improve navigation in the lower Athabasca basin
8. **Land conservation**: Increase the quantity and improve the condition of conserved and restored land across the basin
9. **Forestry practices**: Support practices in Forest Management Agreements (FMAs) that minimize hydrologic change
10. **Wetlands**: Avoid further wetland loss and promote more wetland restoration
11. **Linear Connectivity**: Reclaim linear features and reduce future linear disturbances in watersheds
12. **Oil sands mining reclamation**: Continue to set and meet high standards of reclamation of energy footprint to maintain or improve hydrological functions in a watershed

Numbering does not indicate a priority or ranking of the strategies.
Numbering is only there for referencing purposes

Strategies across the watershed



Today's breakout groups

Participants to rotate through 3 tables to finalize updated strategies

Summary slides provide a brief overview of each strategy, including:

- Strategy overview
- What's already happening with this strategy
- Modelling done to test this strategy and modelling results
- Benefits and tradeoffs
- Implementation challenges and actions
- Screening assessment

The slides mirror what will be put in the Roadmap report. We hope today's discussion will focus on:

- Is the strategy well described?
- Are all perspectives reflected?
- Is the information complete?
- Is the information communicated effectively?

The intent today is to not to change the strategies; rather to finalize and clearly communicate them. The strategies will inform the recommendations and actionable steps.

Tables for the breakout session

Table 1 (Claire)

1. **Effluent reuse**: Enable reuse of industrial or municipal effluent to reduce reliance on freshwater

2. **Water conservation**: Continue to achieve water conservation and efficiency improvements with regional development

6. **Environmental flows**: Establish IFNs for all tributaries in the basin as a precautionary water management measure

7. **Navigational flows**: Implement minimum flows to improve navigation in the lower Athabasca basin

Table 2 (Megan)

3. **On-stream storage**: Explore new on-stream multi-purpose storage options

4. **Off-stream storage**: Develop new off-stream storage sites to meet multiple basin water management objectives

5. **Existing infrastructure**: Alter existing water storage infrastructure and operations to meet multiple basin water management objectives

12. **Oil sands mining reclamation**: Continue to set and meet high standards of reclamation of energy footprint to maintain or improve hydrological functions in a watershed

Table 3 (Ryan and Mike)

8. **Land conservation**: Increase the quantity and improve the condition of conserved and restored land across the basin

9. **Forestry practices**: Support practices in Forest Management Agreements (FMAs) that minimize hydrologic change

10. **Wetlands**: Avoid further wetland loss and promote more wetland restoration

11. **Linear Connectivity**: Reclaim linear features and reduce future linear disturbances in watersheds

Strategy overview: Effluent reuse

Enable reuse of industrial or municipal effluent to reduce reliance on freshwater

Overview

Take return flows (treated effluent) from industrial, municipal, or commercial operations and reuse that water for other industrial purposes. This strategy:

- would support development without needing to withdraw additional fresh water
- would reduce treated effluent release back into the river
- has potential when applied at local levels throughout the basin

What's already happening with this strategy

- ANC may be considering supplying companies with effluent water for the use of hydraulic fracturing
- RMWB is looking into the option of sending treated wastewater to industrial users
- Industry to industry reuse is taking place between the Suncor base mine and the Suncor Firebag SAGD operation

How it was simulated in the model

- Return flows from the industrial and commercial demands in the upper ARB were simulated to flow to off-stream storage instead of a return flow to the river. TDLs in the upper ARB draw from this off-stream storage instead of taking freshwater. Maximum storage is set at 100,000 dam^3 with volumes in excess of storage flow back to the mainstem Athabasca River. Water may also be drawn from this storage to meet the downstream SWQMF.

Key modelling results and discussion: Effluent reuse

Period and Location	_Dry_Reuse	_Hist_Reuse	_Wet_Reuse
Change in number of days meeting Aboriginal Extreme Flow. *Challenge: Ensure sufficient flow for navigation*			
Annual - below Firebag confluence	0.0 Days	0.0 Days	0.0 Days
Change in number of days over 1:100 flood thresholds. *Challenge: Limit damage from floods*			
Annual - Athabasca River at Athabasca	0.0 Days	0.0 Days	0.0 Days
Annual - McLeod River	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca upstream of Whitecourt	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca River at Hinton	0.0 Days	0.0 Days	0.0 Days
Annual - Lesser Slave River	0.0 Days	0.0 Days	0.0 Days
Annual - Pembina River at Sangudo	0.0 Days	0.0 Days	0.0 Days
Annual - Ft. McMurray	0.0 Days	0.0 Days	0.0 Days
Change in annual instream flow needs violations. *Challenge: Maintain or improve ecosystem health*			
Annual - Mouth of the Lac La Biche River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the McLeod River	-24.0 Days	-5.0 Days	-1.0 Days
Annual - Mouth of the Clearwater River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Lesser Slave River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Pembina River	-88.0 Days	-33.0 Days	-19.0 Days
Change in walleye recruitment reduction. *Challenge: Maintain or improve ecosystem health*			
Annual - below Ft. McMurray	1.59%	1.40%	0.63%
Change in seasonal streamflow as a percentage of naturalized streamflow. *Challenge: Minimize the effect of development footprint on basin hydrology*			
Summer - at the Mouth	0.02%	0.01%	0.02%
Spring - at the Mouth	0.02%	0.00%	0.00%
Fall - at the Mouth	0.03%	0.02%	0.03%
Winter - at the Mouth	0.34%	0.02%	0.03%
Change in seasonal system shortages (m3/s). *Challenge: Provide water supply certainty for municipalities and development*			
Spring - whole system	0.0 m^3/s	-0.0 m3/s	0.0 m3/s
Winter - whole system	-0.35 m3/s	0.0 m3/s	-0.02 m3/s
Fall - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s
Summer - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s

Benefits and tradeoffs: Effluent reuse

Benefits

- This strategy shows a slight impact on flow at a basin scale, there is a visible increase in flow on smaller rivers
- This strategy may have substantial benefits to water quality, this cannot be demonstrated through the modelling
- Reusing wastewater may be an effective alternative to sourcing new fresh water, this will reduce loading from nutrients and other constituents on tributaries and the main steam Athabasca
- This strategy simply changes the source of TDL water withdrawals from fresh water to wastewater, thereby allowing more fresh water to remain in the river
- Stored effluent could provide a backup water source when freshwater systems are stressed or not available

Trade-offs

- There is a slight negative impact on walleye recruitment, this impact is seen when the off-stream storage is initially filling
- Developing infrastructure to distribute wastewater for reuse may not necessarily result in net environmental benefit
- Reusing treated wastewater, which is usually returned to the river as per the return flows in licenses, may impact the quantity of water available for downstream water users

Implementation: Effluent reuse

Challenges

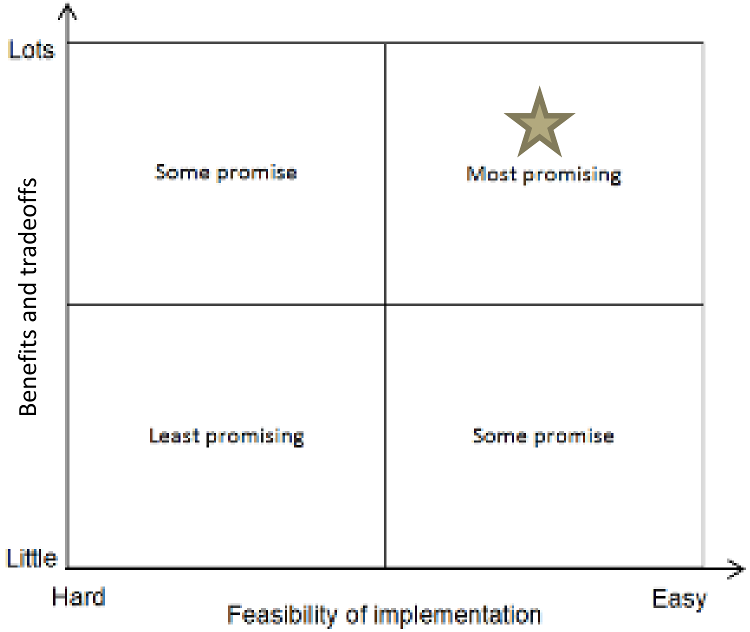
- This strategy is more feasible to implement at a local level with a network of smaller storage facilities, thus minimizing transportation distances
- For this strategy to be implemented there is a need to ensure acceptable quality of the water for reuse depending on the end use

Actions

- Develop and implement a basin-wide or province-wide water reuse policy. Such a policy should change, clarify, or create clear direction for decisions on water reuse
- Match demands opportunistically with available supply

Screening assessment

- This strategy was identified as a most promising strategy
- Ease of implementation of this strategy is contingent on a clear water reuse policy being developed and implemented to allow users to begin the reuse process. This may start with many small water exchanges that develop over time into a larger water reuse network.



Strategy overview: Water conservation

Continue to achieve water conservation and efficiency improvements

Overview

Promote conservation and efficiency practices for municipal, industrial, and commercial water use; supporting future regional development without increasing demand for fresh water.

What's already happening with this strategy

- The Draft Water Conservation Policy was released in October 2016 and outlines the conservation of fresh water for oil and gas development
- The Water for Life Strategy outlines conservation, efficiency, and productivity (CEP) outcomes and actions for specific sectors
- The Alberta Water Council produced recommendations for CEP planning, and outlined a planning process to be followed by the seven major water using sectors in Alberta

How it was simulated in the model

- All municipal, industrial, and commercial demands throughout the basin were reduced by 10%

Key modelling results and discussion: Water conservation

Period and Location	Dry – Water conservation	Historic – Water conservation	Wet – Water conservation
Change in number of days meeting Aboriginal Extreme Flow. *Challenge: Ensure sufficient flow for navigation*			
Annual - below Firebag confluence	1.0 Days	0.0 Days	0.0 Days
Change in number of days over 1:100 flood thresholds. *Challenge: Limit damage from floods*			
Annual - Athabasca River at Athabasca	0.0 Days	0.0 Days	0.0 Days
Annual - McLeod River	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca upstream of Whitecourt	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca River at Hinton	0.0 Days	0.0 Days	0.0 Days
Annual - Lesser Slave River	0.0 Days	2.0 Days	0.0 Days
Annual - Pembina River at Sangudo	0.0 Days	0.0 Days	0.0 Days
Annual - Ft. McMurray	0.0 Days	0.0 Days	0.0 Days
Change in annual instream flow needs violations. *Challenge: Maintain or improve ecosystem health*			
Annual - Mouth of the Lac La Biche River	-3.0 Days	0.0 Days	-2.0 Days
Annual - Mouth of the McLeod River	-54.0 Days	-20.0 Days	-17.0 Days
Annual - Mouth of the Clearwater River	-20.0 Days	-3.0 Days	-3.0 Days
Annual - Mouth of the Lesser Slave river	-40.0 Days	-34.0 Days	-48.0 Days
Annual - Mouth of the Pembina River	-8.0 Days	-6.0 Days	-5.0 Days
Change in walleye recruitment reduction. *Challenge: Maintain or improve ecosystem health*			
Annual - below Ft. McMurray	-7.62%	-7.50%	-7.62%
Change in seasonal streamflow as a percentage of naturalized streamflow. *Challenge: Minimize the effect of development footprint on basin hydrology*			
Summer - at the Mouth	0.10%	0.05%	0.07%
Spring - at the Mouth	0.16%	0.08%	0.08%
Fall - at the Mouth	0.13%	0.06%	0.09%
Winter - at the Mouth	0.25%	0.17%	0.20%
Change in seasonal system shortages (m3/s). *Challenge: Provide water supply certainty for municipalities and development*			
Spring - whole system	-0.88 m3/s	-0.01 m3/s	-0.02 m3/s
Winter - whole system	-3.21 m3/s	-0.0 m3/s	-0.06 m3/s
Fall - whole system	-0.02 m3/s	0.0 m3/s	0.0 m3/s
Summer - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s

Benefits and tradeoffs: Water conservation

Benefits

- Benefits incurred from this strategy would be seen across most PMs and would be proportional to the degree of conservation practiced
- This strategy improves walleye recruitment and reduces IFN violations, improvement in these two PMs indicate healthier aquatic systems
- These is a reduction in shortages for water users because water users are not asking for as much water

Trade-offs

- A great deal of effort and expense may be required to implement conservation programs and initiatives throughout the basin. All sectors have been working towards CEP plans of 30% conservation targets, a 10% target, as modelled, beyond this may be impossible
- Reductions beyond 30% may provide diminishing returns, some sectors may experience more difficulties than others

Implementation: Water conservation

Challenges

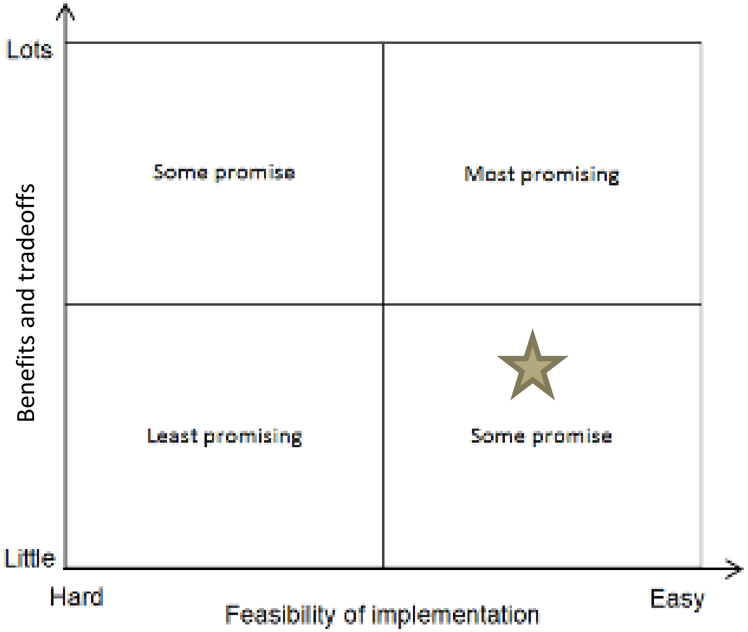
- None identified

Actions

- Outreach and education programs should be implemented for all municipalities and for all industrial and commercial developments. Awareness and education are vital for the combined success of conservation as a strategy.
- Encourage and support water conservation through incentive programs, such as:
  - Enforce stricter water use regulations and imposing higher water rates
  - Establish legislation that encourages water reuse
  - Review the progress on the CEP plans more frequently, perhaps every year

Screening assessment

- This strategy was identified as having some promise
- This strategy was noted to be highly feasible and to yield moderate net benefits for the basin. This strategy is also socially feasible and much is already being done to advance water conservation goals.



Strategy overview: On-stream storage

Explore new on-stream multi-purpose storage options

Overview:

Explore on-stream storage options within the ARB, which would serve multiple purposes, including but not limited to:

- Storage for flow augmentation to meet downstream minimum flows e.g., flows for aquatic health, riparian health, and/or navigation
- Water supply for licensed demands
- Flood mitigation
- Hydropower generation as a renewable energy source

What's already happening with this strategy:

- A report completed in 2010 for AEP by Hatch identified a number of potential hydropower sites in Alberta, with 17 potential sites identified in the ARB
- Alberta's Climate Leadership Plan established aggressive targets for renewable energy
- Applications have been made for two on-stream run-of-river hydropower sites on the mainstem of the Athabasca River; the two proposed sites are the Pelican Renewable Generating Station Project and Sundog Renewable Generating Station Project upstream of Fort McMurray

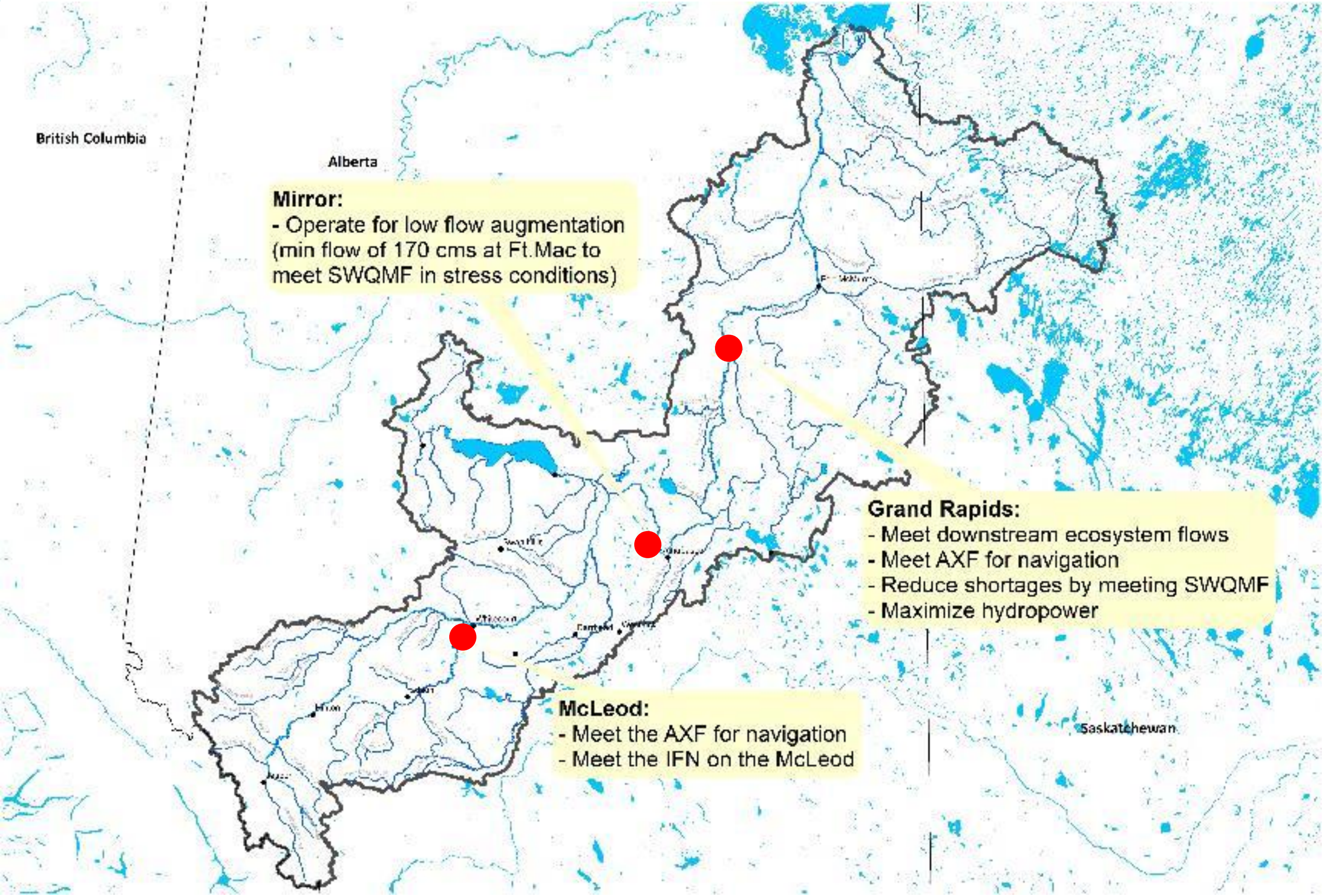
Strategy overview: On-stream storage

How it was simulated in the model

The following model runs were simulated in AIRM to explore the effects of on-stream storage at different locations in the basin:

- On-stream tributary facility - McLeod site
    - This reservoir would have a maximum storage of 694,000 dam^3 and would operate to meet downstream flows for navigation and IFN flows on the McLeod River. The reservoir would only release water when it is needed for these purposes The McLeod reservoir would also be simulated to operate for hydropower purposes only.
- On-stream mainstem facility - Mirror site
    - This reservoir would have a maximum storage of 1,899,600 dam^3 and would operate for low flow augmentation and hydropower production. The Mirror reservoir would also be simulated to operate for hydropower purposes only.
- On-stream mainstem downstream facility - Grand Rapids site
    - This reservoir would have a maximum storage of 407,000 dam^3 and would operate to meet the following objectives in priority order: 1) meet downstream ecosystem flows, 2) meet navigational flow requirements, 3) reduce shortages, and 4) maximize hydropower. The Grand Rapids reservoir would also be simulated to operate for hydropower purposes only.

Strategy overview: On-stream storage



Key modelling results and discussion: On-stream storage tributary (multipurpose storage)

Period and Location	Dry - McLeod	Historic - McLeod	Wet - McLeod
Change in number of days meeting Aboriginal Extreme Flow. *Challenge: Ensure sufficient flow for navigation*			
Annual - below Firebag confluence	43.0 Days	59.0 Days	0.0 Days
Change in number of days over 1:100 flood thresholds. *Challenge: Limit damage from floods*			
Annual - Athabasca River at Athabasca	0.0 Days	0.0 Days	0.0 Days
Annual - McLeod River	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca upstream of Whitecourt	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca River at Hinton	0.0 Days	0.0 Days	0.0 Days
Annual - Lesser Slave River	0.0 Days	0.0 Days	0.0 Days
Annual - Pembina River at Sangudo	0.0 Days	0.0 Days	0.0 Days
Annual - Ft. McMurray	0.0 Days	0.0 Days	-2.0 Days
Change in annual instream flow needs violations. *Challenge: Maintain or improve ecosystem health*			
Annual - Mouth of the Lac La Biche River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the McLeod River	-1904.0 Days	-1701.0 Days	-1640.0 Days
Annual - Mouth of the Clearwater River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Lesser Slave River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Pembina River	0.0 Days	0.0 Days	0.0 Days
Change in walleye recruitment reduction. *Challenge: Maintain or improve ecosystem health*			
Annual - below Ft. McMurray	0.38%	2.54%	0.05%
Change in seasonal streamflow as a percentage of naturalized streamflow. *Challenge: Minimize the effect of development footprint on basin hydrology*			
Summer - at the Mouth	0.26%	0.37%	0.68%
Spring - at the Mouth	1.16%	1.10%	0.77%
Fall - at the Mouth	0.25%	0.66%	0.56%
Winter - at the Mouth	0.35%	0.32%	0.65%
Change in seasonal system shortages (m3/s). *Challenge: Provide water supply certainty for municipalities and development*			
Spring - whole system	-0.01 m3/s	-0.0 m3/s	0.0 m3/s
Winter - whole system	-0.0 m3/s	0.0 m3/s	-0.01 m3/s
Fall - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s
Summer - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s

Key modelling results and discussion: On-stream storage tributary (hydro)

Period and Location	Dry – McLeod hydro	Historic – McLeod hydro	Wet – McLeod hydro
Change in number of days meeting Aboriginal Extreme Flow. *Challenge: Ensure sufficient flow for navigation*			
Annual - below Firebag confluence	1.0 Days	1.0 Days	0.0 Days
Change in number of days over 1:100 flood thresholds. *Challenge: Limit damage from floods*			
Annual - Athabasca River at Athabasca	0.0 Days	0.0 Days	0.0 Days
Annual - McLeod River	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca upstream of Whitecourt	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca River at Hinton	0.0 Days	0.0 Days	0.0 Days
Annual - Lesser Slave River	0.0 Days	0.0 Days	0.0 Days
Annual - Pembina River at Sangudo	0.0 Days	0.0 Days	0.0 Days
Annual - Ft. McMurray	0.0 Days	0.0 Days	-1.0 Days
Change in annual instream flow needs violations. *Challenge: Maintain or improve ecosystem health*			
Annual - Mouth of the Lac La Biche River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the McLeod River	15.0 Days	-7.0 Days	32.0 Days
Annual - Mouth of the Clearwater River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Lesser Slave River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Pembina River	0.0 Days	0.0 Days	0.0 Days
Change in walleye recruitment reduction. *Challenge: Maintain or improve ecosystem health*			
Annual - below Ft. McMurray	6.67%	13.75%	6.67%
Change in seasonal streamflow as a percentage of naturalized streamflow. *Challenge: Minimize the effect of development footprint on basin hydrology*			
Summer - at the Mouth	-0.77%	-0.69%	-0.55%
Spring - at the Mouth	1.11%	0.99%	0.61%
Fall - at the Mouth	0.00%	0.00%	0.00%
Winter - at the Mouth	0.00%	0.00%	0.00%
Change in seasonal system shortages (m3/s). *Challenge: Provide water supply certainty for municipalities and development*			
Spring - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s
Winter - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s
Fall - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s
Summer - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s

Key modelling results and discussion: On-stream storage mainstem (multipurpose storage)

Period and Location	Dry - Mirror	Historic - Mirror	Wet - Mirror
Change in number of days meeting Aboriginal Extreme Flow. *Challenge: Ensure sufficient flow for navigation*			
Annual - below Firebag confluence	-28.0 Days	-4.0 Days	0.0 Days
Change in number of days over 1:100 flood thresholds. *Challenge: Limit damage from floods*			
Annual - Athabasca River at Athabasca	0.0 Days	0.0 Days	0.0 Days
Annual - McLeod River	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca upstream of Whitecourt	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca River at Hinton	0.0 Days	0.0 Days	0.0 Days
Annual - Lesser Slave River	0.0 Days	0.0 Days	0.0 Days
Annual - Pembina River at Sangudo	0.0 Days	0.0 Days	0.0 Days
Annual - Ft. McMurray	0.0 Days	0.0 Days	-3.0 Days
Change in annual instream flow needs violations. *Challenge: Maintain or improve ecosystem health*			
Annual - Mouth of the Lac La Biche River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the McLeod River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Clearwater River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Lesser Slave River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Pembina River	0.0 Days	0.0 Days	0.0 Days
Change in walleye recruitment reduction. *Challenge: Maintain or improve ecosystem health*			
Annual - below Ft. McMurray	107.54%	211.42%	106.98%
Change in seasonal streamflow as a percentage of naturalized streamflow. *Challenge: Minimize the effect of development footprint on basin hydrology*			
Summer - at the Mouth	-11.52%	-13.42%	-7.95%
Spring - at the Mouth	20.49%	16.95%	0.41%
Fall - at the Mouth	8.53%	8.43%	6.16%
Winter - at the Mouth	50.03%	29.01%	6.66%
Change in seasonal system shortages (m3/s). *Challenge: Provide water supply certainty for municipalities and development*			
Spring - whole system	-0.79 m3/s	-0.0 m3/s	0.0 m3/s
Winter - whole system	-2.98 m3/s	0.0 m3/s	-0.02 m3/s
Fall - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s
Summer - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s

Key modelling results and discussion: On-stream storage mainstem (hydro)

Period and Location	Dry – Mirror hydro	Historic – Mirror hydro	Wet – Mirror hydro
Change in number of days meeting Aboriginal Extreme Flow. *Challenge: Ensure sufficient flow for navigation*			
Annual - below Firebag confluence	2.0 Days	2.0 Days	0.0 Days
Change in number of days over 1:100 flood thresholds. *Challenge: Limit damage from floods*			
Annual - Athabasca River at Athabasca	0.0 Days	0.0 Days	0.0 Days
Annual - McLeod River	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca upstream of Whitecourt	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca River at Hinton	0.0 Days	0.0 Days	0.0 Days
Annual - Lesser Slave River	0.0 Days	0.0 Days	0.0 Days
Annual - Pembina River at Sangudo	0.0 Days	0.0 Days	0.0 Days
Annual - Ft. McMurray	0.0 Days	0.0 Days	-1.0 Days
Change in annual instream flow needs violations. *Challenge: Maintain or improve ecosystem health*			
Annual - Mouth of the Lac La Biche River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the McLeod River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Clearwater River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Lesser Slave River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Pembina River	0.0 Days	0.0 Days	0.0 Days
Change in walleye recruitment reduction. *Challenge: Maintain or improve ecosystem health*			
Annual - below Ft. McMurray	8.25%	16.88%	8.25%
Change in seasonal streamflow as a percentage of naturalized streamflow. *Challenge: Minimize the effect of development footprint on basin hydrology*			
Summer - at the Mouth	-2.57%	-2.93%	-1.54%
Spring - at the Mouth	1.03%	1.08%	0.85%
Fall - at the Mouth	0.00%	0.00%	0.00%
Winter - at the Mouth	-1.06%	-1.02%	-1.04%
Change in seasonal system shortages (m3/s). *Challenge: Provide water supply certainty for municipalities and development*			
Spring - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s
Winter - whole system	0.24 m3/s	0.01 m3/s	0.24 m3/s
Fall - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s
Summer - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s

Key modelling results and discussion: On-stream storage mainstem downstream (multipurpose storage)

Period and Location	Dry – Grand Rapids	Historic – Grand Rapids	Wet – Grand Rapids
Change in number of days meeting Aboriginal Extreme Flow. *Challenge: Ensure sufficient flow for navigation*			
Annual - below Firebag confluence	43.0 Days	59.0 Days	0.0 Days
Change in number of days over 1:100 flood thresholds. *Challenge: Limit damage from floods*			
Annual - Athabasca River at Athabasca	0.0 Days	0.0 Days	0.0 Days
Annual - McLeod River	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca upstream of Whitecourt	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca River at Hinton	0.0 Days	0.0 Days	0.0 Days
Annual - Lesser Slave River	0.0 Days	0.0 Days	0.0 Days
Annual - Pembina River at Sangudo	0.0 Days	0.0 Days	0.0 Days
Annual - Ft. McMurray	0.0 Days	0.0 Days	-1.0 Days
Change in annual instream flow needs violations. *Challenge: Maintain or improve ecosystem health*			
Annual - Mouth of the Lac La Biche River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the McLeod River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Clearwater River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Lesser Slave River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Pembina River	0.0 Days	0.0 Days	0.0 Days
Change in walleye recruitment reduction. *Challenge: Maintain or improve ecosystem health*			
Annual - below Ft. McMurray	14.85%	10.96%	4.44%
Change in seasonal streamflow as a percentage of naturalized streamflow. *Challenge: Minimize the effect of development footprint on basin hydrology*			
Summer - at the Mouth	-1.79%	-1.44%	-1.22%
Spring - at the Mouth	16.18%	4.48%	1.17%
Fall - at the Mouth	0.00%	-0.02%	0.00%
Winter - at the Mouth	75.90%	0.00%	0.04%
Change in seasonal system shortages (m3/s). *Challenge: Provide water supply certainty for municipalities and development*			
Spring - whole system	-0.79 m3/s	-0.0 m3/s	0.0 m3/s
Winter - whole system	-2.94 m3/s	0.0 m3/s	-0.02 m3/s
Fall - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s
Summer - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s

Key modelling results and discussion: On-stream storage mainstem downstream (hydro)

Period and Location	Dry - Grand Rapids hydro	Historic – Grand Rapids hydro	Wet – Grand Rapids hydro
Change in number of days meeting Aboriginal Extreme Flow. *Challenge: Ensure sufficient flow for navigation*			
Annual - below Firebag confluence	1.0 Days	0.0 Days	0.0 Days
Change in number of days over 1:100 flood thresholds. *Challenge: Limit damage from floods*			
Annual - Athabasca River at Athabasca	0.0 Days	0.0 Days	0.0 Days
Annual - McLeod River	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca upstream of Whitecourt	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca River at Hinton	0.0 Days	0.0 Days	0.0 Days
Annual - Lesser Slave River	0.0 Days	0.0 Days	0.0 Days
Annual - Pembina River at Sangudo	0.0 Days	0.0 Days	0.0 Days
Annual - Ft. McMurray	0.0 Days	0.0 Days	-1.0 Days
Change in annual instream flow needs violations. *Challenge: Maintain or improve ecosystem health*			
Annual - Mouth of the Lac La Biche River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the McLeod River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Clearwater River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Lesser Slave River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Pembina River	0.0 Days	0.0 Days	0.0 Days
Change in walleye recruitment reduction. *Challenge: Maintain or improve ecosystem health*			
Annual - below Ft. McMurray	4.44%	9.38%	4.44%
Change in seasonal streamflow as a percentage of naturalized streamflow. *Challenge: Minimize the effect of development footprint on basin hydrology*			
Summer - at the Mouth	-1.79%	-1.44%	-1.22%
Spring - at the Mouth	3.31%	2.99%	1.17%
Fall - at the Mouth	0.00%	0.00%	0.00%
Winter - at the Mouth	0.00%	0.00%	0.00%
Change in seasonal system shortages (m3/s). *Challenge: Provide water supply certainty for municipalities and development*			
Spring - whole system	-0.02 m3/s	-0.0 m3/s	0.0 m3/s
Winter - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s
Fall - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s
Summer - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s

Benefits and tradeoffs: On-stream storage

Benefits

- There are potentially large benefits to the basin from on-stream dams and reservoirs; the nature of the benefits would depend on what objectives the storage facility is built and operated to meet
- On-stream storage would allow for water storage at high flow times and releases at low flow times, therefore potentially helping to meet navigational flows more often, reducing shortages to licenced demands, and reducing IFN violations (if storage were on the major tributaries)
- Flow stabilization or augmentation may offer potential for managing ice-jamming
- On-stream storage could result in fewer flood days through communities under wet conditions by capturing and storing peak flows

Trade-offs

- The potential benefits from on-stream storage would result from the facility changing the natural flow regime of the river; such changes can introduce significant trade-offs
- A major trade-off is the potential impact on fisheries; as modelled, this strategy has negative impacts on walleye recruitment during the summer fry period (as walleye rely on naturalized summer flows for recruitment)
- On-stream storage could have impacts on other environmental factors and traditional communities, for example, inhibiting fish passage, altering riparian health, and changing the natural sedimentation of the river
- On-stream storage may have negative effects on Indigenous communities, land uses and sites
- Other cultural and recreational uses of the river, such as canoeing, may be negatively impacted by this strategy; however, in some instances these same uses have seen benefits from flow augmentation from storage

Implementation: On-stream storage

Challenges

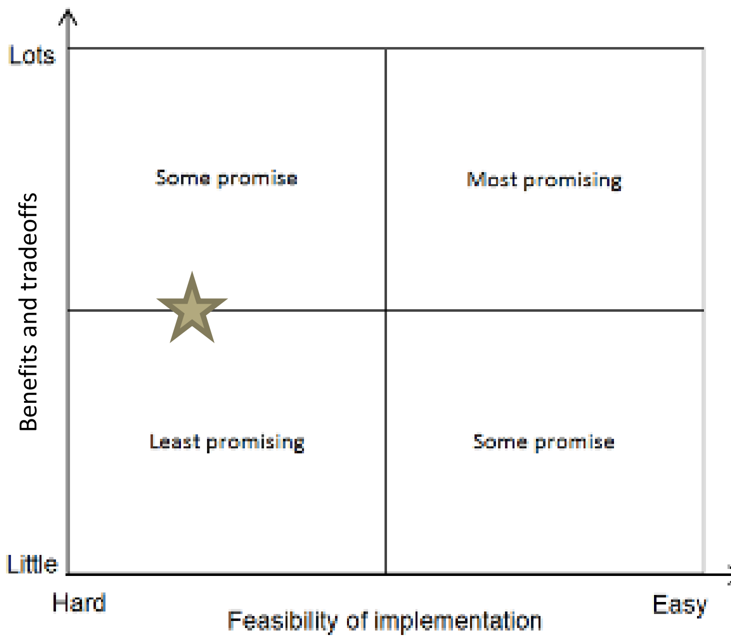
- Large on stream storage infrastructure projects are extremely costly to develop, build and operate
- A wide range of environmental concerns will need to be identified and addressed for an on-stream storage project to proceed, e.g. flows to the Peace-Athabasca Delta, sediment transport, fish migration, and ice-jamming; these should be managed through federal and provincial environmental assessment and mitigation measures

Actions

- Develop basin purposes for any potential on-stream storage facility; should a project be advanced, it would meet basin objectives in addition to energy generation
- Perform site selection, project feasibility and environmental assessments in the context of defined basin purposes
- Align with best practice guidelines through upfront engagement and consultation, and conduct them in accordance with federal and provincial regulations

Screening assessment

- This strategy was identified as being least promising to having some promise
- The strategy was considered to have low feasibility (contingent on site selection, feasibility studies, EAs, adequate engagement, and adequate financial support), with high potential benefit, but also high tradeoffs



Strategy overview: Off-stream storage

Develop new off-stream storage sites to meet multiple basin water management objectives

Overview:

Develop new off stream storage sites to meet multiple basin water management objectives, such as enhancing industrial water supply, flow regulation for aquatic health, improved riparian health or navigation, and hydropower generation

What's already happening with this strategy:

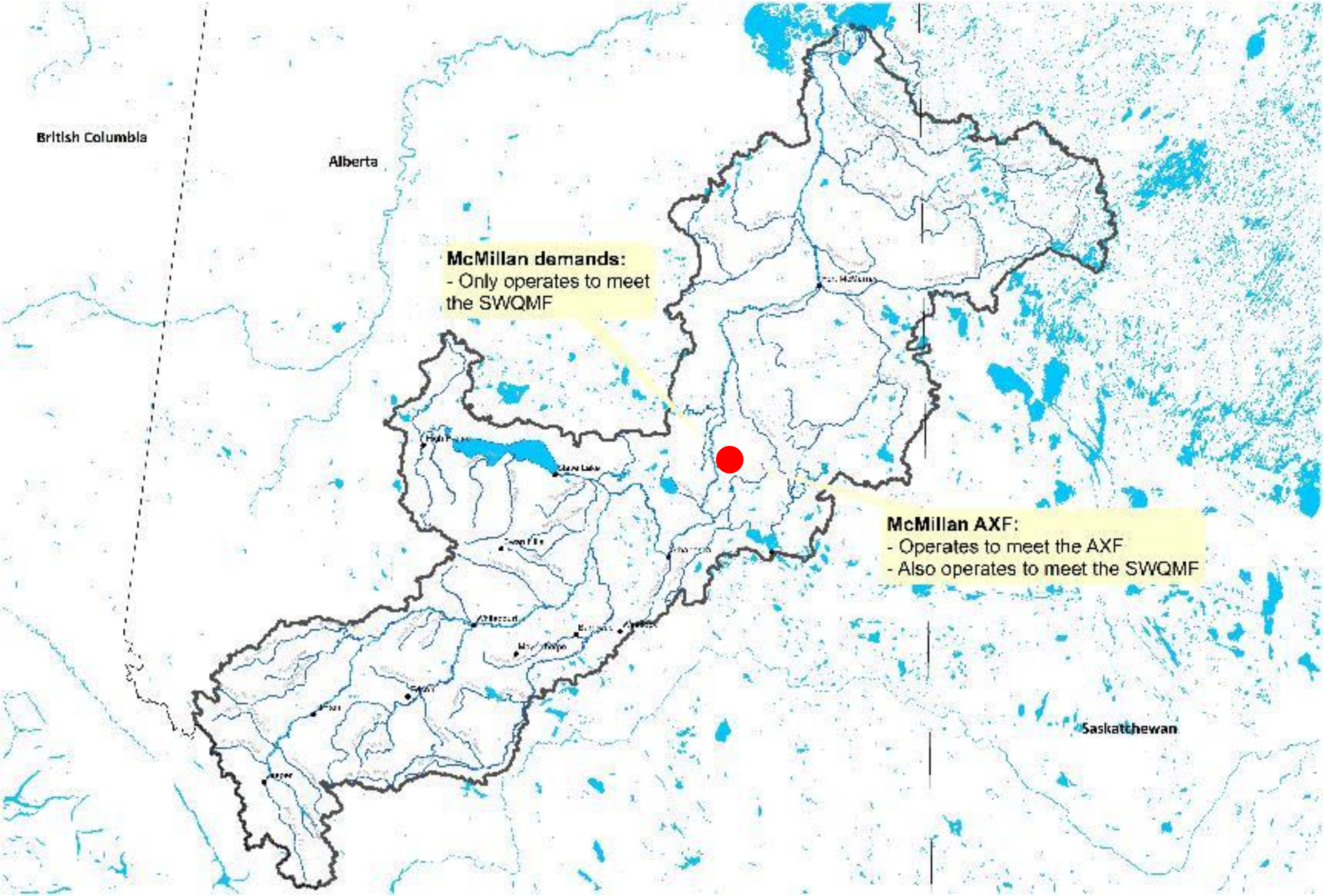
- Several oil sands sites have off-stream water storage. For example, Imperial Oil's Kearl site has storage capacity for make-up water for a 30-day period. These sites allow operators to not divert water during low flow periods; however, they were not built and designed to meet multiple basin water management objectives

How it was simulated in the model

Two model runs were done to test this strategy:

- McMillan demands: assumes both a maximum and initial storage of 100,000 dam^3 in McMillan Lake. Water would only be pumped out of the lake when necessary to meet downstream licence demands.
- McMillan AXF: assumes both a maximum and initial storage of 100,000 dam^3 in the lake. Water would be pumped out of the lake to 1) meet the AXF navigation flow target downstream, and 2) meet any downstream licence demands.

Strategy overview: Off-stream storage



Key modelling results and discussion: Off-stream storage (SWQMF)

Period and Location	Dry – McMillan demands	Historic – McMillan demands	Wet – McMillan demands
Change in number of days meeting Aboriginal Extreme Flow. *Challenge: Ensure sufficient flow for navigation*			
Annual - below Firebag confluence	-8.0 Days	0.0 Days	0.0 Days
Change in number of days over 1:100 flood thresholds. *Challenge: Limit damage from floods*			
Annual - Athabasca River at Athabasca	0.0 Days	0.0 Days	0.0 Days
Annual - McLeod River	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca upstream of Whitecourt	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca River at Hinton	0.0 Days	0.0 Days	0.0 Days
Annual - Lesser Slave River	0.0 Days	0.0 Days	0.0 Days
Annual - Pembina River at Sangudo	0.0 Days	0.0 Days	0.0 Days
Annual - Ft. McMurray	0.0 Days	0.0 Days	0.0 Days
Change in annual instream flow needs violations. *Challenge: Maintain or improve ecosystem health*			
Annual - Mouth of the Lac La Biche River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the McLeod River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Clearwater River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Lesser Slave River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Pembina River	0.0 Days	0.0 Days	0.0 Days
Change in walleye recruitment reduction. *Challenge: Maintain or improve ecosystem health*			
Annual - below Ft. McMurray	0.00%	0.00%	0.00%
Change in seasonal streamflow as a percentage of naturalized streamflow. *Challenge: Minimize the effect of development footprint on basin hydrology*			
Summer - at the Mouth	0.00%	0.00%	0.00%
Spring - at the Mouth	-13.45%	0.00%	0.00%
Fall - at the Mouth	0.00%	0.00%	0.00%
Winter - at the Mouth	36.91%	0.00%	0.04%
Change in seasonal system shortages (m3/s). *Challenge: Provide water supply certainty for municipalities and development*			
Spring - whole system	-0.13 m3/s	0.0 m3/s	0.0 m3/s
Winter - whole system	-2.09 m3/s	0.0 m3/s	-0.02 m3/s
Fall - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s
Summer - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s

Key modelling results and discussion: Off-stream storage (water use for AXF)

Period and Location	Dry – McMillan AXF	Historic – McMillan AXF	Wet – McMillan AXF
Change in number of days meeting Aboriginal Extreme Flow. *Challenge: Ensure sufficient flow for navigation*			
Annual - below Firebag confluence	32.0 Days	51.0 Days	0.0 Days
Change in number of days over 1:100 flood thresholds. *Challenge: Limit damage from floods*			
Annual - Athabasca River at Athabasca	0.0 Days	0.0 Days	0.0 Days
Annual - McLeod River	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca upstream of Whitecourt	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca River at Hinton	0.0 Days	0.0 Days	0.0 Days
Annual - Lesser Slave River	0.0 Days	0.0 Days	0.0 Days
Annual - Pembina River at Sangudo	0.0 Days	0.0 Days	0.0 Days
Annual - Ft. McMurray	0.0 Days	0.0 Days	0.0 Days
Change in annual instream flow needs violations. *Challenge: Maintain or improve ecosystem health*			
Annual - Mouth of the Lac La Biche River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the McLeod River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Clearwater River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Lesser Slave River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Pembina River	0.0 Days	0.0 Days	0.0 Days
Change in walleye recruitment reduction. *Challenge: Maintain or improve ecosystem health*			
Annual - below Ft. McMurray	0.96%	1.17%	0.00%
Change in seasonal streamflow as a percentage of naturalized streamflow. *Challenge: Minimize the effect of development footprint on basin hydrology*			
Summer - at the Mouth	0.00%	0.00%	0.00%
Spring - at the Mouth	-12.45%	1.02%	0.00%
Fall - at the Mouth	0.03%	0.49%	0.00%
Winter - at the Mouth	36.91%	0.01%	0.04%
Change in seasonal system shortages (m3/s). *Challenge: Provide water supply certainty for municipalities and development*			
Spring - whole system	-0.14 m3/s	-0.0 m3/s	0.0 m3/s
Winter - whole system	-2.09 m3/s	0.0 m3/s	-0.02 m3/s
Fall - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s
Summer - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s

Benefits and tradeoffs: Off-stream storage

Benefits

- The benefits to the basin from off-stream reservoirs would depend on what objectives the storage facility is built and operated to meet. Some possible benefits include:
  - Potential reduction in shortages to water users
  - Potentially more days meeting desired navigational flow targets
  - Potentially higher winter streamflow
  - Hydropower generation may be possible depending on how the facility is built

Trade-offs

- The potential benefits from off-stream storage would result in part from a diversion changing the natural flow regime of the source river. Changes to the natural flow regime can introduce significant trade-offs, such as: negative impact to walleye recruitment due to diversions to refill the storage during the summer fry window
- Off-stream storage may create water temperature and water quality concerns depending on the site selected and operating parameters

Implementation: Off-stream storage

Challenges

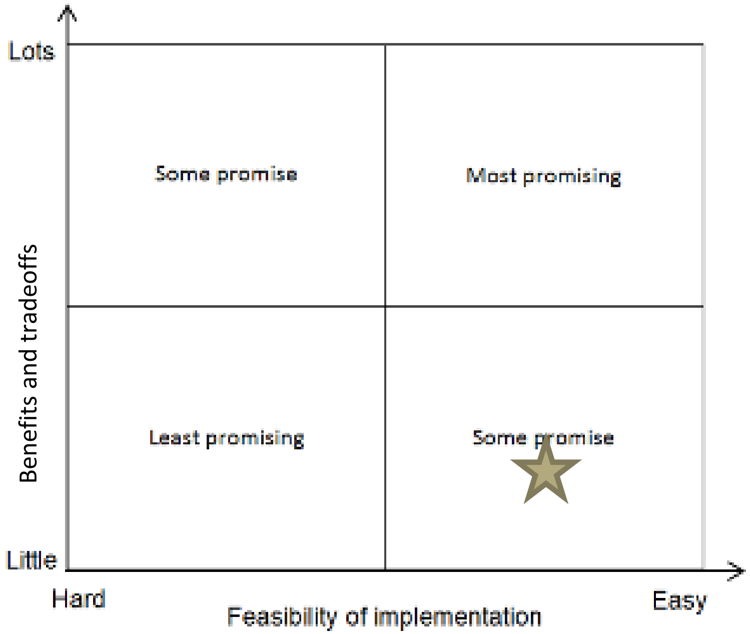
- None identified

Actions

- Develop basin purposes for any potential off-stream storage facility
- Undertake feasibility and engineering studies for specific sites to see if this strategy is viable
- Conduct an EA to identify negative consequences to the environment or Indigenous values in the area

Screening assessment

- This strategy was identified as a strategy having some promise
- This strategy is moderately feasible to implement; the benefits would be low to moderate for the basin as a whole. It is categorized as a strategy of moderate promise, relative to the other strategies assessed in this Initiative.



Strategy overview: Existing infrastructure

Alter existing water storage infrastructure and/or operations to meet multiple basin water management objectives

Overview:

Alter operations on the Paddle River Dam and alter the weir infrastructure on Lesser Slave Lake. These modifications would help meet multiple objectives in the basin, including storage for flow augmentation, licence use, flood mitigation, and restoring natural flow regimes downstream

What's already happening with this strategy:

- Paddle River Dam, which is currently used for flood control and recreation
- Weir on Lesser Slave Lake, which is currently used to reduce fluctuating lake levels and diminish flood risk

How it was simulated in the model

- Alterations to the dam and the weir were modelled together in the same strategy. Paddle River Dam operations were modified so that downstream demands would be able to pull water out of the reservoir during low flow periods when needed. The weir Lesser Slave Lake was raised by 30 cm to simulate increased storage on the lake
- Two variations of this strategy were run
    - Meet the downstream minimum flows for the SWQMF
    - Meet a downstream minimum flow of 15 m^3/s on Lesser Slave River

Key modelling results and discussion: Existing infrastructure (meeting the SWQMF)

Period and Location	Dry – Existing infrastructure	Historic – Existing infrastructure	Wet – Existing infrastructure
Change in number of days meeting Aboriginal Extreme Flow. *Challenge: Ensure sufficient flow for navigation*			
Annual - below Firebag confluence	-9.0 Days	-4.0 Days	0.0 Days
Change in number of days over 1:100 flood thresholds. *Challenge: Limit damage from floods*			
Annual - Athabasca River at Athabasca	0.0 Days	0.0 Days	0.0 Days
Annual - McLeod River	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca upstream of Whitecourt	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca River at Hinton	0.0 Days	0.0 Days	0.0 Days
Annual - Lesser Slave River	2.0 Days	137.0 Days	502.0 Days
Annual - Pembina River at Sangudo	0.0 Days	0.0 Days	0.0 Days
Annual - Ft. McMurray	0.0 Days	0.0 Days	-6.0 Days
Change in annual instream flow needs violations. *Challenge: Maintain or improve ecosystem health*			
Annual - Mouth of the Lac La Biche River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the McLeod River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Clearwater River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Lesser Slave River	-606.0 Days	3327.0 Days	1315.0 Days
Annual - Mouth of the Pembina River	55.0 Days	30.0 Days	3.0 Days
Change in walleye recruitment reduction. *Challenge: Maintain or improve ecosystem health*			
Annual - below Ft. McMurray	0.00%	0.00%	0.00%
Change in seasonal streamflow as a percentage of naturalized streamflow. *Challenge: Minimize the effect of development footprint on basin hydrology*			
Summer - at the Mouth	-0.74%	0.06%	0.03%
Spring - at the Mouth	-1.02%	-0.14%	-0.18%
Fall - at the Mouth	-0.68%	-0.23%	-0.16%
Winter - at the Mouth	0.08%	-0.40%	-0.62%
Change in seasonal system shortages (m3/s). *Challenge: Provide water supply certainty for municipalities and development*			
Spring - whole system	-0.8 m3/s	-0.01 m3/s	-0.0 m3/s
Winter - whole system	-2.93 m3/s	0.0 m3/s	-0.02 m3/s
Fall - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s
Summer - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s

Key modelling results and discussion: Existing infrastructure (not meeting the SWQMF)

Period and Location	Dry – Existing infrastructure without SWQMF	Historic – Existing infrastructure without SWQMF	Wet – Existing infrastructure without SWQMF
Change in number of days meeting Aboriginal Extreme Flow. *Challenge: Ensure sufficient flow for navigation*			
Annual - below Firebag confluence	-6.0 Days	-4.0 Days	0.0 Days
Change in number of days over 1:100 flood thresholds. *Challenge: Limit damage from floods*			
Annual - Athabasca River at Athabasca	0.0 Days	0.0 Days	-1.0 Days
Annual - McLeod River	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca upstream of Whitecourt	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca River at Hinton	0.0 Days	0.0 Days	0.0 Days
Annual - Lesser Slave River	29.0 Days	134.0 Days	495.0 Days
Annual - Pembina River at Sangudo	0.0 Days	0.0 Days	0.0 Days
Annual - Ft. McMurray	0.0 Days	0.0 Days	-6.0 Days
Change in annual instream flow needs violations. *Challenge: Maintain or improve ecosystem health*			
Annual - Mouth of the Lac La Biche River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the McLeod River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Clearwater River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Lesser Slave River	-262.0 Days	3262.0 Days	1325.0 Days
Annual - Mouth of the Pembina River	55.0 Days	30.0 Days	3.0 Days
Change in walleye recruitment reduction. *Challenge: Maintain or improve ecosystem health*			
Annual - below Ft. McMurray	-0.12%	-0.06%	0.00%
Change in seasonal streamflow as a percentage of naturalized streamflow. *Challenge: Minimize the effect of development footprint on basin hydrology*			
Summer - at the Mouth	0.13%	0.06%	0.03%
Spring - at the Mouth	1.21%	0.40%	-0.02%
Fall - at the Mouth	-0.43%	-0.23%	-0.16%
Winter - at the Mouth	0.80%	-0.07%	-0.51%
Change in seasonal system shortages (m3/s). *Challenge: Provide water supply certainty for municipalities and development*			
Spring - whole system	14.69 m3/s	5.55 m3/s	0.4 m3/s
Winter - whole system	15.73 m3/s	3.16 m3/s	0.67 m3/s
Fall - whole system	0.02 m3/s	0.0 m3/s	0.0 m3/s
Summer - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s

Benefits and tradeoffs: Existing infrastructure

Benefits

- The benefits to the basin would depend on what objectives the revised operations of the existing infrastructure are intended to meet.
- This strategy shows increased walleye recruitment due to higher than naturalized summer flows, overall this suggested improved aquatic health

Trade-offs

- Increased flooding hazard on the Lesser Slave River and Lesser Slave Lake due to higher peak flows and increased lake elevation
- Decreased water quality may be expected as increased erosion and sedimentation could result from higher peak flows
- Lower winter flows would also be expected on Lesser Slave River and would thus create more IFN violations, and could potentially increase shortages to water users

Implementation: Existing infrastructure

Challenges

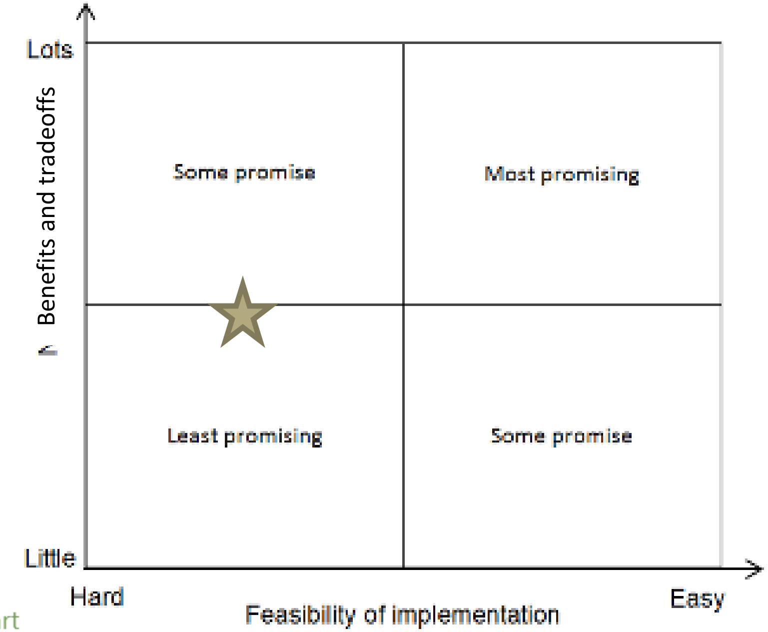
- There are negative social and recreational impacts associated with an increase in the water level on Lesser Slave Lake and the Paddle River Reservoir
- There are few large scale existing facilities in the ARB that could have operational changes for the benefit of the basin
- The operational changes proposed in this strategy may not be feasible or useful given the low benefits seen with this strategy

Actions

- Develop and implement a lake management plan for the Lesser Slave Lake region; this plan should create clear management objectives for lake levels, water allocations, and downstream flows on Lesser Slave Lake to optimize aquatic health, flood mitigation, and recreational and navigational opportunities

Screening assessment

- This strategy was identified as a least promising strategy
- As it was modelled, the effect of modifying existing infrastructure and operations in the basin may not be socially or ecologically feasible due to increased flooding risk and increased IFN violations
- This strategy could be something that could be considered due to its low net impacts



Strategy overview: Environmental flows

Establish IFNs for all tributaries in the basin as a precautionary water management measure

Overview:

Set IFN targets on all tributaries in the basin using the existing Alberta Desktop method. This is intended to proactively manage ecosystem health.

What's already happening with this strategy:

- The Lower Athabasca Region Surface Water Quantity Management Framework (SWQMF)
- All new TDLs issued are subject to IFNs as calculated using the Alberta Desktop method
- A modified desktop method is currently being developed to guide water allocations so that ecosystem health can be maintained
- Water sharing agreements between oil sands operators

How it was simulated in the model

- The Alberta Desktop Method was applied to five tributaries in the model (McLeod, Pembina, Lesser Slave, Lac La Biche, and Clearwater) to set an IFN minimum flow target at the mouth of each tributary. The Alberta Desktop method is the greater of either a 15% reduction in naturalized flow or the Q80 of weekly naturalized flow. Upstream demands were shorted in order to meet the IFN whenever necessary.

Key modelling results and discussion: Environmental flows

Period & Location	Dry – Environmental flows	Historic – Environmental flows	Wet – Environmental flows
Change in number of days meeting Aboriginal Extreme Flow. *Challenge: Ensure sufficient flow for navigation*			
Annual - below Firebag confluence	3.0 Days	0.0 Days	0.0 Days
Change in number of days over 1:100 flood thresholds. *Challenge: Limit damage from floods*			
Annual - Athabasca River at Athabasca	0.0 Days	0.0 Days	0.0 Days
Annual - McLeod River	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca upstream of Whitecourt	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca River at Hinton	0.0 Days	0.0 Days	0.0 Days
Annual - Lesser Slave River	0.0 Days	0.0 Days	0.0 Days
Annual - Pembina River at Sangudo	0.0 Days	0.0 Days	0.0 Days
Annual - Ft. McMurray	0.0 Days	0.0 Days	0.0 Days
Change in annual instream flow needs violations. *Challenge: Maintain or improve ecosystem health*			
Annual - Mouth of the Lac La Biche River	-30.0 Days	-16.0 Days	-20.0 Days
Annual - Mouth of the McLeod River	-470.0 Days	-177.0 Days	-156.0 Days
Annual - Mouth of the Clearwater River	-189.0 Days	-37.0 Days	-56.0 Days
Annual - Mouth of the Lesser Slave River	-2661.0 Days	-1481.0 Days	-1953.0 Days
Annual - Mouth of the Pembina River	-577.0 Days	-504.0 Days	-328.0 Days
Change in walleye recruitment reduction. *Challenge: Maintain or improve ecosystem health*			
Annual - below Ft. McMurray	-13.50%	-7.15%	-7.85%
Change in seasonal streamflow as a percentage of naturalized streamflow. *Challenge: Minimize the effect of development footprint on basin hydrology*			
Summer - at the Mouth	0.70%	0.24%	0.34%
Spring - at the Mouth	1.91%	0.73%	0.69%
Fall - at the Mouth	1.23%	0.31%	0.47%
Winter - at the Mouth	2.48%	1.01%	1.18%
Change in seasonal system shortages (m3/s). *Challenge: Provide water supply certainty for municipalities and development*			
Spring - whole system	18.88 m3/s	5.88 m3/s	13.59 m3/s
Winter - whole system	28.38 m3/s	7.09 m3/s	13.66 m3/s
Fall - whole system	23.02 m3/s	5.45 m3/s	10.31 m3/s
Summer - whole system	16.32 m3/s	5.54 m3/s	11.28 m3/s

Benefits and tradeoffs: Environmental flows

Benefits

- This strategy results in decreased IFN violations throughout the basin, as well as an increase in seasonal streamflow across all four seasons
- This strategy results in increased walleye recruitment, suggesting an improvement to fishery health
- Under dry conditions this strategy results in a slight increase in days that navigational flows are met

Trade-offs

- This strategy has substantial increases in water shortages to all users over all seasons as licences are shorted in order to meet IFNs

Implementation: Environmental flows

Challenges

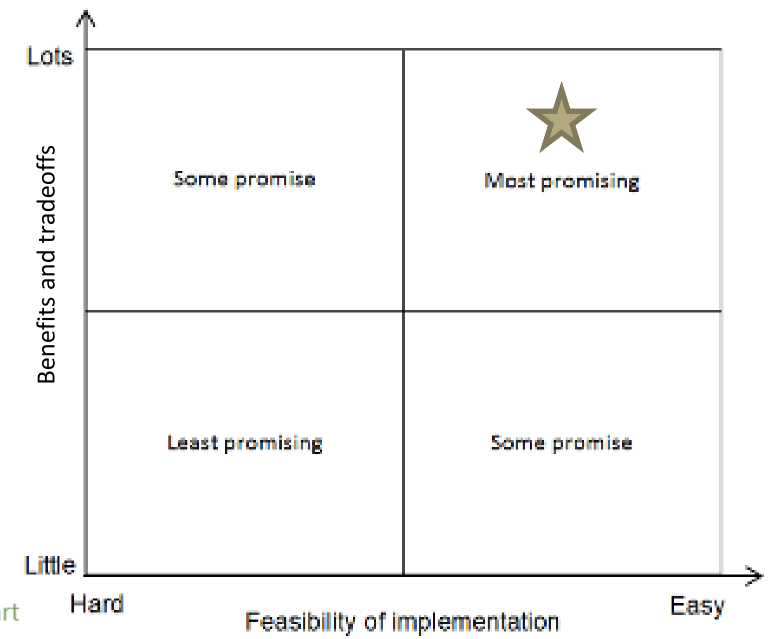
- There is no water management plan in place that speaks directly to IFN minimum flows

Actions

- Establish IFNs in an approved water management plan by exploring the potential of using the Modified Desktop Method to establish the IFN targets
- Develop a database of tributaries that have habitat at risk and/or species at risk and limit water allocations, implement IFNs, and/or restrict activities in those areas
- Determine watershed withdrawal limits based on environmental factors (e.g., a carrying capacity) and manage licences with that limit in mind
- Communicate broadly, in an accessible way, when IFNs are implemented on a licence or a specific stream

Screening assessment

- This strategy was identified as a most promising strategy
- This strategy would have positive net benefits and high feasibility. The most promising use of this strategy is to apply the desktop limits (or modified desktop limits as is currently being developed) to the model to see where the pressures are for water supply, this can be used to illustrate and quantify supply risks to the "next person in the licence queue"



Strategy overview: Navigational flows

Implement minimum flows to improve navigation in the lower Athabasca basin

Overview:

Improve navigation during the open water season on the Athabasca River downstream of the confluence with the Firebag River. The minimum flow is based on the AXF, which is defines a minimum flow of 400 m^3/s between April 16 and October 28. In this strategy, upstream licence demands are shorted to meet the AXF flow target whenever necessary.

What's already happening with this strategy:

- Currently there is no established minimum flow for navigational purposes in the ARB

How it was simulated in the model

- Based on the flow and timing suggested by the AXF, the model applies a minimum flow target of 400 m^3/s downstream of the confluence with the Firebag River, between April 16 and October 28 of each year. The model will short upstream licence users during that period to keep flow in the river and reach the 400 m^3/s target

Key modelling results and discussion: Navigational flows

Period and Location	Dry – Navigational flows	Historic – Navigational flows	Wet – Navigational flows
Change in number of days meeting Aboriginal Extreme Flow. *Challenge: Ensure sufficient flow for navigation*			
Annual - below Firebag confluence	13.0 Days	6.0 Days	0.0 Days
Change in number of days over 1:100 flood thresholds. *Challenge: Limit damage from floods*			
Annual - Athabasca River at Athabasca	0.0 Days	0.0 Days	0.0 Days
Annual - McLeod River	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca upstream of Whitecourt	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca River at Hinton	0.0 Days	0.0 Days	0.0 Days
Annual - Lesser Slave River	0.0 Days	0.0 Days	0.0 Days
Annual - Pembina River at Sangudo	0.0 Days	0.0 Days	0.0 Days
Annual - Ft. McMurray	0.0 Days	0.0 Days	0.0 Days
Change in annual instream flow needs violations. *Challenge: Maintain or improve ecosystem health*			
Annual - Mouth of the Lac La Biche River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the McLeod River	-1.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Clearwater River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Lesser Slave River	-10.0 Days	-1.0 Days	0.0 Days
Annual - Mouth of the Pembina River	0.0 Days	0.0 Days	0.0 Days
Change in walleye recruitment reduction. *Challenge: Maintain or improve ecosystem health*			
Annual - below Ft. McMurray	-0.29%	-0.48%	0.00%
Change in seasonal streamflow as a percentage of naturalized streamflow. *Challenge: Minimize the effect of development footprint on basin hydrology*			
Summer - at the Mouth	0.00%	0.00%	0.00%
Spring - at the Mouth	0.03%	0.02%	0.00%
Fall - at the Mouth	0.02%	0.02%	0.00%
Winter - at the Mouth	0.00%	0.00%	0.00%
Change in seasonal system shortages (m3/s). *Challenge: Provide water supply certainty for municipalities and development*			
Spring - whole system	0.67 m3/s	0.45 m3/s	0.0 m3/s
Winter - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s
Fall - whole system	0.7 m3/s	0.62 m3/s	0.0 m3/s
Summer - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s

Benefits and tradeoffs: Navigational flows

Benefits

- Under dry conditions this strategy provides 13 more days where the navigational flow targets are met, under historic conditions the navigational flow targets are met six more days
- This strategy increases walleye recruitment because of higher streamflow during the open water season which overlaps with the walleye recruitment window
- This strategy decreases the number of days when the IFN is violated in some sub-basins by a small amount

Trade-offs

- In this strategy upstream water users would be shorted during the spring and fall. Users would be shorted in a priority sequence; however, all upstream users may experience a shortage

Implementation: Navigational flows

Challenges

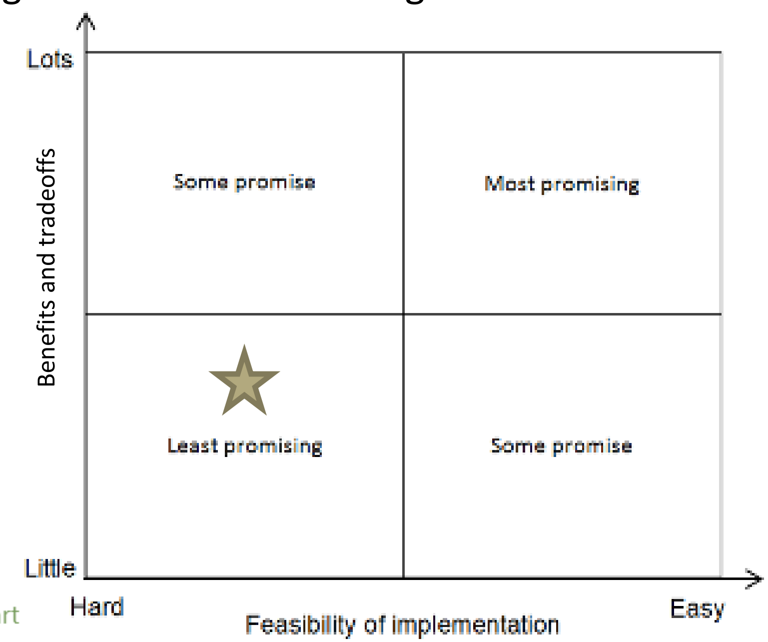
- There is no water management plan in place that defines minimum flows for optimal and sub-optimal navigation
- This strategy requires a greater understanding of navigational needs along different reaches in the Lower Athabasca River, at different temporal scales, including what constitutes minimum acceptable conditions for navigation as well as optimal conditions
- A better understanding of the impacts of climate change on navigational requirements would facilitate implementation

Actions

- Develop a navigation model to understand navigation channels and their changes through time; this model should consider possible future changes in streamflow
- Assess means of obtaining minimum flows for navigation or alternate navigation

Screening assessment

- This strategy was identified as a least promising strategy (as it is modelled)
- Most Working Group participants thought this strategy would have little benefit and that it would be reasonably difficult to implement (i.e., cutting off all water licences upstream)
- It was widely noted that minimum flows for navigation should be implemented in conjunction with other water management strategies, such as off-stream storage)



Strategy overview: Land conservation

Increase the quantity and improve the condition of conserved and restored land across the basin, particularly in areas of high biodiversity or hydrologic importance

Overview

This strategy is intended to maintain and improve hydrologic function and watershed health. It has potential throughout the entire basin but is focused on the upper and central portions. Areas for conservation and restoration have been pre-identified by the Canadian Parks and Wilderness Society (CPAWS), the Alberta Wilderness Association, and Ducks Unlimited Canada.

What's already happening with this strategy:

- Possible conservations areas include the CPAWS high conservation areas for biodiversity, the CPAWS Net Present Value model areas, the AWA areas of concern, and the DUC key wetland areas
- Under LARP, approximately 16% of the Lower Athabasca's land base is managed as new conservation areas in addition to the 6% already protected as wildland provincial parks

Strategy overview: Land conservation

How it was simulated in the model

- Any areas in the CPAWS NPV20 (CPAWS20), and CPAWS NPV50 (CPAWS50) footprints that are human-made were simulated as being restored to a natural land cover
- Footprints to be restored included agriculture, mines, small roads, pipelines, seismic lines, and powerlines
- Features to be excluded from conversion included urban areas, major roads, recreation areas, and trails
- In the model, fires were suppressed and would not be active in the conserved landscape. Suppressing fire was agreed to at a Working Group meeting in order to isolate the effect of simply conserving land without other confounding factors

Key modelling results and discussion: Land conservation (CPAWS20)

Period and Location	Dry - CPAWS20	Historic - CPAWS20	Wet - CPAWS20
Change in number of days meeting Aboriginal Extreme Flow. *Challenge: Ensure sufficient flow for navigation*			
Annual - below Firebag confluence	-3.0 Days	-3.0 Days	0.0 Days
Change in number of days over 1:100 flood thresholds. *Challenge: Limit damage from floods*			
Annual - Athabasca River at Athabasca	0.0 Days	0.0 Days	0.0 Days
Annual - McLeod River	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca upstream of Whitecourt	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca River at Hinton	0.0 Days	-3.0 Days	1.0 Days
Annual - Lesser Slave River	-1.0 Days	-4.0 Days	-23.0 Days
Annual - Pembina River at Sangudo	0.0 Days	0.0 Days	0.0 Days
Annual - Ft. McMurray	0.0 Days	0.0 Days	-1.0 Days
Change in annual instream flow needs violations. *Challenge: Maintain or improve ecosystem health*			
Annual - Mouth of the Lac La Biche River	94.0 Days	56.0 Days	7.0 Days
Annual - Mouth of the McLeod River	1.0 Days	5.0 Days	5.0 Days
Annual - Mouth of the Clearwater River	311.0 Days	200.0 Days	36.0 Days
Annual - Mouth of the Lesser Slave River	59.0 Days	144.0 Days	118.0 Days
Annual - Mouth of the Pembina River	-73.0 Days	-52.0 Days	-21.0 Days
Change in walleye recruitment reduction. *Challenge: Maintain or improve ecosystem health*			
Annual - below Ft. McMurray	0.00%	0.00%	0.00%
Change in seasonal streamflow as a percentage of naturalized streamflow. *Challenge: Minimize the effect of development footprint on basin hydrology*			
Summer - at the Mouth	-0.02%	-0.02%	-0.01%
Spring - at the Mouth	0.05%	-0.04%	-0.01%
Fall - at the Mouth	-0.04%	-0.01%	-0.02%
Winter - at the Mouth	-0.03%	-0.01%	-0.02%
Change in seasonal system shortages (m3/s). *Challenge: Provide water supply certainty for municipalities and development*			
Spring - whole system	0.02 m3/s	0.0 m3/s	0.0 m3/s
Winter - whole system	0.04 m3/s	0.0 m3/s	0.0 m3/s
Fall - whole system	-0.0 m3/s	0.0 m3/s	0.0 m3/s
Summer - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s

Key modelling results and discussion: Land conservation (CPAWS50)

Period and Location	Dry - CPAWS50	Historic - CPAWS50	Wet - CPAWS50
Change in number of days meeting Aboriginal Extreme Flow. *Challenge: Ensure sufficient flow for navigation*			
Annual - below Firebag confluence	-11.0 Days	-8.0 Days	0.0 Days
Change in number of days over 1:100 flood thresholds. *Challenge: Limit damage from floods*			
Annual - Athabasca River at Athabasca	0.0 Days	0.0 Days	-1.0 Days
Annual - McLeod River	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca upstream of Whitecourt	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca River at Hinton	0.0 Days	-3.0 Days	2.0 Days
Annual - Lesser Slave River	-4.0 Days	-22.0 Days	-68.0 Days
Annual - Pembina River at Sangudo	0.0 Days	0.0 Days	0.0 Days
Annual - Ft. McMurray	0.0 Days	0.0 Days	-5.0 Days
Change in annual instream flow needs violations. *Challenge: Maintain or improve ecosystem health*			
Annual - Mouth of the Lac La Biche River	503.0 Days	404.0 Days	407.0 Days
Annual - Mouth of the McLeod River	176.0 Days	128.0 Days	137.0 Days
Annual - Mouth of the Clearwater River	546.0 Days	333.0 Days	153.0 Days
Annual - Mouth of the Lesser Slave River	322.0 Days	601.0 Days	382.0 Days
Annual - Mouth of the Pembina River	-199.0 Days	-160.0 Days	-115.0 Days
Change in walleye recruitment reduction. *Challenge: Maintain or improve ecosystem health*			
Annual - below Ft. McMurray	0.00%	0.00%	0.00%
Change in seasonal streamflow as a percentage of naturalized streamflow. *Challenge: Minimize the effect of development footprint on basin hydrology*			
Summer - at the Mouth	-0.14%	-0.05%	-0.09%
Spring - at the Mouth	-0.16%	-0.09%	-0.05%
Fall - at the Mouth	-0.12%	-0.05%	0.01%
Winter - at the Mouth	-0.19%	-0.07%	-0.07%
Change in seasonal system shortages (m3/s). *Challenge: Provide water supply certainty for municipalities and development*			
Spring - whole system	0.04 m3/s	0.0 m3/s	0.0 m3/s
Winter - whole system	0.1 m3/s	0.0 m3/s	0.0 m3/s
Fall - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s
Summer - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s

Benefits and trade-offs: Land conservation

Benefits

This strategy would have many benefits that cannot be seen in the model, including:

- Increasing conserved or reclaimed land would decrease sediment loading
- There would be a benefits of having a more natural landscape in terms of societal and ecological values
- There would be a benefit of additional baseflow in the winter due to higher amounts of storage and subsequent release of water from the landscape
- Fewer flood days on the Lesser Slave River
- Fewer IFN violations in the Pembina Basin

Trade-offs

- More days where flow is below the navigational target because water is being stored rather than contributing to runoff
- More IFN violations in all other sub-basins; however, this is confounded by the current IFN calculation
- More shortages under dry conditions

Implementation: Land conservation

Challenges

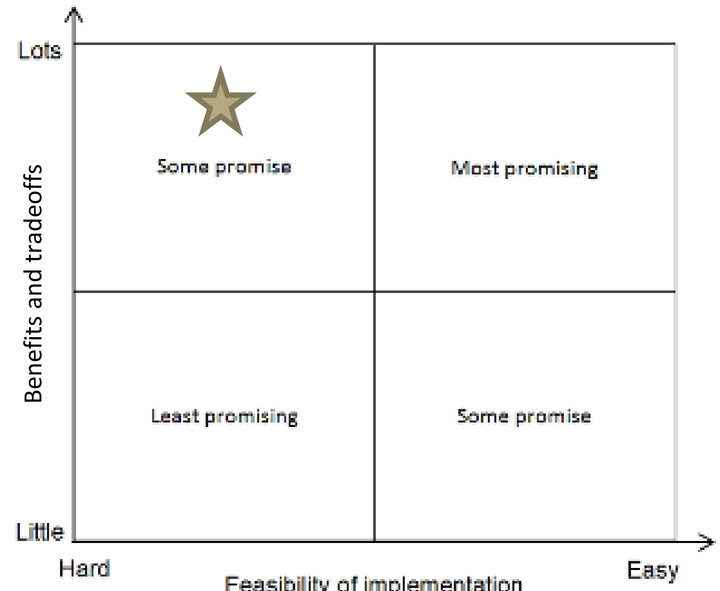
- Any increase in conservation will likely present political challenges
- Implementing this strategy as it was simulated would be difficult considering the economic constraints and lack of political appetite for restoring or reclaiming agricultural lands

Actions

- Develop a land use plan for the whole basin that sets aside areas for conservation
- Make available adequate funding to support conservation and restoration initiatives
- Identify sites of highest conservation and restoration priority that would have the greatest positive impact on peatland complexes, tributaries, and connectivity
  - Potential to build on work from recent WRRP project in the Bow and North Saskatchewan Basins

Screening Assessment

- This strategy was identified as having some promise
- Considering that the Lower Athabasca Regional Plan sets aside 16% of the land in that region for conservation, a CPAWS 20% conservation target may be achievable. A 50% target would be more challenging



Strategy overview: Forestry practices

Support practices in Forest Management Agreements (FMAs) that minimize hydrologic change

Overview

This strategy envisions the continued promotion and enforcement of timber harvest best management practices that minimize hydrologic change. Examples of such practices include:

- Timber Supply Review and updates to Annual Allowable Cut
- Minimize Equivalent Clearcut Area
- Maintaining healthy riparian areas

What's already happening with this strategy:

- Watershed and Disturbance Assessments
- Integrated forest-watershed planning and assessment model
- Alpac and Ducks Unlimited MOU to establish watershed conservation partnership

How it was simulated in the model:

- Simulation explored the strategy by modelling the hydrologic effect of not managing forest disturbance
- This was done by doubling forest disturbance relative to current (approximately 28,000 km^2 of new disturbed forest relative to base case)

Key modelling results and discussion: Forestry practices

Note that this is modelled as an increase in forest harvest

Period and Location	Dry – Forestry practices	Historic – Forestry practices	Wet – Forestry practices
Change in number of days meeting Aboriginal Extreme Flow. *Challenge: Ensure sufficient flow for navigation*			
Annual - below Firebag confluence	29.0 Days	32.0 Days	0.0 Days
Change in number of days over 1:100 flood thresholds. *Challenge: Limit damage from floods*			
Annual - Athabasca River at Athabasca	0.0 Days	1.0 Days	4.0 Days
Annual - McLeod River	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca upstream of Whitecourt	0.0 Days	1.0 Days	0.0 Days
Annual - Athabasca River at Hinton	3.0 Days	19.0 Days	0.0 Days
Annual - Lesser Slave River	43.0 Days	174.0 Days	225.0 Days
Annual - Pembina River at Sangudo	0.0 Days	0.0 Days	0.0 Days
Annual - Ft. McMurray	1.0 Days	3.0 Days	22.0 Days
Change in annual instream flow needs violations. *Challenge: Maintain or improve ecosystem health*			
Annual - Mouth of the Lac La Biche River	-2565.0 Days	-1079.0 Days	-1093.0 Days
Annual - Mouth of the McLeod River	-1140.0 Days	-884.0 Days	-743.0 Days
Annual - Mouth of the Clearwater River	-1109.0 Days	-806.0 Days	-690.0 Days
Annual - Mouth of the Lesser Slave River	-1942.0 Days	-2169.0 Days	-1334.0 Days
Annual - Mouth of the Pembina River	-643.0 Days	-584.0 Days	-405.0 Days
Change in walleye recruitment reduction. *Challenge: Maintain or improve ecosystem health*			
Annual - below Ft. McMurray	0.00%	0.00%	0.00%
Change in seasonal streamflow as a percentage of naturalized streamflow. *Challenge: Minimize the effect of development footprint on basin hydrology*			
Summer - at the Mouth	0.30%	0.16%	0.12%
Spring - at the Mouth	0.39%	0.16%	0.17%
Fall - at the Mouth	0.28%	0.13%	0.18%
Winter - at the Mouth	0.48%	0.22%	0.20%
Change in seasonal system shortages (m3/s). *Challenge: Provide water supply certainty for municipalities and development*			
Spring - whole system	-0.11 m3/s	-0.01 m3/s	-0.02 m3/s
Winter - whole system	-0.74 m3/s	0.0 m3/s	-0.03 m3/s
Fall - whole system	-0.03 m3/s	0.0 m3/s	0.0 m3/s
Summer - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s

Benefits and trade-offs: Forestry practices

Reminder: This strategy was modelled in an inverse manner, therefore the modelling results show the outcomes of a lack of forest practices that minimise hydrological change.

Benefits

- The results demonstrate that increasing the level of forest disturbance does in fact increase flood days; therefore, a benefit of managing disturbance levels is lowering flood potential
- The results for some of the PMs (IFN violations, walleye recruitment reduction) suggest that removing forest cover would result in more flow in the rivers; however, the strategy is to not remove forest. Therefore, the strategy would be assumed to hold more water on the landscape. This is beneficial to the watershed, while perhaps slightly reducing flow in the river.
- Benefits would be seen in smaller watersheds with higher relative levels of disturbance as opposed to the entire basin

Trade-offs

- Lower harvest levels have the potential to have economic consequences

Implementation: Forestry practices

Challenges

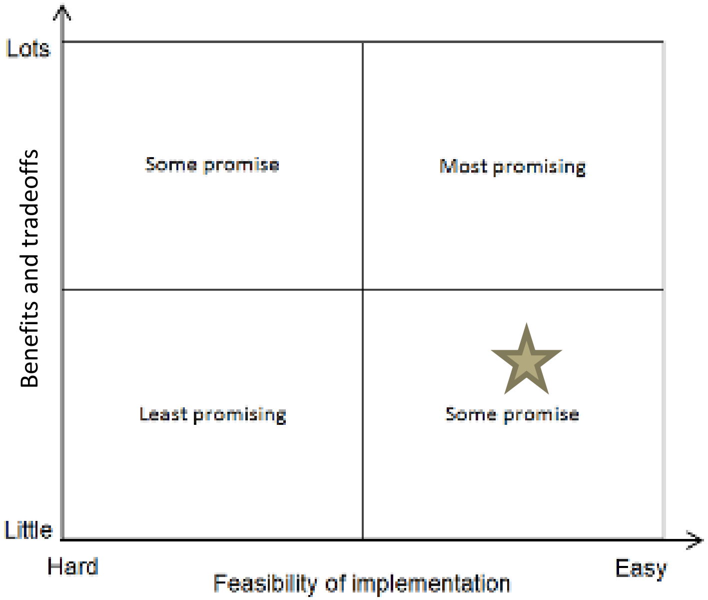
- BMPs can help mitigate the hydrologic effects of forest disturbance at all scales but they are not always put in place. As well, deviations can be granted to Operating Ground Rules with little transparency, wetlands are not always buffered, riparian assessment and retention practices often vary from one FMA to another, and forestry activities are not regulated on private land

Actions

- Alter harvest regimes in some watersheds identified to be hydrologically sensitive
- Improve compliance and application of forestry BMPs
- Incentivize BMPs (e.g., vary types of trees that are replanted, desynchronize runoff from the watershed, reclaim logging roads, retain riparian reserves and management zones around lakes, wetlands, and all streams)

Screening Assessment

- This strategy was identified as having some promise
- This strategy is easy to implement, and would yield moderate benefit at large scales, with potential for substantial benefit at smaller scales
- This strategy is generally seen as an integral and necessary step to sustainable and flexible water and watershed management in the ARB



Strategy overview: Wetlands

Avoid further wetland loss and promote more wetland restoration

Overview

Avoid wetland loss and promote wetland restoration through the continued refinement, implementation, and enforcement of related legislation, policies, and mechanisms such as the Alberta Wetland Policy. The rationale for this strategy is to maintain or improve the hydrological benefits of wetlands, including groundwater recharge, sustained baseflow, water quality, flow attenuation, and others.

What's already happening with this strategy:

- Alberta Wetland policy
- Ducks Unlimited project on quantifying hydrologically sensitive wetlands
- Most mines have wetland reclamation as part of their mine closure plans and sustainability goals
- Watershed Resiliency and Restoration Program (WRRP)

Strategy overview: Wetlands

Reminder: This strategy was modelled in an inverse manner, therefore the modelling results show the outcomes of a decreasing wetlands.

How it was simulated in the model

Model simulated a 30% relative decrease in wetland coverage in the following sub-basins:

- Athabasca River (between Athabasca and Fort McMurray)
- Lac La Biche
- House River
- Christina River

This represents approximately 458 km^2 of wetlands converted to disturbed (non permeable) land

This strategy is modelled as a decrease in wetlands to illustrate the importance of wetlands and their conservation on the landscape

Key modelling results and discussion: Wetlands

Note that this is modelled as a decrease in wetland area

Period and Location	Dry - Wetlands	Historic - Wetlands	Wet - Wetlands
Change in number of days meeting Aboriginal Extreme Flow. *Challenge: Ensure sufficient flow for navigation*			
Annual - below Firebag confluence	N/A	1.0 Days	0.0 Days
Change in number of days over 1:100 flood thresholds. *Challenge: Limit damage from floods*			
Annual - Athabasca River at Athabasca	N/A	0.0 Days	0.0 Days
Annual - McLeod River	N/A	0.0 Days	0.0 Days
Annual - Athabasca upstream of Whitecourt	N/A	0.0 Days	0.0 Days
Annual - Athabasca River at Hinton	N/A	0.0 Days	0.0 Days
Annual - Lesser Slave River	N/A	0.0 Days	-1.0 Days
Annual - Pembina River at Sangudo	N/A	0.0 Days	0.0 Days
Annual - Ft. McMurray	N/A	0.0 Days	0.0 Days
Change in annual instream flow needs violations. *Challenge: Maintain or improve ecosystem health*			
Annual - Mouth of the Lac La Biche River	N/A	-721.0 Days	-879.0 Days
Annual - Mouth of the McLeod River	N/A	0.0 Days	8.0 Days
Annual - Mouth of the Clearwater River	N/A	-5.0 Days	-120.0 Days
Annual - Mouth of the Lesser Slave River	N/A	0.0 Days	18.0 Days
Annual - Mouth of the Pembina River	N/A	0.0 Days	-9.0 Days
Change in walleye recruitment reduction. *Challenge: Maintain or improve ecosystem health*			
Annual - below Ft. McMurray	N/A	0.00%	0.00%
Change in seasonal streamflow as a percentage of naturalized streamflow. *Challenge: Minimize the effect of development footprint on basin hydrology*			
Summer - at the Mouth	N/A	0.01%	0.01%
Spring - at the Mouth	N/A	0.00%	0.00%
Fall - at the Mouth	N/A	0.01%	0.01%
Winter - at the Mouth	N/A	0.01%	0.01%
Change in seasonal system shortages (m3/s). *Challenge: Provide water supply certainty for municipalities and development*			
Spring - whole system	N/A	-0.0 m3/s	0.0 m3/s
Winter - whole system	N/A	0.0 m3/s	0.0 m3/s
Fall - whole system	N/A	0.0 m3/s	0.0 m3/s
Summer - whole system	N/A	0.0 m3/s	0.0 m3/s

Benefits and trade-offs: Wetlands

Benefits

- Simulation results suggest there could be higher streamflow as a result of less storage of water in wetlands, this is demonstrated through fewer IFN violations; therefore, the results provide evidence that maintaining wetlands on the landscape is important given that they do play an important role hydrologically
- Wetland conservation and restoration can increase overall ecosystem health, providing habitat for wildlife, hydrologic connectivity, and diversity across the landscape

Trade-offs

- None identified

Implementation: Wetlands

Challenges

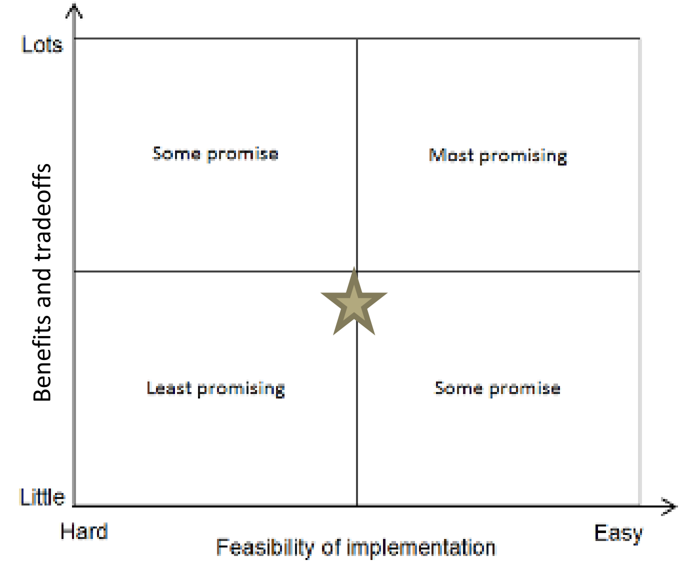
- This strategy would benefit from a deeper understanding and classification of wetland types and associated hydrological sensitivities (e.g., fens may be more sensitive than bogs, swamps, or marshes)
- Traditional Ecological Knowledge could be another valuable resource for better understanding wetlands and their role and the need to protect and conserve them

Actions

- Implement land use planning restrictions to limit residential development and its impacts on lakes and wetlands, specifically in the Lac La Biche area
- Improve understanding of hydrologically sensitive wetlands (additional data and modelling are needed to support this)
- Integrate research on how changes in hydrologic connectivity affect water volumes
- Implement and adopt as standard operations wetland BMPs, including avoidance of wetland loss

Screening Assessment

- This strategy was identified as a strategy having some promise
- Implementation would be fairly easy if it means following the Alberta Wetland Policy more rigorously. Alternatively, if it means that all wetlands in the ARB must be preserved, implementation would be much more challenging



Strategy overview: Linear connectivity

Reclaim linear features and reduce future linear disturbances in watersheds

Overview

Reduce the total linear footprint on the landscape through mechanisms such as road and trail deactivation, seismic line reclamation, and restrictions on off-highway vehicle use. Linear features fragment the landscape and have the potential to interrupt hydrologic functions, ultimately affecting streamflow. This strategy reduces this interruption and aims to determine the hydrological impact of linear disturbances in terms of changes to streamflow.

What's already happening with this strategy:

- COSIA has a few major initiatives to address linear disturbances
    - Algar Historic Restoration Project
    - Linear Deactivation Project
    - Cenvous Caribou Habitat Restoration Project
- Integrated land management plan outlined in LARP strongly emphasizes timely restoration of linear disturbances.

Strategy overview: Linear connectivity

How it was simulated in the model

- This strategy was tested by reclaiming 40% of linear features (trails, minor roads, seismic lines, pipelines) in the following regions:
    - Christina River (15 km2 reclaimed)
    - Hangingstone River (4 km2 reclaimed)
    - Muskeg River (20 km2 reclaimed)
    - MacKay River (8 km2 reclaimed)

- The AIRM replaces disturbed features, which are characterized by surfaces with low permeability and no vegetation, with forest (higher soil permeability and vegetation)

- It is important to note that the AIRM model only changes the landscape type and does not necessarily remove the linear feature entirely. This may result in residual effects that obstruct flow and alter streamflow accumulation in a watershed

Key modelling results and discussion: Linear connectivity

Period and Location	Dry – Linear connectivity	Historic – Linear connectivity	Wet – Linear connectivity
Change in number of days meeting Aboriginal Extreme Flow. *Challenge: Ensure sufficient flow for navigation*			
Annual - below Firebag confluence	0.0 Days	0.0 Days	0.0 Days
Change in number of days over 1:100 flood thresholds. *Challenge: Limit damage from floods*			
Annual - Athabasca River at Athabasca	0.0 Days	0.0 Days	0.0 Days
Annual - McLeod River	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca upstream of Whitecourt	0.0 Days	0.0 Days	0.0 Days
Annual - Athabasca River at Hinton	3.0 Days	0.0 Days	0.0 Days
Annual - Lesser Slave River	0.0 Days	0.0 Days	0.0 Days
Annual - Pembina River at Sangudo	0.0 Days	0.0 Days	0.0 Days
Annual - Ft. McMurray	0.0 Days	0.0 Days	-1.0 Days
Change in annual instream flow needs violations. *Challenge: Maintain or improve ecosystem health*			
Annual - Mouth of the Lac La Biche River	1.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the McLeod River	-4.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Clearwater River	38.0 Days	21.0 Days	21.0 Days
Annual - Mouth of the Lesser Slave River	0.0 Days	0.0 Days	0.0 Days
Annual - Mouth of the Pembina River	0.0 Days	0.0 Days	0.0 Days
Change in walleye recruitment reduction. *Challenge: Maintain or improve ecosystem health*			
Annual - below Ft. McMurray	0.00%	0.00%	0.00%
Change in seasonal streamflow as a percentage of naturalized streamflow. *Challenge: Minimize the effect of development footprint on basin hydrology*			
Summer - at the Mouth	0.00%	0.00%	0.00%
Spring - at the Mouth	0.01%	0.00%	0.00%
Fall - at the Mouth	0.00%	0.00%	0.00%
Winter - at the Mouth	0.00%	0.00%	0.00%
Change in seasonal system shortages (m3/s). *Challenge: Provide water supply certainty for municipalities and development*			
Spring - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s
Winter - whole system	-0.0 m3/s	0.0 m3/s	0.0 m3/s
Fall - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s
Summer - whole system	0.0 m3/s	0.0 m3/s	0.0 m3/s

Benefits and trade-offs: Linear connectivity

Benefits

- Low net benefit to streamflow at the scale of the basin, since hydrologic change is often proportional to the area disturbed and linear features don't represent a large area in and of themselves
- From an ecosystem perspective, reclaiming linear features can help improve water quality by reversing the fragmenting effects on wildlife habitat

Trade-offs

- Slightly more IFN violations due to increased interception and lower streamflows

Implementation: Linear connectivity

Challenges

- Low net benefit to streamflow at the scale of the basin (potentially high benefit at smaller scales)
- Likely environmental and ecological benefits
- Likely improvements in water quality

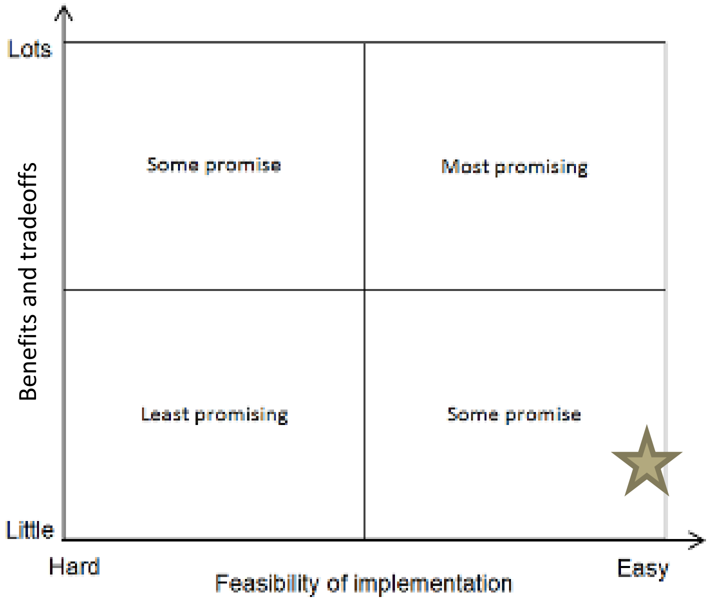
Actions

- Reduce linear disturbance of development by encouraging industry to collaborate and minimize disturbance.
- Increase reclamation compliance by revisiting old reclamation plans and matching their intent and details with current policy goals and practices, and by improving enforcement and timing of reclamation.
- Address access management by improving land use management to minimize the impact of all types of access on the landscape.
- Target priority reclamation sites by building on the WRRP work in the Bow Basin for identifying high value restoration and conservation sites.
- Fill the data and science gap by increasing understanding of how changes in hydrologic connectivity affect water volume, and acquiring data about which seismic lines are and are not compacted in the basin.

Implementation: Linear connectivity

Screening Assessment

- This strategy was identified as having some promise
- Although the overall net benefit is low, this strategy would be feasible and easy to implement. Furthermore, the strategy would likely have environmental and ecological benefits that are unrelated to water quantity, such as improved water quality and aquatic health, improved wildlife habitat and connectivity, and improved biodiversity on the landscape
- There is already a push for linear reclamation in the ARB and this strategy could be part of a greater conservation and reclamation land use strategy



Strategy overview: (Oil sands) mining reclamation

Continue to set and meet high standards of reclamation of energy footprint to maintain or improve hydrological functions in a watershed

Overview:

Support continued reclamation practices and enforcement in the energy sector. This strategy aims to ensure mines are reclaimed in a manner that restores or improves watershed functions. It would apply wherever there is an energy footprint in the basin.

What's already happening with this strategy:

- Muskeg River Watershed Integrity Management Framework
- Oil Sands Mine reclamation plans

How it was simulated in the model

- No modelling was done for this strategy as detailed mine scale water management was not in the scope of the project

Benefits and trade-offs: (Oil sands) mining reclamation

Benefits

- Potential benefits include re-establishment of hydrologic functions and naturalization of the hydrograph

Trade-offs

- Potential decreases in streamflow as a result of increased interception

Implementation: (Oil sands) mining reclamation

Challenges

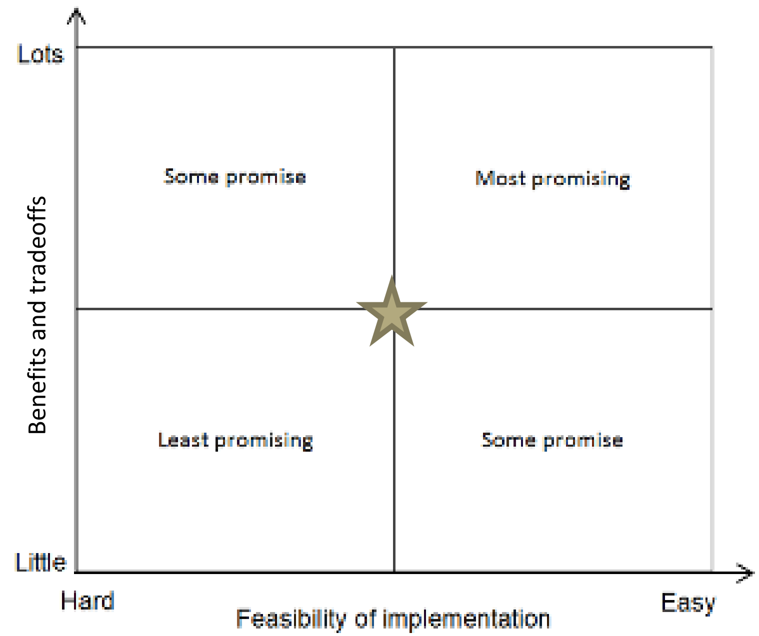
- Potential benefits would include re-establishment of hydrologic functions in the disturbed areas leading to a re-naturalization of the hydrograph

Actions

- Potential to build on the mine reclamation modelling work of CEMA to support and inform reclamation in the region

Screening assessment

- This strategy was identified as a strategy with some promise. However, detailed modelling should be conducted to thoroughly and more confidently screen the degree of promise that this strategy holds



Today’s discussion

9:00	Welcome, introductions, and opening remarks	Mike
9:20	Plenary session 1: basin overview • Reminder of the basin today, learnings and basin challenges	Megan
10:05	Break	All
10:45	Breakout groups: refinement of updated strategies • Participants to rotate through 3 tables and all strategies to provide feedback and additional changes to strategies • Document additional comments • Recap of strategy refinements from breakout groups	All
12:35	Lunch	-
1:20	**Plenary session 2: discussion of recommendations for sustainable water management and actionable steps**	**Claire**
2:20	Break	All
2:35	Plenary session 3: discussion on finishing the Roadmap and what happens next • Mechanics of finishing the Roadmap and communication plans • How to move the Roadmap forward	Megan
3:35	Next steps, and close • Next steps to finalize the Roadmap document • Communication and project close out plans	Mike

Draft recommendations for sustainable water management in the ARB

The project team has developed six actionable recommendations for sustainable water management in the ARB

- Are these recommendations useful to move towards sustainable water management in the AEB?
- Are these recommendations founded on work done by the Working Group?

Draft recommendations for sustainable water management in the ARB

1. **Conserve or better manage what is happening on the landscape** to reduce negative impacts on river flow and water quality.

2. **Establish minimum flows** for watershed health to address specific environmental needs and provide certainty to industry and the public as to the amount and nature of remaining water available for use.

3. **Establish multi-purpose objectives for new on or off-stream projects** to understand and inform how future storage could support basin flow needs.

4. **Increase communication** to the active water community and education to the general public to support sustainable water management.

5. **Address most critical gaps** in data, processes, policy, and knowledge related to sustainable water management.

6. Continue to develop the means to **share, capture and apply traditional knowledge** to sustainable water management.

Draft recommendations for sustainable water management in the ARB (1 of 6)

Conserve or better manage what is happening on the landscape to reduce negative impacts on river flow and water quality

Actions:

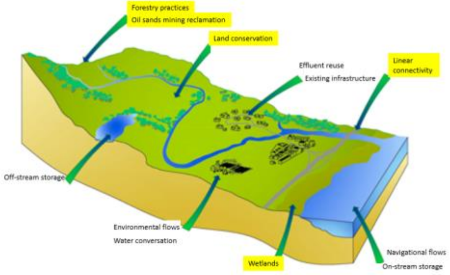
1. Develop a land use plan for the whole basin that sets aside areas for conservation
2. Identify sites of highest conservation and restoration priority that would have the greatest positive impact on peatland complexes, tributaries, and connectivity
3. Improve understanding of hydrologically sensitive wetlands
4. Fill data and science gaps by increasing the understanding of how changes in hydrologic connectivity affect water volumes

Corresponding strategies:

- Land conservation
- Forest practices
- Wetlands
- Linear connectivity
- Mine reclamation

Corresponding challenges:

- Maintaining or improving water quality
- Maintaining or improving ecosystem health
- Minimizing the effort of development footprint on basin hydrology



Draft recommendations for sustainable water management in the ARB (2 of 6)

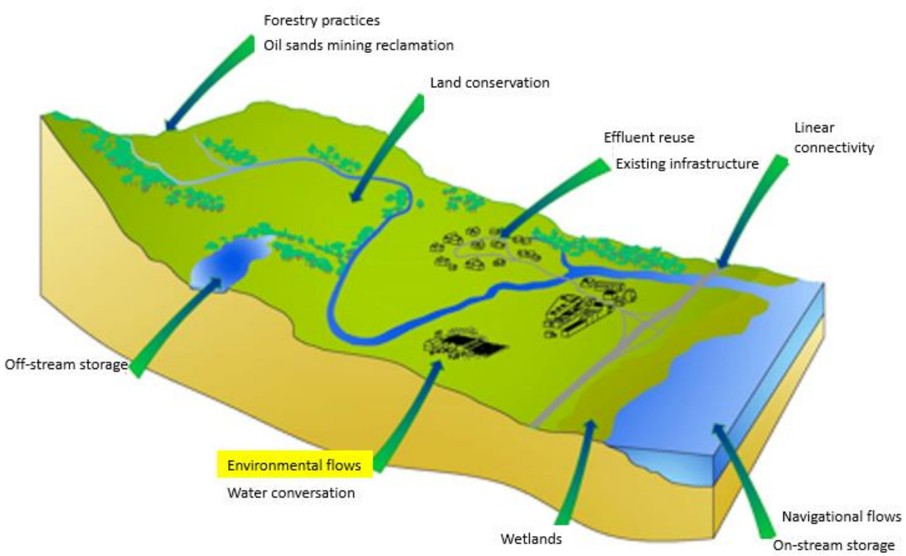
Establish minimum flows for watershed health to address specific environmental needs and provide certainty to industry and the public as to the amount and nature of remaining water available for use.

Actions:

1. Establish IFNs in an approved water management plan by exploring the potential of using the Modified Desktop Method to establish the IFN targets

Corresponding strategies:

- Environmental flows



Corresponding challenges:

- Providing water supply certainty for development
- Maintaining or improving ecosystem health
- Maintaining or improving the health of the Peace Athabasca Delta (PAD)
- Addressing concerns around treaty rights

Draft recommendations for sustainable water management in the ARB (3 of 6)

Establish multi-purpose objectives for new on or off-stream projects to understand and inform how future storage could support basin flow needs

Actions:

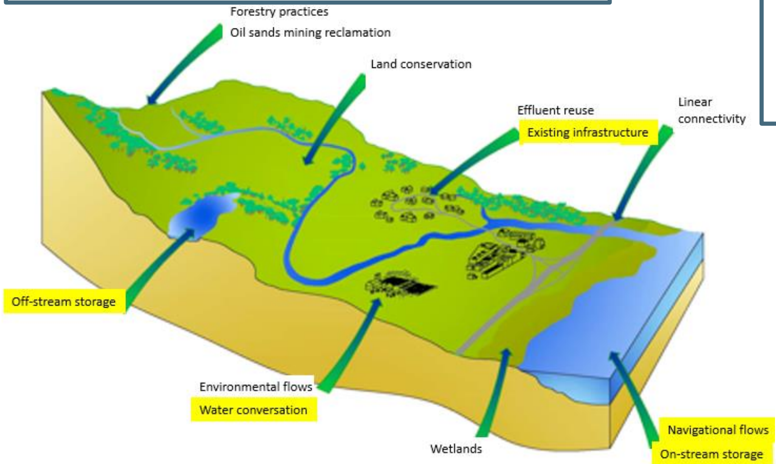
1. Develop basin purposes for any potential on-stream storage facility; should a project be advanced, it would meet basin objectives in addition to energy generation

Corresponding strategies:

- On-stream storage
- Off-stream storage
- Environmental flows
- Navigational flows
- Existing infrastructure

Corresponding challenges:

- Providing water supply certainty for development
- Maintaining or improving ecosystem health
- Understanding the renewable energy potential of the basin
- Ensuring sufficient flow for navigation
- Limiting damage from floods or extreme events



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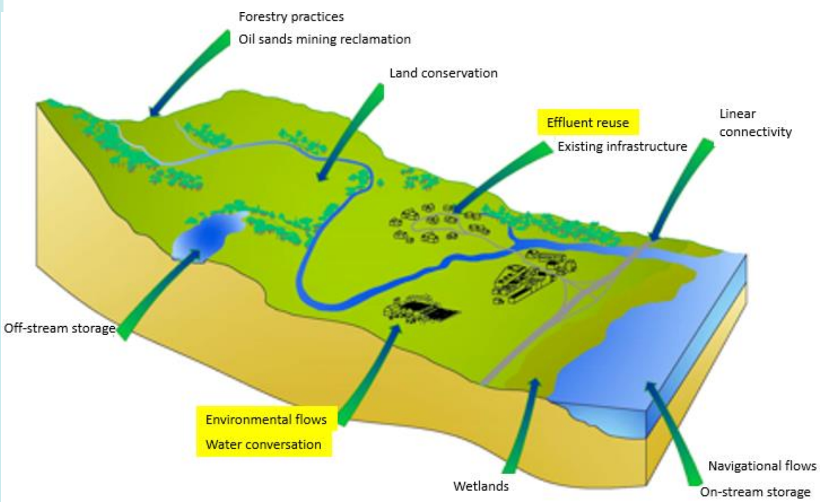
Draft recommendations for sustainable water management in the ARB (4 of 6)

Increase communication to the active water community and education to the general public to support sustainable water management

Actions:

1. Communicate broadly, in an accessible way, when IFNs are implemented on a licence or a specific stream
2. Outreach and education programs should be implemented for all municipalities and for all industrial and commercial developments. Awareness and education are vital for the combined success of conservation as a strategy.



Corresponding strategies:

- Water conservation
- Environmental flows
- Effluent reuse

Corresponding challenges:

- Maintaining or improving ecosystem health
- Accessing data and knowledge in the basin around water
- Minimizing the effect of development footprint on basin hydrology

Draft recommendations for sustainable water management in the ARB (5 of 6)

Address most critical gaps in data, processes, policy, and knowledge related to sustainable water management

Actions:

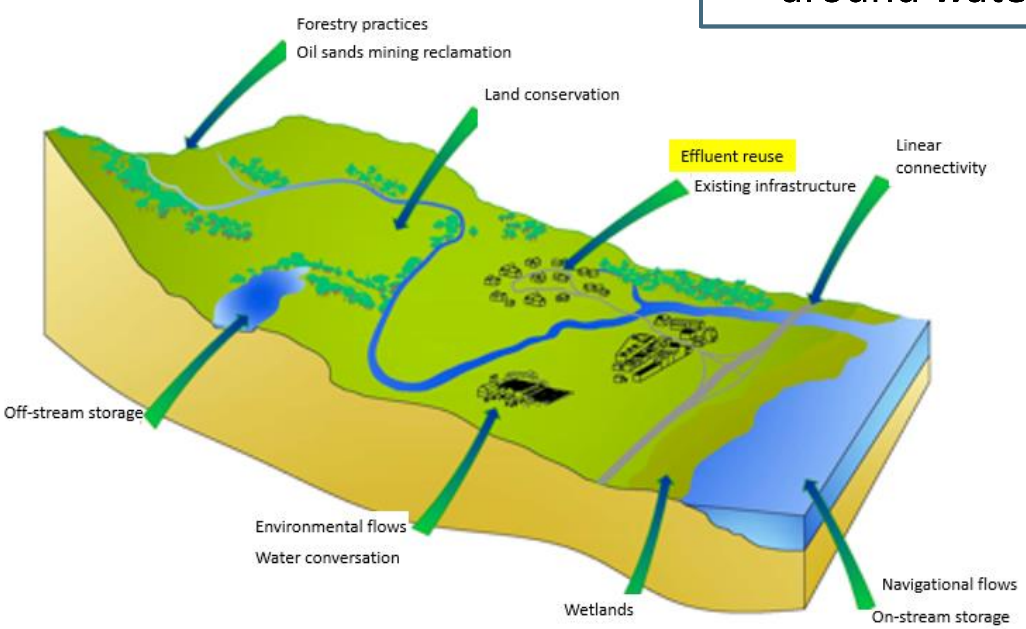
1. Develop and implement a basin-wide or province-wide water reuse policy. Such a policy should change, clarify, or create clear direction for decisions on water reuse.
2. Fill the gaps, starting with the most critical gaps.

Corresponding strategies:

- Effluent reuse

Corresponding challenges:

- Accessing data and knowledge in the basin around water



Running list of gaps: data, knowledge, processes, policy

Data	Knowledge	Processes	Policy
Technology for real-time measurement of winter flows Monitoring and data collection of snowpack, tributary streamflow, and meteorological data in the upper portion of the ARB Awareness of and ready access to all public data sets (e.g., snow surveys) Spill tracking records system and reporting requirements Groundwater withdrawal reporting All water use data for allocation management	Understanding the linkage between hydrology (soil moisture) and wildfires Mapping of hydrologically sensitivity areas in the basin that supply water to sub-basins and are locally important to communities Development of indicators that correlate changes in flow and impacts in ecosystems Understanding of the hydrological effect of watershed and local scale connectivity Understanding of the hydrological effect of an oil sands mine on sub-basin hydrology	Address how to manage tributaries where there is currently no flow data Include water incident related reporting and monitoring (industrial incidents) in water data Prioritize reclamation through strong reclamation modelling	Implement a basin wide water re-use policy Establish a water conservation objective for the basin Establish a water management plan for the basin

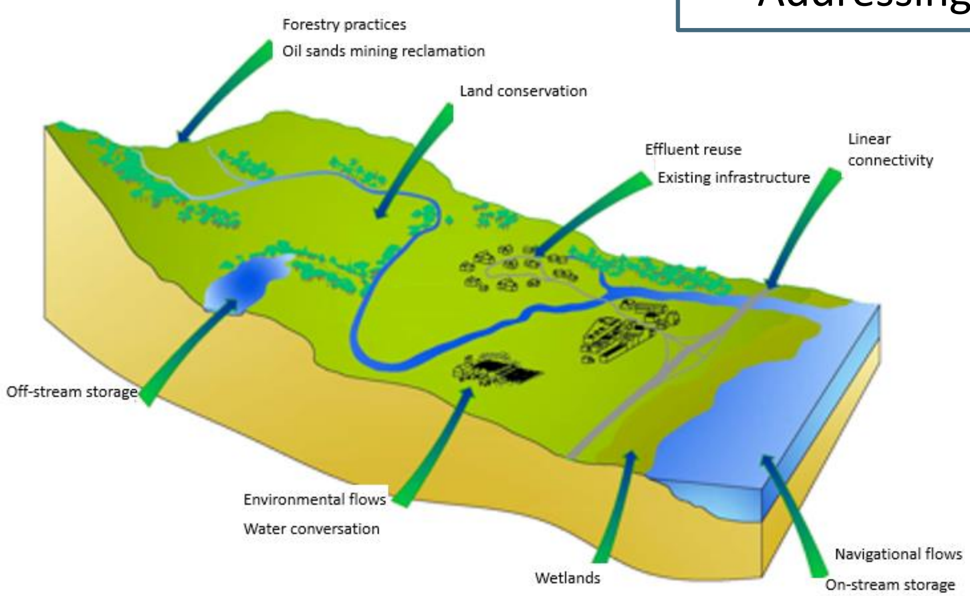
Draft recommendations for sustainable water management in the ARB (6 of 6)

Continue to develop the means to share, capture and apply traditional knowledge to sustainable water management

Actions:

1. Implement all of the above mentioned actions with a awareness and incorporation of TEK.

Corresponding strategies:



Corresponding challenges:

- Maintaining or improving ecosystem health
- Addressing concerns around treaty rights

Draft recommendations for sustainable water management in the ARB

1. Conserve or better manage what is happening on the landscape to reduce negative impacts on river flow and water quality.
2. Establish minimum flows for watershed health to address specific environmental needs and provide certainty to industry and the public as to the amount and nature of remaining water available for use.
3. Establish multi-purpose objectives for new on or off-stream projects to understand and inform how future storage could support basin flow needs.
4. Increase communication to the active water community and education to the general public to support sustainable water management.
5. Address most critical gaps in data, processes, policy, and knowledge related to sustainable water management.
6. Continue to develop the means to share, capture and apply traditional knowledge to sustainable water management.

Water challenges in the ARB	1	2	3	4	5	6
Maintaining or improving ecosystem health	X	X	X	X		X
Providing water supply certainty for development		X	X			
Minimizing the effect of development footprint on basin hydrology	X			X		
Ensuring sufficient flow for navigation			X			
Limiting damage from floods or extreme events			X			
Maintaining or improving the health of the Peace Athabasca Delta (PAD)		X				
Addressing concerns around treaty rights		X				X
Accessing data and knowledge in the basin around water				X	X	
Maintaining or improving water quality	X					
Understanding the renewable energy potential of the basin			X			

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3:35	Next steps, and close • Next steps to finalize the Roadmap document • Communication and project close out plans	Mike

For discussion

Discussion: Plans for finishing the Roadmap

90% complete report will be drafted by WaterSMART by the end of May

- Author will be WaterSMART, not the "ARB Working Group"
- Plan to list organizations and communities that have had a representative at one or more Working Group meeting or Sharing Session as "contributors" to the project - list will be emailed to confirm this
- Welcome volunteers to review drafts

90% complete report will be posted publicly for comment for 1 month (~June)

Project team will share and refine 90% presentation throughout the summer

Project team is determining effective means to e-share project data, model and model results

Final report and presentation will be published in September 2018

For discussion

Discussion: Plans for communicating the Roadmap

Current thinking for final communication plans include:

90% complete report will be posted publicly for comment for 1 month

Project team will share and refine 90% presentation throughout the summer through in-community sharing sessions

- Present Roadmap (story, strategies, actions) as identified by the Working Group
- Explore benefit to community
- Explore other water-related concerns/areas of interest for future consideration

Project team is determining effective means to e-share project data, model and model results – may include informative video format

Final report and presentation will be shared electronically for others to share and use

Discussion: Opportunities to advance Roadmap

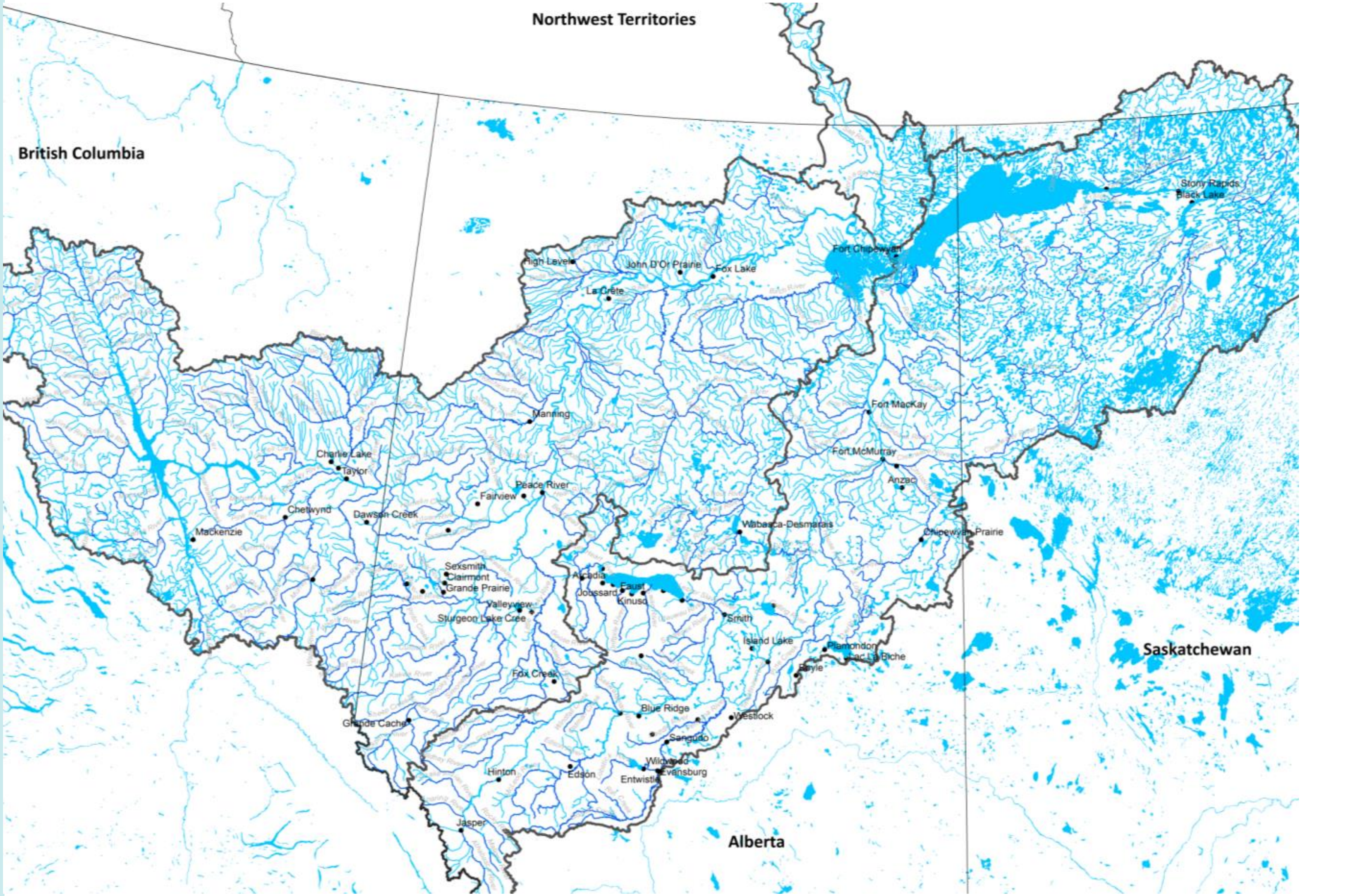
Greater common understanding
Scientific fact base
Athabasca Integrated River Model (AIRM)
Forum for collaborative discussion

Where we could go from here; perhaps:

- Communication of project findings
- Implementation of recommended actions
- ARB phase 4
- Active forum for sustainable water management
- Other suggestions?

Possible scope looking forward

Previous thinking on next steps for the ARB Initiative (2015)



Possible scope looking forward

Previous thinking on next steps for the ARB Initiative (2015)

Phase 1: Draft Initiative scope and long term vision, funding strategy, project structure, communication materials, and Working Group contact list (2014-2015).

Phase 2: A collaborative Working Group representing Indigenous and non-Indigenous groups from across the basin. Review of issues, interests, and opportunities, and draft performance measures (2015-2016).

Phase 3: Common understanding of surface water quantity in the ARB, a shared platform of data and tools, and a roadmap with practical immediate and long-term strategies for sustainable water management in the ARB (2016-2018).

Phase 4: Understanding, platform, and roadmap of water quality (including effects of air deposition) strategies for the ARB (target 2018-2019).

Phase 5: Understanding, platform, and roadmap of groundwater and aquatic resource strategies for the ARB (timeline TBD).

Phase 6: Knowledge integration and system wide support for basin water management based on roadmap for sustainable water management developed in Phases 3-5 by the Working Group (timeline TBD).

Today's discussion

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3:35	**Next steps, and close** • **Next steps to finalize the Roadmap document** • **Communication and project close out plans**	**Mike**

Collaborative process to develop the ARB Roadmap

Working Group meetings	**Understand** the current state of the basin	**Define** the problem or improvement	**Identify & refine** potential strategies	**Assess & sort** which are the better strategies	**Combine** the better strategies to fix / improve	**Recommend** what should be done next
	WG expertise & AIRM	*Working list of issues*	*Working list of opportunities*	*AIRM & PMs*	*Roadmap*	*Next steps*
1						
2						
3						
4		*				
5						
6				*		
7					*	
8						*

focus of work lesser focus * key milestone

Immediate next steps

- WaterSMART will draft meeting summary and distribute to Working Group members for review. Meeting materials are also posted on the ARB Initiative website.
- Come see us if you'd like to be involved in reviewing the final report
- Come see us if your group / organisation / community is interested in a presentation
- Email will be sent out asking if your organisation/community can be listed as a contributor

Please contact us if you have any thoughts, questions, comments!

Thank you!

Thank you to our funders:

Thank you to those who have contributed by sharing invaluable perspectives, including:

- First Nations and Métis communities
- Federal and Provincial Governments and related agencies
- Municipalities, Counties and Districts
- Watershed Planning and Advisory Councils (WPACs)
- Environmental non-government organizations (ENGOs)
- Industry (coal, agriculture, oil and gas, forestry, oil sands, utility companies)

All meeting and project materials are posted on the ARB Initiative website (visit www.albertawatersmart.com or Google "ARB Initiative")

Thank you for all your support and participation

Water: the key to our sustainable future

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waterSMART
Water Management Solutions

For more information:

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