



Wapiti River Water Management Plan

**Wapiti River Water Management Plan
Steering Committee**



28 January 2019

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- Aquatera Utilities Inc.
- City of Grande Prairie
- ConocoPhillips Canada Ltd./Cenovus Energy Inc.
- County of Grande Prairie No.1
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- Fisheries Management, Alberta Environment and Parks
- International Paper Company
- Mighty Peace Watershed Alliance
- Municipal District of Greenview
- Nitehawk Ski Hill
- Seven Generations Energy
- Sturgeon Lake Cree Nation
- Town of Beaverlodge

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Executive Summary

The purpose of the Wapiti River Water Management Plan (the Plan) is to provide guidance to Alberta Environment and Parks and Alberta Energy Regulator staff when making water allocation decisions under the *Water Act*, and where appropriate, under the *Environmental Protection and Enhancement Act*. Recommendations under the *Water Act* focus on the amount of water available for allocation to human needs, while protecting the aquatic environment.

The Plan provides direction on how to best balance the needs of municipal water supply, industry uses, and a healthy aquatic ecosystem, in the Alberta portion of the Wapiti River basin, through the recommendation of a Water Conservation Objective (WCO). The principal recommendations of the Plan encompass both actions that are the legislated responsibility of Alberta Environment and Parks and the Alberta Energy Regulator under the *Water Act*, and actions that are best developed and implemented through a collaborative process.

The recommended Water Conservation Objective (WCO):

- When natural flow¹ in the Wapiti River below Big Mountain Creek is above 20 m³/s: net water use² up to 2 m³/s is allowed in Wapiti River basin;
- When natural flow in the Wapiti River below Big Mountain Creek is between 10 m³/s and 20 m³/s: net water use up to 1 m³/s is allowed in Wapiti River basin; and
- When natural flow in the Wapiti River below Big Mountain Creek is less than 10 m³/s: net water use of 8% of natural flows are allowed in Wapiti River basin.

The WCO will be applied to:

- all new surface water allocation authorizations in the Alberta portion of the Wapiti River basin under the *Water Act*;
- Aquatera Utilities 2013 junior licence (Licence No. 00277161-00-00, Priority No. 2011-05-02-003); and
- where a provision exists and the Director finds cause, may be applied to other licences subject to renewal under the *Water Act*.

The WCO in this plan was developed for Segment A (Figure 2) of the Wapiti River. All other existing water allocation authorizations shall retain their original conditions, including any instream objectives specified.

¹ Natural flows = flow that would occur naturally if there were zero water withdrawals or returns

² Net water use = gross diversions minus returns

As Segment A is the furthest downstream reach within the Wapiti River basin, all new water allocation authorizations in the Alberta portion of the Wapiti River basin are subject to meeting this WCO. New water allocation authorizations in the Alberta portion of the Wapiti River basin outside of Segment A, may also be subject to their own reach or water body specific objectives, WCOs, or other regulatory requirements, in addition to this Wapiti River WCO.

The Plan contains the following supportive actions to implement the WCO:

- Continue advancing a coordinated aquatic ecosystem health monitoring approach among water licence holders.
- Implement a reliable method for determining reference natural flows.
- Report cumulative water use in the Wapiti River basin.
- Review the Plan's implementation progress with the community at least every five years.
- Review the WCO every 10 years.
- Review of the Plan may be triggered if:
 - (a) significant new allocations are approved in the British Columbia portion of the basin;
 - or
 - (b) net water use by International Paper exceeds their current net use (0.04 m³/s) that was used to inform the Steering Committee's recommended WCO.

Recommendations for watershed management priorities:

- Develop a watershed management plan or source water protection plan for the Wapiti River basin that considers cumulative watershed impacts and solutions.
- Improve understanding of the relative contributions of point and non-point source water pollution through collection of field data and the development of a water quality model.

Watershed management plan process implementation:

- A future watershed management plan or source water protection plan will be undertaken through a collaborative process.
- Industry stakeholders and governments are recommended to actively participate and contribute financially to the development and the implementation of the watershed management plan or source water protection plan.
- Alberta Environment and Parks and industry stakeholders should contribute in collecting the necessary field data to calibrate, validate and strengthen the water quality model. The model is required to ascertain knowledge about the relative contributions of point and non-point source pollutions.

This Water Management Plan and future watershed management priorities for the Wapiti River basin will contribute to and support the outcomes of the future Upper Peace regional planning processes. The Plan was developed in a collaborative partnership with the Wapiti River Water Management Plan Steering Committee which consisted of local municipalities, industry stakeholders, Indigenous communities, the Department of Fisheries and Oceans Canada, the Mighty Peace Watershed Alliance, and Alberta Environment and Parks.

1.0 Background

The impetus for developing the Wapiti River Water Management Plan (the Plan) was a concern about Wapiti River water diversions during winter low flow periods. The concern was highlighted during a water licensing process that began in 2006 and concluded in 2013 with the issuance of a term water licence to Aquatera, a local water and utilities provider, with the condition that the licence would be amended to be in accordance with the Plan.

In response, Alberta Environment and Parks, in collaboration with local key stakeholders, established the Wapiti River Water Management Plan Steering Committee in 2012 (Appendix A), and together they initiated development of a Water Conservation Objective (WCO) and recommendations for the Wapiti River basin to support present and future economic and social activities while managing and protecting aquatic resources.

1.1 Context of the Plan

The Wapiti River basin is home to the City of Grande Prairie, one of the fastest growing communities in Alberta, as well as numerous other smaller population centers and Indigenous settlements. In addition to the thriving urban growth, this area supports active and prosperous forestry, agricultural, and oil and gas sectors. As the area's economy continues to flourish, population growth and industrial development place greater pressure on the demand for water. The Wapiti River is an important source of water for all of these uses, and continued population growth and economic development will be highly dependent on reliable quantities and quality of water.

The Wapiti River receives continuous industrial and municipal wastewater discharges as well as other point and non-point source pollution. These, together with water diversions and returns, affect the physical, chemical and biological characteristics of the Wapiti River aquatic ecosystem, especially during periods of low flow. Climate change adds a level of uncertainty to water supply. Such changes may also affect human use and enjoyment of the Wapiti River.

The essence of a water management plan is to strike the right balance between a sustainable environment and the economic and the social well-being of Albertans. The Wapiti River Water Management Plan was developed in accordance with Alberta's Framework for Water Management Planning (Alberta Environment, 2001). The Plan is intended to help the agencies responsible for water licence approvals, Alberta Environment and Parks and the Alberta Energy Regulator, make water management decisions under the *Water Act*.

1.2 Purpose and Objectives of the Plan

The purpose of the Plan is to provide guidance on water allocation decisions for the Alberta portion of the Wapiti River basin. The Plan is to provide greater clarity, consistency, and transparency regarding water allocation decisions while balancing human and environmental needs.

The Plan provides a recommendation for:

- The amount of water available for allocation for out-of-river human needs; and,
- The amount of water required for protecting the health and integrity of the Wapiti River aquatic ecosystem.

More specifically, the objectives of the Plan are to:

- Recommend a Water Conservation Objective (WCO) to Alberta Environment and Parks and the Alberta Energy Regulator that best balances water consumption and protection of the aquatic environment, while taking into consideration environmental, social and economic interests by:
 - Determining the current water allocation, demand and supply for the Wapiti River;
 - Estimating potential future water demand and supply within the Wapiti River basin;
 - Developing a science-based environmental flow needs assessment that includes water quantity, water quality, habitat and aquatic species necessary for protection of the aquatic resource; and,
 - Considering Indigenous perspectives on treaty rights, recognized Metis harvesting and traditional land uses in the area.
- Create a foundation for future integrated watershed management planning by:
 - Providing a comprehensive account of the major issues, challenges, priorities and objectives within the watershed; and,
 - Prioritizing key watershed issues and challenges that should be considered in a watershed management plan.

Since the focus of this plan is on water allocations, other potential watershed issues such as water quality, point and non-point source pollution, groundwater, and land uses are only addressed to the extent necessary for this Plan. It is anticipated that these issues will be addressed in other proposed planning processes such as the government-led Upper Peace Regional Land Use Plan or a future watershed management plan or source water protection plan.

The Wapiti River Water Management Plan is based on a 25-year time horizon of predicted water demands in the region. The Plan was developed with the best available scientific information at the time and considerations of social and economic interest of all stakeholders. However, the Plan will be amended or updated if circumstances change, or if there is a need to address

significant adverse effects on the aquatic environment not reasonably foreseeable at the time of Plan development.

1.3 Regulatory and Policy Context

The Plan was developed within the context of provincial policies and strategic directions to manage water resources (Table 1). Water allocations are regulated under the *Water Act*, and where appropriate, the *Environmental Protection and Enhancement Act*, which are administered by Alberta Environment and Parks and the Alberta Energy Regulator.

Specifically, the Plan provides allocation guidance through recommendations as a Water Conservation Objective (WCO), outlined in the *Water Act* (RSA 2000 Ch W-3, Section 1(hhh)) as:

“...the amount and the quality of water, established by the Director...based on information available to the Director, to be necessary for the

- i. protection of a natural water body or its aquatic environment, or any part of them,*
- ii. protection of tourism, recreational, transportation or water assimilation uses of water, or*
- iii. management of fish and wildlife,*

and may include water necessary for the rate of flow of water or water level requirements.”

A water management plan should be considered by Alberta Environment and Parks and the Alberta Energy Regulator when making day-to-day decisions regarding water allocations within the physical area covered by the plan (Alberta Environment, 2001). The WCO is incorporated into the terms and conditions of the approvals and licences under the *Water Act*. The approval holders are required to comply with WCO conditions and report to the department.

The WCO will be applied to:

- all new surface water allocation authorizations in the Alberta portion of the Wapiti River basin under the *Water Act*;
- Aquatera Utilities 2013 junior licence (Licence No. 00277161-00-00, Priority No. 2011-05-02-003); and
- where a provision exists and the Director finds cause, may be applied to other licences subject to renewal under the *Water Act*.

The WCO in this plan was developed for Segment A (Figure 2) of the Wapiti River. All other existing water allocation authorizations shall retain their original conditions, including any instream objectives specified. As Segment A is the furthest downstream reach within the Wapiti River basin, all new water allocation authorizations in the Alberta portion of the Wapiti River basin are subject to meeting this WCO. All new water allocation authorizations in the Alberta portion of the Wapiti River basin, but outside of Segment A, may be subject to their own reach or water body specific objectives, WCOs, or other regulatory requirements, in addition to this recommended Wapiti River WCO.

Table 1. Relevant Policies and Strategies

Policy/Strategy	Description
Framework for Water Management Planning	<p>Developed in 2001 under Part 2, Division 1 of the <i>Water Act</i>. Requires that all water management plans under the <i>Water Act</i> must follow the guidelines of the Framework for Water Management Planning. It is intended to provide consistent direction for the water management planning process with the vision that all Albertans are stewards of Alberta's water. The main principles are:</p> <ul style="list-style-type: none"> • Water must be managed sustainably to meet current and evolving needs without compromising the ability of future generations to meet their needs. • Water is a vital component of the environment. The aquatic environment, including the diversity of aquatic life must be protected. One of the key components of the framework is the Strategy for Protection of the Aquatic Environment, including Water Conservation Objectives (WCOs). • Water plays an essential role in a prosperous economy. Water must be wisely allocated and used efficiently. • Water must be managed in consultation with the public.
Water for Life: Alberta's Strategy for Sustainability	<p>In 2003, the Alberta Government adopted a province-wide comprehensive strategy to manage water resources. In 2008, the strategy was renewed and re-affirmed to continue to guide the wise management of Alberta's water quantity and quality for the benefit of Albertans now and in the future. The Wapiti River Water Management Plan will support the three goals of the Water for Life Strategy:</p> <ul style="list-style-type: none"> • A safe, secure drinking water supply • Healthy aquatic ecosystems • Reliable, quality water supplies for a sustainable economy.
Land-use Framework and Regional Plans	<p>In 2008, Alberta Government also adopted the Land-Use Framework, a blueprint for land-use management and decision-making to address cumulative effects at the regional level. Regional plans are instruments to implement the provincial land-use framework by establishing a long-term vision, outcomes, strategic actions and policy direction for seven regions that cover the province. The Wapiti River Water Management Plan may form part of a future Upper Peace Regional Plan. It is anticipated that this water management plan may become a sub-regional or issue specific plan under the regional plan and will inform the management of surface water quantity in the broader region.</p>
Water Conservation Policy Direction	<p>Water conservation is one of the three key directions in the Water for Life Strategy. This direction states: "<i>all sectors understand how their behaviors impact water quality, quantity and the health of aquatic ecosystem</i>". The policy direction encourages that all sectors must adopt water conservation ethics, develop best management practices and take actions to ensure water use efficiency and productivity.</p>

Alberta's Policies on Consultation with First Nations and Metis Settlements on Land and Natural Resource Management

The Wapiti River Water Management Plan will adhere to Alberta's commitment to strengthening relationships with Indigenous peoples through the continued recognition of the Treaty relationships between First Nation communities and the Crown, as well as the relationships between the Metis Settlements and the Crown. The Plan will also adhere to Alberta's duty to consult and where appropriate, accommodate potential adverse impacts to First Nations Treaty rights and traditional uses and Metis harvesting activities and traditional uses.

1.4 Geographic Scope

The geographic scope for the Plan is the Alberta portion of the Wapiti River basin, from the British Columbia border to its confluence with the Smoky River, including all tributaries (Figure 1). The Wapiti River basin lies within the larger Smoky/Wapiti basin of the Peace River watershed. Of all basins in the Peace River watershed, the Wapiti basin has the highest concentration and diversity of human impact from water withdrawals and municipal and industrial wastewater discharges.

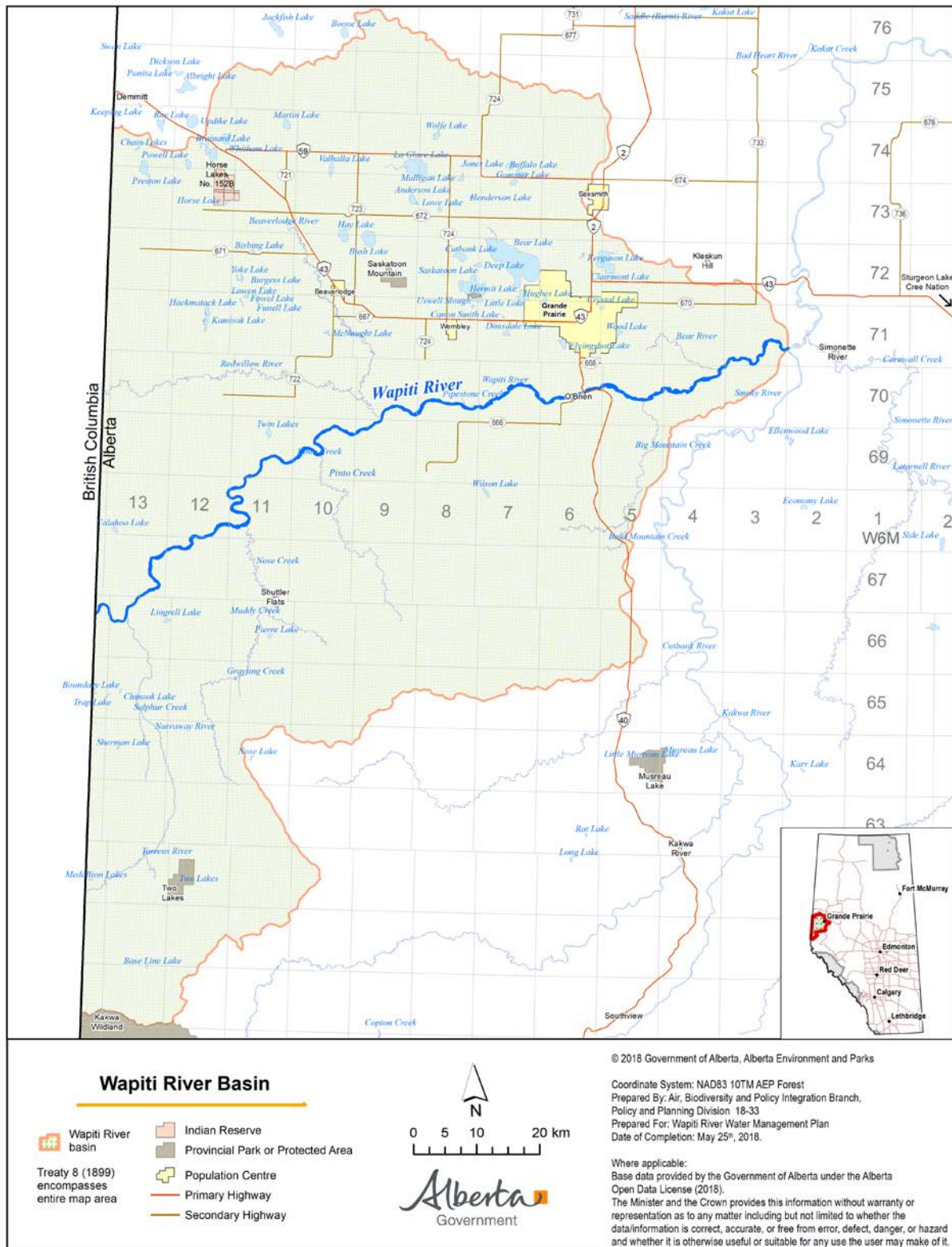


Figure 1. The Wapiti River Water Management Plan encompasses the Alberta portion of the Wapiti River basin from the British Columbia border to the confluence with the Smoky River.

While the water management planning process considered issues throughout the entire Wapiti River basin, assessments focused on areas of highest impact or projected development, in particular the Wapiti River mainstem downstream of the Redwillow River to the confluence with the Smoky River.

The planning process further divided the lower mainstem based on the location of the first major water diversion (Aquatera's water intake). The reach from and including Aquatera's intake downstream to the confluence with the Smoky River is identified as Segment A (Figure 2). As Segment A includes the two largest water diversions in the Wapiti River basin (Aquatera and International Paper), the planning process focused the detailed assessment of aquatic ecosystem effects within Segment A.

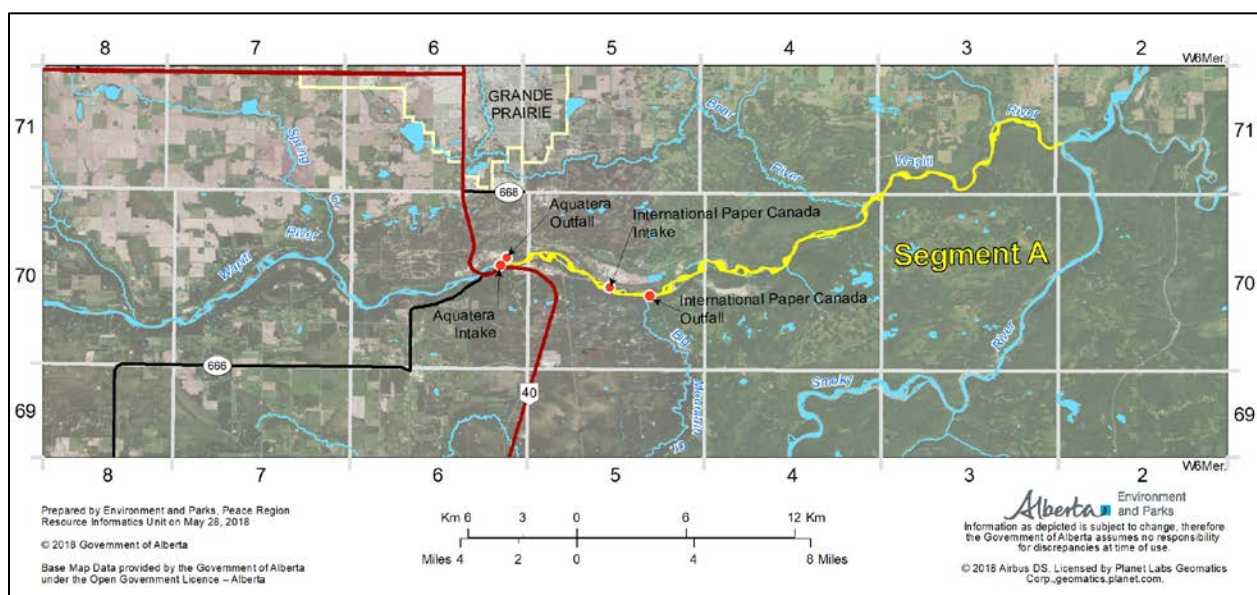


Figure 2. Segment A within the Wapiti River.

The recommended Water Conservation Objective (WCO) will be applied across the Alberta portion of the Wapiti River basin as withdrawals in upstream tributaries ultimately affect the volume of water in Segment A. The Plan recognizes if development and impacts in the tributaries of British Columbia or other areas within the Wapiti basin exceed present understanding, the Plan will be reviewed.

1.5 The Planning Approach – Structured Decision Making

In 2013, a workshop was held for the Wapiti River Water Management Plan Steering Committee in Grande Prairie to discuss and learn about structured decision making and how it may serve as a suitable planning approach for the development of the Plan (Compass Resource Management, 2013). The Steering Committee adopted a structured decision making approach

to enable the group to assess and develop a WCO recommendation. Structured decision making is centered on a set of planning steps (Figure 3) that serve as a guide for working through a decision process and is supported using tools from the decision sciences that help groups deliberate on technically complex decisions where multiple interests are at stake. Structured decision making as a planning framework for water resources management was adopted in British Columbia in the mid-1990s. Since then, many structured decision making community-based water management plans have implemented this successful process in Canada and across the United States.

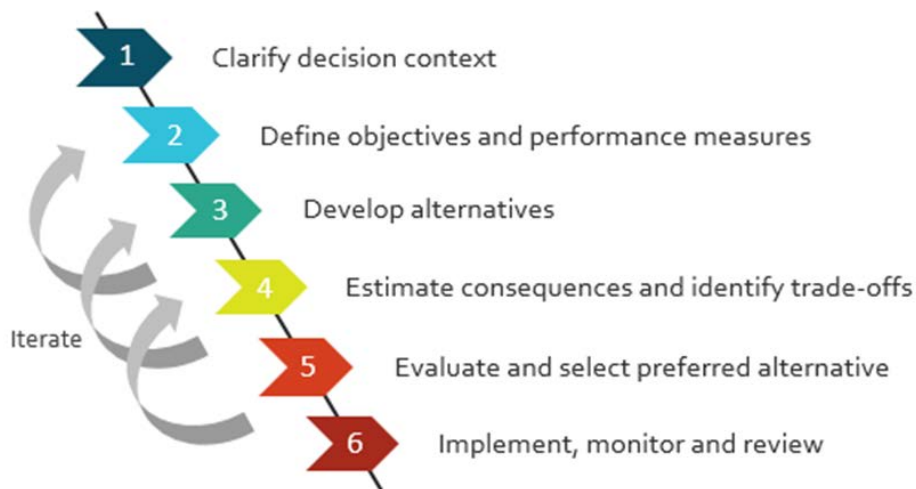


Figure 3. Structured decision making steps (Compass Resource Management, 2013).

The following steps outline the structured decision making process:

Step 1: Clarify the Decision Context. This step involved defining the specific decision(s), the decision maker(s), the scope and bounds for the decision process, and the roles and responsibilities of all participants. This step was completed in the Plan through the Terms of Reference (CharettePelPoscente, 2013) and the Operating Principles and Processes for the Wapiti River Steering Committee (2016).

Step 2: Define Decision Objectives and Performance Measures. This step involved defining decision objectives and sub-objectives, which identify and structure “what matters” for making the decision. Performance measures were then developed as a metric for each sub-objective and ultimately helped decision makers assess and choose among policy alternatives. In the Plan, decision objectives represent values for the aquatic ecosystem, existing and future water supply and water-based recreation (Compass Resource Management, 2017).

Step 3: Develop Alternatives. Once objectives were clear, structured decision making focused on identifying, comparing and iteratively refining water withdrawal limit alternatives. Alternatives present decision makers with options and choices. For the Plan, the Steering Committee scoped and assessed a range of instream flow and water withdrawal alternatives before making a WCO recommendation (Compass Resource Management, 2017).

Step 4: Estimate Consequences. This step integrated the previous two, where estimated consequences of the alternatives are presented in terms of the objectives and performance measures using available knowledge and predictive tools. The assignment of consequences is an analytical task. It does not involve the assessment of value-based judgments about the relative importance of those consequences or the identification of a preferred alternative. This task is generally undertaken by scientists, economists and other subject specialists including holders of local or Indigenous knowledge. Ultimately, objectives, performance measures and alternatives were linked in a summary matrix highlighting the performance of each alternative in relation to the objectives. It exposes key choices and trade-offs among objectives across the alternatives under consideration (Compass Resource Management, 2017).

Step 5: Evaluate Trade-Offs and Make Choices. In this step, participants in the process acknowledged and openly discussed difficult trade-offs and reviewed options for achieving an acceptable balance across all objectives. The structured decision making process required that participants make explicit choices about which alternative is preferred based on their own values and their understanding of the values of those affected. The goal was to choose an alternative based on achieving a balance across multiple objectives (Compass Resource Management, 2017).

Step 6: Implement and Monitor. This step involved identifying the decision-relevant uncertainties and making a plan to reduce these uncertainties over time to promote learning and more informed decision making in the future.

The information assembled in the planning process was brought together to refine the geographic scope, flow alternatives, decision objectives and develop performance measures and method of assessing flow alternatives. A series of Steering Committee structured decision making workshops were held in 2016/2017 to assess alternatives, understand consequences, evaluate trade-offs and come to consensus on a recommended WCO (Compass Resource Management, 2017).

2.0 Engagement

The Wapiti River Water Management Plan Steering Committee is committed to providing meaningful opportunities to engage all stakeholders and Indigenous communities in the development of the Wapiti River Water Management Plan. Public engagement is a key requirement under Alberta's Framework for Water Management Planning (Alberta Environment, 2001). Comments and feedback from the stakeholders, Indigenous peoples and the public formed the basis of this Plan.

2.1 Collaborative Process

At the inception of the planning process, a multi-stakeholder Steering Committee was established to provide overall direction, guidance and, ultimately, the final recommendation for the Plan and the WCO. The members of the Steering Committee included key stakeholders and Indigenous communities that would likely be affected by the outcome of this Plan. The collaborative process was an opportunity for direct participation in the planning process, bringing forward diverse interests, understanding issues and concerns from others and ultimately developing a fair, well-informed and acceptable Water Management Plan with a WCO recommendation.

An Environmental Sub-Committee was established and included technical content experts, comprised of government staff, industry, and consultants representing key stakeholders, to provide science-based analyses and information to the Steering Committee and its planning process. The Environmental Sub-Committee reported directly to the Steering Committee and required Steering Committee approval for all technical studies.

2.2 Public Engagement

The Mighty Peace Watershed Alliance, in collaboration with the City of Grande Prairie, led the public engagement and communication component of the Steering Committee's planning process. A communication and engagement plan was prepared and implemented. The following actions were completed:

- February 13, 2013 – public review of draft terms of reference for the Wapiti River water management planning process
- May 1, 2013 – terms of reference approved by the Government of Alberta (CharettePelPoscente, 2013)
- September 17, 2013 – presentation of the terms of reference to Regional Municipalities
- September 11, 2014 – presentation of progress report to the City of Grande Prairie, County of Grande Prairie and Municipal District of Greenview
- August 4, 2015 – Wapiti River Water Management Plan public Facebook page: <https://www.facebook.com/WapitiRiverWater/>
- September 17, 2015 – Community Consultation and Communication Proposal
- October 7, 2015 – presentation of key findings and progress report to Inter-Municipal Council

- November 17 and 18, 2015 – two community discussions and an open house meeting were held in Grande Prairie to discuss both the social and economic values of the Wapiti River (Stantec Consulting, 2015)
- May 4, 2016 – focus group meeting for recreational users of the Wapiti River to assess how flows impact on-stream activities (RC Strategies, 2016)
- March 17, 2017 – A Public, Stakeholder and Indigenous Engagement and Consultation Plan was developed for the draft Wapiti River Water Management Plan. The Plan complements the Community Consultation and Communications Proposal 2015.
- November 30, 2017 – presentation of the draft recommendation to Inter-Municipal Council

2.3 Indigenous Engagement

Water management planning is a collaborative process and Indigenous communities were invited to participate according to the guidelines of the following consultation policies:

- Consultation with First Nations on Land and Natural Resource Management 2013
- Consultation with Metis Settlements on Land and Natural Resource Management 2015

The following First Nations were identified (draft Aboriginal Consultation Plan, 2012) to be consulted regarding this project, in order to determine if the development and implementation of the Wapiti River Water Management Plan may impact their Treaty rights and traditional uses:

- Sturgeon Lake Cree Nation
- Horse Lake First Nation

Horse Lake First Nation and Sturgeon Lake Cree Nation were engaged at the outset of the planning process by invitation to participate on the Steering Committee. The following engagement actions were completed:

- 2012 – Draft Aboriginal Consultation Plan was developed by the SREM Aboriginal Affairs Branch.
- May 23, 2012 - Horse Lake First Nation representative participated in a conference call and indicated that Horse Lake First Nation is interested to participate the Wapiti River Water Management Plan
- May 24, 2012 - Invitation letters sent to Horse Lake First Nation and Sturgeon Lake Cree Nation to participate in the Steering Committee of the Wapiti River Water Management Plan.
 - Horse Lake First Nation opted not to be directly involved on the Steering Committee due to capacity constraints, but rather be advised at key milestones of the planning process.
 - Sturgeon Lake Cree Nation had a representative on the Steering Committee and provided valuable information for the planning process with respect to their interests and perspectives.

- February 12 and 13, 2013 – Horse Lake First Nation participated in a two-day workshop on the structured decision making process for the Plan.
- Spring of 2013 – Engaged Horse Lake First Nation and Sturgeon Lake Cree Nation on the draft terms of reference for the Water Management Plan.
- November 17-18, 2015 – Workshop and open house in Grande Prairie on social and economic values around water uses and needs on the Wapiti River. Three First Nations (Sturgeon Lake Cree Nation, Horse Lake First Nation, and Duncan's First Nation) and the Metis Nation of Alberta were invited. Only Horse Lake First Nation participated in the workshop.
- September 30, 2016 - The Steering Committee held a Traditional Land Use information sharing workshop on the Wapiti River watershed. The intent of this workshop was to understand Indigenous traditional land use in the Wapiti River basin and how it could help inform recommendations developed in the Plan. Three First Nations (Horse Lake First Nation, Sturgeon Lake Cree Nation, Duncan's First Nation), Aseniwuche Winewak Nation, the Western Cree Tribal Council, and the Metis Nation of Alberta were invited to the workshop, however no representatives from the communities or organizations were able to attend.
 - Through publicly available information, Indigenous interests and concerns were identified in a report titled: Traditional Land Use Information and the Wapiti River Water Management Plan (Petra Rowell Consulting, 2016).
- March 17, 2017 – A Public, Stakeholder and Indigenous Engagement and Consultation Plan was developed for the draft Wapiti River Water Management Plan. The Plan complements the draft Wapiti River Aboriginal Engagement Plan 2012.

As the draft plan neared completion, Ministry of Alberta Indigenous Relations reviewed all supporting documents (Terms of Reference, engagement plans (2012 and 2017), record of consultation, etc.), and provided advice and recommendations on engagement and consultation since requirements and procedures had changed since 2012.

The following communities were engaged on the draft Wapiti River Management Plan:

- Horse Lake First Nation
- Sturgeon Lake Cree Nation
- Duncan's First Nation
- Sucker Creek First Nation
- Aseniwuche Winewak Nation
- East Prairie Metis Settlement
- Gift Lake Metis Settlement
- Peavine Metis Settlement
- Metis Nation of Alberta Region 6
- Metis Local 78, Peace River
- Metis Local 1990, Grande Prairie
- Metis local 1929, Valleyview
- Metis Local 207, Fairview
- Metis Nation of Alberta Region 4
- Metis Local 1994, Grande Cache

3.0 Summary of Issues Considered and Information Assembled

3.1 Issues Considered

Planning issues and concerns were identified using a combination of public consultation, input and feedback from the Steering Committee, discussions with key stakeholders, and accumulation of knowledge and data collected. Issues and concerns identified and summarized in Table 2 were documented in the Wapiti River Water Management Plan Terms of Reference as approved by the Steering Committee (CharettePellPoscente, 2013).

Table 2. Description of issues that are relevant to the management of quantity of water withdrawals in the Wapiti River identified by the Steering Committee for the Wapiti River Water Management Plan.

Terms of Reference Issues	
Water Supply, Use, Demand	Would a secure and reliable supply of water for a growing economy and population be provided now and into the future?
Fisheries	Would natural dynamic patterns of abundance, biomass, and diversity of native fish populations in the Wapiti River be maintained?
Water Quality	Would current water quality in the Wapiti River be adversely affected through reduced dilution capability of the mainstem due to projected increased water use?
Water-based Recreational Use	Would acceptable flows for boating activities, angling opportunities, and swimming be maintained?
Traditional Use	Will traditional use values such as aquatic ecosystem health, retaining wet areas associated with moose habitat, and healthy fish populations be identified, understood, and incorporated into decision making for the Wapiti River Water Management Plan?
Geomorphology and Riparian Habitat	Will a healthy ecological state of the river channel, floodplains, and riparian habitat be maintained?
Climate Change and Drought	Would the Plan provide resiliency to climate change and drought with respect to goals of the Water for Life Strategy, in particular healthy aquatic ecosystems and reliable water supplies?
Cumulative Effects	Have the combined effects of water use with other stressors such as wastewater returns, land use impacts, non-point source runoff or changes to climate been considered in the Plan?

3.2 Information Assembled

The studies listed below were assembled to address key issues and values identified by the Steering Committee, the public and Indigenous community. This information served as a foundation for developing planning objectives and performance measures to assess flow alternatives.

- Wapiti River Environmental Flow Scoping Study (Ecofish Research Ltd. and Compass Resource Management, 2013)
- Structured Decision Making Workshop, Wapiti River Water Management Plan, Facilitator Summary (Compass Resource Management, 2013)
- Habitat suitability curves workshop, Grande Prairie, March 2014 (Palmer Environmental Consulting Group and Normandeau Associates, 2014)
- Naturalized and Regulated Stream Flow Report: Wapiti River and Tributary Flows 1968-2010 (Kerkhoven, 2014a)
- Wapiti River Geomorphology Assessment (Kerkhoven, 2014b)
- Wapiti River Basin Land Cover Change Assessment (Kerkhoven, 2014c)
- Wapiti River Basin Climate change assessment (Kerkhoven, 2014d)
- Wapiti River Habitat Mapping Study (Golder Associates, 2014)
- Wapiti River Dissolved Oxygen Fluctuation Literature Review (Stantec Consulting Inc., 2015)
- Wapiti River Fish Telemetry Program, Mountain Whitefish Under Ice Habitat Use Study (EDI Environmental Dynamics Inc., 2015)
- Adjustments to Open-water Bull Trout and Mountain Whitefish Habitat Suitability Curves, independent expert input process (2015)
- Wapiti River Cumulative Effects Modelling Tool (ALCES Landscape & Land-Use Ltd., 2015)
- Bear Creek Water Quality Study (Hutchinson Environmental Sciences Ltd., 2015)
- Wapiti River Instream Flow Study (Palmer Environmental Consulting Group and Thomas Gast & Associates Environmental Consultants, 2015)
- Recreation Considerations Report: Wapiti River Management Plan (RC Strategies, 2016)
- Traditional Land Use Information and the Wapiti River Water Management Plan (Petra Rowell Consulting, 2016)
- Evaluation of Water Storage in the Wapiti Basin (Victory GIS, 2017)
- Wapiti River Water Quality Assessment (Water Quality Sub-group of the Environmental Sub-Committee and Compass Resource Management, 2017)
- Wapiti River Water Management Plan Steering Committee Final Report (Compass Resource Management, 2017)

4.0 Reaching a Water Conservation Objective Recommendation

The Steering Committee commenced a structured decision making workshop process (Section 1.5) with the goal of reaching an agreement among all Steering Committee members on a recommended Water Conservation Objective (WCO). Three workshops were completed over a period of seven months. The workshops brought all the information assembled together to evaluate flow alternatives and support and inform Steering Committee deliberations. Compass Resource Management facilitated the structured decision making workshop process and was supported by Alberta Environment and Parks staff.

Table 3. Structured decision making (SDM) workshop dates and objectives.

SDM Workshop	Date	Workshop Objectives
#1	November 24 & 25, 2016	<ul style="list-style-type: none">• Review and confirm scope of SDM workshop process.• Review and confirm objectives and performance measures.• Review and discuss tools for understanding the hydrology between different possible mainstem flow alternatives for the Wapiti River.• Agree to a preliminary set of flow alternatives for the mainstem Wapiti River.
#2	May 31 & June 1, 2017	<ul style="list-style-type: none">• Present water quality screening analysis to differentiate among flow alternatives.• Undertake a trade-off analysis on a wide range of alternatives.• Short list flow alternatives. Remove inferior alternatives and add new (or hybrid) alternatives for analysis.• Discuss monitoring and adaptive management requirements for the water management plan.
#3	June 28 & 29, 2017	<ul style="list-style-type: none">• Deliberate on a short-list of preferred alternatives with the goal of reaching agreement on a preferred alternative as the basis for the recommended WCO.• Confirm Steering Committee recommendations for the Plan.

The first workshop focused on confirming the scope of the structured decision making process, confirming the objectives and performance measures, discussing the structure of flow alternatives, and determining the range of flow alternatives that would be evaluated through the structured decision making workshop process. The second workshop started with the presentation of estimated consequences for a wide range of flow alternatives. Steering Committee deliberations reduced this range of flow alternatives down to a short-list of flow alternatives that were deliberated upon in the third workshop. A final recommended WCO was determined by the Steering Committee at this third workshop.

4.1 Flow Alternatives

Flow alternatives represent the different courses of action that are available to decision makers.

The decision before the Steering Committee was:

“what recommendations can we make for the Wapiti River mainstem WCO that will best balance water consumption and protection of the aquatic environment, while considering environmental, social and economic interests?”

Consequently, the alternatives for the structured decision making process consisted of a range of different flow scenarios, each with different rules governing how much water could be withdrawn from the mainstem of the Wapiti River at different times of the year.

Each alternative in the Plan process had two components:

- **Demand scenario:** Defines the quantity of water demanded for human use in the Wapiti River basin.
- **Supply rules:** Defines rules on what water would be made available for human use given natural flow conditions. The supply rules explored through the structured decision making process represented alternative ways of defining a WCO for water quantity.

Two demand scenarios were used in the process. One represented current levels of water consumption and the other represented projected maximum future demand for the year 2040. The year 2040 was chosen to be consistent with a Steering Committee decision that the Plan will use a 25-year time horizon and consider predicted growth and development given current available information.

4.1.1 Current and Future Water Demand Scenarios

Water use by licence or licence grouping for the current and future water demand scenarios were defined as shown in Table 4. The term “current water demand scenario” was used because actual measurements of water use are not available for all water licences in the Wapiti River basin and licenced allocations (which represent maximum allowable use) were used in most cases. Because the current water demand scenario sets water use for unmeasured licences at their licenced allocation, this scenario represents an upper estimate for current levels of water use in 2014/15. The “future water demand scenario” is based on projections for future water demand and represents a plausible upper limit on future water use. The current water demand scenario has a net use of 0.2 cubic meters per second (m³/s) and the future water demand scenario has a net use of 0.81 m³/s.

Industry and commercial stakeholders provided their projected water use by 2040. Forecasted water uses for all other licences were gathered through a combination of Steering Committee input and the Peace River Watershed Current and Future Water Use and Issues Report (Mighty Peace Watershed Alliance and Watrecon Consulting, 2012).

Table 4. Detailed definition of current and future water demand scenarios (Compass Resource Management, 2017).

Licence or Licence Grouping	Current Water Demand Scenario (Reference Case, 2014/2015)			Future Water Demand Scenario (2040)		
	Diversions ³ (m ³ /s)	Returns (%)	Net Use (m ³ /s)	Diversions (m ³ /s)	Returns (%)	Net Use (m ³ /s)
A) Aquatera - senior licence	0.23	79.8%	0.05	0.23	80.0%	0.05
B) Aquatera - junior licence	0.05	79.8%	0.01	0.45	50.0%	0.23
C) International Paper (IP) licence	0.54	92.5%	0.04	0.54	92.5%	0.04
D) Lake stabilization/wetlands licences	0.25	96.0%	0.01	0.25	96.0%	0.01
E) Other existing licences/registrations	0.06	0.0%	0.06	0.06	0.0%	0.06
F) Temporary diversion licences (TDLs) (Oil & Gas)	0.04	0.0%	0.04	0.32	0.0%	0.32
G) New licences	N/A	N/A	N/A	0.11	0.0%	0.11
Total	1.17	82.7%	0.20	1.96	58.5%	0.81

A+B) Aquatera - Aquatera Utilities Inc. holds the largest water licence in the Wapiti River for municipal water use. As the regional water utility, Aquatera provides drinking water to city of Grande Prairie, the County of Grande Prairie, the Hamlet of Clairmont and the Town of Sexsmith, with plans to expand the regional system to surrounding communities in the future. Aquatera also has three bulk water stations that are accessed by customers who use the water for residential, commercial and agricultural (e.g. livestock watering) use.

Aquatera has two *Water Act* licences: senior (1986) and junior (2013). The senior licence has a condition to return 80% of the water diverted, while the junior licence must return greater than 50% of water diverted depending on population growth. Using an estimate of 80% return for the junior licence and measured (actual) diversions and returns for 2014 and 2015, Aquatera's had a combined licence current net use of 0.06 m³/s (Paul, 2017). Future use is based on the maximum total allocation in Aquatera's senior licence and junior licence combined. As Aquatera's water allocation in their junior licence is staged according to population growth, the

³ Diversion rates used in the current and future water demand scenarios represent annual allocated volume except for IP (both scenarios) and Aquatera (current water demand scenario only) which are based on measured diversion and return volumes.

allocation at their highest stage (i.e., full build out level) is used in the future water use scenario. The full build out level requires 50% of the licence to be returned to the Wapiti River. The reduced return at the full build out level (80% to 50%) is based on Aquatera providing treated water to surrounding communities via their regional system, which would not necessarily be returned to Aquatera for treatment (Paul, 2017).

C) International Paper (IP) - The largest commercial water user in the Wapiti River basin is the pulp mill near Grande Prairie, currently owned by International Paper (IP) and formerly owned by Weyerhaeuser Company Limited. Future use is based on IP's 2014-15 use because IP's water use has been declining through water conservation measures for the last 10 years and is not expected to increase from these levels (Paul, 2017).

D) Lake stabilization and wetlands – Lake stabilization licences are associated with weirs that have been used to increase lake area. Kerkhoven (2014a) estimated the net water use of these lake stabilization projects by estimating the additional evaporative loss from the increased surface area. Net water use from wetland projects was set at zero as these projects aimed to restore or compensate losses to natural wetlands. The future use scenario assumes no growth in water use compared to current levels for this category.

E) Other existing licences and registrations – Current diversions in this category are based on allocations as written into the respective licences for existing holders of licences and registrations. Agricultural water use is primarily authorized through registrations, which include allowing for the filling of dugouts. As the current reference case uses licenced allocations, the future use scenario cannot increase beyond licenced allocations.

F) Temporary Diversion Licences (TDLs) - The oil and gas sector have been historically authorized water use through temporary diversion licences (TDLs), which are granted by the province of Alberta for water use over a period of less than one year. TDLs are also issued to users outside the oil and gas sector (e.g., dust control for gravel roads). TDLs have no priority and are the first to be cut off during water use restrictions. Current use is defined as the highest water use recorded in the historical TDL data for the Wapiti River basin. Future use is defined as the highest water use recorded in historical TDL data for the Little Smoky River basin. Little Smoky was chosen as an analogue for possible future TDL water use because it is close in proximity to the Wapiti River basin and has experienced more oil and gas development than in the Wapiti River basin. As the province is moving away from issuing TDLs and toward issuing term licences of shorter duration, this category includes future term licences for the oil and gas sector that may have previously been authorized through TDLs.

G) New licences – This category covers projected growth in water use by new licences not included in categories B or F (for example, new or expanded commercial and industrial uses that source their own raw water outside of a municipal supply source; growth in agriculture such as stock watering or crop irrigation). Estimates for growth in water use from new licences (i.e., those uses not covered by category B or F) were based on a 16% projected increase over 15 years for similar water users (Mighty Peace Watershed Alliance and Watrecon Consulting, 2012). The 16% increase was applied to the diversion volumes of IP's licences (category C) and other licences/registrations (category E) and compounded to 30 years to arrive at the new

licence projection of 0.11 m³/s (Compass Resource Management, 2017). Estimated future water demand could now be determined from the combination of:

- 1) Aquatera's allocation in its junior licence (category B);
- 2) water demand for TDLs or term licences associated with oil and gas development (category F); and,
- 3) new water licences not covered within the previous two categories (category G).

The Steering Committee agreed projected increases in diversions and net use represented a reasonable upper limit to increased water demand by 2040 (Table 5; Compass Resource Management, 2017).

Table 5. Percentage increase between current and future water use demand scenarios by licence grouping and total. Note the total percent increase is the volume weighted summation for each licence grouping.

% Increase between Current Reference Case and Future Water Use Scenario		
Licence Grouping (category)	Diversions (%)	Net Use (%)
Aquatera licence (B)	142%	377%
IP licence (C)	0%	0%
Other licences/registrations (G relative to E)	190%	190%
TDLs (F)	788%	788%
Total	68%	303%

4.2 Decision Objectives and Performance Measures (PMs)

In the structured decision making process, the term “decision objectives” was used to represent the fundamental “ends” or values that matter in a choice between alternatives. Decision objectives were structured in two levels with higher level *objectives* being broad interests and *sub-objectives* being more specific components of the objective (e.g. “Aquatic ecosystem health” as an objective, “Fish” as a sub-objective). Each objective may have one or more sub-objectives and each sub-objective may in turn have one or more performance measures (PM), which are specific metrics for comparing the predicted consequences of flow alternatives on the fundamental objectives. Four high level objectives were identified in this process as having the potential to be affected by different in-stream flow alternatives:

- Aquatic ecosystem health;
- Safe and reliable water source for human consumption;
- Access to water for economic development purposes (interest in access to water for current licence holders and new water applications); and,
- Maintaining or enhancing water-based recreational opportunities.

Table 6 summarizes the objectives that were identified and evaluated through the structured decision making process. Sometimes environmental performance measures were used as a surrogate to assess how well some recreational sub-objectives were being met or not across the alternatives (e.g., fish habitat PMs were used to capture potential angling opportunity impacts).

Table 6. Summary of objectives, sub-objectives and their performance measures (PMs).

Objective	Sub-objective	Description	Performance Measures
Aquatic Ecosystem Health	Fish	Maintain the natural dynamic patterns of abundance, biomass and diversity for native fish populations.	Changes in fish habitat with varying flow alternatives was used as a proxy to changes in fish population.
	Water Quality	Represents an interest that the current river water quality is not significantly altered by the cumulative impact of point and non-point sources of water quality pollution and future water use.	A screening assessment on how flow alternatives would influence water quality was conducted. No significant differences in river dilution capacity and water quality were found among flow alternatives evaluated. Based on this assessment, water quality PMs were not required for the range of alternatives considered (Water Quality Sub-group, 2017).
	Geomorphology Riparian Maintenance	Do not limit high flow conditions which geomorphologic and riparian processes require to maintain the healthy ecological state of the river, floodplains and riparian vegetation.	A threshold PM was developed to indicate if water consumption in a flow alternative reached a level that could influence geomorphology and riparian maintenance.
Water Supply	Existing and New Users	Represents an interest for a reliable water supply that will meet needs now and into the future for municipal, industrial, commercial and agricultural water uses.	A series of PMs and supporting metrics and figures were developed to estimate the performance of flow alternatives on water supply objectives.
Water-based Recreational Opportunities	Boating Opportunities	Represents an interest to maintain an acceptable flow for boating activities in the Wapiti River.	A PM was developed to directly estimate the performance of flow alternatives and impact on number of boating days.

Objective	Sub-objective	Description	Performance Measures
	Angling Opportunities	Represents an interest in maintaining or enhancing angling opportunities in the Wapiti River. The fish habitat and water quality sub-objectives were used as proxies for the angling sub-objective.	The fish habitat PM was used as a proxy to represent the interests of the angling community. Water quality analyses for nutrients, temperature, ammonia and biological oxygen demand consider effects to fish from changes in water quality. These analyses determined water quality PMs were not applicable for this assessment.
	Swimming	Represents an interest in access to the Wapiti River for swimming without water quality risks to human health. The water quality sub-objective and water quality analysis for fecal coliform were used as proxies for the swimming sub-objective.	This objective was assessed through the water quality screening assessment (see water quality sub-objective and PM summary above).
	River Aesthetics	Represents an interest in having a river with desirable aesthetic qualities (e.g. clarity of water and smell) of the river. Increased concentrations of nutrients in the water can lead to increased algae growth. At certain levels, algae growth can have a negative aesthetic impact on the river and, if excessive, can also contribute to odour problems. The water quality sub-objective and water quality analysis for nutrients were used as proxies for how flow alternatives will affect river aesthetics.	This objective was assessed through the water quality screening assessment. PMs were not necessary because the flow alternatives did not substantively differ on performance with respect to water quality.
Traditional use	The aquatic ecosystem performance measures above address a main concern of maintaining aquatic ecosystem health for fish and other aquatic species. The riparian performance measure addresses concerns of maintaining healthy riparian areas and wetlands associated with the river which provide moose habitat and habitat for other terrestrial species.		

Figure 4 presents an impact pathway diagram demonstrating the linkages between water management changes (i.e., WCO) on the left-hand side, the main stressors considered in the analysis (net water use, point and non-point sources of pollutions, and climate change) and the corresponding objectives/sub-objectives on the right-hand side. The WCO is the policy tool to manage water allocations in the Wapiti River mainstem in a manner that balances environmental, social and economic values influenced by instream flows. This diagram was used in the process to show which objectives were directly assessed in the structured decision making process and which objectives were used as proxies for other objectives (e.g., the fish habitat sub-objective was used as a proxy for recreational angling opportunities).

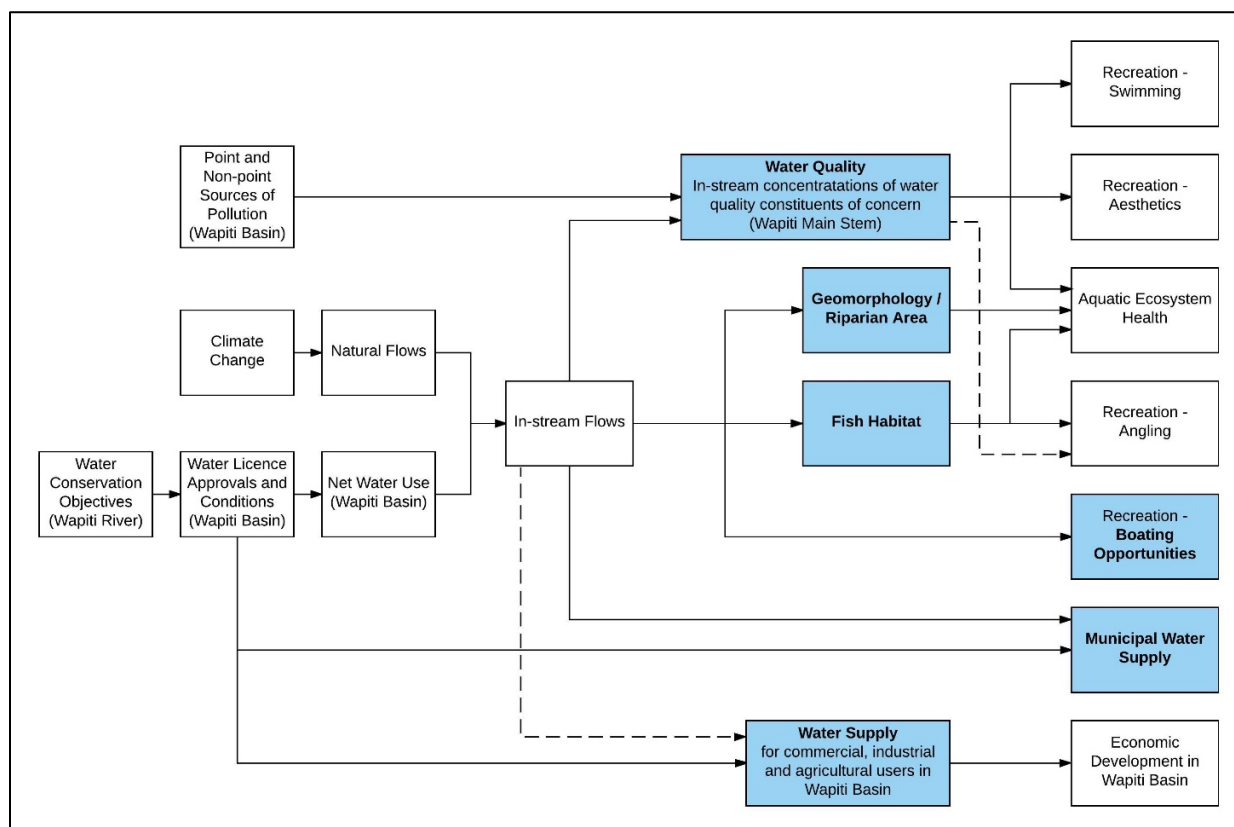


Figure 4. Impact Pathway Diagram. Boxes in blue are objectives / sub-objectives that were assessed in the SDM process. Dashed and solid lines indicate impact pathways (lines are dashed for additional visual clarity and are the same as solid lines).

4.2.1 Fish Habitat Performance Measures

The objective for fish habitat is to maintain the natural dynamic patterns of abundance, biomass, and diversity of native fish populations. As changes to fish populations are difficult to assess over the short term, changes in fish habitat, which are more easily measured, were used as a surrogate to represent changes in fish populations. Increases to fish habitat are assumed to be equivalent to increases in fish population. Fish habitat as a proxy for fish populations is a common approach used in environmental flow assessments (Tharme, 2003; Paul and Locke, 2009).

Fish habitat performance measures for the following species were included in the analysis: bull trout, Arctic grayling, mountain whitefish, longnose sucker, walleye, burbot and slimy sculpin. These species were selected based on their recreational plus social importance or to cover the range of habitat niches present in the river. These selected species were considered by the Environmental Sub-committee to be representative of the range of habitat requirements of the larger aquatic community within the Wapiti River mainstem (Palmer Environmental Consulting Group and Normandeau Associates, 2014).

Fish habitat changes were measured by comparing habitat under a proposed flow alternative relative to the habitat that would have been available under natural flow conditions⁴. Thresholds were used in this process to inform how estimated fish habitat loss relates to potential risks for fish populations. The threshold criteria for habitat loss and its potential impact on populations were adopted from international, national, and other provincial guidelines (IUCN 2001; COSEWIC 2015; Paul and Locke 2009).

4.2.2 Water Supply Performance Measures

The water supply PMs focused on maximum shortage events over the 42-year flow database, and was measured as the maximum number of consecutive days that a licensee or group of licensees could not meet their water demand because of the water supply rules. The water demand for each licensee or group of licensees was defined in the future water use demand scenario (Section 4.1.1 **Error! Reference source not found.**). The maximum shortage event was also measured in terms of volume (total m³ of water shortage experienced for the event).

In addition to the PMs used to characterize the time period and volume of the maximum shortage event experienced for each flow alternative across the 42-year dataset, additional attention was placed on characterizing the level of conservation and water storage that would be needed to offset this maximum shortage event. Water conservation performance measures were calculated that represented the average water demand reduction needed for a licence group to make up for a maximum shortage event.

⁴ Naturalized flow refers to the flow prior to any withdrawals, storage, returns or other human use.

4.2.3 Geomorphology / Riparian Performance Measure

The objective for geomorphology is to maintain peak flow events such that channel forming and channel maintenance flow conditions will not be limited and can maintain the healthy ecological state of the river and floodplains. The objective for riparian areas is to maintain peak flow conditions such that processes required to sustain riparian areas will not be limited and can maintain the healthy ecological state of riparian vegetation.

A geomorphology diversion rate performance measure threshold was developed using analysis documented in Kerkhoven (2014b). A riparian performance measure was adopted from Cows and Fish (2016). Kerkhoven (2014b) concluded that until net use in the Wapiti River exceeds 300 million m³/year (9.5 m³/s instantaneous withdrawal) or a significant hydraulic structure, such as a dam, is proposed, the geomorphology of the Wapiti River is not expected to change significantly. The Cows and Fish (2016) guideline was 16.6 m³/s. As the geomorphology threshold was more sensitive than the riparian threshold, a single threshold of 9.5 m³/s was applied for both.

4.2.4 Recreational Boating Performance Measure

Recreational use was identified as an important ecosystem value amongst Grande Prairie area residents and visitors, second only after water quantity (Wapiti River Water Management Plan Engagement Summary, 2015). The objective is to maintain water-based recreational opportunities with sub-objectives of motorized and non-motorized boating, angling, swimming and river aesthetics. Focus groups and online surveys were conducted with the goal of determining the acceptable minimum flow thresholds for in-stream activities (RC Strategies, 2016). The maximum annual decrease in number of boating days compared to natural flows was used as the PM to evaluate changes in boating opportunities for different flow alternatives. The PM metric is the maximum annual decrease in boating days (for the worst year) over the period of hydrologic record (1968-2010). Refer to the Wapiti River Water Management Plan Steering Committee Final Report (Compass Resource Management, 2017) for further details on background and development of the recreational boating performance measure.

The fish habitat PMs were used as proxies to represent the performance of alternatives on the angling sub-objective. The water quality assessment for fecal coliforms was used as a PM to assess swimming and river aesthetics.

4.3 Evaluating Flow Alternatives using Performance Measures

4.3.1 Naturalized flow

The fundamental dataset used to evaluate PMs is the naturalized stream flow data set for the Wapiti River and key tributaries. This data set provides information on what flows would be naturally, without human water use. A naturalized stream flow data set was developed for the Wapiti River, Pinto Creek, Redwillow River, Bear River (also known as Bear Creek), Big Mountain Creek, and Beaverlodge River (Kerkhoven, 2014a). The naturalized stream flow data set begins in March 1968 and ends December 2010.

The flow alternatives are modelled using naturalized stream flow data for the mainstem of the Wapiti River downstream of Big Mountain Creek (Figure 5). The performance measures are evaluated based on the change from the naturalized flow to the resulting flow from a given alternative.

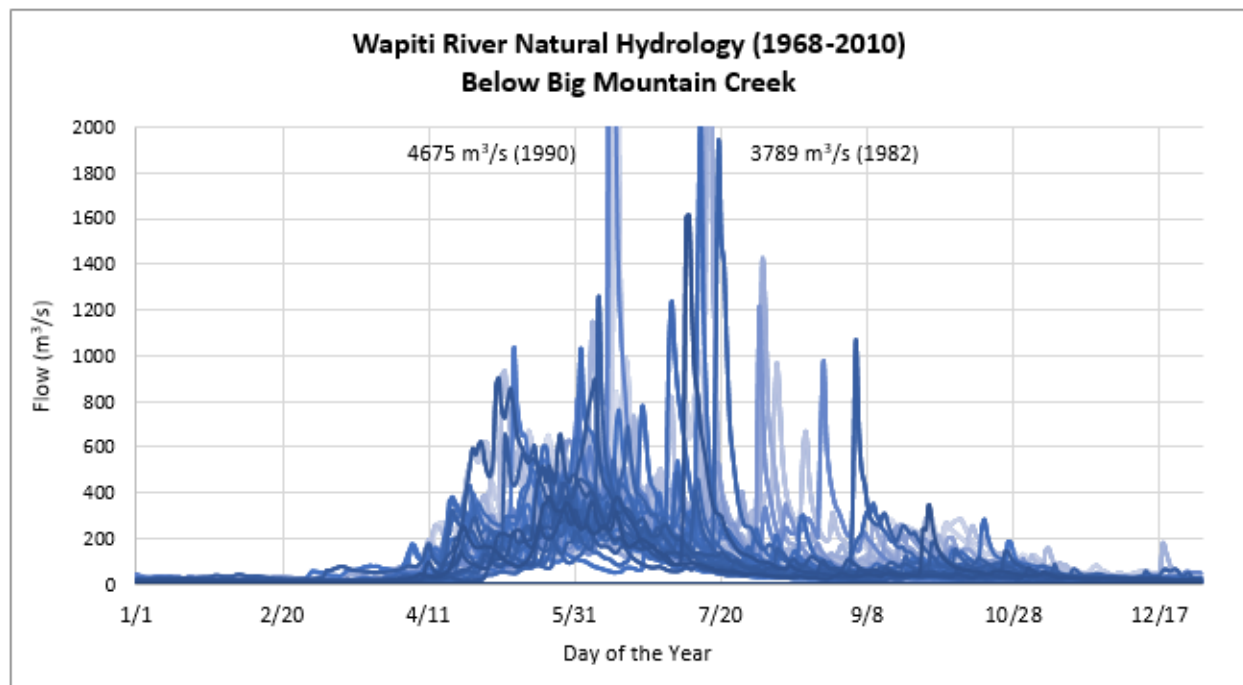


Figure 5. Naturalized flow for the Wapiti River, below Big Mountain Creek. Blue lines show flow for each year from 1968-2010.

4.3.2 Range of Flow Alternatives

During the final structured decision making workshop, the Steering Committee deliberated on a final short list of flow alternatives (Table 7).

Table 7. Final five flow alternatives evaluated by the Steering Committee (modified from Compass Resources Management, 2017).

Flow Alternative	Demand Scenario	Supply Rules		
		Flows at Wapiti River below Big Mountain Creek		
		>20 m ³ /s:	10 – 20 m ³ /s:	<10 m ³ /s:
Alt 3_f	Future Use Scenario	2 m ³ /s:	1 m ³ /s	5%
Alt 3d_f				6%
Alt 3e_f				7%
Alt 3f_f				8%
Alt 6_f				10%

The rationale leading to these final alternatives is:

- When flows are under 10 m³/s, water use is defined as a percentage of natural flows, which provides for more intensive water management during these low flow periods.
- Allowable net use set as a % of natural flow when Wapiti River flows below Big Mountain Creek are less than 10 m³/s:
 - Reduces net use as natural flows decline
 - Provides increased protection during periods when water use would have the most impact on fish habitat
 - 10 m³/s is the approximate 80th weekly exceedance value during under ice conditions.
- When flows are at or above 10 m³/s, the water supply rules used fixed flow values to define the allowable net water use for efficient implementation.
- 1 m³/s allowable net use in the Wapiti River basin when Wapiti River flows below Big Mountain Creek are between 10 and 20 m³/s:
 - 1 m³/s is always less than 10% when natural river flows are between 10 and 20 m³/s
 - Meets net use in future water use scenario, but return flow accounting is required
- 2 m³/s allowable net use in the Wapiti River basin when Wapiti River flows below Big Mountain Creek are greater than 20 m³/s:
 - 2 m³/s is always less than 10% when natural river flows are above 20 m³/s
 - 2 m³/s is greater than the foreseeable future water use scenario's water diversions (1.96 m³/s), meaning net use does not need to be closely managed above 20 m³/s.

4.4 Preferred Flow Alternative and Trade-Offs

Steering Committee members weighed their preferences across the flow alternatives with discussion centered on finding the right balance between maintaining healthy aquatic ecosystems and allowing for increased net water use to support community and local economic growth. Refer to the Wapiti River Water Management Plan Steering Committee Final Report (Compass Resource Management, 2017) for a summary of these discussions and further details from the structured decision making workshops.

The Steering Committee reached consensus agreement on a preferred flow alternative (Alt 3f_f, Table 7). This preferred flow alternative is the recommended Water Conservation Objective (WCO) and has the following limitations on water use:

- When natural flow in the Wapiti River below Big Mountain Creek is above 20 m³/s: net water use up to 2 m³/s is allowed in the Wapiti River basin;
- When natural flow in the Wapiti River below Big Mountain Creek is between 10 m³/s and 20 m³/s: net water use up to 1 m³/s is allowed in the Wapiti River basin; and,
- When natural flow in the Wapiti River below Big Mountain Creek is less than 10 m³/s: net water use of 8% of natural flows are allowed in the Wapiti River basin.

4.4.1 Fish Habitat PM Results and Trade-offs

Under normal flows (defined as occurring 80% of the time) for either summer or winter, all species and life stages considered were predicted to have small changes in their habitat under the recommended WCO and projected future water use (Compass Resource Management, 2017). The reduction in habitat is expected to be sufficiently small such that changes at the population level would be undetectable. However, at the lowest 20% of flows, predicted habitat loss from the recommended WCO may result in measurable but reversible declines in some fish populations from habitat loss. In particular, mountain whitefish adults and juveniles had an expected habitat loss of 7% at low flows in winter. The Wapiti River provides important habitat for mountain whitefish populations with current population status for the basin ranging from moderate to high when compared provincially (MacPherson et al., 2014).

4.4.2 Water Supply PM Results and Trade-offs

The recommended WCO under projected future water use, results in no water shortages to existing water licences including Aquatera's 2013 licence. Current storage capacities at Aquatera and IP are sufficient to meet the recommended WCO at projected future water use therefore no new storage is required (Compass Resource Management, 2017). It is expected shortages that may occur through unpredicted, but short-term variability in hydrology, could be met through conservation measures.

Oil and gas water users withdrawing via TDLs (or term licences) typically withdraw during the open water season and use storage for winter operations (Compass Resource Management, 2017). This greatly reduces the water shortages this sector would experience with the recommended WCO and projected future water use. Without using storage for winter use, this sector would be expected to experience substantial shortages in more than half of the winters. With storage, this sector still is expected to experience small shortages (~36 000 m³) that are likely to last only days but not weeks (Compass Resource Management, 2017).

New licences (future allocations) are predicted to experience shortages in late winter under the recommended WCO and projected future water use. However, shortages are expected to occur in <5% of the winters, have a short duration (~1 week) and be small in volume (~20 000 m³). If the demand for new licences is reduced from 0.11 m³/s to 0.06 m³/s (see Table 4), shortages would be reduced to only 1 day duration and 473 m³ volume (Compass Resource Management, 2017).

4.4.3 Agreement Conditions

Overall, Steering Committee members characterized the recommended WCO as one that balances risks to ecosystem health with a desire to avoid significant barriers to growth. While there was agreement on the recommended WCO, some Steering Committee members included conditions or clarifications on their acceptance.

Provincial fisheries representation could accept the recommended WCO but did not endorse the recommendation. Fisheries preference was for alternatives that placed greater protection on fish habitat and their populations. If unforeseen cumulative effects from other stressors degrade the aquatic ecosystem, the recommended WCO may not provide the desired protection.

The Mighty Peace Watershed Alliance's support for the recommended WCO was linked to having the Steering Committee also recommend the development of a Wapiti River basin watershed management plan that would address cumulative impacts to the aquatic ecosystem.

The oil and gas representatives support for the recommended WCO was linked to having a recommendation in the Plan that recognizes access to water storage. Water storage in the basin is a key factor necessary for the oil and gas sector to operate with the recommended WCO. Conflicting regulatory requirements should be considered to help meet possible storage requirements.

4.5 Summary of Key Findings

A summary of how key issues from Table 2 were addressed and considered in the planning process, and key findings resulting from the scientific and socio-economic assessments conducted, are presented in Table 8. Further details of the assessments are documented in the Wapiti River Water Management Plan Steering Committee Final Report (Compass Resource Management, 2017).

Table 8. Issues that are relevant to management of water withdrawals in the Wapiti River (Table 2), how they were addressed, and key findings related to development of the Wapiti River Water Management Plan and recommended WCO.

Terms Of Reference Issue	
Water Supply, Use, Demand	
Issue	Would a secure and reliable supply of water for a growing economy and population be provided now and into the future?
How was the issue addressed?	The Steering Committee considered different flow alternatives for the Wapiti mainstem with varying levels of water demand and available water supply.
Key Findings	<p>Since 1998, actual net water use in the basin has fluctuated around 5 million m³ per year with a maximum of 6.5 million m³ per year (~0.2 m³/s) (Kerkhoven, 2014a). Net water use is forecasted to reach about 25.5 million m³ per year or 0.81 m³/s by 2040 (Compass Resource Management, 2017). Under the recommended WCO and projected future water use, available water supply is expected to result in:</p> <ul style="list-style-type: none"> • No shortages to all current licences and registrations in the basin (including Aquatera's 2013 licence). • Small volume (~20 000 m³) and short term shortages (~1 week) to new term licences in winter but in less than 5% of the years. • Small volume (~36 000 m³) and short term shortages (few days) to temporary diversion licences (or new term licences to the oil and gas sector) in late winter or very early spring but in less than 5% of the years. A key requirement to meeting this result, however, requires the oil and gas sector to draw upon stored water during the winter.
Fisheries	
Issue	Would natural dynamic patterns of abundance, biomass, and diversity of native fish populations in the Wapiti River be maintained?
How was the issue addressed?	The Steering Committee assessed changes to fish habitat for a range of flow alternatives in the Wapiti River mainstem. Changes in fish habitat were used as a surrogate to represent changes in fish population.

Key Findings	Under projected future water use and the recommended WCO, a small habitat loss (7% loss from what would have been available under natural flows) was predicted for mountain whitefish in winters with lower than normal flows (defined as the lowest 20% of flows for a given winter week) that may result in measurable but reversible declines in their population.
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Water Quality

Issue	Would water quality in the Wapiti River be adversely affected through reduced dilution capability of the mainstem due to increased water use?
How was the issue addressed?	The Steering Committee conducted a screening level analysis to understand how the concentrations of five water quality parameters of interest (nutrients, temperature, ammonia, biochemical oxygen demand, and fecal coliform) change under different water use scenarios. The analysis included estimates of point and non-point sources of pollution covering the whole Wapiti River basin except for Bear Creek, which enters the Wapiti River downstream of International Paper's discharge point. This analysis provided an understanding of how water quality parameters change when dilution capability of the river is reduced.
Key Findings	The water quality analyses found projected future water use would result in negligible changes in dilution capability in the mainstem Wapiti River for the five parameters of concern: nutrients, temperature, ammonia, biochemical oxygen demand and fecal coliform. Water quality is best managed through source control and not dilution. For further details, see Water Quality Analysis to Inform Recommendations for the WCO in the Wapiti River Water Management Plan (Water Quality Sub-group, 2017).

Water-based Recreational Use

Issue	Would acceptable flows for boating activities, angling opportunities, and swimming be maintained?
How was the issue addressed?	The Steering Committee considered three components of water-based recreational use: motorized and non-motorized boating, angling, and swimming. A performance measure to assess changes in boating opportunities with different flow alternatives was developed. Fish habitat assessments were used as proxies for estimating how flow alternatives could influence angling opportunity. Impacts to swimming were addressed using the water quality analysis for fecal coliform concentrations in the Wapiti River.
Key Findings	Projected future water use is expected to have a negligible effect on recreational boating as the median loss of boating days is one day per year (and only 3 days in the worst year). Angling opportunities could be impacted with the recommended WCO as a small impact to mountain whitefish habitat is predicted (see fisheries issue). However, as habitat loss is small, impacts to angling are also expected to be small and reversible. As negligible effects on fecal coliform concentrations are predicted (see water quality issue), no effect on swimming and river aesthetics is expected from the recommended WCO.

Traditional Use

Issue	Will traditional use values such as aquatic ecosystem health, retaining wet areas associated with moose habitat, and healthy fish populations be identified, understood, and incorporated into decision making for the Wapiti River Water Management Plan?
How was the issue addressed?	The Steering Committee commissioned a report on traditional land use information to be considered in the Plan. A workshop was also held in September 2016 to discuss this traditional land use in the Wapiti River Basin. Four Indigenous communities and two organizations were invited, however no representatives from either community or organization were able to attend.
Key Findings	Key issues were identified through publicly available resources and include protecting the Wapiti River for future generations and for the practice of their traditional way of life. Specifically, protecting the water quality, aquatic ecosystem health for fish and other aquatic species, and to maintain healthy wetland areas associated with the river and its tributaries which provide important moose habitat (Petra Rowell Consulting, 2016). One of the main objectives of the Plan is to maintain or improve aquatic ecosystem health to maintain healthy fish populations. The riparian performance measure addresses concerns of maintaining healthy riparian areas and wetlands associated with the river which provide moose habitat and habitat for other terrestrial species. Water diversions from tributaries, wetlands, and lakes in the basin are required to meet the downstream WCO, providing a level of protection for wetland habitat in the basin.

Geomorphology and Riparian Habitat

Issue	Will a healthy ecological state of the river channel, floodplains, and riparian habitat be maintained?
How was the issue addressed?	Analyses were completed by the Steering Committee to understand potential changes to geomorphology and riparian habitat within the Wapiti River mainstem. Performance measures were developed to assess the influence of water use on geomorphology and riparian areas.
Key Findings	Kerkhoven (2014b) found forecasted future water use would need to exceed 300 million m ³ per year or 9.5 m ³ /s before significant impacts to channel geomorphology were expected to occur. Predicted water use needed to change riparian habitat was 16.6 m ³ /s (Cows and Fish, 2016). As projected future water use in the basin was well below 9.5 m ³ /s, impacts to geomorphology and riparian habitat were not expected.

Climate Change and Drought

Issue	Would the Plan provide resiliency to climate change and drought with respect to goals of the Water for Life Strategy, in particular healthy aquatic ecosystems and reliable water supplies?
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How was the issue addressed?	<p>Climate change and drought were considered in two ways through the planning process:</p> <ol style="list-style-type: none"> 1. Kerkhoven (2014d) completed a climate change assessment for the Wapiti River basin. Historical trends in temperature, precipitation, and stream flow in the Wapiti River basin were compared with future climate change projections from General Circulation Models (GCMs). Based on this analysis, the Steering Committee concluded: <p><i>“Until new information proves otherwise, flows in the Wapiti River from 1968- 2010 can be expected to represent flows over the next 30 years given current climate change predictions for the basin. However, there is significant uncertainty around this prediction and even in the absence of climate change extended periods of drought will occur. Therefore, any water management recommendation should be evaluated using an extended period of drought (e.g., 5-10 years). As has been done elsewhere, synthetic hydrologic records for a 1:100 or 1:200 year drought period should be developed and water management recommendations evaluated against it.”</i></p> 2. Following the above recommendation, Alberta Environment and Parks hydrologists created a 6-year synthetic drought time series and sensitivity testing was completed for the recommended WCO.
Key Findings	<p>Climate Change Kerkhoven (2014d) predicted long-term average flows in the Wapiti River are expected to remain within the range of historical variation for the next 30 years. However by the end of the 21st century, uncertainty of future snowfall produces a large range of uncertainty in future river flows.</p> <p>Drought Hydrology Sensitivity testing showed all performance measures (including water supply and fish habitat) were not substantively different when using the 6-year drought hydrology series compared to the 42-year flow time series (1968-2010). The conclusion is the 42-year time series provided a sufficient range of natural variability to represent extreme drought conditions and test resiliency of the recommended WCO.</p>
Cumulative Effects	
Issue	<p>Have the combined effects of water use with other stressors such as wastewater returns, land use impacts, non-point source runoff or changes to climate been considered in the Plan?</p>
How was the issue addressed?	<p>The environmental assessments conducted as part of this planning process considered cumulative effects in the following ways:</p> <ul style="list-style-type: none"> • Total cumulative water use in the Wapiti River basin was used to inform the plan and evaluate the recommended WCO. • Estimates for point and non-point sources for water quality constituents were used to evaluate changes in water quality from the recommended WCO (see water quality issue).

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- Resiliency of the recommended WCO to climate variability was evaluated (see climate change issue).
 - Other stressors were not evaluated when developing the Plan. A recommendation within the Plan is for the development of a watershed management plan to further study cumulative effects risk with other stressors.
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Key Findings

The assessments did not integrate the effects of all stressors (e.g. land use, water pollutants or angler harvest) on a particular interest (e.g., fish populations). However, in making a recommendation on the WCO, the Steering Committee did consider that water use was one of several stressors influencing fish in the Wapiti River and precautionary thinking should be used.

5.0 Recommendations and Management Strategies

This section presents the recommendations and management strategies for the Wapiti River Water Management Plan. The recommendations presented here have been endorsed by the Steering Committee and are organized into two categories:

1. Recommendations for decisions under the *Water Act* – These recommendations provide direct advice to the Minister of Environment and Parks and the designated-Director under the *Water Act*, who is responsible for making water allocation decisions under the *Act*.
2. Recommendations for watershed management planning priorities – The provisions described under these recommendations support implementation of the plan and improve management effectiveness. Actions to implement may be undertaken by the Alberta Government or the Mighty Peace Watershed Alliance (the designated partner for watershed planning and advisory council for the region) with support from other organizations with a specific interest in the management of water in the planning area.

5.1 Recommendations for Decisions Under the Water Act

Alberta Environment and Parks may establish a Water Conservation Objective for water quantity to protect the aquatic environment under section 15(1) of the *Water Act*. These water management objectives are incorporated into the terms and conditions of applicable approvals and licences under the *Act*. Authorization holders are required to comply with recommended conditions. The following recommendations provide advice to the Director when making decisions under the *Water Act*.

5.1.1 Recommended Water Conservation Objective (WCO)

The WCO recommended for the Alberta portion of the Wapiti River basin in this Plan specifies the following limitations on human water consumption:

- When natural flow in the Wapiti River below Big Mountain Creek is above 20 m³/s: net water use up to 2 m³/s is allowed in Wapiti River Basin;
- When natural flow in the Wapiti River below Big Mountain Creek is between 10 m³/s and 20 m³/s: net water use of up to 1 m³/s is allowed in Wapiti River Basin; and
- When natural flow in the Wapiti River below Big Mountain Creek is less than 10 m³/s: net water use of up to 8% of natural flows is allowed in Wapiti River Basin.

Natural flow for the recommended WCO refers to flow in the Wapiti River downstream of Big Mountain Creek prior to any withdrawals, storage or return flows upstream in the watershed including both the mainstem and tributaries. It is recognized that real-time estimation of natural flows will be required to implement the WCO and is a supporting recommendation of this plan. However, it is important to identify both natural flow estimation and net water use are dependent on measured flow and total basin-wide diversions. For example, if measured flow in the Wapiti River at the Highway 40 gauge is 25 m³/s and total diversions are at the future water-use scenario of 1.96 m³/s there is still no need to:

- a) estimate natural flows downstream from Big Mountain Creek; or,
- b) calculate net use from real-time reporting of licences with return flows.

The reasoning follows, for this situation, as natural flows in the Wapiti below Big Mountain must be >25 m³/s and net-use must be <1.96 m³/s; hence, the WCO is achieved. In this light, importance of estimating natural flows and net water use increases as measured flow in the Wapiti drops below 10 m³/s and total diversions increase above 1 m³/s.

Net water use is equal to gross diversions minus return flows (in real-time OR within the management period). Net use is determined for all surface water licences (deemed term or temporary) for Segment A of the Wapiti River, including all contributing upstream water diversions. Individual segments are not managed independently as the river system is considered as a whole and any upstream diversions must meet downstream objectives.

The recommended WCO was determined by the Steering Committee to achieve an acceptable balance among economic development, environmental, and social values. The recommended WCO is summarized in Table 9 and illustrated in Figure 6.

Table 9. Wapiti River Water Management Plan Water Conservation Objective.

Wapiti River Water Management Plan WCO			
Natural flows at Wapiti River below Big Mountain Creek:	<10 m ³ /s	10 – 20 m ³ /s	>20 m ³ /s
Net water use:	8% of natural flow	1 m ³ /s	2 m ³ /s

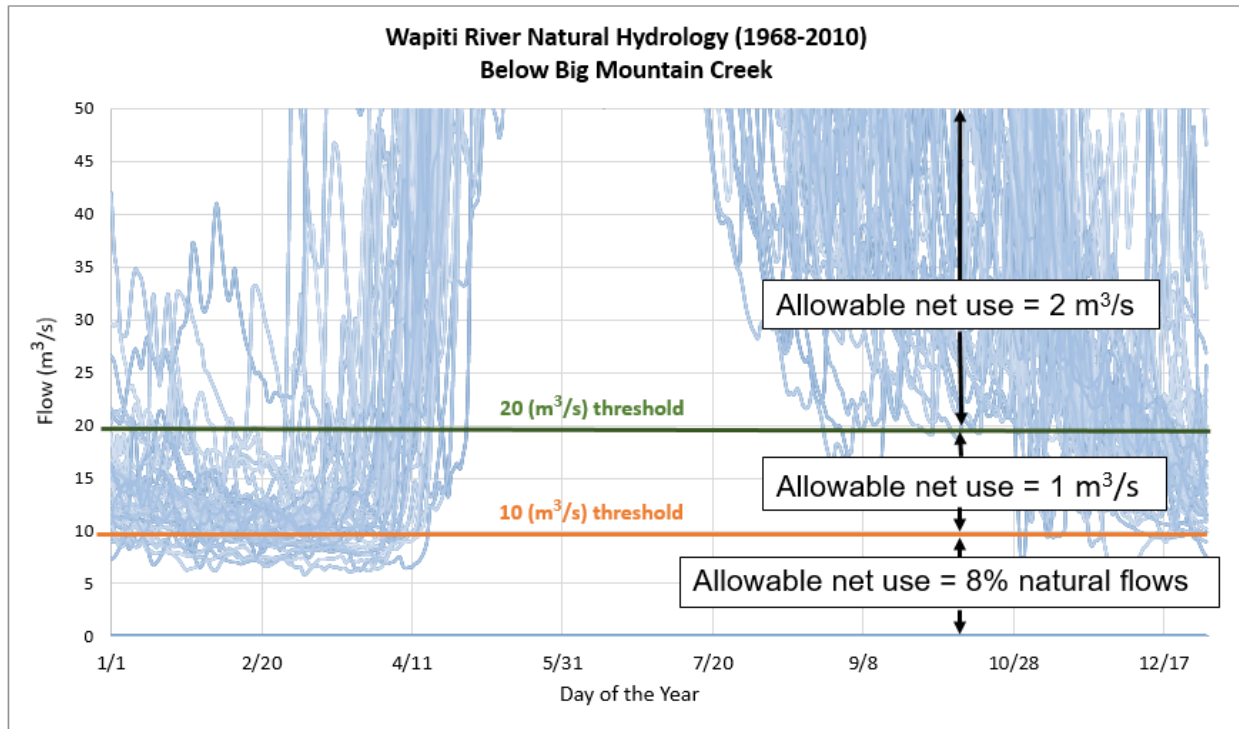


Figure 6. Structure of the WCO. Each blue line represents one year from the natural hydrology flow dataset (1968-2010). Adapted from Compass Resource Management (2017).

The WCO will be applied to:

- all new surface water allocation authorizations in the Alberta portion of the Wapiti River basin under the *Water Act*;
- Aquatera Utilities 2013 junior licence (Licence No. 00277161-00-00, Priority No. 2011-05-02-003); and
- where a provision exists and the Director finds cause, may be applied to other licences subject to renewal under the *Water Act*.

The WCO in this plan was developed for Segment A (Figure 2) of the Wapiti River. All other existing water allocation authorizations shall retain their original conditions, including any instream objectives specified.

As Segment A is the furthest downstream reach within the Wapiti River basin, all new water allocation authorizations in the Alberta portion of the Wapiti River basin are subject to meeting this WCO. New water allocation authorizations in the Alberta portion of the Wapiti River basin outside of Segment A, may also be subject to their own reach or water body specific objectives, WCOs, or other regulatory requirements, in addition to this Wapiti River WCO.

5.1.2 Recommendations to Support the Water Conservation Objective

The following proactive management actions are recommended by the Steering Committee to achieve implementation of the WCO:

Table 10. Recommendations to support the implementation of the WCO

Recommendation Topic	
Aquatic Ecosystem Monitoring	
Recommendation	The Plan recommends a coordinated aquatic ecosystem monitoring approach for the Wapiti River basin and recommends that the Province leads the development of a monitoring framework in consultation with organizations who are interested or obligated as a result of licence conditions.
Rationale/ Considerations	<ul style="list-style-type: none">• General purpose of monitoring: detecting changes in the aquatic ecosystem, understanding mechanisms of change and significance of change.• Intent of coordinated monitoring: Monitoring that aligns where possible, avoids duplication, and benefits a basin-wide aquatic ecosystem monitoring framework. The proposed monitoring builds on the current coordinated monitoring between International Paper and Aquatera and will expand to key tributaries and selected water bodies to understand and determine how other factors, like non-point source pollution, affect the aquatic ecosystem. The coordinated monitoring will not replace the existing company-specific monitoring requirements under their <i>Environmental Protection and Enhancement Act</i> approvals or other legislated requirements; rather, it will complement the existing monitoring programs.• Currently in the Wapiti River basin, the Province undertakes water quality monitoring as part of their role as managers of the aquatic ecosystem. In addition, International Paper (IP) and Aquatera undertake aquatic ecosystem monitoring as required by their water licences and water discharge permits. Municipalities and other organizations also support and conduct aquatic ecosystem monitoring projects in the basin. <p>An aquatic ecosystem monitoring framework would: define monitoring objectives for the basin, identify where current monitoring programs are informing those objectives, and identify gaps. A comprehensive monitoring framework would align the province, industry, municipalities and other organizations to collect data that would be complimentary and produce datasets that would be holistic in nature. This dataset can then be analyzed to produce a greater understanding into the health of the aquatic ecosystem within the Wapiti River basin.</p>

Flow Measurement

Recommendation	Within a year of endorsement of the Plan, Alberta Environment and Parks should develop a reliable method to determine reference natural flow for Segment A (as indicated in Figure 2) that will be used to implement the recommended WCO.
Rationale/ Considerations	Estimation of natural flows for Segment A and basin-wide net water use in Alberta are required to allow for active management of the recommended WCO. Importance of these estimates depends on measured river flow and total diversions. As measured river flow drops 20 and 10 m ³ /s respectively, importance of natural flows increases; similarly, as total diversions increase above 1 and 2 m ³ /s respectively, importance of net water use increases. It is recommended Alberta Environment and Parks develop a strategy outlining how natural flow and net water use will be measured to meet the Water Conservation Objective within one year.

Cumulative Water Use Tracking and Reporting

Recommendation	The Plan recommends that cumulative water use in the Wapiti River Basin should be tracked on an ongoing basis and a Water Use Report for the Wapiti River Basin should be published by Alberta Environment and Parks annually. This report should include a comparison of water use with the WCOs and the Future Water Use Demand Scenario.
Rationale/ Considerations	This is the critical information needed to know if the recommended WCO is being met. It is envisioned that this annual report would be a fairly simple summary of existing water use reporting data (e.g. a summary table of water use) and clear assumptions for water users that do not report water use.

Review of Plan Implementation

Recommendation	The Plan recommends that Alberta Environment and Parks should review the Plan implementation progress with the community at least every five years.
Rationale/ Considerations	This is envisioned as a one to two day workshop organized by Alberta Environment and Parks with representatives from organizations with an interest in the Plan. The workshop would review the recommendations made in the Plan, potential indicators and progress on implementation. This would be an opportunity for Alberta Environment and Parks to recommend any adjustments to the Plan based on any learning that has occurred with implementation.

Minimum Time Period for Review of the Recommended WCO

Recommendation The WCO should be reviewed within 10 years of approval of the Plan.

Rationale/Considerations The recommended WCO was developed based on the best available information as of 2017. A 10-year review frequency is thought to be a time period where new information may become available that should be taken into consideration in the setting of the WCO.

Plan Triggers and Key Assumptions in Future Use Scenario

Recommendation The Plan recommends the following review triggers:

1. If significant new water allocations are approved in the British Columbia portion of the basin, a review of the recommended WCO in the Plan may be triggered.
2. If net water use for existing water licence holders is greater than what was assumed in the future water use scenario, a review of the recommended WCO in the Plan may be triggered.

Rationale/Considerations The recommended WCO was based on an assessment that made specific assumptions about a future water use scenario such as:
(1) no new water use in the British Columbia portion of the Wapiti River basin, and (2) International Paper's net water use would remain at current levels (0.04 m³/s on average) into the future.

If these assumptions do not hold into the future, the WCO will be reviewed. Current water users in Alberta will not be penalized by a future increase in British Columbia.

Support the Oil and Gas sector to Achieve the WCO Through the Regulatory Process

Recommendation The Plan recommends the exploration of opportunities to identify and increase off-stream storage in the basin to support water demand for temporary diversion licences (TDLs).

Rationale/Considerations The oil and gas sector is an important economic pillar in the Wapiti River watershed. Holders of licences in the oil and gas sector will identify and develop water storage facilities (e.g. off-stream water reservoirs) if needed to meet the WCO. Regulatory oversight will be required to coordinate development, maintenance and decommissioning of water storage to be compatible with the recommended WCO and other regulatory requirements.

5.2 Recommended Watershed Management Planning Priorities

Cumulative effects of: a large and growing population, a range of growing industries and the need to manage water for several purposes, including ecological, are difficult to quantify and even more difficult to predict. Thus, it is prudent to pursue additional management approaches that will maintain and conserve the ecological function of this system. To this end, the WCO comes with a recommendation to complete a watershed management plan for the Wapiti River watershed (Table 11).

Table 11. Recommended watershed management planning priorities for the Wapiti River watershed.

Recommended Watershed Management Planning Priorities	
Watershed Management Plan	
Recommendation	<p>The Plan recommends the development of a watershed management plan for the Wapiti River basin that considers cumulative watershed impacts and solutions. A watershed management plan should address and incorporate the following issues:</p> <ul style="list-style-type: none"> • Flow • Water quality • Riparian and wetland areas • Aquatic habitat uses <p>As watershed management planning is a collaborative effort, the Steering Committee recommends that the Mighty Peace Watershed Alliance (the Peace basin multi-stakeholder watershed planning organization) should lead this planning initiative with local stakeholders to develop a source water protection plan or integrated watershed management plan for the Wapiti River basin.</p> <p>The steering committee also recommends that:</p> <ul style="list-style-type: none"> • All levels of government and industry stakeholders must commit financial support (e.g. funding, in-kind contributions, etc.) to developing this planning initiative. • The watershed management plan should be completed within five years upon the approval of the Wapiti River Water Management Plan. This is contingent upon the commitment of stakeholders. • A funding mechanism is established by the Province to ensure the sustainability of the watershed planning process.
Rationale/ Considerations	<p>A watershed management plan will help identify risks to a resource that may be under stress in the future and allow for proactive management and mitigation to occur. A WCO could result in being ineffective if activities such as clearing, development, agricultural runoff, loss of wetlands or increased angler harvest are not effectively addressed. A watershed management plan to support achieving the WCO should include, but not be limited to identification of:</p> <ul style="list-style-type: none"> • Key issues, concerns, challenges, priorities and objectives in the watershed.

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- Current “state of” non-point source knowledge in the basin and provide potential comprehensive and coordinated approaches to non-point source pollution management in the Wapiti River watershed.
 - Opportunities to restore and protect wetlands, riparian areas and lakes.
 - Potential risks to the aquatic habitat and recommended management actions.

Water Quality

Recommendation

While point source discharges continue to be subject to regulatory standards and monitoring requirements, non-point source monitoring is not adequate to characterize the current state and evaluate trends, therefore the Steering Committee recommends the collection of necessary field data to calibrate, validate and strengthen the predictive power of a water quality model.

Rationale/ Considerations

A robust water quality model is required to ascertain the likelihood of ecological impact and to help inform water quality related decisions and plans. Development of a robust water quality model for a Wapiti River watershed plan requires knowledge about the relative contribution of point and non-point pollution sources.

Currently, unlike point sources, the extent and contribution of non-point sources in the Wapiti River watershed is relatively unknown. This limits the development of a water quality model and makes it difficult to develop effective management strategies. To manage non-point sources, we need knowledge and tools to determine: how much there is (quantification), where it is coming from (research), if it is a problem (evaluation) and what we can do about it (mitigation). As population in the Grande Prairie area grows and land use intensifies, the extent and risk of non-point sources will increase, which, in combination with water withdrawals and effluent discharges may lead to further water quality degradation. A proactive approach to managing non-point sources is more cost effective and timely than remediation.

6.0 Implementation and Performance Monitoring Requirements

Effective water management must include a realistic, manageable and effective implementation strategy. An implementation strategy is an important component of any Water Management Plan and must state the roles and responsibilities, priority actions, timelines and strategies to achieve the goals of the Water Management Plan.

The implementation strategy for the Plan encompasses both actions that are the legislated responsibility of Alberta Environment and Parks and the Alberta Energy Regulator and actions that are best implemented through a collaborative approach.

6.1 Implementation of the WCO

Alberta Environment and Parks is the lead ministry responsible for the implementation of the WCO and some of the associated actions that support achieving them.

Alberta Environment and Parks will lead the following actions:

- Within one year upon the approval of this Plan, Alberta Environment and Parks hydrologists will develop a real-time implementation strategy to manage the recommended WCO. The implementation strategy will require, but not limited to, the following supportive actions:
 - Real-time estimation of natural flows as necessary to support the recommended WCO.
 - Real-time estimation of net water use (permanent, term and temporary) as necessary to support the recommended WCO.
 - Alberta Environment and Parks should publish on a public web page near real-time estimated natural flows, estimated net water use and water remaining for use under the recommend WCO.
- Report annually the cumulative water use in the basin.
- Within one year upon approval of this Plan, Alberta Environment and Parks should develop a coordinated aquatic ecosystem health monitoring framework in consultation with Indigenous peoples, other interested stakeholders, or obligated stakeholders as per licence conditions.
- In collaboration with industry stakeholders, gather necessary field data to calibrate, validate and strengthen the predictive water quality model to inform water quality related decisions and plans in the watershed.
- Review the Wapiti River Water Management Plan implementation progress with the communities within the Wapiti River basin at least every five years.
- Review the recommended WCO every 10 years.
- Review of the Plan may be triggered if: (a) significant new allocations are approved in the British Columbia portion of the basin; or (b) net water use for existing water licences

is greater than what was assumed in the future water use scenario used to inform the Steering Committee's recommended WCO.

6.2 Implementation of the Watershed Management Plan

The watershed management plan will recommend a wide range of proactive management actions across the basin to maintain, protect, restore and enhance the quality and health of the aquatic resource. The watershed management plan will also recommend actions that need to be taken to meet the goals of the Water for Life Strategy: 1) safe, secure drinking water; 2) healthy aquatic ecosystems, and 3) reliable quality water supplies for a growing economy. The Steering Committee agreed to the following strategy to develop the Wapiti River watershed management plan:

- The Mighty Peace Watershed Alliance, as the official Watershed Planning and Advisory Council (WPAC), will lead and undertake future watershed management planning in the Wapiti River basin.
- Industry stakeholders and governments are recommended to actively participate and contribute financially (e.g. funding, in-kind contributions, etc.) to the development and implementation of the watershed management plan.
- Alberta Environment and Parks and industry stakeholders should contribute in collecting necessary field data to calibrate, validate and strengthen the water quality model required to ascertain knowledge about the relative contributions of point and non-point source pollutions.

6.3 Monitoring Requirements

Given the commitment and effort put into developing the Wapiti River Water Management Plan, it is important to determine and evaluate whether the efforts are achieving the intended outcomes. Alberta Environment and Parks will lead two complementary approaches to assess the success of the recommended WCO:

- **Short-term Performance Monitoring:**
Typically carried out on annual basis to track and review progress made towards achieving WCO objectives. Annual water use reporting is used to validate this performance monitoring.
- **Long-term Effects Monitoring (also known as outcome or result monitoring):**
The process of collecting and evaluating scientific monitoring data and information to determine whether the desired outcomes of balancing human water demands and the protection of the aquatic environment are achieved. The Wapiti River Water Management Plan recommends 5-year and 10-year reviews to assess the implementation trends and the effectiveness of the WCO. Long-term effects monitoring would be achieved, at least in part, through the coordinated aquatic ecosystem health monitoring discussed previously.

7.0 References

- Alberta Environment (2001) Framework for Water Management Planning.
- Alberta Environment and Sustainable Resource Development (2014) A Guide to Endangered and Threatened Species, and Species of Special Concern in Alberta. Version 1.
- Alberta Government (2015) Lower Athabasca Region: Surface water quantity management framework for the lower Athabasca River. <http://aep.alberta.ca/lands-forests/cumulative-effects/regional-planning/documents/LARP-SurfaceWaterQuantity-Feb2015.pdf>
- Alberta Water Council (2013) Recommendations to improve Non-Point Source Pollution Management in Alberta
- ALCES Landscape & Land-Use Ltd. (2015) Wapiti River Cumulative Effects Modelling Tool. Prepared for the City of Grande Prairie.
- Anderson, K.E., A.J. Paul, E. McCauley, L. J. Jackson, J.R. Post and R.M. Nisbet. (2006) Instream flow needs in streams and rivers: the importance of understanding ecological dynamics. *Frontiers in Ecology and Evolution*. 4(6): 309-318.
- Annear, T., I. Chisholm, H. Beecher, A. Locke, P. Aarrestad, C. Coomer, C. Estes, J. Hunt, R. Jacobson, G. Jöbssis, J. Kauffman, J. Marshall, K. Mayes, G. Smith, R. Wentworth, and C. Stalnaker. (2004) *Instream Flows for Riverine Resource Stewardship*, Revised Edition. Instream Flow Council, Cheyenne, WY. 268 pp.
- CharettePellPoscente Environmental Corp, Hutchinson Environmental Sciences Ltd. (2012) Aquatic Ecosystem Health of the Peace Watershed Project. Prepared for the Mighty Peace Watershed Alliance.
- CharettePellPoscente Environmental Corp. (2013), Terms of Reference for the Wapiti River Water Management Plan. Prepared for the Mighty Peace Watershed Alliance and the Wapiti River Water Management Plan Steering Committee.
- Clipperton, G.K., C.W. Koning, A.G.H. Locke, J.M. Mahoney, and B. Quazi (2003) *Instream Flow Needs Determinations for the South Saskatchewan River Basin, Alberta, Canada*. Alberta Environment and Alberta Sustainable Resource Development, Pub No. T/719.
- Compass Resource Management (2013) Structured Decision Making Workshop, Wapiti River Water Management Plan, Facilitator Summary. Prepared for the Wapiti River Water Management Plan Steering Committee Feb, 2013.
- Compass Resource Management (2017) Wapiti River Water Management Plan Steering Committee Final Report. Approved by the Wapiti River Water Management Plan Steering Committee Dec 13, 2017.
- COSEWIC (2015) COSEWIC Assessment Process, Categories and Guidelines, Committee on the Status of Endangered Wildlife in Canada, Quantitative Criteria and Guidelines for the Status Assessment of Wildlife Species, Table 2.

Cows and Fish (2016) Alberta Lotic Wetland Health Assessments for Large River Systems Survey (update). In collaboration with USDI Bureaus of Land Management in Montana and Idaho, USDI Fish and Wildlife Service, Alberta Environment and Parks.

Ecofish Research Ltd. and Compass Resource Management. (2013) Wapiti River Environmental Flows Scoping Study. Water management plan for the Wapiti River – Information needs and study plan considerations. Consultant's report prepared for Wapiti River Water Management Plan Steering Committee, March 2013.

EDI Environmental Dynamics Inc (2015) Wapiti River Fish Telemetry Program – Final Summary Report. Prepared for the City of Grande Prairie.

George C., W. Tymensen, & S.B. Rood (2002) Recreation Flows for the Bow River Basin and Tributaries, Alberta. Report for Alberta Environment, Lethbridge, AB, July 2002.

Golder Associates (2014) Wapiti River Habitat Mapping Study. Segmentation Study and Habitat Mapping of the Wapiti River near Grande Prairie, Alberta. Prepared for the Wapiti River Water Management Plan Steering Committee.

Hutchinson Environmental Sciences Ltd. (2015) Bear Creek Water Quality Study, prepared for the City of Grande Prairie.

International Union for Conservation of Nature (IUCN) (2001). IUCN Red List Categories and Criteria: Version 3.1. IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, U.K. Available at the [IUCN Red List of Threatened Species website](#).

Kerkhoven, E. (2014a) Wapiti River Watershed - River and Tributary Flows. Prepared for the Wapiti River Water Management Plan Steering Committee, July 2014.

Kerkhoven, E. (2014b) Wapiti River Geomorphology Assessment. Prepared for the Wapiti River Water Management Plan Steering Committee, July 2014.

Kerkhoven, E. (2014c) Wapiti River Watershed – Land Cover Change Assessment. Prepared for the Wapiti River Water Management Plan Steering Committee, June 2014.

Kerkhoven, E. (2014d) Wapiti River Watershed Climate Change Assessment. Prepared for the Wapiti River Water Management Plan Steering Committee, July 2014.

MacPherson, L., M. Coombs, J. Reilly, M.G. Sullivan, and D.J. Park. 2014. A Generic Rule Set for Applying the Alberta Fish Sustainability Index, Second Edition. Environment and Sustainable Resource Development, Edmonton, Alberta, Canada.

Mathews, R. and Richter, B. (2007). Application of the Indicators of Hydrologic Alteration software in environmental flow-setting. Journal of the American Water Resources Association 43(6): 1400-1413.

Mighty Peace Watershed Alliance and Watrecon Consulting (2012) The Peace Watershed: Current and Future Water Use and Issues, 2011.

- Muhlfeld, C.C., L. Jones, D. Kotter, W.J. Miller, D. Geise, J. Tohtz and B. Marotz. (2011) Assessing the impacts of river regulation on native bull trout (*Salvelinus confluentus*) and westslope cutthroat trout (*Oncorhynchus clarkii lewisii*) habitats in the upper Flathead River, Montana, USA. *River Research and Applications*. 28(7): 940-959.
- Palmer Environmental Consulting Group and Normandeau Associates (2014) Habitat Suitability Curves Workshop Report. Prepared for the Wapiti River Water Management Plan Steering Committee.
- Palmer Environmental Consulting Group Inc. and Thomas Gast & Associates Environmental Consultants (2015) Wapiti River Instream Flow Study. Prepared for the Wapiti River Water Management Plan Steering Committee under contract to Aquatera Utilities Inc.
- Paul, A.J. and A. Locke (2009) Evaluation Criteria for Flow Alterations in the Lower Athabasca River–Fish Habitat. Fish and Wildlife Division, Alberta Sustainable Resource Development, Prepared for the Instream Flow Needs Technical Task Group, Surface Water Working Group, Cumulative Environmental Management Association.
- Paul, A.J. (2017) Flow Evaluation Tool for Alberta (FETA): Wapiti River Flow Calculator, Fish and Wildlife Habitat Policy, Alberta Environment and Parks, September 2017.
- Petra Rowell Consulting (2016) Traditional Land Use Information and the Wapiti River Water Management Plan. Prepared for the Wapiti River Management Plan Steering Committee.
- Stantec Consulting Inc. (2015) Wapiti River Dissolved Oxygen Fluctuation Literature Review, prepared for the City of Grande Prairie.
- SREM (2012) Aboriginal Consultation Plan (draft). Developed by Sustainable Resources Environmental Management (SREM) Aboriginal Affairs Branch.
- RC Strategies (2016) Recreation Considerations Report: Wapiti River Water Management Plan.
- Rood, S.B. & W. Tymensen (2001) Recreational Flows for Paddling Along Rivers in Southern Alberta. Submitted to Alberta Environment, Lethbridge, AB.
- Tharme, R. E. (2003) A global perspective on environmental flow assessment: Emerging trends in the development and application of environmental flow methodologies for rivers. *River Research and Applications* 19(5–6): 397–441.
- Victory GIS (2017) Evaluation of Water Storage in the Wapiti Basin. Compilation of GIS files prepared for the Wapiti River Water Management Plan Steering Committee.
- Wapiti River Water Management Plan Steering Committee (2015) Wapiti River Water Management Plan Community Consultation and Communication Proposal.
- Wapiti River Water Management Plan Steering Committee (2015) Wapiti River Water Management Plan Engagement Summary (Workshop November 2015).
- Wapiti River Water Management Plan Steering Committee (2016) Operating Principles and Processes for Wapiti River Steering Committee (revised Sept 2016).

Wapiti River Water Management Plan Steering Committee (2017) Wapiti River Water Management Plan Engagement and Consultation Plan.

Water Quality Sub-group and Compass Resource Management (2017) Water Quality Analysis to Inform Recommendations for Water Conservation Objectives in the Wapiti River Water Management Plan, Prepared by: Water Quality Sub-group of the Environmental Sub-Committee and Compass Resource Management for the Wapiti River Water Management Plan.

Wright, N., E. Smyth, T. Jensma, A. Harwood, and T. Hatfield (2013) Environmental flows information review and gap analysis for the Wapiti River. Consultant's report prepared by Ecofish Research Ltd. for the Wapiti River Basin Water Management Plan Steering Committee. March 2013.

8.0 Appendix A - Steering Committee Members and Project/Technical Support

Member Organization	Steering Committee Representatives*	Project/Technical Support
Alberta Environment and Parks (AEP)	Dave Coish Abdi Siad-Omar Adrian Meinke Craig Johnson	Andrew Paul Lauren Makowecki Alina Wolanski Deepak Muricken Naba Adhikari Amanda Halawell Monica Dahl
Fisheries and Oceans Canada (DFO)	Brandi Mogge Marek Janowicz Mike Hunka	
County of Grande Prairie	Corey Beck Ross Sutherland Deryle Penner Steve Madden Sharon Nelson	
City of Grande Prairie	Michelle Gairdner Kase DeVries (alternate)	Kase DeVries Shelly Pruden
Aquatera Utilities Inc.	Ashley Rowney Jeff Johnston (alternate)	Rick Palmer Tom Gast Russ Brown
International Paper (formerly Weyerhaeuser)	Greg Pippus Nicole Jackson Shelly Pruden Grant Bouree	
Municipal District of Greenview	Gary Couch Bill Smith	Adam Esch Gwen Charlton Danny Williams
Mighty Peace Watershed Alliance (MPWA)	Adam Norris Bob Cameron Rhonda Clarke-Gauthier	

Town of Beaverlodge	Bill McKennan Pat Schulz	Lloyd Sherk
Canadian Association of Petroleum Producers	Garth Davis Sandra Miller (alternate) Scott Hillier Curtis Ferguson	
Sturgeon Lake Cree Nation**	Alexia Goodswimmer Darlene Kappo	
Nitehawk Ski Hill**	Duane Stevenson Johnathan Clarkson	
<p>*This list of SC members includes current and past representatives. The SC members that participated in the SDM workshops and represented their organizations in the voting for the final recommendations are in bold font.</p> <p>**These organizations participated for part of the process and were not voting members when the Steering Committee made their final recommendations.</p>		