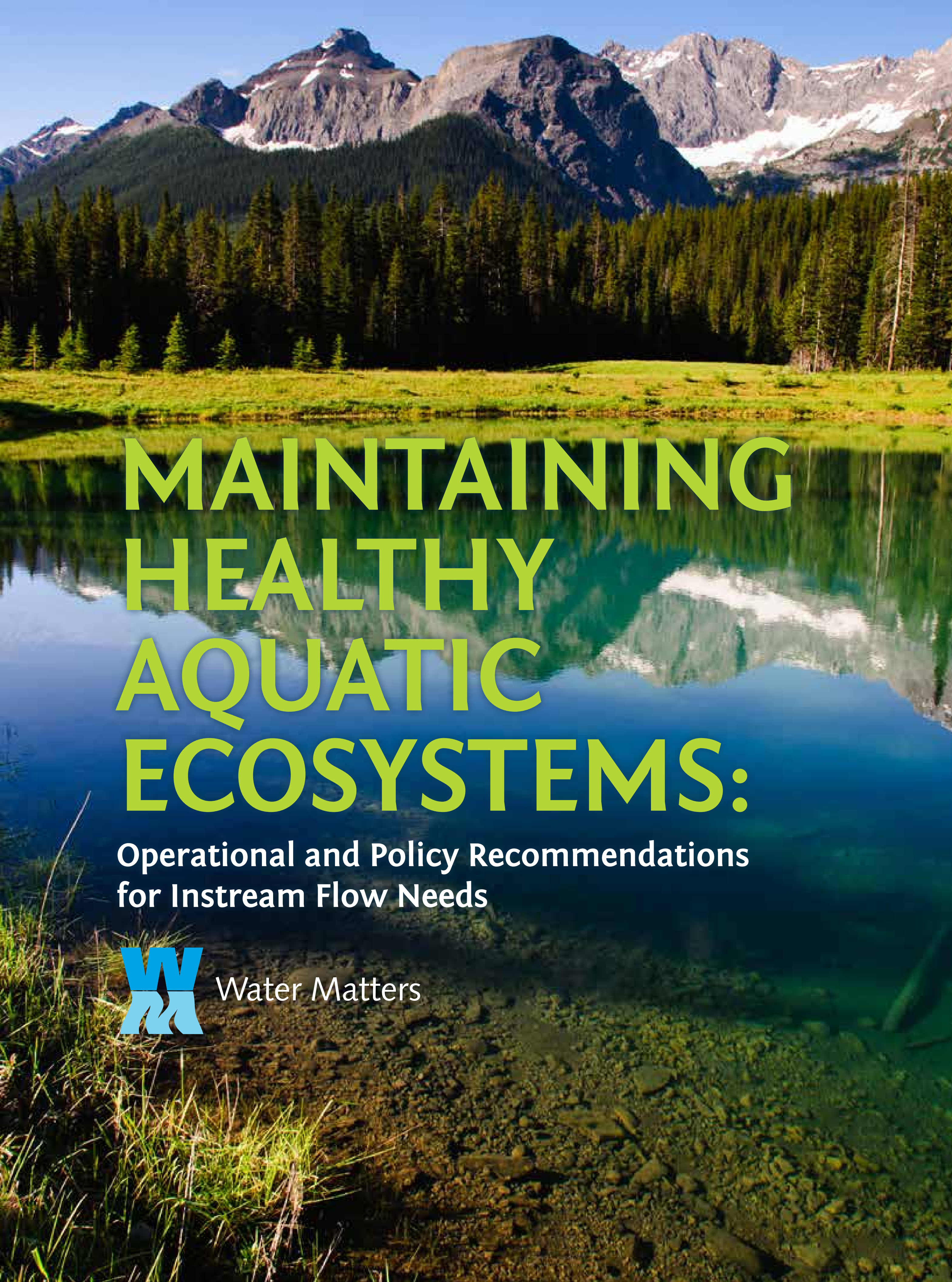

MAINTAINING HEALTHY AQUATIC ECOSYSTEMS:

Operational and Policy Recommendations for Instream Flow Needs

Water Matters

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Maintaining Healthy Aquatic Ecosystems: Operational and Policy Recommendations for Instream Flow Needs

September 2012

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Introduction

This report is intended for Albertans and the Government of Alberta, to provide possible solutions and actions to ensure a more sustainable water future for Alberta. This report builds upon much of the work presented in our September 2009 report, *Share the Water: Building a Secure Water Future for Albertans*. In *Share The Water*, we asserted that without significant changes, the current water allocation system will produce winners and losers from among water licence holders without any specific consideration of how water use and management will impact Albertans. In preparing this report, we have assessed published academic and government literature, and interviewed major water licencees ranging in size and seniority of allocation, throughout Alberta. Our goal is to present effective and attainable recommendations that will achieve long-term benefits for Albertans, our rivers, and water licencees.

We propose solutions that support the development of integrated water and land-use policies. Water Matters has supported Alberta's Land-use Framework (LUF) as a means to manage the cumulative effects of development and landscape change in watersheds, and on water quality and quantity. While it is arguable that Alberta's *Water for Life Strategy* has not delivered upon its promise, the LUF remains the strongest attempt in decades to integrate sustainable water and land-use policies, despite the fact development of preliminary regional planning thresholds for cumulative effects has been elusive.[1] The LUF's regional plans are the logical place to establish thresholds and apply limits to the scale and breadth of landscape uses, and to ensure acceptable limits on chemical loadings to our streams and rivers via runoff. These additions to LUF regional plans would establish clear linkages between the LUF and the *Water for Life Strategy*, which, despite having been highlighted by many observers since the introduction of the LUF, have so far been absent. If instream flow needs (IFNs) and water rights management are not integrated into land-use planning, conflicts will continue to arise between and among water rights holders and landholders, and water management and regional planning in Alberta will continue to lack direction and certainty. Without such integration, demands for water use will continue to rise in regions that are already water stressed, aquatic ecosystems in Alberta will continue to degrade, and Alberta will place itself at more risk of serious social, economic and environmental harm during future droughts.

We propose that essential changes are needed in three separate areas of water management and policy in Alberta, each of which is summarized in a brief: the recognition and protection of IFNs to sustain the healthy aquatic ecosystems and ecosystem services upon which all Albertans rely for our environmental, social and economic well-being; integration of water and land-use policies and planning; and the allocation of water rights to benefit all Albertans. We also provide recommendations for achieving these changes, and include both policy and operational options for each area. Each of these discussions is a part of a holistic water management regime, and the solutions we propose should be implemented in concert to secure sustainable water management for Albertans. For example, ensuring equitable access to water and its use cannot be achieved without also recognizing public interest uses of water. To ensure Albertans have access to a full suite of ecosystem services, such as reliable and healthy drinking water supplies, legal recognition of water as a shared public interest is essential, and the health of aquatic ecosystems must be sustained and protected.

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[1] Water Matters, "A Nervous Summer for the Land Use Framework—You Can Help," *eNews*, August 3, 2011, **http://www.water-matters.org/story/443** (accessed 28 March 2012).

Background

Alberta has the fastest growing population and economy in Canada.[2] The large majority of Albertans (80%) live in the south, which contains only 20% of Alberta's water supply.[3] Further, two of the largest economic engines in Alberta, farming and oil sands development, are highly dependent on long-term sustainable water supplies. The regional imbalances in population, economic growth, and water supply present a unique challenge for provincial resource managers and policy makers. Ultimately, climate change is already reducing water availability in Alberta[4], requiring Albertans to use less water much more efficiently, and develop more effective, flexible, and adaptive management and policy approaches than used now.

Alberta's policies, legislation, and history explain why Alberta may be seeing an increase in water conflict among water users, including pitting competing water interests against river health. The *North West Irrigation Act* of 1894 was critical to settle Western Canada[5], but the adoption of the system of prior allocation left Alberta's senior water licencees holding a disproportionate amount the water rights.[6] In an attempt to deal with these inequities, and after seven years of public consultation, the Alberta government amended the *Water Act* was in 1999 to enable transfers of water rights and the protection of water for the environment.[7] Around the same time, some stakeholders raised the concept of water markets in Alberta. However, even those who initially supported the use of water markets agreed that water markets can fail to secure sufficient environmental protection in the absence of strong government involvement, and that the government must protect the water needs of the public, including for instream flow needs.[8]

Alberta's first water market became active on August 30, 2006, when the South Saskatchewan River Basin (SSRB) was closed to new licences. However, closure of the basin to new allocations was insufficient to rectify chronic water issues in the SSRB, such as failing ecosystem health, First Nations water rights, or equity among junior and senior water licence holders. In September 2008, the Minister of Environment announced a review of Alberta's water allocation system.[9] This was followed by reports from the Alberta Water Council, the Ministerial Advisory

[2] Statistics Canada, *Canada's Population Estimate* (Ottawa, ON, Statistics Canada, June 22 , 2011), **http://www.statcan.gc.ca/daily-quotidien/110622/dq110622a-eng.htm** (accessed December 2, 2011); "Canada's Population Growth Slows: Alberta Has Fastest First-Quarter Growth as National Net Migration Numbers Drop," *CBC*, June 22, 2011, **http://www.cbc.ca/news/canada/story/2011/06/22/statscan-population-study.html** (accessed December 2, 2011); Government of Alberta, *Economic Results*, Alberta's Economic Development Website, **http://albertacanada.com/about-alberta/economic-results.html** (accessed December 2, 2011).

[3] Alberta Environment, *Facts About Water in Alberta*, (Edmonton, AB: Alberta Environment, 2010), **environment.gov.ab.ca/info/library/6364.pdf** (accessed March 2, 2011).

[4] Schindler, D. W. and W. F. Donahue. "An Impending Water Crisis in Canada's Western Prairie Provinces," *Proc. Nat. Acad. Sci.* 103 (2006): 7210-7216.

[5] Percy, D., "Seventy-Five Years of Alberta Water Law: Maturity, Demise & Rebirth," *Alberta Law Review* Vol. 35 No. 221 (1996-1997).

[6] Alberta Environment, *South Saskatchewan River Basin Water Management Plan Phase Two: Background Studies – Finding the Balance Between Water Consumption and Environmental Protection in the SSRB* (Edmonton, AB: Alberta Environment, 2003). For example, 75% of water licenced in the South Saskatchewan River Basin is to be allocated to 13 irrigation districts.

[7] Percy, D. (1996-1997), *supra* note 5.

[8] Livingstone, M. L., "Designing Water Institutions: Market Failures and Institutional Responses," *Water Resources Management* Vol 9. (1995): 203-220; Horbulyk, T. and L. Lo, *Welfare Gains from Potential Water Markets in Alberta, Canada*, in Easter, in K.W., M.W. Rosegrant, and A. Dinar (eds.), *Markets for Water: Potential and Performance* (Boston, MA: Kluwer Academic Publishers, 1998), 253 and 247.

[9] Cryderman, K., "Alberta to Study Water Rights," *Calgary Herald*, September 4, 2008.

Committee and the Alberta Water Research Institute, which provided recommendations for improvement of water allocation in Alberta.[10] Unfortunately, these three reports were incomplete. They failed to provide a clear picture of the *status quo*, identify sources of information, or consider studies on water transfers in Alberta, and they omitted any discussion on relevant and related water issues.[11] Furthermore, the three reports "fail to confront some of the serious empirical shortcomings of Alberta's FIT-FIR ["first in time, first in right," or prior allocation] system, its effects on the environment, or the fact that the entire system itself has yet to be adequately constrained by the water rights of First Nations."[12]

Thus far, the public has not been involved in discussions about the changes in Alberta's water allocation system that are necessary to ensure Albertans are collectively prepared to live in a future with less water. In the absence of public engagement, several organizations and academic writers, despite disagreements on the mechanisms by which Albertans may reach a sustainable future, uniformly agree that water must be secured to ensure healthy aquatic ecosystems and for basic human needs.[13] It remains to be seen whether or how the Government of Alberta will integrate IFNs into regional land-use plans under the *Alberta Land and Stewardship Act* (ALSA).

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[10] Alberta Water Council, *Recommendations for Improving Alberta's Water Allocation Transfer System*. (Edmonton, AB: Alberta Water Council, 2009) **http://www.albertawatercouncil.ca/Portals/0/pdfs/WATSUP_web_FINAL.pdf** (last accessed April 18, 2012); Alberta Environment., *Minister's Advisory Group: Recommendations for Improving Alberta's Water Management and Allocation*. (Edmonton, AB: Government of Alberta, 2009) **http://www.environment.gov.ab.ca/info/posting.asp?assetid=8239&searchtype=advanced** (last accessed April 18, 2012); Alberta Water Research Institute, *Towards Sustainability: Phase I Ideas and Opportunities for Improving Water Allocation and Management in Alberta*. (Edmonton, AB: Alberta Water Research Institute, 2009); and Alberta Water Research Institute, *Water: How Alberta Can Do More With Less*, (Edmonton, AB: Alberta Water Research Institute, 2009).

[11] Bankes, N., "Policy Proposals for Reviewing Alberta's Water Re(Allocation) System," *Journal of Environmental Law and Practice* Vol. 20 (2010): 81-128.

[12] Schmidt, J., *Alternative Water Futures in Alberta* (Edmonton, AB: Parkland Institute, 2011), **http://parklandinstitute.ca/research/summary/alternative_water_futures_in_alberta/** (accessed December 5, 2011), 20.

[13] Droitsch, D. and B. Robinson, *Share the Water: Building a Secure Water Future* (Canmore, Alberta: Water Matters & EcoJustice, 2009); Bjornlund, H., "The Competition for Water: Striking a Balance among Social, Environmental, and Economic Needs," C.D. Howe Institute Commentary (Toronto, Ontario: CD Howe Institute, 2010), **http://www.cdhowe.org/pdf/commentary_302.pdf** (accessed March 9, 2011); Schmidt (2011), *supra* note 12.

Instream Flow Needs (IFNs) in Alberta

In this report, we discuss a foundational set of solutions to enhance recognition and protection of water for IFNs, so sustained aquatic ecosystem services provided by healthy rivers will continue to benefit Albertans in the future. Science-based provincial policy, legislation, and regulations for IFNs are fundamental for integrated and sustainable water resource management[14], and also critical to fulfill the goals for Alberta's *Water for Life Strategy*. Because IFNs are required to protect healthy aquatic ecosystems and human well-being, they are fundamental for safeguarding equitable water sharing and sustaining water for the public interest so we all benefit from ecosystem services.[15] By promoting integrated and sustainable development with wise, efficient, and effective water use, identifying and adhering to science-based IFNs is critical for long-term, sustainable economic development of industries that rely on our water resources.

We examine the rationale for an Alberta IFN policy in general, and specifically identify and address gaps in current policy and legislation. We also discuss the important components of science-based IFNs and how to achieve them. We then present a summary of our discussions on the importance of IFNs with major water users from a variety of sectors, including irrigation, oil and gas, municipalities, hydropower, and water utilities. Finally, we explore policy solutions to water shortages developed in other jurisdictions that should be considered by the Government of Alberta and Albertans, as well as some operational options for increasing volumes of water in the strained South Saskatchewan River Basin (SSRB).

We must call attention to specific caveats to provide important perspective and identify limitations for this report. Unfortunately, we were unable to solicit the participation of junior licence holders. There are likely a number of reasons for the reluctance of junior licencees to participate. However, we suspect that junior licencees were reluctant to speak openly about Alberta's water challenges because it may compromise their relationships with senior licence holders and the Government of Alberta, two key stakeholders with significant leverage and influence over the ability of junior licencees to exercise their water rights. Additionally, we recognize that equity in access to water and enjoyment of traditional uses for First Nations is paramount in the management of freshwaters in Alberta. First Nations in Alberta are critical stakeholders in Alberta's water rights system. We did not have the resources to address the required role of First Nations participation in any water allocation and management review. We recognize there is significant scholarship dedicated to First Nations water rights, and believe there is room for additional study and action in this area. However, this subject is beyond the scope of this study.

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[14] The Brisbane Declaration, *Environmental Flows are Essential for Freshwater Ecosystem Health and Human Well-Being*. Declaration of the 10th International River Symposium and International Environmental Flows Conference, Brisbane, Australia, September 3-6, 2007, Brisbane, Australia, **www.eflownet.org/download.../brisbane-declaration-english.pdf** (accessed: December 5, 2011); Hirji, R. and R. Davis, *Environmental Flows in Water Resource Policies, Plans, and Projects: Findings and Recommendations* (Washington, DC: World Bank, 2009), **http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2009/06/04/000334955_20090604063828/Rendered/PDF/487430PUB0envi101Official0Use0Only1.pdf** (accessed January 24, 2011).

[15] *Ibid*, and Le Quesne, T., E. Kendy, and D. Weston, *The Implementation Challenge: Taking Stock of Government Policies to Protect and Restore Environmental Flows* (Surrey, United Kingdom: World Wildlife Fund and The Nature Conservancy, 2010), **http://wwf.panda.org/about_our_earth/about_freshwater/freshwater_resources/?196955/The-Implementation--Challenge---Taking-stock-of-government-policies-to-protect-and-restore-environmental-flows** (accessed March 11, 2011).

Section 1: An Introduction to Science-based Instream Flow Needs

The concept of "instream flows needs" (IFNs) has recently become the focus in river management, because rather than simply focusing on flow rates and timing, it integrates the "quantity, timing and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend upon these ecosystem."[16] A fundamental part of science-based recommendations for IFNs is often referred to as environmental or ecological flow. In some cases, reference is made to ecosystem base flow (EBF), which corresponds to the lowest levels of natural flow within a river that will maintain the full suite of ecological services provided by a river.[17] However, EBFs do not encompass water quality considerations that are part of an IFN-based assessment. For these reasons, we promote IFNs as the most appropriate and meaningful basis for managing rivers in Alberta.

The presumption is that altered flow regimes, reduced flows and/or declines in water quality that correspond with the exceedance of an ecological threshold will impose a natural limit on some ecological service, such as water quality, sustenance of riparian wetlands or forests that border a river, or sustainable fish populations. Establishing levels at which flow rates, water levels, and water quality change impose limits on the most sensitive aspects of various ecological services is critical to identifying possible thresholds beyond which development pressures should not extend, if a full suite of ecological services is going to be sustained. The EBF is often considered the primary ecological concern with respect to management of water withdrawals, and in determining whether additional withdrawals are ecologically sustainable. However, the importance of water quality and flow regime change cannot be discounted in development of an IFN-based water management framework and program.

1.1 IFNs and Ecosystem Services

Threats to freshwater ecosystems include five main categories: overexploitation, pollution, fragmentation, destruction or degradation of habitat, and invasion by non-native species.[18] They are all related to and made worse by modification of river flows and wetland flooding regimes.[19] The problems we face in managing Alberta's rivers are little different from elsewhere around the world, and include attempting to minimize the impacts on rivers resulting from land-use change, dam construction, and surface and groundwater withdrawals, or correct ecosystem impacts after they have already occurred. The purpose of this review is to describe the scientific foundations

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[16] Acreman, M. C. and A. J. D. Ferguson, "Environmental Flows and the European Water Framework Directive," *Freshwater Biology* 55 (2010): 32-48; Hirji and Davis (2009), *supra* note 14.

[17] Clipperton, G. K. *et al.*, I*nstream Flow Needs Determinations for the South Saskatchewan River Basin* (Edmonton, AB: Alberta Environment and Alberta Sustainable Resource Development, 2003).

[18] Malmqvist, B. and S. Rundle, "Threats to the Running Water Ecosystems of the World," *Environmental Conservation* 29 (2002), 134–153.

[19] Arthington, A. H. *et al.*, "Preserving the Biodiversity and Ecological Services of Rivers: New Challenges and Research Opportunities," *Freshwater Biology* 55 (2010): 1-16.

for management of rivers based on IFNs, and the similarities or differences between this and the operational definitions of IFN employed by resource managers in Alberta and elsewhere.

It can be generally stated that changes in river flow increase the risk or likelihood of ecological changes, and the risk of ecological changes increases as the magnitude of changes in flow increases.[20] Much of the current focus of studies and discussion related to IFNs is on the response of economically and culturally significant fisheries in rivers to water-intensive development, and IFNs are being studied in order to establish limits on development that will effectively protect the fisheries.[21,22] However, such studies ignore the many other ecological systems and processes sustained by the full range of natural flows and from which we benefit directly or indirectly. The difficulty in determining IFNs is closely related to the fact that rivers are dynamic systems that exhibit large changes in physical, chemical, biological and hydrologic conditions along their lengths (spatial variation), and between seasons and from year to year (temporal variation). The substantial differences between sites and over time — as well as the interactions between the different sorts of conditions described above — means that IFNs also are site- and time-specific, in terms of location along the length of a river and the time of year. Ideally, IFNs are determined on the basis of scientific data that describe the relationships between flow and environmental condition throughout the full range in natural flow variation.

For the South Saskatchewan River Basin (SSRB), Alberta Environment followed a method for determining IFNs based on a number of ecosystem components, including water quality, fish habitat, riparian vegetation, and channel maintenance.[23] This was done in recognition that the health of a river and the ability to manage it sustainably depends upon more than simply the status of fisheries or water quality. Relationships between environmental conditions and flow also were assessed for 27 river reaches in the SSRB during each week of the year. By assessing the relationships of a number of ecological components with flow at many sites throughout the basin and the seasons, water and land managers are more likely to identify IFNs that are scientifically robust and more capable of assisting them in managing rivers, our water use, and the land-use change that often causes declines in aquatic ecosystem health and function.

Ecosystem components like water quality, fish habitat, channel maintenance, and riparian vegetation reflect a suite of chemical, physical, biological and hydrological variables and interactions that all provide insight into aquatic ecosystem health. They also are closely related to ecosystem services, which have been generally defined as the benefits people obtain from ecosystems. These can be characterized as *provisioning* services (*e.g.*, of safe food and water) , *regulating* services (*e.g.*, flood and disease control), *cultural* services (*e.g.*, spiritual, recreational, and cultural benefits) and *supporting* services (*e.g.*, nutrient cycling that maintain the conditions for life on Earth).[24]

[20] Poff, N. L. and J. K. Zimmerman, "Ecological Responses to Altered Flow Regimes: A Literature Review to Inform the Science and Management of Environmental Flows, *Freshwater Biology* 55 (2010): 194-205.

[21] Courtney, R., *Lower Athabasca River Instream Flow Needs (IFN) Recommendations, Fisheries Act Implementation Plan and Rationale* (Fisheries and Oceans Canada, 2006).

[22] McEachern, P., and B. Makowecki, *Phase 1 Water Management Framework: Instream Flow Needs and Water Management System for the Lower Athabasca River* (Alberta Environment/Fisheries and Oceans Canada, 2007); Ohlson, D., G. Long, and T. Hatfield. *Phase 2 Framework Committee Report* (Cumulative Effects Management Association, 2010).

[23] Clipperton *et al.* (2003), *supra* note 17.

[24] North South Consultants Inc., *Summary Report on the Initial Assessment of Ecological Health of Aquatic Ecosystems in Alberta: Water Quality, Sediment Quality and Non-Fish Biota* (Alberta Environment, 2007).

Important ecosystem services that are subject to such sudden shifts or changes include dryland agriculture, fisheries, and freshwater quality.[25] All of these depend on a variety of physical, chemical, and biological processes and interactions that, when balanced, help to maintain a healthy aquatic ecosystem. In a river, water supply, water temperature, and flow rates all play important roles in maintaining such things as water quality, riverbed scouring and sediment transport, and flood cycles. Consequently, they are critical in determining health and sustainability of natural river attributes, such as fish, invertebrate and plant communities, replenishment of perched wetlands or lowland delta regions, and maintenance of riparian communities that line rivers and streams.[26]

Human benefits accrued from sustainable management of ecosystem services also include reduction or avoidance of costs or expenses associated with degradation of ecosystems, and the reductions or losses of services they otherwise provide. Because of this, assessments of the value of ecosystem services must include not only an evaluation of the services themselves, but also the cost of the loss of the services. For example, a river may provide sufficient quantities of drinking water, but as water quality declines because of environmental change and increases in pollution inputs to a river, the expenses associated with drinking water treatment rise. Where some form of development directly or indirectly reduces the ecological services provided by healthy rivers, then an assessment of the value of that development should incorporate the loss in value in ecosystem services it causes.[27]

Typically, it is the loss of ecosystem service benefits in the wake of development decisions that trigger demands for compensation by affected people who relied upon the affected ecosystem service for benefits. Depending on the type of service, the amount and even suitability of compensation can vary greatly. For example, the loss of cultural services such as First Nations fisheries, or their spiritual connection to their traditional lands and customs, could be much more significant than losses associated with declines in drinking water quality that could conceivably be corrected with enhanced drinking water treatment. Freshwater systems are the foundation of our social, cultural and economic well-being, yet most are seriously impaired and continue to degrade at alarming rates.[28] Unfortunately, the ecosystem services that rivers provide to Albertans have yet to be assessed for their value, resulting in little understanding or acknowledgement of the value of healthy rivers as a public asset. Because of the breadth of ecosystem services provided by rivers and the degree to which many of them are compromised, a full suite of ecosystem services must be assessed in determining what constitutes adequate IFNs and protection. The particular ecosystem services to be considered and assessed in determining IFNs will depend on the physical, chemical, biological, and spatial attributes of a river, and on the local or regional socio-economic benefits derived from the river.

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[25] Carpenter, S. R. *et al.*, "Science for Managing Ecosystem Services: Beyond the Millenium Ecosystem Assessment," *Proceedings of the National Academy of Sciences* 106 (2009), 1305-1312.

[26] Power, M. E. *et al.*, "Hydraulic Food-Chain Models," *BioScience* 45 (1995): 159-167; Bradford, M. J. and P. S. Higgins, "Habitat-, Season-, and Size-Specific Variation in Diel Activity Patterns of Juvenile Chinook Salmon (*Oncorhynchus tshawytscha*) and Steelhead Trout (*Oncorhynchus mykiss*)," *Canadian Journal of Fisheries and Aquatic Sciences* 58 (2001): 365-374; Bradford, M. J., J. Korman and P. S. Higgins, "Using Confidence Intervals to Estimate the Response of Salmon Populations (Oncorhynchus spp.) to Experimental Habitat Alterations. *Canadian Journal of Fisheries and Aquatic Sciences* 62 (2005): 2716-2726.

[27] Renzetti, S., B. Cairns and Q. Grafton, *Monitoring the Value of Natural Capital: Water* (Ottawa, ON: Environment Canada and Statistics Canada, 2002), section 5.4.

[28] The Brisbane Declaration (2007), *supra* note 14, and as cited in Arthington *et al.* (2010), *supra* note 19.

Section 2: Ecological Thresholds and Decision Making

An ecological threshold is "the point at which there is an abrupt change in an ecosystem quality, property or phenomenon, or where small changes in an environmental driver produce large responses in the ecosystem."[29] Put another way, an ecological threshold is the ecological equivalent of "the straw that broke the camel's back," and can be pictured as a kind of natural teeter-totter: in a sustainably managed or undisturbed scenario everything is in balance, but when some significant pressure is applied to the ecosystem, some or all of the ecological functions or characteristics may slide past a tipping point (Figure 1).

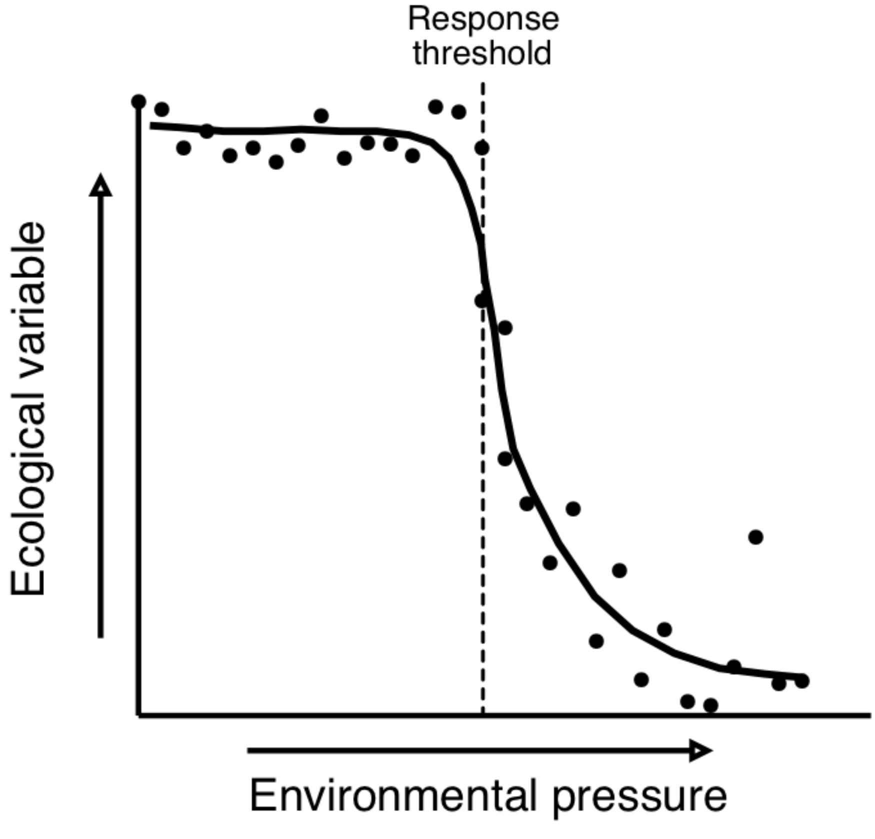

Figure 1. A theoretical threshold relationship of some ecological variable or service and its response to increased pressure. In the context of sustainable environmental management, the goal is to limit the accumulation of imposed pressure to levels below the threshold value, illustrated by the dotted line, so that the collapse of the environmental variable is avoided. Environmental variables that respond this way are almost unlimited, and include such things as animal or fish populations, natural removal of nutrients from water, or binding of heavy metals in soil.

[29] Groffman, P.M. *et al.*, "Ecological Thresholds: The Key to Successful Environmental Management or an Important Concept with No Practical Application?" *Ecosystems* 9 (2006): 1-13.

2.1 Effects of Exceeding Ecological Thresholds

As with a teeter-totter, where the pressure we put on an ecosystem is strong enough to exceed an ecological threshold and trigger a large shift, the pressure we have imposed needs to be reduced if we hope to regain the function of the pre-impacted ecosystem that was in balance. However, unlike with a teeter-totter, once an ecological tipping point is passed the ecosystem can flip into an entirely new state that is not easily reversed, making it very difficult, very expensive, or perhaps even impossible to return things to the condition that existed prior to the disturbance, especially in large rivers.[30]

A good example of the effects of pushing an ecological system beyond sustainable levels is the East Coast cod fishery. After overfishing devastated cod breeding stock, populations crashed to very low levels and other species populations increased in their absence. Some of these other species increased in number because they no longer faced predatory pressure from the cod, while others benefited from reduced competition with cod for food.[31] The result was that the critical position in the food web left empty by the over-exploitation of cod was filled by other fish species, and the door was effectively slammed shut on the potential recovery of the cod fishery. Because of these changes to the food web, recovery of cod populations and the lucrative fishery that depended on them has not occurred, despite a 20-year moratorium on fishing, and the predictably dire social and economic consequences of the collapsed fishery continue.

The acidification of hundreds of thousands of lakes in eastern North America because of acid rain caused by metal smelting and coal-based power production is another good example of the effects of exceeding ecological thresholds, and the difficulty of correcting ecological collapse once it has occurred. Natural biological, chemical, and geological interactions were altered so significantly in terrestrial and aquatic systems that freshwater food webs were devastated. In many lakes the numbers of plant and animal species plummeted and fisheries were wiped out. Despite the reduced inputs of acid over the last 30 years because of tougher anti-pollution laws in the US and Canada, and the recovery of chemical acid-base balances in many regions, the inability of previously acidified lakes to return to pre-acidification ecological states remains a serious problem.[32]

In fact, we are surrounded by innumerable environmental problems caused by exceeding ecological thresholds, including toxic algal blooms, high levels of fish contamination, boil water or swimming advisories, and "fished out" lakes, to name a few. Even where it is possible to reverse or reduce the harm we have caused, it is invariably far more expensive than simply avoiding harm in the first place. It is the hope of avoiding these sorts of ecological disasters — and the associated costs in lost ecological services and required reclamation and rehabilitation — that provides the rationale for designing and implementing adequate long-term environmental monitoring and assessment programs, which are needed to plan and ensure truly sustainable management and use of our living natural resources.

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[30] Gore, J. A. and F. D. Shields Jr., "Can Large Rivers Be Restored?" *BioScience* 45 (1995): 142-152; Pace, M. *et al.*, "Trophic Cascades Revealed in Diverse Ecosystems," *Trends in Ecology & Evolution* 14 (1999): 483-488; Hughes, F. M. R. and S. B. Rood, "Allocation of River Flows for Restoration of Floodplain Forest Ecosystems: A Review of Approaches and Their Applicability in Europe," *Environmental Management* 32 (2003): 12-33; Rooney, N. *et al.*, "Structural Asymmetry and the Stability of Diverse Food Webs," *Nature* 442 (2006): 265-269.

[31] Frank, K. T. *et al.*, "Trophic Cascades in a Formerly Cod-Dominated Ecosystem. *Science* 308 (2005): 1621–1623; Casini, M. *et al.*, "Multi-Level Trophic Cascades in a Heavily Exploited Open Marine Ecosystem," *Proceedings of the Royal Society B* 275 (2008): 1793–1801.

[32] Turner, M. *et al.*, "Benthic Algal Communities: Recovery from Experimental Acidification," *Canadian Journal of Fisheries and Aquatic Sciences* 66 (2009): 1875-1891; Vinebrooke, R. D. *et al.* "A Stressor–Independent Test for Biodiversity–Ecosystem Function Relationships During a 23-Year Whole-Lake Experiment," *Canadian Journal of Fisheries and Aquatic Sciences* 66 (2009): 1903-1909.

Threshold responses to environmental drivers are evident in a wide variety of natural processes, ranging from hydrologic responses to the slope of a hillside, to toxicity responses of species to pollutants.[33] Currently, there is great interest in applying threshold analysis in determining the break-points between withdrawals of water from rivers and the rivers' ecological sustainability. This is demonstrated in the more than 200 environmental approaches and methods in use, all of which are employed in attempts to quantify species, community, or aquatic ecosystem water requirements.[34]

2.2 Climate Change Risk and Water Management

> "No country on Earth has such contrasts of drought and water plenty as Canada. None has so much water ready and available for use. But Canada is learning that national statistics do not begin to portray the complexity of its relationship with its most vital resource.... [A] new reality is emerging ... in which water is in increasingly short supply in some places at some times, where water suddenly has a real value rather than being an unlimited resource – and where rivers truly can run dry."
>
> ~ Fred Pearce,
> *When Rivers Run Dry: Journeys into the Heart of the World's Water Crisis*
> (Key Porter Books: 2006)

It is almost part of our cultural fabric as Canadians to think of ourselves as possessing unlimited quantities of freshwater. However, for large parts of Canada — and especially in Alberta — this is not the case. Alberta has largely been settled and developed since the beginning of the twentieth century, and soon after this we began to monitor flows in major rivers. During the last century, there have been two major drought events that resulted in significant declines in stream flows and the significant socioeconomic impacts that accompanied them: the so-called "Dirty 30s" marked by dust bowl conditions, and the more severe drought period between 1998 and 2004 when unusually warm temperatures combined with low precipitation to devastate agriculture, but modern farming practices greatly reduced the effects of drought on land erosion.[35]

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[33] Montgomery, D.R. *et al.*, "Distribution of Bedrock and Alluvial Channels in Forested Mountain Drainage Basins," *Nature* 381 (1996): 587-589; Hanson, M.L. and K.R. Solomon, "New Technique for Estimating Thresholds of Toxicity in Ecological Risk Assessment," *Environmental Science & Technology* 36 (2002): 3257-3264.

[34] Arthington *et al.* (2010), *supra* note 19.

[35] Schindler and Donahue (2006), *supra* note 4; St. Jacques, J.M., D. J. Sauchyn and Y. Zhao, "Northern Rocky Mountain Streamflow Records: Global Warming Trends, Human Impacts or Natural Variability?," *Geophys. Res. Letters* 37 (2010).

Table 1. Long-Term Trends in Stream flow in Southern Alberta.[36]

The last eight rivers (italics) are regulated and actual and naturalized flow records exist. For those marked with an asterisk (*), at least 40% of average flow change over the period of record is attributable to direct human impacts. (ND = no significant change detect)

River	Period of Record	Flow Change (% per year)
Marias R. near Shelby, MT	1912-2007	-0.26
Waterton R. near Waterton Park	1912-2007	ND
Castle R. near Beaver Mines	1945-2007	ND
Oldman R. near Waldron's Corner	1950-2007	0.43
Highwood R. at Diebel's Ranch	1952-2007	ND
Bow R. at Banff	1911-2007	-0.12
Red Deer R. at Red Deer	1912-2007	-0.22
St. Mary R. at International Boundary	1903-2007	-0.46
Belly R. near Mountain View	1912-2007	ND
*Oldman R. near Lethbridge**	1912-2007	-0.76
*S. Saskatchewan R. at Medicine Hat**	1912-2007	-0.36
*Elbow R. below Glenmore Dam**	1911-2007	-0.70
Bow R. at Calgary	1912-2007	-0.16
*Spray R. at Banff**	1911-2007	-2.20
*N. Saskatchewan R. at Edmonton**	1912-2007	-0.14

2.2.1 Water Supplies in Alberta are Historically Variable and Currently Declining

Recorded river flows peaked in much of Alberta in the early 1980s. Since then, although there have been wet years and dry years, flows in Alberta rivers have generally been in decline because of a combination of changes in climate (including less precipitation, less snowmelt, and warmer temperatures), and severe human impacts caused by increased water withdrawal and land-use change.[37] During the last 100+ years, flow records for Alberta rivers have generally reflected the two major droughts, with increased flow in the intervening years.

Over the full period of recorded history in Alberta, many of the rivers that have been monitored the longest have undergone long-term declines in flow because of climate change, human impacts (including water withdrawals and land disturbance), or a combination of the two (Table 1). In the Rocky Mountains, many headwater streams that feed streams and rivers in southern Alberta have also demonstrated significant declines in flow over the past century.[38] In northern Alberta, water supply also has been declining for much of the last century. For

[36] St. Jacques, Sauchyn and Zhao (2010), *supra*.

[37] *Ibid*; Schindler and Donahue (2006), *supra* note 4.

[38] Rood S. B. *et al*., Twentieth-Century Decline in Streamflows from the Hydrographic Apex of North America, *J. Hydrol*. 306(1–4) (2005): 215–233.

example, since the W.A.C. Bennett Dam installation on the Peace River in British Columbia, in 1968, it has been considered the cause of decreases in frequency of downstream ice-jams and flooding events, and extended periods of drying in the Peace-Athabasca Delta region. However, climate reconstructions from lake cores indicate that this observed drying and warming are part of a longer trend that began in the 1930s to 1940s.[39] In the Athabasca River Basin, in the last 30 years of the twentieth century, there has been a 50% reduction in water being delivered to the mainstem Athabasca River from the ~94% of the basin that is downstream of Hinton.[40]

Despite these documented declines in water supply throughout the province, the impression persists that our supply of water is relatively stable. We also tend to think of the conditions we have experienced in the last 100+ years as representative of what is normal for this part of the world, and therefore suggestive of what future conditions should be like. Not unreasonably, because of the relatively stable water supplies experienced for most of Alberta's history, many of the development trends, decisions, and policies in Alberta reflect a general reliance on relatively stable water supplies, and there therefore has been relatively little drought planning. For the most part, year-to-year variability in precipitation and stream flow has been accommodated via conventional risk mitigation strategies, like insurance and increased reservoir storage, but the risks associated with sustained droughts have not been incorporated into planning.[41]

Where an attempt has been made to incorporate climate change into water management, specifically for oilsands development, the climate change analysis was not done correctly.[42] Notwithstanding this failure to accurately assess climate change risks in the Lower Athabasca Water Management Plan, a stakeholder decision was made to not consider the potential for substantial reductions in water supply caused by climate change, because it "would have significant Provincial-scale policy and management implications that would far dominate the potential implications of water withdrawals of the scale considered in this process."[43] This explicit and intentional reliance on an optimistic assessment of the impacts of climate change on water supplies that will be required to feed the expansion of oilsands industry in Alberta automatically implies that the economic, social, and environmental risks of serious drought or climate change associated with the current business-as-usual approach to oilsands development are significantly underestimated.

The presumption of stable and predictable water availability that appears to provide the foundation for most water management planning in Alberta, while reasonable based on our experience, is fatally flawed and therefore extremely risky. Studies involving reconstructions of past climates from lake sediments or tree rings have demonstrated that what we consider to be normal climate for the twentieth century has in fact been unusually

[39] Wolfe, B. B. *et al.*, "Impacts of Climate and River Flooding on the Hydro-Ecology of a Floodplain Basin, Peace-Athabasca Delta, Canada Since A.D. 1700, *Quaternary Research* 64 (2005): 147-162.

[40] Schindler, D. W., W. F. Donahue and J. P. Thompson, "Section 1: Future Water Flows and Human Withdrawals in the Athabasca River," in *Running Out of Steam? Oil Sands Development and Water Use in the Athabasca River Watershed: Science and Market-Based Solutions* (Edmonton, AB: University of Alberta, Munk Centre for International Studies and Environmental Research and Studies Centre, 2007).

[41] St. Jacques, Sauchyn and Zhao (2010), *supra* note 35; McEachern and Makowecki (2007), *supra* note 22.

[42] Canadian Science Advisory Secretariat, *Science Evaluation of Instream Flow Needs (IFN) for the Lower Athabasca River* (Ottawa, ON: Fisheries and Oceans Canada, 2010).

[43] Ohlson, Long and Hatfield (2010), *supra* note 22.

stable and wet, relative to previous centuries.[44] In past centuries, climate has not only been much more variable, but several major droughts per century were common, frequently lasting several decades.[45] When considered in the *longue durée* historical context, the droughts experienced during the last 100+ years in Alberta that we view as severe have actually been relatively mild.[46] Without even considering future climate change associated with global warming[47], if Alberta experiences a return to the severity and frequency of drought that routinely occurred here during the last 2,000 years, then we can expect to suffer from extreme reductions in water availability for very long periods. While it may be impossible to plan for such an event, it certainly highlights the importance of long-term drought planning as part of landuse and water management in Alberta.

2.2.2 Future Climate Change Will Reduce Water Quality and Availability in Alberta and Increase Risk

It has been demonstrated elsewhere that annual river flows are most influenced by the amount of rain and snow that falls on a watershed, and that timing of that flow is most influenced by temperature.[48] Within the next 35 to 40 years, predictions of climate change for Alberta involve slight decreases to slight increases in precipitation, and increases in mean annual temperature of 3 to 5 °C.[49]

Table 2. Reductions in Mean Annual Flow Caused by Anticipated Climate Change in Alberta Rivers, by the 2050s.[50]

Location	Reduction in mean annual flow (%)
Red Deer River at Bindloss	-13
Bow River at the mouth	-10
Oldman River at the mouth	-4
South Saskatchewan River at Lake Diefenbaker	-8.5

In the event predictions of future climate change for Alberta are accurate, it is likely that water availability will be greatly reduced because of a shift to increased winter and spring stream flow and a reduction of summer and fall stream flows (see Table 2).[51] This may result in drier soils due to higher evapotranspiration, which may

[44] Sauchyn, D. J. and W. R. Skinner, "A Proxy Record of Drought Severity for the Southwestern Canadian Plains," *Canadian Water Resources Journal* 26 (2001): 253-272; Laird, K. R. *et al*., "Lake Sediments Record Large-Scale Shifts in Moisture Regimes Across the Northern Prairies of North America During the Past Two Millennia," *Proceedings of the National Academy of Sciences* 100 (2003): 2483-2488.

[45] Laird *et al*. (2003), *supra* note 44; Axelson, J., D. J. Sauchyn and J. Barichivich, "New Reconstructions of Streamflow Variability in the South Saskatchewan River Basin from a Network of Tree Ring Chronologies," Water Resour. Res. 45 (2009).

[46] Sauchyn, D. J., J. Stroich and A. Beriault, "A Paleoclimatic Context for the Drought of 1999–2001 in the Northern Great Plains of North America," *Geographical Journal* 169 (2003): 158-167.

[47] Schindler and Donahue (2006), *supra* note 4.

[48] Stonefelt, M. D., R. A. Fontaine and R. H. Hotchkiss, "Impacts of Climate Change on Water Yield in the Upper Wind River Basin," *Journal of the American Water Resources Association* 36 (2000): 321-336.

[49] Barrow, E. and G. Yu, *Climate Scenarios for Alberta* (Edmonton, AB: Alberta Environment and Prairie Adaptation Research Collaborative, 2005).

[50] Pietroniro, A., B. Toth and J. Toyra, "Water Availability in the South Saskatchewan River Basin Under Climate Change", presentation at Climate Change and Water in the Prairies Conference, Saskatoon, Saskatchewan, June 22, 2006.

[51] Forbes, K. A. *et al*., "Simulating the Hydrological Response to Predicted Climate Change on a Watershed in Southern Alberta, Canada," *Climatic Change* 105 (2011): 555-576; Barnett, T. P., J. C. Adam and D. P. Lettenmaier, "Potential Impacts of a Warming Climate on Water Availability in Snow-Dominated Regions," *Nature* 438 (2005): 303-309.

in turn result in decreased recharge of groundwater aquifers, a slow, steady decline in the water table in many regions, and reduced supplies and qualities of water for the 23% of Albertans who rely on groundwater for their drinking water.[52] It also would reduce the amount of water discharged to lakes, wetlands, streams and rivers from groundwater sources. When combined with the increasing demand for water being demonstrated throughout the province[53], especially in summer, climate warming is likely to further contribute to a water scarcity crisis in Alberta that involves substantial declines in quantity and quality of water.[54]

2.2.3 Our Failure to Plan for Climate Change Exposes Us to Exceptional Risks and Costs

Risks and costs typically associated with reduced water availability are generally related to economic, social and environmental harm. Water quality is expected to decline due to increases in physical disruptions and chemical and biological contamination caused by increases in land-use impacts of agriculture and forestry, water withdrawals, sewage effluent, and storm water runoff. There also will be less potential for rivers to dilute contaminants in effluent and runoff because of reduced stream flows.[55] In addition to changing the availability of water, increased frequency of drought also can reduce the number and varieties of invertebrates that form the foundation of the aquatic food chain upon which many fish species rely for food, which in turn can contribute to substantial food web changes and related water quality problems.[56]

The most frequently recommended path to reducing risks of water shortages is associated with adaptation strategies and options for the water management sector. Most commonly, these include:[57]

- water conservation measures;
- improved planning and preparedness for droughts and severe floods;
- improved water quality protection from cultural, industrial and human wastes;
- enhanced monitoring efforts; and
- improved procedures for equitable allocation of water.

If predictions of effects of climate change on water supplies, quality and availability are accurate, Alberta will suffer more than most other regions in Canada. Our almost exclusive reliance on water-intensive industries for our economic well-being has made us even more susceptible to significant changes in water availability. Despite this, there has been little long-term planning for development or water management in Alberta that incorporates the potential for substantial future water supply changes. Our existing legal, policy and regulatory regimes continue

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[52] Sauchyn, D. *et al.*, "Prairies," in D. S. Lemmen *et al.* (eds.), *From Impacts to Adaptation: Canada in a Changing Climate 2007* (Ottawa, ON: Natural Resources Canada, 2008), 290.

[53] Increases in demand for non-irrigation uses of water in the SSRB have been predicted to be between 35% and 67% by 2021, and between 52% and 136% by 2046; Sauchyn *et al.* (2008), *supra*, at 291.

[54] Schindler and Donahue (2006), *supra* note 4.

[55] See Sauchyn *et al.* (2008), *supra* note 52 at 291.

[56] Ledger, M. E. *et al.*, "Impact of Simulated Drought on Ecosystem Biomass Production: An Experimental Test in Stream Mesocosms," *Global Change Biology* 17 (2011): 2288-2297.

[57] Bruce. J. *et al.*, *Water Sector: Vulnerability and Adaptation to Climate Change* (Climate Change Action Fund, 2000).

to promote what is largely a business-as-usual approach to development, and to land-use and water management in Alberta. Because Alberta is not seriously considering the risks that drought and climate change pose in its policies and decisions, and because of the potential impacts of drought and climate change on surface waters and groundwater in Alberta, we expose ourselves to the possibility of suffering from exceptional social, economic and environmental losses.

2.3 River Management According to Ecological Thresholds

2.3.1 Ecological Thresholds and Sustainable Development

Human activities and development or utilization of natural resources that proceed in a way that sustains long-term maintenance of full ecosystem function are what constitutes *sustainable management*. However, too often politicians, industrial lobbyists, or regulators refer to a particular project or industry as "sustainable development" when it is not, and the term as generally used is almost universally incorrect and misapplied. This is because most major project approvals are based on a hopeful and largely uninformed decision on how much ecological loss is acceptable as a simple trade-off for economic development, rather than on an understanding of ecological thresholds that informs a decision to limit negative effects of regional development so they don't cause ecological collapse. Individual developments are usually approved on the basis of short-term economic returns and without consideration of cumulative effects of regional development. By assessing only the ecological and associated costs of a single project, the total pressures accumulating in a location or region are externalized or ignored, increasing the likelihood that ecological tipping points are reached or exceeded.

Land and water managers often face long-term losses of ecosystem services because of environmental degradation that results from decisions permitting unsustainable industrial development, land-use, or river management practices that fail to adequately consider and incorporate the risks and costs of environmental harm. This is usually the result of scientific or environmental assessment efforts that do not rely on the creation and use of models that anticipate relevant ecological thresholds, which once passed lead to fundamental changes in ecosystem function or even irreversible collapse.[58] The weighing of benefits and costs of development generally also do not adequately quantify environmental risks or trade-offs associated with development. Development proposals are often also presented as involving "win-win" solutions based on such things as creation of new habitat or rehabilitation of degraded habitat elsewhere, despite the fact it is widely understood that increases in a human activity or a single ecosystem service is usually accompanied by reductions in other services or activities.[59] Further, trade-offs are typically quantified according to a pseudo-economic analysis and decision frameworks that consistently fail to consider the true values of ecosystem services.[60]

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[58] Carpenter *et al*. (2009), *supra* note 25.

[59] Tallis, H. *et al*., "An Ecosystem Services Framework to Support Both Practical Conservation and Economic Development," *Proceedings of the National Academy of Sciences* 105 (2008): 9457–9464.

[60] Carpenter *et al*. (2009), *supra* note 25.

2.4 Ecosystem Management: Knowledge-based or Consensus-based?

Most people probably would expect important regulatory and management decisions related to major projects or land-use change to require consideration of probabilities or uncertainties of particular outcomes, whether negative or positive. However, in most cases, risks for rivers are characterized according to expert judgment or even stakeholder consensus, including a simple agreement on the degree of confidence in the chances some harm may result, rather than according to rigorous quantitative methods that assess data from the particular region, river, or lake.[61] This is especially the case for larger rivers, such as the Athabasca River in Alberta, because large rivers are more difficult to study, less studies have been done on them, and consequently less is known about them.[62] For example, in discussion of fish species habitat suitability in the Athabasca River, stakeholders and experts identified fish preferences for waters of different depth and velocity by consensus opinion, based on relationships developed in the Bow and Red Deer rivers and in some cases in the absence of any empirical data.[63]

While consensus-based judgment is valuable in designing adaptive management or monitoring programs[64], it is a very risky way to approach determinations of IFNs, environmental flows or other ecological limits, because it is not quantitative and likely to be influenced by bias or incomplete information. Relationships between changes in river flow and ecological indicators are not necessarily empirical, unambiguous, and transferable between systems, and those developed in one system may not be appropriate for developing numerical guidelines in support of regional environmental flow standards.[65] The failure to rigorously assess and quantify environmental risks is continued in regulatory and management discussions, because risk management plans proposed to mitigate a project's potential environmental harm necessarily depend on the capacity to predict the consequences of mitigations actions with some quantifiable accuracy and confidence.[66] Without an accurate understanding of the uncertainty and risks associated with management decisions for a particular river – which are usually assessed by mere qualitative consensus opinion rather than by quantitative methods - our ability to mitigate risks or harm associated with them remains tenuous and equally undefined.[67] It also compounds the likelihood of being unable to distinguish between actually recognizing successes and failures associated with a development project, in terms of preventing or mitigating harm, and having simply implemented ineffective monitoring, assessment, and adaptive management programs to track the ecological effects of development decisions.[68]

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[61] *Ibid*. See also: Hardy, T. B. and C. Richards, "Appendix A," in *Summary of the Instream Flow Needs Habitat Suitability Curve Development Workshop* (Edmonton, AB: Cumulative Effects Management Association, 2004); and Walder, G., *Summary of The Lower Athabasca River Fish Habitat Suitability Criteria Workshop* (Edmonton, AB: Cumulative Effects Management Association, 2009).

[62] Robinson, B. L., W. B. Richardson and T. J. Naimo, "Past, Present and Future Concepts in Large River Ecology," *BioScience* 45 (1995): 134-141.

[63] Hardy and Richards, *supra* note 61, lines 649-656.

[64] Failing, L., G. Horn and P. S. Higgins, "Using Expert Judgment and Stakeholder Values to Evaluate Adaptive Management Options," *Ecology and Society* 9 (2004): Article 13.

[65] Poff and Zimmerman (2010), *supra* note 20.

[66] Carpenter *et al*. (2009), *supra* note 25.

[67] Church, M, "Geomorphic Response to River Flow Regulation: Case Studies and Time-Scales," *Regulated Rivers: Research and Management* 11 (1995): 3–22; Bradford and Higgins (2001), *supra* note 26; Bradford, Korman and Higgins (2005), *supra* note 26; Braatne, J. H. *et al*., "Analyzing the Impacts of Dams on Riparian Ecosystems: A Review of Research Strategies and Their Relevance to the Snake River Through Hells Canyon," *Environmental Management* 41(2008): 267-281.

[68] Bernhardt, E. S. *et al*., "Synthesizing U.S. River Restoration Efforts," *Science* 308 (2005): 636-637.

Ideally, threshold analysis is employed by environmental managers in hopes of preventing dramatic changes in the state of some valued ecosystem in response to some form of human pressure. The theory is that if we can manage and limit the intensity of pressures we impose on an ecosystem to levels below which they trigger a significant ecosystem change, then we stand a better chance of maintaining a balance between sustained ecosystem function or services and industrial development. Unfortunately, there is a failure to understand or consider that interactions and interdependences among the physical, chemical and biological components of ecosystems frequently result in cascading secondary impacts after an initial ecological threshold is passed.

2.5 Science-based Aquatic Ecosystem Management: Summary of Needs

Ideally, determination of instream flow needs or "minimum flows" is based on site-specific information that provides an understanding of the relationships between water quantity, water quality, aquatic habitat, and species dynamics, and their roles in maintaining ecosystem services. However, in Alberta there has been insufficient environmental assessment and monitoring to provide the information needed to establish IFNs in a way that links changing environmental quality with reductions in ecosystem services. Because of a general absence of site-specific information, a technique to determine the degree of permissible reduction of natural flows was developed as a tool to be applied in managing our rivers so there is a low probability of ecological effects to aquatic ecosystems: the "Alberta Desktop Method".[69] The Desktop Method is a simple formula, and is the greater of either a 15% instantaneous reduction in natural flows, or the lesser of either the full natural flow or the lowest flows occurring in up to 20% of years (depending on hydrologic data availability).[70]

Alberta has generally adopted the Desktop Method to determine "minimum flows" in particular rivers, apparently to provide fish with sufficient habitat and sustain ecosystem services. The intention is to provide an initial course filter for watershed management planning, and knowledge or data gained from scientific assessment and monitoring performed later can be used to revise IFN determinations. Unfortunately, this approach has been recognized as inadequate for protecting ecosystem services.[71] While various technical methods may be employed to determine ecological thresholds and IFNs, there remains a general lack of understanding of the relationships between flow and ecological responses in Alberta and elsewhere. There also is little understanding of river-specific ecological thresholds in Alberta rivers and how they change along a river's length. Unfortunately, there also is a lack of high-level scientific capacity or knowledge to support development and implementation of adequate programs for environmental flow management and the protection of ecosystem services, including in scientific monitoring, environmental impacts assessment, modeling, adaptive management planning, and program implementation, all of which are needed to develop more refined estimates of IFNs.

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69 Locke, A. and A. Paul, *A Desk-Top Method for Establishing Environmental Flows in Alberta Rivers and Streams* (Edmonton, AB: Alberta Environment and Alberta Sustainable Resource Development, 2011), **http://www.environment.gov.ab.ca/info/library/8371.pdf** (accessed 12 February 2012).

70 Locke and Paul (2011), *supra* at 2. See also: *The Alberta Desktop for Determining Environmental Flows (Instream Flow Needs)*, **http://environment.gov.ab.ca/info/library/8372.pdf** (accessed 14 March 2012).

71 Renöfält, B. M. *et al.* "Effects of Hydropower Generation and Opportunities for Environmental Flow Management in Swedish Riverine Ecosystems," *Freshwater Biology* 55 (2010): 49–67; Arthington *et al.* (2010), *supra* note 19; McEachern and Makowecki (2007), *supra* note 22.

Filling these capacity and knowledge gaps is critical because it is not appropriate to rely on scientific literature for development of quantitative relationships intended to support regional environmental flow measures. Local and regional assessments and monitoring must be performed to provide the foundations for informed freshwater management, if we want to sustainably manage rivers, like the Athabasca, that are not yet substantially impacted, or hope to reduce harm on rivers like those in the South Saskatchewan River Basin.[72]

Fortunately, new methods and protocols for determining ecological thresholds have been developed. Rather than developing specific frameworks for managing each river in Alberta, the Government of Alberta should develop and adopt a province-wide framework for decision making that is based in science. As has been done elsewhere, this should include:

1. Classification of Alberta's rivers and streams according to hydrological regime, based on land-use and environmental variables describing or contributing to ecologically relevant characteristics of a river's natural flow patterns.[73]
    a. Generally, classes of rivers and streams could be identified according to statistical distributions of magnitude, frequency, duration, timing and rate of change in flow, with magnitude, frequency, and duration further divided into low and high categories.
    b. Classification of rivers and streams according to hydrologic regime is important because of the need to recognize that the establishment of environmental flow management strategies and frameworks at regional scales demands an understanding of hydrologic variation at multiple scales.
2. Developing and adopting new scientific frameworks for determining environmental flows, so ecological and management standards for environmental flows at broad geographic scales can be established, implemented, and enforced for all rivers, without having to 'reinvent the wheel' for each river.[74]
    a. Rivers could initially be classified according to ecological integrity using a simple decision tree or key, as "bad", "poor", "moderate", "good", or "high". Degree of deviation from natural flow regimes, chemical status and condition, and fish, invertebrate and plant community composition, structure, abundance, and sensitivity should be considered in assessing ecological integrity.
    b. Rivers with good and high ecological integrity would be managed to maintain their current status, and the other classes would trigger mandatory management responses to improve ecological status to "good". Limited exceptions should be permitted for rivers with physical modifications, such as dams, weirs, or channelling, which fail to meet the normal standards and do so because of their physical modifications.

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[72] Poff and Zimmerman (2010), *supra* note 20.

[73] Kennard, M. J. *et al.*, "Classification of Natural Flow Regimes in Australia to Support Environmental Flow Management," *Freshwater Biology* 55 (2010): 171-193.

[74] Acreman and Ferguson (2010), *supra* note 16.

c. These excepted systems should then be designated as "heavily modified", and be managed to achieve "good ecological potential," which is defined as the best example of biological conditions in a similar water body with the same modifications, where reasonable mitigation measures and best management practices have been implemented and applied.

3. Assessing primary ecosystem processes and functional responses to changes in flow, *e.g.*, riparian production and nutrient retention rates, rather than simply using periodic biomonitoring to provide a site- and time-specific "picture" of the quality and structure of aquatic communities in hopes of tracking ecological change and either inferring or ignoring flow-dependence of many ecological processes.[75]

4. Pursuit of original studies and prescribed monitoring programs that include determinations of relationships between individual ecological components and changes in flow or water quality, throughout the full range of natural or disturbed river conditions (ideally, via before-after-control-impact studies), as well as ecosystem-scale experiments and monitoring.[76]

5. Designing sampling programs that target sites across a gradient of flow and water quality change, including a range of stream and river sizes and condition types, and sites and systems that range from undisturbed to highly disturbed, in order to test specific hypotheses on impacts of ecosystem change and determination of ecological thresholds.[77]

If our desire is to actually manage our rivers sustainably, then we have to develop and implement substantial scientific monitoring and assessment programs that underpin effective water management frameworks. We also must integrate water and land-use planning and decision making, and tie them to science-based assessments and management frameworks, to avoid arbitrary decisions that compromise local ecological sustainability for short-term political or economic advantage. This will demand a fundamental shift to a water-management system based on scientific understanding and assessment of sustainability. It also would demand fundamental changes in provincial water management regimes toward those based on prescribed responses to documented changes in aquatic ecosystem health

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[75] Poff and Zimmerman (2010), *supra* note 20.

[76] *Ibid*. Such studies should also include assessments of experimental flow releases in ecosystems that are substantially disturbed by damming and water withdrawal, because of the exceptional opportunity available in these systems to learn about the interactions between flow variation and environmental condition.

[77] *Ibid*.

> "Ultimately, Albertans may choose to sacrifice aquatic ecosystem health in return for increased short-term economic or other benefits. However, it is critical that this be a fully informed decision, and based on an assessment of the costs and benefits associated with sacrificing or protecting IFNs that have been determined according to the best scientific techniques."

The development of science-based IFNs and water management frameworks could be hastened dramatically by engaging expert scientists in the development of scientific environmental assessment and monitoring programs, rather than pursuing time-consuming and largely ineffective broad public and stakeholder consultations. Public and stakeholder consultation should be limited to identifying the ecosystem services of importance to Albertans, and the best options and trade-offs to be pursued in implementing more sustainable water management strategies. Ultimately, Albertans may choose to sacrifice aquatic ecosystem health in return for increased short-term economic or other benefits. However, it is critical that this be a fully informed decision, and based on an assessment of the costs and benefits associated with sacrificing or protecting IFNs that have been determined according to the best scientific techniques.

Section 3: Water Management in Alberta

3.1 Instream Flow Needs: Collective Water Security for Albertans

Alberta's rivers, lakes, and connected groundwater are a shared resource upon which many of our major social, cultural and economic pursuits rely. As a shared beneficial resource, healthy rivers provide or contribute to many of the ecosystem services that benefit Albertans. Water's role in maintaining environmental health has become recognized nationally as a part of the many values of water, and the recognition and quantification of water's importance in the economy, society, and environment is encapsulated in a full cost accounting of the value of water.[78]

The adoption of a science-based method to determine IFNs is necessary to safeguard the long-term public interest as it relates to rivers. Determining IFNs is also a prerequisite for developing any plan that will redistribute water among water licencees or allocations among individual water users and sectors. For the purposes of this report we have been referring to IFNs, although others also refer to "environmental flows". Because the need for understanding IFNs permeates every aspect of integrated water resource management, determining them scientifically is recognized as the foundation of strong public policy, planning, and management.[79] Furthermore, understanding IFNs better ensures sustainable investments in water resource infrastructure or regulations that are seen as essential for economic development, such as for hydropower, urban water supply, food security and irrigation, flood, and drought mitigation.[80]

IFNs and the importance of the protection and preservation of aquatic ecosystem health are recognized under Alberta's water laws and policies for the shared interests of Albertans. For example, one of the explicit purposes of the *Water Act* is "to support and promote the conservation and management of water, including the wise allocation and use of water, while recognizing the need to manage and conserve water resources to sustain our environment and to ensure a healthy environment and high quality of life in the present and the future." [81] Under the *Act*, the management, planning, and participation in decision making for water also is recognized as a shared responsibility of all Albertans, and the *Water for Life Strategy* affirms the public interest in healthy aquatic ecosystems.[82]

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[78] National Round Table on the Environment and the Economy, *Charting a Course: Sustainable Water Use by Canada's Natural Resource Sectors* (Ottawa, ON: National Round Table on the Environment and Economy, 2011), 37; Renzetti, S., D. Dupont and C. Wood, *Running Through our Fingers: How Canada Fails to Capture the Full Value of Its Top Asset*. (Blue Economy Initiative, 2011).

[79] The Brisbane Declaration (2007), *supra* note 14.

[80] Hirji and Davis (2009), *supra* note 14, 1-5.

[81] S. 2, *Water Act*, R.S.A. 2000, c. W-3 ("the *Act*").

[82] Alberta Environment, *Water for Life – A Renewal* (Government of Alberta, November 2008).

IFNs also have been recognized in Alberta as a criterion by which to determine whether future developments are in the public interest and in accordance with proper cumulative effects management in land-use planning. According to the Alberta Utilities Commission (AUC),

> the incorporation of instream flow needs into the cumulative effects management framework is on Alberta's agenda under the Water For Life Strategy (Healthy Aquatic Ecosystems). Including instream flow needs data in the management framework provides an opportunity to gain better understanding of the overall instream flow that is needed to maintain healthy aquatic systems. This should result in a better understanding of the capacity for water diversion from river systems and provide a baseline for regulatory agencies to make sound decisions for hydro developments.[83]

In addition, the AUC has observed that another advantage of including IFNs in management frameworks is "the increased certainty it would provide for industry regarding proposed projects."[84] Therefore, not only does managing rivers on the basis of IFNs preserve healthy rivers, but it also provides clarity and certainty in expectations or water use limits for Albertans, decision makers, and the various development sectors that rely on sustainable water supplies for their long-term economic health.

As mentioned previously, the idea of full cost accounting of water (*i.e.* incorporating its multiple values that include environmental, social, and economic values) is taking shape in Canada. Recent reports promote the use of economic instruments such as water pricing to help quantify the full cost of water so that water is conserved and used efficiently with the purpose of maintaining or improving ecological integrity of ecosystems that depend on water.[85] However, economic instruments are limited in their ability to quantify the full value of water to the environment and the intrinsic value of water to people in terms of its recreational, cultural, and spiritual importance.[86]

> "We run a number of risks when we fail to account for the many values of water."
>
> ~ Renzetti, Dupont and Wood[78]

[83] Alberta Utilities Commission, *Hydroelectric Power Generation Development Inquiry*, Proceeding No. 561 (Calgary, Alberta: Alberta Utilities Commission, February 28, 2011), 58; **http://www.energy.alberta.ca/electricity/pdfs/hydroelectricpowerinquiry.pdf** (accessed February 29, 2011) .

[84] *Ibid*.

[85] National Round Table on the Environment and the Economy [NRTEE), *Paying the Price: The Economic Impacts of Climate Change for Canada* (Ottawa, ON: National Round Table on the Environment and the Economy, 2011); Brandes, Oliver, Steven Renzetti and Kirk Stinchcombe, *Worth Every Penny: A Primer on Conservation-Oriented Water Pricing*, (Victoria, British Columbia: POLIS Project on Ecological Governance, University of Victoria, 2010); Renzetti, Steven, Diane Dupont, and Chris Wood, *Running Through Our Fingers: How Canada fails to capture the full value of its top asset*, (Toronto, ON: Blue Water Initiative, 2011) **http://www.blue-economy.ca/report/running-through-our-fingers-0** (last accessed April 18, 2012); Olewiler, Nancy, Smart Environmental Policy With Full-Cost Pricing, *University of Calgary School of Public Policy SPP Research Papers* Vol. 5 Issue 6 (2012) **http://policyschool.ucalgary.ca/?q=content/smart-environmental-policy-full-cost-pricing** (last accessed April 18, 2012).

[86] Renzetti, Dupont, and Wood, *(2011), ibid.*

A provincial IFN policy would affirm the qualitative values of water that cannot be captured in economic instruments and safeguard the ecological and public value of water while quantitative metrics are developed. While we are not addressing the matter in this report, the recognition of water's ecological value may also play an important role in defining mutual interests with First Nations. The evolution of Alberta's water policy has been described as "insufficiently orientated towards reconciling how water is shared" among nations in Canada, and it has been recommended that the Government of Alberta take steps to create a First Nations water council.[87] As others have noted, adopting a river management regime based on maintaining IFNs could be the basis for engaging First Nations in conversations on how to incorporate indigenous knowledge into a needs-based assessment.[88]

3.2 Current Gaps in Policy and Law to Protect Instream Flow Needs

Alberta's policy and laws do not adequately recognize the value of water in maintaining healthy aquatic and riparian ecosystems, or the value of healthy rivers to Albertans as a shared resource upon which our social and economic well-being depend. The absence of a policy to protect rivers founded upon evidence-based methods such as IFNs in environmental approvals, planning, and management erodes river health that collectively benefits all Albertans and users of water as a shared resource. If anything, the need for a strong IFN policy reflects the ambiguity in Alberta's laws and policy of the value of ecosystem health, and the challenges associated with integrating protection for the environment and enhancing flows in over-allocated basins for environmental health purposes.[89]

3.2.1 Problems with Water Allocation

Because allocation of water in Alberta generally proceeds according to ordered licensing that is consistent with the Doctrine of Prior Allocation (also known as "First In Time, First In Right," or "FIT-FIR")[90], superiority of water licences is based on earliest date of application, and a senior licence entitles its holder to receive the full licenced allocation of water before a junior licence holder is entitled to receive any water.[91] Ultimately, the nature of Alberta's prior allocation regime shapes the current dynamics of policy and decision making under the *Water Act*. In doing so, it prevents Albertans from recognizing and protecting the value of water for the environment and contributes to the failure to address the important issue of equity among water users that arises in managing a shared water resource. It has been argued that our current water allocation system is out of touch with our growing

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[87] Schmidt (2011), *supra* note 12 at 18-19.

[88] Sandford, R. W. and M.-A. S. Phare, *Ethical Water* (Surrey, BC: Rocky Mountain Books, 2011); Craig Candler *et al.*, *As Long As The Rivers Flow: Athabasca River Knowledge, Use and Change* (Edmonton, Alberta: Parkland Institute, 2010).

[89] Poirier B. and Rob De Loe, "Protecting Aquatic Ecosystems in Heavily Allocated River Systems: The Case of the Oldman River Basin, Alberta," *Canadian Geographer* 00 (2010), 1-19.

[90] Percy, D. R., "Responding to Water Scarcity in Western Canada," *Texas Law Review* 83 (2004-2005), 2095.

[91] *Water Act*, *supra* note 81, s. 29. This general priority rule is subject to the caveat that household use rights have priority over any licenced water allocations or other uses authorized other than by s. 21; see s. 27.

understanding of the complexity of human-water interactions and their dependence on the physical environment. There are a number of reasons for this:[92]

1. By treating groundwater and surface waters separately and distinctly, it does not reflect the reality of the intricate and yet largely unidentified interconnections between them.

2. Allocations presume that instream waters are not in "use" when they are not being manipulated by humans, and therefore environmental and ecosystem services provided by instream water flows are not captured adequately by the current water management regime.

3. Many human activities in a watershed that are not regulated under the *Water Act* still have an effect on water quality or flow dynamics, and therefore affect downstream users and uses that are regulated. For example, clear-cutting in the headwaters of a river can increase rates of erosion and runoff, which in turn increase delivery of sediments and create more variable flows. Because watershed planning or management is unrelated to and not accounted for in our water allocation regime, our ability is limited to effectively address changes in water quality and quantity that are unrelated to regulated uses.

4. Quantities that are licenced are fixed, irrespective of changes in natural supplies of water, and therefore often operate independent of what may be available or hydrologically sustainable. This is especially problematic when considering that the instrumental record of water supply in Alberta for the relatively stable twentieth century does not accurately reflect the historical record of extreme variability associated with extended and severe droughts, that may be more likely to occur as climate change progresses or we simply return to historical norms for drought.

5. FIT-FIR is only concerned with water quantity issues, and is not aligned with rights and responsibilities associated with water quality problems or regulations. This is especially the case with non-point sources of pollution or activities, including those that affect groundwater quality and flow.

Alberta's prior allocation system disproportionately distributes water among users by heavily weighting water use to historical senior licencees. This imposes substantial financial barriers to new access to water, especially in basins like the South Saskatchewan that are closed to new allocations. The result is that Albertans are stuck with a system that provides few opportunities to preserve or recover water to satisfy IFNs and ensure equitable distribution of water among users, including providing water for future economic development. Moreover, the inflexibility and inability of FIT-FIR to meet the changing hydrologic realities of watersheds contributes to a high level of uncertainty and financial risk to new water users and Albertan taxpayers.[93] As environmental lawyer Jason Unger has observed, "Perversely, the public may end up paying licence holders significant amounts of money for historical use of a public resource, even though this public resource has already provided licence holders with substantial private gains over time."[94]

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[92] Schmidt (2011), *supra* note 12.

[93] Unger, J., "Who's it 'FIT FIR'?: Provincial Allocation Review Looms Large for Water Users and the Environment," *News Brief* Vol. 24. No. 4 (Edmonton AB: Environmental Law Centre, 2009), **http://www.elc.ab.ca/pages/Publications/NewsBrief.aspx?id=943** (accessed January 28, 2011).

[94] *Ibid.*

Continuing to rely on our current water allocation system risks undermining the purpose of the *Water Act* and the *Water for Life* policy. Unfortunately, this is reflected in what seems to be either the limited ability or desire of the Government of Alberta to implement effective water conservation policies that protect environmental flows. Although the Director must consider the impact on the aquatic environment in approving water licence transfers or amendments, regulatory decisions on water licencing and use tend to be *ad hoc*. The lack of a provincial IFN-based water management policy contributes to ambiguity and uncertainty in environmental decisions, such as whether conservation tools available under the *Water Act*, like water conservation objectives (WCOs), will be incorporated into any particular decision.

3.2.2 Problems with Legislated Water Conservation Tools

Generally, where adopted, WCOs are the defined "safe" flows that are needed to protect aquatic ecosystem health. However, contrary to arguments or expectations that WCOs should be defined according to science-based determinations and designed to protect healthy aquatic ecosystems (*i.e.* WCOs as the equivalent of IFNs), they are instead being determined and used to "balance" different values in some unquantified and unqualified way that is not clear to any stakeholder or subject to public scrutiny.[95] This undermines the efficacy of the conservation tools themselves, contributing further to ambiguity and uncertainty on the role of conservation efficiency and productivity plans (CEP plans) in enhancing environmental flows. The result is that conservation tools employed by the Government of Alberta to enhance river flows are ineffective in sufficiently recovering water for environmental purposes that has previously been allocated under licence (Figure 2). Another consequence of basing individual new licence or licence amendment decisions on an arbitrary balancing of values and priorities, rather than grounding them in a science-based IFN policy, is that it narrows the scope of assessment applied, and effectively prevents consideration of the cumulative effects of all individual applications and approvals.

[95] Bankes (2010), *supra* note 11; Kleiss, K., "Provincial Rivers Plan Slammed: Newly Released Documents Show Federal Government at Odds with Alberta's Water Conservation Plan," *Edmonton Journal*, August 31, 2011.

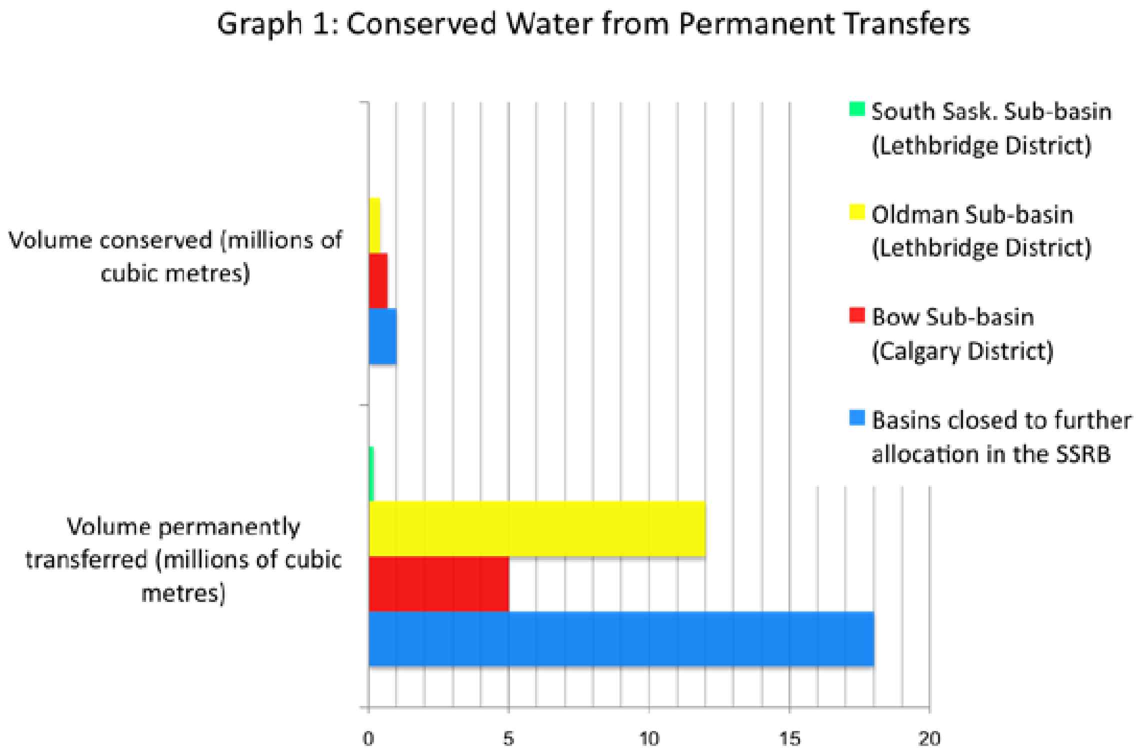

Figure 2: The total volume of water recovered by the Government of Alberta for environmental purposes according to powers conferred by the Water Act, from water transfers in the over-allocated South Saskatchewan River Basin. Recovery of portions of transferred water for environmental purposes has provided only a very small fraction of the water needed to return to the flows recommended in the 2003 South Saskatchewan River Basin Water Management Plan.

Alberta's river management policies do not reflect or rely upon a legitimate scientific assessment of IFNs. An example of this can be seen in the over-allocated rivers in the SSRB, which are and will remain in an ecologically degraded state. However, relative to the other rivers of the SSRB, the Red Deer River could be preserved in an ecologically healthy state because it is not yet over-allocated. Currently, flows in the Red Deer River are at approximately 85% of natural annual flows. According to Alberta's only in-depth assessment of IFNs, which was used as the foundation for the SSRB water management plan, this 85% of natural flows also happens to be the lower limit of environmentally sustainable flows in the Red Deer River, below which dramatic declines in ecosystem health can be expected, and will lead to permanent impairment.[96] Despite this science-based determination of IFNs, WCOs for the Red Deer River have been set arbitrarily at 45% of natural flows, to match the rest of the over-allocated rivers of the SSRB.[97] This divergence from science of policy and regulatory decision making will surely sentence the relatively healthy Red Deer River to the same fate as the other over-allocated rivers of the SSRB. Making matters worse, WCOs are further limited in their efficacy because they do not apply to licences that were issued prior to 1999.[98] Therefore, the ability of WCOs to protect aquatic ecosystem health is

[96] Clipperton *et al.* (2003), *supra* note 17; Donahue, W. F., *Assessment of Ecosystem Health of Major Rivers in Alberta: Sediment Quality, Periphyton, and Benthic Invertebrates* (Edmonton, AB: Surface Water Policy Branch, Alberta Environment, 2010).

[97] Alberta Environment, *Approved Water Management Plan for the South Saskatchewan River Basin [Approved Water Management Plan]* (Edmonton, AB: Alberta Environment, 2006).

[98] This exemption is qualified somewhat, in that some pre-1999 licences include language that refers to the contribution of water to rivers.

especially impaired at the most critical time — during low flow years — when they are effectively subject to the same FIT-FIR restrictions that apply to junior licencees.[99]

Without changing Alberta's water allocation system, it is difficult to see how the Government of Alberta can reach the goals of the *Water for Life Strategy* or satisfy the purpose of the *Water Act* as related to managing the use, allocation, and conservation of water in ways that sustain and ensure a healthy environment now and in the future.[100] Previous attempts to change the system stemmed from seven years of consultation in the creation of the *Water Act* in 1999, and resulted in water being recognized as a public resource under the *Water Act* (*i.e.*, the use of water for the environment and a sustainable economy).[101] Some point out that the Alberta's political history suggest that "more profound changes may need to emerge from a new consensus about water, the economy and the environment."[102]

Without systemic changes in how we manage water, we will likely face further problems and complications as the result of delaying decision making or allowing *ad hoc* regulatory decisions to effectively determine the path we must follow. It may be that the continued reliance on a system in which decisions are made without consideration of the major problems we face simply demonstrates the Government of Alberta's abdication of responsibility to manage water for the long-term public interest.

3.2.3 When Environmental and Licencee Goals Collide with the Water Act

The lack of clarity and guidance in Alberta's legislation and allocation system to protect aquatic ecosystem health — according to a science-based determination of IFNs — and facilitate the return of water to impaired systems has resulted in increasing efforts among senior licencees to commodify their water allocations via change-of-use applications, and has increased conflict over water rights and allocation management in Alberta.[103] Other examples of the erosion of the efficacy of the *Water Act* to protect ecosystem health include the "contracting out of water rights" in industrial water-sharing agreements for the Athabasca River.[104] Efforts to deal with competing industrial interests over water and IFNs for the Athabasca are likely to fail due to "uncooperative legislation and entrenched water rights."[105] In addition, as mentioned previously, the scope of Alberta's allocation system is unable to address the broad impacts of water reuse, huge increases in volumes and use of produced water, and saline groundwater

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[99] Bankes (2010), *supra* note 11; see also Bankes, Nigel and Arlene Kwasniak, Submission with respect to the Draft Water Management Plan for the South Saskatchewan River Basin, December 2005, *Public Interest Submission*, **http://law.ucalgary.ca/law/system/files/Bankes_kwasniak_ssrbsubmissionFinal_december2005-1.pdf** (last accessed April 18, 2012); and, Wenig, M., A. Kwasniak and M. Quinn, *Water Under the Bridge? The Role of Instream Flow Needs (IFNs) Determinations in Alberta's River Management*, in *Water: Science and Politics*, Proceedings of the Conference Held by the Alberta Society of Professional Biologists on March 25-28, 2006, in Calgary, Alberta (Edmonton, Alberta: Alberta Society of Professional Biologists, 2006).

[100] *Water Act*, *supra* note 81.

[101] Percy, D. (1996-1997), *supra* note 5 at s. 2.

[102] Poirier and De Loe, *supra* note 90, 16.

[103] Statements of concern have been submitted by different parties, including Water Matters, on the issue of amendments. For more information please see: Donahue, W.F., "Water License Amendments — An End-run Around Sustainable Water Management?" (Canmore, AB: Water Matters, March 22, 2011); Droitsch, D. and R. Christensen, "Fight to the Last Drop: A Glimpse into Alberta's Water Future" (EcoJustice and Bow Riverkeeper, April 2008); Bankes and Kwasniak (2005), *supra* note 104.

[104] Kwasniak, A. and D. Hursh, "Instream Flow and Athabasca Oil Sands Development: Contracting Out/Waiver of Legal Water Rights to Protect Instream Flow – A Legal Analysis," *Alberta Law Review*, Vol. 48, No.1 (2010); Kwasniak, A. and D. Hursh, "Right to Rainwater - A Cloudy Issue", *Windsor Review of Law and Social Issues*, Vol. 26 (2009).

[105] Kwasniak, A. and D. Hursh (2010), *supra*.

diversions, which may all contribute to poorly regulated water.[106] Existing concerns and conflicts related to ineffective, unsustainable water management in Alberta will likely get worse without legal and regulatory changes that provide environmental sustainability and respond to concerns over equitable access to water for the benefit of all Albertans.

3.3 Summary of Policy Gaps and Issues Complicating Water Management

It is clear that Alberta's current water management system must be amended in a way that will broaden the options for redistributing water to protect the public interest and respond to the substantial inequities among water licencees and users. While the water allocation review was announced by the Alberta Government in 2008, there is little evidence that it has proceeded in any substantial way. Therefore, the public has yet to be informed of or engaged in a legitimate assessment and review of Alberta's water allocation framework and scheme. The Government of Alberta must take a hard and critical look at Alberta's water rights allocation and management policies and systems to respond to the significant risks we face, and to enable real improvements in water allocation while safeguarding the social and economic benefits provided to Albertans by healthy rivers.

Demand for water is increasing while supplies are generally declining.[107] In order to avoid future constraints imposed by unsustainable water use that increases risk to Albertans as a society, and their economy and quality of life, the following specific policy issues and gaps must be addressed as soon as possible:

1. The FIT-FIR system is based upon fixed amounts of water, and is not flexible in the face of declining water quantity or quality. Licencees can individually or cumulatively have adverse downstream effects on communal ecosystem services and water quantity and quality in shared surface and groundwater resources upon which others rely for benefits.

2. FIT-FIR interferes with our ability to manage water and rivers to sustain or recover healthy aquatic ecosystems and IFNs.

3. The lack of flexibility in FIT-FIR and its inability to prioritize water for healthy aquatic ecosystems poses real social, financial, and economic risk to Albertans.

4. Current Alberta policy, legislation, and regulations do not secure sufficient water for rivers to sustain ecosystem services or IFNs in our rivers, and by extension fail to protect the social, environmental and economic benefits Albertans generally should enjoy in perpetuity.

    a. WCOs are not based upon scientifically defensible or evidence-based determinations of IFNs, and can even act to impair healthy rivers.

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[106] Kwasniak, Arlene, "Waste Not Want Not: A Comparative Analysis and Critique of Legal Rights to Use and Re-Use Produced Water – Lessons for Alberta," *Denver Water Law Review*, Vol. 10, No. 2 (2007).

[107] Schindler and Donahue (2006), *supra* note 4.

b. Current legislative and regulatory conservation tools are unable to achieve IFNs.

c. Continued approvals of water use licences and change-of-use amendments for existing licences, in the absence of clear frameworks or criteria for the protection of IFNs and ecosystem services associated with healthy rivers for public benefit, increase the risk of significant social, economic, and environmental harm caused by water shortages.

d. Conservation tools available under the *Water Act* to ameliorate river health are very limited, and therefore potential opportunities to re-establish IFNs in impaired rivers also are limited.

e. Maintenance of environmental flows or IFNs is not among the enumerated uses for water available to water licencees under the *Water Act*, preventing licencees from dedicating any of their existing water allocations to sustaining river health.

f. Only the Government of Alberta can dictate that some volume of water shall remain in a river for the purposes of environmental protection and enhancement, but that water remains subject to ministerial discretion in reallocation for some other use. Therefore, water licencees in Alberta cannot contribute any portions of their licenced allocations for environmental purposes without returning it to Alberta and the possibility of seeing that water eventually reallocated for additional non-environmental use.

Without fundamental changes in water management that anticipate and address conflicts in water demand and supply, fewer options will likely be available to solve growing water problems in a planned, systemic, coherent, and rational way.

Section 4: Discussions with Senior Water Licencees in Alberta

Much of Alberta is likely facing a future that involves significant declines in and changes in timing of freshwater supplies. Unfortunately, demands for water are generally increasing. Recent droughts have made it clear that we need to develop a long-term plan to minimize social, economic, and environmental risks associated with declining water supplies, especially when a variety of sectors are anticipating greater demand for water use and allocations. We asked representatives from major licencees of water rights in Alberta for answers to a variety of questions on the value of healthy rivers in Alberta, and their opinions on possible policy and operational options that could be incorporated into long-term planning of water management in Alberta. Our goal is to find solutions that enhance or at least sustain the health of our rivers while protecting the rights of licencees to the greatest extent possible. Rather than advocating for particular methods or solutions based solely on our priorities, our meetings with senior licencees were intended to inform us of the best possible water management policy or operational options that could be developed that would satisfy the most interests possible. It is our hope that these best options could be incorporated into long-term planning of water management in Alberta, and build upon other stakeholder initiatives like the Bow River Project[108] to reduce future risks associated with water shortage.

Interview questions were targeted to assess senior licencees' degree of satisfaction with Alberta's management of water rights, their willingness to advance protection of river health, options to facilitate more flexible water allocation and management regimes and systems that would lead to preserving or enhancing river health in Alberta, and general governance questions. Licencees interviewed represented a variety of sectors, including irrigated agriculture, oil and gas, utilities, hydropower, and municipalities.

4.1 Licencee Discussion Topics

To gain a better understanding of the different sectors' water needs and priorities, we first discussed each licencee's total allocation, withdrawal and return flow volumes, licence priority, and whether water demands vary significantly from season to season and year to year. We then discussed whether anticipated future water needs will differ in volume from current needs. We also discussed the nature and cost of licencees' existing infrastructure, anticipated future infrastructure costs, risks associated with water demand and supply, and whether licencees had long-term risk management plans that considered significant declines in water supply, or changes in timing of flows, due to climate change.

We asked licencees to characterize the satisfaction they felt with how Alberta manages their water licences individually and more generally for their sector, and elaborate on aspects of provincial water management with which they are most agree or disagree. In terms of Alberta's Conservation and Efficiency and Productivity plans,

[108] Bow River Project Research Consortium, *Bow River Project Final Report* (Edmonton, AB: Alberta Water Research Institute, 2010), **http://www.albertawater.com/reports/BowRiverProject-FullReport-March2011.pdf** (Accessed 9 March 2012).

we identified the degree to which licencees are able to reduce use or otherwise conserve water via improved operational efficiencies, and their plans for use of "conserved" water. We also ascertained whether licencees would be interested in committing a portion of conserved water for enhancing river health, each organization's capacity to improve river health during low flow periods, and what incentives or assurances would be needed to inspire such behaviour.

On the topic of incentives and assurances for committing portions of conserved water to enhance river health, we explored each licencee's familiarity with and interest in water trusts, and tradable water quantity and quality credits. We asked licencees to assume that a water trust would involve acquisition of water rights through purchase or donation from existing licencees, with the possibility of incentives to convert consumptive water use rights to instream water rights. These could include a variety of incentives, such as replacement income from marginally productive areas, replacement feed for lost production, funding for irrigation efficiency projects, a possible tax break for permanent donations of water rights, or flexibility in managing remaining water use and rights.

Water quantity credit trading is what is often thought of as water rights trading, where transfers are based solely on volumes of water. This is typically the kind of trading that has occurred in Alberta and which is contemplated under the *Water Act*. However, we expanded the discussion to include temporary or short-term transfers or leases of water rights, after which the rights return to the original licencee, as well as an expansion of enumerated uses under the *Water Act* to include the use of water for the protection or enhancement of river flows and health.

Water quality trading typically involves the creation of marketable credits for reducing nutrient or sediment loads to a river beyond what is required under law or regulations. Where it is relatively cheap for a licencee to reduce pollution beyond what is required, credits for improving water quality can be gained and sold to another licencee who would face higher costs achieving the same degree of pollution reduction. The market value of the water quality credits would typically be less than the difference between the costs of reducing pollution for the two parties. This is typically the kind of trading that is involved in pollution cap-and-trade markets and regulatory regimes. Government would set the river water quality requirements, on the basis of the need to protect or improve water quality on a basin or sub-basin level. Operations along the river would then be compelled to modify their operations or buy water quality credits from someone else in the basin or sub-basin in order to meet the limits imposed on their ability to release pollution. This approach can be applied whether regulations are based on return flow concentrations of pollutions (for point sources) or on the basis of total delivery of pollution to a river from the point sources and land-uses (non-point sources) in that area.[109]

We also investigated licencees' willingness to have conditions imposed on licences to ensure that river health is not impaired. This presumes that ecosystem health is defined and determined objectively and scientifically. Licence conditions would trigger reduced net withdrawals or return flows in the event of measurable declines in ecosystem health linked to water withdrawals or declines in quality of return flow related to a particular use.

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[109] If non-point sources are to be included, it would require significant expansion of water quality monitoring throughout Alberta, and detailed assessment and modelling of the amounts of pollution delivered to rivers from these broadly distributed sources.

In other jurisdictions, local stakeholder-based bodies have been delegated authority and responsibility for the development of basin-specific water management plans, including allocation caps and instream flow needs, and the result has been successful plans that have satisfied stakeholder interests as much as possible. We asked licencees whether they would be interested in a similar process being adopted by Alberta for the development of watershed plans and management frameworks, as replacements for the Watershed Planning and Advisory Councils (WPACs) established under the *Water Act* to provide advice and recommendations to the minister, which may ultimately be accepted or ignored in the final plans and frameworks. This part of the discussion also more broadly canvassed general governance issues associated with government and stakeholder involvement in WPACs and watershed management plan development.

4.2 Findings from Interviews

We used the discussion outline summarized above when meeting with each licencee. It quickly became evident that different sectors and licencees had some common interests and priorities, as well as some very different interests and priorities. In general, however, some common themes emerged among the interests and priorities of senior licencees, generally based on which sector a licencee was in, and whether a licencee was upstream or downstream in a river basin. Common opinions and priorities include:

1. All senior water rights holders agree the provincial government must play a strong role in both the management and protection of rivers. It is the responsibility of the Government of Alberta to ensure adequate instream flows and/or enhance and protect river health, rather than the responsibility of licencees.

2. All licencees in the SSRB agreed that the Government of Alberta waited too long before closing the Bow, Oldman, and South Saskatchewan rivers to new water allocations.

3. Most senior water rights holders prefer that the nature of the current allocation system (*i.e.* FIT-FIR) remain, because it works for them, is predictable, and provides them with certainty and security that permits long-term planning.

4. Most licencees expressed a significant distrust of the Government of Alberta, in terms of potential attempts to interfere with or otherwise change the nature of rights previously allocated under licence for water use.

    a. One senior rights holder observed that no attempt has been made to question the suitability of FIT-FIR, that FIT-FIR is why junior licencees face such insecurity in water supply, and that adoption of FIT-FIR in Alberta has resulted in the inequity issues in water use and allocation we now face. The level of comfort with FIT-FIR and Alberta's current water management regime may correspond with the seniority of a licence, and the amount of water a licencee has under licence that remains effectively unused.

    b. One licencee pointed out that although licence priority was not exercised in Alberta to circumvent the rights of junior licencees to access water (*i.e.* priority has not been "called") during the low-water years from 2002-2003, the power remains in full force to rely fully on priority in licences, thereby preventing withdrawals by junior licencees during low water years.

5. Several licencees strongly emphasized that they require clarity, predictability, and certainty in water management policies, regulations and decision-making procedures.

    a. The Government of Alberta must clearly enunciate the priorities or criteria it will rely upon in making decisions when it comes to allocation of water rights, identification and implementation of scientific IFNs for reaches/rivers, and development of management strategies according to IFNs.

    b. The Government of Alberta must clarify the roles and responsibilities of WPACs, because of the significant potential of the government to alienate stakeholders who have committed significant time and resources to the development of watershed management plans if plans presented by WPACs are not adopted.

    c. The Government of Alberta must clearly enunciate the intended interactions between watershed management plans or frameworks and land-use management plans or frameworks, and the criteria and priorities that will determine how conflicts between those two types of plan will be resolved.

6. Although most licencee representatives identified aquatic ecosystem health as important to each organization, individual organizations' actions or plans for use of conserved or unused water generally do not include a commitment to return any portion of conserved water to rivers. The opportunity for allocating conserved water to ecological flows rivers also was ambiguous. According to licencees:

    a. Licencee priorities were on preserving source water and water quality rather than on ensuring ecosystem health, and the substantial cost of infrastructure is tied to those priorities.

    b. Organizations understand their impact on the environment, but environmental protection is one among a number of priorities. For example, the first priority for municipalities is ensuring the health of consumers and provision of safe drinking water. Similarly, irrigation districts are primarily concerned with ensuring district members have sufficient water quantities for their farming operations, and corporations are primarily concerned that they have sufficient water of sufficient quality to satisfy their corporate needs.

    c. Due to economic risks associated with using the entirety of a licenced allocation, a common long-term plan adopted by licencees is to preserve a substantial amount of the allocated volumes by improving water use efficiency. This will enable them to deal with future decreases in water supply or increases in demand, and in the interim, the unused portion of the allocation remains instream to the benefit of river health.

    d. Operational options exist that would permit some licencees to increase river flows seasonally or throughout the year, but these are informal opportunities that need to be formalized and would require government approval. Some options involve changing of government limits on withdrawal rates or reservoir filling, and others would require infrastructure improvement.

7. Most senior licence holders agreed that a portion of water in their allocations could be used to benefit aquatic ecosystem health. However, the dominant concern and barrier to this is that there is currently no legal assurance that water committed by licencees to improving river health, via mandatory transfer back to the Government of Alberta, would not be reallocated by the government to a new licencee for additional new use.

    a. Several licencees referred to the large gaps in scientific data and understanding needed to establish consistent ecological thresholds or meaningful restrictions on pollution releases, especially from non-point sources. Therefore it is currently difficult to identify science-based IFNs that would allow licencees to assess the need for them to return conserved water to rivers. Until the science is done, this will remain a problem.

8. Most senior licencees agreed that creation of water trusts that gained the original priority of transferred water could stimulate the transfer of conserved water to protect river health, and would ensure transferred water would remain in the river (*i.e.* an arm's-length, non-government entity is needed to secure transfers of water for river health).

    a. Licencees were worried that water transferred to rivers would be reallocated by the government for another use. As one licencee put it, "it is a fairness question, because water meant for the river could wind up profiting someone else at the expense of your good will."

    b. Establishment of water trusts would be more reliable and comforting than having to rely on the government to preserve the water returned to rivers by licencees.

    c. As one licencee put it, "I would be happier to sell water to a trust than a developer because it would make us look better, and it doesn't hurt us because they may be licences we don't use."

9. Some senior licencees generally agreed that an expanded water market may not be necessary, may not affect their business, or their organizations have yet to contemplate an expanded market because existing legislation is adequate.

    a. Because substantial portions of allocated water rights remain effectively unused, without strong provincial leadership an expanded water market could increase the risk to water rights holders by increasing the total amount of water used in a river basin, especially in the SSRB.

    b. The fear of an expanded market that incentivized major water rights holders to "sell" unused portions of allocated water is questionable, because the cost associated with the infrastructure needed to capitalize on such unused water may be prohibitive to new entries to the market.

    c. Some major water users anticipate being unaffected by expansion of water markets, and have yet to contemplate whether any opportunity exists.

10. Most senior water rights holders identified a percentage of their allocation ranging from 36% to 50% that is currently unused, and their plans are for it to remain unused because this is seen as a form of long-term insurance or security against future risk, including risks associated with climate change, growth pressures, or other sources. Other reasons presented for continuing to hold unused water allocations include:

    a. Currently unused water may be used in the future to benefit from expanded markets, or new uses for unused water could be acquired via licence amendments.

    b. Unused water under allocation is an effective way of insuring water remains instream and is not simply reallocated, because reallocation will result in higher water use and reductions in river flows.

    c. What to do with unused water has yet to be considered by management.

11. Most senior licencees do not think WPACs should receive delegated authority to make decisions on watershed planning or water management. A variety of reasons for this were provided, including:

    a. They are not democratically elected.

    b. The implications of water decisions go beyond watersheds and require leadership from the provincial government, particularly for watersheds that drain into other watersheds. For example, water quality issues extend beyond the scope of a single watershed, and ultimately can affect users downstream. Similarly, management of water quantity by an individual WPAC also may not be done properly, because downstream users in a different watershed may be affected by changes in flow but would have no recourse

    c. The value of goods and services provided to the province from each watershed differ, and decisions on the importance of the various goods and services provided should remain with the provincial government.

    d. WPACs as they currently exist do not have the expertise, capacity, or ability to make policy and decisions on watershed and water management.

    e. WPACs vary greatly in their sophistication, are concerned only with their basins, and likely are inadequate for addressing concerns related to equitable access to water among all sectors and Albertans.

12. Most senior rights holders strongly oppose conditions being placed on their licences that would limit withdrawals or return flows if river health were demonstrated to be impaired.

    a. Some expressed that the current water licence management system has enough restrictions, some of which seem arbitrary. Specific restrictions identified as arbitrary include the 10% holdbacks and two percent restriction for licence amendments.

    b. Some expressed that the Government of Alberta needs to take a clear leadership role in determining how unused water under allocation is to be identified and what should be done with it.

4.3 Other Issues Raised in Interviews

Because of the breadth and detail of discussions we held with senior licencees, and the fact that our basic discussion outline applied in greater or lesser degrees to the various licencees, other unanticipated issues that were indirectly associated with water management in Alberta often were raised. These additional issues or concerns were:

1. Provincial land-use plans need to include consistent thresholds and limits for water quality, quantity, conservation, and reuse so that efforts to steward water are recognized. At least two interviewees provided the following observations:

    a. The legal relationship between land-use plans and watershed management plans is unclear (see 4c above).

    b. It is unclear how policy priorities are being implemented in decision making in a way that incorporates science.

2. Without a consistent goal for unused and conserved water established by the Government of Alberta, conservation and efficiency gains cannot benefit the broader public.

3. The broad public needs to be consulted to determine how Alberta should proceed with dealing with unused water, conserved water, and conservation and efficiency planning.

4. Some licencees are not opposed to ranking the approval of transfers according to the degree to which a transfer would improve or reduce river health.

5. Water quality in rivers is the highest priority among many users, and particularly for water utilities, municipalities, and downstream users, but water quantity remains the highest priority for irrigation districts.

Section 5: Allocation of Licenced Water Rights in Alberta

As outlined in previous sections, fundamental changes are needed in Alberta's water management system to enable timely, reliable, efficient, and flexible transfer of water to achieve the goals in the *Water for Life* strategy. This section expands upon specific pieces of Alberta's water rights system that can help achieve the aforementioned qualities.

5.1 The Ability of Alberta to Grant New Water Rights is Limited by Law

The Government of Alberta allocates water in Alberta by issuing a licence under the *Water Act*, which authorizes the holder of the licence (*i.e*. the licencee) to divert a specified amount water.[110] Under the *Act*, "diversion of water" includes "the impoundment, storage, consumption, taking or removal of water for any purpose … and any other thing defined as a diversion in the regulations for the purposes of this Act."[111] Rather than being automatic, the Director designated by the Minister of Environment to adjudicate water licence applications has discretion in issuing a licence for the diversion of water, and including in it any appropriate terms or conditions governing use of the licence.[112] A licencee has the right to "commence and continue the diversion of water," provided the terms and conditions included in the licence are met.

In making the decision to issue a licence, the Director must consider the matters and factors specified as mandatory in the applicable approved water management plan.[113] This is problematic because most river basins in Alberta do not have approved water management plans, except for the South Saskatchewan River Basin (SSRB) and the Lesser Slave Lake Watershed.[114] However, only the plan for the SSRB includes the required matters and factors that must be considered in deciding whether to issue a water licence or approve a water allocation transfer, so the Lesser Slave Lake plan does not qualify as an approved water management plan under the *Water Act*. The matters and factors that must be considered for licencing or transfers of allocations of water from SSRB are:[115]

- existing, potential and cumulative effects on the aquatic environment, including hydraulics, hydrology, and hydrogeology, or any applicable instream objective and/or water conservation objective;[116]

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110 *Water Act*, *supra* note 81, s. 18.

111 *Ibid*, s. 1(1)(m). Limited exceptions are also listed, and include "the taking or removal for the sole purpose of removing an ice jam, drainage, flood control, erosion control or channel realignment."

112 *Ibid*, ss. 163 and 164. Where there is a conflict between a term or condition and the *Water Act*, the term or condition prevails; *Ibid* at ss. 18(2), 26, 51(1) and 51(3). The Director is any individual designated by the Minister of Environment for the purposes of the *Water Act*; *ibid* at s. 1(1)(k).

113 *Ibid*, s. 51(4)(a).

114 Alberta Environment, *Approved Water Management Plan*, *supra* note 97; Lesser Slave Watershed Council, *Phase 1 Lesser Slave Lake and Lesser Slave River Basins Water Management Plan* (High Prairie, AB: Lesser Slave Watershed Council, 2009). Because the latter does not include the mandatory matters and factors, it does not qualify as an approved water management plan under the *Water Act*, *supra* note 81, s. 11(3)(a)(iv).

115 Table 2, *Approved Water Management Plan*, *supra* note 97.

116 "Water conservation objective" is the amount and quality of water necessary for protection of a natural water body or its aquatic environment, the management of fish or wildlife, or the protection of tourism, recreational, transportation, or waste assimilation uses of water, and may include the amount of water necessary to maintain flow rates or water levels; *Water Act*, *supra* note 82, s. 1(1)(hhh).

- First Nation rights and traditional uses;
- net diversion of water;[117] and
- efficiency of industrial use.

These suggest that a host of environmental and social issues have to be considered prior to approval of new water licences or transfers of allocations elsewhere in Alberta, in addition to a simple assessment of the applicant's need or the economic benefits of the proposal.

5.2 Water Management Should Not Result in Additional Harm to Fully-Allocated Rivers

In addition to the potential effects of issuance of a new licence, the Director also may consider the cumulative effects on the environment and other licencees that may result from a new diversion of water,[118] or anything else that is relevant, including applicable water guidelines, water conservation objectives, and the applicable water management plan.[119] It has been suggested that when new water management plans are approved for rivers in Alberta, the mandatory factors to be considered will significantly affect the issuance of water licences.[120] It is likely that the factors to be considered by the director would be consistent with the protective nature of the examples of potentially relevant matters provided within the *Water Act* (*e.g.* water guidelines or water conservation objectives). In contrast, and as previously discussed in Section 2.3, basing a water allocation decision on a desire to maximize local industrial activity and ignoring its effects on the health of a river would be inconsistent with the purpose of the *Water Act*, and the matters and factors provided in the approved water management plan for the SSRB.

5.3 Transfers of Water Rights Must Be Voluntary and Benign in Their Effect

The SSRB (other than the Red Deer River) has been closed to issuance of new water licences, because in the opinion of the Government of Alberta its waters have been fully allocated and additional allocations would further impair the ecological function of the river and the ecosystem services it provides.[121] Similarly, because Suncor and Syncrude have substantial senior allocations of water from the Lower Athabasca River, it has been effectively closed to new allocations of water under licence, at least for major oilsands projects.[122] Accordingly, the primary way for

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[117] Net diversion is the net amount of water removed from a body of water, or the difference between the total volume diverted and the total volume that is returned to the body of water after diversion and use by the licencee.

[118] Water Act, *supra* note 81, s. 51(4)(b).

[119] *Ibid*, s. 51(4)(c)(iii).

[120] Block, R. W. and J. Forrest, "A Gathering Storm: Water Conflict in Alberta," *Alberta Law Review* 43 (2005), 38-39.

[121] *Approved Water Management Plan*, *supra* note 97, 4.

[122] For mineable oilsands, major companies operating or planning to operate in the Athabasca Region have entered into a voluntary water-sharing agreement, committing to preserving minimum flow rates in the Athabasca River according to the draft *Phase II Water Management Framework*, **http://www.imperialoil.ca/Canada-English/community_ccr2010_environmental_water.aspx.** Imperial Oil also testified before the Alberta Energy and Utilities Board that the maximum amount of water that all existing and future industry may withdraw from the river under the *Phase I Framework for the Lower Athabasca River* was less than the total water diversions allocated under existing licences prior to consideration of its Kearl Oilsands Project; *Imperial Oil Resources Ventures Limited, Application for an Oil Sands Mine and Bitumen Processing Facility* (Kearl Oil Sands Project) in the Fort McMurray Area, Joint Panel Report AEUB Decision 2007-013 (Edmonton, AB: Alberta Energy and Utilities Board and the Government of Canada, 2007), 60.

Alberta to manage water in these basins is limited to facilitating the transfer of water rights or amending existing licences.[123]

All or part of an allocation of water under a licence may be voluntarily transferred in Alberta at the request of the licencee, and this may be either permanent or for a specified period.[124] While transfers are voluntary, they will only be permitted where they do not impair the exercise of rights by other licencees and specified users, and will not harm the aquatic environment.[125] For the SSRB, the effects of any water allocation transfer should be either environmentally benign or beneficial.[126] Extending this to all rivers in Alberta would suggest that it is most important to consider the effects of the transfer on the quantity, quality and timing of return flow to the river — water that is returned to the river after diversion and use — and that these factors should not be compromised any more than would have resulted from the original licencee's diversion and use of water. A final, exceptionally important limit on water allocation transfers is that only the net-use portion of the original licensed allocation is transferable.[127] This limits a licencee to transferring only that portion of a licensed allocation that has been used under the original license.

5.4 Transfers for Economic Efficiency are Limited to Water Already Under Use

It has been suggested that in regions subject to water shortage, the transferability of water rights results in more efficient use of the resource by providing an economic incentive for an original licencee to use less water, given that excess water under the license may then be sold to another potential user.[128] In Alberta this economic-efficiency model of water transferability is tempered by government oversight and statutory limits that only permit transfers of extra water made available via increased efficiency in water use by the original licencee. Increased economic efficiency also can be envisioned by a scenario where water use is transferred to users that produce more economically per unit of water consumed (*i.e.* a "higher use"), and either total diversion is reduced or total return flow is increased, thereby reducing net water use. This kind of increased efficiency is very different from an economic-efficiency model that is based on expanding economic output by maximizing net water use under an allocation, via increased water diversions and consumption (*i.e.* increasing net water use to the full allocation under the original license), which is what Alberta appears to be promoting for current and future expansion of oilsands industry in the Lower Athabasca River Basin.

It was acknowledged by the Joint Review Panel overseeing the environmental review of the Imperial Oil Kearl oilsands project that water shortage could be the limiting factor for oilsands development. This acknowledgement

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[123] Table 2, *Approved Water Management Plan*, *supra* note 97, 15.

[124] *Water Act*, *supra* note 81, s. 81. However, if the applicant for the transfer is not the licencee, then the written consent of the licencee must be provided [s. 81(3)].

[125] *Ibid*, s. 82(3). This includes any household user, traditional agriculture user, or licencee other than the transferor. "Other licencees" refers not only to superior licencees, with regards to priority rankings, but also licencees junior to the transferor. This is explicitly reiterated in the matters and factors enumerated in the SSRB's *Approved Water Management Plan* that must be considered in assessing a proposed water allocation transfer, *supra* note 98.

[126] Table 1, *Approved Water Management Plan*, *supra* note 97. The director must also consider hydraulic, hydrologic, and hydrogeological effects.

[127] *Ibid*, 24. The "net use portion" is the difference between the volume of water diverted from the source water body and the amount of water returned to the same water body. When water is returned to a river, the licencee is effectively credited with that amount of returned water, thereby allowing additional diversions equivalent to the volumes returned. Ultimately, this net use portion may not exceed the full licensed allocation.

[128] Percy, D. R., "The Limits of Western Canadian Water Allocation Law," *Journal of Environmental Law and Practice* 14 (2004), 319; Percy, D. (1996-1997), *supra* note 5, 239.

was accompanied by a recommendation that a decrease in overall water demand of the oilsands industry should be emphasized in water management policies and decisions, to be achieved via increased water-use efficiency and decreased storage of process-affected waters and water in tailings ponds.[129] However, according to the federal Department of Fisheries and Oceans the "current average cumulative water withdrawals for the oil sands industry amounted to 4.6 m^3/second and was expected to rise to 8 m^3/second in 2008, 11 m^3/second in 2009, and 15 m^3/second by 2010."[130] Because there is relatively little return flow from oilsands operations on the Lower Athabasca, it is undeniable that these increases in water withdrawals must be achieved through substantially greater net use of river water, contrary to the *Water Act's* provisions governing transfers and the only approved water management plan in Alberta.

5.5 Amendment of a Water Licence Must be Benign in its Effect

Licencees generally may only transfer portions of their allocations that are already under use, and therefore they are limited in their ability to capitalize on water rights that are no longer being exercised in association with the prescribed use. This limitation has resulted in senior licencees in Alberta pursuing applications to change the purpose of water use on their licences, not only in the SSRB, but also in the North Saskatchewan River Basin and the Athabasca River Basin. With the approval of these applications, unused water in senior licenced allocations may be used to satisfy increasing regional demands for water in a way that avoids the transfer of water rights.

Water Matters has raised concerns about the use of licence amendments to enable irrigation districts to expand the types of water use under licence to include municipal, commercial, and industrial uses. In *Fight to the Last Drop*, we argued that approvals of licence amendments allow water users to determine and expand water use without sufficient public oversight or broader consideration of how what are effectively transfers may affect the public interest in water, especially in closed basins or periods of water shortage.[131] Some have argued that approvals granted in the past for licence amendments of water use (i.e., to permit use of irrigation water for other purposes) have set a negative precedent by giving some senior licencees qualified immunity from provisions and values under the new *Water Act* in 1999.[132] Our fear is that inappropriate licence amendments will enable senior water users to become water brokers driven increasingly by economic self-interest and the desire to capitalize on unused water allocations.

The effective "transfer without a transfer" via change-of-use licence amendments poses a major problem, because it invariably results in increased consumption of water that would otherwise be unavailable for transfer to other users or returned to rivers. Similarly, by accessing water use via an amendment of purpose for a senior water licence, new water users do an end-run around the rules prohibiting the transfer of unused water, and jump to the head of the priority line, which may impose additional limits on existing junior licencees during low-flow periods. It

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[129] AEUB Decision 2007-013, *supra* note 122, s. 14.1.9.

[130] *Ibid*, s. 14.1.7.

[131] Droitsch and Christensen (2008), *supra* note 103.

[132] Bankes, N. and A. Kwasniak, "The St. Mary's Irrigation District Licence Amendment Decision: Irrigation Districts as a Law unto Themselves," *Journal of Environmental Law and Practice*, Vol. 16, No.1 (2005).

is difficult to comprehend how increasing the net use of water via a licence amendment in a basin like the SSRB, which is closed to new allocations for environmental reasons, would not impair the exercise of rights by specified users and more junior licencees or harm the aquatic environment, all of which are prohibited by the *Water Act*.[133]

If the goals of the approved water management plan are to be achieved, then decisions on applications to amend existing licences also should be subject to the same considerations as the issuance of new licences. Because basin closures are based in ecological concerns, it is arguable that the goal of water management in a closed basin is to maintain or reduce the existing net diversion of water, and to ensure that changes in the quality and timing of return flow are either environmentally benign or beneficial. Under Alberta's current laws, applications for amendments of licenced water use purposes should only be approved if they do not result in an increase in net consumption of water. In particular, they should be rejected where they represent a clear end-run around the laws that limit the availability of transfers of licenced water allocations, and the rules that govern the seniority of licences.[134] Some have argued that approvals granted in the past for licence amendments of water use (*i.e.*, to permit use of irrigation water for other purposes) have set a negative precedent by giving some senior licencees qualified immunity from provisions and values under the new *Water Act* in 1999.[135] Licence amendments have the potential to increase the flexibility in Irrigation Districts' licences, similar to the flexibility enjoyed by municipalities. Nonetheless, long-term planning that is overseen, implemented, and enforced by the Government of Alberta remains a critical missing piece in managing water for the public interest in Alberta.

This is not to suggest that licence amendments are universally incapable of responding to the public interest in protecting aquatic ecosystem health. The *Water Act* could be amended to include instream use for environmental enhancement and protection among its enumerated uses, thus providing licencees the opportunity to either contribute further to the maintenance of IFNs or return more water to impaired rivers. The use dictated by a water licence could then be changed from its original use to instream use, effectively transferring water to support environmental sustainability while maintaining the priority of the original licence and ensuring that the water returned to the environment may not be reallocated.[136] Furthermore, because few tools are available for returning water to rivers for instream use, amendment of the *Water Act* to permit temporary leases, water trusts, conservation programs, and permanent transfers for instream purposes would enable this, provided the original priority also transfers to the new environmental rights or uses.[137] Licence amendments have the potential to increase the flexibility in Irrigation Districts' licences, similar to the flexibility enjoyed by municipalities. Nonetheless, long-term planning that is overseen, implemented, and enforced by the Government of Alberta remains a critical missing piece in managing water for the public interest in Alberta.

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133 *Water Act*, *supra* note 81, s. 82(3).

134 See also: Donahue, W. F., "Water License Amendments: An End-Run Around Sustainable Water Management?" (Water Matters: March 2011), **http://www.water-matters.org/story/430**.

135 Bankes, N. and A. Kwasniak, "The St. Mary's Irrigation District Licence Amendment Decision: Irrigation Districts as a Law unto Themselves," *Journal of Environmental Law and Practice*, Vol. 16, No.1 (2005).

136 Kwasniak, A., "Quenching Instream Thirst: A Role for Water Trusts in the Prairie Provinces," *Journal of Environmental Law and Practice*, Vol. 16, No.3 (2006).

137 Kwasniak, A., "Dribs and Drabs: Western U.S. and Canadian Responses to Water Scarcity," *Rocky Mountain Mineral Law Institute* Vol. 53 (2008).

5.6 The Benefits and Failings of FIT-FIR

One of the benefits of Alberta's FIT-FIR system of water allocation is that it is relatively clear and predictable, in terms of enabling licencees to develop long-term plans that depend upon secure water access.[138] The prioritizing of water use according to the age of a licence places the weight of the risk of reduced water availability upon new licencees, who knowingly and willingly accept the risk of future reduced access to water in pursuing their allocations and uses. The FIT-FIR system also has meant that some senior licencees may have fluctuating usage rates of their allocations that are dependent on weather or climate. Consequently, some senior licence holders consider their unused allocation of water as a vehicle for them to act as a form of environmental trustee during high-water years, because unused water allocations remain instream, and therefore contribute to ecosystem services and health. However, Albertans face a number of serious challenges that are the result of ever-increasing demands for water while its availability is generally in decline.

5.6.1 Inequity Introduced by FIT-FIR Presents a Barrier to More Beneficial Water Uses and Long-Term Risk Reduction

The inequity that FIT-FIR preserves in access to water use by prioritizing water allocations that were granted for very large quantities a long time ago is a major issue that must be addressed, because it imposes barriers to long-term planning and adaptive management of our rivers on the Government of Alberta that are critical to preserving river health in Alberta. In most cases, water use efficiencies today are far better than when long-held senior licences were granted, and such licences and unused portions of senior allocations are often now viewed as opportunities to provide additional economic benefits to senior licencees. For example, licences in the SSRB issued long ago for irrigation may have been issued when flood irrigation was the only method of irrigation. Since then, broadcast and drip irrigation technologies have been widely adopted, resulting in substantial water conservation. Similarly, large allocations were granted to Suncor and Syncrude in the 1960s, presumably because anticipated water demands for oilsands development were much higher than is now the case for an oilsands mine. Adoption of improved water use efficiencies in water-intensive industries has meant that substantial portions of water allocations of many senior licencees are now unused, and are being relied upon to facilitate further expansion of regional development and water use.

Unfortunately, regulators now are forced to rely on senior licencees to voluntarily share their water so that junior licencees can have increased access to water use in both the south and the north. In 2001, a very dry year, senior priority was not exercised in the SSRB and water was shared by senior licencees with junior licencees according to what were effectively "gentlemen's agreements", in order to minimize widespread harm imposed by the drought. In fact, this remains the Government of Alberta's official approach to drought-induced shortages of water in the SSRB. It also is the official approach to water allocation being applied in approving expansion of water-dependent oilsands development in the Lower Athabasca River Basin, and being demonstrated in the change-of-purpose approvals granted to senior licencees to facilitate new development and water uses throughout the province.

The danger of Alberta's hands-off, voluntary approach to water sharing as a means of facilitating regional development is that water-sharing agreements between senior licencees and junior licencees or new users are not

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[138] See Section 4.

enforceable by the Alberta government, which consequently limits its ability to manage water as a shared public resource. This is because the government is not party to the sharing agreements, and the *Water Act* clearly states that transfers or sharing of water between senior and junior licencees is voluntary *(i.e.*, not mandatory). Similarly, provision of water services by senior licencees that have followed changes in identified purposes or water uses on their licences generally proceeds under contract between the senior licencee and the recipient of water services, which Alberta also is excluded from enforcing. Further, Alberta lacks the legal authority to take water from senior licencees in order to redistribute it to junior licencees or new users. For these reasons, Alberta's hands are basically tied by FIT-FIR when it comes to planning or promoting water-intensive regional development, reducing inequity of access to water, or implementing provincial drought management policies and plans to reduce future social, environmental, and economic risks.

5.6.2 Drought Planning in Alberta Is Inconsistent and Poor

On a smaller scale, local and regional drought planning in Alberta is either non-existent or inconsistent. Where small communities are close enough to major centres with senior water licenses and substantial unused allocations, drought planning has often been displaced simply by a plan to enter into a water service agreement with major municipal utilities and tap into their water systems. On the other hand, smaller communities that do not have this option face serious problems, often because they are struggling with the pressures of increasing water demands, strained water supply infrastructure systems, and the spectre of future or even current decreasing water supplies that may trigger susceptibility to the priorities of more senior licencees.[139]

Even where communities plan for long-term shortages of water and make decisions on that basis, they may run into resistance from the Government of Alberta itself. For example, the Municipal Government Board of Alberta recently granted an appeal by developers planning a major real estate development outside of Okotoks, which among other reasons had rejected the proposed project because it would challenge the town's ability to provide water. In its decision, the Board simply ruled that the high-density development would not present a problem for the community, which makes it exceptionally difficult for a town like Okotoks to make long-term plans for itself on the basis of anticipated shortages of water.[140]

It is quite possible that communities facing growth pressures, either willingly or unwillingly, will also face substantial and possibly prohibitive capital expenditure costs associated with water infrastructure. Unfortunately, climate change also is expected to substantially inflate infrastructure costs, and this also has rarely been considered in climate change planning, where such planning has even been formally pursued.

The continued reliance on our current water management regime — and lack of integrated regional or provincial watershed and land-use management plans — is contributing to inconsistent or ineffective drought and risk-management planning throughout the province. It is apparent that our water management regime based on FIT-FIR is reasonably effective when water availability may be variable from year to year, but is not generally

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[139] Municipalities invest vast sums in water treatment plants. However, the problems related to the limits on water rights allocation and the associated costs for municipal water infrastructure are plainly evident in Nanton, Vermillion, and Beiseker. See Read, S., "Town Declines Offer for Regional Water Supply," *Nanton News*, February 1, 2012; Isaac, J., "Beiseker's Pricey Water Woes Frustrating for Village Council," *Mountain Village Gazette*, February 14, 2012; Patterson, D., "Town Won't Share Water with Developers in MD," *Okotoks Western Wheel*, March 7, 2012.

[140] Gerson, J., "Mike Holmes Wins Appeal Over Sustainable Development Outside Okotoks," *Calgary Herald*, January 28, 2012, **http://www.calgaryherald.com/business/money/rsp/Mike+Holmes+wins+appeal+over+sustainable+development+outside+Okotoks/6064205/story.html** (accessed March 22, 2012).

in decline. However, if Alberta continues to promote and approve expansion of water-dependent development, either in regions that are now closed to new water allocations or where it contradicts local efforts to implement long-term risk and water management plans, then it will only exacerbate the potential risks and real harms we eventually will have to deal with in the future.

5.6.3 Seniority of Water Licences May Determine Long-Term Winners and Losers

Whether it is a benefit or a failing of FIT-FIR, the sole ability of senior licencees to provide water to new users is conferring upon senior licencees an ability to influence the type or pace of development that can happen in a region, if such development depends upon costs of water infrastructure or access to stable sources of water. Thus, under FIT-FIR, senior licence holders not only enjoy more security than junior licences, but they also play strong roles in determining economic development that should instead be determined by society as a whole, or advanced according to a provincial planning process, such as is being pursued in current land-use and watershed planning initiatives.

The concerns about liberalization of water markets expressed by many people are generally based in equity, and are in part rooted in a resistance to providing a financial windfall to senior licencees that is merely a consequence of being granted excessive water rights long ago. Under the current water allocation regime, winners and losers — in terms of access to water, or perhaps their potential ability to profit from large allocations — are determined in large part according to an arbitrary date upon which water rights were originally granted, rather than the strength and flexibility of business plans to adapt to a changing economic landscape that accounts for the full cost of water use. Unfortunately, changes in water supply due to climate change and increases in water demand due to increased population or economic growth "will define the vulnerability of water infrastructure and the human population that is dependent on these systems."[141] If climate change scenarios and predictions are realized in Alberta, there will be major changes in the timing and amounts of water available in the province. A liberalization of water markets would likely intensify both water use and competing economic self-interests in a future in which climate change reduces water availability, either in terms of timing changes in flow or reduced quantities. Unless we want future winners and losers to be determined according to the strictures of our current water management regime, we will have to consider and implement substantial changes to our water management policies, laws, and regulations.

5.6.4 The Goals of Water Conservation Plans Are Uncertain

Because instream flow and the protection of aquatic ecosystem health are not enumerated uses in the *Water Act*, it is impossible for anyone to transfer or otherwise dedicate a portion of a licenced water allocation to preserving and protecting ecosystem health. This also has implications with regard to Alberta's hands-off approach to its water conservation and efficiency planning, and the associated water use efficiency improvement goals it has imposed on different sectors. Simply, water being conserved by municipalities, irrigation districts, and the energy sector is not being dedicated to improvement of river health, but rather is simply available for expansion by licence holders.

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141 Vörösmarty, C. J. *et al.*, "Global Water Resources: Vulnerability from Climate Change and Population Growth," Science 289 (2000): 284-288. See also: Natural Resources Canada, "Adaptation in the Water Resources Sector," in *Climate Change Impacts and Adaptation: A Canadian Perspective* (Ottawa, ON: Government of Canada, 2004); NRTEE (2011), *supra* note 85; and Walton, B., "Climate Change Alters the Calculus for Water Infrastructure Planning," (Circle of Blue, March 21, 2012).

Our interviews with senior licencees confirm others' conclusions that the objective of the plan to improve water use efficiency and enhance water conservation remains unclear.[142]

Undoubtedly, licencees that conserve water deserve to benefit from their efforts. However, most Albertans likely presume that water conserved by more efficient use will at least in part be used to maintain or improve river health. Also, if public funds are used by senior licencees to achieve water conservation and efficiency improvement goals, then it is reasonable to think that a portion of the conserved water that is in proportion to the public investment used to achieve the goal should be dedicated to public interest goals (*i.e.* returning conserved water to rivers and thereby improving ecosystem health and the ecosystem services we all rely upon).

5.6.5 Water Allocation Management Does Not Consider Water Quality

As highlighted in section 3.2.1, our current water management regime does not effectively consider activities in watersheds that significantly reduce water quality, despite the fact they are not associated with any water licence or regulated use.[143] Water quality in many rivers in Alberta, and especially in southern Alberta, has been compromised by human activities. In most rivers in Alberta, water quality downstream of municipalities is significantly worse than upstream — in terms of nutrient, contaminant and pharmaceutical pollution — and this is reflected in changes in biological communities in the rivers.[144] In the SSRB, the only river that demonstrates improvement in water quality and ecosystem health downstream of major municipalities is the Red Deer River.[145] Likely, this is linked to the relatively low level of water allocations in the basin and the low level of return flows and non-point pollution sources.[146] However, if water allocations and reductions in natural flow in the Red Deer River Basin proceed to the same level as elsewhere in the SSRB (*i.e.* 45% net reductions in flow), it is almost certain that in the future the Lower Red Deer River will experience much worse water quality and substantial reductions in river health.

In order to address significant water quality and quantity issues throughout Alberta, it is likely that a combination of mandatory and voluntary initiatives should be developed and adopted, which we discuss below. We must emphasize that we were unable to solicit the input of junior licence holders to help inform our interpretations and recommendations, and undoubtedly a discussion on the benefits and failings of Alberta's current prior allocation water management system would benefit greatly from frank input from junior licencees from all economic and societal sectors. We would strongly suggest that Alberta adopt an approach that fully engages junior licencees, and fully considers the serious question of equity among current and future licence holders. Our concern is that junior licence holders and future access to water use will continue to be subjected to the limitations imposed by our strict prior allocation water management regime, and that this will in large part hamper our ability to deal with future changes in water supply in innovative ways that reduce the potential harm to the people, environment, and economy of Alberta.

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[142] Bradley, Cheryl, "Linking Water Conservation to River Health in Alberta," *Wild Lands Advocate* Vol. 19 (4) 2011, **http://albertawilderness.ca/wla/2011/2011-08-02-vol.-19-no.-4-wild-lands-advocate** (accessed April 2, 2012).

[143] Schmidt (2011), *supra* note 12.

[144] Donahue, W. F. (2010), *supra* note 96.

[145] *Ibid*.

[146] See Section 3.2.2.

Section 6: Operational and Policy Opportunities

6.1 Policy Options to Enhance IFN-Based Water Management

Alberta's existing policies, laws, and regulations governing water allocation and management insufficiently manage the increasing demands for water use and the spectre of declining water supplies in Alberta, and fail to address the inequitable access of water use among users or preserve ecological services from healthy rivers. Based on our discussions with licencees in Alberta, review of other jurisdictions and their response to water shortages, and Alberta's current water management regime, we recommend the following approaches and changes be pursued by the Government of Alberta. Priorities and feedback described in our discussions with stakeholders have informed these recommendations. However, some recommendations are our own and intended to respond to problems with equity or ecosystem health. Where a recommendation is supported by stakeholder feedback, we refer to the specific finding described above in Section 4.2.

6.2 Legal and Policy Framework

Recommendation 1

Develop and adopt a science-based Instream Flow Needs Policy that provides a clear designation for IFNs, to be applied without exception in a "one-window" approval regime that encompasses all water allocation and water and land-use management approval decisions falling under the authority of the *Water Act*, *Environmental Protection and Enhancement Act*, and *Alberta Land and Stewardship Act* (*i.e.* is a critical aspect of all watershed frameworks and regional plans).

- Stakeholders assert that it is the responsibility of the Government of Alberta to provide leadership in the management and protection of rivers (Finding #1). In the absence of government direction on this, the ability for licence holders to commit water for ecological flows will remain ambiguous (Finding #5).

Elements of a robust IFN policy include:

- Initiate determination of river health throughout Alberta, based upon a scientific assessment of ecosystem services and ecological thresholds, including connected groundwater sources and riparian zones that require peak flows.[147]

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[147] See Section 2.4. See also W. F. Donahue, *Replacing the Oil Sands' Regional Aquatic Monitoring Program (RAMP) with Effective Environmental Monitoring Solutions* (Canmore, AB: Water Matters Society of Alberta, 2011), **http://www.water-matters.org/docs/effective-monitoring.pdf**; and F. J. Wrona and P. di Cenzo (eds), *Lower Athabasca Water Quality Monitoring Program: Phase 1 — Athabasca River Mainstem and Major Tributaries* (Ottawa, ON: Environment Canada, 2011), **http://www.ec.gc.ca/Publications/default.asp?lang=En&xml=1A877B42-60D7-4AED-9723-1A66B7A2ECE8** (accessed February 4, 2012).

- Identify IFNs for unclosed basins on the basis of ecosystem services and ecological threshold analysis, including connected groundwater sources and riparian zones that require peak flows. Designate the over-allocated rivers in the SSRB "heavily modified" (*i.e.*, not including the Red Deer River) and manage them to achieve "good ecological potential", which as described above in section 2.5 is defined as the best example of biological conditions in a similar water body with the same modifications, where reasonable mitigation measures and best management practices have been implemented and applied.
- Highlight that flow restoration to scientific IFNs is the primary criterion in assessing applications for new licences or licence amendments, transfers of water rights, or project applications for environmental approval under the *Environmental Protection and Enhancement Act*.
- In the absence of a scientific determination of IFNs for a particular river, apply interim precautionary IFNs determined according Alberta Environment and Water's Desktop Method.[148] Using a coherent scientific plan, develop a phased approach to define and implement science-based IFNs throughout Alberta, including connected groundwater sources and riparian zones that require peak flows. This approach should include a clear time-line for the development and adoption of science-based IFNs, and an adaptive management approach to continually assess the appropriateness of IFNs.[149]
- During low flow years, prioritize river health and provision of water for basic human needs ahead of other consumptive uses. Any IFN policy should encourage the adoption of consistent standards and bylaws concerning water conservation and provision of regional drinking water during low flow years.

This recommendation supports the desire of stakeholders to keep a FIT-FIR-based water rights system, and provides a foundation for clear, predictable, and certain environmental approval decisions founded upon evidence-based criteria (Findings #3 and #4).

Recommendation 2

Add provisions to the *Water Act* to permit partial cancellation of unused water allocated under licence and/or sleeper licences by the director, in order to enhance the amounts of water reclaimed for environmental purposes. This will not require amendment of provisions associated with defining use. There should also be some mechanism to include pre-1999 licences that have been grandfathered. As a critical first step, all water rights transfers should be scrutinized with an eye to ensuring that water rights being traded are already in use, and transfers are not simply a means by which licencees are transferring unused rights for their own economic benefit.

Recommendation 3

Perform a one-time review of all pre-1999 licences in an effort to standardize all water licences in the language of their provisions or conditions as related to cancellation, amendment, or transferring of rights.

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[148] Locke and Paul (2011), *supra* note 69.

[149] See Section 2.4. See also Donahue (2011) and Wrona and di Cenzo (eds) (2011), *supra* note 147.

Recommendation 4

Change and clearly enunciate in the *Water Act* the purpose of WCOs to ensure that they are based upon or related to a science-based determination of IFNs. This should include a requirement for the director to ensure IFN requirements are satisfied before new approvals are granted.

- Water licencees understand the importance of maintaining and protecting aquatic ecosystem health (Finding #5). However, licencees also highlighted the need for clear legal assurances that their ability to plan for the long term will not be impaired.
- Water licencees prioritized the creation and adherence to clear, predictable water policy and water allocation rules and decision-making ((Finding #4a). This recommendation would provide clarity and predictability in the director's consideration and application of WCOs in regulatory decisions on applications for new water allocations or licence amendments. It also would prioritize protection and maintenance of healthy aquatic ecosystems and protect the public interest in ecosystem services provided by healthy rivers in Alberta.

Recommendation 5

Notwithstanding 2 above, enable the transfer of rights for used or unused water allocated under licence to IFNs, under the assurance that a new licence for an explicit IFN retains the original priority of the rights.

- Water licencees understand the importance of maintaining and protecting aquatic ecosystem health (Finding #5). However, licencees also highlighted the need for clear legal assurances that a portion of water rights under allocation transferred to enhance river health could not be reallocated by the Government of Alberta to new or other licencees for other purposes (Findings #4 and #6). This recommendation provides the legal assurances, certainty, and clarity needed to facilitate redistribution by current licencees of existing water rights to enhance aquatic ecosystem health.

Recommendation 6

Amend the *Water Act* to allow non-governmental entities to acquire water rights allocated under licence for leaving water instream or improving river health.

- As described in Section 3.2, the ability for a non-governmental entity to hold water rights for environmental purposes does not exist. Stakeholders are supportive of amending the uses as defined under the *Water Act* to permit the creation of water trusts to hold licenced allocations of water rights for enhancing aquatic ecosystem health (Findings #3a, #6 and #7). This also is consistent with licencees' desire to ensure the ability of licencees to transfer or dedicate unused water rights for environmental purposes without them being reallocated to other parties for other purposes (Findings #4 and #6).

Recommendation 7

Where portions of water rights allocated under licence are unused, amend the *Water Act* to permit licencees to retain unused water rights, and avoid cancellation of licences based on unused rights, by entering into short-term allocation agreements that commit unused water to instream use or improving river health for a period of no more than five years.

- Short-term allocation agreements should be limited in time to prevent the effective storage of unused water in perpetuity, as either a risk mitigation strategy or in anticipation of long-term changes in water use needs that at present remain unidentified or unquantified.

Recommendation 8

Review criteria for licence cancellation, expand the criteria for "good standing" maintenance of fully or partially unused allocations under licences, and require licence use within a five year period.

- These are consistent with the recommendations made by the Alberta Water Council's Water Allocation Transfer System Upgrade Project Team, and work in concert with Recommendation 7, above.
- The goal of this recommendation is to extinguish the unused portions of allocations under licence in order to eliminate windfalls, in terms of historical water allocation that some licencees enjoy yet no longer use. This will prevent profiteering in water rights with anticipated expansion of market mechanisms and tools in Alberta, and reduce total allocations in river basins so that a better understanding can be gained of volumes of water allocated and used in each basin.

Recommendation 9

Allow regional water-sharing agreements between municipalities and surrounding water users, especially during low flow years, although only insofar as it is done in a manner consistent with Recommendation 1, above. This may also include regional sharing of utilities and infrastructure costs to meet consistent thresholds for water quality that are required for specific river reaches.

Recommendation 10

Develop and implement guidelines that will govern the sharing of water among senior and junior licencees during low flow years (*i.e.* droughts). Sharing must be restricted to remain within watersheds and the highest priority given equally to scientifically-defined minimum ecological flows for rivers and basic human needs. The remainder of available water should be distributed among licencees according to priority, but with prioritized allocation volumes proportionately reduced by the percent reduction in flow, relative to baseline "non-drought" flows. All municipalities should develop and adopt drought risk and conservation plans that are consistent and complementary with each other and adhere to the guidelines. For example, if at a particular location on a river defined IFNs are 700 m^3/s and drought-level flows are 1,000 m^3/s, municipal and non-municipal withdrawals for basic human needs would be permitted, and the remaining water (*i.e.*, 300 m^3/s) would be distributed among other licencees according to priority, but with each allocation proportionately reduced to reflect the reduction in natural flows.

6.3 Expanded Uses and Reallocation of Water Rights

As we have described above in sections 3.2 and 4.2, the number of options available to redistribute water allocated under existing licences back to rivers for environmental purposes require a more flexible system than now exists. A more flexible system to allocate water back instream, backed with a robust IFN policy, will ensure that the goals in the *Water for Life Strategy* are achieved, via a management regime that is evidence-based and which contains robust legal protection for Alberta's rivers.

1. Adopt more policy options and mechanisms for water rights holders to reallocate water to the environment (See Oregon case study example in Section 7.2):
    a. Adopt instream flows as an enumerated use in the *Water Act* for water rights allocated under licence, and allow permanent transfers of rights for this purpose, with the retention of the priority of the licence from which it was transferred.
    b. Permit the transfer of rights to instream flows and the trading of water quality credits to offset activities that will otherwise lead to declines in river health associated with reductions in water quality or quantity in a watershed, because of operational expansions of existing developments, creation of new developments, or granting of new groundwater licences.[150]
    c. Allow temporary transfers, assignments, and leases for instream uses, whereby water is temporarily committed to instream uses as a means by which a water licence can remain active and avoid cancellation because a portion or all of the rights under licence are unused.
    d. Amend existing provincial water conservation and efficiency programs (*e.g.* CEPs) so that conserved water is automatically returned to the Crown. A substantial portion of conserved water is then reallocated to a third-party water trust, secured under licence with the priority of the original licence, to meet instream flow needs. The remainder of conserved water is made available to the original licencee, provided the use for which it is intended is conditional on the employment of best-available efficiencies that are specific to that use and have been demonstrated elsewhere. (See Oregon's water conservation program in Section 7.2 for more details.)
2. Explicitly identify water trusts as eligible licencees, and the holding of water rights for instream needs as an enumerated permissible water use in the *Water Act*. Trusts should be made responsible for ensuring that water to be used for instream needs meets environmental objectives, with clearly enunciated chemical and biological criteria and indicators. (See Finding #6).
3. Allow additional off-stream storage, provided licencees clearly demonstrate that such: storage will enhance or restore natural flows, or increase instream flows (baseflow and peakflows) where scientifically determined IFNs are not being met; and return flows do not reduce water quality in the river (Finding #5d).

[150] This also would be contingent on the creation and adoption of water management regimes that restrict pollution on the basis of total loadings, rather than according to water quality guidelines as is currently the standard.

4. Permit licencees to adapt their operations in ways that simultaneously reduce risks imposed by water shortages on their operations and those of junior licencees, provided instream flows and ecosystem health are either unaffected or enhanced (Finding #5d).

5. Create a fully-funded, independent scientific body to survey surface-groundwater interactions throughout Alberta, so that groundwater management is sustainable, based upon sustainable yields that are defined according to scientific criteria commonly applied and specific to groundwater, and also on the basis that they do not result in reduced surface water flows or quality.

6. Develop a phased approach to define and implement science-based IFNs throughout Alberta, with a clear time-line for their development and adoption, and an adaptive management approach to continually assess the appropriateness of IFNs (Findings #1, #2, and #4). All water licencees should be subject to these IFNs, as should be all water-related approvals, regional plans, and permits governed by the Government of Alberta.

6.4 Operational Opportunities to Enhance Environmental Flows

It is critical that managers develop and implement adaptive environmental flow management regimes in order to respond to opportunities and constraints offered by either anthropogenic or climate change-induced changes in river flow, or simply year-to-year variation in flow that results in unusually high or low flows in a river. For example, enhancing seasonal flexibility in the filling of reservoirs may provide opportunities to enhance environmental flows and realize major ecological gains with minor losses in hydropower or agriculture production.[151] Such an approach was used in 2011 in the SSRB, where high spring flows from heavy winter snowpacks in southern Alberta permitted water managers to allow more water to pass through agricultural reservoirs so that high spring flood conditions could be produced. In Alberta, manipulated high spring flows have been shown to replenish cottonwoods along river edges. Such flexible river management approaches provide a hedge against the risk of serious and irreversible damage to aquatic ecosystems and the services they provide.

We present below three examples of possible operational changes in water management that could result in substantial increases of water in rivers, for minimal or no costs to either licencees or Albertans. Rather than representing an exhaustive list, we present them to illustrate the sorts of options that are available if we focus on enhancing river health and are flexible in the approaches we use to achieve it. It is certain that many similar options are available in a variety of sectors.

6.4.1. Flexible Off-Stream Reservoir Operations to Enhance River Health

The filling of off-stream irrigation reservoirs is generally constrained in the timing and rate by government restrictions. In some cases, reservoirs that over time have become popular recreational sites in summer also may

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[151] See Bow River Project Final Report (2010), *supra* note 108. See also: Renöfält *et al.* (2010), *supra* note 71; Hughes and Rood (2003), *supra* note 30; Kalischuk, A. R., S. B. Rood and J. M. Mahoney, "Environmental Influences on Seedling Growth of Cottonwood Species Following a Major Flood," *Forest Ecology and Management* 144 (2011): 75-89.

not be permitted to be filled to their designed capacity, because of concerns over erosion of banks or encroachment on what may have become beach or shorefront riparian zones for houses or cottages. Irrigation districts have maximum water withdrawal rates that may vary seasonally, but are generally dictated by regulators. Both of these limits — timing and rates of withdrawal from rivers, and inability to utilize full reservoir capacity — can pose problems when the amount or timing of natural water supplies in the source rivers vary substantially from historical norms.

Obviously, in low-flow years, when there is lower-than-average spring and summer flows, there are few options available other than reducing withdrawals from rivers. However, recently there have been a number of years with wet springs and very dry summers. Reservoir operators are limited in how quickly they are permitted to fill their reservoirs in the spring, so in a very wet year reservoirs are not filled in substantially less time than average, and withdrawals continue much later into the summer. This can be problematic if July and August are especially hot and dry, because not only do water supplies decline, but irrigation demands for water increase. Consequently, withdrawal rates from rivers can be high at times when river flows are very low, resulting in maximum negative pressure on river health at the same time they are already most stressed by low summer flows.

The simplest way to avoid this problem is to permit off-stream reservoir operators to increase the rates with which they fill reservoirs when spring flows are high, especially when they are substantially higher than normal. There is no way to predict whether high spring flows will be followed by hot, dry summers, but earlier filling of reservoirs during high peak flows will allow operators to reduce withdrawals from rivers later in a hot, dry summer. In addition, permitting reservoir operators to fill reservoirs to their designed capacity would allow them to reduce later withdrawal rates even further.

It is important to highlight that we are not saying this strategy should be rigorously applied every year during peak spring flows, because peak spring flows and periodic floods also enhance river health, including by increasing riverside cottonwood recruitment, flushing sediments, and scouring problematic rooted aquatic plants that may accumulate downstream of nutrient sources (like municipalities) during years when flows do not exceed threshold levels needed to remove them. However, it does present an operational option that can minimize potential harm to rivers in years when hot, dry summers are expected, or simply employed as a periodic resetting of summer ecological services, by allowing flows to be closer to natural levels than otherwise occurs under normal seasonal water management routines.

Consider the following scenario: A hypothetical reservoir off the Bow River designed with a 300,000 acre-foot capacity is restricted to being filled to 260,000 acre-feet, and at the beginning of spring the reservoir is half-filled. Filling the reservoir normally begins when spring flows start to increase (*e.g.*, May 1), and withdrawal rates slowly ramp up from very low to eventually reach the maximum permitted withdrawal rate of 1,000 cubic feet per second (cfs). Normally, reservoirs are full by mid-July. This maximum permitted withdrawal rate in an average year comprises 9-10% of peak spring flows, and 20-25% of river flows in late July. As irrigation demands in July and August increase, declines in reservoir storage are augmented with continued withdrawals to slow the drainage of the reservoir.

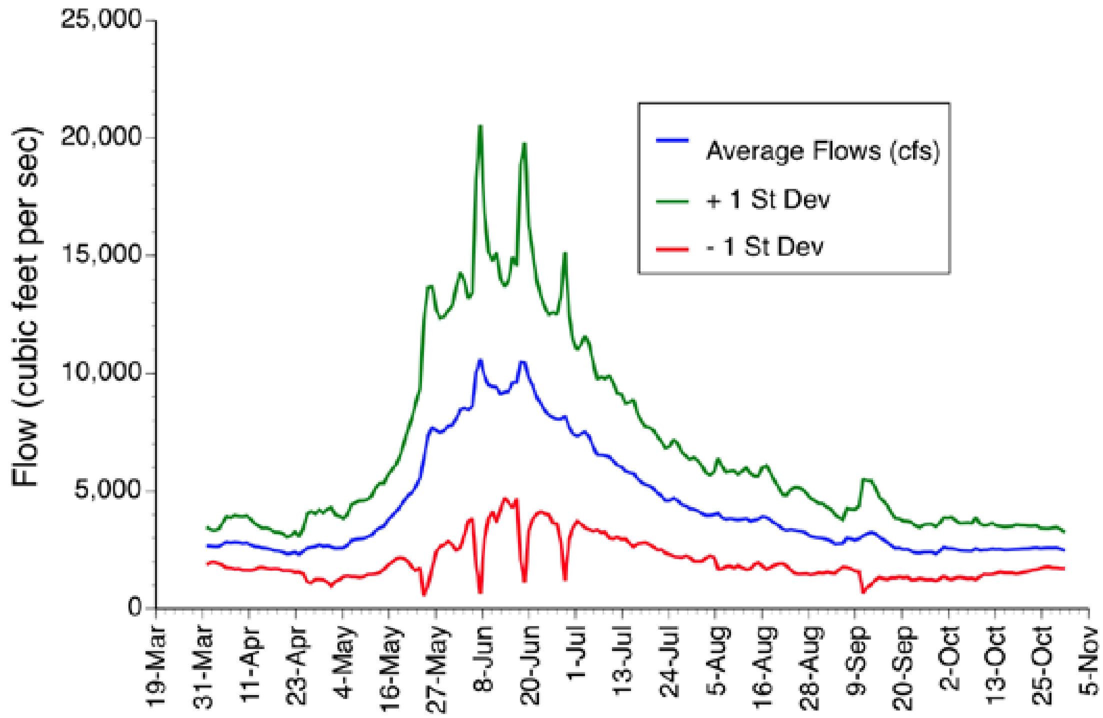


Figure 3. Historical flow in the Bow River downstream of Carseland Dam
(data source: HYDAT database, Water Survey of Canada)

However, periodically years like 2003 arise, with a very wet spring followed by a hot and dry July and August. Starting in late June, flows in the Bow River began to drop quickly; there was little precipitation and the weather was hot and windy. Consequently, flows in August of 2003 were only 41% of average flows. Flows in August in the Bow River downstream of Carseland Dam have been this low on average once every six years from 1972 to 2010, so this is not a rare occurrence (Figure 3). During such years, irrigation needs are exceptionally high in late summer, triggering continued maximum permitted water withdrawal rates from rivers during the coincidental low-flow periods. If higher withdrawal rates were permitted from rivers to fill our hypothetical reservoir during peak spring flows, especially in a year like 2003 in the Bow River when high early flow rates occurred because of the melting of heavy snowpacks in late April, it could be filled by early July and withdrawal rates reduced during August when very low flows are in the river.

This reduction in August withdrawals could be even greater if our hypothetical reservoir were permitted to be filled to its design capacity. Specifically, filling the additional 40,000 acre-feet of designed storage early in the spring and summer during peak flows would allow an operator to reduce river withdrawals by 500 cfs for 40 days in late July and August. This is the equivalent of increasing flows in the Bow River downstream of the Carseland Dam by 13% in the average year, and by 31% in 2003. This would result in proportionate increases in dilution of point source and non-point source pollution inputs in the river, and increase other ecological services that are dependent on flow. This would be especially beneficial during hot years with low late-summer flows, when water temperatures rise and available habitat for cold water fish like trout are at a minimum. In very dry years, when flows are even lower, proportional increases in flows would be even greater, suggesting the proportional ecological benefits to the river of earlier reservoir filling also would be greater during drier years.

6.4.2. Flexible Instream Reservoir Operations to Enhance River Health

Instream hydro reservoirs have relatively large effects on the timing and amounts of downstream flow in rivers because they generally hold back large volumes of water via withdrawals during spring and summer months, and release water during winter months.[152] In Alberta, hydro reservoirs produce approximately 2-3% of Alberta's total power generation. Business imperatives to maximize profit can constrain the timing and rate of filling of instream hydropower reservoirs. Generally, it is in a company's interest to not permit water to flow over a dam, because it does not go through power turbines and therefore does not yield income. Therefore, as flows start to increase in the spring and reservoirs begin filling, it is likely that a hydro reservoir operator will permit water to flow through the turbines. This strategy may be employed to prevent the reservoir from filling too quickly in years when it is expected that water inflow into the reservoir later in the year will be greater than the operational flow range of the turbines (*e.g.*, during years with high mountain snowpack). By doing this, the dam operator is able to capture more water for power generation; it starts generating power earlier in the spring and may also extend the power generation season later in the summer or fall, rather than simply filling the reservoir as soon as possible in the spring then beginning to generate power while letting excess water spill over the dam.

Typically, hydro reservoirs in Alberta are essentially empty in April, well below full by the beginning of August, and eventually full by the approximately by the end of September. If hydro reservoirs were filled aggressively by the end of July, hydro operators run the risk of having to allow water to spill over the dams if there are heavy late summer rains, which constitutes lost income for the hydro operator and in some cases results in dam and spillway safety and design concerns. However, in years where there are no late summer flows there is no excess water to spill in late summer, and therefore no lost income.

If hydro operators were compelled to fill reservoirs earlier in the year to reduce holdbacks later in the summer, provided dam safety is not compromised, then downstream river flows in late July and August would increase. Because seasonal hydro reservoir fill rates are not readily available and different dams fill at different rates according to the location (*i.e.* climatically different regions of Alberta, and low-order versus high-order stream placement), we cannot estimate how much downstream river flow might increase in late summer. If this technique were employed wherever safely possible, and hydro operators were compensated for the proportion of total power that is not generated because of rapid reservoir filling, then their economic resistance to such changes could be removed. Such compensation could be considered the trade-off costs for increasing low summer flows in the downstream reaches of rivers. Alternatively, this could be introduced as a new "cost" that is simply part of doing business in a changing world. Given the value of ecological services in rivers — especially in the SSRB — it is likely that this could be one of the cheapest ways to substantially increase downstream summer river flows.

[152] For example, TransAlta Utilities' hydro storage in the Upper Bow River Basin is approximately 500,000 acre-feet, which is approximately the same amount of reservoir storage available to the Eastern Irrigation District.

6.4.3 Other Water Infrastructure Options to Enhance River Health

Opportunities also exist to improve irrigation canal efficiency and decrease the minimum flow levels needed in the canals, thus allowing irrigation districts to reduce river water withdrawal rates. For example, the canal from the Bow River to McGregor Reservoir was designed to be able to be operated at 300 cfs, but it has been operated at 500 cfs because water surface levels must be maintained at a particular height to permit water movement. A weir is going to be installed that will allow the canal to be operated at 300 cfs, resulting in a potential reduction in river withdrawal rates by 200 cfs.

If this were combined with the flexible reservoir filling options described in section 6.4.1, it would improve the chances of ensuring this 200 cfs reduction in withdrawals during low July and August flows, in addition to contributing to potential financial savings delivered by those strategies. The one-time cost of this weir is estimated to be approximately $300,000. When considered in the context of the potential increases in flow in the Bow River (*i.e.* an additional 5% of flow in average years and 13% increases in flow in low-flow years like 2003), and the likely costs of buying senior water rights of this volume as an alternative strategy for recouping allocated water, this sort of infrastructure-based improvement is exceptionally cheap. Assuming policies and programs similar to those implemented elsewhere are adopted or created in Alberta, which permit water trusts and environmental water uses, rights for such water savings could be transferred under a new licence with the original priority for the permanent enhancement of river health, in return for and in amounts that are proportional to the public investment in improving infrastructure.

Section 7: Case Studies – How Other Jurisdictions Have Dealt With Water Shortage and Allocation

The problems and risks associated with over-allocation of water rights, FIT-FIR, increasing demand for water by water-intensive industries and municipalities, and declining water supply that we have described in this report are not unique to Alberta. Elsewhere in the world jurisdictions facing these same problems have come up with innovative ways of managing their freshwater resources that enhance instream flows and minimize future risks associated with changing water availability and demand. In some cases, governments have been forced to introduce drastic measures very quickly in response to record drought conditions. We describe here three different examples of changes to water management regimes that governments have made, and the successes or problems associated with each. The cases that involve changes triggered by extreme droughts illustrate clearly the extreme costs of being unprepared for significant changes in water availability, and should be considered cautionary tales that illustrate the value of initiating integrated landuse and water management planning, and risk assessment and drought planning in Alberta before we are hit with severe droughts that trigger emergency responses.

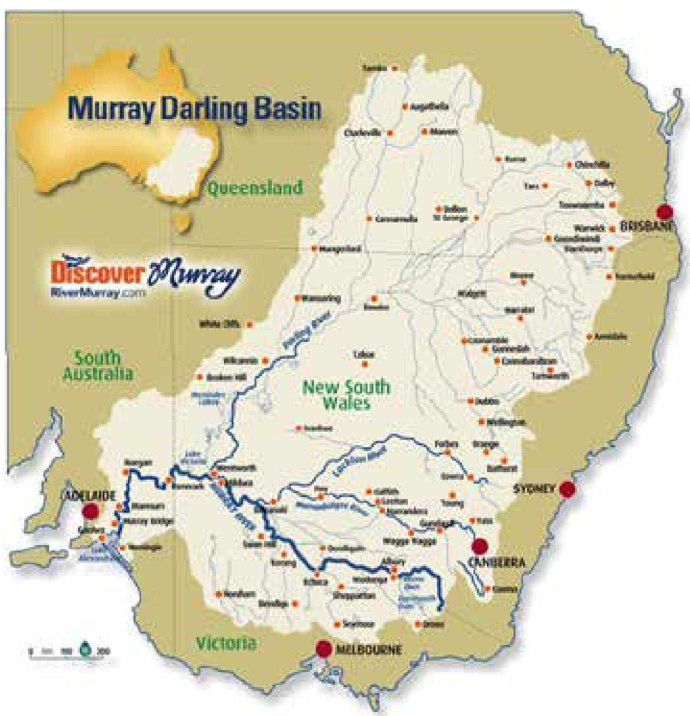
7.1 Australia

Key features for Australia:

- Prior allocation system.
- Water trading began in 1983. In 1995, a cap on new water licences was imposed to limit further diversion, without securing IFNs.
- A decade of drought has resulted in major changes to water management. Environmental flows and critical human needs are now prioritized, and seasonal allocations are based on what is available after they have been satsifed, with licencees sharing proportional amounts of remaining water.
- The government has had to budget $8.9 billion to recover sufficient water for environmental flows, and to facilitate improvement and long-term maintenance of river health.

- Two main rivers make up the Murray-Darling River Basin: the Murray, originating in the Victorian Alps in southeastern New South Wales, and the Darling, originating in southeastern Queensland and northeastern New South Wales. The north of the basin lacks storage while the south has storage, and the waters of both the Murray and the Darling sub-basins are regulated differently. Agriculture is an important part of the greater watershed, comprising 84% of the total land area and providing a gross economic benefit of $15 billion in 2005.[153]

Transfers in water are not new to Australia. Australia has been transferring water since 1983, when a market for water entitlements (referred to as licences in Alberta) and allocations was first introduced in South Australia. In 1995, a cap on issuance of new water entitlements was included in the new water policy framework to limit further growth in water diversions. However, an increased volume of trade in response to reduced inflows and low seasonal allocations actually increased net use of previously underutilized water allocations, thereby increasing pressures in the Murray Darling Basin.[154]



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[153] Grafton, Q., "How to Increase the Cost-effectiveness of Water Reform and Environmental Flows in the Murray-Darling Basin," *Agenda* Vol. 17, No.2 (2010).

[154] *Ibid*, 2. See also Le Quesne, T., E Kendy and D. Weston, *The Implementation Challenge Taking Stock of Government Policies to Protect and Restore Environmental Flows* (Surrey, UK: World Wildlife Fund and The Nature Conservancy, 2010), **http://wwf.panda.org/about_our_earth/about_freshwater/freshwater_resources/?196955/The-Implementation--Challenge---Taking-stock-of-government-policies-to-protect-and-restore-environmental-flows** (accessed March 11, 2011); Bjornlund, H., *Water Scarcity and Its Implications for Land Management: Some Lessons From Australia* (London, UK: RIC Research, 2008).

Water rights management in Australia differs from Alberta in several ways. Most importantly, water allocations are now based upon what is seasonably available: in times of drought, water is distributed to users in accordance with a proportional reduction that reflects what is available. Compare this to Alberta's system of prior allocation (*i.e.* FIT-FIR), where during periods of water shortage junior licencees may suffer partial or complete reductions in available water allocation before more senior licences are affected.

For example, in Australia, if there is 20% less water available in the river for allocation after environmental flows and critical human uses are satisfied, then all other users receive 20% less water than they are allocated under their licences; in Alberta, senior licencees could demand that junior licencees account for the full reduction in water availability, and river health would likely be sacrificed to reduce limits on junior licencees. Furthermore, water shares in Australia are "unbundled" from land (*i.e.* the ownership and transfer of water rights are completely independent of land title and ownership). In Alberta, water licenses are generally attached to land, and the relationship between land and water is not necessarily independent (*e.g.* riparian rights).[155]

A decade of drought in the Murray-Darling Basin, with extremely dry years in 2002-2003 and 2007-2008, made it apparent that there was insufficient water flowing to key environmental assets to maintain them in a healthy state.[156] In 2004, Australia adopted the National Water Initiative to give priority for water use to meet the needs of the environment. However, due to concerns regarding the lack of progress in meeting environmental needs, the Commonwealth government passed the 2007 *Water Act*. The 2007 *Water Act* empowered a new authority to create operational basin plans by July 2011, and to set sustainable diversion limits per watershed based upon availability of surface and groundwater.[157]

In 2008, the *Water Act* was amended to set rules for the water market to meet critical human needs, and later an approved budget of a maximum of $8.9 billion — more than half of the gross domestic product of irrigated agriculture — was approved by the Commonwealth government to purchase water for the environment or to subsidize water infrastructure to improve water use efficiency and reclaim allocated water for environmental purposes. In a recent comparison of Victoria's and Queensland's efforts to achieve appropriate instream flows, it was concluded that "if governments provide prioritised environmental rights for instream ecosystem benefits, together with targeted water acquisitions on the markets to meet environmental needs associated with over-the-bank floods and flushes, there will be lower potential shortfalls relative to targeted environmental flow outcomes."[158] In other words, prioritizing water use for maintenance of base flows of a river, and purchasing additional water for flooding at market price, will most likely enable Queensland to recover and sustain river health.

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[155] AMEC, *Comparison of the Water Allocation Process in Alberta to Other Jurisdictions* (Edmonton, AB: Alberta Environment, 2007), 53-54; Government of South Australia, "Unbundling Water Rights: What Does It Mean?" July 1, 2009, **http://www.waterforgood.sa.gov.au/rivers-reservoirs-aquifers/river-murray/unbundling-water-rights/** (accessed April 3, 2011); Bjornlund, H., CRC in Water Policy and Management, University of Lethbridge / Assoc. Research Prof., University of South Australia (pers. comm., March 10, 2011).

[156] AMEC (2007), *supra*, 23.

[157] *Ibid*, 25.

[158] L., Adam, H. Bjornlund, and R. McIver, "An Institutional Critique of Differing Allocation Models to Deliver Environmental Flows: Case Studies of Queensland and Victoria in Australia," *Environment and Planning C*, Vol. 29: 2011.

In Victoria, regulatory measures were aimed at re-prioritizing water for the environment, but did not consider consumptive uses. Because water supplies were generally reliable, environmental flows were supplemented when flows were abundant. However, during low flow years, the environment and consumptive licence holders share similar priorities and therefore compete for water. When modelled, the probability of Victoria not meeting its environmental objectives is high. In Queensland, 100 percent of the environmental baseflow is satisfied at the expense of consumptive users, and environmental objectives are more likely to be met. During periods of lower flow, water for environmental flows in Queensland is ensured through watershed planning and a sharing process, and during flooding or system flushes, environmental flows are given equal priority in the market, in which the state can participate to purchase rights.

7.2 Oregon

Key features for Oregon:

- Maintained FIT-FIR.
- Adopted a diverse set of market-based tools or economic instruments to transfer water for flow restoration.
- Water availability determines allocation.
- IFNs are an explicit use or purpose for water rights.
- Seniority attaches to transfers of water rights to meet IFNs.
- Unused portions of water rights are cancelled after 5 years.
- Cancellation for lack of use can be delayed via short-term leases or assignments to meet IFNs.
- A minimum of 25% of conserved water is allocated to meeting IFNs.
- The State of Oregon Water can only procure water rights from licencees in partnership with water trusts, thereby securing such water for meeting IFNs.
- Has achieved the most success of any state in the USA in enhancing river flows, with three times the total amount of water returned to rivers in Washington, Idaho, and Montana.

Unlike in many other jurisdictions, Oregon has developed robust protections for aquatic life by prioritizing and ensuring adequate instream flow needs. One of the key developments was the 1987 *Instream Water Rights Act*, which made it "absolutely clear that water rights could be issued for instream purposes without any diversion" by state departments, and opened up a suite of tools to allow voluntary transfers of water rights for instream purposes.[159]

This resulted in success in returning water to rivers in a number of ways. First, the law allowed the transfer of senior water rights for instream flow needs while maintaining original seniority. Restrictions on water use during low flow periods only affected allocations of water for IFNs insofar as the senior licences from which they originated would be affected under FIT-FIR.[160] And second, opening the door to transferring water rights for IFNs inspired a culture of flow restoration because diverse parties, including non-profits, water trusts, land trusts, private companies, and government agencies, were permitted to purchase water for instream purposes.

Key tools that the Oregon Water Resources Department has for water conservation are:

- instream leases and time-limited transfers, including
    - standard leases
    - pooled leases
    - lease renewals
    - split season leases
- permanent instream transfers
- allocation of conserved water

The range of options available to water users provides incentives to transfer water for instream purposes. Water rights can be cancelled (*i.e.* water is returned to the State) if not used within a five-year period, in what is referred to as a "use it or lose it" clause, where notice and warnings are given three years prior to cancellation. However, water can be used by certifying water for instream leases, so that users do not lose their water rights.[161] Therefore, instream leases provide a particular strategic advantage for water users who risk forfeiture of their water rights because of non-use, because they can enter into a temporary lease of their rights for instream uses and avoid

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[159] Neuman, Janet, Anne Squier, and Gail Achterman, Sometimes a Great Notion: Oregon's Instream Flow Experiments, *Symposium Articles in Environmental Law* Vol. 36 (2006) p. 1150.

[160] *Supra* at 1151.

[161] Oregon Water Resource Department, "Chapter 6: Cancelling Rights", in An Introduction to Oregon's Water Laws: Water Rights in Oregon, (Salem, Oregon: Oregon Water Resources Department, 2009) **http://www.oregon.gov/OWRD/PUBS/aquabook_canceling. shtml** (accessed April 20, 2012); Oregon Revised Statutes (2011 Edition), Water Laws, Chapter 537 (Appropriation of Water Generally) at 537.348 and 537.455-537.500, http://www.leg. state.or.us/ors/537.html (accessed April 20, 2012); Zetland, D., and R. Harmon, Aguanomics: the political-economy of water (and other diversions), **http://www.aguanomics.com/2009/12/rob-harmon-on-in-stream- water-markets.html** (December 3, 2009; accessed April 18, 2012).

forfeiture.[162] Furthermore, because the State can only procure water rights through active partnerships with water trusts, water trusts are an essential element in Oregon's program for returning water to rivers for instream purposes.[163] This is distinct from Alberta's approach, in which the Government of Alberta alone holds water for instream purposes, with the discretion to reallocate it.

Permanent transfers also allow water trusts to purchase water at market value, after which the Oregon Water Resources Department (OWRD) retires the right for instream use with its priority. For any transfer of water rights associated with land, the Department of Water Resources reviews and is responsible for approving the transaction. Irrigation districts are given additional flexibility, and transfers can include changes in the point of diversion or appropriation, the place of use, or the use of the right.[164] One of the incentives of permanent transfers are that if a water right is going to be cancelled, water can be gifted back to the State for instream purposes. The water rights holder still needs to go through a transfer process, but a 50% discount is given and processing of the application can be sped up using a third-party contractor.[165]

An additional incentive to allow users to voluntarily identify water for instream flow needs is Oregon's water allocation conservation program. Conserved water must be approved by the Department of Water Resources; in the absence of an approval, conserved water cannot be used for new needs. Under a voluntary program, where a water user demonstrates the use of less water that result from adoption of efficiency or conservation programs (*i.e.* water is conserved), the Water Resources Department allocates a minimum of 25% of the conserved water to the State for an instream water right and a maximum of 75% to the applicant, unless the applicant proposes a higher allocation to the State. This 75% of conserved water is allocated to the applicant under a new permit with the original priority, with the expectation that this conserved water will be subject to a use that incorporates newer and improved efficiencies than those originally in place.[166] Where improved efficiencies have been achieved with the aid of public funding, conserved water returned to the OWRD is proportional to the amount of public funding provided for a project.[167] For example, if 50% of the funding for the water conservation project was provided by the State, then the State will most likely take 50% of conserved water for instream uses.

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[162] Oregon Revised Statutes (2011 Edition), Chapter 537 Appropriation of Water Generally, Water Laws, *ibid*.

[163] Oregon Water Resources Department, Flow Restoration Program, **http://www.oregon.gov/OWRD/mgmt_instream.shtml**, (accessed April 20, 2012). For more details, see the Oregon Water Resource Department's "Cancelling Water Rights", Chapter 6 in An Introduction to Oregon's Water Laws: Water Rights in Oregon (Salem, Oregon: Oregon Water Resources Department, 2009), **http://cms.oregon.gov/owrd/ pages/pubs/aquabook_canceling.aspx** (accessed April 20, 2012). Wilkee, Laura, Flow Restoration Program Coordinator, Oregon Department of Water Resources, (pers. comm., November 29, 2011).

[164] Oregon Water Resource Department, Instream Transfers, **http://www.oregon.gov/OWRD/mgmt_transfers.shtml** (accessed April 20, 2012). For more detail, see Oregon Revised Statutes (2011 Edition), Water Laws, Chapter 540 (Distribution of Water; Watermasters; Change in Use; Transfer or Forfeiture of Water Rights) at 540.510-540.532, 540.545, 540.570 and 540.572-540.580, **http://www.leg. state.or.us/ors/540.html**, and ORS 541.327 and 541.329, **http://www.leg.state.or.us/ors/541.html.**

[165] Wilkee, L. (2011) *supra* note 163.

[166] Oregon Water Resource Department, Allocation for Conserved Water, **http://www.oregon.gov/OWRD/mgmt_conserved_water. shtml** (last updated April 20, 2012). See also Oregon Revised Statutes (2011 Edition), Water Laws, Chapter 537, supra note 161 at 537.455- 537.500.

[167] State of Oregon Water Resources Department, 2006, Applying for the Allocation of Conserved Water Program (Overview and process diagram); **http:// cms.oregon.gov/owrd/pubs/docs/reports/conserved.pdf** (accessed August 1, 2012).

Since 1987, the State of Oregon has continued to develop instream flow needs legislation. Most notably, the recent passage of Bill HB3369 provides grants and loans for water conservation so that peak and ecological flows are considered in instream flow need designations that include options for storage.[168] Another key feature to Oregon's success is the implementation of planning and managing water availability on a monthly basis for each basin. As described by the Peak Ecological Flow Technical Advisory Committee, water availability is calculated by subtracting all water rights, including instream water rights, from the unimpaired natural stream flow estimate.[169] As a result, water availability has become a key criterion for off-stream water use during the irrigation season.

When IFNs originally were introduced, they were not popular. However, two additional benefits of IFN options are emerging.[170] The State of Oregon can cancel a licence if it is not used within five years. However, during periods of financial hardship, IFNs offer security to farmers because they are able to maintain unused water instream under a lease, effectively preserving their rights of water use for the next year. Alternatively, if a farmer is uncertain about their crop yield, they also can maintain water instream under a short-term lease for environmental use, but still retain the right of use if necessary. However, water users are subject to a two-year limit for maintaining their unused rights instream, thereby incenting the use of Oregon's water conservation program and short-term lease program.

Another emerging trend has instream leases and transfers being used to offset or mitigate impacts to surface water from new groundwater permits, which seems to be working well in basins that are seeing changes in land-use.[171] In the upper Deschute Basin in Oregon, land-use has changed dramatically, from the historic domination of irrigated agriculture to recreational and hobby-farming as the dominant land-uses. This has resulted in an increase in available surface water in concert with increased drilling of new groundwater wells. This shift has benefited from the utility of Oregon's instream program to mitigate the over-exploitation of groundwater that would otherwise reduce surface water flows.[172] For example, if your well is located too close to a creek and you're applying for a well water licence, then you may offset your impact by purchasing water instream.

Despite relying entirely on a voluntary system for enhancement of instream flows, Oregon leads the United States in restoration of flows in rivers to enhance and protect aquatic ecosystem health. More than 70% of water that is now permanently committed to IFNs in the state has been transferred from senior licences that were granted prior to creation of Oregon's original water law in 1909. In total, Oregon has returned three times as much water to rivers as Washington, Idaho, and Montana combined, with 1,700 cubic feet per second returned to rivers via more than 3,000 instream leases, transfers, and allocations.[173]

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[168] Norris, B. (ed.), White Paper: Peak and Ecological Flow; a Scientific Framework for Implementing Oregion HB 3369, Peak and Ecological Flow Technical Advisory Committee, Oregon Water Resources Department (Salem, Oregon: State of Oregon, 2010), **http://www.wrd. state.or.us/OWRD/docs/EFTAG_Final.pdf** (last accessed, April 18, 2012).

[169] *Ibid*, 2.

[170] Wilkee, L. (2011), *supra* note 163.

[171] See United States Geological Survey, Oregon Water Sciences Study Centre, 2005, **http://or.water.usgs.gov/projs_dir/deschutes_gw/pubs.html** (accessed December 12, 2011); Lieberherr, L., "Acceptability of the Deschutes Groundwater Mitigation Program," *Ecology Law Quarterly* Vol., 38 (2011), **http://elq.typepad.com/currents/2011/06/currents38-04-lieberherr-2011-0607.html** (accessed December 12, 2011).

[172] Lieberherr (2011), *supra*.

[173] Oregon Water Resource Department, *2009 Instream Accomplishments*, (Salem, Oregon: Water Resource Department, 2009) **www.wrd.state.or.us/OWRD/docs/2009_Instream_Accomplishments.pdf** (last accessed, April 18, 2012).

7.3 Texas

Key features for Texas:

- Environmental flow allocations rely on non-market, regulatory changes.
- Consensus-based stakeholder committees (basin-specific) given one year to identify opportunities and incentives to increase water use efficiency and protect river health, and develop recommendations.
- Broad multi-stakeholder support for establishment of science-based environmental flow allocations, and basing water use allocations upon them.
- Each watershed has an independent science team that must submit, within a year of being formed, recommendations that will permit maintenance and protection of river health
- A committee comprised of members of the science and stakeholder teams, state representatives, and other state departments, must develop recommendations for water management for the Texas Commission on Environmental Quality (TCEQ).
- TCEQ amends the Texas Water Code based on recommendations, which are subject to review every five years.
- No legislated change to FIT-FIR, but record droughts have led to adoption of emergency provisions that may limit both prior appropriation and environmental flow allocations.

Texas is a geographically diverse jurisdiction, with relatively abundant water in the East. In the West, water is more scarce, with many of the watersheds draining into coastal estuaries bordering the western shore of the Gulf of Mexico. Unlike in Australia, Oregon, and Alberta, Texas has adopted a water management system that maintains a prior appropriation approach, but does not include water markets as a tool to enhance protection of river health or facilitate redistribution of water rights among licencees. As in Australia, Texas has been forced to undertake significant changes to water management because of severe droughts that have significantly reduced water availability.

In 2010, Texas adopted a new environmental flow allocation process. Science and stakeholder teams established for each basin were given legal authority and responsibility to develop basin-specific IFNs within 18 months.

Texas's water regulator, the Texas Commission on Environmental Quality (TCEQ), then had an additional six months to consider the recommendations from both groups and adopt legal standards for each river and bay system. A state-wide Science Advisory Council supports each basin in the determination, coordination, and application of scientific principles for identifying instream flow needs. Meanwhile, an Environmental Flow Advisory Council, comprised of members from the science and stakeholder committee, state representatives and government department staff, liaise with the TCEQ in creating legally binding standards for achieving and protecting river health for each watershed. The legal standards adopted by the Commission are then written into the *Texas Water Code*, and are subject to five-year reviews.[174]

One of the reasons for passing this landmark legislation (see Appendix II) is that its development involved expressions of mutual interest in developing standard environmental conditions for industrial licences among environmental groups and industry alike. Industries obtaining water rights had a strong interest in the development and application of standardized, scientific environmental conditions for their permits, because in the absence of the scientific determination of valid environmental flow allocations, there would be a high level of uncertainty on what kinds of standards would be adopted and whether they would be arbitrary, necessary, or fair.[175]

In 2010, Texas was hit with a severe drought that has resulted in record losses of $5.2 billion in the first year of the drought in the agriculture sector alone, according to the Texas AgriLife Extension Service.[176] As a result, on 4 November 2011 the TCEQ adopted new emergency provisions permitting the executive director to suspend or adjust water rights during drought or emergency water shortage, including setting aside or otherwise overruling environmental flow allocations.[177] It remains to be seen what the final outcome or success of Texas is, in terms of managing its water allocation and use in the face of record drought and the potential direect and indirect costs of insufficient historical drought planning.

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174 Texas Water Matters website, "The Environmental Flow Allocation Process," 2010, **http://www.texaswatermatters.org/flows.htm** (accessed June 1, 2011); cross referenced with Texas Commission on Environmental Quality, Environmental Flow Assessment, 2009, **http://www.tceq.texas.gov/permitting/water_rights/eflows** (accessed June 1, 2011); Ellis J., Outreach Coordinator, National Wildlife Federation with Texas Living Waters, (pers. comm., December 12, 2011).

175 Ellis, J., (pers. comm.), *supra*. This concern reflects similar concerns expressed to us by senior licencees in Alberta, in reference to Water Conservation Objectives, and how they are established and applied in sebsequent licencing and permitting decisions by the Director.

176 Texas Water Resources Institute, "Timeline of Droughts in Texas," in *txH20*, Fall 2011, **http://twri.tamu.edu/publications/txh2o/fall-2011/timeline-of-droughts-in-texas/** (accessed December 12, 2011); see also Wythe, K., "The Time It Never Rained — How Texas Water Management Has Changed Because of Recurring Droughts," in *txH20*, Fall 2011, **http://twri.tamu.edu/publications/txh2o/fall-2011/the-time-it-never-rained/** (accessed December 12, 2011). In Texas, the worst drought led to losses of an estimated $3.5 billion (in 2008 terms), thus losses estimated to be $5.2 billion for agriculture alone associated with the current drought exceed the costs of the 2008 drought.

177 Cagle, M. and P. Williams, "Proposed Rules for Suspension or Adjustment of Water Rights During Drought or Emergency Water Shortage," *V&E Environmental Law Update E-communication*, November 7, 2011 **http://www.velaw.com/resources/pub_detail_print.aspx?id=20209** (accessed December 12, 2011); Ellis, J. (pers. comm.), *supra* note 174. The National Wildlife Federation was one of the key actors in creating legislation to create the Environmental Flow Allocation Process.

Moving Waters – What Can We Learn?

Australia's experience, and their need to spend $8.9 billion on recovering water rights to enhance and protect river health in the Murray-Darling Basin, highlights the danger of over-allocating water rights and then closing a basin to issuance of new licences because of concerns about effects of increasing water use on river health. This is a clear example of the exceptional financial cost of unsustainable water management and haphazard introduction of water markets that do not have a clearly enunciated purpose that prioritizes protection of instream flows and river health. Similarly, the situation Texas is now in—having recognized the need to change how water is managed and allocated to regain and protect river health, only to be hit by a record drought—is a cautionary reminder of the dangers of delaying a move toward more sustainable water management until it is too late. Nonetheless, Oregon's water management system presents a variety of creative options and tools that can help restore, maintain, and enhance river health while ensuring and facilitating appropriate economic development.

Alberta could conceivably face a fate similar to Australia or Texas if it does not clearly prioritize long-term recovery or protection of river health as a primary purpose underlying its water management laws and policies—including any water market—and introduce market limits and incentives that are strictly intended to enhance recovery and protection of river health. Similarly, Alberta must integrate watershed and land-use planning in a way that seriously considers approving new water-intensive development only in parts of the province where risks of future water shortages are low. Ultimately, Albertans must carefully consider options and approaches that combine both market and policy changes if they desire a future that includes safe, secure drinking water supplies, healthy aquatic ecosystems, and reliable water supplies for a sustainable economy.

Appendix I: Review of Alberta's Draft Lower Athabasca River Water Management Plan

W. F. Donahue, Water Matters

Habitat Exceedance Curves

Data on fish habitat use and other biota are very limited for the lower Athabasca River and its tributaries. Consequently, many of the conclusions in current estimates of IFN for the region are based on unsupported assumptions and application of methods developed for southern rivers. It is for this reason that IFN estimates for the Athabasca River have been limited to assessments of the relationship between river flow and availability of fish habitat.

Mean weekly values of wetted area data were calculated for the entire 48-year period, and then data for each of weeks 1 through 52 were ranked from greatest to lowest to provide exceedance curves for each week of the year.[178] For illustration's purposes only, I present an example of an exceedance curve for flow in the Athabasca River downstream of Ft. McMurray (Figure A1). Threshold analysis was performed on ranked flow-based wetted area, as a proxy for fisheries habitat and based on flow data between 1957 and 2004 for the various reaches of the river.[179]

Presence of an inflection point in the weekly wetted area exceedance curves was interpreted as an indication of some sort of threshold (*e.g.* Figure A1). Based on the apparent predominance of break points that occur above the 80% exceedance level (*i.e.* more than 80% of years have more habitat), this appears to be the level that was selected as indicative of the associated flows that are protective of fish habitat. This selection of the 80% exceedance level seems to be almost arbitrary, especially when significant numbers of the curves display inflection points that are below this threshold level (Table A1). When considered as a proportion of the total number of inflection points, it is clear that many of the apparent thresholds occur below this supposedly protective level (for example, 53% of weeks during summer in Reach 2; Tables A2 and A3). In addition, it appears that there is a pattern as one proceeds downstream from Ft. McMurray. Frequency and location of inflection points appear to be lower and at lower exceedance levels, respectively, as one moves downriver through the different reaches. Unfortunately, the absence of data for reaches 3 and 1, and the lack of winter data below Reach 4, limit one's ability to draw strong inferences.

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[178] Courtney, R. (2006), *supra* note 21, Figure 2.

[179] Courtney, R. *Interim Framework: Instream Flow Needs and Water Management System for Specific Reaches of the Lower Athabasca River*. (Edmonton, AB: Alberta Environment, 2006). This method was carried over into the Phase 2 Water Management Framework for the Lower Athabsca River, as the basis for "Alternative 1", which is described as "the most environmentally protective bookend", the "fully protected case", and the "Alberta Desktop method"; Ohlson, D., G. Long and T. Hatfield, 2010, Phase 2 Framework Committee Report, at 60, **http://albertawilderness.ca/issues/wildwater/archive/2010-02-05-athabasca-water-management-framework-phase-2-report/at_download/file**.

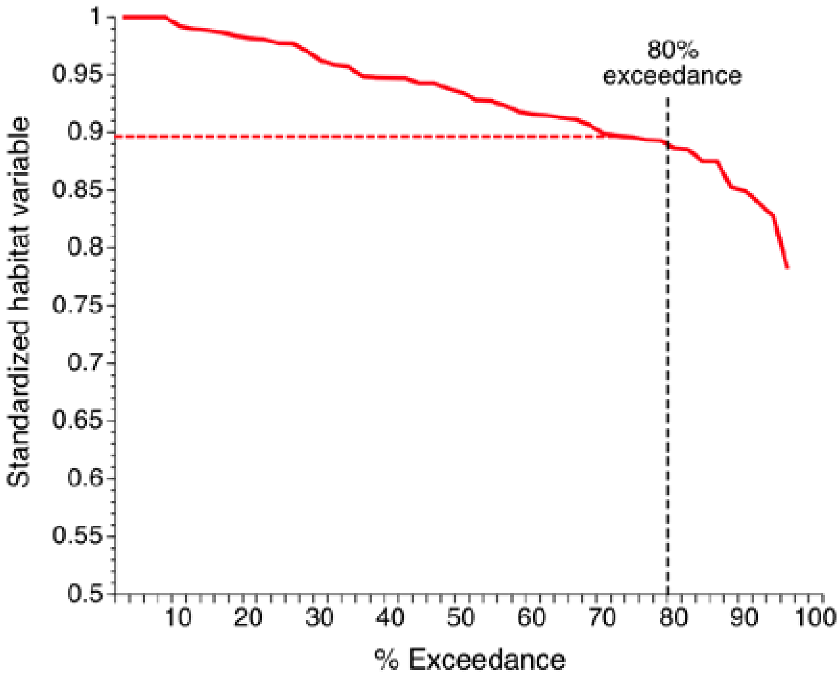

Figure A1. An example of an exceedance curve of amount of habitat for a particular week during the year, over a long period. For calculation of ecosystem base flows for the Athabasca River, these plots were created for each week of the year, and then analysed to identify whether an inflection point in the slope of the plot was evident, as is shown in this example. The 80% exceedance point is used to identify the minimum amount of habitat that is present in the river 80% of the time, which in this example is ~89% of the maximum amount present during the full period of record.

The absence of data for the delta region of the Athabasca River is especially worrisome. Deltas are especially rich ecologically, and the expansive floodplains of the lower Athabasca are sustained by periodic flooding.[180] Typically, deltas also are very sensitive to changes of timing and amounts of stream flow, making them very dynamic and sensitive ecosystems. It is likely that periodic flood events and seasonal high water periods provide additional habit for fish and other aquatic biota. Because the delta area is probably very different structurally from upstream reaches of the river, it is equally probable that models used to calculate wetted area for reaches 2, 4, and 5 would not adequately indicate fish habitat for reach 1. These differences, and the wide and flat nature of floodplains, suggest that a percent-based reduction in flow in the Athabasca River will probably have its most noticeable effects on the Athabasca River delta.

Because the habitat or flow data in exceedance curves are simply ranked from greatest to least, they only indicate what flows or modeled areas of habitat have occurred in the past, and the variability in the flows. During high-flow seasons, 90-100% of possible habitat existed during many years. During low-flow seasons of approximately 50% of the years considered, declines in available habitat from 75% to 50% of the maximum occurred. In addition, whether or where inflection points occur provides little information on ecological thresholds in the relationship between flow and habitat quality that may result from changes in hydrologic processes like sediment transport, changes in riverbed properties that are induced by low flow, or the effects of terrestrial disturbance on catchment water yields to the river. Equally, they do not provide any information about potential thresholds in the

[180] Wolfe, B.B. *et al.*, "Classification of Hydrological Regimes of Northern Floodplain Basins (Peace-Athabasca Delta, Canada) from Analysis of Stable Isotopes (delta O-18, delta H-2) and Water Chemistry. *Hydrologic Processes* 21(2): 151-168 (2007).

relationship between sustainability of fish populations and the amount of habitat they are permitted. For example, it can be reasonably expected that if the amount of habitat is reduced below a particular critical level in any body of water, then a fish population will fail. Above all, it is clear that critical ecological relationships and their thresholds are not understood for the lower reaches of the Athabasca River, and this point is highlighted numerous times in the various government documents on IFN of the river.

What inflection points do indicate is a change in the expected patterns of variability in historical flow. The most basic kind of pattern, which is not accounted for by the threshold analyses, is a ranking curve that shows a straight line between the highest level and the lowest level. This would indicate that there has been an even distribution of the occurrence and intensity of high, medium, and low habitat years throughout the period of record, for that particular week (Figure A2). It also would imply that a reduction in flow will result in a reduction in habitat, despite the absence of a threshold. When such an analysis was done using the flow data for the Lower Athabasca River for the entire period of record (not shown), according to the methods used in the Draft Water Management Plan for the Lower Athabasca River approximately one-third of winter weeks and one-fifth of summer weeks demonstrate reductions in potential habitat that will be directly proportional to reductions in flow, irrespective of whether the managed flow is above or below the 80% exceedance level. Put another way, the 80% exceedance level highlighted as protective in the Draft Water Management Plan is not relevant to protection of fish habitat during these weeks

Contrary to the straight-line declines described above, an inflection point above the 80% exceedance level indicates an unusual frequency or intensity of lower-than-expected habitat areas. In these instances, while variability appears to be stable above the value of flow indicated by the inflection point, it changes below the inflection point. If anything, this indicates some environmental threshold that becomes operable during years in which there are conditions that contribute to lower than normal flows in the river, thereby resulting in the presence of less habitat in the river. This implies important management implications related to the possibility that our development decisions in the river basin may amplify the effects of this unknown threshold, resulting in even less delivery of water to the river during critical low-flow years.

It is not clear whether the goal of the proposed Water Management Framework is to sustain fisheries at historical levels, or to simply prevent near-absolute collapses and thereby retain presence of representative species (as opposed to healthy populations that conceivably occur throughout the region). It is conceivable that while some minimal amount of habitat may be sufficient to sustain a presence of fish populations, it may not support fish populations as they now exist in the river. Management of aquatic ecosystem health in the mainstem Lower Athabasca River that also does not consider the importance or role of tributaries, and simply relies on mainstem habitat attributes, is not likely to be adequately informed in its predictions of or responses to ecosystem change. Consequently, ecological services such as support of Aboriginal fisheries could be severely limited if management of water supply in the lower reaches of the Athabasca River permits withdrawals that sustain mainstem water levels at historically low levels for much longer periods than would otherwise be experienced under natural flow regimes.

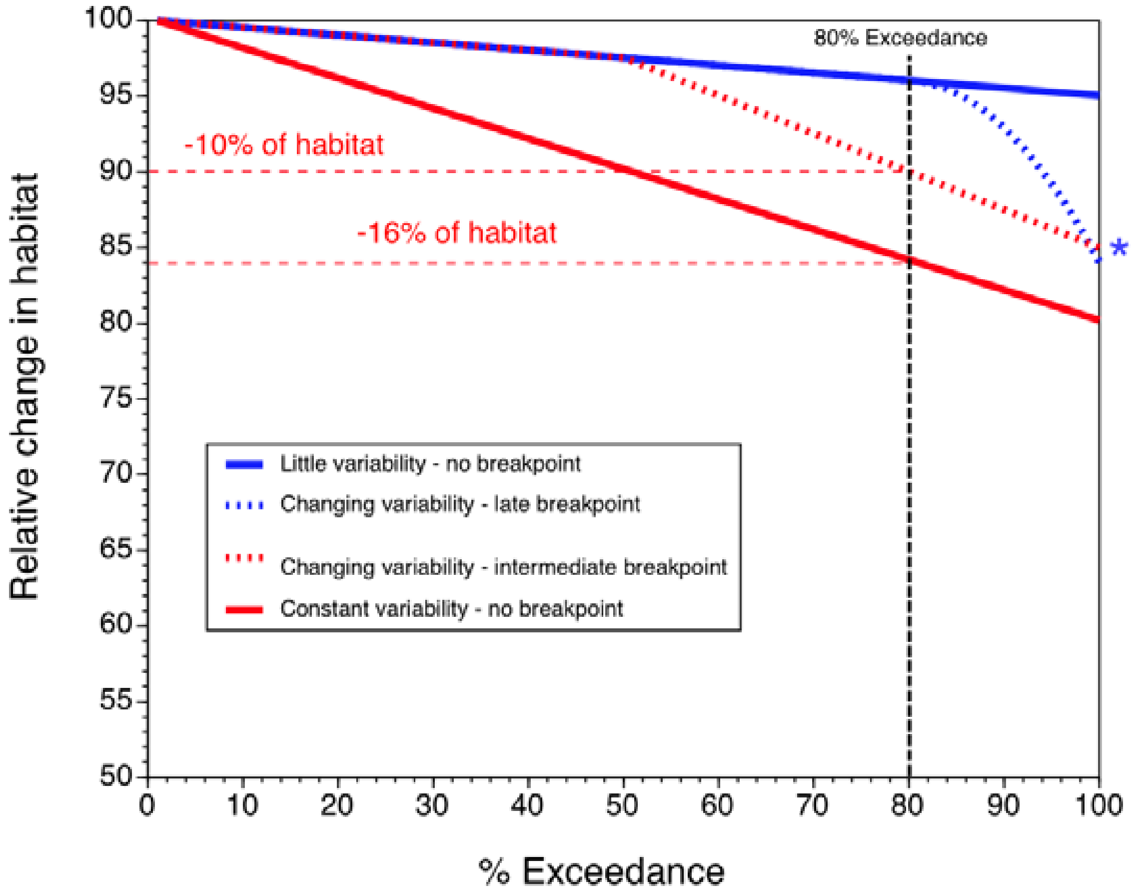

Figure A2. Diagrammatic representation of four basic patterns of ranked fish habitat exceedance curves. Governmental reliance on late inflection points (blue dotted line with asterisk) for establishment of IFNs ignores constant declines in habitat with changing flow, as indicated by straight curves of varying slope. It also does not account for curves that have earlier inflection points.

Temporal Trends in Habitat vs. Ranking

It is exceptionally important to recognize that exceedance curves demonstrate only a relative ranking of historical habitat or flows. They do not account for trends in habitat or river flow over time — whether there tends to be less habitat available today than 50 years ago, and whether withdrawals that may now be deemed appropriate may not be in the future because of declining water supply.[181] A simple way of assessing temporal trends in ranked data involves assessing patterns in the years during which each of the ranked values occurred. For example, for a river that has been undergoing steady declines in flow over a long period, one would expect the exceedance-style percentage ranking of its flows (or inferred fish habitat) to show weeks from years at the beginning of the period of record toward the 0% end of the ranking, and weeks from the end of the period at the 100% end. If these ranked year values were then plotted, rather than the relative habitat area or flow, an upward sloping line would demonstrate a declining trend in fish habitat over time.

To illustrate this point, trend analyses of monthly averages of weekly ranked flow can be done, with years (1957 or 1958, to 2004) numbered from 1 to 47 or 48. These numbers can be substituted for the respective ranked flows for each week of the year, and for each rank position the mean of the represented years for the weeks in any given month calculated. A simpler and more time-consuming analysis of flow-year rankings could be done for each week, but likely the results would not be much different. Alternatively, one could simply analyse the trends in flow or habitat, on weekly, monthly, or annual bases, to determine if the river is less capable of withstanding negative effects of water withdrawals now than it was in the past.

The most important and fundamental presumption of the IFN calculations that underpin the draft Phase 2 Water Management Framework for the Lower Athabasca River is that there have been no changes in river flow or fish habitat over time. The only way a method of calculating IFNs that is based on ranked habitat can hope to confer protection on fisheries in a river is if high, medium, and low flows are randomly distributed within some acceptable range, and that the variability in future flows reflects the same variability and lack of trend. However, an assessment of when the various ranked habitat areas occurred during the period of record suggests that statistically significant relationships exist between ranked flow and time for all months but July (not shown), with the lowest flows during the period of record generally occurring in the recent past. During some months, for example January, there are high year values for both high and low flow rankings, suggesting flows in the past 20-25 years have shown great variability, and include both the highest flows on record and the lowest. Generally, however, the most common trend is that the majority of low flow has occurred during the last half of the period of record (*i.e.* since the early 1980s). If this pattern continues, then the likelihood of persistent low flow conditions, especially during winter months, will be greater in intensity, duration, and frequency than accounted for in the IFN calculations that form the foundation of the draft Water Management Plan. Consequently, continued and even increased water withdrawals in the future will stand an increasing chance of negatively impacting the fisheries (and likely other ecological services) in the lower reaches of the Athabasca River.

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181 Courtney (2006), *supra* note 179, 20.

Conclusions

The methods used for calculating management limits for water withdrawals are not protective of fisheries in the lower reaches of the Athabasca River. Relationships between flow, habitat availability, and fisheries thresholds are unknown for large sections of the Lower Athabasca River basin, including the delta. In addition, winter habitat is not accounted for in the lower reaches of the river. There has been no consideration of habitat threshold patterns on an upstream-downstream basis, and no attempt to incorporate trends in habitat availability that have occurred in the past and are likely to occur in the future. As is made clear in Fisheries and Oceans Canada's draft IFN report, DFO scientists have found that the proposed method is not protective of fisheries.

By all appearances, Alberta Environment's proposed IFN framework, based largely on work done in the South Saskatchewan River Basin (SSRB), is much less conservative than the federal framework. Critically, the method developed for the SSRB has not been validated via monitoring and assessment. Therefore, it is unclear whether calculated habitat areas correspond to actual habitat, or whether IFNs calculated in this fashion actually protect fisheries. There is a low level of understanding of even the most basic of ecological processes in the Athabasca River Basin, including the primary drivers of water supply to the river and their associated thresholds. Consequently, the conclusions that the recommended ecosystem base flow will be protecting of aquatic ecosystem health are likely inaccurate, and most likely overestimate the amount of water that should be allowed to be withdrawn from the river.

The decision to permit additional large-scale water withdrawals that result in river flows that are less than presumed IFNs appears arbitrary. While the IFN frameworks presented for the Lower Athabasca River are represented as a compromise and an acceptable balance between economic interests in oilsands development and ecological sustainability, they are not. Perhaps most critically, only the mainstem Athabasca River is being considered in regional management and development decisions, and little or nothing is known about ecological thresholds in its tributaries, regional streams and lakes, or the vast wetland complexes that form part of the Peace-Athabasca Delta.

The Athabasca is the only large river in Alberta that has neither dams on its reaches nor large extractions of water. The very basic conclusions presented here — that flows in the Athabasca River have been in general decline since the late-1950s — are consistent with paleo-climatic reconstructions for the Peace-Athabasca Delta, suggesting a drying period since the early- to mid-1900s.[182] Our fear is that continued allocation and withdrawal of large amounts of water from the Lower Athabasca River in support of oilsands development, and increases in contaminant releases, deposition, and accumulation in the region, will result in irreversible harm. This harm will be exacerbated in the future if long-term drying continues and projections of climate change for this region are realized.

182 Wolfe *et al.* (2005), *supra* note 39.

Table A1. Frequency of inflection points in ranked weekly fish habitat % exceedance curves for some of the lower reaches of the Athabasca River. Approximately 20-30% of the curves, depending on the reach and season, demonstrated no significant change in slope, meaning inferred fish habitat area steadily declines with decreasing flow.

	Reach					
	2		4		5	
% Exceedance midpoint	Summer	Winter	Summer	Winter	Summer	Winter
5						
15						
25	2					
35						
45	1		2	1		
55				4	1	
65	5		2	1	1	1
75	2		5	2	5	
85	9		14	9	16	16
95						
Total weeks with inflection points	19		23	17	23	17
Total # of weeks	28		28	24	28	24
% of weeks demonstrating breakpoints	67.9%		82.1%	70.8%	82.1%	70.8%

Table A2. Relative location of inflection points in ranked weekly fish habitat % exceedance curves for some of the lower reaches of the Athabasca River. Significant percentages of inflection points in the curve slope occur before the 80% habitat exceedance level, and increasingly so the further one moves downstream from Fort McMurray.

	Reach					
	2		4		5	
% Exceedance midpoint	Summer	Winter	Summer	Winter	Summer	Winter
5						
15						
25	10.5%					
35						
45	5.3%		8.7%	5.9%		
55				23.5%	4.3%	
65	26.3%		8.7%	5.9%	4.3%	5.9%
75	10.5%		21.7%	11.8%	21.7%	
85	47.4%		60.9%	52.9%	69.6%	94.1%
95						

Table A3. Distribution of cumulative occurrence of inflection points in weekly % exceedance curves for wetted area. Despite that the IFNs are based on the 80% habitat exceedance level, significant numbers of identified inflection points occur below this exceedance level (*e.g.*, at the 75% exceedance level, 53% of summer weeks in Reach 2). In addition, there is evidence of a shift in the location of the inflection points as one travels further downstream to further away from the deemed protective level of the 85% exceedance level, suggesting reliance on the 80% exceedance as the foundation for IFN limits on withdrawals may be inappropriate.

	Reach					
	2		4		5	
% Exceedance midpoint	Summer	Winter	Summer	Winter	Summer	Winter
5	0%		0%	0%	0%	0%
15	0%		0%	0%	0%	0%
25	11%		0%	0%	0%	0%
35	11%		0%	0%	0%	0%
45	16%		9%	6%	0%	0%
55	16%		9%	29%	4%	0%
65	42%		17%	35%	9%	6%
75	**53%**		**39%**	**47%**	**30%**	**6%**
85	100%		100%	100%	100%	100%
95	100%		100%	100%	100%	100%

Appendix II: The Texas Environmental Flows Allocation Process

Reprinted with permission (Updated October 4, 2010).[183]

New process examines how much water is necessary to keep Texas rivers healthy and explores ways to protect water for the environment

Water is the lifeblood of our Texas landscapes. Unfortunately, it is possible to take too much water out of a river or alter a river's natural flows too much. Texas' rapid population growth means the demands on our rivers will increase and put the health of our rivers and coastal bays at risk.

The new Environmental Flows Allocation Process attempts to address two key issues: how much water is needed to keep the state's rivers and coastal estuaries healthy, and how to ensure that water is protected. The process was created by Article 1 of Senate Bill 3 passed in 2007.

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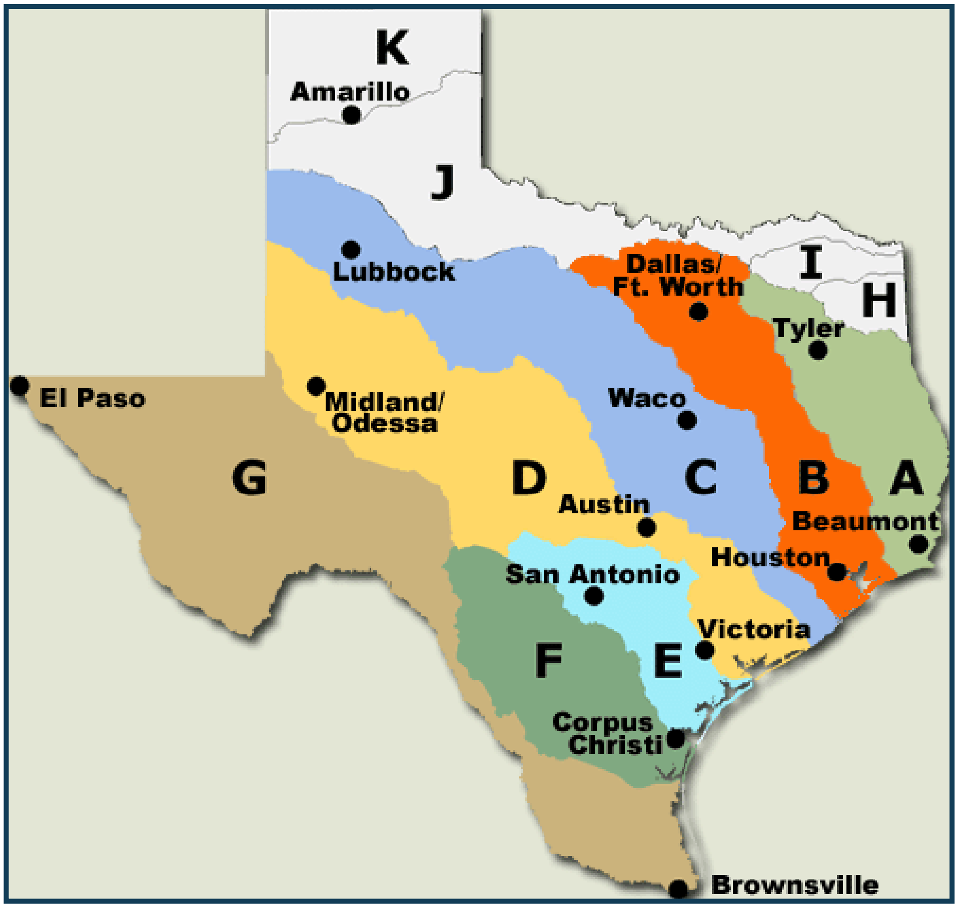
[183] National Wildlife Federation, Lone Star Chapter of the Sierra Club, and Galveston Bay Foundation, Environmental Flow Allocation Process, Website, **http://www.texaswatermatters.org/flows.htm** (last accessed April 18, 2012).

About the Process

In recognition of the unique nature of each of Texas' river basins, the legislation divided the state into eleven regions. A staggered timeline has been set for each of the seven river basins that feed into Texas' major coastal estuaries.



Group 1 - TCEQ decision due June 2011
A. Sabine/Neches
B. Trinity/San Jacinto

Group 2 - TCEQ decision due Sept 2012
D. Colorado/Lavaca
E. Guadalupe/San Antonio

Group 3 - TCEQ decision due Sept 2013
C. Brazos
F. Nueces
G. Rio Grande

Group 4 - Dates to be determined:
H. Cypress
I. Sulphur
J. Red
K. Canadian

How It Works

The law creates a public process for soliciting input from scientists and stakeholders. Each area of the state has a Stakeholder Committee made up of people from diverse interest groups and an Expert Science Team made up solely of technical experts. The Texas Commission on Environmental Quality (TCEQ) considers reports from both groups and then adopts legal standards for each river and bay system.

Each Bay/Basin Expert Science Team (BBEST) has a year to examine the available science and develop a recommended flow regime. The Expert Science Team is to use its best professional judgment in creating their recommendations and should work on a consensus basis. Read more about the Expert Science Teams here.

Each Bay/Basin Stakeholder Committee (BBASC) considers their Science Team's recommended environmental flow regime, adds their associated policy considerations, and develops strategies to meet the flow recommendations. The Stakeholder Committee is also to work on a consensus basis. The implementation strategies for protecting flows could include options such as efficiency incentives, the dedication of treated wastewater, and the purchase or donation of existing water rights. The Stakeholder Committee periodically reviews their analyses and recommendations in light of any new scientific information. Read more about the Stakeholder Committees here.

The TCEQ, through a public rulemaking process, has one year to use the Science Team and Stakeholder Committee recommendations to legally adopt environmental flow standards-state requirements for flows in the river basin and inflows to the associated bay system. When adopting the flow standards, TCEQ can also "set-aside" some of the water that is not already spoken for by existing permits.

The Environmental Flows Advisory Group (EFAG) appoints members to all the Stakeholder Committees and the statewide Science Advisory Committee. In addition to interacting with these committees, this group may submit comments to TCEQ about the various flows recommendations. The Environmental Flows Advisory Group is made up of three state senators, three state representatives, and one representative each from the Texas Commission on Environmental Quality, the Texas Department of Parks and Wildlife, and the Texas Water Development Board.

The Science Advisory Committee (SAC) helps provide overall direction, coordination, and consistent application of scientific principles throughout the Environmental Flows Allocation Process. Through a liaison member, they work with each Bay/Basin Expert Science Team. This is a nine-member committee that was appointed by the Environmental Flows Advisory Group. The Environmental Flows Advisory Group appoints members to the Stakeholder Committees, and the Stakeholder Committees will create their area's Expert Science Team.

Additional Resources

- The Texas Commission on Environmental Quality website also has information on this process.
- There is a two-page handout summarizing the process
- For a print-friendly page describing the players and the process, click here.

Water Matters

As Alberta continues to chart its water management path, strong leadership from an independent non-governmental organization with expertise and resources dedicated to province-wide watershed protection is vital. Established in October 2007, Water Matters is a champion for watershed protection in Alberta.

Visit us online at **www.water-matters.org**