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ADAPTATION TO
CLIMATE CHANGE TEAM

BACKGROUND REPORT

CLIMATE CHANGE ADAPTATION AND WATER GOVERNANCE

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Bob Sandford, the lead policy author for ACT's fourth set of findings, is the EPCOR Chair of the Canadian Partnership Initiative in support of the United Nations "Water for Life" Decade, a national partnership initiative that aims to translate scientific research outcomes into language decision-makers can use to craft timely and meaningful public policy. In this capacity, Bob sits on the Advisory Committee for the Rosenberg International Forum on Water Policy, where he works to bring broad international example to bear on Canadian water issues. Bob is the Director of the Western Watersheds Climate Research Collaborative and an associate of the Centre for Hydrology, which is part of the Global Water Institute at the University of Saskatchewan. He was recently appointed a Fellow of the Biogeoscience Institute at the University of Calgary, sits on the Advisory Board of Living Lakes Canada, the Canadian chapter of Living Lakes International and is co-chair of the Forum for Leadership on Water (FLOW), a national water policy research group centred in Toronto. Bob is also a member of the Advisory Panel for the RBC Blue Water Project. He is the author of four books on water policy in Canada and abroad.

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This document summarizes the conclusions drawn from the accompanying extensive Background Report, which includes case studies on the Okanagan, BC; the Bras d'Or Lakes region, NS; and the Northwest Territories. Please refer to the Background report for extensive data, research and resources on climate change adaptation and water governance.

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1. INTRODUCTION

As climate change progresses, the hydrologic cycle will be significantly affected by regional shifts in temperature, precipitation and extreme weather events. These changes require adaptations in the way people manage water, because we can no longer base water management on historical climate data.

As climate change progresses, the hydrologic cycle will be significantly affected by regional shifts in temperature, precipitation and extreme weather events; indeed, impacts are already being observed and experienced across the country. These changes require adaptations in the way people manage water, because we can no longer base water management on historical climate data and the standard assumptions about day-to-day systematic demands.

Last year, the National Round Table on Environment and Economy released a report that said Canada's water management approach is outdated, and highlighted climate change as one of the four most important water sustainability issues affecting our country, predicting that we will need to transform the way we manage water.[1] Despite this growing awareness of the effects of climate change, Canada did not demonstrate leadership during international negotiations for a climate change deal at the 16th Conference of Parties in Cancun. This lack of leadership is a symptom of an ongoing lack of focus on climate change that caused concern for many Canadians who value our country's role on the international stage as an environmental innovator.[2] From unprecedented drought and wildfires in the Okanagan in 2009 to catastrophic flooding in Manitoba in 2010, from compromised water quality due to the oil sands to debates about trans-boundary allocations, Canadians are becoming increasingly aware of both the value and the vulnerability of our seemingly limitless supply of fresh water.

Fortunately, Canada is better positioned than many nations to address the challenges of a warming climate. Examples of water-related climate change adaptation are emerging in pockets across the country, such as these examples from federal, provincial, local and First Nations governments:

- Natural Resources Canada provided matching funding for four cross-Canada Regional Adaptation Collaboratives, all of which identified water as their top priority and are focused on actions to implement adaptation to water impacts;[3]
- Environment Canada supported Dr. Stewart Cohen's work on water adaptation in the Okanagan and has been integral to the development of many other water-related initiatives and important resources;[4]
- BC's modernization of *The Water Act*[5] includes climate change as a key driver, as does the Northwest Territories' new water strategy;[6]
- Toronto includes water conservation within its climate change action plan;[7] and
- The annual First Nations Mother Earth Water Walk, begun by Anishinabe grandmother Josephine Mandamin

1 Canada National Round Table on the Environment and the Economy (2010)
2 Angus Reid poll results, January 5, 2010
3 Natural Resources Canada, 2010
4 For example, see the Climate Adaptation and Impact Research Publications on Environment Canada's website at http://www.ec.gc.ca/sc-cs/default.asp?lang=En&n=4CD42550-1#reports_and_brochures
5 BC Ministry of Environment, 2010
6 Northwest Territories Ministry of Environment and Natural Resources, 2010
7 City of Toronto, 2010

We need to act now, before the effects of climate change become a challenge on an order of magnitude with which we have difficulty coping, rather than one for which we are prepared.

and others, is designed to bring attention to the combined threats of pollution and climate change to fresh water supplies.[8]

The proliferation of water-related adaptations, acknowledging that climate change is a serious challenge, points to a growing understanding of the need to act and underscores the urgent need for leadership to coordinate these largely disparate efforts. In order to adequately prepare for the future and build a truly resilient country, it would be useful to establish over-arching goals for Canada along with strategic policy approaches that can help coordinate our efforts at all levels. We need to re-assess the values and challenges underpinning Canada's current water management strategies and we need to consider ways that policy leaders can help us move forward in the most effective way through policy innovation.

The challenges facing water governance and management in Canada are many and varied, and climate change will exacerbate them all. However, Canadians are prepared to meet these challenges and we are hopeful that Canadians will find the courage to change our concept of water and its value in a way that will help us promote long-term sustainable well-being for our ecosystems, communities and industries. We need to act now, before the effects of climate change become a challenge on an order of magnitude with which we have difficulty coping, rather than one for which we are prepared.

In this report, Simon Fraser University's Adaptation to Climate Change Team explores ways to effect adaptation in the form of planned water policy responses, designed to complement the equally important goals embodied in the drive to reduce emissions and promote sustainable development, while increasing the resilience of Canada's natural, socio-economic and built environments.

This report represents the results of background research carried out from March 2010-June 2011, and acts as the basis for the accompanying *Summary Recommendations* for decision-makers. This process included in-depth study and literature reviews by a team of graduate researchers drawn from the disciplines of Resource and Environmental Management, Planning, Earth Sciences and Public Policy, guidance and insights from lead policy author Bob Sandford, policy advice from ACT's Board, and consultation with all orders of government, industry, NGOs, experts and communities through roundtables in three regions.

The next section of this report discusses climate change as a driver for new approaches to water governance and outlines the barriers to effective adaptation in the water resources sector; Section 3 explores emerging adaptive water governance in three regions: the Okanagan, Nova Scotia, and the Northwest Territories; Section 4 discusses our founding First Nations' water ethic and proposes principles for a new Canadian water ethic; the final section outlines conclusions for policy which opens the door to the accompany summary report: *Climate Change Adaptation and Water Governance: Summary Recommendations for Decision-Makers.*

8 Mother Earth Water Walk, 2010

2. CLIMATE CHANGE AS A DRIVER FOR NEW APPROACHES TO WATER GOVERNANCE

CLIMATE CHANGE AND WATER IN CANADA

Canada's climate is changing and the effects on fresh water and aquatic ecosystems are already being experienced across the country, with many more effects anticipated as climate change intensifies. Climate change influences all aspects of water, including:

- Hydrologic cycle;
- Surface water and groundwater;
- Ice and snow;
- Ecology and habitat;
- Weather patterns; and
- The oceans.[9]

Experts predict that climate change will increase precipitation, evaporation, water temperatures, and hydrological variability across Canada, all of which will negatively affect the quality of our water.[10,11,12,13,14] While climate change and climate influences on water show general consistency across the country, there are important regional differences. Table 1 outlines some of the region-specific climate change impacts on water. (For a more in-depth discussion of climate change impacts on water across Canada, please see Appendix A.)

Table 1 - Potential impacts of climate change on water resources across Canada[15]

REGION	POTENTIAL CHANGES	ASSOCIATED CONCERNS
Yukon and coastal British Columbia	Increased spring flood risks (BC), impacts on river flows caused by glacier retreat and disappearance	Reduced hydroelectric potential, ecological impacts (including fisheries), damage to infrastructure, water apportionment
Rocky Mountains	Rise in winter snowline in winter-spring, possible increase in snowfall, more frequent rain-on-snow events	Increased risk of flooding and avalanches
	Decrease in summer stream flow and other changes in seasonal stream flow	Ecological impacts, impacts on tourism and recreation

9 Lemmen et al, 2008
10 Ibid
11 LiveSmart BC, 2010
12 Lemmen and Warren, 2004
13 NRCan, 2011
14 Environment Canada, 2010
15 Lemmen and Warren, 2004

REGION	POTENTIAL CHANGES	ASSOCIATED CONCERNS
Prairies	Changes in annual stream flow, possible large declines in summer stream flow	Implications for agriculture, hydroelectric generation, ecosystems and water apportionment
	Increased likelihood of severe drought, increasing aridity in semi-arid zones	Losses in agricultural production, changes in land use
	Significant fluctuations in irrigation demand and water availability	Uncertain impacts on farm sector incomes, groundwater, stream flow and water quality
Great Lakes basin	Possible precipitation increases, coupled with increased evaporation leading to reduced runoff and declines in lake levels	Impacts on hydroelectric generation, shoreline infrastructure, shipping and recreation
	Decreased lake-ice extent, including some years without ice cover	Ecological impacts, increased water loss through evaporation and impacts on navigation
Atlantic	Decreased amount and duration of snow cover	Smaller spring floods, lower summer flows
	Changes in the magnitude and timing of ice freeze-up and break-up	Implications for spring flooding and coastal erosion
	Possible large reductions in stream flow	Ecological impacts, water apportionment issues, hydroelectric potential
	Saline intrusion into coastal aquifers	Loss of potable water and increased water conflicts
Arctic and Subarctic	Thinner ice cover, 1- to 3-month increase in ice-free season, increased extent of open water	Ecological impacts, impacts on traditional ways of life, improved navigation, changes in viable road networks
	Increased variability in lake levels, complete drying of some delta lakes	Impacts on ecosystems and communities

The sheer extent of the projected impacts of climate change on water resources across Canada serves as a strong impetus to ensure that we adapt appropriately to minimize negative effects. Yet our current approach to water management is proving largely ineffective at enhancing our resilience in the face of climate change. Last year, the National Round Table on Environment and Economy confirmed that Canada's water management approach is outdated and highlighted climate change as one of the four most important water sustainability issues affecting our country, predicting that we will need to transform the way we manage water.[16] One of the top concerns associated with climate change is the growing problem of change in what hydrologists call 'stationarity'.[17]

Stationarity gives us the comfort we need to build our houses to withstand winds of a certain speed and snowfalls of a certain weight. It is the foundation for determining insurance rates related to risks associated with the protection of our homes, property and food crops from fires, flood, tornadoes, hurricanes and droughts. It is also the foundation of the reliable function of the natural ecosystem processes that provide a stable and resilient backdrop to our human existence.

Now, increasing average temperatures and extensive changes in land-use globally are altering the patterns of water's movement through the global hydrological cycle. This means that the statistics from the past related to how surface, subsurface and atmospheric water will act under a variety of given circumstances are no longer reliable. Unfortunately,

16 Canada NRTEE, 2010
17 Milly et al, 2004

we have made the stationarity associated with those statistics the foundation of risk assessment in engineering upon which we depend for the construction of our buildings, roads, bridges and other infrastructure. We have also made stationarity the foundation of planning for the future.

Hydrologists throughout the Western Hemisphere have observed that, because climate and earth systems are in constant change, we have actually established our own mathematical interpretation of the range of natural climate variability in the global hydrological cycle that represented too brief a period of record. We then built our society and the entire infrastructure that supports it around that range which we now increasingly realize no longer represents reality.

We do not as yet have an adequate replacement for stationarity statistics. Until we find a new way of substantiating appropriate action in the absence of stationarity, risks will become increasingly difficult to predict or, in the case of the insurance industry, to price.

2.1 ADAPTATION

The primary response to climate change thus far has largely focused on mitigating it by reducing greenhouse gas emissions. While such action is crucial, it is also inadequate because current atmospheric concentrations of greenhouse gasses are substantial enough to mean that changes in our climate will occur regardless of our success in reducing emissions.[18,19] Therefore, it is important to couple our efforts to *mitigate* the cause of the problem – GHG emissions – with efforts to *adapt* to the current and anticipated effects of climate change.

Table 2 - Mitigation and adaptation

MITIGATION	ADAPTATION
Mitigation is either the elimination or reduction of the risk and hazards associated with climate change through the reduction of greenhouse gas emissions.[1]	Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation.[2]

Climate change adaptation is any alteration of current human practices – including activities of decision-making, development and operations – to better cope with the negative effects of a changing global climate. Adaptation is intended to reduce vulnerability and enhance resilience, which is defined as follows by the Intergovernmental Panel on Climate Change (IPCC): "the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change."[20]

Adaptive policy is a kind of adaptation that can be applied by a set of policy actors to affect what kinds of decisions are made about social standards; infrastructure development and management practices; land and ecosystem planning; civic goals; and how those decisions are made. The most common adaptation options for the water resources sector all represent 'no-regrets' adaptation options, meaning that their implementation would lead to benefits irrespective of the effects of climate change. These include:

- Water conservation measures;
- Improved planning and preparedness for droughts and severe floods;

18 Field et al., 2007
19 Meehl et al., 2007
20 Parry et al., 2007, p. 37

- Improved water quality protection from cultural, industrial and human wastes;
- Enhanced monitoring efforts; and
- Improved procedures for equitable allocation of water.[21]

It is important to emphasize that adaptation involves more than merely reinforcing infrastructure and investing in new technology; rather, truly effective adaptation demands a holistic approach, which includes "adjusting *decisions, activities, and thinking* because of observed or expected changes in climate in order to moderate harm or take advantage of new opportunities."[22]

2.2 BARRIERS TO EFFECTIVE ADAPTATION IN THE WATER RESOURCES SECTOR

While the need for a coordinated approach to adaptation in the water resources sector in Canada is clear, there are several key challenges to achieving this goal that we identified, including: jurisdictional fragmentation, reactive governance, policy gaps, and information gaps. The following sections briefly outline each of these barriers:

2.2.1 High Cost of Infrastructure Replacement

Adaptation to the water-related effects of climate change will require expensive infrastructure upgrades. The cost of such infrastructure is an enormous obstacle to increasing resilience and is therefore a significant barrier to effective adaptation. This is highlighted by the 2007 Canadian Water Network report, which estimated that Canada's water infrastructure deficit – in terms of *maintenance* alone – is approximately $88 billion.[23]

2.2.2 Jurisdictional Fragmentation

Responsibility for water resource management in Canada is deeply fragmented due to the Canadian Constitution, which divides legislative power over freshwater between the federal government and the provinces, producing a complex regulatory web that spans municipal, regional, provincial and federal orders of government. Although no powers are explicitly delegated for "water" or the "environment", the constitution identifies many responsibilities that necessarily include these topics. The federal government has constitutional power over fisheries, trans-boundary waters and First Nations lands; provincial governments have power over water quality regulation and allocation rights; and municipalities are most often responsible for land-use planning, water services and infrastructure.[24] A summary of the 1867 *Constitution Act's* division of federal/provincial jurisdiction relating to water is presented in Table 3.

21 Lemmen and Warren, 2004
22 Policy Research Initiative, 2009
23 Cotter, 2007
24 Cote, 2004

Table 3. Federal/ Provincial jurisdiction over water as defined by Constitution Act, 1867[25]

	JURISDICTIONAL POWERS	ENABLING SECTION
FEDERAL	The sea coast	Section 91(12)
	Fisheries, including the protection of fish habitat	Section 91(12)
	Navigation and shipping	Section 91(10)
	Beacons, buoys, lighthouses, and Sable Island	Section 91(9)
	Naval service	Section 91(7)
	Control of toxic substances, including into water	Section 91(27)
	Pollution in Canadian waters outside the boundaries of the provinces	Section 91(1A)
	Water on federal lands, including in the territories	Section 91(1A)
	Emergencies (peace, order and good government)	Opening words of section 91
	Water pollution that is beyond the capacity of the provinces to control (peace, order and good government)	Opening words of section 91
	Environmental impact assessments	Various subject matter in section 91
	Water on lands reserved for the Indians	Section 91(24)
PROVINCIAL	Property and civil rights, including land use, business activities, emissions from businesses, water withdrawals	Section 91(13)
	Environmental impact assessments	Various subject matter in section 92
	Hydro-electricity	Section 92(10) and 92A(1)(c)
	Municipal institutions, which oversee water infrastructure, regulation of water purification and sewage	Section 92(8)
	Water on provincial public lands	Section 92(5)
	Pollution control in the province	Various subject matter in section 92

Each province has developed its own unique approach to regulating water (see Appendix B for a list of provincial statutes). Due to this legislative maze of over 75 acts and regulations, the provinces vary in most aspects of water management. As well, the *Federal Water Policy* has not been updated since 1987 – a time when many of the threats now facing Canada's water resources were not yet fully appreciated.[26] Despite not updating the water policy, the federal

25 Adapted from Becklumb, 2010
26 Environment Canada, 1987

government has published two documents to synthesize information and research for water quality and quantity, including climate change concerns: *Threats to Sources of Drinking Water and Aquatic Ecosystem Health in Canada*[27] and *Threats to Water Availability in Canada*.[28]

One key challenge arising from Canada's complex web of water legislation is the fact that three distinct legal frameworks exist for determining water allocations across the country, making coordination across jurisdictional boundaries between provinces and with the United States difficult. The three water allocation frameworks and the provinces that subscribe to them are shown in Table 4. Either a license or permit is required for removal of both surface and groundwater under all provincial and territorial water allocation systems, except in BC, where no system is in place for groundwater withdrawals. However, fees for licenses and water use restrictions are exceptionally lax across the country.[29] In a climate change context, this relaxed fee and water use structure, combined with uncoordinated regulation across jurisdictional boundaries, sets a concerning precedent, since it fails to support water conservation or preservation of Canadian source water.

Table 4. Water allocation frameworks in Canada[30]

	DESCRIPTION	PROVINCES
First in Time, First in Right (FITFIR)	Based on the principle of prior appropriation, which gives the licensee exclusive rights to use the water in a system of seniority based on the age of the license.	British Columbia, Alberta, Saskatchewan, Manitoba, Yukon, Northwest Territories and Nunavut
Common Law of Riparian Rights	Gives individuals who own or occupy land beside lakes and rivers the right to the natural flow of the water adjacent or through their property. The provinces supervise allocations, which are not to change quality or quantity.	Ontario, New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland and Labrador
Civil Law	Water is not owned by anyone and its use is common to all.	Quebec

Canadian water policy is complex and fragmented and as such lacks the coordination and oversight needed to adequately protect the best interests of citizens. The result of this complexity, fragmentation and lack of coordination is a mish-mash of water policies that are often inconsistent with respect to drinking water quality, ecosystem protection, allocation rights and climate change adaptation. According to Dr. Karen Bakker, editor of *Eau Canada: The Future of Canada's Water*, the trend of "passing the buck" between orders of government creates "an ill-coordinated downshifting of responsibilities leaving key areas in a policy vacuum."[31] As Canada's water resources come under increasing pressure from climate change in the coming decades, combined with changing national trends such as the push to develop domestic sources of energy and the needs of a growing population, it is crucial that all orders of government address this source of vulnerability.

27 Environment Canada, 2001
28 Environment Canada, 2004
29 Canada National Round Table on the Environment and the Economy, 2010
30 Adapted from: Canada National Round Table on the Environment and the Economy, 2010
31 Bakker, 2007

2.2.3 Reactionary Governance and Policy Gaps

Due to the jurisdictional fragmentation outlined in the previous section, Canada lacks a clear national vision for managing our water resources partially evidenced by the fact our federal water policy has not been updated in two decades.[32] Water tends to be governed in a "reactive, crisis management mode",[33] and this largely reactionary approach to water governance has left Canada with significant gaps in policy.

Perhaps the starkest policy gaps are seen in water quality regulations, where major inconsistencies exist in public safety standards across the country. We are one of the very few developed countries without legally enforceable water quality standards. In place of these standards, Health Canada publishes the federal *Guidelines for Canadian Drinking Water Quality* (the "Guidelines"),[34] a document that is developed jointly by the Federal-Provincial-Territorial Committee on Drinking Water, composed of representatives from Health Canada, Environment Canada and each province/territory. The document contains 113 guidelines with 16 additional Guideline Technical Documents covering a wide range of chemical, physical and microbiological parameters. Unfortunately, the guidelines are neither binding nor enforceable, and are currently fully adopted only in Nova Scotia and Alberta.[35]

In the other provinces, standards range widely. In some, regulations exceed the guidelines (e.g. microbiological contaminants regulation in Ontario), while in others they fall far behind (e.g. monitoring and reporting requirements in PEI). Some of this variation is due to regional differences in water quality, but more often it arises because the provinces lack the financial and scientific capacity to implement comprehensive plans and monitor and enforce regulations. Instead, they are forced to approach water quality regulation on an 'as-needed basis.' This reactive approach creates problems with drinking water quality across Canada and opens the door for new Walkerton-type tragedies. The Honourable Dennis O'Connor, Commissioner of the Walkerton Inquiry writes:

> "The failures at Walkerton were…[failures] of the systems that were supposed to ensure they [the water quality objectives] were met. Reviews of outbreaks…suggest that this pattern holds *on a larger scale* [emphasis added]. As was the case in Walkerton, operational, managerial, and regulatory failures can lead to a major breakdown."[36]

At the time the Walkerton tragedy occurred, even wider policy gaps existed across the country. The same emergency could have happened anywhere, and it is important to note that there are ongoing water crises on a startlingly large number of First Nations reserves.[37,38,39] Since that tragedy, most provinces have taken action and implemented improved regulations; however, in the context of climate change, these actions serve to illustrate how water policy in Canada typically unfolds in a reactive, crisis management fashion.

2.2.4 Information Gaps

Jurisdictional fragmentation also contributes to compromised coordination of government responsibility in the realm of water science and research, which means Canada has generally failed to acquire adequate water data and information that can support climate change adaptation, especially in relation to our groundwater sources of which less than 20% are currently mapped.[40] According to the Standing Senate Committee on Energy, the Environment and Natural Resources, "we cannot manage and protect that which we do not properly understand…when it comes to water, there are still too many questions to which we do not yet have satisfactory answers."[41] Additionally, the Standing Committee

32 Pentalnd and Goucher. 2010
33 Muldoon and McClenaghan, 2007
34 Health Canada, 2009
35 Hill, Carey, 2007
36 O'Connor, 2002
37 Stavenhagan, 2004
38 Freek, 2010
39 Harden and Levalliant, 2008
40 Standing Senate Committee on Energy, the Environment and Natural Resources, 2005
41 Ibid

said, "this information gap is more than regrettable; it is unacceptable…this stems in large part from the Government of Canada's retreat from water management issues and from funding relevant research."[42]

More recently, the federal Commissioner of the Environment and Sustainable Development echoed the Committee's stance when he reported in 2010 that Environment Canada "is not monitoring water quality on most federal lands… It also does not validate the data collected through the water quality-monitoring program. As a result, Environment Canada cannot assure users that its water quality data is fit for use," and, "[Environment Canada] does not know what monitoring, if any, is being done by other federal departments."[43]

At one time, particularly in the 1970s and 1980s, water was clearly on the national agenda, as evidenced by the establishment of the *Canada Water Act* (1970) and the *Federal Water Policy* (1987). These contributions were meant to establish a national consultation process and improved cooperation between federal and provincial governments.44 Funding was provided for major inter-jurisdictional basin studies, studies of water quantity and quality in river basins, flood damage reduction programs, and a major federal-provincial-territorial study of stream flow, water levels, water quality, and sediment monitoring programs.45 Unfortunately, most of these goals were never realized, the *Federal Water Policy* was largely shelved, and minimal funding is now available. The Gordon Water Group, whose member Ralph Pentland authored the 1987 *Federal Water Policy*, writes:

> The 1990s saw deep budget and staff cuts, limited program implementation and a paucity of resources to maintain even basic scientific commitments. At an institutional level, federal agencies and programs that focused on freshwater, such as the Inland Waters Directorate, were disbanded. As well, funding for activities under the *Canada Water Act* was slashed.[46]

Such budget cuts were detrimental to the state of water research in Canada, and many key reviewers, including the Standing Senate Committee on Energy, the Environment and Natural Resources as well as the Commissioner of the Environment and Sustainable Development now call for immediate funding initiatives to reverse the lack of federal engagement in freshwater issues.

2.2.5 Inadequate Recognition of Traditional Ecological Knowledge

Failure to value traditional ecological knowledge (TEK) is an additional challenge to effective adaptation in the water resources sector in Canada. Aboriginal peoples have lived on this continent for thousands of years and developed in-depth knowledge and understanding of ecosystems upon which they relied and with which they lived in harmony. Wade Davis, the acclaimed ethnographer and National Geographic journalist, reminds us that western science is only one way of viewing the world, and that each culture can contribute unique answers to challenges like climate change, particularly highlighting the insights offered by indigenous cultures.[47] Mi'kmaq elder Albert Marshall uses the term "two-eyed seeing" to describe a way of viewing Canadian land-use and entitlement simultaneously through both an aboriginal and a non-aboriginal lens. Accommodating multiple worldviews in this way permits us to harness the strengths of each to produce climate change adaptations previously unconsidered using a single cultural lens. One way to prepare for the expected impacts of climate change is to incorporate First Nations' TEK into water regulation and planning – particularly different ways of viewing human-water relationships – and to make a point of collaborating with them to learn about the changes they are experiencing. To overcome this challenge and reap the benefits of this knowledge that has been developed over centuries, we therefore advocate for involvement of First Nations as partners in the water policy, planning and decision-making process.

42 Ibid
43 Office of the Auditor General of Canada, 2010
44 Morris et al, 2007
45 Ibid
46 Ibid
47 TED 2008

3. EMERGING ADAPTIVE WATER GOVERNANCE IN THREE REGIONS

Having established the need for adaptation in the water resource sector, and outlined some of the key challenges to effective adaptation approaches in the Canadian context, we will now turn our attention to examples of emerging adaptive water governance in three regions: the Okanagan, Yellowknife and Cape Breton.

This section is grounded in a case study of the Okanagan Basin in British Columbia. The Okanagan case is particularly compelling because the region is both a growing economic hub and drought-prone, making it a "canary in the coal mine" for climate change. The region has also made significant strides towards progressive, multi-level governance approaches to the challenges of water governance, including climate change adaptation. The Okanagan is therefore at the forefront of climate change adaptation in the context of water relative to most other regions of Canada, and thus provides an opportunity to witness how one region is approaching adaptation within the fragmented Canadian water governance system. What we discovered was reason for optimism, but it also highlighted some key areas where the broader Canadian system of water governance is failing us at the regional level.

After presenting the Okanagan case study, we present snapshots of adaptation actions in the two other selected regions, followed by findings from all three of the regional roundtables conducted for this research. In doing so, we examine current water governance challenges and approaches and the related state of climate change adaptation in three very different regions of Canada, with conclusions for policy recommendations that can be made to nurture effective adaptation measures in water governance throughout the country.

3.1 THE OKANAGAN CASE STUDY

The University of British Columbia's Program on Water Governance recently began promoting the concept of "water security". Defined as "sustainable access, on a watershed basis, to adequate quantities of water, of acceptable quality, to ensure human and ecosystem health,"[48] the goals of water security align with those of climate change adaptation. In the program's *Water Security Primer*,[49] the Okanagan Basin is highlighted as a frontrunner in the quest for water security. Strong linkages between the regional water board, government agencies and universities are credited as a key driver. In the following sub-sections we look more closely at the Okanagan case study and roundtable to examine regional efforts from a climate change adaptation perspective.

3.1.1 Background on the Okanagan

The Okanagan Basin is a semi-arid valley (8200 km^2 in area) located in south-central BC. Over 30 major sub-catchments are defined within the basin, each of which drain into the river-lake system that flows along the valley bottom. As part of the larger Columbia River Basin, the Okanagan watershed crosses into the United States to the south, drains into the Columbia and ultimately reaches the Pacific Ocean. Groundwater is also present throughout the watershed in bedrock and unconsolidated aquifers of varying degrees of productivity and generally at depths less than 30m.

Relationships between people and water in the Okanagan have changed over time, as has the extent of water's use for human purposes. Historically, the valley was traditional territory for the Okanagan people, an interior Salish First Nation, whose worldview was guided by a holistic impression of the entire hydrologic system as integral to life.[50] A more utilitarian attitude was ushered in when European settlers arrived in the early 1900s, transforming areas of land from dry pine and rangeland to orchards, tobacco farms and hay farms that required more water. At that time,

48 Norman et al., 2010, p.14
49 Norman et al., 2010
50 Okanagan Water Stewardship Council, 2008

irrigation was primarily supplied via surface water extractions and diversions from lakes and streams.[51] An increase in urban and agricultural development through the 1950s prompted the inclusion of groundwater to support agriculture and domestic supply. In the 1960s, development escalated and water quality issues emerged including algal blooms, deteriorating lake quality and invasive species such as the Eurasian milfoil. In response, the Okanagan Basin Water Board ("the Water Board") was established in 1969 with a mandate to better define water problems in the valley and determine priorities and opportunities for solving these challenges.[52]

Today the Water Board's mandate has expanded to include climate change and population growth, the convergence of which has created problems for the region's water resources. The Okanagan's 1968 population of 210,000 grew to 310,000 by 2001 with an increase to 445,600 projected by 2035.[53],[54] Statistics Canada claims the basin now has the country's smallest per capita availability of freshwater; an issue complicated by the fact that licenses for surface water are already fully allocated. The predicted impacts of climate change further complicate these pressures.[55] A 2009 telephone survey conducted by the Water Board indicates that 64% of respondents feel a water supply problem is likely within 10 years.[56]

Figure 1. Okanagan Basin, BC

51 Ibid
52 Okanagan Basin Water Board, 2010a
53 Cohen an Neale, 2006
54 Okanagan Water Stewardship Council, 2008
55 Okanagan Water Stewardship Council, 2008
56 Okanagan Basin Water Board, 2010c

Climate Change Studies in the Okanagan

In 2001, Environment Canada and the University of British Columbia initiated the first research into potential impacts of climate change and population growth on the Okanagan's water resources.[57] Over the next decade the region became a focal point in BC for climate change research. Various studies improved understanding of predicted impacts on the region's snowpack, streamflow, groundwater, and water demand.[58]

Most climate change research in the Okanagan involves statistical and trend analysis of historical climate data and the use of general circulation models (GCMs). First, statistical and trend analyses illuminate the Okanagan's past responses to the El Nino Southern Oscillation (ENSO) and Pacific Decadal Oscillation (PDO) – two recurring, large-scale atmospheric patterns with which regional records can be compared and used as proxy-data to understand potential responses to global climate change.[59] Second, the use of GCMs provides large-scale climate predictions for temperature and precipitation based on global warming scenarios. These global models utilize a coarse resolution of 400km but can be downscaled to support the development of regional projections.[60] In one example, Agriculture and Agri-Food Canada is developing gridded climate surfaces for the Okanagan in daily increments from 1960 to 2005.[61] Statistical downscaling of generated GCM data will combine with these surfaces to produce climate predictions across the Basin at a resolution of 500m.[62] The latest Water Board effort – the Phase 2 Okanagan Water Supply and Demand Project – also uses GCMs to forecast regional supply and demand under different population growth and land use scenarios.[63] In addition, Toews and Allen (2009), and Toews (2007) provide one of the few groundwater/climate change studies in the region. Their work uses downscaled data from three GCMs to investigate impacts of increasing irrigation in south Okanagan on groundwater recharge.

3.1.2 THE NEED FOR ADAPTATION

This section provides a summary of documented climate trends, climate change predictions, and projected climate change influences on water resources indicated by the aforementioned studies. These trends and projections highlight the need for climate change adaptation in the Okanagan Basin.

Observed Changes

The 2004 report by Cohen et al. provides the original climate trend analysis done in the Okanagan. The researchers conducted a statistical and trend analysis of available climate and hydrometric data from monitoring stations across the Okanagan Basin; relating these records to ENSO, PDO and other large-scale atmospheric changes allowed the research team to identify regional trends based on known responses to these recurring climate fluctuations. Results revealed the following:

- Periods of warming and cooling correlate with the presence/absence of ENSO and PDO, confirming that large-scale atmospheric changes impact the region's temperature.
- Overall regional warming trends in winter and spring based on data collected since the early 1900s from climate stations at Summerland and Vernon.
- Increases in daily minimum temperatures more than increases in daily maximum temperatures.
- Increases in spring and summer precipitation over the past few decades.
- Decreases in the proportion of precipitation falling as snow at lower elevations but not at higher elevations.
- Increases in cloud cover, mainly at night.

57 Cohen and Kulkarni, 2001
58 For example, see: Cohen et al. 2004; Cohen and Neale 2006; Merritt et al. 2006; Toews and Allen 2009; Toews 2007; Van der Gulik et al. 2010
59 Cohen et al., 2004
60 Cohen and Kulkarni, 2001
61 Neilson et al., 2010a
62 Neilsen et al., 2010b
63 OBWB 2010b

- Decreases in mean annual solar radiation, but an increase in net radiation.
- Earlier onset of snowmelt.
- Drought periods in the 1920s, 1930s, 1967, and 2003.
- Increases in lake inflows, possibly due to increases in spring and summer precipitation.

Projected Changes

Regional climate change projections for the Okanagan Basin are extrapolated from the results of Cohen et al.'s (2004) comparison of available historical data with ENSO and PDO records (mentioned previously) and from results of coarse-scale GCM modeling.[64] The following general trends are predicted:

- An overall increase in air temperature.
- Longer, hotter, and drier summers.
- Warmer, wetter winters.
- Earlier snowmelt.
- A longer, warmer growing season.
- More extreme climate events (e.g. more intense storms, drought).
- A greater proportion of precipitation falling as rain rather than snow, reducing snowpack.
- Uncertainty regarding changes in average total annual precipitation (depending on choice of GCM and scenario variables).

Ongoing GCM statistical downscaling efforts[65] may provide additional projections at a finer resolution and may help to confirm or reject the general basin predictions noted above.

Predicted Influences of Climate Change on Okanagan Water Resources

Future climate change is predicted to alter the quantity and quality of water in the Okanagan Basin as well as water demand. The following general trends are expected for the region's water resources.[66,67,68,69]

- A decline in Okanagan Lake inflows (i.e. from streams).
- Changes in streamflow timing, with earlier onset of seasonal peak streamflow by a month or more in 2080, and an extended low flow period.
- Increased frequency of drought and/or longer drought periods.
- Increases of up to 60% in crop water demand by 2080 due to a longer, drier, and hotter growing season.
- Increases in residential water demand during the longer, drier, hotter growing season compounded by population growth.
- Increases in late summer water shortages during periods of low supply and high demand.
- Higher seasonal and annual variability in both water supply and water demand.
- Increased incidence of high turbidity.
- Increases in health related issues associated with water quality.
- Changes in basin hydrology due to changes in the timing of water use.
- Altered timing and quantity of runoff due to changes in forest cover (resulting from the climate-related Mountain Pine Beetle infestation)
- Increased groundwater recharge due to increased return flow from irrigation.

64 See Okanagan Water Stewardship Council, 2008
65 See Neilsen et al., 2010a
66 Cohen and Neale, 2006
67 Merritt et al., 2006
68 OWSC, 2008
69 OBWB, 2010b

3.1.3 Key Organizations in Okanagan Water Governance

The organizations involved in Okanagan water governance play important roles in generating financial support for water-related research, influencing public attitudes about water through education and public engagement, and responding to existing water issues like climate change. Okanagan water governance is best described as a distributed, multi-level system, with varying levels of authority derived primarily from provincial legislation and policy.[70]

The different jurisdictional levels and associated organizations involved in the region's water management are outlined in Table 5. As shown, the regulatory system is complex and dominated by the provincial scale of governance with more than twenty provincial acts, regulations and policies that directly or indirectly govern Okanagan water.[71] Several criticisms of the Okanagan water governance structure are associated with fragmented roles and responsibilities, the complexity and ineffectiveness of provincial regulation and overlapping provincial agencies, the lack of power sharing with local, municipal and regional scales of governance, and the need to improve integration of the numerous agencies.[72]

Perhaps predictably, amid the confusing web of provincial administration (as discussed in section 2.3) it is the agencies operating at regional and local scales rather than the provincial scale that have emerged as the real drivers of climate change adaptation. But this mobilization is enabled, in part, by unique ways in which the existing provincial regulatory framework is applied. In particular, local water purveyors (e.g., municipalities, irrigation districts), regional districts, Joint Water Committees and the Interior Health Authority – all of which strongly influence water decisions for the region – are forged into an interconnected governance network by the watershed-scale hub of innovation that is the Okanagan Basin Water Board and Okanagan Water Stewardship Council. The existence of these two organizations is enabled by a clause within provincial legislation that is unutilized elsewhere in BC. The following sections discuss the roles and contributions of these and other key agencies involved in Okanagan water governance.

70 Wagner and White, 2009
71 OWSC, 2008
72 For example, Patrick, et al., 2008; Wagner and White, 2009

Table 5: Organizations Involved in Okanagan Water Governance and Associated Regulations Relevant to Water by Jurisdictional Level[73]

	ORGANIZATIONS	ASSOCIATED WATER REGULATIONS
INTERNATIONAL	International Osoyoos Lake Board of Control	Order of the International Joint Commission (IJC) – Zosel Dam Order of Operation International Boundary Waters Treaty Columbia River Treaty
FIRST NATIONS	Okanagan Nation Alliance	Self government arrangements
FEDERAL	Environment Canada Agriculture Canada (Summerland Research Centre) Department of Fisheries and Oceans	Environmental Assessment Act Environmental Protection Act Department of Environment Act Federal Water Policy (1987) Fisheries Act Indian Act International River Improvements Act Navigable Waters Protection Act Species at Risk Act Water Act Wildlife Act
PROVINCIAL	BC Ministry of Environment BC Ministry of Forests BC Ministry of Agriculture Interior Health Authority (BC Ministry of Health Services)	Action Plan for Safe Drinking Water (2004) Agricultural Land Commission Act Dike Maintenance Act Drinking Water Protection Act Environmental Assessment Act Environmental Management Act Farm Practices Protection (Right to Farm) Act Fish Protection Act (Riparian Areas Regulation) Forest and Range Practices Act Health Act Land Act Living Water Smart: British Columbia's Water Plan Local Government Act Mines Act Okanagan-Shuswap Land and Resource Management Plan Private Managed Forest Land Act Range Act Utilities Commission Act Water Act (incl. Groundwater Protection Regulation) Water Protection Act Weed Control Act Wildlife Act Water Utility Act
REGIONAL AND SUB-REGIONAL	Okanagan Basin Water Board (OBWB) Okanagan Water Stewardship Council (technical advisory committee to the OBWB) Regional Districts Joint Water Committees (Kelowna Joint Water Committee, West Kelowna Joint Water Committee)	Regional bylaws
LOCAL AND MUNICIPAL	Improvement Districts Municipalities/Towns Individual well or surface water licence owners	Official Community Plans Zoning bylaws and other bylaws

73 OWSC, 2008

Okanagan Basin Water Board (OBWB) and Okanagan Water Stewardship Council (OWSC)

The Okanagan Basin Water Board was established in 1969 under the *BC Municipalities Enabling and Validating Act* to address water resource issues within the Okanagan watershed.[74] The Water Board is a unique form of local government unduplicated elsewhere in BC. Board members include representatives from all three Okanagan regional districts, the Okanagan Nation Alliance, the Water Supply Association of BC, and the Okanagan Water Stewardship Council. Other regions tend to discard the option due to weak regulatory powers enabled by the legislation.[75,76,77] But despite this lack of regulatory power, the Water Board does have taxation powers and is proactive and influential in the region – relying on incentive-based programs to promote its water sustainability initiatives.[78] The OBWB is a "carrot" organization in that they work only with incentives, which include providing funding, providing direction to obtain funding, helping communities with water management improvements and information sharing.

One example of the Water Board's influence was its 2001 formation of an advisory body called the Okanagan Water Stewardship Council. The Council was formed, in part, as a response to the Board's earlier collaborative discussions with stakeholders, which continue to form an important part of regional decision-making for water. The Council is itself an example of multi-stakeholder collaboration since it includes water and climate change scientists from different levels of government (including the IHA) as well as representatives from local academic institutions, water user groups, non-profit organizations, professional associations, economic interests and First Nations. An important accomplishment of the Council is the Okanagan Sustainable Water Strategy (see section 3.1.4), which emphasizes environmental stewardship, equity, and consensus-building and outlines long-term objectives – including climate change adaptations – for basin-wide water management.

The OBWB is unique because it is based on hydrologic (or watershed) boundaries not political boundaries. The general success of the OBWB is demonstrated by their role in coordinating watershed-scale water management initiatives (including the Strategy).

Interior Health Authority

The Interior Health Authority (IHA) is a provincial agency responsible for the Okanagan, Thompson/Cariboo, Kootenay/Boundary, and East Kootenay service areas – it is one of five regional health authorities in BC. Each health authority operates under the BC Ministry of Health Services and is empowered by the provincial *Drinking Water Protection Act* and *Public Health Act* to develop health related policies appropriate to the specific needs of each region. In 2003, water-related health and supply issues in the Okanagan prompted an IHA initiative to encourage large water systems to comply with a "multi-barrier approach". The approach, promoted by the Canadian Council of Ministers of the Environment (CCME), implements "barriers" against health risk at three points along the water supply path. These barriers include source water protection, drinking water treatment and careful design, construction and review of drinking water and distribution systems.[79]

As part of its Okanagan initiative to have large water purveyor comply with the CCME "multi-barrier approach", the IHA invoked the *Drinking Water Protection Act* to initiate a permitting system that now requires water utilities to complete "Source Assessments" and "Water Master Plans". Water management measures to address climate change impacts on water supply and quality are implicitly included in these documents. Source Assessments use the multi-barrier framework as a guide for risk assessment and develop measures to improve drinking water safety and availability.[80] Water Master Plans outline management procedures and infrastructure requirements for all supply, demand, and quality aspects

74 OWSC 2008
75 Warwick-Sears, personal communication
76 OBWB, 2010c
77 OWSC, 2008
78 Wagner and White, 2009
79 Canadian Council of Ministers of the Environment, 2002
80 BC Ministry of Healthy Living and Sport, 2010

of the water system. Currently, twelve Okanagan water utilities have completed or are in the process of completing Source Assessments, and some have developed Water Master Plans. In the context of climate change adaptation, these numbers are significant when compared to other areas in BC where similar planning initiatives are rare. Much of this momentum is generated by need – water utilities seeking to better address existing or worsening water issues such as those predicted by climate change – but the IHA's strong relationship with the Okanagan Basin Water Board and its representation on the Water Stewardship Council also plays an important role in terms of streamlining effective coordination of funding.

Regional to Sub-Regional Government and Organizations

Regional and sub-regional government bodies and organizations responsible for aspects of water in the Okanagan have varied roles within the Basin. The following text discusses Regional Districts and Joint Water Committees, as examples of regional to sub-regional organizations that influence water governance in the Basin.

There are three regional districts within the Okanagan Basin (representing the North, Central, and South portions of the Okanagan). Representatives from each of the three regional districts are members of the OBWB. In general, Regional Districts operate water utilities, or play a role in water management, for locations that are not managed by an existing water purveyor. Thus, Regional Districts have variable involvement with respect to water management in the Basin, depending on the locations/areas within their jurisdictions for which they hold water licences and/or manage water.

A Joint Water Committee is a group of water utilities/purveyors within a given sub-watershed that act to bring a collective approach to water management within their combined service areas. There are two joint water committees in the Basin: Kelowna Joint Water Committee[81] and the Westside Joint Water Committee.[82] These organizations provide a vehicle for information sharing and implementation of regional programs, for example, but do not have regulatory authority.

Local Water Purveyors

Local water purveyors include municipalities and improvement districts that provide water within their jurisdictional areas. Water purveyors are at the front lines of climate change adaptation in the Okanagan since they are the entities most in touch with the local conditions on-the ground. These organizations implement water conservation programs, metering, water pricing, infrastructure modifications and maintenance. Local water purveyors are also the first to respond in the event of water shortages and health risks and have the authority under provincial legislation to regulate water use by imposing restrictions and pricing. Water purveyors in the Okanagan service varying population sizes using a variety of water sources including lakes (e.g. City of Kelowna), upslope reservoirs (e.g. Black Mountain Irrigation District), stream water (e.g. Trout Creek, District of Summerland), and groundwater (e.g. Okanagan Falls Irrigation District).

Irrigation districts are a common type of water purveyor in the Okanagan. Over 40 irrigation districts hold surface water licenses in the region. These licenses are an administrative artifact of attempts in the early 1900s to promote equitable sharing of water among users of cooperative family farms and those involved in the orchard economy.[83,84,85] Regular communication between irrigation districts and regional districts permits local water interests to be considered within a broader regional framework and contributes to the development of region-wide water adaptations. Recently, the BC Ministry of Community Services (2006) announced a new policy direction to end the creation of new improvement districts (i.e. irrigation districts) and dissolve existing ones. Regional districts and municipalities will absorb the water purveyors' responsibilities.

81 KJWC, 2010
82 WJWC, 2010
83 Cohen et al., 2004
84 Wagner, 2008
85 Wagner and White, 2009

3.1.4 The Okanagan Sustainable Water Strategy

The Okanagan Water Stewardship Council (the "Council") released the Okanagan Sustainable Water Strategy (the "Strategy") in 2008. The document outlines region-scale actions for sustainable water management. Although the Strategy is framed broadly as a water management document, its development was supported, in part, by climate change dialogue that began with stakeholders in the early 2000s. The Water Board asserts that this earlier collaboration generated the public interest and involvement needed to propel the Strategy forward.[86,87] As a result, many of the actions contained in the Strategy emerge directly from the need for climate change adaptation.[88,89,90]

The key linkage of the Strategy to climate change is related to the future use of the Strategy as a whole, not necessarily the conditions under which it was developed, or the intent of the individual actions within the strategy. By implementing the general water management actions in the strategy, the Okanagan will be better prepared for the impacts of climate change.

Currently the Strategy's various actions are either in pre-implementation or implementation stages, with an evaluative follow-up planned for this year (2011) to assess progress and identify upcoming priorities.[91,92] A summary of actions recommended by the Strategy is outlined in Table 6. As shown, these actions are organized under the general themes of water source protection, securing adequate water supply, and delivery of the Strategy. The first two sections contain actions that will ideally occur under the Strategy, while the third section details governance and funding options that will make implementation possible.

Table 6: Recommended Actions in Okanagan Sustainable Water Strategy[93]

NUMBER	RECOMMENDED ACTION
Source Water Protection	
2-1	Off-stream cattle watering stations
2-2	Protect, restore, and enhance riparian and wetland
2-3	Develop a basin wide source protection strategy
2-4	Implement well protection toolkit
2-5	Implement bylaws and best practices for all geothermal groundwater wells
2-6	Consider water in community design
2-7	Implement stormwater management plans
2-8	Use best practice local government land-use bylaws to protect local water sources
2-9	Develop a groundwater bylaws toolkit and harmonize groundwater bylaws
2-10	Support and coordinate sustainable septic field development along sensitive waterways
2-11	Accountability of "Authorized Person"
2-12	Research emerging health risks identified in other jurisdictions
2-13	Complete appropriate mapping

86 Warwick-Sears, personal communication
87 OBWB, 2010c
88 Cohen and Kulkarni, 2001
89 Cohen, et al., 2004
90 Cohen et al., 2006
91 Jatel, personal communication
92 OBWB, 2010c
93 OBWB, 2010

NUMBER	RECOMMENDED ACTION
2-14	Create a streamlined on-line data reporting system for water quality and suppliers
	Securing Our Water Supplies
3-1	Manage water quantity
3-2	Establish an Agriculture Water Reserve
3-3	Extend the date on irrigation licenses
3-4	Ensure availability of potable water
3-5	Review water licensing
3-6	Implement drought management plans
3-7	Prepare Water Use Plans for all fish bearing streams
3-8	Prepare a comprehensive Water Management Plan for the Okanagan Basin
3-9	Develop a Regional Water Conservation Strategy
3-10	Reduce outdoor water use by using Certified Irrigation Designers
3-11	Universal installation of water meters
3-12	Conduct a water pricing assessment
3-13	Affordable water for agriculture
3-14	Ensure water storage is identified as a strategic and critical component to water management
3-15	Change water license structure associated with storage
3-16	Implement policies that support coordinated water storage by utilities
3-17	Maintain and expand the network of hydrometric and climate stations
3-18	Install flow measurement recorders at all reservoir spillways
3-19	Collect better information on evaporation and evapotranspiration
3-20	Develop a groundwater regulation pilot program
3-21	Develop a regional well/borehole database
	Delivering the Strategy
4-1	Support and foster collaboration
4-2	Partner with aboriginal people in the development of Basin water strategies
4-3	Obtain local government representation on the Southern Interior Regional Drinking Water Team
4-4	Develop an Okanagan Basin Information Network
4-5	ID knowledge gaps and support research to strategically fill gaps
4-6	Analyze funding mechanisms to support water governance
4-7	Create an Okanagan water fund
4-8	Develop a Basin-wide community engagement strategy
4-9	Develop water management reporting tools
4-10	Reassess and improve the Sustainable Water Strategy

Source Water Protection

Source protection is one of the three elements of the multi-barrier approach encouraged by the Interior Health Authority. Primarily, source protection efforts under the Strategy involve stakeholder development of plans to prevent, minimize or control potential water pollution that could affect drinking water. Many of the source protection actions recommended by the Strategy relate to water quality concerns that may be exacerbated by climate change (e.g., algal blooms, turbidity due to hydrological variability, potential for water-borne disease, increased concentrations of anthropogenic chemicals, health influences of storm events).

Recommended source water protection actions vary in complexity and scope. For example, the well protection tool kit (2-4) is relatively straightforward and narrow in scope. The action requires water purveyors using groundwater to develop well protection plans using clear procedures outlined in the toolkit. Meanwhile, researching emerging health risks (2-12) is more complex and broader in scope. This action involves long-term research initiatives to investigate the effects of endocrine disrupting chemicals, pharmaceuticals and personal care products in wastewater discharges.

Securing Adequate Water Supply

Recommended actions for securing enough water in the Okanagan relate to the availability of water supply and the nature of water demand for both surface and groundwater. Predicted climate change impacts will directly influence water supply and demand in the Basin.

A key principle of the Strategy is that water should be shared in a "clear, transparent, and equitable way". Accomplishing allocation in this fashion involves reserving water for appropriate uses, such as environmental, agricultural, domestic, and development.

Again, the recommended actions vary in complexity and scope. For example, action 3-6 requires all major water purveyors to prepare drought management plans and action 3-18 entails a straightforward installation of flow measurement recorders at reservoir spillways. On the other hand, managing water quantity (3-1) involves establishing conservation flows, which entails multi-stakeholder input and consideration of existing governance constraints as well as dealing with complex multi-disciplinary scientific problems that vary from stream to stream.

Delivering the Strategy

Actions focused on delivering the Strategy are designed to "bridge the gap between talk and action," and address some of the anticipated challenges in implementing the strategy. These actions include educating the public and generating public and stakeholder support.

In addition to the Okanagan Sustainable Water Strategy, several locally implemented water management initiatives contribute to regional climate change adaptation. Although many of these initiatives are not direct responses to climate change, they support the overall resilience of the Okanagan water supply. Examples include reservoir expansion to increases upslope water storage, enforcement of lawn watering restrictions, improvements in communicating water restrictions/advisories using online tools, changes in water pricing and metering, improvements to infrastructure and leak repair, initiation of technical system evaluations and studies and development of water management plans.

3.2 EMERGING ADAPTIVE WATER GOVERNANCE IN THREE REGIONS

In order to explore the degree to which regional context defines governance responses to water and climate change adaptation challenges, ACT conducted cross-sectoral roundtables in the three highlighted regions, each of which are: a) experiencing and projected to experience significant water stress from climate change, and b) are making solid efforts to address these issues through inclusive, multi-level governance approaches. The goal of this series of roundtables examining ground-up water governance concerns was to explore what commonalities may be identified across regions

that are experiencing diverse kinds of water stress and are very different in terms of their resources, demographics, geographic locations, and governance structures. The findings demonstrate that water governance for climate change adaptation can benefit from common policy measures despite regional differences; also acknowledging, of course, that there are regional specifics that can only be addressed by local planning. Full reports from each workshop are included in Appendices C, D and E. The next section presents a snapshot of adaptation challenges and actions in Nova Scotia and the Northwest Territories, followed by an outline of the findings from each of the three roundtables, and the conclusions regarding water governance and climate change adaptation.

3.2.2 WATER AND ADAPTATION IN NOVA SCOTIA

Nova Scotia is treating climate change as a priority, with specific issues for water in the province identified as follows:

- Higher water temperatures may render marine animals such as salmon, capelin, and cod increasingly vulnerable to competitors and parasites.
- Supplies of fresh water may be at greater risk of salt contamination from rising sea levels, pollution from runoff caused by heavy rains and snow, and parasites drawn to warmer water temperatures. NS expects increased demand for water and increased competition for it.

Actions included in the provincial adaptation plan, all of which are related to water, are outlined in Table 7.

Table 7 - Water-related adaptation actions in Nova Scotia[94]

ACTION #	ACTION
Action 53	Create an Adaptation Fund within Nova Scotia Environment to encourage adaptation research and development starting in 2009.
Action 54	Develop statements of provincial interest on adaptation by 2010 to provide guidance on land-use planning. This is a formal tool established under the Municipal Government Act to protect the province's interest in such areas as land use, water resources, and community planning.
Action 55	Incorporate climate change impacts and adaptation response plans into the strategies and initiatives of all provincial departments by 2012.
Action 56	Establish criteria in 2009 for the consideration of climate change during Nova Scotia Environment's environmental assessment process and develop a guide to climate change for project proponents.
Action 57	Launch a web-based clearinghouse of information and tools to support adaptation to climate change in Nova Scotia in 2009.
Action 58	Begin work on a provincial vulnerability assessment and progress report on adaptation to climate change in Nova Scotia. This report, which will be updated biannually, will provide updates on the latest climate research, review critical information gaps, and provide policy direction for the province.
Action 59	Continue to work with the other Atlantic provinces on common adaptation goals.
Action 60	Create an interdepartmental steering committee and external advisory committee responsible for coordinating adaptation efforts and providing adaptation policy advice, in 2009.
Action 61	Ensure that design standards and plans for new provincial construction, and for the renewal of existing provincial infrastructure, reflect projected climate trends, not historical records, by 2010.

94 Nova Scotia Environment, 2009

ACTION #	ACTION
Action 62	Release a Sustainable Coastal Development Strategy by 2010. A major part of the strategy will focus on strengthening our resiliency to climate change impacts along our coast.
Action 63	Take sea-level rise into consideration and place priority on conserving coastal wetlands in preparing a policy to prevent net loss of wetlands. The Environmental Goals and Sustainable Prosperity Act requires that this policy be developed by 2009.
Action 64	Develop a strategy to ensure the sustainability of the province's natural capital in forests (forestry), minerals (mining), parks, and biodiversity by 2010. This strategy will be led by the Department of Natural Resources.
Action 65	Develop a comprehensive water resource management strategy by 2010 (see below). As a key priority, the strategy will consider climate change impacts on water quality and quantity.
Action 66	Lead, through the Department of Natural Resources, an interdepartmental and forest industry working group on forest carbon management and forest adaptation to climate change.

Nova Scotia's Water Resource Management Strategy was released in January 2011 and is structured around the following three priorities:

1. Understand the Quality and Quantity of our Water
2. Protect the Quality and Quantity of our Water
3. Engage in Caring for our Water

Table 8 = Nova Scotia's Water Resources Management Strategy[95]

PRIORITY: UNDERSTAND THE QUALITY AND QUANTITY OF OUR WATER		
Actions for Today	Actions for Tomorrow	Directions for the Future
• Enhance the system for receiving and sharing water quality and quantity information with government and the public. • Continue to build, support, and integrate existing water-monitoring networks to bolster baseline data and assessment tools, and to identify stresses on quality and quantity. • Identify ecologically significant water resources, such as wetlands and critical groundwater recharge areas. • Assess surface and groundwater in watersheds to develop water budgets on a priority basis. • Engage with post-secondary institutions, industry, and communities in order to improve knowledge about water-related issues across the province. • Undertake work to determine what impacts climate change will have on Nova Scotia's water cycle.		Watersheds and ecosystems are constantly evolving. This can be from natural environmental processes or from constant human activities. Because of this, we will need to support and invest in science and research to understand future changes. This can include enhancing tools and systems for sharing and analysing data, such as Geographic Information Systems (GIS).
PRIORITY: PROTECT THE QUALITY AND QUANTITY OF OUR WATER		

95 Nova Scotia Environment, 2010

Actions for Today	Actions for Tomorrow	Directions for the Future
• Require water conservation plans from large water users. • Develop guidance for allocating water in times of emergency, such as a drought, contamination, or where aquifer and stream health is at risk. • Assist municipalities, First Nations, and communities with source water-protection planning. • Continue to implement and update municipal and public drinking water standards, and municipal wastewater effluent standards. • Assess the current and future use of setbacks from fresh and coastal water resources. • Integrate water values in the selection, planning, and management of parks and protected areas. • Apply Canadian Council of the Ministers of the Environment (CCME)-based water quality standards and objectives as water-use targets for fresh and coastal waters.	• Update current guidance for storm water management and sediment control to improve protection of water quality from land development activities. • Continue to update the Nova Scotia Building Code to include water conservation and encourage efficiency and re-use. • Develop tools to promote conservation and restoration of sensitive ecosystems and watershed features, such as wetlands. • Evaluate and improve the regulatory framework for private wastewater treatment systems, including on-site sewage disposal. • Enhance the protection of drinking water for rural communities with our community partners. • Work with First Nations, municipalities, and communities to pursue innovative solutions to improve wastewater and drinking water treatment.	Conservation and the efficient use of water plays an important role in this strategy. Not only do we need to protect the amount of water that is available, we must also ensure that high quality water is available when and where it's needed. For example, in rural areas people depend on wells for their drinking water and cannot afford for them to run dry.
PRIORITY: ENGAGE IN CARING FOR OUR WATER		
Actions for Today	Actions for Tomorrow	Directions for the Future
• Build capacity for community water monitoring in watersheds across the province. • Work to engage youth in water stewardship and management activities. • Support the establishment of national water efficiency and labelling standards program. • Engage in outreach and partnership activities to promote water stewardship practices for residents to maintain and protect their health and property. • Confirm support for the Canadian Heritage Rivers System, and increase the knowledge and profile of Canadian Heritage Rivers in Nova Scotia.	• Facilitate the sharing of information and ideas between water users at a regional level through the establishment of a forum on water management. • Recognize and encourage water stewardship efforts by establishing a program to recognize exemplary instances of water stewardship. • Provide assistance to develop, implement, and promote projects that maintain or improve the stewardship of our fresh and coastal waters. • Evaluate and update water-related educational tools for a range of water-related topics including conservation, property management, septic systems, and drinking water. • Partner with business to develop and promote water-wise best practices such as conservation and efficiency.	Many Nova Scotians are already engaged in caring for our water. But we understand that many watershed stewardship groups, nongovernmental organizations, Aboriginal communities and organizations, businesses, and individuals require additional support. Because of this, we will continue to develop new ways of funding, and developing outreach and educational materials, and other tools for these groups.

With tangible water-adaptation actions being implemented now, and serious consideration being given to medium- and long-term adaptations, Nova Scotia is treating climate change as a priority, particularly as it relates to water stewardship.

3.2.3 Water and Adaptation in the Northwest Territories

The Arctic Climate Impact Assessment (ACIA), released by the Arctic Council in 2004, concluded that the circumpolar Arctic region as a whole is experiencing some of the most rapid climate change on earth. The ACIA report presents information about climate change impacts that is consistent with the impacts now being seen in the NWT. Over the next 100 years, climate change is expected to accelerate, contributing to major physical, ecological, social and economic changes in the Arctic, many of which have already begun.[96]

The Mackenzie Basin Impact Study (MBIS), a six-year collaborative research effort led by Environment Canada and published in 1997, described potential climate change impacts. The MBIS report concluded that lower water levels, permafrost thawing and other problems caused by climate change would offset any potential benefits from future warming. Only a few early, observed impacts were reported in MBIS such as winter road problems identified in 1992. Most of the impacts described in this report have become evident in the ten years since the MBIS was published.[97]

The Government of the Northwest Territories (GNWT) acknowledges that water is integral to the ecological, social, cultural and economic fabric and health of the Northwest Territories. GNWT is responsible for managing drinking water in the NWT and the federal Department of Indian and Northern Affairs Canada (INAC) is responsible for managing other water resources. GNWT recognizes the deep and fundamental relationship between residents and the waters of the Northwest Territories, and that water is a renewable resource that, if managed wisely, will sustain the people and ecosystems of the NWT now and into the future. The Department of Environment and Natural Resources, with INAC, has released *Northern Voices, Northern Waters: NWT Water Stewardship Strategy*, designed to guide efforts to protect water quality and quantity and deal with the cumulative impacts of developments on NWT water resources. The Action Plan for the strategy is currently being developed.[98]

The proposed NWT *Northern Voices, Northern Waters Strategy* has the potential to model one of the most progressive examples of water governance and adaptation in Canada, including measures such as:

96 Arctic Council, 2004
97 Cohen, 1997
98 Northwest Territories Ministry of Environment and Natural Resources, 2010

Table 9 - Proposed NWT Northern Voice, Northern Waters Strategy

Working together	Developing a co-operative working environment for water partners
	Implementing collaborative planning to address capacity issues
	Using best available knowledge to inform all water partners
	Continuing ongoing communication, awareness and engagement among water partners and with the general public
Knowing and planning	Collectively developing comprehensive monitoring and research programs to understand ecosystem health and diversity
	Ensuring communities have the opportunity to be actively involved and collaborate on research, monitoring and planning initiatives
	Developing consistent approaches to research and monitoring that will increase our ecosystem understanding
	Reporting research and monitoring results
	Advancing transboundary discussions, agreements and obligations
Using water responsibly	Developing and updating guidance and policy documents for water partners to ensure consistent, transparent stewardship actions and decisions
	Routinely evaluating current legislation and regulations and amending as required to ensure they effectively achieve their intended purpose
	Ensuring water managers have the capacity to fully promote compliance
Checking progress	Conducting comprehensive evaluations of the Strategy's implementation progress

Additional earlier water actions (2008-2009) in the NWT included:

Table 10 – Actions to protect water in the NWT

DEPARTMENT	DESCRIPTION	STATUS
Public Works and Services	Investment in remote system pilot studies to monitor health based parameters, turbidity and chlorine.	Two remote sensing systems were installed and operating.
Municipal and Community Affairs	To improve the capacity to manage the NWT water supply.	Site specific training to water treatment plant operations in communities. New courses developed and existing courses updated related to water and wastewater.
Health and Social Services	To enhance public awareness and education regarding water quality and potential waterborne diseases.	Ongoing public awareness related to drinking water quality and public safety.

3.2.4 The Regional Roundtable Workshops

This section outlines the main themes that emerged from the roundtable discussions in the three regions. Workshops were attended by a comprehensive cross-section of representatives from all orders of government, NGOs, industry, communities, and researchers from each region, including senior decision-makers.

Table 11 - Overview of Regional Roundtable Discussions on Adaptation in the Water Resources Sector

KEY THEMES FOR ADAPTATION IDENTIFIED BY ROUNDTABLE PARTICIPANTS			
BROAD DISCUSSION AREA	SPECIFIC DISCUSSION TOPICS IN EACH REGION		
	THE OKANAGAN, BC	YELLOWKNIFE, NWT	CAPE BRETON, NS
GOVERNANCE	Nested (multi-level) governance Effective governance Politics and water management decisions	Collaboration and partnerships Trans-boundary issues	Legislation and controls
FIRST NATIONS	First Nations knowledge sharing	Indigenous rights Traditional ecological knowledge	Including First Nations communities
ADAPTIVE, NOT REACTIVE			Reactive versus adaptive actions
WATER FOR NATURE FIRST	Water allocation/legislation	Watershed-scale management	Source water protection
PRICING	Incentives		
NEW APPROACH	Need for a new water ethic		Need for a new water ethic
OTHER	Discussion and dialogue	Climate change monitoring and uncertainty Community-level issues	Uncertainty of climate change predictions and knowledge The role and importance of science Engaging the public, press, and politicians Regional issues (sea-level rise, ecosystem health, fisheries and forestry)

The Okanagan

- **Nested governance:** It was generally agreed that the Okanagan has the fundamental building blocks for an effective nested governance system, but that some problems with governance structure and authority remain. Nested governance, in general, was defined as including all orders of government from local to federal (a "vertical" structure).). It was also suggested that "horizontal" structure is an important element of nested governance, as it allows for sharing and consideration of voices, principles, and ideas between governance levels and interested organizations. The OBWB was considered a key player in the nested governance structure of the Okanagan, with the role of providing a "space" for sub-regional levels of government and First Nations to bring together ideas, coordinate funding, synthesize perspectives, and create projects. However, while a clear a foundation for a nested governance

structure exists in the Okanagan, participants recognized that there are some deficiencies and uncertainties, including:

- The lack of enabling legislation is a major roadblock to establishing an effective nested governance structure;
- The lack of well defined roles for the various levels of government and the need for some degree of regional authority, with both approval and veto-power regarding local water management decisions;
- The need for provincial or federal government coordination, reviewing and monitoring; and
- Concern about how to ensure that First Nations are fully included.

- **Effective governance:** The theme of effective governance parallels the theme of nested governance structure and authority, but is all-encompassing in terms of the general effectiveness of water governance in the basin. Concerns were expressed regarding communication deficiencies, unclear responsibilities, jurisdictional fragmentation, and confusion over Okanagan water governance. Some groups identified "solutions" or ideas to improve water governance in the basin and address some of the needs identified above. One suggestion was the development of a document clarifying how water is to be managed within the Okanagan governance framework/structure (similar to the OBWB Water Governance Manual). Such a document would clearly define roles and responsibilities, and work to address some of the inefficiencies of water governance in the basin. Suggestions also included the proposal that there should be a single system for policy application within the basin, which would decrease existing fragmentation and promote a truly integrated approach. The development of groundwater legislation was also identified as a necessary part of moving forward with effective governance.
- **Politics and Water Management Decisions:** Participants felt that public perception, public support, and how these interact with politics around water management decisions in the Okanagan are an important factor in future planning. (Strategic political decisions were conceptually distinguished from day-to-day decisions that should not be influenced by politics.) Potential solutions identified were as follows:
  - Harmonizing well researched standards across jurisdictions to depoliticize water management decisions;
  - Having water experts and knowledgeable individuals and organizations support those in public office who, in turn, support potentially unpopular but necessary decisions for climate change adaptation and water management; and
  - Improving communications and education to generate informed public opinion regarding water issues and the need for adaptation, including the need to change public behaviours with respect to water use (e.g. lawn watering).
- **First Nations Knowledge Sharing:** Respect for First Nations knowledge (TEK and adaptive case studies completed by First Nations) and their cultural and spiritual relationship with water and associated values was identified as an important aspect of ensuring First Nations are included in water management discussions. Recognizing First Nations' water rights and treaty claims is also important in all water management decisions. Another important factor is the need to acknowledge capacity issues within First Nations, who have limited resources for attending meetings; as well as the need to overcome First Nations' ingrained belief that their views will not be honoured but will simply be included as a form of tokenism. It was also suggested that it would be useful to establish a specific communications process involving First Nations to encourage and facilitate their participation as a priority in ensuring they have an equal presence at the water governance table.
- **Discussion and Dialogue:** The importance of discussion and dialogue in working toward adaptive water management was emphasized by a number of round table groups. Discussion and dialogue were seen variously as: exploring and understanding the complexity of issues, making decisions, inclusion, sharing information, acknowledgment, respecting others, a forum for honesty, participation, trust building, consensus building, realizations, and/or generating empathy.
- **Incentives:** Roundtable participants considered ways to engage individuals or water user groups and motivate

behavioural change through incentives. Two approaches were identified: the "carrot" approach (reward-based) and the "stick" approach (penalty-based). Examples of "carrot" incentives included: developing water conservation incentives for businesses (e.g. sustainability awards, green program for hotels), increasing knowledge of existing federal/provincial incentive programs, education and awareness (e.g. improve water bill breakdown), sustainability features in homes as marketing tool. Competitiveness was also suggested as a possible "carrot" incentive. Examples of "stick" based approaches included: Local improvement charges (LICs), Development Cost Charges (DCCs), building code requirements, health requirements, metering and water pricing.

- **Water Allocation/Legislation:** Participants acknowledged that stricter water allocation mechanisms might be an emerging need in the Okanagan as population growth continues and the effects of climate change become more apparent. Concerns raised included the under-representation and under-valuation of ecosystem goods and services as well as ecosystem needs in water allocation decisions.
- **New Water Ethic:** Participants identified a need to examine and change in the current water ethic - a change in how we view water and how people use it. Some principles of a water ethic were suggested such as: water stewardship and sharing (versus entitlement), assuming responsibility (versus "a right"), respect for water. It was noted that it is difficult to articulate and define ethics.

Climate change is of high concern in the Okanagan due to its arid geo-morphology, and thanks to the efforts of practical scientists such as Environment Canada's Dr. Stewart Cohen, who engaged municipal and industry leaders effectively with a groundbreaking study in 2006 that demonstrated the effects of climate change and water consumption on Lake Okanagan and surrounding water resources. The Okanagan has the benefit of a unique and highly engaged collaborative governance body, the Okanagan Basin Water Board (OBWB). The OBWB has the potential to unite disparate organizations and drive interest in and understanding of the urgent need for radical measures to cope with climate change in a region whose demographic is expanding rapidly and which is most threatened by drought of any region in Canada. However, challenges exist in the Okanagan, including: engagement of First Nations, coordination between governments and decision-making bodies, data collection and monitoring, and the perception of water's value along with the understanding of how it should be managed. With respect to the latter challenge, participants identified the need for a radical re-think of the ethics we have developed surrounding water's use and our relationship with aquatic ecosystems.

Yellowknife

- **Collaboration and Partnerships:** Collaboration and partnerships were considered essential to moving forward with adaptation to climate change and implementation of the Northwest Territories Water Stewardship Strategy (WSS) – which is being developed in recognition of the significant ecological and cultural importance of water in the NWT with the overall objective of protecting water in this region for current and future generations. The identification of common issues is key to effective collaboration and partnerships.
- **Transboundary Issues:** The Mackenzie River Basin (MRB) spans various jurisdiction – BC, Alberta, Saskatchewan and the Yukon – as it flows toward the Arctic Ocean, and transboundary issues were identified as a significant concern for water resources management. The NWT, which is situated downstream, is influenced by upstream water use/activities and the influences of climate change across the entire basin. Specific concerns were identified to be associated with industrial operations within the western provinces that may influence water quality and/or water quantity (e.g. oil sands operations, Site C hydroelectric generating station). There was significant discussion regarding the nature of transboundary negotiations and agreements. Negotiations with respect to transboundary agreements must consider the potential for industry to undermine an agreement, the balance of power, nature of information, and selection of standards. In addition, negotiations/agreements must consider the potential for future amendments, which may add complexity to moving forward. Participants suggested that in order to move forward,

it might be necessary to formulate agreements on some aspects at a time, rather than requiring full agreement on every issue. Examples of negotiations and agreements in other parts of Canada and throughout history were referred to during the discussions. Obstacles in moving forward with transboundary discussions/agreements included lack of capacity, challenges of the WSS, uncertainty of climate change issues, impact of devolution, complexity of governance, inter-jurisdictional issues, and integrating FN concerns. Concerns were also expressed regarding the effectiveness and role of the Federal water policy.

- **Climate Change Monitoring and Uncertainty:** The importance of monitoring for climate change and the need for data and ongoing monitoring of water quality and quantity was emphasized. There was concern associated with the idea that we are currently basing decisions (e.g. industrial development) on data that are no longer applicable in the context of the rapidly changing climate. The new "normal" is not represented by existing data. The lack of infrastructure (e.g. weather stations, stream gauge locations) was also highlighted as an obstacle in monitoring climate change. In particular, participants noted a lack of data at higher elevation mountain regions that is important for upstream assessment, and the assessment of upstream changes on downstream users. Participants also suggested that there is a need for increased monitoring downstream of potential impacts (e.g. downstream of industry). It was noted that TEK plays an important role in providing information regarding big historical events. The importance of including TEK information with monitoring data was identified.
- **Indigenous Rights:** The following key questions were raised regarding indigenous rights. How do we incorporate indigenous rights in processes involving lands and waters? How do indigenous rights relate to climate change? Who has responsibility to protect lands from climate change? What impact will devolution have on indigenous rights?
- **Traditional Ecological Knowledge:** Traditional knowledge is considered by many to be valuable, meaningful and relevant. There is very limited scientific data relating to the environment in the NWT and thus traditional knowledge (integrated with Western science) must play a key role in decision-making. Participants emphasized that TEK must be recognized and made equivalent to Western science in decision-making around water management resources.
- **Community-level Issues:** Many of the issues related to water and climate change are realized at the community level. Some specific community-level issues that were raised included potable water supply (health and supply issues), protection and maintenance of infrastructure (e.g. lagoons, wastewater treatment), protection of land from flooding/erosion, and changes to navigable waters. There was concern associated with the territorial department delegating infrastructure issues and costs to municipalities.
- **Watershed-scale Management:** The practicalities and benefits of addressing water issues on a watershed basis were discussed. It was noted that current planning boards are not structured on a watershed basis and yet there is a general recognition that we need to consider cumulative impacts within a watershed. It was suggested that, for practicality, watershed management must be undertaken at the sub-basin scale

Of the three roundtables, awareness of climate change issues was highest and perceived as most urgent in the NWT. Awareness of climate change is unusually high in the region due to their northern location, in which the warming and associated impacts are impossible to ignore. The new water strategy promises to be a groundbreaking piece of legislation and policy innovation that will encapsulate many of the standards and actions required in other parts of Canada. In the big picture of Canada's water governance as a nation, the proposed NWT water strategy represents an extraordinary opportunity to place ecosystems and water above consumption pressures that, once in place, are deeply challenging to reverse. As such, it represents one of the most significant adaptation initiatives in Canada in the context of water governance. Of course, significant challenges to effective adaptation in the water resources sector remain, including the difficulties associated with transboundary negotiations from the point of view of a downstream negotiator faced with upstream neighbours committed to high levels of water consumption, and complexities of land claims agreements and First Nations government in a territory approaching devolution.

Cape Breton

- **Uncertainty of Climate Change Predictions and Knowledge:** Uncertainty of climate change predictions and knowledge was a discussion topic that was raised by some groups. Of particular concern was the uncertainty of sea level rise predictions – ranging from 1 to 10 m, and the uncertainty of the potential effects of sea level rise. Uncertainty, in general, with respect to climate change predictions (e.g. temperature and precipitation) was also identified. It was recognized that predictive models can be variable and questionable. A global climate model has been adapted to a regional (provincial) scale, however, it was suggested that more research is needed to understand climate change and effects on water, as scientific information needs to be credible to truly influence decision-making.
- **The Role and Importance of Science:** The importance of science to effective climate change adaptation was acknowledged. It was emphasized that climate change adaptation actions and priorities must be founded in science.
- **Legislation and Controls:** Effective legislation and other means of control were identified as important for moving forward with sustainability and adaptations to changing water issues. The concept of "courageous legislation" was discussed by two of the groups, defined by the following descriptions:
  1. May be politically unpopular;
  2. Deals with problems over the longer time span than the duration of a single government's term of office (i.e. long term effects of climate change);
  3. Has a "black and white" element – e.g., "if an industry is going to negatively affect water then it shouldn't be allowed" or "no one should be permitted to damage the quality of our shared water resources"; and
  4. Considers the real cost of environment effects and impacts.
- **Source Water Protection:** The importance of effective source water protection (SWP) for protection of water supplies and to protect what hasn't been damaged was discussed. It was suggested, that climate change is relevant to everything and needs to be mainstreamed, and SWP planning was identified as a important component of climate change adaptation. A SWP plan should be developed on a watershed basis, be based on science/knowledge as well as qualitative concerns and issues regarding impacts to water, list key actions, and identify roles and responsibilities. An effective SWP plan was deemed to be the result of effective collaboration and involvement of many groups, who work together in plan development to identify common issues, problems and values. It was noted that one of the key benefits of a SWP plan is that it determines accountability (by defining roles and responsibilities). Concerns regarding the development and implementation of a SWP plan included the lack of funding, difficulty with prioritizing in terms of implementing a plan, and including First Nations.
- **Including First Nations:** Suggestions to improve involvement of FN in water management and environmental decisions included:
  1. Water decisions should consider FN concepts such as resilience, balance, and availability, and that decisions should be "good for seven generations";
  2. Involve First Nations groups such as FN national technical group, and national FN Water Commission;
  3. Involve FN on a community-by-community basis (e.g. NS Sustainable Communities Initiative initiated community level meetings so that local critical issues and funding needs could be presented);
  4. Protection of treaty rights; and
  5. Build relationships.
- **Engaging the Public, Press, and Politicians:** Public support and engagement was identified as an important component of moving forward with adaptations. Government decisions are often political and without public support/engagement, the issues may not be given priority by government.
- **Reactive Versus Adaptive Actions:** There was a sense of urgency in some of the discussion regarding the need

to act now with respect to scientific research (considering studies may take three years or more to complete), development of legislation, improving relations, and setting priorities (e.g. what areas to protect first). It was suggested that acting now with pro-active or adaptive actions will set the stage to moving forward with future water management decisions. Despite the fact that current knowledge is uncertain we can "start with what we have" and built on it as new information becomes available.

- **Regional Issues:** Some key regional issues emerged during the discussions:
  1. Sea-level rise: concerns included loss of land/communities (flooding), impacts to ecosystems (discussed further below), coastal erosion, sea water contamination of potable water sources, and impacts to harbours;
  2. Ecosystem health: participants specifically discussed the delicate fresh-salt water balance in the Bras d'Or lakes, and how sea-level rise and increases in spring run-off from Cape Breton highlands. The need to practice ecosystem management by protecting water was recognized; and
  3. Fisheries and Forestry: impacts to fish habitat due to climate-related changes in water systems were expressed as a general concern with respect to potential fisheries impacts. In addition, the impact on fisheries due to a change in sea temperature was identified, as was the potential loss of small harbours (loss of land/infrastructure) due to sea level rise. Forestry was discussed in terms of potential impacts for source water protection (e.g. logging near streams, clear cutting without appropriate stream buffer, stream crossings). Forest practices related to harvesting sustainability were also raised as issues (e.g. clear cutting, not using wood waste from mills).
- **A New Canadian Water Ethic:** It was suggested that a new Canadian water ethic is needed to bring out widespread changes in the way we manage and protect water in Nova Scotia and across the country. This ethic would resemble an organizing principle, around which people and politicians can move forward with water management decisions (similar to the heath care ethic of free care for everyone). Public support for a new water ethic was identified as an important component to moving forward. It was suggested that a new water ethic would increase future adaptive capacity to climate change.

Through the roundtable discussion in Cape Breton, it became increasingly apparent that the Bras d'Or Lake region has created initiatives and organizations that are groundbreaking in their efforts to drive collaborative governance of water and ecosystems, placing the region in an advantageous position to design and implement adaptation measures. However, the region's governance organizations are still struggling with limited resources, aspects of jurisdictional fragmentation, and lack of information about climate impact projections, as well as a need for greater access to data analyzing climate impacts that the region must prepare for and actions they would be well advised to take and associated socio-economic implications. As well, to date, climate change adaptation has yet to become a strong concept, but was acknowledged as a useful approach and a much-needed one as climate change accelerates. Due to the unique marine/freshwater interface of the Bras d'Or Lake, sea-level rise is seen as one of the biggest impending threats. Other threats to water such as higher temperatures and shifting ecosystems were also acknowledged but can be addressed with more general water governance standards and approaches that encompass a variety of concerns and drivers (i.e. "sustainability").

3.2.5 Broad Conclusions

As outlined in Table 11 and in the text above, many themes emerged in the roundtable discussions. Some of these themes differed according to region, including the important role of science in Cape Breton, water allocation in the Okanagan, and Indigenous rights in Yellowknife. Other themes emerged in all three regions, including concerns about governance, watershed management, effective involvement of First Nations, and access to safe, high-quality drinking water. The six broad conclusions that emerged from the roundtable discussions are outlined in Table 12.

Table 12 - Broad Conclusions from Regional Roundtable Discussions

THEME	BRIEF EXPLANATION
Adaptive, Not Reactive	Choosing to be adaptive, not reactive, is the best approach to water management. There are seven key elements of an adaptive approach that build resilience by increasing a water governance system's capacity to absorb disturbances, and making it more responsive to change: (1) experimental approach that promotes learning; (2) management at the basin scale; (3) multi-level governance; (4) stakeholder participation; (5) open, coordinated sharing of information; (6) leadership; and (7) financial and insurance mechanisms.
Water for Nature First	All living things should have a right to enough water for survival before surplus amounts are re-allocated. By imbuing nature with water rights, we acknowledge the contribution of ecosystem services to our own quality of life, thus compelling decision-makers to weigh the benefits of development against an assessment of costs that is more complete than those historically considered. Effectively doing this involves: (1) protecting source water; (2) meeting in-stream flow needs; (3) paying for ecosystem services; and (4) expanding reuse of water.
Human Right to Water	Climate change intensifies the need to approach water from a human rights perspective because those who already lack access to safe, affordable water supplies, or who cannot afford additional burdens will suffer most from the effects. Respecting the human right to water involves the following: (1) a public and private sector commitment to equitable universal access to water; (2) affordable water pricing; (3) resolution of the water crisis in First Nation communities throughout Canada; and (4) mandatory, legally binding drinking water quality standards.
Respect for First Nations Values	First Nations culture and traditions reflect a deep respect for the environment and an in-depth relationship with nature. Respecting their values and incorporating their perspectives into water management strategies is crucial to strengthening those strategies and produce climate change adaptations previously unconsidered using non-First Nations cultural lens. Respecting First Nations values includes working with First Nations as equal partners and incorporating traditional ecological knowledge into our water management approach.
Effective Multi-Level Governance	There is a significant need for improved collaboration and coordination in water management, given the fact that water governance in Canada is marked by institutional territoriality and jurisdictional fragmentation.
Appropriate Economic Signals	To achieve effective water management, it is imperative for governments to send appropriate economic signals in order to affect the needed change. This includes valuing the ecosystem services water provides and ensuring that insurance price signals are not distorted by government action.

Additionally, participants in the Okanagan and Cape Breton roundtable workshops specifically mentioned the need for a new water ethic – a comprehensive re-think of the system of principles that govern how we use water and our relationship with aquatic ecosystems. While the participants in the Yellowknife roundtable workshop did not specifically identify this need, it was woven throughout much of the discussion and is evident in the very creation of the NWT Water Stewardship Strategy. The position of this report is reflective of the input we received during the regional roundtable discussions: the current water ethic guiding this country's response to climate change is outdated and insufficient to help us cope with the myriad pressures facing Canada's water resources. Next, we outline the concept of a new water ethic and the principles we believe should be at its heart.

4. A NEW CANADIAN WATER ETHIC

4.1 DEFINING A WATER ETHIC

An ethic is essentially a set of moral principles concerning how we conduct ourselves in our relationships with one another and with the rest of the world. A water ethic then refers to the system of moral principles that we have established to govern our behaviour as it relates to water, including how we use water and how we treat aquatic ecosystems.

4.2 FIRST NATIONS' WATER ETHIC

The First Nations Peoples of this land had a strong connection to water that remains at the very heart of their water ethic. Two of the fundamental principles of the First Nations water ethic are as follows:

1. The relationship between humans and water is one of mutual responsibility and reciprocity and this must be kept in balance.
2. The relationship between humans and water is deeply spiritual and, thus water must be respected and honoured.

The post-European settlement water ethic that has emerged in Canada is largely antithetical to that of the First Nations' water ethic. Rather than treating water as a precious physical and spiritual partner in life, the typical Canadian water ethic views water in the context of an economic and legal framework and approaches it as merely a resource.

4.3 THE NEED TO RE-THINK OUR CURRENT APPROACH

Many Canadians have a misguided assumption that water in our country is of limitless abundance.[99,100,101102,103] The reality is that Canada has only 6.5% of the world's renewable fresh water supply; the same as the United States and much less than Brazil and Russia.[104] Moreover, 60% of Canada's water flows north towards the Arctic, while 85% of our population lives along the southern border.[105] Canada is a much drier place than many believe, particularly in the prairies and regions of central BC, which are semi-arid. Yet, the myth of water abundance contributes to our country's high levels of consumption and the jurisdictional fragmentation of water governance and management (section 2.3).[106]

In its 2005 report, *Water in the West: Under Pressure*, the Standing Senate Committee on Energy, the Environment and Natural Resources recognizes that key western areas "face important water challenges" and, in many cases, "water consumption now matches or possibly exceeds what is renewed every year."[107] Adding further strain to western water resources is the fact that these areas are growing rapidly, are the epicentre of Canada's energy and agricultural production, and are expected to be hit the hardest by climate change impacts.

The impact of climate change on Canada's water resources poses a significant problem for policy-makers because:

1. It puts people and the natural resources on which they depend at risk;
2. The potential harms to people are not only mere inconveniences but, in some cases, may include catastrophic reductions in quality of life and even loss of life;
3. To a large extent, those who are vulnerable must rely on government's sense of responsibility toward protecting them from harm, and
4. The inevitable question is raised of "who pays for water protection, how much, and who is responsible for what action?"

99 Sandford, 2007
100 Sprague, 2003
101 Schindler, 2006
102 Sprague, 2007
103 Shrubsole and Draper, 2007
104 Sprague, 2007
105 Ibid
106 Sandford, 2007
107 Standing Senate Committee on Energy, the Environment and Natural Resources, 2005

Simply put, water is not secure throughout Canada – we lack sustainable supplies of water needed to provide for human use, continued economic prosperity and a healthy environment. Misplaced beliefs that Canada has an excess of water have led to decisions that are detrimental for current and future generations, especially considering that the full impacts of climate change on the water supply are yet to be realized. ACT's goal is to propose the replacement of these beliefs with a new set of values – a new Canadian water ethic – supported by pro-active policy recommendations that reflect the conclusions we have drawn from our research and roundtables.

4.4 PROPOSED ELEMENTS OF A NEW CANADIAN WATER ETHIC

This section outlines the elements we propose for a new Canadian water ethic. These are based on the ideas raised at the three regional roundtable workshops – readers will note that they align with the broad conclusions from the regional roundtable workshops as outlined in Section 3.2.4. But it is important to note that these elements are also based on the extensive research and experience of the lead policy author for ACT's Water session, Bob Sandford.

Table 13 - Proposed elements of a new Canadian water ethic

ADAPTIVE, NOT REACTIVE	Element 1	Recognizing nature's need for water
	Element 2	Recognizing water as a human right because it is integral to human health
	Element 3	Respecting the water rights of Indigenous peoples and honouring the First Nations' water ethic
	Element 4	Promoting institutional openness and jurisdictional cohesion in order to manage water more holistically
	Element 5	Recognizing the importance of economic signals in affecting positive change with respect to how water and water infrastructure are valued and managed

4.4.1 Cross-cutting Element: Adaptive, not reactive

Pursuing an adaptive approach to water management – rather than a reactive approach – is crucial to enhancing our resilience in the face of climate change. Most water management regimes today are not adaptive because large infrastructure and investment costs, rigid legal regulations and entrenched institutional cultures prohibit flexibility and timely change.[108] An adaptive approach involves anticipating challenges and working to address them in advance; this is a stark contrast from an approach that simply involves waiting for a crisis and only then seeking to address the problem. Adaptation involves more than reinforcing infrastructure and investing in new technology; rather, truly effective adaptation demands a holistic approach, which, as previously stated, includes "adjusting *decisions, activities, and thinking* because of observed or expected changes in climate in order to moderate harm or take advantage of new opportunities."[109]

In the fall of 2010, the federal Commissioner of the Environment and Sustainable Development described Canada's progress toward climate change adaptation as "piecemeal" and emphasized that our country still has, "no federal adaptation policy, strategy, or action plan in place."[110] The report also determined that, overall – and despite the efforts mentioned earlier – Environment Canada, Natural Resources Canada, Health Canada, Indian and Northern Affairs Canada, and Fisheries and Oceans Canada have yet to take any "concrete actions to adapt to the impacts of a changing climate."[111] Primary funding for climate action from these Departments stems from the federal Clean Air Agenda. While funding for most of these programs was scheduled to end in March 2011, the 2011 Budget set aside $52 million

108 Pahl-Wostl et al., 2009
109 Policy Research Initiative, 2009
110 Office of the Auditor General of Canada, 2010
111 Ibid

over two years (2011-2013) to continue previous adaptation programs and begin new ones in the areas of transportation, infrastructure, agriculture, oceans, and human health.

The resulting lack of preparedness means Canadian responses to extreme events and long-term changes are – and will increasingly be – conducted on an 'as needed' basis. While responding in such a reactionary way sometimes works, it can also fail dramatically.[112] In Canada, the impacts of climate change could potentially cause significant reductions in quality of life for many, particularly those at the margins who cannot afford to protect themselves from these impacts, those who are dependent upon healthy ecosystems for their survival, and those who already suffer as a result of water challenges. Choosing to be adaptive, not reactive, is not simply a question of picking the better management strategy; it is a question of protecting the quality of life of everyday Canadians, and protecting the long-term sustainability of our communities and industries. As a developed nation with ample resources, Canada is also relatively well positioned to adopt an adaptive approach to water governance.

As discussed in Section 2, *climate change adaptation* is defined here as any alteration of current human practices – including activities of decision-making, development and operations – to better cope with the negative effects of a changing global climate. In the context of water resources, this definition applies to changes in water governance, infrastructure and management. *Adaptive policy* is a kind of adaptation that can be applied by a set of policy actors to affect what kinds of decisions are made about social standards, infrastructure development and management practices, land and ecosystem planning, and civic goals, and how those decisions are made. There are two kinds of adaptive policy: those that embed a practice of continual learning, evaluation and improvement into the processes and procedures of water governance and management, and those that emerge from an adaptive process to guide a course of action on the ground. The former structures the process of decision-making, while the latter directs the outcomes of decision-making. Both approaches are required for effective adaptation.

Idealized in theory and hard to implement in practice, *adaptive management* is often used as a catch phrase. Many initiatives are promoted as 'adaptive' while exhibiting few characteristics that are actually essential to the approach.[113] Below we outline what is required to achieve adaptive water policy, so that it can be applied more effectively to climate change adaptation in Canada. A review of relevant water governance and adaptive management literature isolated seven key prescriptions that define adaptive approaches to water governance, displayed below in Table 14.

Table 14. Key adaptations prescribed for adaptive water governance

ADAPTATION	INDICATORS
Experimental approach that promotes learning[1,2,3,4,5,6,7,8]	Our limited knowledge and uncertainty is recognized and emphasis is placed on learning from experience. Management is viewed as a form of experimentation remaining flexible, without rigidly set regulations and establishes a process of continual monitoring, evaluation and refinement. Experimentation might also involve implementing two or more different policy programs and comparing competing hypotheses about each program to enhance learning and improve policy.
Management at the basin scale[9]	Consistent with the principles of Integrated Water Resources Management, management actions are designed with the entire watershed in mind, which requires cooperation across multiple, overlapping jurisdictional boundaries. This cooperation can be coordinated by a river basin organization or it can occur in a polycentric, patchwork fashion.

112 For more information see Munich Re, 2010. Munich Re documents an increasing trend in atmospheric events of various kinds (storm, flood, drought, heatwave, etc).

113 Gregory et al., 2006

ADAPTATION	INDICATORS
Multi-level governance[10,11]	Multiple centres of power are recognizable, rather than one centre of control. Decision-making power is dispersed across different organizations with overlapping jurisdictions and a more diffuse division of authority replaces the traditionally separated hierarchies (national, regional, local). Decision-making is steered by public, private and government interests and takes place across multiple geographic scales and sectors. Higher-level policies enable, rather than control local and regional initiatives. Vertical and horizontal networks among organizations and stakeholders are promoted.
Stakeholder participation[12]	Collaboration between government and non-government stakeholders is embedded in decision-making processes.
Open, coordinated sharing of information[13,14]	A coordinated system is established for collecting and sharing sufficient information about the system's stocks, flows and processes, as well as information about human-environment interactions.
Leadership[15]	Individuals and organizations responsible for implementation are identified and strong leaders are nurtured via training and education to motivate adaptive approaches. These leaders act as 'champions' for adaptation in political arenas and within water management organizations.
Finance/insurance[16]	A well-defined strategy for funding adaptation programs is observed. Risk is distributed across a broad cross-section of stakeholders via insurance, with governments working with the insurance industry to ensure appropriate risk price signals.

1 Lee, 1993
2 Lee, 1999
3 Huitema et al., 2009
4 Dovers et al., 2003
5 Johnson, 1999
6 US Department of the Interior, 2009
7 National Research Council, 2004
8 BC Ministry of Forest and Range, 2010
9 Standing Senate Committee on Energy, the Environment and Natural Resources, 2005
10 Ibid
11 Keskitalo, 2010
12 Owens, 2009
13 Stankey, 2005
14 Dietz et al, 2003
15 Standing Senate Committee on Energy, the Environment and Natural Resources, 2005
16 Bouwer et al., 2006

Each of the adaptations outlined in Table 14 contains important elements that build resilience by increasing a water governance system's capacity to absorb disturbances, and making it more responsive to change.

Acquiring better information about the possible effects of various policy options is a key component of adaptive water governance. The more information we have about a system's response to human interventions, the more capable we are of choosing the option that best copes with the negative impacts of climate change. Conventional water management tends to rely on trial and error, which is a very slow way of collecting information about a system and may also lead to path dependency. An adaptive approach treats water management as an experiment where science is used to monitor social and environmental feedbacks, which are then combined with traditional ecological knowledge and used to shape policy. In this experimental approach, each policy program is, in turn, monitored, evaluated and revised based on an iterative process of continual learning.

The scale of management also impacts a water governance system's ability to respond to change. Municipalities that divert water without considering impacts on the watershed as a whole risk undermining the ecological integrity of the basin and making the entire system more susceptible to disturbance. On the other hand, governments that manage water at too large a scale risk overlooking locally significant feedbacks. Managing at the basin scale is widely viewed

as the most appropriate level for water, but this strategy also contains complications. Jurisdictional boundaries rarely correspond with watershed boundaries, meaning that most basins contain multiple jurisdictions both horizontally (e.g. more than one municipality, regional district and/or First Nation shares a watershed), and vertically (e.g. a community watershed also supports salmon spawning, thereby placing it in the jurisdiction of both the municipality/regional district and the federal Department of Fisheries).

Therefore, water basin management requires cooperation across jurisdictional boundaries. Often, this cooperation is coordinated by a river basin organization, which can operate as a regional hub, supporting multi-level governance, which entails a shift away from the conventional hierarchy of local, regional and national levels of government where each level is characterized by central authority and is distinctly separate from the other levels. Instead, a diffusion of decision-making power is enabled across a network of agencies and actors at all levels, breaking down jurisdictional silos that once obstructed coordination and sharing.

Multi-level governance also includes public and private interests in the decision-making process, which necessitates a system for collaboration between government and non-government stakeholders. Stakeholder participation is a crucial component of adaptive water governance because stakeholders hold valuable local knowledge about water resources and constitute a crucial part of the feedback loop in an experimental approach. In addition, stakeholder participation increases public trust in adaptation programs, educates the public about climate change impacts on water, and helps build the social capital necessary for an adaptive society.

Gathering local knowledge via stakeholder participation also increases the quality of information available about water resources. When this, and other information about water stocks, flows and environmental processes are shared openly, in a coordinated way across jurisdictional and organizational boundaries, regions become more responsive to change because they have more efficient access to data required for making informed decisions.

None of these characteristics of adaptive water governance can occur without leadership, facilitation and bridge-building. Catalysts are required to initiate change within government, among stakeholders and within water management organizations. Adaptation champions can provide the momentum required for such shifts. To prepare for climate change, these individuals can be nurtured via training and education and by providing them with a forum through which they can directly influence other actors in the water governance arena.

Climate change adaptation programs also require money, and no strategy is complete without an adequate financing plan. Various economic tools are available to cover the costs of water-related adaptations including government grants, subsidies, cost recovery, and taxes. Adaptation for private property is also important since it includes lands and waters that provide ecosystem services which extend beyond property lines to the benefit of the broader public. Investments against future risks to such property also make the public less vulnerable. One important adaptation is to ensure financial services are available for private property owners, such as insurance against weather related natural disasters. Insurance plays an important indirect role in climate change adaptation by setting standards for buildings and land use planning because insurance is only available to those who comply with the insurance broker's stringent standards. It is also important for governments to act to ensure less distortion of the insurance price signals that are based on risk: by accurately pricing risk, insurers incentivize risk-reducing decision-making but as market-based instruments, insurance tools can only be effective if government actions do not serve to distort or undermine the incentives.[114] Risk-reducing behaviour will only occur if actors are held fully responsible for their risky behaviour. This concept will be outlined further in Section 4.4.6.

The need for an adaptive rather than reactive approach to water management therefore needs to be a foundational component of a new Canadian water ethic, and is woven through the principles that follow:

114 Zurich, 2009

4.4.2 Element 1: Recognizing Nature's Need for Water

A new Canadian water ethic needs to ensure that the rights of people are balanced with the rights of nature. To secure water and environmental services for people, nature needs water first. Postel (2010) argues that an ethically based water policy must begin with the premise that all people and *all living things* have equal rights to enough water for survival before any surplus amounts are re-allocated. But the harsh reality is that, in Canada, there are no surplus amounts of water: all of the fresh water in our country is already used, whether by people or by nature. Imbuing nature with water rights is far from altruistic idealism; rather, it recognizes the immense importance of the ecosystem services provided by water to our own quality of life.

Water plays a fundamental role in the maintenance of ecosystem resilience. Negative impacts on water diminish the self-organizing capacity of ecosystems. When this capacity reduces beyond a certain threshold, important buffers to disturbance are lost. Without these buffers, ecosystems become vulnerable to extreme weather events like those predicted as a result of climate change. This added vulnerability means ecosystems are pushed more easily into undesirable states, as is the case when prairies are degraded into deserts. Because water is required for intact ecosystems, and intact ecosystems are required for human well being, protecting the critical role of water in ecosystem function is a form of insurance against the impacts of climate change. Investing in water for nature first spreads the future cost of disturbance across a wider range of ecological buffers and provides Canadians with greater water security.

Water for nature first is a challenging proposition since it requires an adequate understanding of nature's needs and a way of generating agreement about that amount – incorporating TEK is an important component of this since it is based on an understanding of human *relationship* with nature. These problems are difficult to address because technically all flows are utilized by nature in some way regardless of human intervention. Participants in the regional roundtable discussions identified four key components of recognizing nature's need for water, which would help to establish this principle as part of a new Canadian water ethic:

1. Protecting source water:
2. Meeting in-stream flow needs.
3. Paying for ecosystem services.
4. Expanding reuse of water.

1. Protecting Source Water

The first option – protect source water – is relatively straightforward and based on the precautionary principle – it does not require a detailed understanding of the water needs of nature to be effective. Increasing the protection of water sources is a crucial, commonsense approach to ensuring better quality and quantity of water downstream, for use by both humans and nature. Protecting water from development at its upstream source is accomplished using existing planning tools such as protected area designations, conservation easements, and regulations limiting land use. By default, excluding source water areas from development maintains upstream ecosystem services and should be a minimum requirement in community watersheds. Of course, unlimited protection of all source water areas is an untenable economic proposition and it fails to address all downstream problems. Nevertheless, there is a critical need to do much more to protect source water as part of a new water ethic.

2. Meeting In-stream Flow Needs

The second option is more complicated but it considers *entire* water systems and potentially leaves more room for human uses without undermining ecosystem resilience. It also requires identifying and agreeing upon ecosystem needs. The question Canada must answer is, "Where is the dividing line between what nature needs and what humans can safely use without risking deterioration of ecosystem services?" Fortunately, some guidelines are already developed. For instance, the BC government's Living Water Smart Team seeks to establish a legal require-

ment to meet 'environmental flow' needs in a modernized version of the provincial Water Act and provides a set of guidelines for measuring these flows.

3. Paying for Ecosystem Services

Each of the aforementioned options can be used separately or together, but they are difficult to enforce when water passes through privately owned land, as is often the case. One strategy to protect water on private land is to calculate the value of the ecosystem services the water provides and make direct payments to landowners if they forego development that would adversely affect the water. For context, Table 15 outlines some of the examples of ecosystem services provided by water and wetlands.

Table 15 - Examples of Ecosystem Services Provided by Wetlands[115]

USE BENEFITS			NON-USE BENEFITS
Direct-use benefits	**Indirect-use benefits**	**Option benefits**	**Existence benefits**
Recreation (boating, birding, wildlife viewing, walking, fishing) **Commercial harvesting** (nuts, berries, grains, peat, forestry, fish, trapping, hunting)	**Nutrient retention** **Water filtration** **Flood control** **Shoreline protection** **Groundwater recharge** **External ecosystem support** **Micro-climate stabilization** **Erosion control** **Associated expenditures** (e.g., travel, guides, gear, etc).	**Potential future uses** (either direct or indirect) **Future value of information** (e.g., pharmaceuticals, education)	**Biodiversity** **Culture** **Heritage** **Bequest value**

Ducks Unlimited completed a synthesis of various studies in which a range of valuation methods were used to arrive at estimates of the value of various ecosystem services. While there is much debate on whether this is an ideal way to value ecosystems, for reference sake and illustrative purposes for this context, here is the average annual global values of ecosystem services from those studies[116] (total value/hectare–1994US$/ha/yr):

- Wetlands $14,785
- Lakes/rivers $8,498
- Forest: $969
- Marine: $577
- Grass/rangelands: $232
- Cropland $92

Clearly, water provides highly valuable ecosystem services.

115 Environment Canada, 2005a
116 Ducks Unlimited, 2010a

4. Expanding Re-use of Water

Another way to ensure nature has an adequate supply of water is to reduce pressure on water resources by re-using water. For example, greywater (all non-toilet household wastewater, including wastewater from baths, showers, hand basins and the final rinse-water from washing machines, but excluding most kitchen water due to contamination by food particles, grease, etc.) can be reused to water gardens and plants.[117] Similarly, industrial water can be reused for a variety of purposes including cooling, material washing, irrigation or toilet flushing.[118] Reusing water reduces demand and is a key element in ensuring *water for nature first*.

4.4.3 Element 2: Water is Integral to Human Health and Must be Recognized as a Human Right

The impacts of climate change are intensifying the need to approach water from a human rights perspective because, largely, it is people at the margins of society – often those who already lack access to safe, affordable water supplies or who simply cannot afford additional burdens – who will bear the brunt of the adverse effects.

An historic moment occurred on July 28, 2010, when the UN Human Rights Council passed a resolution declaring that the right to safe, clean drinking water and sanitation is a universal human right.[119] Canada abstained from voting,[120] but is bound by the agreement and it remains to be seen if the federal government will live up to its obligations. Currently, the only provincial/territorial jurisdiction in the country that legally grants its citizens the right to clean water is the Government of the Northwest Territories. International commentators, including former UN High Commissioner for Human Rights, Louise Arbour, notes that Canada's vigorous efforts to avert international recognition for the human right to water were uncharacteristic of its traditional role as a 'peacemaker' and 'consensus-builder' in international affairs.[121]

Adapting to climate change in Canada includes living up to our nation's obligation to the UN by putting 'water as a human right' into practice. At the core of the resolution is an important ethical concern – that nearly a billion people around the world lack access to a safe water supply and 2.6 billion people lack basic sanitation[122]. Climate change intensifies the need to approach water from a human rights perspective because it is people at the margins – those who already lack access to safe, affordable water supplies, or cannot afford additional burdens – who will suffer most from the effects.

One argument against recognizing water as a human right is the perception of entitlement it brings and the potential tension that creates with environmental values. The fear at the basis of this argument is that a human rights recognition will be used to institutionalize water provision in ways that overlook ecosystem needs. Of course, the reverse scenario is also possible – that an ecological argument will be used to protect water in ways that undermine quality of life in local communities. For this reason it is particularly important that the Human Right to Water is applied in conjunction with the second principle – Water for Nature First. Considering these two principles together provides an ethical foundation from which decision-makers can address human and environmental concerns simultaneously. We acknowledge there will always be tradeoffs in any decision-making scenario, but this pairing is intended to discourage lowest common denominator solutions, and instead provoke creative strategies that accommodate a human right to water while still supporting ecosystems.

Applying a human right to water requires criteria for gauging the degree to which that right is achieved. The criteria outlined by the United Nations include the following:[123,124,125,126]

117 EPA Victoria, 2010a
118 EPA Victoria, 2010b
119 United Nations, 2010c
120 United Nations, 2010a
121 United Nations, 2007
122 Solon, 2010
123 Committee on Economic, Social and Cultural Rights, 2002
124 Economic and Social Council, 2005
125 World Health Organization, 2003
126 United Nations, 2007

- Sufficient quantity
- Safe and acceptable quality
- Equitable and physical access
- Affordability

These criteria are reflected in the four priority actions ACT recommends in the following paragraphs to help Canada implement 'water as a human right':

1. Public and private sector commitment to equitable universal access;
2. Affordable water pricing;
3. Resolution to the water crisis in First Nations communities; and
4. Mandatory, legally binding drinking water quality standards.

1. Public and Private Sector Commitment to Equitable Universal Access

A joint public-private sector commitment to equitable universal water access requires that both sectors commit to implementing creative strategies that do not undermine public control over the resource and provide water services regardless of some people's inability to pay.

Efforts to gain recognition for water as a human right are typically associated with public, not private ownership of water supply services. This is because private ownership is often coupled with the erosion of public control as highlighted by cases of the abuse of power by private water companies in the developing world. Nevertheless, some private sector involvement can improve water security in the right contexts.

Canada's water is primarily managed as a public good, but several local governments across the country utilize public-private partnerships (e.g., Moncton, NB; Hamilton, ON; Halifax, NS; London, ON; Canmore, AB).[127] Privatization of water services is contentious in Canada. Indeed, private water provision is prone to market failures (i.e., monopolies, externalities), does not always serve the public interest and generates strong opposition from many Canadians who fear a loss of public control.[128] Nevertheless, Canadians need to prepare for the fact that this option may become more popular in the coming decades as the country faces significant costs of replacing its aging water supply infrastructure. A federal government report estimated that, by 2003, 63% of Canada's wastewater treatment facilities had exhausted their useful life.[129] In Ontario, the provincial government acknowledges that an investment of $30 to $40 billion is required over the next 15 years to bring water and wastewater facilities in Ontario into a "state of good repair and accommodate growth."[130] In 2006, at least $290 million was required in Alberta, with perhaps a billion more over subsequent decades.[131] In 2003, Indian and Northern Affairs Canada (INAC) completed a comprehensive on-site assessment of water and wastewater treatment facilities on 740 reserves across Canada. INAC estimated that the capital cost to address deficiencies is between $475-$560 million and the capital investment to provide basic water and wastewater services to about 5,300 homes which do not currently have basic water and sewer services is $185 million.[132] Finally, in 2007, the Canadian Water Network estimated Canada's infrastructure maintenance deficit at $88 billion.[133]

Given these figures, many Canadian communities are vulnerable to the effects of deteriorating water systems at a time when the predicted impacts of climate change will further challenge local governments' ability to provide safe water to citizens. In communities with financial struggles, the huge expense of updating and maintaining water supply systems will make outsourcing water services increasingly attractive to local governments.

127 Bakker, 2007
128 Ibid
129 Gaudreault and Lemire, 2006
130 Ontario Ministry of Energy, 2011
131 Sandford, 2007
132 INAC, 2003
133 Cotter, 2007

Therefore, adapting to climate change means it is important to acknowledge in advance the roles and responsibilities of both public and private sectors will play in implementing a human right to water.

Following Dr. Bakker (2007) from the UBC Program on Water Governance, we take a pragmatic view – securing water as a human right means creative solutions are required and outsourcing some aspects of water service may be desirable given the current state of Canada's water supply infrastructure and the coming impacts of climate change. Outsourcing to private enterprise does not automatically necessitate loss of public control over the resource. Relationships between the public and private sectors can be, and often are, structured in such a way that control remains in the hands of the public. Robert Sandford, lead author for ACT's *Water Governance Session* indicates in his book, *Restoring the Flow: Confronting the World's Water Woes*, that water should not be entirely separated from the private sector. Rather, Sandford asserts that it should remain under public control, which "means not only government oversight but public involvement in decision-making related to the management of water resources characterized by active, popular, democratic citizen participation."[134]

2. Affordable Water Pricing

In most cases, Canadians do not pay the full costs associated with supplying drinking water,[135] including: operating costs; financing costs; renewal and replacement costs; improvement costs associated with extracting, treating or distributing water to the public; regulatory costs, as well as environmental costs.[136] The fact that we do not have full-cost accounting and full-cost recovery contributes to our high rate of water consumption[137] – Canada ranks among the highest water users per capita in the entire world[138] and a 2008 Conference Board of Canada report gave our country a "D" grade due to "poor conservation effort."[139] Applying a human right to water does not mean water will be free, but it does mean it should be affordable. Economic policy instruments such as pricing metered water need to be utilized more widely to encourage water conservation, and to make affordable universal water access more feasible. Like privatization, water pricing is a contentious issue in Canada because it is often misinterpreted as the commoditization of water; the myth of limitless abundance of water also creates challenges when discussing water pricing.

Pricing can be effective in guiding human behaviour towards environmental objectives without reliance on stringent regulations. Through the incorporation of negative externalities, the pricing of negative environmental commodities, and the valuation of ecological services, pricing tends to lead to more sustainable behaviour. Contrary to the assumptions of many, free market principles and environmental sustainability do not have to oppose one another. Properly used, environmental pricing tools employ market principles to attain environmental ends. But when market prices fail to include environmental costs or benefits, they mislead firms and consumers about real values and costs and encourage decisions that result in environmental damage.[140]

Contrary to the impression of some, water pricing does not mean turning water into a commodity like Coca-Cola – water services are not necessarily sold for profit. Rather, pricing is a way in which governments and private companies can recover the true costs associated with water service provision.

According to the National Round Table on Environment and Economy (NRTEE), Canada presently uses a limited suite of policy instruments for water service provision – most are regulatory.[141] NRTEE asserts that economic instruments could now play a larger role. All Canadian households should be provided access to a basic water supply necessary for personal use, and then charged for any additional use at rates that cover the cost of

134 Sandford, 2009
135 Conference Board of Canada, 2008
136 O'Connor, 2002
137 Conference Board of Canada, 2008
138 Environment Canada, 2011
139 Conference Board of Canada, 2008
140 Thompson and Bevan, 2010
141 Canada NRTEE, 2010

constructing, operating, maintaining and replacing water supply infrastructure. In this way, those who can afford it subsidize those who cannot, and at the same time, Canadians are encouraged to conserve water to avoid the expense of consuming beyond the basic amount.

3. Resolve the Water Crisis in First Nations Communities

The policy gaps caused by jurisdictional fragmentation are much more detrimental for First Nations communities than for the rest of Canada. Because First Nations are under the jurisdiction of the federal government, they do not benefit from provincial water quality regulations and therefore often find themselves in a dangerous policy gap. Canada, which once consistently topped the United Nations' Human Development Index (HDI), no longer ranks first-place. A 2004 report by the UN's special investigator, Rodolfo Stavenhagen, indicated that if Canada were ranked based solely on the socio-economic well-being of First Nations, we would rank 48 out of 174.[142] The report estimated that 20% of Aboriginal people in Canada have inadequate water and sewage systems and that Aboriginal Canadians are 90 times more likely than other Canadians to be without piped water. The 2010 HDI saw Canada drop from fourth to eighth place overall, in part due to the introduction of new ranking indices that reflect issues of inequality and poverty.[5]

Inequality and poverty are appropriate words to describe the water crisis in First Nations communities across Canada. As of April 30, 2010, 116 First Nations communities were under a drinking water advisory.[143] Some of these communities have been under advisories for years. Between 2003 and 2007, the average duration of a drinking water advisory in First Nations communities was 295 days[144]. In 2005, the entire community of the Kashechewan reserve in northern Ontario, which had been under boil water advisory for two years, was evacuated when it was discovered that their water supply also caused impetigo and other skin diseases.[145] In Fort Chipewyan, a First Nations community downstream from the Athabasca tar sands, dangerous levels of arsenic, mercury, and polycyclic hydrocarbons are found in drinking water, local rivers and fish stocks. These chemicals are the suspected culprits of the unusually high cancer rates in the community.[146] On the same date that the UN General Assembly declared water a human right (July 28, 2010), a state of emergency was declared for 900 Constance Lake First Nations members due to algal blooms overtaxing their aged water purification system.[147] These water tragedies reveal Canada's Aboriginal people as disproportionately vulnerable to the impacts of climate change and should be considered an unethical violation of human rights in this country.

4. Mandatory, Legally Binding Drinking Water Quality Standards

A basic part of implementing a human right to water is ensuring safety of and access to the drinking water supply for all Canadians. This assurance is difficult to provide without regulating water quality. Unfortunately, as noted in section 2.3.2, Canada currently lacks any legally enforceable water quality standards. In place of these standards, Health Canada publishes the federal *Guidelines for Canadian Drinking Water Quality* (the "Guidelines")[148], which contains 113 guidelines with 16 additional Guideline Technical Documents covering a wide range of chemical, physical and microbiological parameters. Mandatory, legally binding national drinking water standards are critical to ensuring that all Canadians have access to safe drinking water.

142 Stavenhagan, 2004
143 Freek, 2010
144 Harden and Levalliant, 2008
145 Ibid
146 Ibid
147 thestar.com, 2010
148 Health Canada, 2009

4.4.4 Element 3: Respect the Indigenous Peoples' Right to Water and Honour the First Nations' Water Ethic

In the same way that biodiversity is an indicator of ecosystem health, cultural diversity is an indicator of societal health. Both make us more resilient to the impacts of climate change. In Section 2.3.4, we referenced Mi'kmaq elder Albert Marshall's term "two-eyed seeing", which is used to describe a way of viewing issues simultaneously through both an aboriginal and a non-aboriginal lens. Accommodating multiple worldviews in this way permits us to harness the strengths of each to produce climate change adaptations previously unconsidered when using a single cultural lens. To accomplish this, Canada would do well to demonstrate respect for First Nations' values by involving them as equal partners in the water policy process and incorporating traditional ecological knowledge (TEK) into water planning.

1. **Involving First Nations as Equal Partners**

   Involving First Nations in decisions about water is not just an ethically appropriate choice; it is a legal obligation. First Nations started redefining their role in decision-making for lands and waters in 1973, when, in Calder v. Attorney General of BC, the courts first recognized that Aboriginal title existed before colonization. The outcomes of Calder catalyzed a chain reaction that eventually prompted the 1982 revisions to the Canadian Constitution Act to "recognize and affirm" the "existing Aboriginal and treaty rights of the Aboriginal peoples of Canada". Thanks to the efforts of various Aboriginal groups, great strides were made in subsequent years to define the legal interpretation of these newfound constitutional rights. From 1990-2000, more than two-dozen decisions were rendered by the Supreme Court dealing with the rights of Aboriginal people in Canada.[149] Important findings included recognition of current rights and title to traditional territories, and the requirement for provincial governments to consult and accommodate First Nations before developing Crown Land that overlaps traditional territory, even if that land is surrendered by treaty.[150] This legal recognition also means that governments cannot infringe upon Aboriginal rights to water and Aboriginal water rights could potentially take priority over all other uses.

   In the context of climate change, these legal shifts are a positive development since they somewhat institutionalize the application of "two-eyed seeing". However, involving First Nations as equal partners in the water policy process is not as straightforward as it sounds. The biggest obstacle is capacity. Administrative demands on First Nations resulting from the aforementioned legal shifts are overwhelming, so trained personnel are not always available. Another challenge is ensuring policy processes acknowledge Aboriginal rights to self-government. This obstacle arose during the BC land use planning process in the 1990s, when collaborative planning efforts failed to secure adequate First Nations representation because Aboriginal groups were only considered 'stakeholders' at the planning table, which made them equivalent to environmental NGOs and industry rather than separate orders of governments. Involving First Nations as equal partners involves meeting them on a government-to-government basis, and sharing administrative duties in proportionately appropriate ways.

2. **Incorporating Traditional Ecological Knowledge into Water Management Strategies**

   Traditional ecological knowledge (TEK) is defined as "a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and their environment."[151] Vedan describes First Nations' TEK in the Okanagan Basin as follows:

   > The Okanagan view of the world is one in which people, beliefs, and nature are intertwined and inseparable. The plants, animals, hills and water were viewed as having their own spirits and were

149 Borrows, 2001

150 See Calder v. Attorney General of BC 1973; R. v. Sparrow 1990; Taku River Tlingit First Nation v. BC 2004; Haida v. BC 2004; Canada v. Mikisew Cree First Nation 2005

151 Berkes, 1999, p. 8

> likewise treated with the utmost respect. The idea of humans having dominance over nature was non-existent; instead nature was viewed as a relative who provided assistance and was treated in a corresponding manner. ... This worldview ensured sustained management.[152]

According to White, this perspective was rooted in a recognition of a spiritual component to everything: "Before one cut a tree, mined a mountain, or dammed a brook, it was important to placate the spirit in charge of that particular situation and keep it placated."[153] First Nations' TEK tells us that, "water is the element from which all else came; it is the primary substance within the interconnected web of life; it is the centre of the web, rather than being just one component."[154] Recognizing the value of TEK and incorporating it into decision making around contemporary water use is an important component of respecting First Nations' values and thus ensuring more sustainable management of the precious resource of water.

4.4.5 Element 4: Promoting institutional openness and jurisdictional cohesion

Section 2.3.1 outlines the complexity and deep fragmentation of water governance arrangements in Canada. The Canadian Constitution divides legislative power over freshwater between the federal government and the provinces, producing a intricate regulatory web that spans municipal, regional, provincial and federal orders of government. Additionally, each province has developed its own unique approach to water management (see Appendix B for a list of provincial statues regulating water which illustrates the complexity and high degree of variation in Canadian water law).

During the roundtable discussions, we heard about nested governance, which was defined as including all orders of government from local to federal – a "vertical" structure – as well as a "horizontal" structure that allows for sharing and consideration of voices, principles, and ideas between governance levels and interested organizations. Barriers to effective nested governance included:

1. The lack of enabling legislation establishing an effective nested governance structure;
2. The lack of well-defined roles for the various levels of government and the need for some degree of regional authority, with both approval and veto-power regarding local water management decisions; and
3. The need for provincial or federal government coordination, reviewing and monitoring; and concern about how to ensure that First Nations are fully included.

Regional roundtable participants raised potential solutions to break down institutional territoriality and jurisdictional fragmentation, and thus improve water governance, included: increased collaboration between governments; the development of a governance framework to define roles and responsibilities, and work to address some of the inefficiencies of regional water governance.

Other important components of breaking down institutional territoriality and jurisdictional fragmentation include: empowering watershed basin councils; tying agricultural policy to water policy; recognizing the value of on-going monitoring; and adjusting the way we think about our water supply, including recognizing that surface and groundwater are part of the same supply.

4.4.6 Element 5: Recognizing the importance of economic signals in affecting positive change

While the need for appropriate economic signals was touched upon in Sections 4.4.1 and 4.4.2, we believe this topic is important enough to warrant its own section. One of the main roles of government is to direct the economy toward desired social goals. If we are to achieve a more sustainable future, it is imperative for governments to send appropriate economic signals in order to affect the needed change, including valuing the ecosystem services water provides.

152 Vedan, 2002
153 White, 1967
154 Blackstock, 2001, p. 5

For insurance to be effective at encouraging risk-reducing behaviour and climate change adaptation, governments need to allow the knowledge and experience of the insurance industry to work, and to take responsibility for prudent zoning and land management decisions that take climate risks and projections into account.

Additionally, governments need to minimize distortion of insurance price signals that are based on risk. Because they price risk, insurers essentially provide incentives for risk-reducing decision-making. However, since they are market-based instruments, insurance tools can only be effective if government actions do not serve to distort or undermine the incentives.[155] Risk reduction will only occur if actors are held fully responsible for their risky behaviour. An example in the context of climate change and water resources is the United States National Flood Insurance Program, which provides broad financial aid packages to flooded homes and businesses. By doing so, this program undermines the feasibility of a private insurance market.[156] For insurance to be effective at encouraging risk-reducing behaviour and climate change adaptation, governments need to allow the knowledge and experience of the insurance industry to work, and to take responsibility for prudent zoning and land management decisions that take climate risks and projections into account.

155 Zurich, 2009
156 Zurich, 2009

5. RECOMMENDATIONS

We must value water to meet nature's needs and ensure its use is consistent with sustaining resilient and functioning ecological systems.

Based on the principles outlined above, we recommend a policy road map consisting of eleven critical steps. The accompanying *Summary Recommendations* document for decision-makers fully outlines each of these steps.

5.1 SHORT-TERM RECOMMENDATIONS

These short-term recommendations are intended for the next three years.

1. Value water appropriately, and promote its wise use and conservation by establishing national water conservation guidelines;
2. Value water to meet nature's needs and ensure its use is consistent with sustaining resilient and functioning ecological systems;
3. Recognize and value established knowledge and experience in prediction by strengthening and harmonizing flood protection strategies nationally;
4. Support the design and sustainability of water supply and waste disposal infrastructure based on ecological principles and adaptation to a changing climate with special attention to First Nations communities;
5. Recognize the value of comprehensive monitoring and fulfill the need for the accessible information required to manage water in a changing climate;

5.2 MEDIUM-TERM RECOMMENDATIONS

These medium-term recommendations are intended for the next three-to-five years.

1. Recognize, value and support the role of education in public understanding of the importance of water to our way of life;
2. Recognize water as a human right integral to security and health;
3. Support holistic approaches to managing watersheds through collaborative governance;
4. Recognize the importance of groundwater and understand and value its role in creating a sustainable future for Canada;
5. Recognize the value of developing coordinated long-term national strategies for sustainably managing water in the face of climate change;

5.3 LONG-TERM RECOMMENDATIONS

These long-term recommendations are intended for the next five-to-ten years.

1. Consider the value of creating a non-statutory National Water Commission to champion the new Canadian Water ethic; and
2. Continue to articulate and promote a new Canadian water ethic.

CONCLUSION

Water is the lifeblood of our country. We are already locked into ongoing climate change due to the current atmospheric concentrations of greenhouse gases, and the fact that global emissions are continuing to increase. Climate impacts such as melting permafrost and shifting ecosystems are already clearly apparent, and should serve as urgent signifiers that we need to undertake coordinated adaptation on a national scale.

With mounting pressure on our water resources from population growth and industry development combined with the ever-increasing impacts of climate change, it is imperative that we revisit our relationship with water in Canada. We need to fundamentally re-think our relationship with water and take the necessary steps to establish an adaptive approach to water governance. This will require significant leadership from our federal, provincial, territorial, regional, municipal, and First Nations leaders.

Effective political leadership must support mitigating climate change by aggressively reducing greenhouse gas emissions; we need to do everything we can to minimize the extent of climate change because the potential – and, according to scientific consensus, *likely* – impacts are significant, particularly those associated with our water resources. Including an adaptive approach to how we govern and manage water is essential. We must mitigate what we can, and adapt to that which we cannot.

Policy development designed to support climate change adaptation will be most effective if it reflects, or is driven by, an overarching move to a new Canadian water ethic. Water is essential to the well being of Canadians and the health of our ecosystems and industries. It is a crucial point that is worth reiterating: **to achieve sustainability and enhance our resilience in the face of climate change, we need to fundamentally re-think our relationship with water.**

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APPENDIX A - REGION-SPECIFIC CLIMATE CHANGE IMPACTS ON WATER

A lowering of water levels has implications for water management (supply and treatment), hydroelectric power, transportation, agriculture, tourism/ recreation, and ecosystems and habitat.

1. NORTHERN CANADA

The northern Canada region encompasses nearly 60% of the Canadian landmass, and includes Yukon Territories, the Northwest Territories, and Nunavut[1]. The region has unique bio-geographic, environmental, socio-economic, cultural, and political characteristics. Both western science and Traditional Ecological Knowledge (TEK) indicate that Canada's north is already experiencing changes in climate[157].

Temperatures in northern Canada are increasing[158,159] and historical data suggest that northern Canada has experienced the greatest temperature increases in the country[160]. This trend is consistent with findings of the Intergovernmental Panel on Climate Change (IPCC)[161] which predicts the largest warming in North America to be focused across northern Canada and Alaska. Natural Resources Canada climate predictions, using a Coupled Global Climate Model CGCM2 with a projected greenhouse gas concentration scenario (IS92a), indicate increases in temperatures between the periods 1961-1990 and 2040-2060 ranging from 2 to 5°C for Yukon Territories, the Northwest Territories, and Nunavut, with greater increases in the high Arctic of 6°C or more[162].

Northern Canada has also experienced the greatest percentage increase in precipitation (compared to the rest of Canada). Across most of Nunavut, precipitation has increased over the past few decades by 25-45% (compared to 5-35% in southern Canada)[163]. Climate model projections for Canada[164,165] also indicate projected future increases in precipitation. Some variability is indicated, however, with decreases in precipitation projected in some areas within the northern Canada region.

Impacts of climate change on water in the north are already being realized and further impacts are projected[166]; some with global implications[167]. The vulnerability of northern First Nations communities to changes in water systems has also been identified as a primary concern in the north[5]. Specific climate change impacts related to water and water systems that are being realized or are predicted in northern Canada are described briefly below:

157 Lemmen et al, 2008
158 Ibid
159 INAC, 2010
160 Environment Canada, 2010
161 IPCC, 2008
162 NRCan, 2011
163 Lemmen et al, 2008
164 Ibid
165 NRCan, 2011
166 INAC, 2010
167 NRCan, 2011

Impacts of changes to the hydrologic cycle will impact ecosystems and habitat, including freshwater ecosystem balance, patterns of species/wildlife breeding and migration, and changes to vegetation zones.

- Decrease (melting/thinning) of Arctic sea ice[168,169]: The extent of Arctic sea ice during the late summer has decreased by 8% since 1979. Impacts of changes in Arctic sea ice include shoreline and infrastructure damage, and marine transportation impacts/changes.
- Degrading (melting) of permafrost[170,171,172]: Shallow permafrost temperatures have increased over the past few decades, but warming varies spatially and seasonally. Greater permafrost warming has been observed in the western Arctic. Further warming and thickening of the active layer (soil layer above permafrost that thaws seasonally) is projected to occur, with increase in active layer depth ranging from 0% to >50% over the next 50 years. Implications of permafrost degradation include effects on ground stability, buildings and infrastructure, transportation, hydrology, and increased generation of methane gas.
- Melting of glaciers and ice sheets[173]: Glacier retreat and volume decreases have been observed since approximately 1920 in the Arctic, with ongoing implications for sea level rise. Changes to glaciers may also impact micro-climates and habitat, stream hydrology, and water supply and quality.
- Sea level rise[174,175,176]: Rising sea levels in the Arctic Ocean may impact northern Canada coastal areas. Some areas experiencing vertical land uplift (due to isostatic rebound) may be less affected by areas experiencing subsidence where relative sea level rise will be more significant. Sea level rise could result in increased flooding, coastal erosion, and impacts to coastal infrastructure and remote communities.
- Changes to snow and ice cover[177,178]: Although there have been observed increases in the total amount of snow, there has been a decrease in average snow cover duration by approximately 20 days since 1950. Changes to snow cover have implications for transportation on winter ice roads, hydrology, and permafrost stability.
- Changing hydrology of rivers[179]: Impacts due to changes in river hydrology such as changing levels and flows and warmer temperatures include ecosystem/habitat degradation and change, water supply and quality issues, effects on

168 Lemmen et al, 2008
169 INAC, 2010
170 Lemmen et al, 2008
171 INAC, 2010
172 Environment Canada, 2010
173 Lemmen et al, 2008
174 Lemmen et al, 2008
175 NRCan, 2011
176 Environment Canada, 2010
177 Lemmen et al, 2008
178 Environment Canada, 2010
179 Lemmen et al, 2008

hydroelectric power generation, and changes in navigable waters due to sediment deposition.

- Water-related impacts to habitat and ecosystems[180,181]: Impacts of changes to the hydrologic cycle will impact ecosystems and habitat, including freshwater ecosystem balance, patterns of species/wildlife breeding and migration, and changes to vegetation zones (impacts to food security for northern communities).
- Increasing weather variability and extremes[182]: Extreme weather events (storms, drought, etc.) may cause increases in forest fires, impacts to small or remote communities, impacts to transportation, changes to forests (e.g. pests),

2. ATLANTIC CANADA

Climate across Atlantic Canada is variable and influenced by the Atlantic Ocean and the cyclic North Atlantic Oscillation, and inland influences. There is significant variability across the region with respect to both trends in climate and projected changes[183]. Despite spatial variability, some general trends are observed across the region.

Trends based on historical data indicate seasonal temperatures for Atlantic Canada exhibited an overall increase of 0.3°C over the period from 1948-2005. Temperature increases were observed in summer, spring, and fall, and decreases in temperature were observed in winter (-1.0°C)[184]. Future temperature projections[185] suggest temperature increases of 2-4°C in summer and 1.5-6°C in winter, by 2050. Coastal areas are predicted to experience less change in temperature than interior areas.

Over the period between 1948 to the 1990s, average precipitation increased in Atlantic Canada by approximately 10%[186]. Global climate models[187] project increases in overall annual precipitation ranging from 0-10% by 2050. Seasonal and yearly variability of precipitation will increased and interior regions may experience drier summer conditions due to increases in evapo-transpiration losses[188].

Climate change impacts related to water identified as significant for Atlantic Canada are briefly described below:

- Sea level rise[189,190,191,192]: One of the most significant influences of climate change for Atlantic Canada is a rise in sea level. Effects include: higher storm surges, more coastal erosion, flooding, damage to coastal infrastructure (e.g. harbours), sea water intrusion impacting fresh water resources, changes to estuaries, and impacts to fisheries. The magnitude of relative sea level rise along Canadian coastlines depends up on whether the coast is experiencing crustal (glacio-isostatic) rebound or subsidence. Regional land subsidence has been identified along most of the Atlantic coastline, which has doubled the rate of relative local sea level rise (e.g. Charlottetown: relative sea level rose 32 cm over the 20th century).
- Decrease (melting/thinning) of Arctic sea ice[193]: Impacts of a reduction in sea ice are similar to those identified for northern Canada (see above).
- Changing ocean temperatures[194]: Due to the importance of the fisheries industry to the economy in Atlantic Canada, impacts to marine ecosystems are a primary concern related to climate change. Changes (increases) in ocean temperatures have been identified as a potential impact to fisheries.

180 Ibid
181 INAC, 2010
182 Lemmen et al, 2008
183 Ibid
184 Ibid
185 NRCan, 2011
186 Lemmen et al, 2008
187 NRCan, 2011
188 Lemmen et al, 2008
189 Ibid
190 INAC, 2010
191 Environment Canada, 2010
192 Atlantic Environment Ministers, 2008
193 Lemmen et al, 2008
194 Ibid

- Changes to hydrology with possible reductions in summer stream flows[195]: As with other regions across Canada, changes to river/stream hydrology are predicted. Hydrologic changes are likely to influence water supply and quality, water storage, and/or ecology and habitat.
- Changes to groundwater replenishment[196]: Groundwater is an important water source for many parts of Atlantic Canada (e.g. southern NS, eastern NB, and PEI). Despite projected increases in precipitation, it is predicted that concurrent increases in evaporation/evapo-transpiration will offset precipitation increases and may lead to a reduction in groundwater recharge.
- Extreme weather events[197,198]: Increases in extreme weather events are predicted across Canada. Atlantic Canada is particularly susceptible to associated increases in flooding and storm surges.
- Anticipated changes to water supply and demand[199]: Longer growing seasons are projected for the region. Changes to water supply (surface water and groundwater) due to hydrologic and replenishment changes, as well as increased water demand are projected.

3. QUEBEC

The province of Quebec has a large areal extent and consists of four sub-regions (south, maritime, central, and north) all of which have their own unique climate characteristics and vulnerabilities[200]. Because of the physiographic/climate differences across the province, climate trends based on historical data are also variable. The use of increasingly sophisticated climate models provides predictions for climate parameters for several regions, and trends are apparent[201]:

Temperature trends based on historical data indicate statistically significant rises in annual temperature over many decades. Data indicate that, during the 20th century, northern Quebec warmed faster than the rest of the province, increasing 2.9°C from 1922 to 2004 at one station, and observed as a more recent phenomenon at other stations. It is projected that northern Quebec will experience the most dramatic changes in climate. A warming trend is observed between 1960 and 2003 of 0.5-1.2°C across southern Quebec. Projected temperature increases (predominantly in the cold season) are also indicated using six global climate models and different emission scenarios[202].

Historical precipitation trends across the province indicate an increase in total annual precipitation with an increase in number of days of rainfall (due to higher temperatures). The general trend, of increasing seasonal precipitation in winter and spring, is indicated with global climate model predictions. GCM predictions of precipitation changes are uncertain for southern and maritime sub-regions of Quebec.[203]

The predominant impacts of climate change on water, and resulting impacts to the region of Quebec are variable due to the spatial variability of climate and climate change across the province and differences in vulnerabilities (e.g. differences in demographics, socio-economic conditions, culture, resources, etc.). The following points identify some predicted influences of climate change for Quebec:

- Increases in water demand[204]: Increases in temperature will result in increased growing degree days, increased heating degree days, and a longer frost-free season. These effects are anticipated to impact both water supply and demand for agriculture and domestic use.
- Decrease in ice/snow cover[205]: The ice/snow cover is projected to decrease/shrink and is a particular concern for

195 Ibid
196 Ibid
197 Ibid
198 Atlantic Environment Ministers, 2008
199 Lemmen et al, 2008
200 Lemmen et al, 2008
201 Ibid
202 Ibid
203 Ibid
204 Ibid
205 INAC, 2010

northern Quebec. Changes to ice/snow cover could impact hydrology, transportation, and traditional way of life for northern and remote communities.

- Changes to hydrology and lakes[206]: Changes to hydrology and lakes have impacts for the natural environment, ecosystems, hydroelectricity generation, habitat, and water supply and quality. Quebec hydroelectric power generation is highly climate-dependent.
- Sea level rise[207]: Sea level rise is predicted to impact maritime Quebec including the St. Lawrence River. Maritime Quebec will experience increased shoreline erosion which could in turn impact both ecology (fisheries), navigation, and infrastructure (structures, harbours).
- Increased intensity and duration of extreme weather events[208]: Extreme weather events in Quebec such as ice storms, heat waves, drought, and winter storms are anticipated to increase, with potential impacts to communities, infrastructure, water quantity/quality, and the environment.
- Loss of permafrost[209]: Increasing temperatures and melting of permafrost are anticipated for northern Quebec, as described for northern Canada (see above).

4. ONTARIO

Ontario's climate varies significantly from season to season and from south to north[1]. Ontario is also subject to a variety of extreme weather events (e.g. tornadoes, heat waves, drought, snow/ice storms). The Great Lakes provide a major climate-influencing factor for the southern part of the province, causing "lake effect snow", and microclimate influences[210,211].

Across Ontario, historical data indicate trends of increasing annual temperature (over the last half of the twentieth century) ranging from 0-1.4°C. Greater increases in temperature are observed in the spring. Increases in the number of warm days and warm nights are observed, with the largest increase in warm days observed in the north. Global climate model predictions, ranging from conservative to aggressive with respect to emission rates, indicate increases in annual temperature within the next 20-50 years as well as greater temperature extremes. Maximum warming is predicted to occur in the north during the winter season.[212]

With respect to precipitation (rain or snow), annual precipitation in the south and central portions of the province has increased from approximately 5-35% since 1900. Snowfall has increased in the north. Variability of precipitation, across the province and seasonally, leads to uncertainty in trends for some areas. Global climate model predictions for precipitation are somewhat variable and indicate increases in annual precipitation for some areas (with the greatest increases in the north), and slight decreases in other areas of the province.[213]

The following climate change impacts related to water are examples may be important for the Ontario region:

- Changes to Great Lakes water levels[214,215]: Decreases in Great Lakes water levels are projected to have significant impacts for southern Ontario. A lowering of levels (projected to be between 0.5-1.0m[10]) has implications for water management (supply and treatment), hydroelectric power, transportation, agriculture, tourism/recreation, the St. Lawrence River outflow (may be reduced by 20%)[10], and ecosystems and habitat.

206 Rodenhuis et al, 2009
207 Lemmen et al, 2008
208 Ibid
209 INAC, 2010
210 Lemmen et al, 2008
211 Hall and Stuntz, 2007
212 Lemmen et al, 2008
213 Ibid
214 Environment Canada, 2010
215 Rodenhuis et al, 2009

- Increases in Great Lakes temperature[216,217]: Warming of Great Lakes waters may impact ecosystems, and cause algae blooms and invasions of non-native species. Temperature increases may result in decreases in water quality for communities that use this water.
- Changes to hydrology[218]: Changing hydrologic systems (stream flow, lake renewal) may impact ecosystems, water supply and quality, hydroelectric power generation, agriculture, and transportation of navigable waters.
- Extreme weather events[219]: Extreme weather events (floods, droughts, high intensity storms, etc.) are projected to have impacts on water quality and quantity, infrastructure, potential for forest fires, and agriculture. Human health may also be influenced due to water born disease or mosquito-borne disease outbreaks as a result of extreme weather events.
- Earlier onset of lake-ice breakup[220]: On the Great Lakes (and other large lakes), the season of ice cover has been shortened up to two months during the last 100-150 years. Impacts of early ice melting include greater evaporation losses, shoreline erosion, and possible influences on lake-effect snowfall.
- Increases in seasonal water shortages (exacerbated by increasing populations)[1]: Communities rely on both surface water and groundwater, both of which are susceptible to climate change and extreme weather events such as drought. Seasonal water shortages may also impact agriculture.

5. PRAIRIES

The Prairies region includes Alberta, Saskatchewan and Manitoba, extending from Hudson Bay to the Rocky Mountains, and spans several major climatic zones. The Prairies region represents the driest region of Canada. Increases in water scarcity and increased frequency of/duration of drought are the most serious climate risks for the Prairie Provinces which rely on agriculture and forestry as major economic contributors.[221]

Climate trends show increases in temperature averaging 1.6°C for 12 stations since 1985. Increases in temperature are more pronounced since the 1970s. Global climate model projections to the 2080s also indicate temperature increases, with the greatest warming projected in the north and east.[222]

Annual precipitation decreases are the general trend. The number of days with precipitation increased during the last 75 years but the amount falling on each day was low (generally less than 5mm). Both increases and decreases in precipitation are projected by climate models, which provide variable predictions seasonally and across the region. Increases in precipitation, however, are projected to be cancelled out by increases in evaporation causing summertime drying.[223]

The most significant impacts of climate change for the Prairies are related to changes in the water supply, which is a result of changes to the hydrologic cycle (precipitation, recharge to groundwater, evaporation/ evapo-transpiration, stream flow and run-off, lake replenishment, and changes to ice and snow). The following examples illustrate how changes to the water cycle could influence the Prairie region:[224]

- Water scarcity and increased drought frequency: Drought and water shortages have high economic impacts for agriculture, which may be exacerbated by increases in forest fires or pests (also resulting from drought conditions).
- Lower summer stream flows: Winter warming, a reduction in snow accumulations in alpine areas, glacier retreat, and increases in evapo-transpiration, will influence stream flow and stream flow timing, and thus surface water

216 Environment Canada, 2010
217 Rodenhuis et al, 2009
218 Ibid
219 Ibid
220 Ibid
221 Ibid
222 Ibid
223 Ibid
224 Lemmen et al, 2008

supplies. Ecological impacts may also result from changes to stream flow.

- Changes to groundwater resources: Future groundwater supplies may increase in some regions and decrease in others, a reflection of the complex balance between recharge, discharge, and groundwater storage.
- Falling lake levels: Declines may represent the combined effects of water use and climate change.
- Increasing soil and surface water deficits[225]: Increases in moisture deficits would result from increased evapo-transpiration rates and may impact agriculture and ecosystems.
- Impacts to ecosystems: Shifts in bio-climate and changes to disturbances such as insects and fire as a result of changes to the water/climate systems are projected. Impacts could include livelihoods of First Nations communities and agricultural/forestry industries.
- Increased water demand: Increases in water demand for agriculture and domestic use is projected due to growing population and water scarcity, and drought.
- Changes to water quality: A range of threats related to water quality for across the Prairies may be exacerbated by climate change.

6. BRITISH COLUMBIA

British Columbia has a diverse climate due to the combined effects of the Pacific Ocean, the North American landmass, and variable topographic relief. In addition, BC climate is influenced by El Niño and La Niña climate oscillations and the Pacific Decadal Oscillation. Despite significant climate variability, as well as climate data gaps across some regions of the province and at higher elevations, some general climate trends are documented[226,227]:

Although there is spatial variability across the province, analysis of historical data for the 20th century (1901-2004) indicates overall increases in mean, minimum and maximum temperatures, with the greatest increases observed in minimum temperatures. Average annual temperatures have warmed by between 0.5-1.7°C (a maximum of 0.17°C per decade), varying across the province[228,229]. Climate predictions using GCMs and emission scenarios also suggest warming temperatures across BC[230,231] from 1.2-2.5°C.[232]

With respect to total annual precipitation, data over the past century indicate general increases in annual precipitation across the province (2.4% per decade), with the greatest increases occurring in winter and across drier areas of the province. Decreases in precipitation, however, were identified for shorter record periods (50 and 30 years). Climate predictions also suggest increases in precipitation by 3-11% across BC, mainly in winter[233]. Both decreases and increases in precipitation are projected in the summer (-9-% to +2%), with the south and the coast projected to become drier[234].

The following climate change impacts on water may be significant in BC:

- Decline in snowpack[235]: A decline in snowpack of up to 55% is predicted, with the most significant effects in the coastal mountains. (Influences of changing snow pack on the stream hydrograph (streamflow) are discussed below.)
- Glacier melt[236]: Glacier volume loss has been measured in BC. Impacts to glaciers may influence hydrology (as

225 Ibid
226 Rodenhuis et al, 2009
227 Schnorbus and Rodenuis, 2010
228 LiveSmart BC, 2010
229 Schnorbus and Rodenuis, 2010
230 NRCan, 2011
231 Schnorbus and Rodenuis, 2010
232 Lemmen et al, 2008
233 NRCan, 2011
234 Rodenhuis et al, 2009
235 Ibid
236 Ibid

discussed below) and hydro-electric power generation. Micro-climates and ecology/habitat may also be influenced by changes to glaciers.

- Changes to streamflow[237,238]: Streamflow hydrographs are shifting due to changes in snowpack and glaciers, timing of melting, and changes to type of precipitation (snow or rain), with earlier freshet and lower summer flows. Coastal systems are becoming rainfall dominated, and interior streams are experiencing lower summer flows due to loss of snowpack and earlier melting. Changes to stream flow have the potential to impact water supply (quantity and quality), reservoir storage, hydroelectric power generation, flood control, and in-stream flow needs for fish habitat. Water supply impacts could exacerbate conditions in areas of BC that are already water-stressed (e.g. Vancouver Island and the Okanagan). Changes in stream flow also have the potential to have trans-boundary influences between Canada and the USA.
- Increases in frequency and magnitude of extreme events[239,240]: Extreme weather events in BC (e.g. windstorms, forest fires, storm surges, landslides, snowstorms, hail and floods) have the potential to impact communities and community infrastructure, hydroelectric power generation infrastructure, water quality, water quantity, slope/land stability, and ecosystem health.
- Sea level rise[241,242]: Along the west coast, relative sea level rise has ranged from 4cm in Vancouver to 12 cm in Prince Rupert, while sea level has dropped by 13 cm in Tofino due to vertical land movements. Sea level rise may result in impacts to coastal infrastructure, and low lying areas (e.g. Vancouver area) would be particularly vulnerable.
- Decreased duration of lake ice[243]: The spring break-up of lake ice is occurring earlier for most monitoring stations. Impacts include ecological and habitat impacts, and impacts to hydrology.
- Impacts to ecosystems and habitat[244]: Changes to the hydrologic cycle and temperatures may impact ecosystems and habitat including BC fisheries.
- Increases in water demand[245]: Increases in agricultural, domestic, and in-stream, water demand due to higher temperatures and longer growing season are projected and may have significant impacts for water-stressed regions.

237 Ibid
238 Schnorbus and Rodenuis, 2010
239 Lemmen et al, 2008
240 Schnorbus and Rodenuis, 2010
241 Lemmen et al, 2008
242 NRCan, 2011
243 Rodenhuis et al, 2009
244 Lemmen et al, 2008
245 Ibid

APPENDIX B - CORE PROVINCIAL STATUTES REGULATING WATER, BY PROVINCE

Table 16 - Core Provincial Statutes Regulating Water, By Province[246]

NEWFOUNDLAND
- Water Resources Act (2003, 2004, 2005)
- Municipalities Act (1999)
- Public Health Act (1996)
- Labrador Inuit Land Claims Agreement Act (2005)

NOVA SCOTIA
- Environment Act (1994, 1998, 2001, 2004)
- Water and Wastewater Facilities and Public Drinking Water Supplies Regulation (2005)
- Municipal Government Act (1998, 2001, 2002, 2004)
- Water Resources Protection Act (2000)

NEW BRUNSWICK
- Water Act (1989, 1990, 1994, 2000, 2001, 2002)
- Municipalities Act (1973, 1981, 1995)
- Public Utilities Act (1973)
- Health Act (1988, 2005)

PRINCE EDWARD ISLAND
- Water and Wastewater Facility Operating Regulations (2004)
- Sewage Disposal Systems Regulation (2004)
- Water and Sewerage Act (1988, 2003)
- Environmental Protection Act (1988, 2005)
- Water Wells Act (1988, 2004)

QUEBEC
- Watercourses Act (1964, 1979, 1994, 1999, 2003)
- Environment Quality Act (2005)
- Public Health Act (2001)
- Water Resources Preservation Act (2001)

ONTARIO
- Ontario Clean Water Act (2006)
- Ontario Water Resources Act (1993, 1998, 2000, 2001)
- Municipal Water / Sewage Transfer Act (1997)
- Safe Drinking Water Act (2002)
- Sustainable Water / Sewage Systems Act (2002)
- Annex Agreement to the Great Lakes (2005)
- Nutrient Management Act (2002)
- Water Transfer Control Act (1990)
- Drainage Act (1990)
- Lakes and Rivers Improvement Act (1990)
- Environmental Bill of Rights (1993)

MANITOBA
- Drinking Water Safety Act (2002)
- Water Rights Act (1987, 2005)
- Water Supply Commissions Act (2005)
- Water Resources Conservation and Protection Act (2000)
- Water and Wastewater Facility Operators Regulation (2003)
- Ground Water and Well Water Act (2001)

SASKATCHEWAN
- Environmental Management and Protection Act (2002)
- Water Regulations (2002)
- Conservation and Development Act (1978)
- Saskatchewan Watershed Authority Act (2005)
- Rural Municipalities Act (1989)
- Water Corporation Act (2002)
- Public Health Act (1994)
- Groundwater Regulations 172/66 (2002)
- Health Hazard Regulations (2002)

ALBERTA
- Water Act (2000)
- Public Utilities Board Act (2000)
- Environmental Protection and Enhancement Act (200)
- Municipal Government Act (1994, 1995, 2000, 2003)
- Standards and Guidelines for Municipal Waterworks, Wastewater and Strom Drainage Systems (1997)

BRITISH COLUMBIA
- Drinking Water Protection Act (2001)
- Drinking Water Protection Regulation (2003)
- Water Act (1996, 1988, 2000, 2004)
- Water Protection Act (1996)
- Environmental Management Act (2003)
- Water Utility Act (1996)
- Environmental Assessment Act (2002)
- Fish Protection Act (1997)
- Dike Maintenance Act (1996)
- Drainage, Ditch and Dike Act (1996)

YUKON
- Yukon Waters Act and Regulation (2003)
- Waters Regulation, Bulk Delivery of Drinking Water Regulation (2003)
- Public Health and Safety Act (2002)
- Public Utilities Act (2002)
- Environment Act (1991, 2002)

NORTHWEST TERRITORIES
- Water Resources Agreements Act (1988, 1995)
- Public Health Act (1990, 2004)
- Public Water Supply Regulations (1990, 2004)
- Public Utilities Act (1988, 1993, 1995, 1998, 1999, 2004)
- Environmental Protection Act (1988, 1991, 1998)
- Environmental Rights Act (1988, 1999, 2000)

NUNAVUT
- Nunavut Waters and Surface Rights Tribunal Act (2002)
- Nunavut Power Utilities Act (1999)
- Public Utilities Act (1999)

246 Adapted from: Hill, Carey, et al. "A Survey of Water Governance Legislation and Policies in the Provinces and Territories." Appendix 1 in Bakker, K. (Ed.), Eau Canada: The Future of Canada's Water. Vancouver: UBC Press (2007)

APPENDIX C - ACT OKANAGAN WORKSHOP REPORT

INTRODUCTION AND BACKGROUND

On October 27, 2010, ACT and *Water* session policy author Bob Sandford, Chair of the Canadian Partnership Initiative of the United Nations International "Water for Life" Decade, hosted the first of three regional roundtables on water governance and climate change adaptation in Canada. This first event was specifically designed to support and develop a case study ACT has developed on the Okanagan Basin and its water governance structures as they relate to climate change, and was convened with the help and support of the Okanagan Basin Water Board (OBWB). This case study is a central component in ACT's upcoming final session report, and is intended to frame water governance issues in a bottom-up context.

The following two roundtables, held in Sydney, Cape Breton, and Yellowknife, Northwest Territories, were designed to provide insight into water governance and climate change adaptation measures in other areas of Canada, and provide an opportunity to compare both challenges and approaches in three very different regions with widely varying demographics, aquatic ecosystems, resources, and economic drivers. Our goal is to identify common approaches in order to draw conclusions about governance solutions that may be applicable in all cases, as well as aspects of governance that are local by definition.

The workshops used Open Space Technology to engage participants in discussion regarding past experiences, current challenges and approaches, concerns and possible solutions. Participants represented a comprehensive cross-section of involved groups including: First Nations, local, regional, and municipal government, Interior Health Authority, University of British Columbia Okanagan, real estate, agriculture and other industry including utilities and practitioners. This document summarizes the major themes that emerged from the group discussions at the workshop and the takeaway messages formulated by each group.

THEMES

Discussion topics were generated for round table discussions through a preliminary brainstorming session in which participants were asked to provide written questions or concerns related to water and adaptations to climate change. These questions were then organized or grouped into categories for the round table discussions. This section summarizes the key concerns and major themes that emerged during the discussions:

1. Nested Governance – Governance Structure and Authority
2. Effective Governance
3. Politics and Water Management Decisions
4. Including First Nations – Knowledge Sharing and Communication
5. Discussion and Dialogue
6. Incentives
7. Water Allocation/Legislation
8. A New Water Ethic

1) NESTED GOVERNANCE – GOVERNANCE STRUCTURE AND AUTHORITY

Nested governance was a common topic that was discussed in different contexts by many of the groups. The general concept of nested (or multi-level) governance was considered appropriate for effective water management in the basin. It was also generally agreed that the Okanagan has the fundamental building blocks for an effective nested governance system, but that some problems with governance structure and authority remain.

Nested governance, in general, was defined as including all levels of government from local to federal (a "vertical" structure). It was also suggested that "horizontal" structure is an important element of nested governance, as it allows for sharing and consideration of voices, principles, and ideas between governance levels and interested organizations. The OBWB was considered a key player in the nested governance structure of the Okanagan, with the role of providing a "space" for sub-regional levels of government and First Nations to bring together ideas, coordinate funding, synthesize perspectives, and create projects.

Participants recognized that, while a clear foundation for a nested governance structure exists in the Okanagan, there are some deficiencies and uncertainties. Some groups questioned whether there are sufficient levels of government in the basin to truly form a nested governance structure, and whether the roles defined for each level are clear. It was suggested that the involvement of both watershed-based (i.e. the OBWB) and sub-watershed-based governments are necessary for effective nested governance. The ability to establish policy that can be effectively translated into application is also a key focus, as the practitioner/operational level must be carefully considered to make policies practical.

Concern was expressed regarding how to ensure that First Nations are included; it was also suggested that, while local/regional levels should play a key role with respect to water management decisions, a higher level of government (provincial or federal) should play an overarching role in terms of "coordinating", "reviewing", and "monitoring", but with some deference to regional/local level governments. The new provincial Ministry of Natural Resource Operations, which covers many aspects of water governance, was identified as a possible overarching higher level of government.

Authority and roles of different government levels were identified as key issues in working toward a truly nested governance structure. Some degree of regional authority was identified as necessary to address region-specific issues. It was suggested that under the umbrella of higher-level governance, a regional body should have approval or veto power regarding water management decisions. It was also suggested that the province should relinquish some authority to regional/local levels of government. A lack of enabling legislation was identified as a major roadblock in establishing an effective nested governance structure both for the ability to form regional sub-watershed government bodies and for defining authority.

2) EFFECTIVE GOVERNANCE

The theme of effective governance parallels the theme of nested governance structure and authority, but is all-encompassing in terms of the general effectiveness of water governance in the basin. Concerns were expressed regarding communication deficiencies, unclear responsibilities, jurisdictional fragmentation, and confusion over Okanagan water governance.

At present, roles and responsibilities are somewhat unclear and there is a high degree of fragmentation, in which a variety of levels of government are responsible for different water-related decisions/policies, and some government organizations have competing interests. Continuity in government, jurisdictional harmonization, and working toward a truly integrated approach were identified as major areas for improvement. The province has made some progress resulting from a MOU suggesting separate ministries meet to establish ways to work in a more integrated way to address water management issues; however, this progress will only be effective if it can withstand future government re-organization.

Regional representation can bring issue-based concerns into such a cross-ministry forum. To be successful, however, regional representatives need to bring clarity of purpose and solutions that work to the table. A recent battle over keeping cottage development out of the headwaters area of the Okanagan Basin is offered as a case in point; it took the cooperation and forceful advocacy of every authority in the basin to make sure that the provincial government did not undermine local values and wishes by simply granting permits for such development on Crown land to large provincial development interests.

Concerns were expressed related to governance and integrated watershed planning: a particularly important water management aspect in the Okanagan, where upstream actions/activities affect downstream water users. Needs for improvement included the need for a clear statement on how water is to be managed, the need for clarity and equality in regulation and enforcement, the need to establish a working environment with First Nations that considers cultural needs and fosters consensus building and communication, and the need for collaboration between different higher-level ministries to identify/address potentially competing interests (e.g. logging and source water protection (SWP)). One suggestion outlined the possibility of associations for each sub-watershed similar to the OBWB at the Basin level.

Some groups identified "solutions" or ideas to improve water governance in the basin and address some of the needs identified above. One suggestion was the development of a document clarifying how water is to be managed within the Okanagan governance framework/structure (similar to the OBWB Water Governance Manual). Such a document would clearly define roles and responsibilities, and work to address some of the inefficiencies of water governance in the basin. Suggestions also included the proposal that there should be a single system for policy application within the basin, which would decrease existing fragmentation and promote a truly integrated approach. The development of groundwater legislation was also identified as a necessary part of moving forward with effective governance.

3) POLITICS AND WATER MANAGEMENT DECISIONS

Participants felt that public perception, public support, and how these interact with politics around water management decisions in the Okanagan are an important factor in future planning. (Strategic political decisions were conceptually distinguished from day-to-day decisions that should not be influenced by politics.) The discussion revolved around how to decrease the negative impacts and increase the positive effects of the influence of politics on decision-making.

Establishing standards that are harmonized across jurisdictions was identified as important for de-politicising day-to-day decisions that need to become established practices and actions. Clearly established, thoroughly researched, and thoroughly debated standards (and requirements to adhere to standards) may minimize the potential for political roadblocks to have negative effects on ongoing progress and maintenance of adaptive water management. Discussion and debate regarding unresolved water issues pertaining to standards should therefore be initiated and addressed before political decisions are made.

Leadership plays a critical role in depoliticizing water management decisions. It was suggested that the OBWB could encourage other levels of government to formalize standards and requirements in regulation, and that water experts and knowledgeable others should take a "leadership role" and support those in public office who, in turn, support potentially unpopular decisions with respect to climate change adaptations and water management.

A parallel issue identified alongside the need to depoliticise water management decisions is the need for improved communication/education to generate informed public opinion regarding water issues and the need for adaptations (i.e. for informed political influence). Public scepticism regarding climate change issues was identified as a major obstacle to progress. It was suggested that there is a need for some form of multi-pronged social marketing program in basin communities, and the need to change public behaviours with respect to water use (e.g. lawn watering).

An idea put forward was the use of a referendum on (for example) drought preparedness, to promote public involvement and interest, encourage debate, and increase awareness so that public support for "unpopular" water management actions/decisions may be generated.

4) FIRST NATIONS: KNOWLEDGE SHARING AND COMMUNICATION

A number of groups identified the importance of knowledge sharing and communication with First Nations to achievement of effective adaptive water management in the basin, especially as many Nations have already developed and implemented effective adaptive approaches that could be showcased as examples of sustainable solutions.

The need for more effective First Nations involvement in Okanagan water governance processes is highlighted by the fact that highland precipitation, falling on First Nations traditional lands, replenishes water resources used by non-First Nations communities located in the valley bottom. Respect for First Nations knowledge (TEK and adaptive case studies completed by First Nations) and their cultural and spiritual relationship with water and associated values was identified as an important aspect of ensuring First Nations are included in water management discussions.

It was suggested that, historically, water agreements were established by "local consensus" but that the situation is more complex now, as it is increasingly acknowledged that First Nations' water rights and treaty claims must be taken into account and respected as a sensitive and influential issue. Source water protection is a key issue for First Nations, as all water in the Basin originates as precipitation on their lands. One participant posed the question: "How can you work toward source water protection without agreements in writing?"

It was agreed that there is a need for First Nations and local government to agree upon a secure environment/place for discussions in which First Nations feel they truly have the ability to make a difference. Another important factor is the need to acknowledge capacity issues within First Nations, who have limited resources for attending meetings; as well as the need to overcome First Nations' ingrained belief that their views will not be honoured but will simply be included as a form of tokenism. For instance, the OBWB is financed through local taxes that are not paid by First Nations, and there is some doubt as to the viability of their being given a decision-making role as a result, if only on their part.

Written agreements or MOUs with the Okanagan Nation Alliance – ensuring freedom from the concept of consultation in local water governance involvement and acknowledgment of the importance of their role, as well as the significance of their traditional lands in the aquatic ecosystem – may therefore be one factor that is necessary to facilitate more in-depth First Nations involvement in decision-making.

It was also suggested that it would be useful to establish a specific communications process involving First Nations to encourage and facilitate their participation as a priority in ensuring they have an equal presence at the water governance table. Also, participants noted that this inclusion process is also the responsibility of First Nations – they must be prepared to drive their own involvement as much as possible, and make the effort to overcome past barriers.

5) DISCUSSIONS AND DIALOGUE

The importance of discussion and dialogue in working toward adaptive water management was emphasised by a number of round table groups. There are differences of opinion, however, regarding the nature and purpose of discussion and dialogue.

Discussion and dialogue were seen variously as: exploring and understanding the complexity of issues, making decisions, inclusion, sharing information, acknowledgment, respecting others, a forum for honesty, participation, trust building, consensus building, realizations, and/or generating empathy.

The general consensus is that all these iterations of discussion and dialogue are important and necessary and should be encouraged and promoted. For instance, roundtables such as the ACT event could be used to help develop an ethical framework and promote understanding between groups as well as help to educate the public. It was noted that appropriate timeframes for discussions and dialogue are important in order to ensure effective engagement of all parties, with careful use of deadlines to move specific important things forward.

It was suggested that dialogue should be inclusive, and that there is currently a noted disconnect between government and community that dialogue could help to address.

6) INCENTIVES

This theme considered ways to engage individuals or water user groups and motivate behavioural change through incentives. Two approaches were identified: the "carrot" approach (reward-based) and the "stick" approach (penalty-based).

Examples of "carrot" incentives included: developing water conservation incentives for businesses (e.g. sustainability awards, green program for hotels), increasing knowledge of existing federal/provincial incentive programs, education and awareness (e.g. improve water bill breakdown), sustainability features in homes as marketing tool. Competitiveness was also suggested as a possible "carrot" incentive.

Examples of "stick" based approaches included: Local improvement charges (LICs), Development Cost Charges (DCCs), building code requirements, health requirements, metering and water pricing.

The complexity of establishing, enforcing, monitoring, and rewarding was identified as an important consideration regarding incentives. This concern was identified as particularly important for agriculture (the biggest water user in the valley), due to the costs associated with changing agricultural water systems, differences in crop requirements, jurisdictional, and other issues.

Another issue identified with respect to incentives is the possibility of conflicting regulations (e.g. health regulations and the re-use of grey water). In general, there are difficulties in developing incentives, and a clear regulatory framework may be needed for some programs.

One important consideration for any incentive development is the need for adequate data. Reliable data are needed to design incentive programs, implement them, monitor them, and follow up with rewards/penalties. The accuracy of available measurements (e.g. water use) must be considered. Individuals need to feel they have control over conservation, and see a reward for conserving water.

Water metering and water pricing as incentives (either carrot or stick) were discussed by a number of groups. Concerns raised included the potential for water pricing/metering to have the most influence on those who cannot afford to pay. Water pricing/metering was likened to commoditization of water, which is a contentious issue. It was suggested that water pricing must consider the "real" cost of water, including infrastructure system renewal, asset management mechanisms, and future infrastructure needs (i.e. storage).

It was also suggested that communication is needed to prepare residents now for future increases in pricing to reflect the cost of water.

7) WATER ALLOCATION/LEGISLATION

Stricter water allocation mechanisms may be an emerging need in the Okanagan as population growth continues and the effects of climate change become more apparent. It was suggested that the Okanagan may need to increase its upland water storage mechanisms to augment water availability and offset future scarcity as much as possible. There is also a clear need to increase rural-urban cooperation on water allocation, as there is equally a need to educate all users about other users and competing needs and requirements (see #5).

Water allocation decisions may reduce some disagreements regarding water, however, a few potential issues were identified:

- Under the First In Time, First In Right (FITFIR) allocation basis, the ecosystem is not considered in the granting of water licences.
- People are fiercely protective of existing water licences, particularly with water scarcity concerns.
- There is a need to define future water requirements of First Nations in this region; culturally, they have a sharing

ethic that should be considered and that should not be allowed to impact them negatively.

- First Nations want a larger say in how water is managed in terms of rights and title.
- Effectiveness of water allocation decisions will partly depend on education of the public regarding the myth of water abundance (see Water Ethic discussion in #7).

Water allocation mechanisms might also benefit from a common water pricing strategy, although as noted above there are concerns about the commoditization of water, as well as the under-representation and -valuation of ecosystem goods and services as well as ecosystem needs. However, it was noted that due to demographic changes and climate change impacts, water rates ten years from now will likely no longer resemble what exists today, and that it would be prudent to plan pro-actively for future pressures, especially as existing regulations are not adequate to offset the hydrological impacts of pine bark beetle devastation and outdated former forestry practices such as clear-cutting.

As there is no groundwater legislation in BC, anyone who wants to augment surface water availability or needs more water than is readily available simply punches in a new well. This situation clearly underscores the urgent need for provincial groundwater legislation.

Raising water rates and recycling a portion of the proceeds visibly (via bills?) into water conservation measures could improve source protection.

Coach farmers on water conservative crops; introduce water metering?

8) A NEW WATER ETHIC

Some groups indicated a need to examine and change in the current water ethic - a change in how we view water and how people use it. Some principles of a water ethic were suggested such as: water stewardship and sharing (versus entitlement), assuming responsibility (versus "a right"), respect for water. It was noted that it is difficult to articulate and define ethics.

It was suggested that we may be able to develop a framework to decide what is ethical or not (i.e. to guide decision making). This type of framework is used by the health sector to ensure ethical decision-making. Any policy decisions must meet and acknowledge the value/ethical statements in the framework, thus such a framework would hold decision makers and citizens accountable. Such a framework would also provide for a better understanding of the risks of not making decisions.

An ethics framework should be based on anticipation of issues, incorporate/consider all people affected by decisions, and employ cultural indicators, health indicators, and other indicators. First Nations link health and justice as incorporated into their value system; a similar link could be developed into an ethical framework. Medicine's ethical framework key components include: do good, avoid doing harm, respect autonomy, and justice (do not unfairly victimize one person at the benefit of another). There must be a good reason for any deviation from the framework.

An ethical framework will be even more vital as we see water shortages, as water allocation emerges. One issue identified was how to consider difference in ethical issues associated with individual versus collective values.

CONCLUSION

Participation in the Okanagan roundtable was outstanding; with senior representatives of all sectors attending and sharing valuable, in-depth information on the processes they have developed or are interacting with, and suggestions for the most effective ways to move forward.

Coordination between governments and decision-making bodies was identified as a major concern for effective water governance, as was the involvement of First Nations as both a knowledgeable and an influential decision-making

government body. The public's influence on political ability was also noted, and led to the highlighting of effective communications as a key requirement in future processes.

Data collection and monitoring are essential components of all the above, needed both to make effective decisions and inform the public of their significance. Measures such as water allocation and metering, which may be needed as water stress in the Okanagan intensifies under climate and population changes, will depend on the data available for their planning and implementation.

Finally, the perception of water's value, and our understanding of how it should be managed, may benefit from a radical re-think of the ethics we have developed surrounding its use and our relationship with aquatic ecosystems. This is a complex issue that like all of the above requires further discussion; however, it may well prove the answer to many of the issues raised.

Further analysis of the conclusions from the Okanagan workshop will emerge in conjunction with the reports from the other two regional workshops, as we identify common challenges and approaches for inclusion in our policy recommendations in the final *Water* report.

WORKSHOP REPORT ANNEX: OKANAGAN BREAKOUT GROUPS, DISCUSSION TOPICS AND TAKEAWAY MESSAGES

AM OSOYOOS

Discussion topics:

- How can we best promote working together/cooperation within a region?
- Can we integrate water and land use planning at the regional scale?
- Integrated watershed planning: where are changes needed most? What initiatives are most likely to succeed within a reasonable time period?
- Source water protection and preparation.

Resulting key messages:

- Recognition of First Nations water rights is fundamental to moving forward.
- Provincial watershed authority should defer to regional body (which has approval and veto power) regarding watershed decisions.
- Improve continuity at all levels of government.
- Consider additional impacts of actions within a watershed.
- Need enabling legislation to establish governance at regional (watershed) and sub-regional (sub-watershed) levels.
- Can we utilize the new provincial Ministry of Natural Resource Operations - which covers numerous watershed-wide concerns?

AM KALAMALKA

Discussion topics:

- Traditional teachings: contributions to water policy.
- Nested governance.
- First Nations adaptive management approaches at watershed scale,

Resulting key messages:

- Empowering origins will lead to inclusive engagement: share values, don't want personalities getting in the way of principles.
- Current system reinforces divisiveness. Need to change this. People disconnecting because we are not dialoguing.
- More roundtables needed on a community scale.
- More time and space just for discussion (hosting dialogues; deep listening; drilling own to where dialogue goes).
- Reflection, respect and relationships are ends in themselves.

AM OKANAGAN

Discussion topics:

- How to increase rural-urban cooperation on water allocation? E.g. control of local irrigation allocation.
- How can we overcome public apathy towards climate change so as to really make progress toward adaptation/mitigation?
- Water decisions are political. What are ways to apoliticize (de-politicize?) decisions?

Resulting key messages:

- Establish standards.
- Critical role of leadership.
- Change public attitudes and behaviour.
- Force the political debate with a referendum?
- Need for a new Basin water ethic.

AM SKAHA

Discussion topics:

- What does "enough" water mean? All water is used by the ecosystem. Are we takers or sharers?
- Ecological flow (goods and services).

Resulting key messages:

- Showcase adaptive management success stories and demonstrate First Nations leadership, e.g. COBTWIG/OBTWIG fish management plan.
- Identify and remove other barriers to engagement, e.g. OBWB and other governance bodies to make MOUs that free FN from "consultation".
- Bioregional economic policy growth; no growth policy, e.g. in Victoria; Dutch low per capita CO2 measures. Per capita targets for local governments to manage.
- Design and practice new approach to water issues that combines TEK/resource views.

PM OSOYOOS

Discussion topics:

- Issue of multi-use watershed; conflicting interests.
- Common water pricing strategy (supply, quality, demand = separate systems).
- Province and regional districts, municipal, laws – jurisdictional harmonization.
- Do we need to increase upland water storage?
- Can existing infrastructure (roads, bridges, etc.) withstand more extreme events? (risk assessment, simulation).

Resulting key messages:

- Provincial MOU suggesting separate ministries establish ways to work in a more integrated way to address water management issues has been in effect for a number of years and appears to be resulting in some progress with respect to cross-ministry cooperation on water concerns, but not sure how it will survive recent cabinet re-shuffle.
- Regional representation can bring issue-based concerns into the cross-ministry forum. To be successful, representatives need to bring clarity of purpose and solutions that work to the table.
- First Nations do not have consistent input into development decisions that may affect them.
- Existing regulations and forestry practices are not adequate to what we are discovering is happening hydrologically in the wake of pine bark beetle devastation and clear-cutting.
- As there is no groundwater legislation in BC, anyone who wants to augment surface water availability or needs more water than is readily available simply punches in a new well. This situation clearly underscores the urgent need for provincial groundwater legislation.
- Upgrading of water-related infrastructure in the basin is required for health reasons.
- Can either deal with this issue now or when it becomes a crisis.
- Ten years from now, water rates will no longer resemble what exists today.

PM OKANAGAN

Discussion topics:

- Moving policy/governance to action and measuring success on the ground (behaviour changes).
- How can we work to increase affordability to implement sustainable technology/systems? (at the municipal level).
- What are best methods to educate the tourism industry on water usage? (e.g. golf courses, recreation lakes, etc.)

Resulting key messages:

- Raising water rates and recycling a portion of the proceeds visibly (via bills?) into water conservation measures could improve source protection.
- Coach farmers on water conservative crops; introduce water metering?
- Build incentives programs like local improvement charges/prizes for reduction.
- Municipalities should lobby for changes to codes relating to size not building, and standards for water use on development basis.
- Real estate industry should communicate with Canadian Home Builders Association and promote green/water conservation products.

PM KALAMALKA

Discussion topics:

- Ethics and delay of action.
- Water education - schools, community.

Resulting key messages:

- Use Open Space Technology to help develop an ethical framework.
- Need for education regarding actualization of respect, values.
- Ethics are culturally based (without a strong sense of culture this makes articulating an ethical framework difficult).
- Basic assumption: as the ethical framework is developed, have First Nations for guidance and involvement.
- Need for self-reflection and question our own assumptions: applies to everyone!

- Can start with an example framework but must be tailored to a local group/level.
- It will take significant work to make an ethical framework! Perhaps use the assistance of an ethicist?
- Dr. Jeannette Armstrong could be an example leader for creating an ethical framework.
- There is a need for an ethical framework for water management/allocation decision-making.

OTHER DISCUSSION TOPICS THAT WERE SUGGESTED BUT NOT ALLOCATED/DISCUSSED

- Agricultural water reserve
- Local food production
- Climate change is by its nature unpredictable, but by reducing human and natural vulnerabilities we will reduce impacts; suggestions or ideas to reduce vulnerabilities?
- Water and health
- Implementation
- Adaptive integrated infrastructure planning (e.g. reservoir planning)
- Information and knowledge: needs and gaps
- How do we engage private sector participation?
- Knowledge transfer

APPENDIX D - ACT YELLOWKNIFE ROUNDTABLE REPORT

INTRODUCTION AND BACKGROUND

On January 19, 2011, ACT and Water session policy author Bob Sandford, Chair of the Canadian Partnership Initiative of the United Nations International "Water for Life" Decade, hosted the third of three regional roundtables on water governance and climate change adaptation in Canada. This third event was partly designed to respond to a major meeting on the new water strategy being proposed by the Government of the Northwest Territories.

MAJOR THEMES

Discussion topics were generated for round table discussions through a preliminary brainstorming session where participants were asked to provide written questions or concerns related to water and adaptations to climate change. These questions were then organized or grouped into categories for the round table discussions. This section summarizes the major themes that emerged during the discussions.

The Northwest Territories Water Stewardship Strategy (WSS) is being developed in recognition of the significant ecological and cultural importance of water in the NWT, with the overall objective to protect water in this region for current and future generations. The group discussions during the ACT roundtable focussed on climate change adaptation in general, and the implementation of the WSS. The themes that emerged were:

1. Collaboration and partnerships
2. Transboundary issues
3. Climate change monitoring and uncertainty
4. Indigenous rights
5. Traditional ecological knowledge
6. Community-level issues
7. Watershed-scale management

1) COLLABORATION AND PARTNERSHIPS

Collaboration and partnerships was a topic discussed to different degrees by many of the groups. The importance of collaboration and partnerships was also discussed in the context of transboundary issues (also see section on Transboundary Issues). Collaboration and partnerships were considered essential to moving forward with adaptation to climate change and implementation of the WSS. It was noted that collaboration with more organizations might lead to greater funding.

It was suggested that partnership and collaboration need to be all-inclusive. However, it was also noted that there is a long list of potential partners within the MRB (e.g. various levels and departments in government, FN, NGOs/ industry, research institutions, interest groups), and there is a need to define a more concise list (based on a defined set of criteria). The WSS may be facilitating in this regard as it provides a dimension to drive partnerships.

It was suggested that one of the key steps to establishing partnerships was to identify common issues. In order to identify common issues, it was suggested that the broader impacts of climate change across the Mackenzie River Basin (MRB) and across Canada be emphasized. Concern was expressed regarding the time frame and resources necessary to

influence organizations for the purpose of developing partnerships. In addition the lack of capacity to work on building partnerships was also identified as a constraining factor.

2) TRANSBOUNDARY ISSUES

Transboundary issues (between NWT and western provinces) were identified as a significant concern with respect to the development and implementation of the WSS. The MRB crosses the NWT border between BC, Alberta, and Saskatchewan, flowing north toward the Arctic Ocean. Thus, NWT (situated downstream) will be influenced by upstream water use/activities and the influences of climate change across the entire basin. Specific concerns were identified to be associated with industrial operations within the western provinces that may influence water quality and/or water quantity (e.g. oil sands operations, Site C hydroelectric generating station).

The MRB agreement specifies that water will "remain substantially unaltered as to quality, quantity and rate of flow". There was some concern expressed regarding the difficulties in defining "unaltered". It was suggested that aboriginal ideas do not accept any amount of pollution in water, whereas other governments have "acceptable" levels. This point further emphasises the importance of coordinating TEK with Western science (also see section on TEK).

There was significant discussion regarding the nature of transboundary negotiations and agreements. Negotiations with respect to transboundary agreements must consider the potential for industry to undermine an agreement, the balance of power, nature of information, and selection of standards. In addition, negotiations/agreements must consider the potential for future amendments, which may add complexity to moving forward. It was suggested that in order to move forward, it might be necessary to formulate agreements on some aspects at a time, rather than requiring full agreement on every issue. Examples of negotiations and agreements in other parts of Canada and throughout history were referred to during the discussions. Lessons learned from past examples may be useful for current negotiations.

Questions were raised regarding how to generate support (public, political), influence public perception, influence politics, and engage provinces. Concerns were expressed regarding the influence of the different interests of upstream users. Some strategies discussed included employing a "stick" approach when possible/necessary, developing a strategic campaign, appealing regarding the importance of MRB to Canada, linking southern and northern issues, and emphasizing NWT's importance for natural resources during negotiations.

Obstacles in moving forward with transboundary discussions/agreements included lack of capacity, challenges of the WSS, uncertainty of climate change issues, impact of devolution, complexity of governance, inter-jurisdictional issues, and integrating FN concerns. Concerns were also expressed regarding the effectiveness and role of the Federal water policy.

3) CLIMATE CHANGE MONITORING AND UNCERTAINTY

The importance of monitoring for climate change was highlighted. Examples of climate change impacts that are being realized in the NWT included: permafrost melt, changes in river/lake levels (Great Slave River and Lake are experiencing record low flows), slumping and sediment input to lakes and navigable waters, and changes to caribou migration. It was suggested that the NWT may experience different climate trends than elsewhere in the country (i.e. NWT projected wetter summers). The need for data and ongoing monitoring of water quality and quantity was emphasized; both from the perspective of establishing baseline conditions, and for identifying climate change trends. There was concern associated with the idea that we are currently basing decisions (e.g. industrial development) on data that are no longer applicable in the context of the rapidly changing climate. There is a new "normal" that is not represented by existing data.

It was suggested that data availability and accessibility are key to an effective monitoring program. While data may be available for some areas, there needs to be a common place, such as a database, where data from multiple sources can

be brought together. Such a database would require initiative, coordination, collaboration, and ongoing maintenance. Data ownership is an issue that may impede progress toward the development of such a database. It was suggested that there could be a requirement for upstream industries to provide data for sharing.

The lack of infrastructure (e.g. weather stations, stream gauge locations) was also highlighted as an obstacle in monitoring climate change. In particular it was noted that there is a lack of data at higher elevation mountain regions that is important for upstream assessment, and the assessment of upstream changes on downstream users. It was also suggested that there is a need for increased monitoring downstream of potential impacts (e.g. downstream of industry). It was noted that TEK plays an important role in providing information regarding big historical events. The importance of including TEK information with monitoring data was identified (also see section on TEK).

Funding was identified as a major obstacle to developing an adequate monitoring and data management program. Some ideas put forward to address funding included applying water licence fees directly to monitoring programs, engaging universities, and linking monitoring requirements to transboundary agreements and regulations on industry to provide data when developing projects.

4) INDIGENOUS RIGHTS

The following key questions were raised regarding indigenous rights. How do we incorporate indigenous rights in processes involving lands and waters? How do indigenous rights relate to climate change? Who has responsibility to protect lands from climate change? What impact will devolution have on indigenous rights?

The reality of climate change is a relatively new realization and many previous First Nations agreements (e.g. treaties) did not consider the impacts. Climate change is also not considered in the land claims framework. It was suggested that the impacts of climate change on FN rights needs to be determined and monitored through integration of TEK and Western science, with cooperation between provinces.

It was put forward that climate change affects all, and that the (federal) government has the responsibility to protect the environment from climate change through consideration of a balance of many factors. It was also suggested that the federal government has a responsibility to mitigate climate change for the protection of lands. It was noted, however, that there is uncertainty regarding the obligations of layers of federal government with respect to First Nations rights, which creates obstacles and confusion. Boards can have a role (by creating conditions) in preventing impacts on FN rights.

5) TRADITIONAL ECOLOGICAL KNOWLEDGE

One of the sessions focussed on Traditional Ecological Knowledge (TEK). The subject of TEK was also considered during other sessions where it pertained to the discussion topic. Key points that were identified with respect to TEK were:

- Traditional knowledge is considered by many to be valuable, meaningful and relevant. There is very limited scientific data relating to the environment in the NWT and thus traditional knowledge (integrated with Western science) must play a key role in decision-making. There has been significant work to capture and communicate TEK, and to make it accessible for decision-making. Gathering, transferring, and cataloguing TEK requires both expertise and funding.
- TEK must be recognized and made equivalent to Western science. There was consensus that TEK and Western science are not viewed (by some) as equivalent, with TEK often being regarded as "background" knowledge. It was suggested that each knowledge source be given equal weight. Difficulties in determining the most appropriate and respectful way of merging TEK with technical information included the fact that not all traditional knowledge is meant to be shared.

- TEK embraces different worldviews and different views of science. A key aspect of TEK is that it promotes understanding and acceptance of broader social values and worldviews. TEK is founded upon different views of science and governance from those usually considered or cited and because of this, concerns were raised regarding the difficulty in communicating TEK to other governments in policy and decision-making (e.g. AB and BC).
- It is important to generate public support for values of TEK. It was suggested that careful communication of TEK might be necessary to generate popular support. The Northern Voices, Northern Waters stewardship strategy and the people of the NWT may have to appeal to a wide international audience to support the values for which the strategy stands.
- TEK is relevant to climate change. There was concern expressed regarding the potential for rapid climate change to undermine TEK. Changes are occurring so fast and are so profound that one system of measuring change will not be adequate; and TEK is an essential part of monitoring change. It was suggested that the loss or diminished use of TEK at this time of rapid change would be a tragedy for the NWT and the world.

6) COMMUNITY-LEVEL ISSUES

Many of the issues related to water and climate change are realized at the community level. Some specific community-level issues that were raised included potable water supply (health and supply issues), protection and maintenance of infrastructure (e.g. lagoons, wastewater treatment), protection of land from flooding/erosion, and changes to navigable waters. There was concern associated with the territorial department delegating infrastructure issues and costs to municipalities.

The need for, and role of, scientific knowledge at the community level was discussed. It was suggested that there is a need for climate change scenarios for the whole territory that communities can draw from. It was noted that Natural Resources Canada (NRCan) has provided a range of estimates for 17 regions that will soon be published. CIER (with 40 northern communities) has also published a risk assessment guide that includes projections for climate changes over the next four years. The relevance of TEK for communities was also identified. It was concluded that community-based participatory research engaging community members on source water protection, water quality/quantity monitoring is ideal, but it needs resources.

The need to tailor actions to community issues was identified during discussions of how the WSS will be implemented within communities. Specific concerns included financial limits (small tax base), lack of capacity, need for leaders, and need for data and knowledge. The importance of collaboration and sharing with respect to water resources was highlighted as a means to increase capacity. It was also suggested that climate change adaptation needs to be discussed at a manageable scale – to "make it real and solvable". It was also suggested that climate change be integrated into all community-level decision-making including the WSS.

7) WATERSHED-SCALE MANAGEMENT

The practicalities and benefits of addressing water issues on a watershed basis were discussed. It was noted that current planning boards are not structured on a watershed basis and yet there is a general recognition that we need to consider cumulative impacts within a watershed. It was suggested that, for practicality, watershed management must be undertaken at the sub-basin scale (i.e. smaller basins within the extensive MBR). It was noted that the intention of the WSS is to use smaller watersheds as a pilot for eco-indicators and use this local information/data for watershed-wide SWP planning. The Cumulative Impacts Monitoring Program (CIMP) could be a vehicle for getting inputs from community-level planning boards regarding watersheds, but would need consistent funding from INAC.

Watershed scale management may be challenged by political boundaries, and there is a need for a coordinated approach so that impacts within a watershed to all users are addressed/considered. Establishing linkages and collaborative participation between all watershed users was considered important for watershed scale management. Effective watershed

management would link land-use plans together to address inter-jurisdictional concerns including issues concerning unsettled land claims. Integrated watershed planning should consider social, political, and cultural landscape elements as well as ecosystems. Watershed management plans should also address issues associated with accountability, responsibility, and licensing (fees). The NWT Board Forum can play a key role in watershed scale management as a communications vessel for action items (would require attendance form all aboriginal organizations to be effective).

Some of the discussion focused on establishing water quality goals/objectives for watersheds. It was noted that the WSS does not set water quality objectives in the land use planning context. It was suggested that there is a need for a policy guidance document on how to set water quality objectives at the watershed scale and/or a need for globally applied water quality goals/objectives. Concern was expressed regarding the capacity for water quality monitoring which would be needed to ensure goals/objectives are met. It was suggested that there is a need for an additional "layer", linking INAC and GNWT and decision makers, to facilitate planning and monitoring in watersheds.

CONCLUSIONS

Participation in the Yellowknife roundtable was outstanding with senior representatives of all sectors, including the Deputy Premier and the Deputy Minister for Environment, attending.

The Northwest Territories' new water strategy promises to be a groundbreaking piece of legislation and policy innovation that will encapsulate many of the standards and actions required in other parts of Canada to respond to the challenges of climate impacts on fresh water.

Key issues in this roundtable included the challenges of both transboundary negotiations from the point of view of a downstream negotiator faced with upstream neighbours committed to high levels of water consumption, and complexities of land claims agreements and First Nations government in a territory approaching devolution.

In the big picture of Canada's water governance as a nation, the proposed NWT water strategy represents an extraordinary opportunity to place ecosystems and water above consumption pressures that, once in place, are deeply challenging to reverse. Awareness of climate change is unusually high in the region due to their northern location, in which the warming and associated impacts are impossible to ignore. This raises questions being asked around the world by less developed nations in terms of culpability behind the causes of climate change.

Of the three roundtables, awareness of climate change issues was highest and perceived as most urgent in the NWT, and the water strategy features climate changes and their current and projected impacts as one of the key drivers for its design and implementation. As such, it represents one of the most significant adaptation initiatives in Canada in the context of water governance.

In the meantime, adaptation initiatives in existence in the territory are being considered for water but still require greater accumulation data for real confidence in new initiatives, such as monitoring and analysis of projected impacts.

WORKSHOP REPORT ADDENDUM: YELLOWKNIFE BREAKOUT GROUPS, DISCUSSION TOPICS AND TAKEAWAY MESSAGES

AM MACKENZIE

Discussion topic:

- Watershed-scale management for climate change impacts

Resulting key messages:

- Board Forum can play a key role in watershed scale management as a key communications vessel for action items. BUT it would require attendance from all aboriginal organizations in order to be effective (many do not come due to lack of resources etc. – not sure if all are being invited or if this would be a new model for the Forum).
- Collaborative participation across the board for developing key action items is required, plus NWT has a central group working on "Keys to Success" that can actually field and stickhandle these.
- CIMP could be a useful tool on a planning and protocol level for an integrated watershed approach, but needs multi-year funding from INAC.

PM MACKENZIE

Discussion topic:

- Community-level adaptation measures and implementation issues

Resulting key messages:

- Everyone needs to work together to collaborate and share resources to enhance capacity.
- Champions in communities and organizations are needed to drive action.
- Mainstream climate change into decision-making – not just cc but water strategy in general, plus climate change methodology (resources plus actions).
- Foster communications between communities, government and organizations about action plans.
- Community-based participatory research engaging community members on source water protection and water quality/quantity monitoring is ideal, but needs resources.

AM NAHANNI

Discussion topic:

- Valuing traditional knowledge (TK)

Resulting key messages:

- TK is valuable, meaningful and relevant
- TK must be recognized and made equivalent to Western science
- TK embraces matters related to different worldviews and different views of science and governance
- Because of its broader implications, TK may be resisted by some southern others
- The project of recognizing and valuing TK will require broader outside support to succeed
- We cannot give up now

AM ARCTIC RED

Discussion topic:

- Importance of monitoring in context of uncertainty of climate impacts

Resulting key messages:

- Funding is huge problem – need money to monitor water quantity, quality, and weather patterns.
- Data availability and accessibility; need some kind of central plan and sharing process; guidelines for long-term programs; federal role.
- Link monitoring requirements into transboundary agreements and regulations on industry to provide data when developing projects.
- Keep in mind that many changes are climate related—need to know to what we are monitoring for – we need data because we are currently basing industrial developments on data that is no longer applicable.
- We need data to make better decisions, to better manage resources – there is a new 'normal' that is not represented by existing data.

PM ARCTIC RED

Discussion topic:

- How do we incorporate indigenous rights in processes involving lands and waters?

Resulting key messages:

- Crown not divisible, so what are obligations of layers of govt with respect to rights in the face of industrial development that impact FN
- Devolution point – if it occurs before FN get settlement claims in, possible NWT may not finalize claims – trust issue here for FN and GNWT and feds – FN and GNWT could demand unsettled claims be finalized from feds before devolution proceeds
- Integration of TK and western science to monitor impacts on rights, such as hunting rights (e.g. caribou) – need co-operation b/t provinces and transboundary monitoring
- Idea of giant claim by FN on failure to consult by upstream govt for cumulative impacts (AB, BC)
- Role of Boards in preventing/accommodating impacts on rights – compensation section in Water Act

AM KUGALAK

Discussion topic:

- Building effective partnerships, communication, and funding in order to achieve action

Resulting key messages:

- Develop long and short list of partners, based on a variety of criteria, potentials of the partners, leverage, change the outcome of the WSS or need, some groups that are useful in short time,
- Research for the long term,
- Articulate how Mackenzie is connected to the rest of the country, time scale and geographic scale.
- The logistics of sticks or carrots, negotiation doesn't start with sticks, but partners can change that.
- Voters only care about economics and health. also reputation , social licence, leverage points.
- Which group have the best direct benefits.

PM KUGALAK

Discussion topic:

- Transboundary water issues that need to be considered in light of climate change impacts.

Resulting key messages:

- The process of engagement to develop the WSS should be maintained and be part of the negotiations.
- Essential to understand who negotiating parties are, what their interests are (no right and wrong), why do they want to negotiate? Identify best conditions, worst-case scenario, the fact that counter partners might not want to reach an agreement, national standards for the agreement.
- A strategic public campaign to raise awareness about the importance of the Mackenzie and climate change/water issues related to the Arctic would be useful.
- Parallel process needed to prepare people and change entrenched attitudes towards water use.

APPENDIX E - ACT SYDNEY ROUNDTABLE REPORT

INTRODUCTION AND BACKGROUND

On November 5, 2010, ACT and Water session policy author Bob Sandford, Chair of the Canadian Partnership Initiative of the United Nations International "Water for Life" Decade, hosted the second of three regional roundtables on water governance and climate change adaptation in Canada. This second event was specifically designed to explore water governance structures as they relate to climate change in Cape Breton.

MAJOR THEMES

Discussion topics were generated for round table discussions through a preliminary brainstorming session where participants were asked to provide written questions or concerns related to water and adaptations to climate change. These questions were then organized or grouped into categories for the round table discussions. This section summarizes the key concerns and major themes that emerged during the discussions. The major themes identified were:

1. Uncertainty of climate change predictions and knowledge
2. The role and importance of science
3. Legislation and controls
4. Source water protection
5. Including FN communities
6. Engaging the public, press, and politicians
7. Reactive versus adaptive actions
8. Regional issues

1) UNCERTAINTY OF CLIMATE CHANGE PREDICTIONS AND KNOWLEDGE

Uncertainty of climate change predictions and knowledge was a discussion topic that was raised by some groups. Of particular concern was the uncertainty of sea level rise predictions – ranging from 1 to 10 m, and the uncertainty of the potential effects of sea level rise. Uncertainty, in general, with respect to climate change predictions (e.g. temperature and precipitation) was also identified. It was recognized that predictive models can be variable and questionable. A global climate model has been adapted to a regional (provincial) scale, however, it was suggested that more research is needed to understand climate change and effects on water. It was noted that scientific information needs to be credible.

The uncertainty of climate change predictions was identified as a factor that affects decision making and prioritizing pertaining to adaptations. It was suggested that uncertainty of climate change predictions may lead to reduced impact or influence of those predictions on decision making. Uncertainty in predictions may also impede the ability to set priorities and conduct cost-benefit analyses for adaptations. An example put forward was the construction of the bridge between NB and PEI which was built based on a 1-2 m sea level rise. It was suggested that construction to accommodate possible greater sea level rise was not considered practical due to the additional cost (versus uncertain benefit) and anticipated public response. It was suggested that there is a need for more concrete science-based working assumptions that can be used for decision making.

2) THE ROLE AND IMPORTANCE OF SCIENCE

The importance of science to effective climate change adaptation was acknowledged. It was suggested that climate change adaptation actions and priorities must be founded in science.

Knowledge translation between universities and government (decision-makers) was discussed by some groups. It was suggested that top researchers need to know what policy questions are anticipated so that they can determine what research should be conducted. Research should consider outcomes that would be useful to decision-makers with respect to basin wide policies supporting sustainable development and protection of crucial water resources. One group indicated that universities and research institutions have an obligation to convey to government the need for adaptation to climate change and an obligation to work with government to prioritize actions.

A major concern was associated with the poor funding level and the lack of government initiative in support of climate change research, data collection, and monitoring. Funding for water monitoring was reportedly cut in the 1990s, and there is a lack of baseline data for important ecologically sensitive areas such as Bras d'Or Lakes. It was suggested that government funding initiatives to promote economic stimulus should be far-sighted; taking into account current and actual climate change impacts. Another comment suggested that the process of developing effective collaboration often takes up so much time and resources that important research required to inform the process is not undertaken. The time frame to obtain research results (three or more years) should be considered proactively.

3) LEGISLATION AND CONTROLS

Effective legislation and other means of control were identified as important for moving forward with sustainability and adaptations to changing water issues. Courageous legislation was discussed by two of the groups. Courageous legislation was defined by the following descriptions:

- May be politically unpopular
- Deals with problems over the longer time span than the duration of a single government's term of office (i.e. long term effects of climate change)
- Has a "black and white" element – "if an industry is going to negatively affect water then it shouldn't be allowed" or "no one should be permitted to damage the quality of our shared water resources".
- Considers the real cost of environment effects and impacts

The concept of "courageous legislation" was distinguished from those of "heroic legislation" (which recognizes true costs of all impacts), and "warrior legislation" (which holds decision makers personally accountable).

It was suggested that courageous legislation can be both ethical and effective.

An example put forward was the Nova Scotia Environmental Goals and Sustainable Prosperity Act which outlines 22 specific goals for sustainability. An acknowledged weakness with this example was that this Act lacks regulatory components for implementation. It was suggested that governments need to be held accountable not just for passing legislation, but for making sure it is implemented and effectively enforced. Another comment suggested that guidelines may, in some cases, be more useful than legislation because they are often more flexible; however it was noted that guidelines need to be founded upon legislation to be enforceable.

The following points were raised regarding the need for stronger courageous legislation in Nova Scotia:

- Need to protect what has not been damaged
- Damaging water quality should not be acceptable under any terms
- Environmental Assessments must have force
- Affordability of proper environmental controls should not be an excuse
- Start with passable legislation and then build on it or strengthen it (flexibility).

An important link between science and legislation emerged. In order for legislation to be effective and enforceable, it needs to be founded on science and knowledge. It was also acknowledged that, while it is important for legislation

to consider the real cost of environmental effects/impacts, there are issues associated with the uncertainty of scientific predictions and understanding potential impacts.

4) SOURCE WATER PROTECTION

The importance of effective source water protection (SWP) for protection of water supplies and to protect what hasn't been damaged was discussed. It was suggested, that climate change is relevant to everything and needs to be mainstreamed, and SWP planning was identified as a suitable vehicle to introduce climate change.

A SWP plan should be developed on a watershed basis, be based on science/knowledge as well as qualitative concerns and issues regarding impacts to water, list key actions, and identify roles and responsibilities. A good SWP plan is the result of effective collaboration and involvement of many groups, who work together in plan development to identify common issues, problems and values. It was noted that one of the key benefits of a SWP plan is that it determines accountability (by defining roles and responsibilities). Concerns regarding the development and implementation of a SWP plan included the lack of funding, difficulty with prioritizing in terms of implementing a plan, and including FN.

In Nova Scotia, it was noted that SWP plans are mandated but are often "municipality based"; which was considered a weak start to the process. Related to SWP, the provinces of PEI, NB, NS use site-specific environmental assessments to prioritize impacts involving wells. It was suggested that a balance is needed between government incentives for SWP development and legislative requirements for groups to deal directly with government. It was also suggested that groups might work more effectively at collaboration if they do not feel one government body is controlling the process. Government enforcement, however, may expedite stalled progress or play a role in dispute resolution, and there was a suggestion that SWP planning needs to be more regulated by legislation. Saskatchewan was noted as an example of moving forward with SWP through collaborative discussion (including NGOs, land owners, FN, agriculture).

5) INCLUDING FIRST NATIONS

The involvement of First Nations (FN) was a topic that emerged throughout the discussions. In general, it was suggested that the provincial process is not welcoming, and FN question whether it is beneficial to participate in a committee. Suggestions to improve involvement of FN in water management and environmental decisions included:

- Water decisions should consider FN concepts such as resilience, balance, and availability, and that decisions should be "good for seven generations"
- Involve First Nations groups such as FN national technical group, and national FN Water Commission
- Involve FN on a community-by-community basis (e.g. NS Sustainable Communities Initiative initiated community level meetings so that local critical issues and funding needs could be presented)
- Protection of treaty rights
- Build relationships

The question of how to involve FN in the development of a source water protection plan was specifically discussed. One of the difficulties with source water protection initiatives for FN communities stems from the fact that the current Federal focus is on infrastructure and treatment, and there are not resources to go beyond this aspect of water management. It was suggested that the importance of developing a SWP plan could be emphasized through INAC through direction, guidance, and funding. Another issue with respect to the development of SWP plans to benefit FN communities is the difficulties that arise when part of the watershed lies outside the reserve.

6) ENGAGING THE PUBLIC, PRESS, AND POLITICIANS

Public support and engagement was identified as an important component of moving forward with adaptations. Government decisions are often political and without public support/engagement, the issues may not be given priority by government. The importance of public support with respect to implementing courageous legislation (discussed above) was highlighted.

Questions were raised regarding how to get decision-makers attention, who to target, and how to influence political decisions. It was noted that the press/media plays an important role in influencing public engagement and that public engagement, in turn, influences media coverage. Consumer choice (i.e. purchasing sustainable products) also influences public engagement. It was noted that climate change is relevant to everything and needs to be mainstreamed (not separated), which may also increase public awareness and engagement.

7) REACTIVE VERSUS ADAPTIVE ACTIONS

There was a sense of urgency in some of the discussion regarding the need to act now with respect to scientific research (considering studies may take three years or more to complete), development of legislation, improving relations, and setting priorities (e.g. what areas to protect first). It was suggested that acting now with pro-active or adaptive actions will set the stage to moving forward with future water management decisions. Despite the fact that current knowledge is uncertain we can "start with what we have" and built on it as new information becomes available – setting benchmarks that can be incrementally strengthened later. Source water protection (discussed above) was identified as an example of a pro-active (preventative) approach to water management.

A concern was identified with respect to the current "crisis-response" or reactive approach which is observed in situations such as the Walkerton tragedy; where significant funding was directed due to crisis response. This political response was inferred to be influenced by media attention and public engagement. We need to consider how to generate support in the absence of a specific current crisis.

8) A NEW CANADIAN WATER ETHIC

It was suggested that a new Canadian water ethic is needed to bring out widespread changes in the way we manage and protect water in Nova Scotia and across the country. This ethic would resemble an organizing principle, around which people and politicians can move forward with water management decisions (similar to the heath care ethic of free care for everyone). Public support for a new water ethic was identified as an important component to moving forward. It was suggested that a new water ethic would increase future adaptive capacity to climate change.

9) REGIONAL ISSUES

Some key regional issues emerged during the discussions. These issues were often discussed as examples in the context of the themes identified above, but also emerged as themes in themselves.

- **Sea Level Rise**

  A primary issue identified by many of the groups was related to sea level rise. Water-related concerns associated with sea level rise included: loss of land/communities (flooding), impacts to ecosystems (discussed further below), coastal erosion, sea water contamination of potable water sources, and impacts to harbours.

  The need for more concise predictions related to sea level rise was highlighted as currently predictions may range from 1 to 10 m. Much of the discussion regarding sea level rise focussed on the need for more data, better scientific understanding, more concise predictions, and a better understanding of the effects of sea level rise. For

example: What specific land areas will be lost? What specific areas need to be protected? How will these areas specifically be impacted? In terms of planning for effects of sea level rise, important public policy issues were identified such as: influence on settlement patterns, affects on available taxation revenues, and costs of relocation for affected communities. In addition, the socio-economic question of how communities will react was raised.

It was suggested that it might be necessary, due to financial and practical constraints, to identify priority areas where efforts would be focused on protection from sea level rise (i.e. where funds and efforts would be directed for protective measures). It was noted that such prioritization would necessarily involve "writing off" of some areas, and there was concern regarding the responsibility for paying for adaptations. There was some urgency identified with respect to moving forward with adaptations to sea level rise in order to take a proactive approach and to be prepared for future adaptive measures.

- **Ecosystem Health**
  Concern with respect to the impacts of climate change on ecosystems through water-related changes was identified during some group discussions. Changes to ecosystem health may influence fisheries (fish habitat) which is a primary socio-economic concern for the region and First Nations communities (additional notes regarding fisheries are provided below).

  The Bras d'Or Lakes were specifically discussed. The lakes were noted to be mostly saltwater, with an important fresh-salt water balance maintaining ecosystem function. Potential climate change influences to this water system included changes to the fresh-salt water balance due to sea level rise and changes (increases) in spring run-off from Cape Breton highlands. The importance of further scientific research and monitoring of the Lakes was highlighted (both for baseline information and to monitor for changes). One of the participants indicated that the Bras d'Or Lakes region would likely qualify for significant university research funding in the near future.

  The need to practice ecosystem management by protecting water was recognized. Determining (prioritizing) the ecosystem areas to protect, however, was identified as a potential difficulty. It was noted that nature (ecosystems) is/are constantly changing and we need to be aware of this fact, as well as the fact that we are causing changes. It was also suggested that ecosystem health must be considered at the regional watershed level.

- **Fisheries and Forestry**
  The impacts of water-related impacts of climate change to fisheries were discussed by some groups. As indicated above, impacts to fish habitat due to climate-related changes in water systems were expressed as a general concern with respect to potential fisheries impacts. In addition, the impact on fisheries due to a change in sea temperature was identified, as was the potential loss of small harbours (loss of land/infrastructure) due to sea level rise.

  Issues related to the general sustainability of the fisheries (i.e. overharvesting, catching endangered species) were discussed by one group. While not specifically related to climate change, unsustainable fish harvesting practices could, when combined with climate change influences (i.e. warmer temperatures, impacts to ecosystems) exacerbate fisheries impacts. Examples of measures that have been employed to improve fisheries sustainability include: industry saying no to unsustainable practices (e.g. requests for endangered species), product source tracing, sustainability labelling to allow for consumer choice (e.g. Marine Stewardship Council approval), the federal Department of Fisheries and Oceans (DFO) monitoring of fish stocks, and partnerships between industry and universities.

Forestry (another important regional industry) was a focus area for discussion by one group. Forestry was discussed in terms of potential impacts for source water protection (e.g. logging near streams, clear cutting without appropriate stream buffer, stream crossings). Forest practices related to harvesting sustainability were also raised as issues (e.g. clear cutting, not using wood waste from mills).

Private land ownership (leading to lack of control), and difficulty with enforcement of standards (e.g. ISO14000) were identified as issues that could affect source water protection. In addition, it was noted that there is no identified immediate crisis with respect to protection of headwaters/streams and thus there is a lack of incentive for source water protection in these areas.

CONCLUSIONS

Participation in the Sydney roundtable was outstanding; with senior representatives of all sectors attending and sharing valuable, in-depth information on the processes they have developed or are interacting with, and suggestions for the most effective ways to move forward.

The Bras d'Or Lake region has created initiatives and organizations that are groundbreaking in their efforts to drive collaborative governance of water and ecosystems, placing the region in an advantageous position to design and implement adaptation measures. For instance, the multi-level governance and stakeholder NGO CEPI (Collaborative Environmental Planning Initiative) brings people from all relevant organizations together, makes connections and creates networking – all based on positive reinforcement.

However, the region's governance organizations are still struggling with limited resources, aspects of jurisdictional fragmentation, and lack of information about climate impact projections, as well as a need for greater access to data analyzing climate impacts that the region must prepare for and actions they would be well advised to take and associated socio-economic implications.

Climate change itself has not constituted a strong driver in the formation of organizations nor initiatives and decision-making to date. Adaptation has yet to become a strong concept, but was acknowledged as a useful approach and a much-needed one as climate change accelerates. Due to the unique marine/freshwater interface of the Bras d'Or Lake, sea-level rise is seen as one of the biggest impending threats unique to climate change with specific responses required; other threats to water such as higher temperatures and shifting ecosystems were also acknowledged but can be addressed with more general water governance standards and approaches that encompass a variety of concerns and drivers (i.e. "sustainability").

WORKSHOP REPORT ADDENDUM: SYDNEY BREAKOUT GROUPS, DISCUSSION TOPICS AND TAKEAWAY MESSAGES

AM TROUT

Discussion topics:

- Pros and cons of legislation vs. positive enforcement

Resulting key messages:

- Generate change through positive enforcement as well as legislation
- Spend more time building relationships and encouraging people to change behaviour
- Develop a new generation of environmentalists by rewarding good behaviour
- Charge people less if they keep water use within a limit, e.g. rebates (CBRM had a $50 rebate on low-flow toilets – huge uptake & millions of gallons saved. Potential for provinces and feds to be involved, and municipalities could be much stronger on these kinds of initiatives as well))
- Use public education to promote TEK/LEK in schools
- "We are all fingers of the hand, but together we make a powerful fist" (Chief Joseph)
  - Use diplomacy and communication to strengthen connections and effective coordination between organizations
  - Example: Multi-level governance and stakeholder NGO CEPI (Collaborative Environmental Planning Intiative) brings people together, makes connections and creates networking – all based on positive enforcement
  - CEPI is moving slowly because it is working to establish relationships and build trust so it can be more effective in the long run – need to accept requirement to put in time
- CEPI should develop a water management plan with the strength of all its partners behind it
- Develop public image & opportunities in Cape Breton/stimulate economy
- Cape Breton University could establish a cluster of knowledge on adaptive water management – become world leaders in this research

AM EEL

Discussion topics:

- Sustainability always leads back to water
- We want to have the least impact but do we really understand how?
- What is too much or too little – how do we judge?

Resulting key messages:

- Media plays a large role in how we think about issues – we need to bring them in
- We need more research, including baseline information – otherwise how do we know what "sustainable" means?
- But we can use the best info we have to drive action now – starting with the minimum if necessary, such as scenario building
- Government must put more money into research, especially monitoring
- People have power with their daily dollar to support sustainable practices, they just need to be clear what they are
- Mother Nature is not constant anyway – need the resources to adapt to changes that will happen naturally as well as those that are human-induced

AM OYSTER

Discussion topics:

- Courageous legislation
  - We have to engage with legislation to make sure it does what we want in terms of effecting change.
  - Courageous legislation is that which aims to deal with problems over the longer time span than just the duration of a single government's term of office.
  - It is the creation of legislation that demands that the real cost of environmental effects and impacts is clearly understood and properly accounted for in everything we do.
  - Courageous legislation demands that all known externalities are accounted for in all development proposals.
  - Good legislation can stimulate discussion at the regional, provincial and national level.
  - There is no reason such legislation cannot be both ethical and effective.
  - The principle behind this kind of legislation is that no one in any situation should be permitted to consciously damage the quality of our shared water resources.
  - E.g. the *Nova Scotia Environmental Goals and Sustainable Prosperity Act* had unanimous support when it was passed recently in the Nova Scotia Legislature
  - BUT getting courageous legislation passed is one thing; ensuring that it is enforced may be quite another.
  - Government departments responsible for implementation of new legislation often end up working with a fraction of the resources they need to be effective.
  - Thus we find that governments even in Canada are now being sued for not acting upon their own laws.
  - Resources must be committed to effecting the legislation after it is passed.
  - Citizens must recognize that in this process persistent public pressure not just before but after the passage of new legislation becomes and remains central to its ultimate success.
- Water ethics and law
- Water research & monitoring
  - The lack of resources to fund research in support of policy
  - Although collaborative processes are important to the development of watershed approaches to managing and protecting water, the process of developing effective collaboration often takes up so much time and resources that important research required to inform the process and make it relevant is ignored or not undertaken.
  - Relevant research on matters related to watershed management can take up to three years or longer to complete at a reliable baseline standard.

Resulting key messages:

- We need to protect what hasn't been damaged
- Damaging water quality is not acceptable under any terms
- Environmental assessments must have force
- Not being able to afford proper environmental controls is no excuse
- Start with legislation that can be passed then build on it
- A new Canadian water ethic may be just what we need to bring about widespread change in the way we manage and protect water not just in Nova Scotia but everywhere in the country.
  - Effective policy change needs an organizing principle or ethic around which the people and the politicians that represent them can rally.
  - E.g. the health care debate that took place in Canada during the 1960s, when the ethic of free care for everyone emerged as the driving principle in the reform of our country's health care system.
  - The ethic at the heart of this principle was strong enough to survive three attacks on it by Alberta Premier

Ralph Klein who throughout his long term of office advocated repeatedly for private health care.
- We need Canadians to get behind a new water ethic in the same way.

AM LOBSTER

Discussion topics:

- Ecologically-sound, integrated land use planning
- Land use impacts water cycles and is governed by many jurisdictions with confusing and contradictory legislation.
- We need to have WATER as overriding concept, like SARA

Resulting key messages:

- Water basin, river basin, sewer basin, are all different things and need to be treated as such
- We need to work based on natural boundaries, not political ones
- There are too many jurisdictions, too many boards
- Need to find ways to connect/unify voices (such as elders, the Senate, and environmental groups) – the university could help facilitate

PM EEL

Discussion topics:

- Source water protection (SWP)
  - Process, effectiveness, risk assessment
  - How can SWP and IWRM meet climate adaptation needs?
- Agricultural water issues
- Practical mechanisms for incorporating climate change adaptation into current infrastructure and water resource decision-making

Resulting key messages:

- Importance of procurement, for all levels of government, should be brought into everyday discussions
- SWP needs to be regulated by legislation – not just provincially, federally
- FN need the human and financial resources to be actively involved in SWP
- Investments in publicly-available climate change science are useful to everyone
- Build climate change into all areas of government and their regulatory processes, not just specialized departments

PM LOBSTER

Discussion topics:

- Strengthening national links
- Connect governance processes across different scales

Resulting key messages:

- Water management plans across the country – create links on developing water strategies especially those with FN influence.
- There is a FN national tech group – feed water strategies to this group.
- National FN Water Commission: Communities would need to be involved on a community-by-community basis, not working through one consolidated national commission.

- Protection of treaty rights. MOU can waive this problem.
- FN should be involved in FN studies currently being taught in schools through provincial/federal funding
- Build a pilot FN committee to promote awareness of:
  - Seventh generation decision-making approach
  - All my relations spirituality/philosophy as regards nature/water etc.
- Create links between regions developing water strategies across the country, especially those with FN involvement and influence.
- Establish "courageous legislation" (see **AM Oyster**) via a national water strategy – if your industry is going to negatively affect water, you can't proceed.

PM TROUT

Discussion topics:

- How do we engage the public?
- Climate scales are too long to get the public engaged. What are the drivers of motivation? (Not always media)
- Public engagement is often crisis-driven. Can we make more people aware of the water crisis?
- How can we move beyond crisis – can we use it to change government legislation?
- What strategies can we use to promote/influence change?
- How can we use public education versus legislation?
- What are the institutional barriers?
- What methods can be used to enable & empower people who are not already involved?
- How do we help economically disadvantaged communities to adapt? (Combatting lack of capacity & resources + fear of driving away investment)
- How do we aggregate leadership?
- How do we make sustainability exciting?

Resulting key messages:

- Make green products more palatable
- Offer daily reinforcement
- Establish opportunities for community engagement such as community gardens
- Develop sustainable greywater systems – could be done on a block-by-block scale
- Link jobs to sustainability to get regions interested

PM OYSTER

Discussion topics:

- Science and policy – what are the challenges with getting scientists and politicians to speak the same language?
- Without baseline monitoring it will be difficult if not impossible to forecast how a changing climate will affect freshwater inputs into the saline Bras d'Or lakes, and how the condition of the aquatic ecosystems upon which human and fisheries health depend will be affected by warming temperatures.
- The biggest threat is sea-level rise:
  - Risk of effects on settlement patterns, revenues generated through taxation, and costs associated with relocating affected communities and rural populations.
  - Who will pay for these expensive relocations?

Resulting key messages:

- Researchers need to know what management policies are going to emerge from collaboration on watershed management research so that they can determine:
  - What should be conducted
  - How long it will take
  - What it will cost
- Other research that would be useful to decision-makers in their efforts to craft basin-wide policies that support sustainable development while at the same time protecting crucial water resources include:
  - Acid rain – still an issue in the Bras d'Or Lakes region.
  - In the absence of sea ice in the region over an extended period of time each year, snowfall patterns are changing.
  - More and more snow is falling in the highlands leading to increased spring run-off, which has begun to tax water treatment systems
  - Increases in spring run-off are also beginning to affect aquatic ecosystems.
- Universities and research institutions have a huge obligation to:
  - Convey to government the need for change
  - To work with government to prioritize actions, so that changes in regional and global environmental and

APPENDIX F - CASE STUDY: THE EVOLUTION OF CLIMATE CHANGE ADAPTATIONS IN WATER RESOURCES MANAGEMENT IN THE OKANAGAN BASIN, B.C.

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The Okanagan has responded to the need for effective water management, and has made significant progress in preparing for the anticipated impacts of climate change and population growth with the development of adaptations for water management.

EXECUTIVE SUMMARY

The Okanagan Basin is a semi-arid valley in south-central British Columbia that has a growing population, significant agricultural development, and existing areas of stressed water resources. Statistics Canada identifies the Okanagan as having the smallest per capita freshwater availability in Canada. The Okanagan has responded to the need for effective water management, and has made significant progress in preparing for the anticipated impacts of climate change and population growth with the development of adaptations for water management.

This report (1) documents climate change knowledge and research relating to water resources in the Okanagan Basin, and (2) examines water management adaptations that have been developed for effective and sustainable long-term regional water management. Key facilitating concepts that emerge from the Okanagan experience are highlighted as possible guidance for other communities as they move forward with water management adaptations to climate change in their regions.

PROJECTED CLIMATE CHANGE IMPACTS ON WATER RESOURCES

Scientific research since 2000 involving climate trend analysis, general circulation model application, and hydrologic modelling/analysis, indicates the following expected influences of climate change on water resources in the Okanagan Basin:

- A decline in Okanagan Lake inflows (i.e. from streams)
- A change in streamflow timing, with earlier onset of seasonal peak streamflow and an extended low flow period
- Increased frequency of drought and/or longer drought periods
- Increase in crop water demand (longer, drier, hotter growing season)
- Increases in residential water demand during the growing season (with additional increases due to population growth)
- Increases in late summer water shortages
- High variability (both seasonal and yearly) in both water supply and water demand
- Increases in health related issues associated with water quality
- Influences of changes in water use (e.g. timing) on basin hydrology

A decade of collaborative discussions and research, combined with the need for adaptations and the existing governance structure, has lead to and legitimized the actions proposed in the Okanagan Sustainable Water Strategy.

WATER MANAGEMENT ADAPTATION DEVELOPMENT IN THE OKANAGAN BASIN

The evolution of climate change adaptations for water resources management in the Basin (since the early 2000s) is a process that has been influenced by components of the regional framework. These components consist of: the need for adaptations, availability of knowledge and scientific research, socioeconomic environment, and governance structure and initiatives.

Within this regional framework, a decade of collaborative discussions and research, combined with the need for adaptations and the existing governance structure, has lead to and legitimized the actions proposed in the Okanagan Sustainable Water Strategy (OSWS) (OWSC, 2008). The OSWS outlines 45 actions dealing with source protection, security of water supplies, and delivering the strategy. The actions in the OSWS are currently at the pre-implementation to implementation stage. The OSWS represents a coordinated approach that will promote regional adaptation to climate change as the actions are collectively applied.

KEY CONCEPTS OF SUCCESSFUL WATER MANAGEMENT ADAPTATION DEVELOPMENT

Key factors or concepts that have influenced the successful development of water management adaptations in the Okanagan include:

- A governance structure which has characteristics of a distributed-multi level approach
- A history of multi-stakeholder involvement
- Availability of knowledge and research
- Preparation
- Regional thinking
- Educated and innovative policy makers
- Effective communication

These factors may be useful to guide other regions as they move forward with adaptations to climate change.

The purpose of this report is to identify progress made toward water management sustainability and adaptation to climate change in the Okanagan Basin. A detailed analysis of the effectiveness of the adaptations, the degree of adaptation progress compared to other regions, constraints and limitations that may have interfered with progress, or an in-depth analysis of water governance in the region is beyond the scope of this paper.

1. INTRODUCTION

The subject of "climate change adaptation" with respect to water resources in Canada is receiving increased attention (e.g., BC Ministry of Environment, 2010a; Harford, 2008; Cohen and Neale, 2006) as the result of a combination of factors, including improved understanding of global and regional climate change, and an understanding of potential impacts of climate change on water resources.

The Okanagan Basin, BC, is a semi-arid valley in south-central British Columbia Figure 1), which has a growing population, significant agricultural land use, and existing areas of stressed water resources. Various levels of government and other organizations in Okanagan Basin have, collectively, played a leading role in British Columbia with respect to the discussion and development of water resources management practices in light of predicted influences of climate change (e.g. Cohen and Kulkarni, 2001; Cohen, et al., 2004, Cohen and Neale, 2006; OWSC, 2008). A decade of research, collaborative discussions, and water management decisions in the Okanagan Basin have resulted in the development of specific water management "adaptations" to prepare for continued population growth and projected influences of climate change.

The objectives of this report are to (1) present an overview of climate change research related to water resources in the Okanagan Basin and (2) document and examine water management initiatives that have been developed in the Okanagan Basin as adaptations to the predicted influences of climate change. Region-specific factors facilitating, driving, or influencing the successful development of climate change adaptations for water management in the Okanagan are highlighted. As a result of this analysis, we identify key concepts that may be useful to other communities in making progress toward sustainable water management.

This report was prepared as part of Simon Fraser University's ACT (Adaptation to Climate Change Team)'s fourth session – *Climate Change Adaptation and Water.*

Figure 1: Okanagan Basin, BC

2. REPORT STRUCTURE AND SCOPE OF WORK

As indicated above, the objectives of this report are to document climate change knowledge and research in the Okanagan Basin, and examine water management adaptations to climate change that have been developed in the Basin. The overall purpose is to identify key factors that have facilitated the successes in the Okanagan with respect to their progress toward sustainable water management and adaptation to climate change. This report contains the following sections:

- Section 0 summarizes relevant background information related to water and climate change in the Okanagan.
- Section 0 provides an overview of previous research regarding climate change in the Okanagan Basin and predicted impacts of climate change on water resources. A significant amount of scientific research and data collection/analysis has been completed since 2000. This report references previous work and reports, and summarizes key findings.
- Section 0 defines key components of a pre-existing Regional Framework ("need for water management", "knowledge", "governance", and "socioeconomic environment") that have permitted, driven, facilitated, and/or influenced water management in the Okanagan with respect to climate change preparedness/adaptations.
- Section 0 discusses adaptations to climate change (and other water stressors) that have been developed in the Okanagan and provides an overview of regionally focused climate change adaptations in the Okanagan Sustainable Water Strategy (OWSC, 2008).
- Sections 0 and 0 present a discussion and conclusions regarding region-specific factors facilitating the successful development of climate change adaptations for water management. Emerging concepts that could be useful to other communities in moving forward with adaptive water management are highlighted.

In developing the scope of work for this project, climate change adaptations are defined as: "water management initiatives, related to supply and demand quantity or quality, that address one or more potential implications of climate change." This definition includes water-related strategies that address (directly or indirectly) climate uncertainty, drought preparedness, and general water sustainability, and thus includes strategies developed to address combined effects of population growth, climate change, and other influences on supply and demand.

Lastly, the focus of this report is the Okanagan Basin. Provincial/federal water resource or climate change initiatives, applied across the province or country, are not discussed.

3. BACKGROUND – OKANAGAN BASIN DESCRIPTION AND BRIEF WATER HISTORY

The Okanagan Basin, BC, is a semi-arid valley located in south central British Columbia. The Okanagan Basin (8200 km2 in area) is part of the larger Columbia River Basin, which extends into the United States, and ultimately drains to the Pacific Ocean. A mainstem river-lake system is present in the Okanagan Basin valley bottom and flows to the south across the US border. Over 30 major subcatchments are defined within the basin, which direct highland streamflow to the mainstem river-lake system. Groundwater is present across the basin, generally at depths less than 30m, within bedrock and unconsolidated aquifers of variable productivity.

Historically, the Okanagan Basin area was traditional territory for aboriginal people who recognized the water systems as central to life (OWSC, 2008). European settlers arrived in the early 1900s, and areas of land were transformed from dry pine and rangeland to orchards, tobacco farms, and hay farms, with irrigation mainly via surface water extractions/diversions (OWSC, 2008). Through the 1950s, urban and agricultural development increased, and both surface water (lakes and streams) and groundwater were used for agriculture and domestic supply. In the 1960s,

agriculture and urban development escalated, and water quality issues emerged (e.g. algal blooms, deteriorating lake quality, Eurasian watermilfoil). The Okanagan Basin Water Board (OBWB) was established in 1969 with a mandate to better define water resource problems in the valley (mainly water quality issues at that time) and determine priorities and opportunities for solving them (OBWB, 2010a).

In the early 2000s, the first research to investigate potential impacts of climate change and population growth on water resources in the Okanagan Basin was initiated (Cohen and Kulkarni, 2001). Climate change research, research to understand current and future water supply and demand, along with preliminary collaborative discussions regarding water management adaptations to prepare for climate change, continues through to the present (see Section 0). Also during this time period, the OBWB redeveloped its water management initiative in response to continuing water issues (in 2003), and the Okanagan Water Stewardship Council (OWSC) was formed (in 2006). In 2008, the OWSC produced the Okanagan Sustainable Water Strategy (OSWS) which outlines 45 specific actions for water management to address influences of climate change, population growth, and other factors influencing water supply and demand (see Section 0).

The population of Okanagan Basin was 210,000 in 1968 and grew to 310,000 by 2001 (Cohen and Neale, 2006). It is projected to reach 445,600 by 2035 (OWSC, 2008). Statistics Canada has identified the Okanagan Basin as having the smallest per capita availability of freshwater in Canada (OWSC, 2008). Surface water licences are fully allocated and there is increasing groundwater use across valley bottom unconsolidated aquifers and some highland bedrock aquifers. Current water issues include water supply and demand concerns (quantity) due to impacts of population growth, as well as potential impacts of climate change and drought on water quantity and quality.

4. OVERVIEW OF OKANAGAN BASIN CLIMATE CHANGE PROJECTIONS

The Okanagan has been a focal point in BC for climate change research. As indicated in Section 0, climate change research, and research to understand impacts of climate change on water resources, was initiated in the Okanagan in the early 2000s (Cohen and Kulkarni, 2001). Throughout the 2000s, this initial research was augmented (e.g. Cohen et al., 2004; Cohen and Neale, 2006; Merritt et al., 2006), and provided an understanding of climate change impacts on surface water resources (snowpack and streamflow) and water demand. Climate change impacts to groundwater have been investigated in the south Okanagan (Toews and Allen, 2009; Toews, 2007).

Climate change research in the Okanagan continues today. The recently completed Phase 2 Okanagan Water Supply and Demand Project (OBWB, 2010b) provides climate change predictions for water supply and demand based on global climate model (i.e. general circulation model, GCM) predictions with different population growth and land use scenarios. Recent and ongoing work by Agriculture and Agri-Food Canada involves the development of daily gridded climate surfaces for the basin for the period 1960 to 2005 (Neilsen et al., 2010a), and statistical downscaling of generated GCM data to produce gridded (500m) climate predictions across the basin (Neilsen et al., 2010b). Van der Gulik et al. (2010) developed an agriculture water demand model that considers the impacts of climate change.

Climate change research in the Okanagan involves (a) statistical and trend analysis of historical climate data, and/or (b) the use of General Circulation Models (GCMs). Analysis of historical climate data provides an understanding of the influences of known climate variability due to ENSO (El Nino Southern Oscillation) and PDO (Pacific Decadal Oscillation), as well as other large-scale climate influences (i.e. climate change). Climate change projections based on GCMs provide large-scale climate predictions, due to global warming, for parameters such as temperature and precipitation, for grid area dimensions of approximately 400 km by 400 km (Cohen and Kulkarni, 2001). There are a

number of different GCMs available, each scientifically based, but each producing slightly different projections. While the different GCMs may have differences in absolute projections for specific climate variables, they do show agreement for scenarios of general climate trends (Cohen and Kulkarni, 2001). Once climate change projections are determined, they can be used as inputs to hydrology or water use models to investigate climate change impacts on water.

The following sections provide a summary of documented climate trends (Section 0), climate change predictions (Section 0), and projected climate change influences on water resources (Section 0). Further information can be obtained by consulting the sources of the information.

4.1 CLIMATE TRENDS IN THE OKANAGAN

Statistical and trend analysis of available climate station and hydrometric station data for the Okanagan Basin is presented in Cohen et al. (2004). This research investigated the influence of ENSO, PDO and other large-scale atmospheric changes on Okanagan climate and hydrology data, and identified the following trends:

- Climate variability in the Okanagan is influenced by the ENSO and PDO, both of which cause periods of warming and cooling.
- Data from long term (since the early 1900s) climate stations at Summerland and Vernon indicate warming trends in the Okanagan climate (predominantly in winter and spring seasons). Increases in daily minimum temperatures are greater than increases in daily maximum temperatures.
- Increases in spring and summer precipitation over the past few decades.
- A decrease in the fraction of precipitation falling as snow at lower elevation climate stations (this change not observed at higher elevation stations).
- Increase in cloud cover, mainly at night.
- A decrease in mean annual solar radiation, but an increase in net radiation.
- Earlier onset of snowmelt.
- Drought periods in the 1920s, 1930s, 1967, and in 2003.
- Increases in lake inflows, possibly due to increases in spring and summer precipitation.

4.2 CLIMATE CHANGE RESEARCH AND PROJECTIONS

Regional climate change projections for the Basin have been made based on results of GCM modelling. In addition, some predictions are obtained based on extrapolation from available historical climate data. The following general trends are predicted for the Okanagan Basin (Cohen et al., 2004; OWSC, 2008):

- An overall increase in air temperature
- Longer, hotter, and drier summers
- Warmer, wetter winters
- Earlier snowmelt
- A longer, warmer growing season
- More extreme climate events (e.g. more intense storms, drought)
- A greater proportion of precipitation falling as rain rather than snow (reduced snowpack)
- Uncertainty with respect to changes in average total annual precipitation (depending on choice of GCM and scenario variables)

Current GCM statistical downscaling (Neilsen et al., 2010a) may provide additional climate change projection information that can be used to look at small-scale climate projections and/or confirm the general basin predictions noted above.

4.3 PREDICTED INFLUENCES OF CLIMATE CHANGE ON WATER RESOURCES

Future climate change is predicted to alter the quantity and quality of water in the Okanagan Basin as well as water demand (OWSC, 2008). The following general trends are predicted for the Okanagan Basin (Cohen and Neale, 2006; Merritt et al., 2006; OWSC, 2008; OBWB, 2010b).

- A decline in Okanagan Lake inflows (i.e. from streams)
- A change in streamflow timing, with earlier onset of seasonal peak streamflow (by a month or more by 2080s), and an extended low flow period
- Increased frequency of drought and/or longer drought periods
- Increase in crop water demand by up to 60% by 2080s (longer, drier, hotter growing season)
- Increases in residential water demand during the growing season (with additional increases in demand due to population growth)
- Increases in late summer water shortages (during periods of low supply and high demand)
- High variability (both seasonal and yearly) in both water supply and water demand
- Increases in health-related issues associated with water quality (e.g. increased incidence of high turbidity)
- Influences of changes in water use (e.g. timing) on basin hydrology (i.e. climate change causes changes in hydrology, which cause changes in water use, which in turn influence basin hydrology)

Limited research has been completed to investigate the potential influences of climate change on groundwater resources in the Okanagan. Research by Toews and Allen (2009) and Toews (2007) investigated the influence of climate change on groundwater recharge in the south Okanagan area near Oliver using downscaled data from three GCMs with consideration of future changes (increases) to irrigation return flow rates. Their results suggested increased groundwater recharge mainly due to increased irrigation return flow for their study area.

5. OKANAGAN BASIN REGIONAL FRAMEWORK

The development, implementation, and monitoring of climate change adaptations for water management in the Okanagan Basin have been facilitated by the existing Regional Framework. Four key components of this framework that have permitted, driven, facilitated and/or influenced water management with respect to climate change preparedness and adaptations are:

- Need (Section 0): The need for water management climate change adaptations (i.e. concerns with respect to water supply and demand);
- Knowledge (Section 0): Research and data regarding climate change and the potential effects on water resources;
- Socioeconomic Environment (Section 0): Social and economic factors that influence stakeholder involvement, collaborative discussions and dialogue, and effective development of water management adaptations;
- Governance (Section 0): Governance and legislation that enable or constrain climate change adaptations for water management.

The interplay of these components influences the development and implementation of adaptations as illustrated on Figure 2. The following sections discuss the role of each of the components in the Regional Framework.

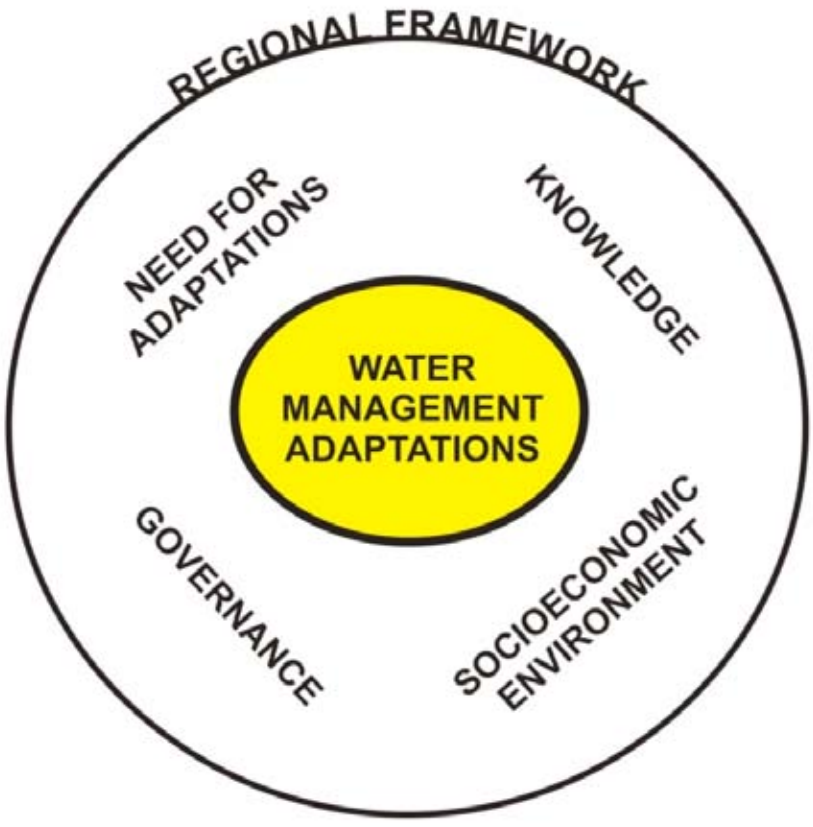

Figure 2: Regional Framework Components for Water Management Adaptations

5.1 NEED FOR CLIMATE CHANGE ADAPTATIONS

The inherent need for water conservation is a key component of the Okanagan's successes in water management and preparing for climate change (i.e. developing climate change adaptations). The Okanagan Basin is a semi-arid water-stressed valley with a growing population and significant agricultural development. Concerns regarding water quantity and quality are long-standing. Because the Okanagan is already a water-stressed region, it is an area that is particularly sensitive to the potential impacts of climate change (i.e. compared to a wetter region).

The following examples illustrate ways in which the need for water management may interplay with other regional framework components:

- Supports (legitimizes/drives) research initiatives and data collection
- Engages the public and stakeholder groups (e.g. those who are personally affected)
- Influences regional water governance (e.g. development of OBWB)

5.2 KNOWLEDGE

Knowledge regarding water resources in the Okanagan Basin has accumulated over time from both science and experience. First Nations contribute traditional ecological knowledge (TEK), which evolves from centuries of observations of, and responses to, the environment and is orally passed down through generations (IPRN, 2010). Local water knowledge gained through experience is also held by various water users throughout the Okanagan (e.g. agricultural community, fish and game clubs), and water practitioners such as municipal water managers, irrigation districts, and the BC Water Supply Association.

Scientific research to understand the potential influences of climate change on water resources in the Okanagan Basin was initiated in the early 2000s. An overview of scientific research completed in the Okanagan Basin to understand the potential impacts of climate change and impacts of climate change on water resources was presented in Section 0.

Scientific knowledge, TEK, and local experience regarding water resources in the Okanagan have contributed to the development of knowledge-based water management initiatives/adaptations. This knowledge has verified the importance/urgency of water issues in the basin, which, in turn, may help to legitimize water management decisions and expenditures by local/regional government.

The following examples illustrate how climate change knowledge may interplay with other regional framework components:

- Verifies the need for water resource adaptations to climate change
- Legitimizes and drives water governance (i.e. role of OBWB)
- Provides guidance and direction for further research
- Promotes information sharing and education

5.3 SOCIOECONOMIC ENVIRONMENT

Numerous groups are involved in, or are influenced by, water management decisions in the Okanagan. These include individuals, community interest groups, businesses, agricultural community, developers, research institutions, First Nations, water purveyors, local governments, and others. The history of multi-stakeholder discussions regarding climate change adaptation and water management dates back to work initiated in the early 2000s (Cohen and Kulkarni, 2001). The relatively long history of focused collaborative discussions regarding the advantages and disadvantages of different climate change adaptation options has been seminal in creating an environment that fosters consensus building and cooperation. The OBWB indicates that, because these groups have historically been involved in, and are directly impacted by, the development of water management adaptations they are eager to continue to provide input regarding water management initiatives in the basin (Warwick-Sears, personal communication, 2010).

While the Basin as a whole has a history of multi-stakeholder involvement and discussion with respect to climate change adaptations, work by Shepherd et al. (2006) demonstrated that local socioeconomic differences exist within the Basin, and can either enable or constrain moving forward with the implementation of water management adaptations. Enabling factors included a high level of awareness and education of policy makers, proactive and progressive policy makers, a collective users' philosophy, educated users, and others (Shepherd et al., 2006). Barriers to water management adaptation included attitudes of discontent and distrust, strong interest group lobbying, entrenched values with respect to entitlement, and others. In general, this work emphasizes that socioeconomic factors may vary from location to location within the Basin, and may enable or constrain progress toward the implementation of adaptations.

Education and awareness is one socioeconomic factor that may facilitate or constrain the implementation of adaptations. A telephone survey completed by OBWB in 2009 (Warwick-Sears, personal communication, 2010) provides baseline data that captures the level of awareness and interest of Okanagan residents with respect to water. Based on this survey, 64% of respondents agreed that there is "likely to be a water supply problem in the Okanagan Valley within 10 years." The survey indicates regional differences in perception of water issue prioritization; for instance, a growing population was identified as important by Central Okanagan respondents, while South Okanagan respondents rated water quality highest.

With respect to economic development, the Okanagan Sustainable Prosperity Strategy (Okanagan Partnership, 2004) has identified the importance of environmental sustainability. The strategy recognizes that the Okanagan's economic future depends on the quality of its environment (including water) and a successful economic-environmental balance. Comments regarding the importance of water to the regional economy are also presented in the OSWS (OWSC, 2008).

The following examples illustrate how the socioeconomic environment may interplay with other regional framework components:

- Facilitates stakeholder discussions and communication with government
- Supports/influences collection of data/knowledge (e.g. research initiatives)
- Facilitates implementation of adaptations
- Influences water governance/policy

5.4 GOVERNANCE AND ENABLING LEGISLATION

The water governance structure in the Okanagan has characteristics of a "distributed, multi-level system", with varying levels of authority derived (mainly) from provincial legislation and policy (Wagner and White, 2009). Table 5 provides an overview of the different levels of government involved in water management in the Okanagan Basin. Further discussion regarding Okanagan Basin water governance is provided in subsequent sections.

The regulatory framework of legislation and policies that directly or indirectly govern water in the Okanagan Basin consists of more than thirty-five Acts, Regulations, and policies concentrated at the provincial and federal levels of government (OWSC, 2008). Local legislation consists of Official Community Plans and zoning bylaws, with some additional international influence via treaties. A list of relevant water legislation and documentation is provided in the OSWS (OWSC, 2008) and is reproduced as a list in the last column of Table 5. Further discussion regarding these regulations/policies is not provided in this report; details can be obtained by consulting the noted documents.

Governance and enabling legislation interplay with other regional framework components as illustrated in the following examples:

- Financially (or otherwise) supports research initiatives (e.g. supply and demand study)
- Influences attitudes or educates/engages public (e.g. OBWB promotes a basin-wide approach to water management)
- Responds to existing water issues

5.4.1 Overview of Okanagan Governance Structure

Government bodies, groups, and organizations that influence water governance in the Okanagan Basin are identified Table 5. Of the government agencies and organizations listed, some agencies have played a key role in Okanagan-specific water governance. The Interior Health Authority, the Okanagan Basin Water Board, regional to sub-regional level government and organizations, and local water purveyors (e.g. municipalities, Improvement Districts) have all contributed to the region in terms of water governance. The following sections discuss the contributions of these agencies to water management and the development of climate change adaptations in the Okanagan.

Provincial/federal water governance is not specifically discussed as it is applied universally across the province/country, and it is the purpose of this report is to highlight aspects of water governance that are unique to the Okanagan Region. Additionally, international influences on Okanagan water governance are not discussed (e.g. Osoyoos Lake Board of Control) as these water governance aspects are addressed in a separate component of ACT's Water Session report.

It should be noted that some researchers have identified aspects of water governance in the Okanagan region that have constrained progress toward improving water management in the basin (e.g. Patrick et al., 2008; Wagner and White, 2009). Criticisms of the governance structure with respect to water management initiatives are associated with the role of the provincial government (e.g. fragmented roles/responsibilities; overlapping provincial agencies; lack of provincial power sharing; and ineffective provincial legislation), and further need to improve integration of the numerous organizations that are involved in water management within the Basin. The focus of this paper is to highlight enabling factors, and thus further analysis of these constraints can be referenced in the above-noted reports.

Table 17: Okanagan Water Governance/Management Organizations and Relevant Legislation

LEVEL	GOVERNMENT OR ORGANIZATION	*RELEVANT DOCUMENTS/LEGISLATION (FROM BOX 4-1, OWSC, 2008)
International	• International Osoyoos Lake Board of Control	• Order of the International Joint Commission (IJC) – Zosel Dam Order of Operation • International Boundary Waters Treaty Act • Columbia River Treaty
Federal	• Environment Canada • Agriculture Canada (Summerland Research Centre) • Department of Fisheries and Oceans	• Environmental Assessment Act • Environmental Protection Act • Department of Environment Act • Federal Water Policy (1987) • Fisheries Act • Indian Act • International River Improvements Act • Navigable Waters Protection Act • Species at Risk Act • Water Act • Wildlife Act

LEVEL	GOVERNMENT OR ORGANIZATION	*RELEVANT DOCUMENTS/LEGISLATION (FROM BOX 4-1, OWSC, 2008)
Provincial	• BC Ministry of Environment • BC Ministry of Forests • BC Ministry of Agriculture • Interior Health Authority (BC Ministry of Health Services)	• Action Plan for Safe Drinking Water (2004) • Agricultural Land Commission Act • Dike Maintenance Act • Drinking Water Protection Act • Environmental Assessment Act • Environmental Management Act • Farm Practices Protection (Right to Farm) Act • Fish Protection Act (Riparian Areas Regulation) • Forest and Range Practices Act • Health Act • Land Act • Living Water Smart: British Columbia's Water Plan (2008) • Local Government Act • Mines Act • Okanagan-Shuswap Land and Resource Management Plan • Private Managed Forest Land Act • Range Act • Utilities Commission Act • Water Act (Groundwater Protection Regulation) • Water Protection Act • Weed Control Act • Wildlife Act • Water Utility Act
First Nations	• Self government arrangements	• n/a
Watershed	• Okanagan Basin Water Board (OBWB) • Okanagan Water Stewardship Council (technical advisory committee to the OBWB)	• n/a
Regional and Sub-Regional	• Regional Districts • Joint Water Committees (Kelowna Joint Water Committee, West Kelowna Joint Water Committee)	• Bylaws
Local (Water Purveyors)	• Improvement Districts • Municipalities/Towns	• Official Community Plans • Zoning bylaws and other bylaws
Private Residents	• Individual well or surface water licence owners	• n/a

*Relevant documents and legislation are listed by legislation government level, but may be applicable to other levels of government (e.g. the Local Government Act is provincial legislation that is applicable to local governments).

5.4.1.1 Interior Health Authority (Provincial)

The Interior Health Authority (IHA) operates as one of five regional health authorities throughout BC under the Ministry of Health Services. The IHA covers the Okanagan as well as the Thompson/Cariboo, Kootenay/Boundary, and East Kootenay regions of BC. The following information was obtained from interviews with R. Birtles, Environmental Health Officer, IHA (R. Birtles, personal communication, 2010), and from the documents referenced below:

Each regional health authority in BC develops regional policies under enabling legislation such as the BC Drinking Water Protection Act (2001) and the BC Public Health Act (2008). This governance structure allows each health

authority to develop individual policies that are designed to address predominant region-specific issues related to health. Due to the history and prevalence of water-related health and supply issues in the Okanagan, in 2003 the IHA developed an initiative within their Okanagan service area to have large water systems comply with the multi-barrier approach as outlined in a CCME document on drinking water (CCME, 2002). As a result of this initiative, conditions on permits were applied (under the Drinking Water Act legislation) to all water systems in the Okanagan supplying 500 or more users. These conditions on permit included requirements for water utilities to complete Source Assessments and Water Master Plans.

The Source Assessment involves the characterization of risks using a "multi-barrier" approach to help water systems develop an understanding of the risks to, and develop measures to improve, drinking water safety and availability (Ministry of Healthy Living and Sport, 2010). The Water Master Plan is a comprehensive document that outlines management procedures and infrastructure requirements for all supply, demand, and quality aspects of the water system. Embedded within these documents are water management measures or adaptations to address hydrological concerns and changes that may influence water supply or quality (including climate change).

To date, twelve water utilities in the Okanagan have completed or are in the process of completing Source Assessments, and some of these utilities have developed Water Master Plans. These numbers are significant when compared to other areas in BC. Factors driving these numbers include funding opportunities through application to the OBWB, and individual water utility initiatives (e.g. the need to address existing or worsening water issues).

The IHA has a strong relationship with the OBWB, with an IHA representative sitting on the OWSC. As such, it has influenced, and been involved with, the development of water management adaptations for the basin as outlined in the OSWS. IHA also works with the OBWB to provide guidance and advice to assist it in prioritizing funding applications for Source Assessments.

5.4.1.2 Okanagan Basin Water Board and Water Stewardship Council

As indicated in Section 0, the OBWB was established in 1969 as a body responsible for valley wide water resource issues within the hydrologic boundaries of the Okanagan Basin watershed. The OBWB was established under the "BC Municipalities Enabling and Validating Act through Supplementary Letters of Patent of the three Okanagan regional districts" (OWSC, 2008). The OBWB is a unique form of local government, based on physical watershed boundaries, that has not been duplicated elsewhere in the province due to lack of strong enabling legislation (Warwick-Sears, personal communication, 2010). The OBWB has no regulatory authority, but has taxation powers to support its initiatives (OWSC, 2008). Board members include representatives from the three Okanagan regional districts, the Okanagan Nation Alliance, the Water Supply Association of BC, and the OWSC. Additional information regarding the OBWB can be referenced in its Governance Manual (OBWB, 2010a).

The OBWB operates regionally through incentive-based programs in support of water management projects (OWSC, 2008). Although the OBWB has no regulatory authority, it has become proactive and influential with respect to basin water management initiatives and adaptations (Wagner and White, 2009), including promoting the implementation of regionally coordinated water sustainability initiatives (including climate change adaptations), that consider the "one watershed" approach to water resources management.

The OWSC was formed in 2006 as an advisory body to the OBWB. The OWSC utilizes local water expertise in support of developing long-term sustainable water management initiatives for the Okanagan region (with members representing Okanagan College and UBC Okanagan, water and climate change scientists from different levels of government, water user groups, non-profit organizations, professional associations, economic interests, and First Nations). The OWSC developed the OSWS (OWSC, 2008), which outlines long-term objectives for water management in the basin including adaptations that consider climate change. The OSWS emphasizes "the importance of environmental

stewardship, equity of access, effective communication, and consensus building across all levels of the governance system, and . . . an integrated, watershed-wide approach."

5.4.1.3 Regional to Sub-Regional Government and Organizations

Regional and sub-regional government bodies and organizations responsible for aspects of water in the Okanagan have varied roles within the Basin. The following text discusses Regional Districts and Joint Water Committees, as examples of regional to sub-regional organizations that influence water governance in the Basin. A detailed analysis of the effectiveness and interaction of these organizations within the water governance structure is beyond the scope of this paper.

There are three regional districts within the Okanagan Basin (representing the North, Central, and South portions of the Okanagan). Representatives from each of the three regional districts are members of the OBWB. In general, Regional Districts operate water utilities, or play a role in water management, for locations that are not managed by an existing water purveyor. Thus, Regional Districts have variable involvement with respect to water management in the Basin, depending on the locations/areas within their jurisdictions for which they hold water licences and/or manage water.

A Joint Water Committee is a group of water utilities/purveyors within a given sub-watershed that act to bring a collective approach to water management within their combined service areas. There are two joint water committees in the Basin: Kelowna Joint Water Committee (KJWC, 2010) and the Westside Joint Water Committee (WJWC, 2010). These organizations provide a vehicle for information sharing and implementation of regional programs, for example, but do not have regulatory authority.

5.4.1.4 Local Water Purveyors

Local water purveyors include municipalities and Improvement Districts that provide water within their jurisdictional areas. Water purveyors in the Okanagan Basin service varying sizes of populations using a variety of water sources including lakes (e.g. Okanagan Lake, City of Kelowna), upslope reservoirs (e.g. Black Mountain Irrigation District), stream water (e.g. Trout Creek, District of Summerland), and groundwater (e.g. Okanagan Falls Irrigation District). Water purveyors individually contribute to sustainable water management within their jurisdictions in varying degrees via water conservation programs, metering, water pricing, infrastructure modifications and maintenance. Local water purveyors must be able to respond to water shortages affecting their systems and have the authority to regulate water use (e.g. through restrictions and pricing) under provincial legislation. They also must comply with requirements of the IHA. Local water purveyors may interact with the OBWB for information sharing or funding applications.

Of the local water purveyors in the Okanagan, over forty are Irrigation (i.e. Improvement) Districts (Cohen et al., 2004), which hold surface water licences. Wagner (2008) and Wagner and White (2009) note that the historical establishment of Irrigation Districts in the Okanagan was a characteristic feature of the cooperative family farm and orchard economy that existed in the region, and suggest that the early development of Improvement Districts promoted equitable sharing of water among users. Improvement Districts have provided a vehicle for local water interests to be considered within the broader Regional Districts, and have brought local water knowledge to the development of water management adaptations in the Okanagan. Recent policies adopted by the BC Ministry of Community Services (BC Ministry of Community Services, 2006) involve ceasing the creation of new Improvement Districts, moving toward dissolving existing Improvement Districts, and transferring responsibilities to Regional Districts or municipalities. Changes in water governance as a result of these new policies may influence future water management for these areas (an analysis of the potential influences is beyond the scope of this paper).

6. CLIMATE CHANGE ADAPTATIONS AND THE OKANAGAN SUSTAINABLE WATER STRATEGY (OSWS)

The OSWS, developed in 2008 by the OWSC, outlines regional actions (or adaptations) for sustainable water management in the Basin. The OSWS was developed based on technical expertise of the OWSC. Many of the actions outlined in the OSWS were established, at least in part, based on previous climate change dialogue and collaborative discussions since the early 2000s (e.g. Cohen and Kulkarni, 2001; Cohen et al., 2004; Cohen et al., 2006). The OBWB also indicates that this previous work generated the interest, involvement, and momentum that were needed to move forward in developing the OSWS (Warwick-Sears, personal communication, 2010).

This section provides an overview of the actions/adaptations outlined in the OSWS that deal with source protection, securing water supplies, and delivering the strategy (see Sections 0, 0, 0, below, and Table 6). Note that all actions in the OSWS are identified, whether their intent is to address climate change or other aspects of water sustainability. A review of the effectiveness of the strategy at achieving its objectives (i.e. progress toward the actions) is beyond the scope of this paper. The OBWB (Jatel, personal communication, 2010) indicates that, in general, the actions in the OSWS are at the pre-implementation to implementation stage. Follow-up regarding the progress made toward implementing the actions in the 2008 OSWS, as well as discussions regarding prioritizing tasks to ensure the continued application of the strategy, are planned for late 2010 and 2011.

It should be noted that other locally-implemented water management initiatives have made valuable contributions to the water management successes in the Okanagan Basin. Based on interviews conducted in preparation of this paper, many local initiatives have been driven by economic needs, regulatory requirements, infrastructure needs, treatment issues, or drought pressure/urgency, rather than being responses to climate change knowledge. Examples include reservoir expansion (increases in upslope water storage), lawn watering restrictions, incentives for lawn top dressing, improvements in web-based information sharing (e.g. informing of water restrictions/advisories), water pricing changes and metering, improvements to infrastructure and leak repair, technical system evaluations/studies, water management plan development, and others. It is beyond the scope of this paper to provide a detailed accounting of the numerous local-scale water management actions across the Basin, however some of these initiatives will be captured by the regional actions outlined in the OSWS.

Table 18: Table of Recommended Actions in Okanagan Sustainable Water Strategy (OWSC, 2008). Further details and descriptions of the actions can be referenced in the Sustainable Water Strategy document (www.obwb.ca/water_strategy).

NUMBER	RECOMMENDED ACTION
Source Protection	
2-1	Off-stream cattle watering stations
2-2	Protect, restore, and enhance riparian and wetland
2-3	Develop a basin-wide source protection strategy
2-4	Implement well protection toolkit
2-5	Implement bylaws and best practices for all geothermal groundwater wells
2-6	Consider water in community design
2-7	Implement stormwater management plans
2-8	Use best practice local government land-use bylaws to protect local water sources
2-9	Develop a groundwater bylaws toolkit and harmonize groundwater bylaws
2-10	Support and coordinate sustainable septic field development along sensitive waterways
2-11	Accountability of "Authorized Person"
2-12	Research emerging health risks identified in other jurisdictions
2-13	Complete appropriate mapping
2-14	Create a streamlined on-line data reporting system for water quality and suppliers
Securing Our Water Supplies	
3-1	Manage water quantity
3-2	Establish an Agricultural Water Reserve
3-3	Extend the date on irrigation licenses
3-4	Ensure availability of potable water
3-5	Review water licensing
3-6	Implement drought management plans
3-7	Prepare Water Use Plans for all fish bearing streams
3-8	Prepare a comprehensive Water Management Plan for the Okanagan Basin

3-9	Develop a Regional Water Conservation Strategy
3-10	Reduce outdoor water use by using Certified Irrigation Designers
3-11	Universal installation of water meters
3-12	Conduct a water pricing assessment
3-13	Affordable water for agriculture
3-14	Ensure water storage is identified as a strategic and critical component to water management
3-15	Change water license structure associated with storage
3-16	Implement policies that support coordinated water storage by utilities
3-17	Maintain and expand the network of hydrometric and climate stations
3-18	Install flow measurement recorders at all reservoir spillways
3-19	Collect better information on evaporation and evapotranspiration
3-20	Develop a groundwater regulation pilot program
3-21	Develop a regional well/borehole database
Delivering the Strategy	
4-1	Support and foster collaboration
4-2	Partner with aboriginal people in the development of basin water strategies
4-3	Obtain local government representation on the Southern Interior Regional Drinking Water Team
4-4	Develop an Okanagan Basin Information Network
4-5	ID knowledge gaps and support research to strategically fill gaps
4-6	Analyze funding mechanisms to support water governance
4-7	Create an Okanagan water fund
4-8	Develop a basin-wide community engagement strategy
4-9	Develop water management reporting tools
4-10	Reassess and improve the Sustainable Water Strategy

6.1 SOURCE PROTECTION ADAPTATIONS

Source protection, as described in the OSWS, involves coordinated stakeholder efforts to develop plans that prevent, minimize, or control potential water pollution to drinking water, land, ecosystems, and the entire hydrologic cycle.

Source protection represents one component of a "multi-barrier approach" that considers water quality from the source (watershed) to the tap.

Table 6 provides a listing of Actions 2-1 to 2-14 from the OSWS that are related to source protection. While these actions focus on protecting water quality, water quality concerns may be exacerbated by climate change (e.g. algal blooms, turbidity due to hydrological variability, potential for water-borne disease, increased concentrations of anthropogenic chemicals, health influences of storm events), and thus source protection actions are indirectly related to climate change.

The source protection actions are variable in both ease and timeframe of implementation. As an example, Action 2-4a calls for water purveyors using groundwater to develop well protection plans. This action is well defined (due to the clear procedures in the Provincial Well Protection Toolkit). Action 2-13, another example, is a potentially longer-term initiative involving Sensitive Habitat Inventory Mapping (SHIM).

6.2 SECURING WATER SUPPLIES

OSWS actions developed for securing water supplies consider water availability (quantity) and demand. An underlying principle of the OSWS is "water allocation" which involves identifying how to share water in a "clear, transparent, and equitable way." This concept involves reserving water for appropriate "uses", such as the environment, agriculture, human needs, and economic development. Climate change (coupled with population growth) has a direct influence on the quantity of water available and the timing of supply and demand (Section 0).

Table 6 lists Actions 3-1 through 3-21, which relate to securing water supplies. The actions address both surface water and groundwater supplies from "supply" and "demand" perspectives. Again, the proposed actions are variable in both ease and timeframe of implementation. For example, Action 3-1 deals with establishing conservation flows for streams, which is a complex multi-disciplinary scientific problem that is specific for a given stream, and must consider multi-stakeholder opinions and the existing governance constraints. Other actions may be less complex or more easily implemented, such as Action 3-6, which calls for all major water purveyors to prepare Drought Management Plans, or Action 3-18, the installation of flow measurement recorders at reservoir spillways. All actions require some degree of multi-stakeholder coordination, initiative, financing, planning, and preparation.

6.3 DELIVERING THE STRATEGY

The OSWS includes actions directed at delivering the strategy designed to "bridge the gap between talk and action", and address some of the anticipated challenges in implementing the strategy. Actions include educating the public, and generating public and stakeholder support that would facilitate the implementation of actions related to water sustainability and climate change. Table 6 includes Actions 4-1 through 4-10, which address delivering the strategy.

7. DISCUSSION

This report examines the development of water resources adaptations to climate change in the Okanagan Basin. Progress has been made in adaptation development relating to source protection and securing water supplies. The Okanagan Sustainable Water Strategy (OWSC, 2008) outlines well-considered actions that promote regional preparedness/adaptation to climate change impacts on water resources.

The regional framework under which the adaptations evolved has facilitated (or even permitted) adaptation development. This regional framework includes the long-standing need for water management in the basin (water-stressed region), unique governance structure and initiatives, regionally-focused scientific research, and a socioeconomic environment that promotes a basin-wide approach to water management and multi-stakeholder involvement. The concurrent evolution of these key regional framework components and their interplay have permitted the successes to date with regard to the development and implementation of climate change adaptations for water management in the Okanagan Basin.

The ultimate purpose of the information and analysis presented in this paper is to examine the development of water management adaptations in the Okanagan to identify key factors or concepts influencing the Okanagan's successes in water management. These key factors/concepts may be useful to other communities as they move forward with water management adaptations to climate change. This section provides a discussion of emerging key concepts:

- **Distributed multi-level water governance structure:** Researchers have identified multi-level governance structures as superior to centralized, top-down approaches to water governance (Wagner and White, 2009). As discussed in Section 0, Okanagan governance has characteristics of an integrated multi-level system (Wagner and White, 2009). At the basin or watershed scale, the OBWB, OWSC, and IHA (through Okanagan-specific initiatives) provide regionally coordinated water governance. At a sub-regional or local scale, Improvement Districts, joint water committees, municipalities, and water purveyors employ local efforts in water management. Communication and coordination between these levels of government is a characteristic of a multi-level approach for water governance.

Wagner and White (2009) suggest that the existence of the OBWB and OWSC has played a particularly important role in moving toward effective water governance in the Basin. At present there is no strong legislation to enable the formation of a body similar to the OBWB (Warwick-Sears, personal communication, 2010). The OBWB indicates that with the modernization of the BC Water Act (underway), there may be enabling legislation for other regions to form this type of organization.

- **Multi-Stakeholder Involvement:** A decade of collaborative discussions and multi-stakeholder involvement in the Okanagan has resulted in the thorough examination of potential adaptations to climate change (and population growth), development of potential adaptation strategies, and consideration of potential impacts of different adaptations. This involvement of stakeholder groups established a cooperative environment and provided the groundwork for the development of specific documented actions outlined in the OSWS of 2008. Early multi-stakeholder involvement and collaborative discussions (at the stage of adaptation development) may assist other communities in establishing a similar cooperative environment to the Okanagan.
- **Availability of Knowledge and Research:** The Okanagan Basin has been a focus area for scientific research and knowledge accumulation due to historical water issues and the importance of water in the region for many user groups. This knowledge acts as a pillar in support of the effective development and implementation of adaptations in the basin. Some aspects of the water resources and climate change knowledge for the basin may be transferable to other communities, or may provide other communities with direction for identifying their research/knowledge needs.

- **Preparation:** Shepherd et al. (2006) note that greater preparation by policy makers can facilitate the adaptation process, and that adaptations proposed or imposed out of a sense of urgency may be less easily implemented. Success in the development and implementation of water management adaptations in the Okanagan is the result, in part, of years of planning, community education and awareness, and multi-stakeholder involvement. In recognizing the timeframe necessary to develop well-planned adaptations for water management, other communities would be well-advised start now so that, when water issues emerge, they are in a position to implement well-planned actions in a timely and effective manner.
- **Regional Thinking:** Water boundaries do not always coincide with governance boundaries due to the interconnectedness of water within a watershed (streams, lakes, groundwater, etc., flow across governance boundaries). A regional watershed approach to water management and adaptations considers the interconnectedness of water, allows region-specific issues to be addressed, and promotes collective thinking as opposed to entitlement thinking. The regional approach also relates to the scale of climate change knowledge, which currently consists of identified regional trends. The actions developed in the OSWS provide examples of regional adaptations. Many of these actions require implementation at the local level, but when collectively implemented, they create regional consistency.
- **Educated and Innovative Policy Makers:** The importance of educated and innovative policy makers for success in water management is highlighted by Shepherd et al. (2006). Education and innovation facilitates effective adaptation from the initial development of innovative or unique adaptation options, through the development of innovative ways to involve stakeholders, and implementation of the action. An example of innovation in the Okanagan is the development of the OSWS, which is a unique document that sets the stage for similar efforts in other communities.
- **Communication:** This concept involves communication between stakeholders, different levels of government, and the public. Early collaborative discussions in the basin allowed for information sharing and established communication networks between and among stakeholders and levels of local/regional government. Communication with respect to the public has been achieved through local education initiatives (e.g. websites) as well as media coverage.

While the above-noted concepts stem from the Okanagan's success in water management and adaptation to climate change, it is recognized that there are deficiencies or limitations that may have hindered or delayed progress. These limitations could include governance constraints, regulatory constraints, financial constraints, knowledge constraints, infrastructure constraints, constraints relating to public support, or other factors.

The purpose of this report is to examine the positive outcomes of the Okanagan experience, and thus an analysis of the constraints and/or the limitations with respect to the effectiveness of the progress to date has not been completed. Based on the information presented in this report, it is apparent that the Okanagan has achieved some success in preparing for or adapting to climate change and other water stressors, despite inherent knowledge, governance, and socioeconomic limitations.

8. CONCLUSIONS

The potential influences of climate change on water resources in the Okanagan Basin were first considered in the discussion and development of water management adaptations in the early 2000s. Collaborative discussions and multi-stakeholder involvement documented from 2001 (Cohen and Kulkarni, 2001) to 2006 (Cohen et al., 2006) examined potential adaptations to climate change (and other water stresses to supply and demand), identified potential adaptation strategies, and considered potential impacts of different adaptations. This early consideration of different water management adaptations to climate change, and involvement of stakeholder groups, established a cooperative environment and provided the groundwork for the development of specific documented actions outlined in the Okanagan Sustainable Water Strategy (OSWS) of 2008.

The OSWS outlines 45 specific water management actions/adaptations for the Okanagan region. The success with respect to the implementation of these actions is being monitored by the OBWB and will be discussed during planned follow-up meetings in 2010-11. Other levels of government (e.g. Improvement Districts, municipalities) have facilitated local implementation of other water management adaptations (to climate change, population growth, economic, infrastructure, or other stressors). These local initiatives, though largely driven by factors other than climate change, are also important in moving forward with proactive water management within the basin.

While well-considered water management initiatives have been developed and implemented in the Basin, their application was facilitated (or even permitted) by the regional framework under which they evolved. This regional framework includes:

- **Need:** The long-standing need for water management in the basin (water-stressed region).
- **Knowledge:** Okanagan knowledge and focused scientific research to understand the potential impacts of climate change and other factors on water resources.
- **Socioeconomic Environment:** An environment that fosters information sharing, collaborative multi-stakeholder discussion and dialogue, and communication.
- **Governance:** Regional water governance structure and initiatives (e.g. the formation of the OBWB and OWSC, region-specific initiatives employed by the IHA, and an integrated approach to water governance).

The concurrent evolution of these key regional framework components and their interplay have permitted the successes to date with regard to the development and implementation of climate change adaptations for water management in the Okanagan Basin.

Key guiding principles of effective water management adaptation that emerge from the Okanagan experience are:

- Develop or promote an effective integrated multi-level governance system
- Promote multi-stakeholder involvement in adaptation development
- Recognize the value of, and ease of implementation of, well-prepared initiatives and a proactive approach
- Promote regional thinking about water management
- Seek educated and innovative policy makers
- Encourage public and stakeholder education and communication
- Identify research/knowledge needs and opportunities

While it is recognized that there are obstacles, deficiencies, and constraints with respect to water management in the Okanagan Basin, the region has made progress toward preparing for climate change. Lessons learned from the Okanagan experience may be used to provide guidance to other communities as they consider/realize the potential impacts of climate change to water resources in their region.

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