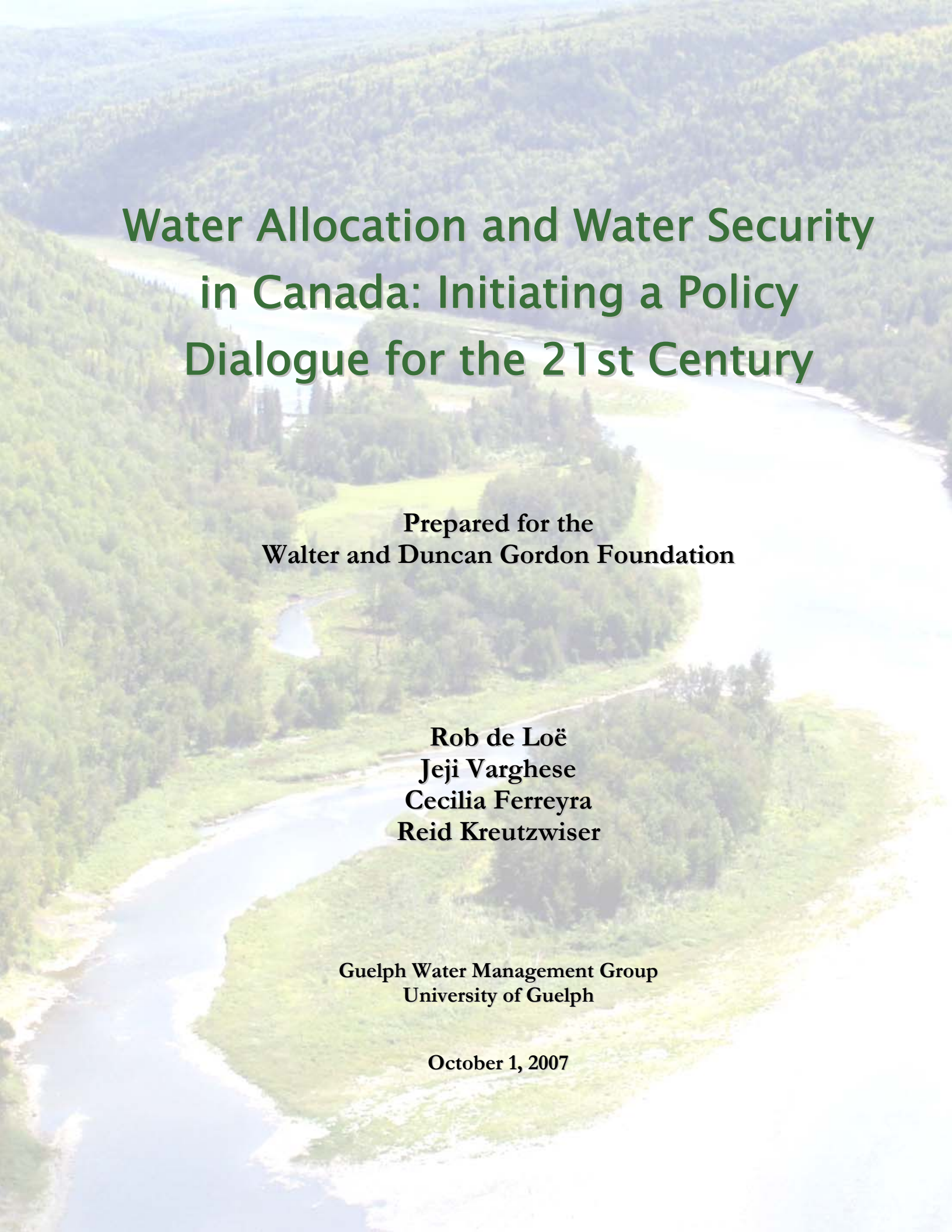

Water Allocation and Water Security in Canada: Initiating a Policy Dialogue for the 21st Century

Prepared for the
Walter and Duncan Gordon Foundation

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The aim of the project was to undertake a comprehensive, national assessment of provincial and territorial water allocation arrangements, with the goal of assessing how these water allocation systems contribute to Canada's water security. This report synthesises main findings from the study. Two technical background reports present the data that were used to prepare this report. These are available at the website of the Guelph Water Management Group: www.uoguelph.ca/gwmg

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Executive Summary

Water security is a multi-dimensional concept that recognizes that sufficient good quality water is needed for social, economic and cultural uses while, at the same time, adequate water is required to sustain and enhance important ecosystem functions. Increasing demands for water and land from growing populations and economies, and fundamental changes in the hydrologic cycle due to climate change, require concerted action now in order to avoid a future water security crisis.

In a country as large and diverse as Canada, achieving water security depends on decisions made by a host of actors, from individual water users to governments at all levels. This fact draws attention to the importance of good *water governance*, which is characterized by participation, transparency, equity, accountability, coherence, responsiveness, ethical choices, and integration of water decision making with other pertinent concerns. Good governance is particularly important in the case of *water allocation*: the rules and procedures through which access to water for both consumptive and non-consumptive uses is determined. Effective, efficient, and equitable water allocation systems are critical to achieving water security.

This study characterized formal institutional arrangements for water allocation across Canada, and explored critical linkages between these systems and selected key water security concerns. It had two major phases. In the first phase, water allocation systems were documented and analyzed using a set of common attributes. In the second phase, water security was explored in the context of seven interrelated concerns: ecosystem protection, economic production, equity and participation, integration, water conservation, climate variability and change, and transboundary sensitivity. Importantly, an evaluation of the *actual performance* of water allocation systems in Canada was beyond the scope of this exploratory study. Instead, critical linkages between water security and water allocation in the Canadian context were mapped out in a way designed to foster policy learning. Our ultimate goal was to provide a solid foundation for a national policy dialogue about water allocation and water security in Canada.

Three documents resulted from the work completed during the study. This report synthesizes main findings of the study, while two supporting technical reports provide detailed background information:

- *Technical Report 1: Characterization of Water Allocation Systems in Canada* provides background information on water allocation systems in each of Canada's provinces and territories. It identifies legislation, regulations and policies, and characterizes each system according to a common set of environmental, economic, and social attributes.
- *Technical Report 2: Water Security Assessment of Water Allocation Systems in Canada* draws on the detailed characterization in Technical Report 1 to assess in an exploratory fashion the ways in which seven critical water security concerns are addressed within each jurisdiction.

Main findings of this study for each key water security concern include the following:

- *Ecosystem protection* is an explicit concern addressed to some extent by the allocation systems of most jurisdictions, but monitoring and enforcement for ecosystem protection is limited, and fewer than half of the jurisdictions had mechanisms in place to incorporate ecological knowledge into water allocation decision making. An important knowledge gap is the lack of evaluation and adaptation of available instream flow needs methods to the Canadian context. Funding for scientific knowledge is substantial in contrast to traditional ecological knowledge.
- From the perspective of *economic production*, relatively clearly defined allocation rules are a positive feature of Canadian water allocation systems, but monitoring and enforcement is not systematic. The lack of access of water users to real-time monitoring data on water supply and actual water use is a critical gap across Canadian jurisdictions, especially regarding groundwater. This undermines the stability of water allocation in Canada from an economic point of view. At the same time, with very few exceptions, water allocation systems reduce flexibility by constraining water reallocation.
- *Equity* is not a dominant concern in water allocation systems across Canada. Although water for domestic purposes is exempted from permitting or licensing requirements, there is a general lack of participatory mechanisms for meaningful negotiation of allocation trade-offs. Multi-stakeholder committees are increasingly relevant for watershed management purposes, but not necessarily in water allocation decision making. Several jurisdictions have developed mechanisms to address conflict at different scales, and are starting to address requirements for Aboriginal consultation emerg-

ing from case law. However, strategies for conflict resolution in Canada may be constrained by historical allocation decisions.

- All jurisdictions at least acknowledge the need for *integration* of water quality and quantity, surface water and groundwater, and land and water management – but significant knowledge gaps exist, especially in relation to groundwater. Importantly, water allocation decisions and land use planning decisions tend to remain separate in most jurisdictions. While integration is emerging in the context of drinking water source protection, this may not be enough to provide for ecosystem protection and other important considerations.
- *Water conservation* is recognized as a concern in all jurisdictions, but mechanisms that promote conservation at the provincial or territorial scale are not widely used or consistently applied. Conservation practices include the beneficial use principle, sectoral best management practices, economic incentives, and linking conservation practices to allocation decision making. Pricing to promote conservation is not a commonly used instrument. The limited monitoring of actual water use in most jurisdictions poses a fundamental challenge to water conservation using pricing or other instruments.
- *Climate variability and change* are recognized as a concern in most jurisdictions, but very few have actually incorporated knowledge about anticipated climate change into their water allocation systems. In general, historical patterns and observed trends continue to guide water allocation decisions despite the fact that these patterns and trends are not likely to be representative of future hydrological conditions. Furthermore, most investments to increase our understanding of climate change impacts have not focused on water supply and allocation schemes. In this context, only a few jurisdictions are currently exploring and/or negotiating adaptation strategies within water allocation systems.
- Coordination of *transboundary water allocation decision making* occurs in specific contexts, such as along the Canada-US boundary and between selected provincial/territorial boundaries. Issues of state sovereignty regarding water allocation across the Canada-US boundary are a concern despite the arrangements that exist. Canadian sovereignty over water is also bounded by the provincial role in water allocation. Tensions between statutory water allocation systems and Aboriginal water rights are gradually being reconciled from the perspective of Crown sovereignty; nonetheless, many Aboriginal people and others believe water to be an inherent right emerging from indigenous sovereignty. Thus, this issue is far from settled.

Considerable variability clearly exists across Canada in the extent to which water allocation systems addressed the seven water security concerns. This is not surprising in light of the tensions and interrelationships among the various concerns; the fact that for most of Canada's history, water allocation has been a primarily administrative function dominated by technical specialists and focused on technical and legal concerns; and the context-dependent nature of water security. Unfortunately, a key overall finding of this report is that *many of the innovations and enhancements to water allocation systems described in this study are actually incidental to water allocation*. Thus, there is a real danger that in the absence of more specific attention to water allocation, needed improvements may not occur. Relying on happenstance to address critical water security concerns is dangerous.

An important first step towards elevating the importance of water allocation, and thereby strengthening links to water security, is a national dialogue that addresses questions such as the following:

- Is water security a national concern that demands national leadership, or is it a regional concern that is best handled by individual provinces and territories, or even by local organizations?
- How can water allocation be elevated from a relatively insular, administrative function, to a fundamental component of water security?
- Which administrative and technical approaches to water allocation enhance water security, and can be adopted by most jurisdictions?
- In the context of Canadian water allocation, what are the critical attributes of governance that influence water security?

A broad, inclusive national dialogue about water allocation and water security could provide an opportunity for stakeholders to critically evaluate the extent to which their own water allocation systems address current and emerging water security challenges. Such a dialogue would also facilitate policy learning within and between jurisdictions. However, *lesson learning from other jurisdictions must be approached with caution*. Each province and territory in Canada faces distinct water security challenges as a function of its own historical, political, socioeconomic, and hydrological circumstances. Therefore, rather than seeking one-size-fits-all solutions, we argue that a much more productive approach is to identify lessons that have the most relevance, governance models and approaches that are most adaptable to other circumstances, and tools and techniques that are most generally applicable.

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1. Introduction

For most of the world's citizens, the fact that inadequate quantities of clean water can lead to death, disease and environmental degradation is a reality of daily life[12, 24]. Most Canadians, in contrast, assume that water is plentiful and safe. Why is this the case, given that in Canada we face well-documented problems of scarcity and contamination[7, 8, 15, 20]? In part, the answer lies in our attitudes towards water, which are strongly influenced by our good fortune. Relative to many countries, Canada has considerable water resources in its rivers, lakes and aquifers. Unfortunately, our apparent water wealth has fostered a deeply-entrenched myth of abundance[22], which, in turn, has contributed to neglect and misuse of water resources.

With increased demands for water and land from a growing population and economy, and with the prospect of fundamental changes in the hydrologic cycle due to climate change, threats to water resources in Canada will increase as time goes by[15, 18]. Accordingly, there is no reason to think that Canada will be immune to the kinds of problems experienced in other countries (see Box 1). To avoid a future crisis response in Canada, we need to recognize that achieving *water security* demands concerted action now.

Water security is a multi-dimensional concept that has widely differing interpretations. For example, in the United States, fears about terrorist attacks have spawned an industry focused on identifying vulnerabilities in drinking water systems[13]. A much broader perspective on water security is offered by the Global Water Partnership (GWP), which defines it as "access to adequate quantities of water, of acceptable quality, for human and environmental uses"[12]. It is the broader perspective of the GWP that informs this report. We argue that water security exists when sufficient water of good quality is available for social, economic and cultural uses while, at the same time, adequate water is available to sustain and enhance important ecosystem functions[9, 23]. Achieving water security is critical to our environmental, economic and social wellbeing.

In a country as large and diverse as Canada, achieving water security is not a simple goal. The specific threats to water security that exist in any particular region, the way those threats are experienced by people in those places, and the capabilities to respond to those threats, vary enormously[11, 14, 21,]. Adding to this complexity, whether or not water security is achievable depends on the decisions made by a host of actors, from individual water users to governments at all levels. This fact draws attention to the importance of *governance*.

Box 1: Australia's Water Security Crisis

Living on the world's driest continent, Australians are familiar with water shortages. Drought conditions affecting much of Australia for the past five years are considered the worst in 115 years of flow records[a]. Conditions in the nation's iconic Murray-Darling River Basin are particularly severe, with the Head of the Murray-Darling Basin Commission suggesting that conditions most closely resemble a one in one-thousand year drought[f]. Water restrictions for municipalities, and restrictions on water availability for irrigation and industry, are now part of everyday life. Among the 24 cities with populations greater than 50,000 people, 16 are relying on water restrictions to deal with water supply shortages[e].

The economic impacts of the drought and restricted water supply are being felt in many sectors of the economy. Agricultural output currently accounts for 3.6 percent of Australia's GDP; a sharp drop in agricultural output is expected to slow economic growth[c]. The mining industry, which is heavily reliant on water, also is being affected. For example, the operators of the Tarong coal mine owned by Rio Tinto in Queensland have indicated that 160 people, or two-thirds of the work force, may have to be let go after the power station it supplies reduced output by 70% due to the lack of water[b]. A particular challenge being confronted in Australia is balancing environmental quality with the many human demands being placed on water resources.

Public – and government – concern is extremely high. In January, 2007, Prime Minister John Howard committed $10 Billion (AUD) towards a National Plan for Water Security to improve water efficiency and to address the over-allocation of water in rural Australia, particularly in the Murray-Darling Basin[d]. State and Territorial governments have put in place a variety of drought assistance plans worth millions of dollars. With the extensive media coverage, Australian's from all parts of the country have expressed concern about the diminishing rural population, the sustainability of the country's economic prosperity, and the state of the environment as it relates to river flows.

The problems Australians are facing today relate to *water security*. They are different water security challenges than those that are being faced in many developing countries; nonetheless, the current drought is posing serious threats to environmental quality, the economy, and human well-being in Australia. *Canada is not immune to these challenges.*

Governance refers to the processes through which societies make decisions that affect water. Good water governance depends on broad participation by affected stakeholders, and is characterized by transparency, equity, accountability, coherence, responsiveness, ethical choices, and integration of water decision making with other pertinent concerns[24]. Increasingly, people concerned about governance explicitly recognize the fact that public decision making should involve not only governments, but also citizens, non-governmental organizations and businesses. From this perspective, good governance is essential to the achievement of water security in Canada.

One specific area in which water security depends on good governance is *water allocation*. Water allocation systems are the rules and procedures through which access to water for both consumptive and non-consumptive uses is determined. By establishing the availability and priority of access to water resources for consumptive uses such as cities, agriculture, and manufacturing, and for non-consumptive uses such as hydropower, recreation and environmental protection, water allocation systems influence economic productivity, social and cultural wellbeing and ecosystem quality[9, 11, 19, 23].

The socioeconomic, cultural and ecological implications of water allocation in Canada are amplified when water resources become scarce due to population growth and climate change, or due to changes in societal preferences[8, 15]. In the context of scarcity – whether created by societal or natural processes – water allocation systems can increase or decrease water security. Thus, effective, efficient, and equitable water allocation systems are critical to maintaining and enhancing environmental quality, economic productivity, and social wellbeing.

Under Canada's Constitution, responsibility for water allocation in Canada is shared between the provinces/territories and the federal government. The federal government has important constitutional responsibilities relating to fisheries, navigation, transboundary flows and Aboriginal peoples. Nonetheless, water allocation is primarily a provincial and territorial responsibility[17, 20]. Given the different social and economic histories of Canada's provinces and territories, and the enormous variability in the distribution of water resources across the country, it should not be surprising that there is considerable variation in water allocation systems from region-to-region, and that governance is extremely complex and context-specific[19]. The evolving role of Aboriginal peoples in resource development and environmental management across jurisdictional boundaries is further increasing the complexity of governance for water allocation in Canada[3].

The predecessors of Canada's water allocation systems were created a century or more ago, when the political context, economic circumstances and social priorities were different, and when demands for water were frequently less pressing than today[17]. However, circumstances have changed. When pressures on water supplies increase, weaknesses in water allocation systems – such as inflexible rules, promotion of inefficient uses, or an inability to resolve conflicts – quickly become evident[4, 5, 6, 10]. These kinds of problems have become more apparent during the past two decades, and can be expected to become more severe as increasing demand for water coupled with climate change increases pressures on water resources across Canada[1, 2].

To varying extents, all Canadian provinces and territories have recognized that water allocation systems contribute to water security – today and into the future. This recognition is reflected in changes that have been made, or are being proposed, and in the approaches that are being used across the country to confront contemporary challenges. However, missing is a strong national understanding of options and approaches. While there have been other national studies of water allocation systems[16, 17], some are outdated, others focus on specific concerns rather than providing a comprehensive perspective, and none directly address the ways in which water allocation systems contribute to overall water security. Thus, answers to important questions such as the following are needed:

- What is the status of water allocation in Canada?
- To what extent are water allocation systems able to respond to current and emerging water security challenges?
- How are problems that exist in all jurisdictions being addressed (if they are)?
- What innovative approaches are being developed that have the potential to be useful elsewhere?

This study addressed questions such as these in a way that is designed to foster policy learning across jurisdic-

tions, with the goal of initiating a national dialogue about water allocation and water security. It had two specific aims: (1) to complete a comprehensive, national characterization of provincial and territorial arrangements for allocating both surface and groundwater resources, and (2) to build on this characterization to explore the extent to which, and how, water allocation systems in Canada are addressing critical water security concerns.

Significantly, this study did not set out to evaluate the actual performance of water allocation systems in Canada. This would have required in-depth field work and detailed investigation that was beyond the scope of this study. Instead, this exploratory study maps out the linkages between water security and water allocation in the Canadian context, and thus can guide and inform future investigations of the effectiveness of the kinds of governance arrangements discussed.

Three documents resulted from the work completed. This report synthesizes main findings of the study. Two supporting technical reports also were produced during the study and provide detailed background information:

- *Technical Report 1: Characterization of Water Allocation Systems in Canada* provides background information on water allocation systems in each of Canada's provinces and territories. It identifies legislation, regulations and policies, and characterizes each jurisdiction's system according to a common set of environmental, economic, and social attributes.
- *Technical Report 2: Water Security Assessment of Water Allocation Systems in Canada* draws on the detailed characterization of Canada's water allocation systems in Technical Report 1 to assess in an exploratory fashion the ways in which seven critical water security concerns are addressed within each jurisdiction.

Both technical reports are available at the Guelph Water Management Group website:

www.uoguelph.ca/gwmg/

1.1. Structure of the Report

This report is organized as follows:

- Chapter 2 provides an overview of the study approach. The evaluative framework used in the assessment is introduced.
- Chapter 3 presents findings from the assessment. The chapter is organized around the seven key water security concerns in the evaluative framework; for each concern, a brief overview and rationale is provided, followed by a synthesis of findings from across Canada that focuses on potential innovations and lessons learned.
- Chapter 4 presents a discussion that synthesizes main findings, and identifies conclusions and recommendations. Ways in which water security in Canada can be enhanced are emphasized.
- References cited in the report are presented in Chapter 5, and are organized by chapter and section. References used in boxes are listed separately in Section 5.2.
- An Appendix presents basic background information about the water allocation systems considered in the study. A series of tables summarises some key information from Technical Report 1.

2. Study Approach

This study had two major phases, which were completed between April 2005 and March 2007. In the first phase, water allocation systems in all Canadian provinces and territories were systematically characterized according to a common set of water allocation attributes. This phase of the study provided a database that was used to conduct the second phase, an exploratory evaluation of the extent to which water allocation systems addressed seven key water security concerns that are prominent in the literature.

In the first phase of the study, Canadian water allocation systems were documented and analyzed using a set of common characteristics or attributes (see Box 2). These attributes address major themes and concerns found in the water allocation literature [5, 6, 4, 1, 7, 3]. Emerging issues, such as adaptation to climate change also were taken into consideration.

For each of the 15 attributes shown in Box 2, data were collected from a variety of sources, including more than 85 provincial and territorial laws, policies, and regulations, and numerous reports from academia, government, and NGOs. Inter-jurisdictional arrangements, such as the *Master Agreement on Apportionment* that specifies rules for water allocation among Alberta, Saskatchewan and Manitoba, were addressed in the context of relevant jurisdictions. International arrangements such as the *Boundary Waters Treaty* were treated in the same fashion.

Preliminary characterizations completed for each jurisdiction were verified with government personnel currently involved in water allocation decision making and/or implementation. These verified water allocation characterizations are presented in *Technical Report 1: Characterisation of Water Allocation Systems in Canada*. A summary of major characteristics of the systems is presented in the Appendix to this report. While this process of verification could not ensure that the characterizations were entirely free of errors, it did permit confidence that the basic factual information presented in Technical Report 1 was as accurate and up-to-date as possible (as of early 2007).

Box 2: Key Water Allocation Attributes

- Legal authority
- Roles and responsibilities
- Basis of allocation
- Priorities in water use
- Limits or duration of allocation
- Fees/charges
- Monitoring of water use
- Environmental protection
- Enforcement of allocations
- Transferability of allocations
- Compensation if allocations are reduced
- Provisions for stakeholder input
- Notification of allocation decision
- Dispute resolution arrangements
- Other issues (e.g., climate change, drought management, integration)

Two other caveats about the research must be emphasized: First, the focus in this first phase of the study was on formal institutional arrangements. Where possible, we considered informal arrangements and actual practices. However, it was not possible to assess informal arrangements and actual practices in a systematic fashion. Second, changes to water allocation systems were ongoing across the country during the study period. While reference is made to firm plans and proposals, where information was available, the focus in the study necessarily was on *existing* institutional arrangements.

In the second phase of the study, water security was explored in the context of seven critical concerns presented in Box 3. Water security as a concept does not have a universally accepted definition, and the literature reflects numerous different kinds of concerns and perspectives. The seven interrelated concerns were selected following a review of relevant Canadian and international literature, and reflect previous research conducted in the Guelph Water Management Group[2]. The issues that are raised under each of the seven key

water security concerns in Box 3 are extremely broad. Therefore, we drew again on the literature to select specific indicator questions for each concern. Descriptions of, and rationales for, the seven key concerns and their corresponding indicator questions are presented in Chapter 3.

Data used in the assessment completed in the second phase of the study were drawn from two main sources: (1) the characterization of water allocation systems completed in the first phase (Technical Report 1); and (2) an extensive supplemental review of over 200 additional documents. The same water management practitioners who reviewed Technical Report 1 also offered comments on drafts of the exploratory water security assessments and provided corrections and clarifications for their jurisdictions. In many cases, these professionals also consulted with other staff personnel with relevant expertise to cover areas beyond their own areas of expertise. The results of this phase of the study are presented as *Technical Report 2: Water Security Assessment of Water Allocation Systems in Canada.* As in the case of Technical Report 1, the practitioner review was meant only to identify incorrect facts or interpretations of laws, regulations and policies. Thus, the assessments presented in Technical Report 2 reflect the judgment of the study team, and were not necessarily endorsed by the practitioners consulted.

These two technical reports formed the basis for the exploratory evaluation of water security and water allocation in Canada that is presented in Chapter 3 of this document. Despite the fact that the focus was on formal institutional arrangements, rather than on informal arrangements and actual practices, the comprehensive national assessment of water allocation presented in this report can be the basis for a national dialogue about water security, and can provide a solid foundation for more nuanced and detailed analyses in each jurisdiction. More significantly, a national exploratory evaluation completed during a time of considerable change in Canadian water governance can contribute to policy learning across Canadian jurisdictions during a period when such learning is essential. To foster policy learning, the report concentrates on potential innovations and successes, rather than dwelling exclusively on weaknesses and failings. To that end, the report incorporates a series of "highlight boxes" that explore novel and/or potentially effective approaches for addressing water security concerns in different jurisdictions. These are drawn from across the country because innovation is occurring in every Canadian province and territory.

Box 3: Evaluation Criteria

1. Ecosystem Protection

- Are there environmental water allocations?
- Is ecosystem protection monitored and enforced?
- Are there mechanisms for the creation and incorporation of ecological knowledge into water allocation systems?

2. Economic Production

- Are allocation rules stable and clearly defined?
- Is sufficient water allocation-related information available to make economically sound decisions?
- Can water be re-allocated?

3. Equity and Participation

- Are equity concerns built into water allocations?
- Are there mechanisms to facilitate sustained and meaningful stakeholder and public participation?
- Are there mechanisms to address potential conflicts at different scales?

4. Integration

- Is integration between groundwater and surface water resources considered in water allocation systems?
- Is integration between water quality and water quantity considered in water allocation systems?
- Is there integration between land use planning and water allocation?

5. Water Conservation

- Is there a charge for water allocated to users, with the goal of promoting conservation?
- Is re-allocation of water to more efficient and less consumptive uses encouraged?
- Are water conservation practices incorporated into water allocation systems?
- Are there other innovative water allocation mechanisms for promoting water conservation?

6. Climate Variability and Change

- Are investments being made to understand the impacts of climate variability and change on water allocation systems?
- Are adaptation strategies being developed and applied to address climate variability and change within water allocation systems?

7. Transboundary Sensitivity

- Is there coordination of water allocation systems across political boundaries in Canada?
- Is state sovereignty over water reflected in water allocation systems?
- Are water allocation systems cognizant and respectful of indigenous customary allocation boundaries and traditions?

3. Water Allocation and Water Security in Canada

Water allocation decisions have implications for environmental quality, human health, economic prosperity and, especially for Aboriginal peoples, cultural preservation and survival. Thus, they are fundamental to water security. Reflecting this perspective, the link between water allocation and water security is explored in this chapter via seven key concerns (Box 3). These interrelated concerns highlight critical ways in which water allocation systems can enhance or undermine water security in different places and different contexts. The tension and interplay among the seven concerns provide a more holistic understanding of the types of trade-offs that must be made, and the broader implications of water allocation decision making and implementation. For example, the need for institutional mechanisms to incorporate evolving ecological knowledge into water allocation schemes may undermine water security for economic production, which requires stability in allocation rules to encourage financial investment. Similarly, water conservation strategies that lead to re-allocation of water to more efficient and less consumptive uses of water in rural areas may have important equity implications for rural communities.

As noted in Chapter 2, this study is based primarily on analysis of laws, regulations and policies, with attention to informal arrangements and actual practices where practical. This approach did not permit us to consider how effective arrangements were *in practice*, or to recommend specific approaches as being universally suitable. Instead, the chapter explores the seven key water security concerns, and highlights approaches that are being used to address them across Canada. Concrete examples are drawn from background research presented in Technical Reports 1 and 2. A series of highlight boxes is used to present additional details about noteworthy examples. As is argued in Chapter 4, whether or not the approaches discussed are as effective as their designers hoped, let alone applicable in other parts of the country, is a matter for further study and policy dialogue.

3.1. Ecosystem Protection

Water is critical in numerous terrestrial and aquatic ecosystems because it contributes to the capacity of these ecosystems to perform natural processes and functions[5, 12]. Around the world, terrestrial and aquatic ecosystems have been extensively modified by human societies. At the same time, human societies are shaped by ecosystems[7, 19]. In recent years, there has been increasing recognition of the fact that terrestrial and aquatic ecosystems produce not only renewable resources but also essential ecosystem services on which human societies depend, including water supplies, biodiversity conservation, water purification and recreational opportunities[16, 17].

It is within the context of ensuring the sustainability of these essential ecosystem services that ecosystem protection becomes a central concern for water security. In response to this concern, water allocation systems in other countries have started to incorporate ecosystem protection as a critical guiding principle for allocation decision making. In Australia, for example, the Council of Australian Governments' *Water Reform Framework* of 1994 recognized the need to include the environment as a "legitimate" user of water when determining water allocation schemes[9, 13]. In South Africa, the *National Water Act* of 1998 established a "water reserve" that includes not only water necessary to provide for basic human needs, but also water needed to sustain valuable ecosystem services[3, 17].

The extent to which different water allocation systems provide for water security through ecosystem protection is strongly related to the approach to scientific uncertainty that lies behind those systems. There is general agreement regarding the need to allocate water to secure essential ecosystem services, but less certainty exists regarding how much water is enough[17, 19]. Scientific uncertainty, therefore, can undermine the position of the environment as a legitimate water user *vis a vis* other human needs in water allocation, a decision making process that typically involves resolving competing human uses and values[6, 14]. In this context, water allocation systems built upon flexible institutional arrangements that enable an adaptive management approach will be better prepared to address the challenges of ecosystem protection[7, 8].

To address these concerns, we posed three questions about water allocation and ecosystem protection:

- Are there environmental water allocations?
- Is ecosystem protection monitored and enforced?
- Are there mechanisms for the creation and incorporation of ecological knowledge into water allocation systems?

Are there environmental water allocations (EWAs)?

Ecosystem protection is better addressed by water allocation systems that provide for environmental water allocations (EWAs). In this study, EWAs are the result of water allocation decision making processes that take into account ecological water requirements (EWRs) in addition to hydrological, social, and economic considerations[9]. EWRs are the water regimes that are needed to maintain desired water-dependent ecosystem services (sometimes referred to as "ecological outcomes")[9]. Determining site-specific, holistic EWRs is an expensive and complex undertaking that draws from multiple disciplines and requires modeling tools and adequate ecological and hydrological data[1, 21]. Complicating the topic of EWRs is the fact that maintaining *variability* in flows and levels is often more critical than simply maintaining certain *flows and levels*[17].

EWRs vary according to the characteristics of different terrestrial and aquatic ecosystems, such as groundwater-fed marshes and surface water-dependent lakes[5]. Thus, EWAs may involve ensuring that certain volumes of water are left in rivers (instream flows), that water levels are maintained in wetlands during critical periods, or that a portion of groundwater recharge is retained[15, 17]. Determining EWRs and negotiating EWAs for a particular terrestrial or aquatic ecosystem is complicated because achieving desired ecological outcomes implies the provision of variable levels or flows of water that can mimic the seasonal and annual variability of its natural flow regime, instead of a minimum level or flow deemed appropriate to protect a few target species [10 ,15, 19]. Moreover, negotiations and agreements concerning EWAs in different jurisdictions are highly influenced by historical allocation decisions and schemes[21].

In Canada, different types of EWAs exist in the legislation and policies of eight jurisdictions as components of strategies for ecosystem protection. These include aquatic reserves, instream flow needs (IFNs), and groundwater extraction limits.

Aquatic reserves are a special status assigned to certain bodies of water, as in the network of aquatic reserves being created in Quebec, where only activities compatible with maintaining the aquatic reserve's biodiversity and ecological characteristics are authorized.

Instream flow needs (IFNs) refer to water allocated to maintaining ecological functions and processes in surface water bodies. This is being pursued through initiatives such as the following:

- Classifying watershed systems taking into account IFNs, and using the classifications to influence allocation decision making, as occurs in Ontario (see Highlight Box 1). In Ontario, IFNs, by regulation, consider variability as well as minimums in flows and levels.
- Taking into consideration IFNs when establishing availability of water for allocation through water licenses; the "fish clause" included in the covering letter accompanying water licenses in British Co-

Highlight Box 1: Classification Systems for Ecosystem Protection

Under the Permit to Take Water (PTTW) program, watersheds across Ontario are classified into three categories according to the intensity of water use. The formula used compares water demand to water supply less a reserve for instream needs[b]. As a result, instream needs are considered a legitimate water use for the purposes of the calculations used to determine the placement of each watershed into one of the three categories. When new PTTWs are sought, criteria used in decision making are more restrictive in high use watersheds than those applied in low use watersheds. This is an example of a type of EWA based on IFNs. This risk-based approach in itself is an innovation because it ensures more stringent criteria for higher risk watersheds while still balancing human and financial resource constraints. Nonetheless, the effectiveness of the approach is strongly influenced by how instream flow needs are estimated.

In New Brunswick, the Water Classification Regulation is an innovative approach to addressing ecosystem protection. Waters are classified into six categories related to desired water quality and biological standards[a]. The "outstanding natural waters" category refers to lakes and rivers that are relatively unaffected by human activities. By prohibiting significant withdrawals in "outstanding natural waters," the classification system provides for ecosystem protection of these specially designated water bodies.

lumbia is an example of this mechanism.

- Requiring maintenance of a designated water flow rate for ecological purposes within the terms and conditions of permits and licenses, as provided for in New Brunswick.
- Holding water back for IFNs in license/permit transfers, as can occur using provisions for up to 10% holdbacks for water transfers in highly allocated systems in Alberta.
- Reserving unallocated water for IFNs, as provided for in the Northwest Territories.

The effectiveness of environmental protection strategies based on IFNs will depend, to a large extent, on the method used for their determination. There is agreement within the international water community on the need for holistic approaches that go beyond establishing minimum flow requirements and water quality to focus on variable, natural flow regimes[1, 17, 19]. An analysis of IFNs methodologies applied in the different Canadian jurisdictions was beyond the scope of this study. However, there is evidence to suggest that Canada has not played a significant role in the advancement of IFNs methodologies, in contrast to the cases of Australia, South Africa and the US[2, 15, 17]. Moreover, the critical evaluation and refinement of available methods in the Canadian context is still in its infancy[10, 18, 21, 22].

Groundwater extraction limits are restrictions on groundwater withdrawal rates to protect groundwater-dependent aquatic ecosystems. This is the case of groundwater allocation in Prince Edward Island, where extraction rates are not permitted to exceed 50% of the annual recharge. It is not clear, however, if this limit was established taking into consideration the importance of other attributes for ecosystem protection, such as the timing and quality of groundwater flows[15].

Although ecosystem protection is not pursued through EWAs in every Canadian jurisdiction, other relevant mechanisms and innovative approaches are being proposed and implemented. These include the following:

- In New Brunswick, wetlands and coastal marshes are included in the permitting/licensing system, rather than just lakes and rivers. In addition, permitting/licensing for water withdrawals in this province includes all non-domestic water uses, regardless of volumes. As well, in Newfoundland and Labrador, water use licenses are required to divert surface, ground and shore water for all non-domestic uses, and the *Water Resources Act* does not specify a *de minimus* amount below which a license is not required.
- In the case of the Yukon, consideration of environmental impacts before approving water allocations allows for mitigation measures to be incorporated in allocations as part of the corresponding terms and conditions. In Saskatchewan, projects envisioned to have environmental implications are referred to Saskatchewan Environment for further consideration. In Ontario, allocation decisions must consider the cumulative effects of water takings.
- In Manitoba, transfer of untreated water requires a complete assessment of potential environmental, social, and economic impacts on both basins. This is an approach that can be used to consider environmental impacts on both donor and receiving basins.
- Water allocation systems can provide for suspension of, or restrictions on, water withdrawal permits/licenses for ecosystem protection purposes, including changes in ecological circumstances (e.g., drought). In Nunavut, these provisions give priority to the environment.
- In Nova Scotia, priority within appeals processes is given to the environment over personal grievances.
- It is possible to institute special designations/classifications of water resources that are related to ecosystem protection. This is an approach used in New Brunswick (see Highlight Box 1).
- Finally, plans for watersheds/aquifers can be designed to include dynamic and evolving priorities related to ecosystem protection, as in Manitoba's basin planning processes.

Is ecosystem protection monitored and enforced?

Water allocation systems that provide for ecosystem protection should be concerned not only with establishing EWAs, but also with monitoring and enforcement of these allocations. Monitoring plays a key role in ecosystem protection because the scientific uncer-

tainty that surrounds EWAs requires an adaptive management approach to water allocation in which relevant knowledge can be generated and incorporated in decision making processes. Monitoring for ecosystem protection, however, goes beyond gathering and assessing climatic and hydrological information. Instead, monitoring EWAs also entails gathering and assessing ecological information to draw, to the extent possible, causal links between surface and groundwater regimes and desired ecological outcomes for terrestrial and aquatic ecosystems[9, 15].

If variable EWAs are established in order to protect essential ecosystem functions, then enforceability becomes a highly relevant issue, as non-EWAs will also need to be adjusted to the seasonal availability of water. In this case, the capacity to enforce EWAs will depend to a large extent on the capacity to implement appropriate monitoring and accounting systems of water supply and water use[9, 11].

Across Canada, ecosystem protection is monitored and enforced to varying degrees. Regarding monitoring, the emphasis has traditionally been placed upon gathering and assessing relevant hydrological information, either on a provincial, regional or local scale. For surface water resources, the following kinds of monitoring occur:

- Lake level and streamflow (MB, NB, ON, PE, YK)
- Percent of licensed stream length with water allocation restrictions per decade (BC)
- Province-wide stream allocation restrictions (BC)

For groundwater resources, the following examples of monitoring were identified:

- Water levels in observation wells (BC, NB, NS, ON, PE)
- Number of heavily used aquifers across province (BC)

As already mentioned, water security is better addressed by monitoring systems that also gather and assess ecological information in order to link hydrological information and desired ecological outcomes. This is the case of Saskatchewan's State of the Watershed Reporting Framework (refer to Highlight Box 2). Other provinces are also working towards developing ecosystem protection indicators (e.g., British Columbia, Alberta, and Manitoba). In this context, it should be noted that ecological monitoring is part of a broader trend towards an adaptive management approach, including assessment across multiple temporal and spatial scales, and incorporation of both scientific and traditional ecological knowledge.

An important source of hydrological information that can act as a building block of monitoring systems for

Highlight Box 2: Top-down and Bottom-up Approaches to Monitoring

The State of the Watershed Reporting Framework developed in Saskatchewan is an example of an innovative provincially-based approach to monitoring water resources at a watershed scale. The framework integrates information collected by numerous provincial and federal agencies and presents it in an indicator-based report card format[c]. The selected set of monitoring indicators follows the Stress-Condition-Response model, in which *stress* indicators monitor human activities that lead to environmental stresses, *condition* indicators monitor the health of the watershed, and *response* indictors monitor the effectiveness of management activities within the watershed. Data collected are intended to guide future water management activities by identifying significant problems and future threats. Given the comparability of the indicators, they provide a snap-shot in time of the state of watersheds within the province. Limited financial, human and technical resources can then be focused on the most significant problems.

Voluntary community-based monitoring programs in Nova Scotia, such as the Sackville Rivers Association and the Clean Annapolis River Project[a, b], are examples of innovative approaches to water monitoring. They are particularly relevant to ensuring a long-term record for local aquatic ecosystems in the absence of government-mandated monitoring. Volunteers within these community groups collaborate to monitor biological, physical and chemical water quality parameters. Although the emphasis of these collaborative monitoring efforts is on water quality, they have the potential to assist in ecosystem protection. It is important to note, however, that community-based monitoring programs in Nova Scotia are not currently linked to water management in an effective way[d], and this may undermine their potential contribution to water security.

The top-down approach to monitoring in Saskatchewan and the bottom-up approach in Nova Scotia demonstrate the different levels within which monitoring for ecosystem protection can occur. However, within either approach, monitoring of ecosystem protection needs to be linked to water management and water allocation in order to contribute to water security.

ecosystem protection is actual water use. Ideally, actual water use should be monitored by individual licensees and permit holders at a frequency that is useful for ecological modeling purposes. Across Canada, required water use monitoring is carried out on a daily basis in some jurisdictions, with annual reporting unless conditions specify otherwise; however, not all water users have licenses and or permits, and even if they do, they may not be required to monitor and report water use (see Section 3.2).

Enforcement of water allocations may be reactive, as in the complaint-based system in Newfoundland and Labrador, or proactive, as undertaken by the Water Licensing Section of Manitoba Conservation. Proactive enforcement is preferred when pursuing ecosystem protection through water allocation in order to avoid environmental harm. Other noteworthy enforcement provisions identified across Canada include the following:

- Having a statutory basis for enforcement of ecosystem protection, as in the *Clean Water Act* of New Brunswick
- Having the authority to suspend, amend, or cancel the license based on non-compliance of ecosystem protection related conditions, as provided for in the Northwest Territories under the *Waters Act* and the *Mackenzie Valley Resource Management Act*.
- Committing human, financial, and technical resources to enforcement, as occurs in the case of the Waters Inspection Branch of the Yukon Government.

Are there mechanisms for the creation and incorporation of ecological knowledge into water allocation schemes?

Water allocation systems usually include processes for resolving conflicting social values that may or may not include ecosystem protection[19, 20]. This is one fundamental challenge relating to addressing ecosystem protection through water allocation. Another challenge in effective EWAs is a widespread lack of knowledge that exists regarding links between particular surface and groundwater regimes and specific ecological outcomes (ecological knowledge)[1, 19, 23]. Relevant ecological knowledge is particularly lacking for groundwater-dependent ecosystems[15]. Water allocation systems that provide for ecosystem protection need to be supported by the necessary financial and human resources to expand the ecological knowledge base, including not only scientific knowledge but also traditional and local forms of knowledge[15]. Different sources of knowledge are required to deal with the complexity and uncertainty of ecosystem protection as part of an adaptive management approach to water allocation[7, 9]. In this context, water security is best addressed by water allocation systems that can provide mechanisms to incorporate evolving ecological knowledge into water allocation schemes.

Across Canada, several jurisdictions are explicitly working to expand science-based ecological knowledge through a series of mechanisms advanced in legislation, policies, and/or practice. This is particularly the case of a series of initiatives in which the commitment to generating new ecological knowledge has been supported by concrete financial and human resources:

- Advisory/technical committees and networks of researchers/organisations can be established to investigate sources of uncertainty in ecosystem protection (e.g., causal links between EWAs and desired ecological outcomes, cumulative allocation impacts, IFNs). In Ontario, for example, the Ministry of Environment conducted studies in partnership with Conservation Authorities to establish methods to determine IFNs in selected watersheds across the province[4].The Prairie Provinces Water Board organized a committee to review IFNs methods in use in the provinces of Alberta, Saskatchewan and Manitoba[18].
- Sustainable funding can be committed to investigate sources of uncertainty in ecosystem protection. One prime example is the Government of Alberta's $30 million investment over a two-year period in the newly created virtual institute, Alberta Water Research Institute (AWRI), which builds on the work of the Alberta Ingenuity Centre for Water Research (AICWR) to implement a water research strategy for Alberta.
- Decision-support systems (including modeling and simulation studies) and integrated knowledge database systems can be created to support the work of agencies and organizations involved in water alloca-

tion. For example, the Saskatchewan Watershed Authority is partnering with SaskPower to develop an IFN model for the Saskatchewan River.

Although investment of financial and human resources to expand the ecological knowledge base is a critical component of any strategy for ecosystem protection, knowledge generation in itself is insufficient to achieving water security. Instead, mechanisms must be in place to take advantage of evolving ecological knowledge, allowing for its incorporation into water allocation schemes[10, 18, 19]. For example, the ability to revise water licenses/permits for environmental protection purposes enables governments to act in the public interest[21].

In Canada, seven jurisdictions have mechanisms in place for incorporating evolving ecological knowledge into water allocation schemes:

- Alberta's *Water Act* (s.55) has provisions to suspend or amend licenses based on new ecological knowledge, although compensation is to be provided for any ensuing losses in the case of license amendments[21]. Importantly, this provision only applies to license issued after January 1, 1999[21].
- The Nunavut Waters and Nunavut Surface Rights Tribunal Act (s.43), Yukon's *Waters Act* (s.16), and the Northwest Territories' *Waters Act* (s.18), have provisions to amend or cancel licenses in response to water shortages or to protect the public interest.
- Prince Edward Island's moratorium on new groundwater irrigation licenses represents a precautionary approach where allocation decisions are put on hold until sufficient knowledge is generated (refer to Highlight Box 3 for more information on this example).
- Newfoundland and Labrador (*Water Resources Act*, s.50) has established a statutory requirement for water users to report new ecological information even if it may result in a change in their allocation.
- Finally, in Ontario, an adaptive management approach to water allocation is reflected in the province's PPTW program, where short-term monitoring of environmental effects is a requirement within high-use watersheds.

From a water security perspective, addressing the challenges of ecosystem protection in water allocation requires expanding and implementing not only science-based but also traditional and local forms of ecological knowledge. Across Canada, however, efforts to advance ecosystem protection rely heavily on scientific expertise. An innovative approach that can offer important insights in this regard is found in the Northwest Territories, in which water allocation decision making draws from both science-based and traditional sources of knowledge (refer to Highlight Box 4).

Highlight Box 3: Incorporating Ecological Knowledge into Allocation Decisions

Water allocation systems should permit making changes to allocations based on new ecological information, or prohibiting new allocations due to lack of ecological knowledge under extreme conditions. In Prince Edward Island, the provincial government announced a moratorium in 2002 on new groundwater irrigation permits pending further study of the impacts of irrigation on groundwater resources[a]. Although aquifer depletion as a result of irrigation practices was not thought to have occurred up to that time, concerns regarding the protection of aquatic resources and drinking water supplies caused the province to undertake a comprehensive study.

The moratorium for new irrigation wells is an indication of commitment to flexibility in allocation decision making in the face of a lack of information. This commitment is also reflected in initiatives to address knowledge shortfalls. For example, under the Canada/Prince Edward Island Water Annex to the Federal/Provincial Framework Agreement for Environmental Cooperation in Atlantic Canada, the two jurisdictions have agreed to long-term water quality, water quantity and aquatic ecosystem health monitoring programs directed at maintaining and improving Prince Edward Island's water resources.

Summary

Numerous mechanisms for ecosystem protection are being proposed and implemented across Canada. These mechanisms include establishing and negotiating different types of EWAs, such as aquatic reserves, water allocated to the environment for IFNs and restrictions on groundwater withdrawal rates to secure recharge. Other jurisdictions aim at protecting aquatic and terrestrial ecosystems by considering wetlands and coastal marshes as water bodies in allocation decision making, and assessing potential environmental impacts before approving water licenses/permits. There is evidence to suggest that little progress has been made regarding the assessment and adaptation of available methods to determine IFNs in the Canadian context.

Major challenges exist to instituting effective EWAs. Monitoring and enforcement of water allocations for the purposes of ecosystem protection is still in its infancy in Canada. Most jurisdictions have traditionally

focused their monitoring efforts on hydrological and climatological information. However, there is a trend in some jurisdictions towards gathering and assessing ecological information in order to link current and future allocation schemes to desired ecological outcomes.

The capacity to establish, monitor and enforce ecosystem protection within water allocation systems is highly dependent on the existence of mechanisms to create and incorporate ecological knowledge. Several jurisdictions across Canada are actively working to expand the ecological knowledge base by establishing advisory committees and networks of researchers, committing sustainable funding to policy relevant, action-oriented research, and developing integrated database systems. Funding of science research is substantial in contrast to funding for TEK. With the exception of the Northwest Territories, traditional and local forms of knowledge are not included in current efforts to generate ecological knowledge for water allocation across Canada.

Finally, significant institutional barriers for ecosystem protection exist. For example, existing, long-term water allocations to human uses can create a sense of entitlement that is difficult to challenge, especially when these allocations are established through mechanisms considered inviolable.

3.2. Economic Production

Water plays an important role as a resource for economic production. Examples include water used in agriculture to irrigate crops and in thermal power production for cooling, and water used for instream activities such as hydropower and recreation[5 ,18]. From an economic production perspective, water security is achieved by water allocation systems with clearly defined and stable allocation rules that foster private and public economic investment[8, 13]. Water security is also enhanced by flexible water allocation systems that can provide for the (re)allocation of water resources to economic activities that have the greatest technical and economic efficiency, in order to improve overall water allocation and water use efficiency[1, 9].

Different kinds of water allocation systems, which are the result of a set of historical socio-economic, political, ecological, and cultural circumstances, are needed in order for water allocation decisions to be responsive to local needs[2, 6, 11]. In this context, a key concern is the extent to which these different systems provide water security for economic production. This is highly dependent on the contribution of water allocation systems to institutional uncertainty/certainty, which is related to their approach to addressing the tension between the need to simultaneously provide for flexibility and stability in water rights[8, 13].

Highlight Box 4: Incorporating Traditional Knowledge into Allocation Decisions

Innovation is shown through the incorporation of Traditional Ecological Knowledge (TEK) in water allocation decision making in the Northwest Territories[a, b, c, d]. The acceptance and inclusion of multiple ways of knowing, including western scientific knowledge and Aboriginal traditional knowledge, better enables ecosystem protection and water allocation. As part of its public awareness and communications strategy, the Northwest Territories Water Board is focusing on improving ways to receive and share information and ideas with the public. This includes traveling to meet with local agencies and organizations, and providing language and interpretation services, among other things. The Gwich'in Land and Water Board incorporates TEK into decision making that relates to water allocation under the Northwest Territories Waters Act. The Board's permitting and licensing process directly involves communities and uses both traditional and scientific knowledge about the physical and social environment for decision making. The Sahtu Land and Water Board also requires TEK and scientific knowledge to be incorporated into all applications. According to the Board, TEK could consist, among other things, of knowledge regarding streams and lakes being affected.

To address these concerns, we posed three questions that explored links between water allocation and economic production:

- Are allocation rules stable and clearly defined?
- Is sufficient water allocation-related information available to make economically sound decisions?
- Can water be re-allocated?

Are allocation rules stable and clearly defined?

Water allocation systems that provide security for economic production have rules that are stable and clearly defined[8]. Clearly defined water rights, varying in design according to local needs, history and circumstances (e.g., individual vs. communal water rights), can promote institutional certainty and facilitate efficient water use[11, 13]. In this regard, the duration of the water right is a key component of water security for economic

production because certain periods of time may be required in order to obtain a return on investment[4]. Another key issue is the extent to which it is clear who will bear the financial costs associated with future regulatory and climatic risks, for instance, potential reductions in water allocations due to evolving knowledge regarding ecosystem needs[1, 9, 19]. Finally, from the perspective of water security, economic production concerns are better addressed when water rights are both monitored and enforced[11]. Measurement of water rights is a complex matter requiring continued monitoring activity, while enforcement usually requires provisions in legislation for the appointment of inspection officers and political will to enforce those provisions[8].

In Canada, a number of factors influence whether allocation rules are stable and clearly defined, including awareness of water priorities, duration of the right to allocated water, and financial compensation for modified or revoked allocations. Priorities for water allocation in Canada exist in some, but not all, jurisdictions.

- Six Canadian jurisdictions have allocation systems in which priority of water allocation is assigned to users based on the timing of their application (AB, BC, MB, NT, NU, YT). These systems have their roots in the "prior appropriation" doctrine, which assigns rights to fixed amounts of water to license holders for particular beneficial uses. "Every appropriator of water senior in time to another appropriator is entitled to have the senior right fully satisfied before the junior right receives any water"[3]. As a result, these jurisdictions have transparent and clearly defined water allocation rules.
- Prince Edward Island and Newfoundland and Labrador have allocations systems in which priority of water allocation is based on a water use priority system stemming from the riparian rights doctrine. Under this doctrine, those who own lands adjacent to flowing watercourses may reasonably use them. Thus, "while domestic uses...are given preference over other uses, the only real restriction on the use by one riparian is that a use cannot impose 'unreasonable harm' on another riparian right"[3]. In the allocation systems in these two provinces, water allocation rules are relatively clear and transparent because priority is assigned to water users according to the types of water use.
- In Nova Scotia, timing and use priority is combined. The first priority is sustainability, the second is to minimize conflict, the third is based on a first come-first serve basis-with priority given to drinking water, and then to existing over new applications, and the fourth priority is to ensure water allocation is based on current not future need.

- The remaining four jurisdictions do not follow either of the above priority schemes. The rules for allocation of water in Ontario vary according to the category of water taking and are clearly stated in the Permit to Take Water (PTTW) Manual[17]. However, it is important to note that the *Ontario Water Resources Act* provides the Director with a large amount of discretionary power to issue, refuse, or impose conditions on a license, as well as to alter these conditions after a license is issued. Moreover, since the allocation rules are laid out in a manual rather than in a regulation, their legal basis may be less secure from an economic production perspective. In addition, riparian rights have not been eliminated in Ontario. In Saskatchewan, Quebec, and New Brunswick, water allocation rules are not clearly defined, limiting the degree of clarity and stability in institutional arrangements required for economic production.

There is no standard approach regarding duration of water allocations across Canada. A few jurisdictions, such as British Columbia, do not specify time limits in their water licenses/permits, and water allocation instruments may actually have no expiry date. In contrast, there are a number of jurisdictions that specify maximum limits regarding the length of allocations. In Ontario, for example, the maximum duration of a new or renewed water permit under the PTTW Program is 10 years. Within the territories (Yukon, Northwest Territories and Nunavut), the maximum duration of water allocations is a 25 year term.

Six jurisdictions across Canada have clauses within their respective water laws and regulations enabling financial compensation if allocations are reduced under a specific set of conditions. In Alberta, for example, licensees are entitled to compensation for losses incurred from amendments, suspensions, and cancellation of water licenses. In Manitoba, financial compensation is used as a mechanism that can help reduce the risk to water users given the fact that the government can real-

locate water to higher priority uses. In this case, financial compensation is provided to the lower priority user by the higher priority user who will receive the reallocated water.

As noted previously, water security is addressed by allocation systems that can both monitor and enforce clearly defined and transparent water rights. Requirements exist to monitor water on a daily basis in Ontario, Nova Scotia, and on a monthly basis in Saskatchewan (for groundwater and industrial users) and Newfoundland and Labrador. In some provinces, requirements exist to keep detailed water use records (e.g., Manitoba, Northwest Territories, Nunavut, Alberta's licensees in water-short areas), with annual reporting unless terms and conditions specify otherwise. Moreover, in some jurisdictions, such as Manitoba and Ontario, the Minister or Director, respectively, prescribes and approves the monitoring devices that are to be used to record water use[14, 22]. Significantly, not all water users within each jurisdiction are required to hold water licenses and/or water permits, and even if they do, they may not be required to monitor and report actual water use. In British Columbia, for example, only large surface water users are required to report water usage annually. In Ontario, domestic users and agricultural users taking water for livestock (when they do not store the water) do not require a Permit to Take Water, and thus are not required to monitor their use.

Mechanisms for enforcement can be categorized as reactive or proactive. *Reactive* mechanisms rely on complaints as triggers for investigation (e.g., Alberta), review, and assessment of monitoring records (e.g., Prince Edward Island). *Proactive* mechanisms, which have the most potential for enhancing water security, mainly comprise water inspections and water audits (e.g., the Northwest Territories). A few jurisdictions have an enforcement portfolio that includes both proactive and reactive mechanisms. For example, Ontario's Ministry of the Environment assesses monitoring records and responds to complaints while at the same time annually conducting 100-200 planned inspections of permitted water takers to ensure that they are meeting the conditions in their permits[20]. For cases of non-compliance, every jurisdiction but Nunavut has defined the corresponding fines within their respective water-related legislation. Since effective monitoring and enforcement of water rights is a particularly challenging yet essential component of allocation systems, it is desired that appropriate and sufficient human, financial, and technical resources are committed by the responsible authority (see Highlight Box 5).

Is sufficient water allocation–related information available to make economically sound decisions?

Water allocation systems that enhance water security for economic production are concerned not only with setting clear and stable rules, but also with providing timely access to water allocation-related information. This type of information, which constitutes a valuable resource for economically sound decision making, includes not only real-time water monitoring data but also information about allocation decisions and allocation implementation[6, 11]. However, in many parts of the world regional and national data on water supply and use are not collected, and even when they are, in-

Highlight Box 5: Compliance Monitoring and Enforcement

Monitoring and enforcing water allocations are essential, in part because they provide confidence in the system. In the Yukon, the *Waters Act* has provisions for the Yukon Water Board to include in any license conditions relating to monitoring programs and maintenance of records for enforcement purposes[a]. Enforcement is an important component of the *Waters Act*. Section 34 enables inspectors to enter and inspect any place in a water management area. The inspector may also examine any books, records or documents containing information related to the use of waters. In the case of private dwelling places, inspectors are not allowed to enter without permission, but owners are required to assist them in carrying out inspection functions. As one possible consequence of an inspection, the inspector may direct reasonable measures to be taken, including the cessation of an activity. In such cases, the Minister shall upon request review these directions. These responsibilities are carried out by the Yukon Government's Water Inspections Branch.

formation availability may be restricted[7]. In recent years the Internet has provided a new vehicle for efficiently distributing water allocation-related information. However, jurisdictions that rely almost exclusively on online portals to provide relevant information may actually exclude some water users, especially in rural areas in which access to and use of the Internet may not be widespread[1].

Across Canada, available water allocation-related information generally includes databases of allocation decisions:

- Some jurisdictions provide water users and the general public with access to online databases of water licenses and/or permits. This is the case of the Authorization/Approval Viewer in Alberta, the Water Licenses Web Query database in British Columbia, the Environmental Bill of Rights Registry in Ontario, and the Registry of Water Rights in Newfoundland and Labrador (refer to Highlight Box 6).
- Jurisdictions, such as New Brunswick, the Yukon and the Northwest Territories, maintain a publicly accessible registry of water licenses and/or permits available through their respective agency offices.

Whether accessible online or in an office, the addition of real-time monitoring data on water supply and actual water use would make pubic registries a valuable resource in making economically sound decisions. This represents an important information gap for economic decision making across Canada, especially in regards to groundwater resources. Available tools in Alberta have the potential to track water use at the district level, but there is a lack of accurate natural flow data[21]. In Ontario, agricultural and other water users have had concerns regarding the lack of adequate information on water use and water supplies[12]. This shortcoming has been partially addressed by the Ontario Low Water Response Program[15], which aims to support local responses under low water conditions and provides online water supply information. However, as of March 2007 this program had yet to incorporate groundwater resources and associated monitoring indicators into the online information system.

Quality control of water supply and water use information becomes critical if such information will form the basis for economic decision making. More critical, however, is its accessibility for water users and members of the general public. In this regard, some Canadian jurisdictions are still lacking. For example, the government of Ontario has recognized that although water managers in different agencies need accurate, up-to-date water-related information, access to data is limited due to institutional fragmentation. The joint Water Resources Information Project[16] was launched to address this shortcoming, but access to the information is limited to authorized government officials.

Highlight Box 6: Public Registries of Water Allocation Information

Publicly accessible registries are an important tool for fostering water security because they can provide timely access to water allocation-related information. This facilitates effective public involvement, while at the same time supporting economically sound decision making. The Newfoundland and Labrador Department of Environment and Conservation maintains and operates an online publicly-accessible Registry of Water Rights which lists all water use licenses in the province (active, cancelled, temporary, transferred and expired)[a]. Provisions for the Registry are contained in the Province's *Water Resources Act* (2002, s.13). The registry is intended to raise awareness regarding allocation decision making, while at the same time fostering better planning and reducing conflicts. It contains more than 1,600 records and is continuously updated to include new registrations as received.

Can water be re-allocated?

Water re-allocation refers to the process of transferring water between different water uses, different economic sectors and/or different geographic regions. Around the world, many formal and informal institutional arrangements for water re-allocation exist, including water leases, water banks and water markets[10]. Water markets increasingly are being proposed as an institutional alternative for semi-arid and arid regions[1, 9], but these require that tradable water rights be established and separated from the corresponding land rights[8].

From a water security perspective, it is important to assess the extent to which institutional arrangements for the re-allocation of water take into consideration the economic efficiency and economic flexibility of water transfers. Economic efficiency is advanced when water is transferred from low-value or low-efficient uses of water, to high-value or more efficient uses[11]. Economic flexibility in water re-allocation refers to transfer of water that can enable economic development by recognizing that historic uses of water may not be relevant for current (and changing) economic conditions[6, 13].

Institutional arrangements for water re-allocation are not well developed across Canada. In Ontario and New

Brunswick, for example, water licenses/permits are not transferable under any circumstances. Transfers of water licenses/permits in the Canadian context generally require approval and have to comply with certain conditions. In Manitoba, for example, approval is granted only if the water is used for the same purpose, at the same rates, in the same amounts, and in accordance with the same conditions as the former license. Other jurisdictions have limitations regarding the type of water resources that can be transferred. This is the case in Prince Edward Island, where only water associated with storage ponds may be transferred, and in Newfoundland and Labrador, where the portion of water allocated that is not used by licensees can be reallocated. Only in Alberta is re-allocation permitted independently of the transfer of land (see Highlight Box 7). Alberta also stands out among Canadian provinces and territories because water re-allocation is seen as a mechanism to provide economic efficiency and flexibility in basins where water resources are fully allocated.

Summary

A few jurisdictions do not have clearly defined water allocation rules and therefore provide less security to water users engaged in economic production activities. The length of water allocations varies widely across Canada, with some jurisdictions allocating water on a permanent basis, while others establish maximum limits for permits/licenses that range from 10 to 25 years. Only six jurisdictions have provisions in relevant legislation or regulations to provide financial compensation if allocations are reduced under certain conditions. In the Canadian context, water re-allocation presently does not play an important role as a mechanism to pursue economic efficiency and flexibility in allocation systems.

When required, water users across Canada monitor their water use on a daily or monthly basis, with annual reporting unless terms and conditions specify otherwise. However, not every water user in each jurisdiction is required to hold a permit/license, and if so, they may not be required to monitor actual water use unless they are allocated large volumes of water. Most jurisdictions enforce water allocations on a reactive basis, although some jurisdictions conduct planned inspections and water audits. In general, systematic monitoring and proactive enforcement in Canada are limited by the available human, financial, and technical resources assigned to these functions in the different jurisdictions. This has important implications for the type of water-related information that is available to water users in order to make economically sound decisions. The lack of access to real-time monitoring data on water supply and actual water use is a critical gap across Canadian jurisdictions, especially in regards to groundwater resources.

Highlight Box 7: Voluntary Re-allocations

Provisions for re-allocations through voluntary water transfers are an innovative mechanism for promoting water security, particularly in highly allocation systems. In Alberta, all or part of a licensed water allocation can be re-allocated on a temporary or permanent basis without affecting the priority of the license[b]. The *Water Act* permits two kinds of re-allocations: "assignments" (temporary re-allocations from one licensee to another for a specific period of time) and "transfers" (temporary or permanent re-allocations of all or part of an existing licensed allocation to another person). Transfers and assignments can be made from one parcel of land to another. In the case of transfers, provisions exist for up to a 10 percent conservation holdback. Both transfers and assignments are subject to a review by Alberta Environment, with transfers receiving the most scrutiny. Assignments are typically used to increase flexibility during drought emergencies, while transfer provisions were designed to increase economic efficiency[d] and flexibility in what was otherwise a rigid system of water right priorities[a, e]. Within the South Saskatchewan River Basin, 25 water license transfers occurred between 2002 and 2007[c].

3.3. Equity and Participation

Water scarcity is seen by some as a natural phenomenon over which people have no control. In reality, scarcity is very much socially constructed. For example, it commonly reflects a mismatch between available supplies and demands due to inappropriate development decisions. In many places, scarcity is simply a function of growing demands, rather than reductions in the supply of freshwater[6, 20]. Allocation plays an important role in the social construction of water scarcity because it is the process used to determine who will get water, and under what circumstances. This is particularly the case of water allocation systems in which water is treated as an economic good. Treating water as an economic good has important benefits for water security. However, some critics have noted that doing so can have negative consequences for groups within society that cannot pay the price, or for whom water also holds symbolic and spiritual meanings[1, 18, 37]. In this context, the existence of transparent and participatory

governance structures and procedures for the allocation of water is highly desirable because water allocation decision making and implementation (or lack thereof) have important equity implications[20, 24].

From an equity and participation perspective, water security is enhanced by water allocation systems that enable stakeholder involvement and public participation in discussions surrounding the tensions among the social, cultural, economic and ecological implications of water allocations[1, 21]. Enabling participation for water security, however, goes well beyond simply offering selected opportunities during the allocation process for stakeholders and/or citizens to provide input. Instead, meaningful and sustained participation in water allocation requires long-term, in-depth forums or platforms for deliberation[9, 37]. Participation is also enabled when opportunities to contribute to the collective water-relevant knowledge base are provided. Water-relevant knowledge, for the purposes of water allocation, includes not only knowledge about hydrology and ecosystem dynamics, but also knowledge about conflict resolution and water governance[1, 13].

To address these concerns, we posed three questions that explored links between water allocation and equity and participation:

- Are equity concerns built into water allocations?
- Are there mechanisms to facilitate sustained and meaningful stakeholder and public participation?
- Are there mechanisms to address potential conflicts at different scales?

Are equity concerns built into water allocations?

Water allocation systems that increase water security have transparent and fair water allocation criteria that acknowledge that water may be a commodity for the purposes of economic production, but it is also an essential human right[37, 38]. According to the United Nations Committee on Economic, Social and Cultural Rights, "the human right to water entitles everyone to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses"[33]. Thus, a first step for incorporating broad equity concerns related to basic human water requirements into water allocation systems is to provide priority to domestic uses of water[18]. Beyond securing water for essential human needs, equity is best pursued by establishing open and fair allocation structures and processes that aim to strengthen the capacity and bargaining position of the most disadvantaged groups within society[25, 37].

In allocation systems that are increasingly treating water as an economic good, the equity implications of tradable water rights also are a concern. In the case of agricultural production, for example, the value of irrigated land is highly dependent on the associated water rights[3]. Moreover, when water is privately traded and, therefore, "lost" to a particular agricultural region, broader negative consequences for the rural community may exist[20]. In this context, water allocation systems should integrate allocation efficiency with equity of allocation via appropriate compensation schemes and democratic consideration of trade-offs[1, 33].

No Canadian jurisdiction has enacted legislation that recognizes the human right to water as advanced by the UN Committee on Economic, Social, and Cultural Rights. This may reflect the fact that across Canada, unlike many other countries, most of the population already enjoys access to water of good quality for personal uses; of course, Aboriginal communities living on remote reserves are an obvious exception[27]. Furthermore, the simple recognition of the right to use or drink water does not reflect the special relationship of Aboriginal peoples to the land and its resources[7, 22].

Notwithstanding the evolving issue of indigenous water rights, all Canadian jurisdictions recognize in a limited sense basic human water needs. They do so by exempting from permitting or licensing requirements the taking of water for domestic purposes by individual landowners. Some water allocation systems, such as those of Alberta and Manitoba, specify a limit on the volumes of water under which this exemption is allowed. Others, such as those of Ontario and Newfoundland and Labrador, do not.

Other equity considerations and concerns, including open and fair allocation systems, are therefore much more relevant for the analysis of water allocation across Canada. These equity considerations are built, to varying extents, into the water allocation systems of all Canadian jurisdictions through a variety of mechanisms, including the following:

- The "first in time, first in right" principle underlying the allocation systems of Alberta and Manitoba is an example of *transparent criteria* for allocation decision making.
- In other jurisdictions, such as the Northwest Territories and Nunavut, *transparency in the allocation decision making process* is promoted by making available to the public the rationale for any decision made by the respective Water Board in regards to water applications (Refer to Highlight Box 8).
- In Newfoundland and Labrador, applicants to licenses of high priority water uses are required to provide *financial compensation* to existing license holders of lower priority water uses who will be affected by the new licenses when approved.

Although these mechanisms are important building blocks for ensuring equity in water allocation, water security is best advanced by allocation systems in which consideration of potential social, cultural, economic and ecological tradeoffs is part of an inclusive and fair decision making process. Across Canada, some jurisdictions are implementing innovative approaches to enabling more participatory and democratic water allocation systems:

- In British Columbia, for example, provisions exist for licensees and riparian owners who object to the granting of a water license to file an objection within a prescribed time. If the comptroller or the regional water manager decides that the objection warrants a hearing, the applicant and objectors are entitled to be heard and to be notified of the decision following the hearing (*Water Act*, s.11).
- In the Northwest Territories, Water Boards are required under the *Canadian Environmental Assessment Act* (CEAA) to take into consideration environmental and socio-economic impacts before water licenses are issued. Environmental impact assessment processes advanced by the CEAA have provisions for public input in regards to the consideration of trade-offs (Refer to Highlight Box 8).

An evolving institutional mechanism of increasing relevance for the open and fair allocation of water resources across Canada is requirements for Aboriginal consultation[7]. As established by recent Canadian case law (e.g., *R. v. Sparrow*, 1990), governments (federal and provincial) have a "duty to consult" with Aboriginal communities when their actions or decisions may affect existing or claimed Aboriginal or treaty rights[2]. In other words, the duty of consultation recognizes that Aboriginal communities should not be treated like other stakeholders, and that a separate and meaningful consultation process is required[27]. In this context, governments are to provide a two-way communication process in which Aboriginal communities can gain a thorough understanding of the potential impacts of resource allocation decisions, and can respond to them[26]. Of concern, however, is the fact that the nature and scope of the duty to consult of water administrators has not been clarified by the Courts, and thus Aboriginal consultation varies according to circumstances and interpretations, and may or may not include a "duty to accommodate" identified concerns[7, 22].

Finally, it is significant that equity in water allocation is promoted when the water needs of future generations are considered alongside those of current generations. This principle is reflected in the Manitoba Water Strategy and Alberta's Water for Life Strategy, both of which promote intergenerational equity by establishing goals for the short, medium and long terms[36].

Highlight Box 8: Democratic and Transparent Processes

In the Northwest Territories, prior to issuing a water license, the Water Board must consider not only the environmental but also socio-economic impacts of the applications. This is part of the requirements of the Canadian Environmental Assessment Act (CEAA), which guides the decision making process followed by the Water Board[a]. According to the CEAA, an environmental effect means, among other things, any effect of an environmental change in the current use of lands and resources for traditional purposes by Aboriginal persons.

In Nunavut, the transparent, participatory water allocation process is evident in the Nunavut Water Board Licence Process[b]. Stages at which "participants" are involved are explicitly identified. In this system, "participants" include federal departments, territorial departments, Nunavut Tunngavik Incorporated., Regional Inuit Associations, communities, and elders.

Are there mechanisms to facilitate sustained and meaningful stakeholder and public participation?

Sustained and meaningful stakeholder involvement and public participation is an important factor for achieving water security through water allocation. Meaningful participation in water allocation implies that people, organizations and communities that will be affected to some degree by allocation decisions should have a say in the decision making process[1, 37]. Different mechanisms may be available for participation. From a water

security perspective, water allocation systems should provide, and be responsive to, forums or platforms for in-depth, long-term deliberation (e.g., community forums and irrigation committees)[33, 35]. In this context, it is important to provide opportunities for inclusive and broad representation[1, 11].

Forums and platforms for sustained and meaningful participation are not only important because of their capacity to deal with conflict or equity concerns in water allocation, but also because they can provide an opportunity for social learning[9, 13]. Social learning in water allocation implies building an evolving and collective understanding of freshwater and ecosystem dynamics that combines various sources of information and knowledge, as well as the systematic evaluation of past and current allocation experiences[16, 17]. Social learning for water allocation also includes learning about how to deal with conflicting values and perspectives in participatory decision making processes[5, 13].

Across Canada, several jurisdictions are implementing different mechanisms within their water allocation systems that are designed to facilitate sustained and meaningful stakeholder involvement and public participation. Examples include the following:

- A few jurisdictions across Canada, including Nova Scotia, Alberta, Saskatchewan, the Yukon and the Northwest Territories, provide opportunities to the general public, stakeholders, and/or affected communities to participate in the review of water license applications and renewals, as well as of water transfers. As a result, their systems promote *inclusiveness* in decision making.
- *Multi-stakeholder water committees* are used in several jurisdictions. At the provincial level, the Alberta Water Council, Saskatchewan Provincial Water Panel, and Manitoba Water Council have representation from key stakeholders, and provide opportunities for public input through public outreach and consultation processes. Representation of multiple stakeholders is also pursued at the regional level, such as in Saskatchewan's watershed advisory committees, and Quebec's priority watershed organisations (refer to Highlight Box 9).
- *Registries* are used in several jurisdictions to make water allocation information available to the public. For example, the Register of Water Rights in Newfoundland and Labrador, the Environmental Registry in Ontario, the Alberta Environment Authorization/Approval Viewer, and British Columbia's Water Licenses Web Query provide relevant information regarding existing water licenses and applications that can enable different stakeholders and interested publics to be prepared to engage in meaningful participation.
- The trend towards water planning processes that engage different publics at multiple levels is reflected in Alberta's Watershed Management Framework, British Columbia's Water Use Plans and Water Management Plans, Manitoba's Water

Highlight Box 9: Meaningful Participation via Watershed Organisations

At the watershed level, 33 priority watershed organizations have been created in Quebec to better integrate water decision-making and implement Integrated Water Management principles[b]. These organizations, which have a coordinator and a board of directors, identify public concerns, as well as solutions to protect, restore, and determine best uses of watershed resources. The board of directors includes representatives from the community, municipal sector, the economic sector having a direct impact on the watershed, and provincial government organizations (although provincial representatives do not have voting rights). Management processes in these organizations are expected to be open and transparent, and all members are to agree on common water management goals.

Watershed organizations can make an innovative contribution to water security because they can provide forums for sustained and meaningful participation, preventing conflicts and fostering social learning. For example, the Matapedia River Watershed Council, one of the 33 priority watersheds, organized a symposium in March of 2006 titled "Sustainable Lands and Rivers: for better understanding of agricultural and salmon fisheries sectors" (Colloque sur les Terres et les rivières durables: pour mieux se comprendre entre les secteurs agricole et salmonicole). The symposium played a significant role in clarifying misconceptions and misunderstandings between the two sectors. Through this event, the Matapedia River Watershed Council enabled stakeholder groups to agree on common orientations, ensure long-term dialogue, and plan common projects. According to participants, the symposium approach encouraged stakeholder groups to put energy toward informing each other rather than simply defending their interests[a]. Following the symposium, a committee comprising several agencies was formed to invest effort and money in protecting and restoring agricultural stream banks.

Strategy, and the emerging source water protection process in Ontario.

- In New Brunswick the Environmental Trust Fund (~ $4-6 million /year) has been used to support community-based watershed groups in education, outreach, and planning activities. Quebec's 33 watershed organizations each receive $65,000 annually from the province to support a full-time coordinator position.

Mechanisms to facilitate sustained and meaningful stakeholder involvement and public participation are an important component of water security through water allocation. In this context, water security is best advanced when there are mechanisms in place to monitor the effectiveness of such participatory processes and structures. In this regard, the watershed planning process in Saskatchewan, which monitors participation rates of local stakeholders such as municipalities, irrigation districts, watershed associations, conservation groups, and stewardship groups, is a positive example[31].

Are there mechanisms to address potential conflicts at different scales?

Water allocation systems have the potential to generate conflict at different scales (e.g., local, regional, provincial, national, international)[1, 18, 37]. This is because water allocation decisions determine patterns of access to water resources among competing users, including individuals, businesses and communities, within a particular jurisdiction. For instance, decisions about water resources located upstream in a watershed have implications for downstream water users[12]. Water reallocated to higher value uses, such as municipal uses in urban areas, has implications for the rural economic base[3, 20]. Importantly, historical water allocation decisions, and entrenched allocations to long-term license holders, can constrain current decision making processes and add to water-related conflict. In this context, water allocation systems enhance water security when they provide appropriate mechanisms to address these and other potential sources of conflict across levels of government and geographic scales[1].

A water security perspective is particularly concerned with the existence of decentralized water governance processes and structures that can address conflict[1, 37]. In this context, the watershed is often recognized as the appropriate scale for decentralization in water resources management[6, 12, 16]. However, it is also important to consider other relevant scales for water governance, which may be arranged according to social, economic, political and cultural boundaries instead of biophysical boundaries[4, 14, 23]. For example, numerous important land use and environmental stewardship decisions are made at the municipal level, and the corresponding mechanisms for conflict resolution are also found at this geographic scale[8, 15].

Across Canada, several jurisdictions have developed institutional arrangements to address potential conflicts at multiple levels and scales. Selected examples include the following:

- In Saskatchewan, the Saskatchewan Watershed Authority takes into account water uses upstream and downstream when determining the water allocations.
- Examples of *decentralized water governance* include Conservation Authorities in Ontario and Conservation Districts in Manitoba (refer to Highlight Box 10). Water management plans in British Columbia and Saskatchewan also reflect decentralized planning processes for water governance.
- Mechanisms for *public consultation*, such as public hearings and stakeholder consultation, are used to address water-related conflicts in many jurisdictions, including British Columbia, Quebec, Saskatchewan, and the territories.
- Conciliation, negotiation, mediation, and arbitration are among the *alternative dispute resolution mechanisms*

Highlight Box 10: Decentralization through Watershed Conservation Districts

Manitoba has 16 Conservation Districts, comprised of groups of neighbouring rural municipalities within a watershed that partner with the provincial government to develop programs to effectively manage their natural resources[a]. Each Conservation District develops an Integrated Resource Management Plan, in consultation with local ratepayers and provincial partners. To date, Conservation Districts have worked at the local level with community members to revitalize waterways and manage water control structures. Building on its experience with Conservation Districts, the Government of Manitoba has made a commitment to watershed-level planning and management. This commitment is particularly reflected by the Watershed Stewardship Fund. Among other objectives, the fund assists with projects that involve the formation of watershed planning authorities and the development of watershed management plans. Conservation Districts are an example of an innovative approach to water security because they provide a mechanism for conflicts to be addressed at an appropriate local scale.

used to deal with water allocation-related conflicts in Nova Scotia.

- *Appeals processes and structures,* such as the Nunavut Surface Rights Tribunal, are institutional arrangements used to address water allocation conflicts that cannot be solved through negotiations. In Ontario, water allocation and numerous other environmental decisions can be (and are) appealed under the *Environmental Bill of Rights Act*.

Institutional arrangements to address existing and potential conflicts in regards to water allocation and asserted Aboriginal or treaty rights are also emerging as a result of the "duty to consult". In British Columbia, for example, the provincial government is working together with First Nations organizations to "develop a New Relationship founded on respect, recognition and reconciliation of Aboriginal rights and title" [19]. One of the principles guiding this new relationship includes the implementation of dispute resolution processes to resolving conflicts. In Saskatchewan, the Saskatchewan Watershed Authority intends to use its Community Involvement Policy and the new provincial guidelines on the "duty to consult" to meet provincial obligations towards First Nations. In its Performance Plan for 2007/08, the Authority recognizes that Aboriginal consultation is an evolving area which will require new expertise and resources, and that it must work to accommodate First Nations' aspirations without compromising the province's ability to manage water supplies[30].

From a water security perspective, institutional arrangements to address conflict at different scales and levels have also to take into consideration historical allocation decisions that may constrain current allocation decisions and conflict resolution strategies. This is the case of inter-basin transfers and diversions, which have been an important component of the evolution of water resource development and management in Canada[31]. Inter-basin transfers are both complex and controversial, and the trade-offs between their proposed benefits and potential negative impacts usually involve conflicts of fundamental values[10]. Although inter-basin diversion projects for hydroelectric production are found in almost all Canadian provinces, there is no formal inventory of the history and operation of these projects[28]. Most were initiated before the mid-1970s, and were situated in less populated areas, leaving Aboriginal communities to bear the brunt of the negative impacts. Avenues for participation and consideration of equity and ecological implications on inter-basin transfers and diversions were not an important aspect of planning processes at that time[10]. Although much progress has been made in this regard, and provincial legislation is in place to protect the integrity of basins and watersheds (Table A3), existing inter-basin transfers are to be grandparented in these arrangements, and thus not subject to reversal[10, 28]. Moreover, transfers prohibited under provincial legislation usually involve major water basins and primary watersheds (Table A3), highlighting the need for institutional arrangements that can address potential conflicts emerging from inter-basin transfers between common basins or secondary watersheds (intra-basin transfers).

Summary

No Canadian jurisdiction has enacted legislation recognizing the human right to water as advanced by the UN Committee on Economic, Social, and Cultural Rights. In a limited sense, all Canadian jurisdictions recognize the importance of basic human water needs by exempting domestic uses of water from licensing requirements. The right to water for domestic purposes, however, does not properly reflect the role of water in sustaining the traditional way of life of Aboriginal communities. Other equity considerations, such as openness and fairness in water allocation, are therefore more relevant in the Canadian context. In this regard, some jurisdictions use public disclosure of the rationale behind water allocation decisions to ensure transparency in the decision making process. Public registries with relevant information regarding existing water licenses and applications are also provided in a few jurisdictions. However, there is a general lack of participatory allocation structures and processes that will enable the general public, especially the most disadvantaged groups in society, to fully engage in the negotiation of allocation trade-offs.

Across Canada, there is a trend towards increasing stakeholder involvement and public participation in water management. This is particularly reflected by the current emphasis on multi-stakeholder watershed committees, forums and planning processes as the preferred approach to decentralized water governance in

Canada. Decentralization in water governance is not only pursued as a mechanism for sustained stakeholder involvement and public participation, but also as a mechanism to prevent and manage conflict. The role of watershed committees and forums in planning processes for the purposes of water allocation, however, is not yet as important as their role in water management in general.

An evolving institutional mechanism of increasing importance in water allocation is Aboriginal consultation. Some jurisdictions are developing consultation approaches in order to fulfill the "duty to consult" with Aboriginal communities when water allocation decisions may affect asserted Aboriginal rights. The need for a separate and meaningful consultation process, as reflected by Canadian case law, recognizes that Aboriginal communities have a special relationship with water, and should not be treated like other stakeholders.

Strategies to address conflict at different levels and scales are constrained in many jurisdictions by their inability to affect historical allocation decisions. This concern is especially prominent when allocation decisions involve inter-basin diversions and transfers; Canada has many of these.

3.4. Integration

Water allocation takes place within the context of multiple water connections linking aquatic and terrestrial ecosystems and human societies[8, 14]. From a water security perspective, there is particular interest in water allocation systems that take into consideration water connections across natural boundaries, such as those between surface and groundwater resources and between water and land resources[9, 15]. Institutional arrangements dealing with water quality and water quantity management often seem to be separated by a boundary that, from a water security perspective, should also be eliminated. The intricate links between groundwater and surface water imply, for example, that groundwater withdrawals may also affect rivers dependent on groundwater base flows and their associated ecosystem services[18]. Storm runoff resulting from increasing urbanization is one among many examples of the potential of land use practices to have a large impact on the ability of communities to secure sufficient quantities of water of good quality[8, 11].

The extent to which different water allocation systems can provide for water security through integration is strongly related to the presence of an enabling institutional environment that allows decision making processes at different levels to be coordinated[9, 15]. Although there is general agreement regarding the need for an integrated approach to water resources management (including water allocation), the implementation of such an approach in the context of institutional fragmentation still represents a considerable challenge[7, 13, 20]. Integrated water allocation systems that enable a broad range of institutional arrangements to be coordinated to protect the quality and quantity of both groundwater and surface water resources will be better prepared to address water security challenges.

To address these concerns, we posed three questions about integration and water allocation:

- Is integration between groundwater and surface water resources considered in water allocation systems?
- Is integration between water quality and water quantity considered in water allocation systems?
- Is there integration between land use planning and water allocation?

Is integration between groundwater and surface water resources considered in water allocation systems?

When water allocation systems treat surface and groundwater resources as distinct or separate resources, important negative impacts can result on both communities and ecosystems. For example, there are a variety of groundwater-dependent ecosystems, such as wetlands and streams, which can be affected by groundwater removal[18]. Reduced streamflow due to overpumping of groundwater also has implications for water users dependent on these streams for economic purposes such as irrigation[16].

Although integration has been advanced worldwide in the last few decades as part of the trend towards inte-

grated water resources management[10, 15], this management approach has usually emphasized surface water resources and related watersheds[9]. In this context, water security is better advanced by water allocation systems that recognize the interconnections of groundwater and surface water resources, and which make these interconnections an explicit component of the allocation decision making process[4, 7].

Integration of groundwater and surface water resources in water allocation varies significantly across Canada. Some jurisdictions, such as British Columbia, have licensing requirements for water diversion and water use that do not currently apply to groundwater resources. The existence of licensing/permitting requirements for both groundwater and surface water, however, does not imply that the interconnections between these resources are taken into consideration during water allocation decision making. In Saskatchewan, for example, although allocation provisions for groundwater and surface water are contained in different sections of the same Act, there is little evidence of integration within the legislation. In the Northwest Territories, even though the same rules apply to surface and groundwater takings, there are few groundwater takings that are large enough to trigger the licensing process[5].

A number of jurisdictions have recognized in legislation the importance of taking into consideration the interconnections of groundwater and surface water resources in allocation. In Alberta, for example, the *Water Act* (2000) includes provisions for considering the integration of groundwater and surface water resources. Unfortunately, the legislation leaves this integration to the discretion of the directors, who may or may not choose to consider hydraulic, hydrological and hydrogeological effects when issuing water licenses. From a water security perspective, however, integration of groundwater and surface water should not be a matter of discretion, but an explicit component of water allocation decision making. For example, in Manitoba, the *Water Rights Act* (s.9) makes explicit the need to consider impacts on groundwater and surface water in order to protect and maintain aquatic ecosystems. Other proposed mechanisms that pursue a high degree of surface/groundwater integration at local and regional scales include the following:

- In Nova Scotia, groundwater withdrawal applicants are required to consider in their applications impacts on nearby surface water bodies. Moreover, an evaluation of the potential for groundwater-surface interaction is required if the proposed well is located within 60 meters of a surface water body, in order to prevent stream-aquifer depletion effects.
- In Ontario, the Director is required to consider the interrelations between surface and groundwater. Scientific evaluations of applications under the PTTW program are led either by a groundwater specialist or a surface water specialist, with no explicit mention of the need for considering surface-groundwater interactions. In practice, however, consultation between groundwater and surface water specialists occur when there is evidence that surface water and groundwater resources are connected[22].
- In Alberta, approved Water Plans must be taken into consideration in decision making regarding water licenses and water transfers under the *Water Act*. According to the *Framework for Water Management Planning* (1999), which outlines Alberta's water planning process, surface water and groundwater are to be integrated at the watershed/aquifer scale.
- In Ontario, under the Water Taking and Transfer Regulation, a Director who is considering an application to take surface or groundwater is required to ensure compliance with Ontario's obligations under the Great Lakes Charter. The Great Lakes Charter Annex 2001 explicitly advances integration of surface and groundwater resources at the basin scale.
- In Quebec, agencies responsible for implementing integrated water management are required to prepare Master Water Management Plans. These plans are to include the level and types of activities and impacts allowed in every surface water body and aquifer contained within the boundaries of their basins.

One of the most important challenges for the integration of surface water and groundwater in water allocation systems across Canada is the knowledge gap regarding groundwater resources and groundwater use[9, 21, 23]. The lack of knowledge pertaining to surface-groundwater interactions in Alberta, for example, is documented within a background report that supported the development of the Water Management Plan for

the South Saskatchewan River Basin[1]. Another example is the Ontario Low Water Response Program, which has the potential to affect water permits under severe low water conditions and it is based on a set of criteria that currently does not include groundwater indicators. This groundwater knowledge gap is the focus and priority for many current knowledge production efforts, such as Alberta's new *Water Research Strategy* (2006), Ontario's Low Water Response Program and British Columbia's water management plans (see Highlight Box 11).

Is integration of water quality and quantity considered in water allocation systems?

Water allocation systems, by determining the amount of water that can be used and the types of acceptable water uses, have the potential to affect water quality[16]. For example, water returned to water sources after non-consumptive use has the potential to undermine water supplies if return flows are of poor quality[15]. Excessive aquifer extractions can also lead to water quality degradation due to land subsidence, and salt-intrusion in coastal areas[6, 17]. Moreover, water conservation strategies based on increased efficiencies due to reductions and/or transfers in water allocations may reduce essential return flows and deep percolation, with important water pollution implications[8]. This can occur if a capping or reduction in water allocated to irrigation leads to increased efficiency in irrigation water use, which then leads to an overall increase in consumption even though less water is diverted[12]. Thus, institutional mechanisms may be needed to ensure that water quality is not affected in such cases.

From a water security perspective, the potential impacts of water allocation on water quality should be taken into consideration as part of the allocation decision making process. In this context, water security is best advanced by allocation systems that are formally linked to water quality objectives and strategies advanced in policies and regulations. Ideally, this integrated approach should also include the coordination of water allocation and management across the continuum from fresh water to coastal waters[15].

Highlight Box 11: Protecting Groundwater Resources Through Planning

The Township of Langley, in collaboration with the Province of British Columbia, is developing the Province's first water management plan focusing on groundwater management[c]. This pilot project aims to develop policies and regulations to protect local groundwater resources for community use and to integrate groundwater and surface water concerns, particularly with respect to preserving fish habitat in streams dependent on groundwater flow. Currently, groundwater withdrawal is unregulated in the province, and scientific studies indicate a trend of declining water levels in local aquifers. The plan will be the result of an inter-agency and public planning process that will involve integrating public values; assessing the effectiveness of various regulatory, economic, and voluntary measures; selecting a preferred package of management options; and developing a monitoring and implementation plan[a, b]. Regulatory tools under consideration include mandatory water conservation measures, well permitting, water allocation, water metering, innovated irrigation practices and technologies, water audits, wellhead protection measures, water quality targets, and bans on cosmetic pesticides. The plan is expected to be completed by December of 2007. Once approved, the plan will be legally enforceable to assist communities in addressing or preventing conflicts between water users and between water users and in-stream flow requirements, as well as risks to water quality[b].

Integration of water quality and quantity concerns is pursued through a variety of institutional arrangements in Canadian jurisdictions. The following are examples where this integration is not part of the allocation decision making process.

- In Manitoba, integration occurs at the monitoring stage. Government monitoring efforts regarding water quality and quantity of both surface and groundwater resources are integrated in order to achieve water quality policy commitments.
- Integration can occur through planning, as in the case of the *Framework for Water Management Planning*

in Alberta. This framework applies to all types of water bodies, and advances an integrated management approach that recognizes the interdependence of water quality and quantity.

- Integration also can occur in legislation, as in the case of the *Water Act* in British Columbia. This statute has provisions for water management plans that can be used to prevent or address risks to water quality in designated areas. This is also the case of source water protection plans in New Brunswick, Saskatchewan and Ontario (see Highlight Box 12).

These efforts represent an important initial step towards integration. However, water security is best advanced when water quality and water quantity concerns are taken into consideration as part of the water allocation decision making process. In Canada, some mechanisms for integration of water quality and quantity in water allocation include the following:

- Integration of water quality and quantity can occur within the terms and conditions attached to water licenses in Manitoba.
- Integration of water quality and quantity can occur within studies required as part of the application process for water permits in Nunavut and Nova Scotia.
- Consideration of water quality standards to regulate flow alterations is required for all classes of lakes and rivers in New Brunswick.
- Integration of water quality and quantity criteria occurs when assessing water permits for all development activities affecting wetlands and shore water zones in Newfoundland and Labrador.

Highlight Box 12: Integration of Water Quality and Quantity in Source Protection

In Ontario, integration of water quality and quantity concerns in regards to sources of drinking water is expected to occur under the *Clean Water Act* (2006)[a]. In the Act, a "drinking water threat" is defined as an activity or condition that adversely affects or has the potential to affect the quality or quantity of any water that is or may be used as a source of drinking water. In this context, an assessment report will be prepared for each source water protection region across Ontario that must characterize the quality and quantity of water sources in each watershed. Multi-stakeholder committees then negotiate an action plan in order to address significant threats in vulnerable areas. All local and provincial decisions, including water taking permits, are to be consistent with source water protection plans[b].

Although the emerging source water protection process in Ontario represents an important innovation regarding the integration of water quality and quantity at the watershed scale, it currently is restricted to existing and future sources of municipal drinking water. In order for source water protection to better enable the integration of water quality and quantity concerns in the Province, all water resources in a watershed should be taken into consideration, as well as other water-quality dependent issues beyond drinking water safety (e.g., ecosystem protection).

Is there integration of land use planning and water allocation?

Land use practices have the potential to affect, and be affected by, water allocation decision making and implementation. For example, before urban development is allowed to proceed, it is important to determine whether water supplies are available for such growth[3, 4]. Water bottling operations drawing from groundwater sources may have significant impacts on the water supply of surrounding rural communities[16]. Moreover, the types of land uses in a watershed determine the proportion of rainfall that returns to the atmosphere as evapotranspiration, and the movement and storage of the remaining water through the landscape[8]. In this context, it is critical for water allocation and land use planning to be coordinated whenever land use decisions can lead to significant changes in the hydrological cycle[3, 11, 14].

From a water security perspective, water allocation systems should recognize the interconnections of water resources and land use practices, and should take into account these interconnections as part of the allocation decision making process. For this purpose, it is important for allocation systems to be formally linked to land use planning processes at the municipal, regional and provincial scales[16, 19].

Across Canada, integration of land use planning and water allocation is advanced through a variety of institutional arrangements, including the following examples:

- Source water protection plans in Ontario, Quebec and Saskatchewan aim to identify and regulate land use practices that have the potential to affect the quality and quantity of drinking water sources.
- In Alberta, the Integrated Land Management Program integrates the Land-Use Framework and Wa-

ter for Life Strategy[2]. In BC, integration of land use planning and water allocation occurs through voluntary (e.g., Integrated Water Management Plans, Landscape Unit Water Management Plans) and legislated plans (e.g., Water Management Plans).

- In Saskatchewan, stress-response indicators are used to support integrated planning at the watershed/aquifer scale. One example of an integrated "stress indicator" is the spring runoff potential of impervious areas. However, "response indicators" for land use planning have yet to be developed.

These examples provide an indication of a trend towards integration of land use planning and water allocation. However, from a water security perspective, integration of land use planning and water allocation should occur explicitly as part of the allocation decision making process. This type of integration is currently being pursued in the Northwest Territories, Nunavut, and New Brunswick (see Highlight Box 13).

Summary

Several jurisdictions in Canada have recognized the need for taking into consideration surface/groundwater interactions in water allocation. However, the degree of integration of surface and groundwater resources in allocation decision making varies among these jurisdictions. Examples of a high degree of integration include explicit consideration of surface/groundwater interactions during the review of water licenses/permits (local scale) and the preparation of water management plans (regional scale). However, the knowledge gap regarding groundwater resources and groundwater use across Canada poses a significant challenge for integration efforts in water allocation.

The potential impacts of water allocation schemes on the quality of water resources is also taken into consideration as part of integration in water allocation. Some jurisdictions pursue water quality/quantity integration as part of broader water planning processes. Other jurisdictions go beyond considering integration in planning processes to include water quality/quantity integration in terms and conditions attached to licenses, or to request relevant studies on integration as part of the water allocation process. In addition, some coastal jurisdictions pursue water quality/quantity integration as part of the review process of water licenses/permits that affect wetlands and shore water zones. Integrated planning processes are the preferred institutional mechanisms for the integration of land use planning and water allocation across Canada. However, the scope of land use/water allocation integration is usually restricted to drinking water sources as part of source water protection planning and plan implementation.

Highlight Box 13: Integration of Water Allocation and Land Use Planning

In Nunavut, there is a high level of integration of land use planning and water allocation decision making, since water license applications must conform with approved land use plans. As part of the allocation decision making process, the Nunavut Planning Commission must inform the Nunavut Water Board whether water license applications are in accordance with the land use plan applicable in the relevant settlement area. Licenses may not be issued by the Nunavut Water Board unless the proposed water allocations comply with land use plans, which address conservation, development, use of land, water and other resources in settlement areas[b].

In New Brunswick, the Department of Environment is responsible for the *Clean Water Act*, the *Clean Environment Act,* and the *Community Planning Act*. Thus one department is responsible for coordinating land use planning and water allocation. For example, when a subdivision is proposed in a rural area, the developer is required to ensure adequate water availability as part of the permit application process[a].

As these examples demonstrate, integration of water allocation and land use planning can be pursued by coordinating approval processes of different agencies (as in the case of Nunavut) or by integrating different functions under one organization (as in the case of New Brunswick).

3.5. Water Conservation

In general terms, water conservation refers to beneficial reductions in water loss, water waste or water demand[28]. Water conservation can be achieved through increased technical efficiency in the production of goods and services (more output per unit of water), water rationing, and water demand management (e.g., using pricing to influence water use behaviour)[11]. Increases in technical efficiency may also result in increases in economic efficiency (more output per dollar)[15]. However, *water conservation* is a broader notion than water efficiency because the main purpose is not necessarily to achieve the same level of goods and services with smaller amounts of water, but to achieve levels that are consistent with ecological limits[4, 6].

Water conservation in different places is strongly influenced by the particular water allocation system in place. This relationship exists because water allocation decision making and implementation determine not only which demands on water will be satisfied, but also the conditions and requirements (or lack thereof) to be met by such water uses[10]. From a water security perspective, water conservation is enhanced by water allocation systems that encourage allocation efficiency and use efficiency, as well as reductions in water demand[4, 21]. This implies, among other things, allocating water to those uses that are more efficient and less consumptive, and which therefore can increase return flows. Water security is also enhanced by water allocation systems that promote conservation awareness among water users, and support initiatives to reduce water use.

To address this concern, we posed four questions about water conservation and water allocation:

- Is there a charge for water allocated to users, with the goal of promoting conservation?
- Is re-allocation of water to more efficient and less consumptive uses encouraged?
- Are water conservation practices incorporated into water allocation systems?
- Are there other innovative water allocation mechanisms for promoting water conservation?

Is there a charge for water allocated to users, with the goal of promoting conservation?

Water security can be enhanced by water allocation systems that provide appropriate economic incentives to address conservation concerns[6, 26]. Water pricing as a conservation strategy is commonly used by water utilities that supply water to households, industries and businesses. Pricing to promote conservation also can be used in the context of water allocation systems[21]. In this context, water prices may be intended to reflect the value of water as a raw resource, costs associated with water management, and the value of the services embodied in the resource[19]. It is important to acknowledge that the conservation effectiveness of water pricing is influenced by the price elasticity of the particular water use and the type of pricing structure used (e.g., an increasing block pricing scheme), and that evidence of effectiveness is not conclusive[2, 9, 32]. Moreover, an essential yet challenging pre-condition for the implementation of water pricing as a conservation strategy is the ability to monitor actual use of water on a volumetric basis[18, 21].

Pricing water for conservation purposes draws from an economic perspective that assumes individuals, organizations and communities act as rational economic actors who will only conserve water when they have to pay for it[6, 18]. Although this rationale is generally supported by scholars and practitioners within the water community, the concern about the effectiveness of pricing, noted above, is pertinent. Moreover, this is not the only issue associated with pricing schemes. It is also expected that conservation strategies based on water pricing will take into consideration equity and ecological implications[1, 4, 14]. These are numerous, and relate to concerns such as equitable access to water, and the potential impacts on ecosystems associated with the commodification of water.

Administrative fees for processing permit or license applications are common in Canada. However, fees that are not tied to water use, whether charged annually or on a one-time basis, do not promote water conservation. Thus, from a water security perspective, the concern is whether or not pricing mechanisms of some kind are used to promote water conservation.

- New Brunswick and Prince Edward Island have no volumetric pricing mechanisms nor any expressed commitment within policy to do so in the future.
- Four jurisdictions have provisions within policy or legislation to establish water pricing, or are considering water pricing but have yet to link water rates to actual volumes of water use. In Newfoundland and Labrador, water power rentals for water power generation are based on megawatt hour generated. In Quebec, the government currently is revising the legal framework to develop and implement water use charges, which will first apply to industrial users. In Alberta's *Water for Life* strategy, the government expressed its commitment to evaluate the merits of using economic instruments, such as water pricing, to meet key water conservation objectives. The Province of Ontario recently passed legislation to start charging commercial and industrial users for water as a means of recovering a portion of the

costs of provincial water management programs with a secondary benefit of encouraging conservation (Bill 198, *Safeguarding and Sustaining Ontario's Water Act*, 2007).

- Five jurisdictions (Northwest Territories, Yukon, Nunavut, British Columbia, and Nova Scotia) require annual water allocation fees that vary based on the type and amount of water allocated (see Highlight Box 14). Some water conservation may be achieved through these annual allocation fees.
- Two jurisdictions use volumetric pricing to achieve conservation aims. In Saskatchewan, industrial users are charged based on the use of water and type of source. In Manitoba, an increasing block rate structure is used as the basis for volumetric water pricing for industrial users[23].

The actual price charged for water varies widely within jurisdictions that use this mechanism. This is illustrated in the following examples:

- In British Columbia, annual "rental" fees for the right to divert, use and or store water range, according to the sector of water use, from $0.01 to $1.10 per 1,000 m^3. The annual rental for Local Authorities, which are primarily large-scale water suppliers (municipalities, private utilities, and irrigation districts), is based on the amount of water which is reported used.
- The Northwest Territories, Nunavut, and the Yukon have annual water allocation fees that vary based on eight types of use (see Highlight Box 14). For example, agricultural uses are charged the greater of $30 or $0.15 for each 1,000 m^3 authorized by the license. Industrial uses have an increasing block rate structure ranging from $1 per 100 m^3 for the first 2,000 m^3 to $2 per 100 m^3 for quantities greater than 4,000 m^3.
- The Saskatchewan Watershed Authority maintains a schedule of charges for the use of water by industries according to use and source of water that ranges, for example, between $1.57 and $43.07 per 1,000 m^3 for the 2004 to 2007 period.
- In Manitoba, volumetric fees are based on an increasing block rate structure for industries, ranging from $1 per m^3 for the first 100 m^3 per year, to $2 per m^3 (for each m^3 between 20,000-100,000 m^3 per year).

Finally, it is important to emphasize that exemptions exist in all jurisdictions. As noted above, in jurisdictions where volumetric fees are charged, these apply only to certain types of users. Another kind of exemption relates to the source of water. For example, British Columbia requires an annual water rental for certain kinds of uses, but because only surface water is licensed, there is no water allocation fee for groundwater.

Highlight Box 14: Water Pricing Strategies

Water conservation through pricing water can be accomplished by volume-based fees (e.g., Nova Scotia) and/or fees within different sectors (e.g., Northwest Territories and Nunavut). In Nova Scotia, the *Environment Act* (1994-1995: s.15) includes provisions for the use of economic instruments and market-based approaches for the management of the environment[a]. The Fees for Water Licenses under the Activities Designation Regulations (NS Reg. 59/2005) establish fees for water use that increase by volume of water allocated, thereby reflecting water conservation concerns. Importantly, licensees using water for agriculture, conservation or beautification purposes are exempted.

In addition to volume of water allocated, the Northwest Territories and Nunavut have provisions for water use fees under the Northwest Territories Waters Regulations, which also vary according to the type of sector. According to s. 9 of the Regulation "the fee payable by a licensee for the right to the use of water, calculated on an annual basis, is (a) in respect of an agricultural undertaking, the greater of (i) $30, and (ii) $0.15 for each 1 000 m^3 authorized by the licence; (b) in respect of an industrial, mining and milling or miscellaneous undertaking, the greater of $30 and the aggregate of (i) for the first 2 000 m^3 per day that is authorized by the licence, $1 for each 100 m^3 per day, (ii) for any quantity greater than 2 000 m^3 per day but less than or equal to 4 000 m^3 per day that is authorized by the licence, $1.50 for each 100 m^3 per day, and (iii) for any quantity greater than 4 000 m^3 per day that is authorized by the licence, $2 for each 100 m^3 per day; and (c) in respect of a power undertaking, (i) for a Class 0 power undertaking, nil, (ii) for a Class 1 power undertaking, $1,500, (iii) for a Class 2 power undertaking, $4,000, (iv) for a Class 3 power undertaking, $10,000, (v) for a Class 4 power undertaking, $30,000, (vi) for a Class 5 power undertaking, $80,000, and (vii) for a Class 6 power undertaking, $90,000 for the first 100,000 kW of authorized production and $1,000 for each 1000 kW of authorized production in excess of 100,000 kW."

Is re-allocation of water to more efficient and less consumptive uses encouraged?

Water allocation systems that enhance water security may encourage re-allocation of water to more efficient and less consumptive uses of water, in order to reduce demand and increase return flows or recharge to surface and groundwater resources[14, 17]. As mentioned within the economic production criterion, there are many formal and informal institutional arrangements for water re-allocation such as water leases, water markets and water banks[20]. From a water security perspective, the focus is on the extent to which allocation systems incorporate water conservation as one of the purposes of re-allocation. In this context, it may not be enough to encourage transfers of water to those uses with the highest economic or technical efficiency (e.g., drip irrigation versus flood irrigation) if total water consumption is not simultaneously reduced[17]. In other words, from a water security perspective the intent is to bring total water use, particularly in over-allocated systems, to levels that are consistent with ecological limits by ensuring that the saved water is re-allocated to the environment.

In Canada, Alberta is the only jurisdiction that has provisions to encourage the re-allocation of water to less consumptive uses. These provisions include the following measures:

- *Water withheld in water transfers*: The *Water Act* enables the Director to withhold up to 10% of water allocated under a license that is being transferred. The rationale for this withholding of water is found in the need for environmental protection, or the implementation of a water conservation objective (WCO) which represents a less consumptive water use. However, in order to be effective, water holdbacks must pertain to fairly senior licenses[31]. Thus, the effectiveness of this type of strategy will be highly dependent on historical allocation decisions.
- *Water conservation objectives* (WCOs): Provisions for the establishment of Water Conservation Objectives within the *Water Act* can encourage the re-allocation of water to a less consumptive use (see Highlight Box 15).
- *Limits to water diverted in irrigation districts*: The *South Saskatchewan Basin Water Allocation Regulation* fixes the maximum volume of water that may be diverted by an irrigation district. During implementation of the regulation, districts have been allowed to increase the area irrigated as long as the volume of water used does not exceed the regulated amount. This may encourage water efficiency for irrigation within the agricultural sector, although not necessarily re-allocation to other less consumptive uses, or a reduction in total basin water use.

Highlight Box 15: Conservation Through Re-allocation

In Alberta, Water Conservation Objectives (WCOs) are allocations of a certain amount and quality of water to remain in rivers for the protection of a natural water body and its aquatic environment[a]. As such, they are an example of an innovative approach to re-allocating water, in this case, to environmental purposes. Public consultation is carried out during the establishment of a WCO. The Director sets the amount of water in a WCO based on the public review and relevant technical information. Importantly, WCOs are implemented as licensed water uses – but the Act specifies that only the government can apply for and hold a WCO license. A limitation of this conservation strategy is found in the fact that potential tools to implement WCOs, such as license amendments and inclusion of relevant license conditions, do not apply to licenses issued before the *Water Act* came into effect[b].

In 2006, approval of the Water Management Plan for the South Saskatchewan River Basin provided direction on opportunities to increase flows in the highly allocated rivers in the Bow, Oldman and South Saskatchewan River Sub-basins. This was achieved through a set of recommended WCOs, in the form of specific flow targets for the quantity and quality of water to remain in the river. Recommended WCOs for each river drew not only from technical information on instream flow needs (IFNs) and the state of the basin, but also on public comments. In this regard, WCOs do not necessarily aim to fulfill IFNs, but to achieve a compromise among competing water values and demands[b]. Thus, the WCOs recommended for the South Saskatchewan River Basin are more closely related to an environmental protection strategy based on negotiated EWAs, rather than on imposed EWRs (refer to Criterion 1). They are subject to future review and refinement in light of improved knowledge and information about the aquatic environment and water quality.

Are water conservation practices incorporated into water allocation schemes?

Water allocation systems that enhance water security incorporate water conservation practices as part of al-

location schemes. This may include, for example, providing information about and credit for water saving technologies, as well as developing beneficial management practices and auditing systems for different sectors in the economy[21]. Water security is enhanced the most, however, when the adoption of available conservation technologies and practices is part and condition of (re)allocation decision making criteria[10, 22]. The need to link water conservation practices to licenses/permits becomes particularly relevant when it is the same water user who is applying for additional allocations of water. In this case, water security is usually pursued by requiring applicants to provide evidence of appropriate conservation measures for current water use as part of any application for further licenses/permits[3].

Water conservation practices are not consistently incorporated into water allocation schemes throughout Canada. The diverse set of approaches gives jurisdictions multiple means to tailor conservation practices to their own particular contexts. Some jurisdictions rely on the beneficial use principle, some have developed beneficial management practices for specific sectors, some offer incentives to encourage water conservation practices, and some specifically tie conservation practices to permit/license application processes and/or allocation decision making. Examples of each approach are elaborated below.

The principle of beneficial use is meant to ensure the appropriate use of allocated water. In practice, this principle has been implemented in different ways in different jurisdictions. In Manitoba, for example, "specific water conservation measures are not attached to individual licenses as the doctrine of beneficial use implies that water must not be wasted"[24]. In British Columbia, however, beneficial use is not defined within the legislation and is at the discretion of the statutory decision maker. In this context, water conservation practices are generally not incorporated into water allocation schemes unless the license application corresponds to one of British Columbia's designated sensitive streams. In this case, licensees may need to include water conservation measures as part of their water allocation application, as outlined in the *Sensitive Streams Designation and Licensing Regulation* (2000, s.5).

In some jurisdictions, water conservation is addressed through beneficial management practices for specific sectors. In the case of the oil and gas sector, for example, Alberta's new policy related to oilfield injection aims to achieve significant reductions in the total allocation of non-saline water resources for underground injection (see Highlight Box 16). Importantly, reductions in total water allocation for oilfield injection may imply increased water availability for other less consumptive users such as environmental protection. In the case of the agricultural sector in New Brunswick, the Canada-New Brunswick Program for the Implementation of Beneficial Management Practices (BMPs) provides financial support to encourage farm level water conservation[8].

In Quebec, a new provincial strategy for drinking water conservation will require adoption of water conservation measures as a pre-condition for municipalities to access financial assistance for waterworks[16]. The intent of this strategy, currently being developed by the Min-

Highlight Box 16: Adopting Sectoral Beneficial Management Conservation Practices

In Ontario, water conservation practices are incorporated into water allocation schemes by requiring applicants to submit, as part of the Permit to Take Water application, information on the water conservation measures and practices that the applicant has undertaken or will undertake for the duration of the permit[b]. It is important to note that beneficial practices for water conservation are assessed based on the type of industry or economic sector, if these are available. The use of appropriate water conservation practices is considered especially important in high use watersheds.

In 2003, as part of Water for Life, Alberta committed to preparing water conservation and productivity plans for all water using sectors by 2010[a]. A new policy for the oil and gas sector came into effective January 2006, with the aim of achieving significant reductions of non-saline water resources for underground injection through identifying conservation objectives on a case-by-case basis. When granting or renewing a water license, Alberta Environment will include terms and conditions to satisfy, among other things, the intent of the Water Conservation and Allocation Policy for Oilfield Injection. Projects that have demonstrated significant progress in achieving water conservation goals will be recognized by allowing them to apply for license renewal based on a simplified economic and environmental evaluation. In the case of permanent license holders, Alberta Environment will encourage them to identify and undertake water conservation measures to reduce water use because the ultimate goal of the policy is to reduce or eliminate allocation of freshwater for oilfield injection while respecting the rights of current license holders.

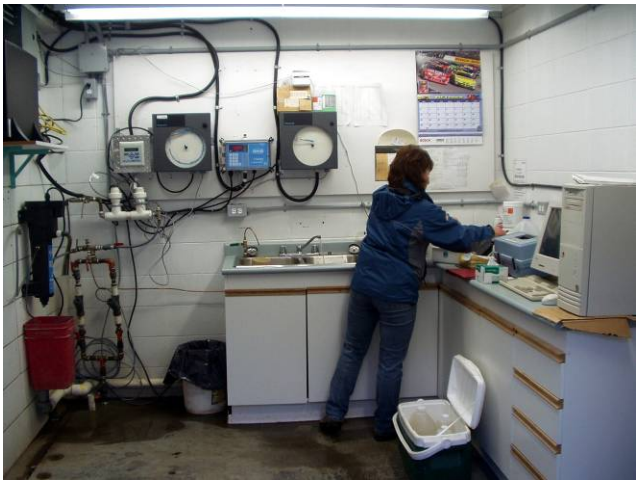
istère des Affaires Municipales et Régionales (MAMR) and the Ministère du Développement Durable, de l'Environnement et des Parcs (MDDEP), is to achieve at least a 20% reduction in average per capita water consumption, and to achieve a 20% reduction in water leakage within 10 years. These conservation measures should lead to sectoral water loss assessments, and thus allow for targeted leakage-detection programs[12].

In Manitoba, the *Ground Water and Water Well Act* states that conservation practices could be incorporated into groundwater allocations through the establishment of groundwater conservation programs, whereby regulations and orders may be made to manage groundwater for such programs. The *Water Protection Act* also allows for regulations to be made to promote water conservation, either through establishing water conservation programs or generally in terms of reducing water use, as well as the establishment of a Water Stewardship Fund to provide support for water conservation programs.

Water security is best enhanced when conservation practices are incorporated into permit/license application processes and/or allocation decision making. This is the case of Nunavut, where license applicants are required to submit, among other things, information regarding the amount of water to be used, the amount and quality of return flows, as well as the measures the applicant proposes to take to mitigate any adverse impact of the use of waters. Similarly, in Ontario, beneficial management water conservation practices are identified as part of the Permit to Take Water application (see Highlight Box 16). In Prince Edward Island, the Agricultural Irrigation Policy[25] encourages the construction of storage ponds adjacent to streams at suitable locations in order to reduce rates of withdrawal, therefore reducing potential impacts on stream flows. Users who build storage ponds are given a higher priority for water withdrawal permits and are the last to have their allocations cut off under low flow conditions, thus encouraging water conservation in agricultural allocations for irrigation. Finally, other jurisdictions such as Saskatchewan have also expressed a commitment to revise water allocation policies to encourage water conservation[27].

Other innovative water allocation mechanisms for promoting water conservation.

Water conservation encompasses a range of concerns related to ecosystem protection that include, but go well beyond, increasing the technical and economic efficiency of different water uses[3, 6]. Water conservation, therefore, represents a few among the multiple set of individual and societal values that are at the heart of



water allocation systems[13, 30]. In this context, institutional innovations, such as water conservation awareness programs that foster new ways of thinking about water demand, supply and consumption, are an important component of allocation schemes that advance water security[7, 22, 29].

Across Canada, jurisdictions are implementing other innovative institutional arrangements for water allocation that promote water conservation, such as water reuse, recycle and auditing. These innovations emphasize the important role that municipalities can play in the sustainable use of water resources.

Examples of water conservation awareness initiatives include the following:

- In Alberta, water conservation has been proposed as one of the cornerstones of the Water for Life strategy. One of the short-term actions to implement this strategy is to establish a public education and awareness program on water conservation.
- In Ontario, water conservation awareness at the watershed level is a key component of the Ontario Low Water Response Program. However, membership on Low Water Response Teams is restricted to major water users and water managers in each watershed, and teams are active only under low water conditions. As a result, the focus on water conservation awareness of this program may be too narrow.
- In Nova Scotia, those seeking approvals as of 2007 have been asked to prepare water conservation plans. These are seen as an educational tool, supported by resources that are available to assist in the preparation of such plans.

Examples of water recycling and reuse initiatives are found in British Columbia and Saskatchewan:

- In British Columbia, one of the water conservation accomplishments under the Freshwater Strategy has been the enactment of the *Municipal Sewage Regula-*

tion. This regulation authorizes the "re-use of highly treated wastewater for a broad range of purposes"[5].

- In Saskatchewan, efficient use of water by the industrial sector will be encouraged through the regulation of the use of water produced as a by-product of industrial processes, among other things[27].

Examples of local initiatives tied to water allocation exist in Ontario and British Columbia:

- The PTTW program in Ontario has used conditions attached to permits to encourage water conservation through municipal bylaws (see Highlight Box 17). Additionally, under Ontario's Low Water Response Plan, actions to be taken by water response teams under Level 1 and Level 2 of low water conditions include enforcement of municipal water restrictions bylaws. In Level 3, encompassing the most severe low water conditions, local municipalities may pass bylaws restricting water use.
- The South East Kelowna Irrigation District's metering and pricing program is another example of an initiative by a local water management organization that contributes to water conservation (see Highlight Box 17).

Finally, Saskatchewan provides an example of a water auditing initiative. Under Saskatchewan's Water Conservation Plan, water auditing will be required as a condition of provincially-issued environmental operating permits and water use permits to ensure that the industrial sector uses water allocations efficiently.

Summary

Water conservation in water allocation is pursued through a wide range of mechanisms across Canada. A few jurisdictions use volumetric pricing to achieve conservation aims at the provincial scale. Most of these jurisdictions have charges associated with allocations that promote some level of conservation. However, it should be emphasized that charges associated with actual use, as in the case of industrial users in Manitoba and Saskatchewan, better promote water conservation. In Alberta, water conservation has also been encouraged in over-allocated streams by re-allocating water to less consumptive water uses (e.g., WCOs). Some jurisdictions are developing beneficial practices for water conservation tailored to the needs and characteristics of specific sectors in the economy, while other jurisdictions require water users to adopt conservation strategies in order to access financial assistance or as part of applications to water licenses/permits.

Other innovative approaches to water conservation across Canada include water conservation awareness initiatives, as well as water recycling and reuse pro-

Highlight Box 17: Local Water Conservation Initiatives

Faced with future water supply shortages, the City of Guelph in southern Ontario sought a new Permit to Take Water for additional groundwater extraction. The Ontario Ministry of Environment indicated that no new permits would be granted unless the City implemented measures to use its current water allocation more efficiently[b]. Thus, the City instituted an Outdoor Water Use Program (OWUP) in 2002[c]. The OWUP includes three levels of water use to deal with residential outside use and a fourth for commercial water use. The City determines these levels based on weather conditions, storage reservoir levels, and the status of the provincial Ontario Low Water Response. Restrictions on outdoor water use vary depending on the level, with the most restrictions at Level 2 (Red), where no lawn watering is permitted. Guelph received 30 percent less precipitation than normal between the months of July-October, 2002, and, as a result, Level 2 (Red) was instituted. Average daily demand between July-October was 25 percent lower than the historic peak day demand. As a result of the program, the City has been able to defer construction of infrastructure that would otherwise have been needed to meet summer demands. A recent study surveying Guelph residents revealed broad support and satisfaction with the Outside Water Use Program[a].

In British Columbia, the South East Kelowna Irrigation District (SEKID), a public water utility, responded to a series of droughts combined with expanded irrigation in its service area by implementing a metering program in 1994 to educate irrigators about their water use. Metering was followed in 2002 by a pricing program: irrigators were charged a flat rate for a basic water allotment and a volumetric rate for water use beyond that allotment. In 2003, the program changed to an inclining block rate to discouraging "excessive" water use, with charges for exceeding the basic allotment. As a measure of the program's success, the number of users who uses more than 130% of their basic allotment was reduced to zero in 2004, from an average of 5 percent in the previous three years[g]. In 2004, water use under above-average demand conditions was 27.4% below the 29 year average[f]. The District's program created water savings through a combination of metering, pricing, irrigation scheduling, conversion to more efficient irrigation systems, increased awareness of water conservation, and improved management (e.g., spilling less water at the intakes)[e].

grams. In this context, the municipal level is playing an increasing role in water conservation through the use of municipal planning processes and bylaws. In some jurisdictions, these strategies are highly influenced by requirements regarding water conservation and efficiency that municipalities face when requesting additional water allocations given current trends in population growth and economic development.

3.6. Climate Variability and Change

Water allocation decision making and implementation take place in an environment of scientific uncertainty and institutional complexity. The lack of relevant knowledge for environmental water allocations, and changing allocation criteria that can reflect shifts in societal values, also are important concerns[8]. These sources of uncertainty are likely to increase in the future under the influence of climate change[10, 12, 14]. Across Canada, analyses of plausible climate change scenarios suggest increased variability and intensity in patterns of precipitation, as well as significant changes to streamflows, lake levels, and groundwater recharge and discharge[3, 5]. In this context, there is a need for water allocation strategies that can reduce the vulnerability of ecosystems and human societies to the observed and potential impacts of climate variability and change[11, 12].

From a water security perspective, adaptation to climate variability and change is enhanced by water allocation systems that expand the knowledge base regarding the impact of climate change on allocation schemes, both for domestic and transboundary water resources[3, 9, 21]. More importantly, water security is best enhanced by flexible water allocation systems that can translate climate change knowledge into relevant adaptation strategies[14, 16, 19]. Adaptation strategies to reduce vulnerability to climate variability and change may take the form of institutional, technological or behavioural changes[6, 17, 20]. Success in translating climate change knowledge into adaptive strategies, however, can be highly dependent on the existence of participatory governance processes and structures that can properly address the equity implications of adaptation to climate variability and change[1, 18, 23].

To address these concerns, we posed two questions about the extent to which water allocation systems recognize climate variability and change:

- Are investments being made to understand the impacts of climate variability and change on water allocation systems?

- Are adaptation strategies being developed and applied to address climate variability and change within water allocation systems?

Are investments being made to understand the impacts of climate variability and change on water allocation systems?

Water allocation systems that enhance water security in the context of climate change recognize the need to develop a relevant knowledge base[9, 11]. This knowledge base includes not only the potential impacts of climate change on water resources, but also the potential impacts of these changes on allocation schemes[3, 16]. For example, changes in climatic variability on runoff and groundwater levels may affect compliance with already controversial and uncertain water allocations to sustain ecosystem services[10]. At the same time, while relationships between streamflows and diversion rights may remain constant in some water allocation systems (e.g., prior appropriation), the same cannot be said of return flows that are likely to be reduced due to evaporation losses under warmer conditions[5, 14]. Expanding the knowledge base about the vulnerabilities of water allocation schemes to the potential impacts of climate variability and change is particularly important because of the limited predictive capability of available hydrological models at the watershed scale[9, 21].

In Canada, concerns regarding the potential impacts of climate variability and change on water resources have been translated into investments to expand the knowledge base. The federal government has been a leader in this regard through a series of studies and programs including the Canada Country Study, the Climate Change Action Fund and its successor the Climate Change Impacts and Adaptation Program. Much activity has also occurred at the provincial scale. The Water for Life Strategy in Alberta, for example, has been advanced as one of the key actions for climate change

adaptation in that province. One of the main long-term goals of this strategy is to provide Albertans with the necessary knowledge and tools to implement actions that will maintain or improve water resources[2]. This is also the case in Quebec, where the government plans to invest in the consolidation and modernization of climatic and hydrometric networks that can provide relevant information in order to understand and assess impacts of climate variability on water resources[13].

In some provinces, efforts to understand the potential impacts of climate change have gone beyond broad water resources management concerns to focus on impacts on water supply and water allocation schemes. The Manitoba Climate Change Fund, for example, has funded a multidisciplinary study that used mathematical models to determine possible effects of climate change on water supplies in the Assiniboine Delta Aquifer[24]. In British Columbia, investment through BC's Climate Change Plan supports research, such as the comprehensive regional assessment that has been conducted to assess possible impacts of climate change on water allocation and options for adaptation in the Okanagan Basin[4]. Importantly, this study included not only the development of model and scenarios, but also the discussion of such scenarios among basin stakeholders (see Highlight Box 18).

Investments to expand the climate change knowledge base across Canada have also occurred through federal-provincial-university collaborative efforts. In New Brunswick, for example, the Department of the Environment and Local Government has been collaborating with the Université de Moncton and DFO under the Climate Change Action Fund to evaluate potential impacts of climate change on water availability, and the implications of reduced flows on irrigation and water supplies[7]. In Quebec, a research consortium on regional climatology and adaptation to climate change has been created as a joint initiative of the provincial government, Hydro-Quebec and the Meteorological Service of Canada[15]. In Ontario, a communications science network to explore vulnerabilities and potential adaptations to climate change has been established under the national Canadian Climate Change Impacts and Adaptation Research Network (C-CIARN). Projects funded under this initiative include not only biophysical studies of potential impacts of climate change on water quantity and quality, but also institutional arrangements and capacity for adaptation.

In the last few years, federal-provincial partnerships have increasingly recognized the importance of biophysical boundaries for increasing our understanding of potential impacts of climate change on water supply and allocation. This is reflected by a series of initiatives across the country that are conceptualized and implemented in major bioregions:

- The *Water Use and Supply Project* is a federal-provincial assessment of water supply and use in the Great Lakes Basin. The ultimate goal is to improve understanding of the diversity of water resource conditions across the Great Lakes Basin, and the

Highlight Box 18: Comprehensive Regional Assessment of Climate Change

In 2005, a comprehensive regional assessment of the possible impacts of climate change on water resources and options for adaptation in the Okanagan Basin was conducted as part of a collaborative, interdisciplinary effort involving researchers from Environment Canada, Agriculture and Agri-Food Canada, the University of British Columbia, the British Columbia Ministry of Water, Land and Air Protection, and the District of Summerland[b]. The Okanagan Basin is an important region in which to explore the links between climate change and water allocation, due to its semi-arid climate, increasing population pressures, the perpetual nature of water licenses, and a high local dependence on irrigation for agriculture.

From a water security perspective, this comprehensive regional assessment represents an innovative approach for adaptation to climate variability and change. The study greatly expanded the knowledge base by developing locally-relevant scenarios for climate change, basin hydrology and water supply and demand. Importantly, the study provided an opportunity to translate this new relevant climate change knowledge into adaptation strategies through the exploration of adaptation strategies in the context of the different scenarios, including water licensing, flow regulation and development restrictions. Additionally, the comprehensive regional assessment of the Okanagan Valley represents a water security innovation because the exploration of adaptation strategies was conducted by a broad range of basin stakeholders, rather than just a research team[a]. Stakeholder dialogue sessions focused on the implications of climate change scenarios on water licensing, preferred adaptation options and processes for their implementation. The ultimate goal was not to seek consensus on the "best" process or option, but rather to develop an adaptation portfolio that could address both the supply and demand aspects of water management in the Okanagan region under climate change.

sensitivity to potential climate change and variability.

- The *Prairie Adaptation Research Collaborative* (PARC) is a partnership of the governments of Canada, Alberta, Saskatchewan and Manitoba mandated to pursue climate change impacts and adaptation research in the Prairie Provinces. PARC also hosts C-CIARN Prairies, part of the national Canadian Climate Impacts and Adaptation Network.

Are adaptation strategies being developed and applied to address climate variability and change within water allocation systems?

Water allocation systems that enhance water security by addressing climate variability and change recognize the importance of translating relevant knowledge into adaptive strategies. Adaptation options are numerous, and include institutional measures through municipal water rates (e.g., promoting water conservation), technological adjustments (e.g., switching to low-water-using sprinklers in agricultural production), and behavioural changes (e.g., water sharing agreements during shortages)[6]. Fortunately, many options for adapting to climate change may be found among existing water management practices that address current climatic variability[5, 19, 21]. In this context, water security is best advanced when existing and future adaptation options and practices are incorporated into water allocation schemes as part of an explicit strategy for adapting to climate variability and change. This implies not only linking adaptation strategies to evolving climate change knowledge, but also the communication and negotiation of such strategies with relevant stakeholders to properly address the equity implications of adaptation to climate variability and change[1, 23]. Stakeholder communication and negotiation of adaptive strategies is particularly relevant at the local level, because such strategies may affect existing (and emerging) social relationships and networks among different water users[9, 11, 20].

In Canada, options for adapting to climate change can be found in existing water allocation policies and regulations. The provision for temporary reductions in water allocations is a potential adaptation strategy advanced by British Columbia's *Fish Protection Act,* Ontario's *Permit to Take Water Manual*, and Prince Edward Island's *Agricultural Irrigation Policy*. Temporary reductions aim at reducing the impact of low flow conditions on fish populations and fish habitat, potentially reducing ecosystem vulnerability to climate change. Prince Edward Island's strategy not only has provisions for allocations to be reduced in accordance to low flow conditions, but also has a pre-determined order of priority among users for such reduction. Finally, Newfoundland and Labrador's *Water Resources Act* provides as a potential option for adaptation to climate variability and change the re-allocation of water. In this case, it is also ecosystem protection that could provide a rationale for the Minister to establish water re-allocations.

From a water security perspective, however, the focus is on provincial efforts that explore existing and potential allocation practices as part of an explicit adaptive strategy. Examples of some of these kinds of efforts include the following:

Some jurisdictions provide opportunities for community/stakeholder exploration of issues around water resources and adaptation to climate variability and change.

- In Manitoba, a community consultation workshop was held by Climate Change Connection in order to provide recommendations for the Climate Change Action Plan for Manitoba. Climate Change Connection aims to build awareness and to empower Manitobans to take action on climate change.
- In 2003, the Department of the Environment and Local Government of New Brunswick organized a meeting of water resources managers, environmental specialists and climate change experts to discuss adaptation to climate change. Several allocation adaptation strategies were identified and recommended as a result of this meeting.

Opportunities for community/stakeholder negotiation of allocation options for adaptation to climate variability and change are provided in some jurisdictions. For example, in British Columbia, a comprehensive regional assessment of the potential impacts of climate change on water resources and options for adaptation in the Okanagan Basin has recently been completed[4]. As part of the study, stakeholder dialogue sessions were held in order to discuss and "negotiate" preferred adap-

tation options for water licensing under different climate change scenarios (see Highlight Box 18).

Finally, some jurisdictions enable the implementation of negotiated allocation strategies for adaptation to climate change. For example, in Alberta, the 2001 Southern Alberta Water Sharing Group was formed to manage allocated water as effectively and fairly as possible under abnormally warm and dry weather conditions. Rather than strictly enforcing existing allocations based on the "First in Time, First in Right" regulations, a shared strategy was negotiated and agreed upon by stakeholders, including irrigation districts, farmers, livestock operations, recreational facilities, towns, villages, industries, local and provincial governments[20].

Summary

In Canada, efforts to increase understanding of potential impacts of climate variability and change on water resources have mostly been implemented through federal-provincial-university partnerships. A few of these collaborative efforts have focused not only on potential impacts on water resources at a general level, but also on water supply and water allocation schemes under climate change scenarios on regional and provincial scales. Several jurisdictions are going beyond increasing understanding of links between water resources and climate variability and change to assessing options for adaptive management strategies. For this purpose, the climate change dialogue is generally expanded to incorporate the perspectives of communities and stakeholders. In the Canadian context, these participatory processes are being used not only as part of exploratory assessments of adaptation options, but also as part of the multi-stakeholder negotiations for water sharing agreements under low water conditions.

3.7. Transboundary Sensitivity

Water is a "fugitive" resource, meaning that it flows from place-to-place, and changes its physical state according to gradients in pressure and elevation. In this context, "transboundary" can refer to transitions from wet to arid zones, and from upstream to downstream[30]. Transboundary also can refer to cases where water flows from one administrative jurisdiction to another. A water security perspective is particularly concerned with those transboundary issues that arise when water flows across political boundaries. In this context, water security challenges involve agreeing on a decision making process for the fair allocation of transboundary

waters, including the relevant decision making parties, procedures and criteria to balance tradeoffs, as well as agreeing on underlying allocation principles and values[1, 2]. Thus, transboundary water allocation systems can be a potential source of conflict between competing water uses and users, or a potential forum for cooperation in the sharing and protection of the benefits provided by transboundary aquifers, lakes and streams[28, 36].

Another concern relates to the fact that transboundary issues have different implications for conflict and/or cooperation in water allocation according to the geographic scale[1, 35]. Enabling meaningful public participation in water allocation, for example, can be challenging when those who will be affected by allocation decisions reside in the same basin but in different municipalities, provinces or states. Public participation in the allocation of water resources that are located in more than one sovereign country can be complicated by matters of national security[7, 12]. Finally, challenges to public participation are also posed by the co-existence of provincial/national legislation that proclaim state ownership or control of water, and traditional indigenous water sharing agreements[9, 38].

To address these concerns, we posed three questions about how boundaries are recognized in water allocation:

- Is there coordination of water allocation systems across political boundaries in Canada?
- Is state sovereignty over water reflected in water allocation systems/schemes?
- Are water allocation systems cognizant and respectful of indigenous customary allocation boundaries and traditions?

Is there coordination of water allocation systems/schemes across political boundaries within Canada?

Water allocation systems can enhance water security by addressing the need for coordination of allocation schemes across political boundaries, such as those dividing municipalities, provinces, and countries. This implies the establishment of appropriate institutional mechanisms for dialogue and conflict resolution among affected parties from the public, private and civil society sectors and, if appropriate, the linking of mechanisms across politically-relevant geographic scales[1, 2, 13].

Another important area for coordination in water allocation of transboundary resources is monitoring and information sharing, which can facilitate a more transparent verification and consequent enforcement of transboundary allocations[7]. Finally, water allocation systems can best advance water security when allocation schemes for transboundary water resources have the flexibility to respond to changes in ecological conditions and in regional values and contexts[2, 12, 34].

In Canada, different allocation systems have been developed to allocate water within each territory and each province, reflecting different contexts, histories, and legal traditions[11, 20, 26]. However, because water is not constrained by provincial and territorial boundaries, special allocation agreements between neighbouring provinces and territories have also been developed. The following are selected examples.

- The *Master Agreement on Apportionment*, signed in 1969 by Alberta, Saskatchewan and Manitoba, and the Government of Canada, contains a simple formula based on the principle of equal sharing of available water among the Prairie Provinces. Alberta and Saskatchewan are entitled to one half of the natural flow of water originating within their boundaries, and one half of the flow entering their provinces. The remainder is left to flow into Manitoba. As a result of the Master Agreement on Apportionment, all three provinces receive approximately equal shares of the total water flow even in drought periods[21].
- The *Mackenzie River Basin Transboundary Waters Master Agreement* enables neighbouring jurisdictions to negotiate bilateral water agreements, including water allocation (see Highlight Box 19).

An important water security dimension of these types of agreements is their flexibility to respond to changes in ecological conditions and regional values. The Master Agreement on Apportionment's primary historical function is to apportion river flows among the three

Highlight Box 19: Coordination Within Canada's North

The Mackenzie River Basin Transboundary Waters Master Agreement (MRBTWMA) (1997) is an example of a framework for coordination of water allocation systems across multiple political boundaries. The agreement enables neighbouring jurisdictions to negotiate bilateral water management agreements to address water issues at jurisdictional boundaries on transboundary streams and to provide parameters on the quality, quantity and flow of water. The agreement was jointly signed by the governments of Canada, B.C., Alberta, Saskatchewan, Yukon and the Northwest Territories. The agreement is founded on cooperative management guiding principles: equitable utilization, prior consultation, sustainable development and maintenance of ecological integrity. Importantly, it commits the six governments to carry out their responsibilities within the Mackenzie River Basin according to the five principles[d].

The Yukon-Northwest Territories Transboundary Water Management Agreement, the first of seven bilateral agreements under the MRBTWMA, was signed in 2002[c]. This agreement provides for the protection of the ecological integrity of the aquatic ecosystem of the basin for future generations. Specific water quality objectives, and interim water quantity objectives, are set out. In addition, each jurisdiction is required to provide early notification of, and consultation opportunities for, activities that may affect the aquatic ecosystem of the other jurisdiction. The authority to negotiate water management agreements with other jurisdictions that share drainage basins with the Yukon, and to consult with affected Yukon First Nations where there is crossover with Yukon First Nations' Traditional Territories, is provided for in the Umbrella Final Agreement[b].

The MRBTWMA represents an innovation in water security because it directly addresses transboundary coordination issues by establishing institutional mechanisms for dialogue and conflict resolution, and enabling provisions for monitoring and information sharing. Unfortunately, although the agreement was signed in 1997, bilateral negotiations for most of the remaining six bilateral agreements are barely underway[e]. Moreover, there are no timelines for the negotiation of such agreements, and even after signed, parties can choose to withdraw from them[a].

provinces in order to maximize their consumptive uses, and does not contain any overriding obligation to maintain instream flow needs[39, 40]. The Prairie Provinces Water Board completed a report in 1998 on IFN methods and practices in the region[29]. A workshop conducted in 2006 explored insights and gaps emerging from the report; however, next steps for IFNs in the region were not clarified[39]. The Mackenzie River Transboundary Waters Master Agreement, conversely, has provisions to protect the ecological integrity of aquatic ecosystems, reflecting current societal values[5]. However, the agreement provides the Mackenzie River Basin Board very limited powers to fulfill these environmental values[40]. The Board published in 2003 a report that included a discussion of issues surrounding IFNs, but no recommendations or strategies were provided[39].

Mechanisms for coordination across multiple political jurisdictions are not restricted to provincial and territorial agreements. In Newfoundland and Labrador, for example, the *Water Resources Act* requires the Minister to inform affected municipalities of all applications for water use licenses in the province. In Manitoba, the *Shoal Lake Watershed Management Plan* is another mechanism for coordinating water issues among multiple jurisdictions. This plan was drafted by the Shoal Lake Watershed Working Group, which includes representatives from the Federal Government, Ontario, Manitoba, and the City of Winnipeg, among others. At present time, not all participating jurisdictions have endorsed the plan, which is still under review[21].

Is state sovereignty over water reflected in water allocation systems?

Allocation of international waters, and subsequent implementation of water allocation decisions, has important social, economic and ecological implications for countries sharing water resources. Water allocation systems can best advance water security when national sovereignty is reflected in water allocation schemes. This includes an allocation decision making process that is built upon principles of transparency and power-sharing, in order to enable equity to be incorporated as a critical aspect of the resulting allocation schemes[1, 28]. This is not straightforward. How the concept of equity when sharing international waters is to be conceptualized and implemented is under debate; numerous models are proposed, including ones based on votes according to total population, or on water needs[2, 22]. Sovereignty in water allocation is reflected not only by allocation schemes that are the result of transparent and equitable processes of negotiations among riparian countries, but also by the existence of multilateral mechanisms with enough authority to oversee and enforce them[7, 12].

International waters, in the Canadian context, comprise the many rivers that flow along or across the Canada-US border (e.g., Columbia River, Milk River, Red River, St. Lawrence River), as well as the numerous lakes, wetlands and aquifers divided by this political boundary. Neither Canada nor the USA can be considered to be a purely "upstream" nation, and this fact may have influenced the commitment to cooperation that characterizes their water relations[35]. The *Boundary Waters Treaty* of 1909 is the main institutional arrangement that advances water security for international waters shared by Canada and the United States, as reflected by the following[20]:

- The treaty determines how specific allocation issues are to be addressed (e.g., sharing the flow of the St. Mary/Milk rivers).
- It establishes several basic principles to prevent unilateral actions by either country that would affect the levels and flows of boundary waters.
- It establishes a body for addressing future boundary water issues, the International Joint Commission (IJC).

The IJC is composed of six Commissioners, three representing each country under appointment by the respective federal governments. This arrangement reflects the egalitarian spirit under which the treaty was drafted, and provides Canada with relatively equal power *vis a vis* the United States despite population differences between the two countries[11, 35]. However, a critical limitation of the role of the IJC in enabling water security through water allocation is its lack of formal powers to address problems relating to groundwater[23].

Issues surrounding Canada's sovereignty over water resources are best understood within the context of

evolving federal-provincial relationships and spheres of jurisdiction. In the Canadian federation, both federal and provincial governments have power to legislate with respect to water[32]. However, the provinces are perceived as the "natural" managers of water resources due to their ownership of Crown lands and natural resources[11, 39]. This can be seen in a series of institutional arrangements that pertain to allocation of international boundary waters and have one of more provinces among the involved parties:

- The 2001 *Great Lakes Charter Annex* is an agreement that coordinates the actions of two Canadian provinces (Ontario and Québec) and eight American states to manage diversions and consumptive uses of the shared waters of the Great Lakes Basin, including a commitment to develop a common standard for new water withdrawal proposals in the basin[19]. The non-binding *Great Lakes Basin Sustainable Water Resources Agreement* was signed in 2005 to carry out these commitments.
- The *St. Croix International Waterway Commission Act* provides for the creation of a Commission that is to guide natural resource management in the St. Croix Basin, which is shared between New Brunswick and the State of Maine. Although water allocation is not mentioned specifically within the Act, it is the Commission's duty to prepare a plan for the management of the natural, historical, cultural, and recreational resources of the waterway.

Provincial jurisdiction over water allocation is also reflected by provisions within legislation of all provinces (except New Brunswick) that prohibit direct bulk transfers of water outside their jurisdictional boundaries (see Table A3 in the Appendix). They emerged as part of a strategy advanced by the federal government to prevent bulk water removals using the protection of the integrity of drainage basins as the main rationale[31]. The three territories have adopted policies prohibiting bulk water removal from major river basins (see Table A3 in the Appendix). These provisions co-exist with those advanced by the Federal Government, such as the 2001 legislation enacted to amend the *International Boundary Waters Treaty Act* and prohibit the bulk removal of water out of the Canadian portion of boundary water basins[20]. In addition, the two 2005 Great Lakes Charter Annex agreements prohibit large scale diversions and transfers out of the Great Lakes basin. These kinds of initiatives reflect a broader concern in Canada for inter-basin transfers[31].

The tension emerging from the division of powers in Canadian federalism, and consequent federal/ provincial jurisdiction over water resources, is particularly evident in the case of Quebec. The Quebec government is currently working on asserting its jurisdiction and power over water at the national and international levels, and on strengthening its role and participation in international agreements with international agencies whose decisions can affect its territory[10, 14].

Canada's sovereignty over water resources is also influenced by multilateral arrangements, such as NAFTA and the proposed Security and Prosperity Partnerships (SPP, also known as NAFTA Plus). Whether or not NAFTA applies to water in the context of bulk exports is still debated; thus, this issue will not be decided until a dispute arises under NAFTA that decisively proves which interpretation might be applied[4]. Also of concern to some are negotiations relating the Security and Prosperity Partnerships, and their implications for water. The fear is that the SPP could undermine Canada's authority to protect Canadian water resources and environmental and social standards[17].

Are water allocation systems cognizant and respectful of indigenous customary allocation boundaries and traditions?

Water allocation systems are generally based on a particular set of formal and informal institutional arrangements that determine how water resources are to be shared among competing uses and users[1]. From a water security perspective, it is expected and desired that allocation schemes will not arbitrarily interfere with indigenous customary or traditional arrangements for water allocation[18, 33]. This is particularly relevant in countries such as Canada, in which indigenous peoples with distinctive cultures and social systems were present for millennia before European settlement[3, 27]. In this context, water security is best advanced by water allocation systems that are cognizant and respectful of indigenous customary allocation boundaries and traditions. This includes, for example, flexibility in allocation schemes to allow for institutional arrangements that take into account different cultures in areas such as

stakeholder involvement and public participation, communication and awareness, and conflict resolution[1, 8, 18, 38].

Addressing the existence and scope of indigenous water rights is an extremely complex matter[9, 15, 27]. Nonetheless, these challenges must be addressed in order for water allocation systems to enhance water security. Failure to recognize the existence and resilience of indigenous customary allocation systems, and to take them into consideration in statutory legislation, is likely to remain an important source of conflict[6, 24].

Understanding of the existence and scope of indigenous water rights in Canada is closely related to the particular perspective chosen to interpret the historical relationship between Aboriginal communities, including First Nations, Métis and Inuit, and the British Crown. A position held by many indigenous peoples and others across Canada is that indigenous rights are inherent, and should be determined in the context of indigenous self-determination and indigenous sovereignty[19, 37]. This is not the position advanced by Canadian courts and governments, which recognize the assertion of British sovereignty over indigenous peoples ("Indians") as legitimate, and from this basis are attempting to reconcile Aboriginal and treaty rights with statutory legislation and practices[15, 25]. It is important to note that indigenous customary laws are part of the oral tradition and, as such, unwritten; this adds to the misconceptions and challenges associated to their application as part of the current legal system[25, 37].

Canadian law regarding Aboriginal people (as distinct from indigenous law based on indigenous sovereignty) [19], has been shifting since existing Aboriginal rights were entrenched in the Constitution in 1982. This evolution is largely influenced by a number of significant court cases in the last decade, as well as ongoing negotiations and settlement of comprehensive land claims and self-government agreements (i.e., modern day treaties)[8, 25]. A background paper prepared by the Government of Canada in 2003 suggested that there are 80 comprehensive claims and/or self-government negotiations in progress involving over 200 First Nation and Inuit communities[15]. In this context, the following sources of Aboriginal rights to water have been identified[25]:

- As a constitutionally protected Aboriginal right to use water and other resources on unceded land.
- As included in the property interest recognized in Aboriginal title to unceded tribal territory.
- As a reasonably incidental right to an existing treaty right to the resources.
- As a reserve based right founded on the Winters doctrine established by the US Supreme Court in 1908.
- As a common law right, such as a riparian right.
- As a statutory right under applicable provincial legislation.

Potential and existing tensions between the different sources of Aboriginal rights to water and provincial/territorial institutional arrangements for water allocation are recognized and addressed in the water allocation legislation of some Canadian jurisdictions:

- The Northwest Territories' *Water Resources Agreement Act* states in section six that "Nothing in this Act shall be interpreted so as to affect or diminish Aboriginal rights."
- In Nunavut, the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* was formulated to be respectful of Aboriginal customary allocation boundaries and traditions.
- In Newfoundland, the *Water Resources Act* is to be applied in conjunction with the *Labrador Inuit Land Claims Agreement*, which includes provisions for Inuit water rights, allocation and management (see Highlight Box 20).

Co-management is another institutional mechanism used to incorporate Aboriginal and treaty rights within statutory legislation and practices. In this sense, Canadian comprehensive regional agreements with Aboriginal peoples are much more that a land tenure settlement because they are meant to provide a policy framework for ongoing cooperation in resource development and environmental management[8]. This is the case of the Yukon Water Board, and the five Boards in the Northwest Territories, which have representatives from both Aboriginal and territorial governments. In Nunavut, the Water Board is part of a larger management regime constituted under the *Nunavut Land Claims Agreement*, including the Nunavut Planning Commission

(NPC). The main function of the NPC is to develop land use plans, policies and objectives that guide resource use and development (including water) throughout Nunavut[16]. Members of the NPC are nominated by Inuit organizations and the governments of Canada and Nunavut.

Co-management agreements outside the modern day treaties settled in Canada's northern territories, however, do not operate under similar parameters for equality in power sharing[8, 24, 25]. Many land claim agreements usually require the recognition of government jurisdiction over water by the affected indigenous group in exchange for a guaranteed allocation of water and some form of co-management of watercourses[37]:

- The *Nisga'a Final Agreement Act* resulted from negotiations among the federal government, the government of British Columbia, and the Nisga'a Nation. Under Nisga's Treaty one percent of the annual average flow is allocated from the Nass Valley watershed for their domestic, industrial and agricultural needs[27].
- In Quebec, the 2002 *Agreement Concerning a New Relationship Between the Government of Québec and the Crees of Québec* provides for a nation-to-nation relationship between Quebec and the Cree Nations in Quebec, and ensures that forestry operations protect fish habitats, drinking water sources and riparian corridors, among other things,. This agreement was meant to ensure the implementation of section 28 of the James Bay and Northern Quebec Agreement signed in 1975, which promised Cree participation in the economic development of the Territory

Notwithstanding the importance of governments' "duty to consult" whenever Aboriginal or treaty rights may be affected (see Equity and Participation criterion), water security also is promoted via meaningful involvement of Aboriginal communities in other water-allocation related arenas. This is the case of provincial public participation forums, communication and awareness efforts, and conflict resolution strategies, which generally have not involved Aboriginal communities living on reserves[24]. In this regard, progress is being made in some Canadian jurisdictions, as reflected by the following examples:

- The provincial-scale *Alberta Water Council* is one of the cornerstones for the implementation of the Water for Life Strategy. It includes representatives from First Nations and from the Métis Settlement area.
- *Manitoba's Water Strategy* is part of a public participation process for sustainable water management in the province. This process proactively seeks engagement of Aboriginal and northern residents.
- The 1999 Freshwater Strategy for British Columbia established a multi-party Water Use Planning Program for water use planning that includes the involvement of First Nations.
- Implementation of the *Québec Water Policy* includes measures to promote and ensure the participation of Aboriginal nations and communities in water management. Currently, two Aboriginal communities are represented in watershed organizations[14].

Highlight Box 20: Inuit Water Rights, Allocation, and Management

The Labrador Inuit Land Claims Agreement (LILCA, 2005) includes provisions for Inuit water rights, allocation, and management (among other considerations)[a]. Newfoundland's *Water Resources Act* (2002) states that it is to be applied in conjunction with the Labrador Inuit Land Claims Agreement, and in matters of Inuit water rights or where conflicts exist between the two Acts, the LILCA has precedence over the *Water Resources Act*. Also, under the *Water Resources Act*, the Minister has the right to require permit holders to comply with certain conditions in order to ensure compliance with the LILCA.

The Nunatisiavut Government has authority to reject or approve water use proposals with or without conditions (LILCA, s.5.4.4). Approved proposals are then submitted to the Minister who will determine whether to grant a Water Use Permit. The Minister may only reject an approved proposal/application if it will cause adverse effects outside the Labrador Inuit Lands for which compensation of a third party whose rights are detrimentally affected is not possible or would not be adequate. Compensation awarded to Inuit must take into account, among other considerations, the cultural attachment of Inuit to their lands and water that would be adversely affected by changes in the quantity, quality or rate of flow of water; and the anticipated adverse effects of changes in quantity, quality or rate of flow of water on pre-existing Inuit water use or land (LILCA,s.5.6). Water Use Permits in the Labrador Inuit Settlement Area must conform to the Land Use Plan (LILCA, s. 5.2.10).

These provisions for Inuit water rights are innovative because they represent a more inclusive, respectful allocation system that enables decision-makers to take into account cultures differences.

Summary

In Canada, special water allocation agreements have long been implemented between neighbouring provinces and territories in order to share the benefits provided by transboundary water resources. The Government of Canada, which has jurisdiction over interprovincial transboundary waters, is also a signatory of these allocation agreements. The ability of historical and more current agreements to incorporate evolving societal values, such as ecosystem protection through IFNs, is limited.

In the case of water resources shared between Canada and the United States, allocation issues are addressed within the International Joint Commission (IJC) established by the Boundary Waters Treaty of 1909. Unfortunately, the IJC, which has three representatives from each country, does not have formal powers to address groundwater issues [17]. Concurrent federal/provincial jurisdiction over international water resources is reflected in a series of institutional arrangements for water management that involve one or more Canadian provinces among the signatory parties; the Great Lakes Annex is an example. Concurrent jurisdiction is also reflected by the series of provisions within federal/provincial/territorial institutional arrangements that prohibit direct bulk water transfers outside jurisdictional boundaries. Multilateral agreements such as NAFTA and the proposed Security and Prosperity Partnerships also have implications for Canadian sovereignty over water.

Potential and existing tensions between federal/provincial/territorial water allocation arrangements and the different sources of Aboriginal water rights are gradually being addressed in Canada. This is reflected by the emergence of negotiated allocation agreements, settled land claims, and nation-to-nation resource management relations. Another important innovation regarding Aboriginal water issues, which traditionally are under federal jurisdiction, is the emergence of opportunities for Aboriginal participation in provincial water management planning processes as key stakeholders.

4. Discussion and Conclusions

Water security is a function of access to adequate quantities of water, of acceptable quality, for human and environmental uses. In this study, the concept of water security was framed in terms of seven interrelated concerns that are pertinent to water allocation:

- *Ecosystem protection*
- *Economic production*
- *Equity and participation*
- *Integration*
- *Water conservation*
- *Climate variability and change*
- *Transboundary sensitivity*

Other perspectives on water security certainly exist. However, the seven water security concerns emphasized in this study are critical for three reasons: (1) they permit a multi-dimensional and comprehensive evaluation; (2) they address the *immediacy* of water security concerns for Canadians; and (3) the individual concerns – and the interplay among them – are relevant in every jurisdiction.

While the water security challenges that exist in Canada are not currently as severe as those in places such as Australia (Box 1), there is no reason for Canadians to be complacent, or to wait for a similar crisis situation to occur. Numerous threats to water security in Canada have been documented by government agencies[4, 5, 7] and by non-government organizations and academics[1, 2]. For instance, during the past decade severe droughts have been experienced on the Prairies, stress on aquatic ecosystems is evident in many watersheds, and growth and development is putting pressure on water resources in many parts of the country. Climate change is likely to magnify current threats to water security in Canada because of the ways in which it will transform the hydrologic cycle during the next century.

Concerns such as these highlight the fact that water security is a critical determinant of human wellbeing and environmental quality, and, at the same time, that water allocation is a critical determinant of water security. As is illustrated in the following examples, decisions we make about how water is allocated affect not only the quantity of water that will be available for human and environmental uses, but also its quality:

- Failing to involve stakeholders equitably can produce conflicts, as can failing to link water allocation effectively with decision making around land use and economic development.
- A lack of transparency in decision making processes can create uncertainty, and can lead to poor investment decisions on the part of water users.
- Environmental degradation can result from a failure to provide adequate environmental flows, or to protect groundwater recharge.

The multi-dimensional framework used in the study permitted an evaluation of the ways in which water allocation systems contribute to water security. As such, it allows for a better understanding of the implications of water allocation decisions, and the types of tradeoffs involved in water allocation decision making.

In this study, water allocation systems in all Canadian provinces and territories were characterized, and the extent to which, and how, Canadian water allocation systems addressed critical water security concerns was explored. Factors that facilitate and constrain water security were revealed, and analysis of Canadian water allocation systems identified numerous ways in which water security in Canada can be enhanced. The study relied on analysis of existing institutional arrangements, rather than an evaluation of actual practices on the ground. Nonetheless, the exploratory but wide-ranging evaluation presented in Chapter 3 demonstrates that water security in Canada is strongly dependent on decisions that are made in the context of water allocation.

This chapter summarizes major findings from the study, and then outlines the rationale for a national dialogue on water allocation and water security.

4.1. Summary of Findings

In the first phase of the study, water allocation systems were characterized according to a set of common attributes (see Box 2 for attributes and *Technical Report 1* for detailed findings). The appendix to this report provides a brief summary of these findings, emphasizing the following topics:

- Legal authority and policy commitments related to water allocation
- Water ownership, basis for water allocation, and priorities and duration of allocation
- Prohibition of bulk water exports
- Water fees, monitoring of water use, and enforcement
- Transferability of allocations
- Mechanisms for participation in water allocation

Data collected during the first phase of the study provided a database for completing the second phase: an evaluation of the extent to which, and how, Canadian water allocation systems contribute to water security. For each of the seven water security concerns around which the study was organized, specific indicator questions were posed. These questions point towards ways in which water security can be increased or decreased through water allocation decision making. For example, in the context of concern for ecosystem protection, water allocation systems *contribute* to water security when they establish environmental water allocations that protect ecosystem functions; include monitoring and enforcement systems to ensure that environmental water allocations are being implemented; and facilitate adaptive management through establishing mechanisms for incorporating new ecological knowledge into water allocation decision making. Conversely, water security can be *reduced* if water allocation decision making fails to establish, monitor and enforce environmental water allocations, and if decisions are based on outdated knowledge.

Chapter 3 synthesized findings from the second phase of the study. Table 1, below, summarizes key findings for each water security concern and related indicator question; *Technical Report 2* presents additional supporting details for each jurisdiction. Table 1 highlights the fact that considerable variability exists across Canada in the extent to which water allocation systems addressed the water security concerns emphasized in this study. No province or territory addressed all the concerns. This is not surprising in light of the tensions and interrelationships among the various concerns, and the context-dependent nature of water security. However, as illustrated by the highlight boxes presented in Chapter 3, each of the concerns was addressed in at least one province or territory. This confirms that the water security concerns identified in this study are pertinent and *can* be addressed where it has been determined they are relevant.

The previous paragraph paints an optimistic picture of Canada's water security. Unfortunately, this optimism must be tempered due to another key overall finding from the research: *many of the innovations and enhancements to water allocation systems described in Chapter 3 are actually incidental to water allocation*. In numerous cases, the arrangements and mechanisms that were identified as strengthening water allocation relative to the seven water security concerns were neither prompted by water allocation concerns, nor designed explicitly with water allocation in mind. This is shown in the following examples:

- Opportunities for public involvement, mechanisms for conflict resolution and requirements for public disclosure of water allocation decisions commonly were instituted through broader requirements. This can be illustrated by the example of Ontario's *Environmental Bill of Rights*, which provides information about environmental proposals and decisions made by the Ontario government, including most kinds of permit applications.
- Water conservation initiatives often have been motivated by concerns relating to infrastructure, rather than by concern for more effective water allocation. For instance, in Quebec, access to financial assistance for improvements to municipal drinking water systems is tied to the adoption of leakage reduction and water conservation measures.
- Governance relating to water has been transformed during the past decade. The relationship between Aboriginal communities and the provincial and federal governments has been transformed by the *R. v. Sparrow, 1990* decision, which established a new duty to consult. In a different context, decentralization is occurring through a host of mechanisms that shift responsibility for key water planning and management functions to local actors at the watershed scale; important examples were highlighted in Manitoba and Quebec. Water allocation systems are affected by these changes to governance, even though concern for water allocation was not a driver.
- A significant investment has been made in research and networking to increase understanding of climate change mitigation and adaptation. The federal government, in particular, has played a leadership role since the 1990s in funding and establishing research networks. Water resources have been an important consideration in this work, but water allocation has been incidental.
- Integration of water management and land use planning is being driven in several jurisdictions by concerns for source water protection. Ontario's *Clean Water Act* is a notable example, but others were discussed in Chapter 3.

These examples are not meant to suggest that specific concern for water allocation does not exist, or that no steps have been taken to improve water allocation directly; clearly, as illustrated in Chapter 3, this is not the case. Nonetheless, a key finding of this report is that to a significant degree, enhancements to water security in Canada through improvements to water allocation have occurred incidentally. Thus, there is a real danger that in the absence of more specific attention to water allocation, needed improvements may not occur unless they also happen to be needed in other contexts.

Table 1: Summary of Findings by Water Security Criterion

Water Security Concern	Indicator Questions	Summary of Findings for Provincial and Territorial Water Allocation Systems
1. Ecosystem Protection	Are there environmental water allocations?	• EWAs (e.g., aquatic reserves, IFNs, and/or groundwater extraction limits) are used in eight jurisdictions. Other mechanisms include assessing environmental impacts prior to approving water licenses/permits, and prioritizing ecosystem protection within watershed/aquifer plans. • The critical evaluation and refinement of available IFNs methods in the Canadian context is still in its infancy.
	Is ecosystem protection monitored and enforced?	• Most jurisdictions focus monitoring activities on hydrology and climatology. Only a few jurisdictions have started to gather and assess ecological information to link current and future allocation schemes to desired ecological outcomes. • Enforcement for ecosystem protection through proactive mechanisms is very limited across Canada.
	Are there mechanisms for the creation and incorporation of ecological knowledge into water allocation systems?	• Although several jurisdictions are working to expand the ecological knowledge base, funding for scientific knowledge is substantial in contrast to traditional ecological knowledge. • Seven jurisdictions have mechanisms in place to incorporate some ecological knowledge into water allocation systems.
2. Economic Production	Are allocation rules stable and clearly defined?	• In most jurisdictions allocation rules are clearly defined, but only six jurisdictions have provisions within legislation to provide for financial compensation if allocations are reduced. • Lack of systematic monitoring of actual water use and proactive enforcement of permits/licenses makes allocation systems in Canada less stable from an economic production viewpoint.
	Is sufficient allocation-related information available to make economically sound decisions?	• The lack of access of water users to real-time monitoring data on water supply and actual water use is a critical gap across Canadian jurisdictions, especially regarding groundwater.
	Can water be re-allocated?	• Institutional arrangements for water re-allocation are underdeveloped across Canada. Only Alberta is implementing water re-allocation as a strategy to provide both economic efficiency and flexibility, but only within fully allocated basins.
3. Equity and Participation	Are equity concerns built into water allocations?	• No Canadian jurisdiction has enacted legislation to recognize the human right to water, although water for domestic purposes is exempted from permitting or licensing requirements • Some jurisdictions have mechanisms in place to ensure transparency of allocation decisions. However, there is a general lack of participatory mechanisms to enable the general public to fully engage in the negotiation of allocation trade-offs.
	Are there mechanisms to facilitate sustained and meaningful stakeholder and public participation?	• Multi-stakeholder watershed committees are increasingly relevant for water management purposes across Canada, but not necessarily for water allocation decision making. • Aboriginal consultation emerging from case law is an evolving mechanism of increasing importance in water allocation.
	Are there mechanisms to address potential conflicts at different scales?	• Several jurisdictions have developed mechanism to address conflict at different scales (e.g., watershed governance, public consultation, appeals processes, Aboriginal consultation). • Historical allocation decisions, such as inter-basin transfers and diversions, may constrain current allocation processes and associated strategies for conflict resolution across Canada.

Water Security Concern	Indicator Questions	Summary of Findings for Provincial and Territorial Water Allocation Systems
4. Integration	Is integration between groundwater and surface water resources considered in water allocation systems?	• Integration of groundwater and surface water considerations in allocation decision making occurs in several jurisdictions, although in varying degrees. • The knowledge gap in terms of groundwater resources and use is a significant challenge for integration across Canada.
	Is integration between water quality and water quantity considered in water allocation systems?	• Most jurisdictions take into consideration water quality and quantity concerns as part of broader planning processes. • Only a few jurisdictions integrate water quality and quantity concerns into the water allocation decision making process.
	Is there integration between land use planning and water allocation?	• Integration of land use planning and water allocation decision making is currently being pursued in three jurisdictions. • Integration is advanced in other jurisdictions through various mechanisms, usually in the context of source water protection.
5. Water Conservation	Is there a charge for water allocated to users, with the goal of promoting conservation?	• Only a few jurisdictions use volumetric pricing to achieve conservation aims at the provincial scale. Most have allocation-related charges that promote a limited level of conservation.
	Is re-allocation of water to more efficient and less consumptive uses encouraged?	• Only Alberta has provisions for the re-allocation of water to less consumptive uses in highly allocated water systems.
	Are water conservation practices incorporated into water allocation systems?	• Conservation practices are not consistently incorporated across Canada. Examples include the beneficial use principle, sectoral best management practices, economic incentives, and linking conservation practices to allocation decision making.
	Are there other innovative water allocation mechanisms for promoting water conservation?	• Innovations are focusing particularly at the municipal level, and include water conservation awareness initiatives, water recycling and reuse programs, municipal planning and bylaws, and water auditing programs.
6. Climate Variability and Change	Are investments being made to understand the impacts of climate variability and change on water allocation systems?	• Most investments to increase our understanding of climate change impacts have been implemented through federal-provincial-university partnerships. Only a few of these efforts have focused on water supply and allocation schemes under climate change scenarios on regional and provincial scales.
	Are adaptation strategies being developed and applied to address climate variability and change within water allocation systems?	• Options for adaptation to climate change can be found in current allocation systems across Canada. • Only a few jurisdictions are currently exploring and/or negotiating adaptation strategies within water allocation systems (e.g., water sharing agreements during low conditions, stakeholder dialogue on adaptation options for water licensing).
7. Transboundary Sensitivity	Is there coordination of water allocation systems across political boundaries in Canada?	• Coordination of transboundary water resources occurs in Canada through special allocation agreements between selected neighbouring provinces and territories. Their ability to address evolving societal values (e.g., IFNs) is limited.
	Is state sovereignty over water reflected in water allocation systems?	• The *Boundary Waters Treaty* provides for cooperative relations regarding international waters shared by Canada and the US. • Canadian sovereignty over water is bounded by the provincial role in water allocation, as well as by multilateral agreements.
	Are water allocation systems cognizant and respectful of Aboriginal customary allocation boundaries and traditions?	• Tensions between statutory water allocation systems and Aboriginal water rights are gradually being reconciled from the perspective of Crown sovereignty over indigenous peoples. • Still, many Aboriginal people and others believe water to be an inherent right emerging from indigenous sovereignty.

This is not a desirable state of affairs because water allocation is *fundamental* to water security, and deserves ongoing public and political attention. To illustrate, the following are examples of the kinds of concerns that may not be addressed incidentally through changes made in other realms:

- Water allocation is a key determinant of the sustainability of ecosystems and the services they provide. It may not be possible to provide adequate protection for ecosystems if this relationship is not recognized and explicitly addressed. For example, efforts to protect ecosystems through land-use planning, soil and water conservation programs, and water quality management initiatives can be undermined – or nullified – if water allocation systems ignore environmental water requirements. Conversely, carefully designed environmental water allocations can be undermined by a failure to recognize the impacts of decision making in other contexts, such as suburban development, waste water treatment, or aggregate development.
- Effective water allocation requires certain kinds of data that may not be collected in other contexts. To illustrate, links between particular surface and groundwater regimes and specific ecological outcomes may not be adequately revealed when the only available data were collected for state-of-the-environment reports. Similarly, water budgets developed for one purpose, such as drinking water source protection, may not support effective water allocation decision making in the context of climate change unless data needed for modeling impacts of climate change on hydrology are collected. These include data that permit consideration of long-term climatic trends and calibration of models against observed data; watershed-specific data on climatological variables important to climate change, including at a minimum seasonal data on temperature, precipitation, evaporation; and data necessary to predict changes in hydrologic variables likely to be affected by climate change, such as the impacts of snowmelt volumes on streamflow.
- The previous two examples focus on technical concerns. However, as demonstrated throughout this report, governance issues are critical for water security. For example, the role of Aboriginal communities in water allocation has become much more significant. Land claims in northern Canada have clarified some issues relating to Aboriginal water rights, as in the case of the Labrador Inuit Land Claims Agreement. However, lessons learned in northern Canada about Aboriginal water governance may not be applicable to the rest of the country. At the same time, across Canada, the role of Aboriginal communities in environmental governance has become much more complex due to the duty to consult established by the Sparrow decision. Provincial water allocation systems view Aboriginal people as "stakeholders", alongside other water users, whereas court decisions such as Sparrow are not consistent with this perspective. This kind of uncertainty creates the potential for conflict across Canada – especially in settled parts of southern Canada where it may be impossible to successfully negotiate comprehensive agreements relating to outstanding land claims comparable to those in northern Canada.

Clear answers to issues like these are not self-evident – yet they must be addressed. While it is apparent that many people have roles to play, and that leadership is essential, what those roles should be, and who should lead in specific contexts, is not clear. There are many reasons why this situation exists. In Chapter 1, it was argued that a prevailing "myth of abundance" has contributed to historical neglect of water resources in Canada. How water allocation is generally perceived at the present time, in other words, as a relatively perfunctory administrative provincial or territorial function, is another pertinent consideration. An important first step to elevating the importance of water allocation, and to strengthening the link to Canadian water security, is a national dialogue that addresses the fundamental challenges raised here. Such a dialogue would also facilitate policy learning within and between jurisdictions.

4.2. A Call for a Canadian Water Security Dialogue

The water security challenges discussed in Chapter 3 exist, to varying degrees, in all provinces and territories in Canada. If the challenges are common, are the solutions common too? Do opportunities exist to learn from the experiences of other jurisdictions? That lessons can be learned from across Canada is supported by the twenty highlight boxes presented in Chapter 3. These describe ways of dealing with common challenges based on experiences from every province and territory in Canada. Examples of these challenges included identifying watersheds where ecosystem protection concerns were most severe; building traditional ecological knowledge into water allocation decision making processes; coordinating water allocation across jurisdictional boundaries; enhancing

the ability to adapt to climate change through water allocation systems; using economic instruments to promote water conservation; integrating land use planning and water allocation; and increasing the role of citizens in water allocation decision making. It should also be emphasized that in creating the highlight boxes presented in this report it was necessary to select from among a much larger set of innovative approaches identified during the study (see *Technical Background Report 2*).

Unfortunately, learning lessons from other jurisdictions must be approached with caution. Each province and territory in Canada faces distinct water security challenges as a function of its own historical, political, socioeconomic, and hydrological circumstances. This basic fact makes pursuing one-size-fits-all solutions to the water security challenges faced in Canada unrealistic and unhelpful. Rather than seeking one-size-fits-all solutions, we argue that a much more productive approach is to identify lessons that have the most relevance, governance models and approaches that are most adaptable to other circumstances, and tools and techniques that are most generally applicable.

A national dialogue on water allocation and water security, we argue, can facilitate lesson learning that is needed. Such a dialogue is urgent because of the immediacy of water security challenges that Canada faces. The timing for a national dialogue is opportune. Water increasingly is on the minds of Canadians, in large part because of crises such as Walkerton and North Battleford, controversies relating to water export, and growing concern over climate change. Building on the work completed for this study, a national dialogue on water allocation and water security in Canada could address the following kinds of issues:

- Is water security a national concern that demands national leadership, or is it a regional concern that is best handled by individual provinces and territories, or even by local organizations?
- How can water allocation be elevated from a relatively insular, administrative function, to a fundamental component of water security?
- Which administrative and technical approaches to water allocation enhance water security, and can be adopted by most jurisdictions?
- In the context of Canadian water allocation, what are the critical attributes of governance that influence water security?

Throughout this study, a number of administrative and technical approaches were identified that are broadly accepted across Canada as being best practices for water allocation. For example, integrating water allocation decision making with land use planning is a widely-accepted (if not widely implemented) best practice. This kind of integration can avoid situations where one agency authorizes a development that depends on water, while another agency refuses to issue the needed water license – a situation that occurred recently in Alberta[8]. Similarly, volume-based administrative fees associated with licenses and permits that support the administration of water allocation systems, including monitoring and enforcement, are an important tool that could be implemented relatively easily in all jurisdictions. Hydrologic models developed for use in one jurisdiction potentially can be adapted for use in others, while some kinds of standards may be almost universal (e.g., water use standards for plumbing fixtures).

There is no question that enhancing water security requires addressing a host of *technical* and *administrative* challenges, such as developing better methodologies for determining environmental flows; improving mechanisms for data collection and monitoring; refining tools for modelling surface water and groundwater interactions; and improving technical standards, technologies and practices relating to water use in agricultural, industrial and urban settings. Improvements in these areas are necessary for greater water security, but alone they are not sufficient. Attention also must be directed to the critical *governance* challenges that were identified throughout this study. These include the following:

- At what scale should water allocation decision making take place? Is the local (e.g., watershed) scale most appropriate, or should decisions be made at the provincial/territorial scale?
- What is the appropriate role of the federal government in Canadian water allocation?
- What is the appropriate role of citizens, industries, and non-government organizations in water allocation decision making relative to governments?
- How can Aboriginal customary water rights be addressed in provincial and territorial water allocation systems?
- What is the appropriate balance between regulatory and non-regulatory approaches in water allocation?

Examples of responses to these kinds of governance challenges were identified during this study – suggesting that opportunities for policy learning exist. However, *governance* models generally are not transferable in the same way that hydrological models are – primarily because governance strongly reflects biophysi-

cal, institutional, political, economic and even cultural circumstances in particular places. For instance, Alberta currently is the only jurisdiction in Canada that permits the buying and selling of water rights. Water markets are not without controversy[6]. However, if they facilitate re-allocation of water from inefficient uses to efficient uses, or if they create the flexibility to meet new demands (such as environmental flows) in fully allocated watersheds, then water markets may contribute to water security. The *idea* of water markets certainly is transferable, but the specific mechanisms developed in Alberta directly reflect hydrological circumstances (fully allocated rivers in the southern tributaries), the importance of irrigation as a water user in southern watersheds, political commitment to the prior appropriation system, and the longevity of many existing licenses. Hence, the transferability of Alberta's system to other jurisdictions that have decided that water markets are desirable is not assured.

This example demonstrates that direct transfer of innovative governance models is not necessarily feasible (or even desirable). However, through analyzing local circumstances and needs, it may be possible for one jurisdiction to adapt and refine aspects of innovative governance models that work well in other jurisdictions. While standard methodologies do not exist for evaluating the transferability of governance arrangements, the following questions offer a starting point:

- Is the governance arrangement being considered for adoption compatible with other institutional arrangements? Does political support exist for the arrangement being considered? Is it compatible with prevailing legal and political doctrines and values in the home jurisdiction? Is it compatible with economic circumstances?
- Does public support exist for the approach being considered? Does it depend on a level of public involvement that exists in the home jurisdiction? Is it compatible with the social objectives people in the home jurisdiction have for water? What are the socio-economic costs and benefits of implementing the governance arrangement being considered?
- Is the arrangement compatible with local scientific and administrative capabilities? For example, do agencies and organizations that will be responsible for administrating new arrangements have the necessary staff, knowledge, and resources? Do needed scientific data (e.g., on river flows, ecosystem components) exist and, if not, can they be collected?
- Finally, how well does the new arrangement match local biophysical circumstances? Was it designed to work in a similar hydrological and climatological regime? Does it require certain water management infrastructure, and do these exist in the jurisdiction where the governance arrangement is being considered?

These are the kinds of questions that should guide policy learning, and which will shape the extent to which a particular governance arrangement can be used in jurisdictions outside of the ones that created them. A national dialogue on water allocation and water security offers a platform for people in each jurisdiction to consider these kinds of questions relative to their own water security concerns, and, at the same time, to share their experiences with people in other jurisdictions.

4.3. Conclusions

For most of Canada's history, water allocation has been a primarily administrative function, dominated by technical specialists, and focused on technical and legal concerns. Cases that become politically controversial, such as Sun Belt Water Inc.'s plan to export water by tanker from Tzela Creek in British Columbia to southern California[3], stand out because they are relatively rare. Nowadays, however, the significance of water allocation decision making for environmental quality, economic prosperity and human health and wellbeing is becoming much more widely appreciated. At the same time, there is an expectation that people who are affected by decisions being made should participate in the processes for making those decisions. In other words, water allocation is now being seen by many people as an important avenue for governance.

Attempting to enhance water security through developing new governance models for water allocation can be extremely challenging because changes to the rules may threaten established water users. Some Canadian jurisdictions have made significant changes to their legal frameworks for water allocation (e.g., Alberta's adoption of water trading and Saskatchewan's abandonment of the first-in-time, first-in-right system). However, no Canadian jurisdiction has broken with the past in the way that countries such as South Africa and Australia have while reforming their water allocation systems[1]. The cautious approach to institutional change in Canadian water allocation has tended not to threaten existing water rights holders, and therefore has minimized (or deferred) conflict. However, in areas where water is scarce, the tension

between respecting long-established water rights and meeting new demands such as environmental flows has not necessarily been resolved by changes to the water allocation systems that have been instituted.

Will current water allocation systems permit all Canadians to overcome current water security challenges, let alone the kind that may be expected in the future as populations grow, demand for water increases and the climate changes? We cannot rely on incidental changes to water allocation systems that result from adjustments in other areas to address the kinds of fundamental challenges to water security identified in this study. A broad, inclusive national dialogue about water allocation and water security would enhance the profile of water allocation as a governance challenge. At the same time, such a dialogue could provide an opportunity for stakeholders to critically evaluate the extent to which their own water allocation systems address current and emerging water security challenges.

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Chapter 3: Water Allocation and Water Security in Canada

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6. Appendix: Summary of Water Allocation Systems

The tables in this appendix provide a brief summary of provincial and territorial water allocation systems. Readers interested in more details should consult *Technical Report 1: Characterization of Water Allocation Systems in Canada*.

Table A1: Summary of Legal Authority and Policy Commitments Related to Water Allocation by Jurisdiction

Jurisdiction	Agency Primarily Responsible for Water Allocation	Basis of Authority		
		Act	**Regulation**	**Other**
AB	Alberta Environment	*Water Act* (R.S.A. 2000, c. W-3)	Water (Ministerial) Regulation (205/1998), Oldman River Basin Water Allocation Order (319/2003), South Saskatchewan Basin Water Allocation Regulation (307/1991), Water (Offences and Penalties) Regulation (AR 193/1998)	Water for Life – Alberta's Strategy for Sustainability (2003)
BC	Ministry of Environment-Water Stewardship Division	*Drinking Water Protection Act* (S.B.C. 2001, c.9), *Environmental Assessment Act* (S.B.C. 2002, c.43), *Fish Protection Act*, S.B.C. 1997, c.21), *Water Act* (R.S.B.C. 1996, c. 483), *Water Protection Act* (R.S.B.C 1996, c.484)	Groundwater Protection Regulation (B.C. Reg. 299/2004), Sensitive Streams Designation and Licensing Regulation (B.C. Reg. 89/00), Water Regulation (B.C. Reg. 204/88),	Waterpower Policy (2005), Water Programs – Policy and Procedures Manual (1996), A Freshwater Strategy for British Columbia (1999)
MB	Manitoba Water Stewardship	The *Water Protection Act* (S.M. 2005, c. 26), The *Water Resources Conservation Act* (S.M. 2000, c. 11), The *Water Rights Act* (R.S.M. 1988, c. W80)	Water Rights Regulation (Man. Reg. 126/87)	Manitoba's Water Policies (1990), Manitoba Water Strategy (2003)
NB	Department of Environment	*Clean Water Act* (S.N.B. 1989, c.C-6.1)	Watercourse and Wetland Alteration Regulation (N.B. R. 90-80), Water Classification Regulation (N.B. Reg. 2002-13), Environmental Impact Assessment Regulation (N.B. Reg. 87-83).	Watershed Protected Area Designation Order (2001)
NL	Department of Environment and Conservation: Water Resources Management Division	*Water Resources Act* (S.N.L. 2002, c. W-4.01), *Environmental Protection Act* (S.N.L. 2002, c.E-14.2), Labrador Inuit Land Claims Agreement (2005)	Water Power Rental Regulations (2003, N.L.R. 64/03)	N/A
NT	Gwich'in Land and Water Board, Mackenzie Valley Land and Water Board, Northwest Territories Water Board, Sahtu Land and Water Board, Wek'eezhii Land and Water Board	*Mackenzie Valley Resource Management Act* (S.C. 1998, c.*25), Northwest Territories Waters Act* (S.C. 1992, c.39)	Northwest Territories Waters Regulations (SOR 93-303)	N/A

Jurisdiction	Agency Primarily Responsible for Water Allocation	Basis of Authority		
		Act	**Regulation**	**Other**
NS	Department of Environment and Labour	*Environment Act* (S.N.S. 1994-95, c.1), *Water Resources Protection Act* (S.N.S. 2000, c10)	Activities Designation Regulations (N.S. Reg. 47/95, last amendment. N.S. Reg. 52/2005- N.S. Reg. 72/2005), Fees for Water Withdrawal Approval (N.S. Reg. 57/2005), Fees for Water Withdrawal Annual Approval Administration (N.S. Reg. 58/2005), Fees for Water Licenses (N.S. Reg. 59/2005), Approvals Procedure Regulations (N.S. Reg. 48-95)	Drinking Water Strategy for Nova Scotia (2002), Guide to Surface Water Withdrawal Approvals (2004), Guide to Groundwater Withdrawal Approvals (2004)
NU	Nunavut Water Board	*Nunavut Waters and Nunavut Surface Rights Tribunal Act* (S.C. 2002, c.10)	Northwest Territories Waters Regulations (SOR/93-303), Nunavut Water Board Order (SOR/2002-253)	N/A
ON	Ontario Ministry of the Environment	*Ontario Water Resources Act* (R.S.O. 1990, c.O.40)	Water Taking and Transfer Regulation (O. Reg. 387/04)	Permit to Take Water Manual (2005), Ontario Low Water Response (2003)
PE	Department of Environment, Energy and Forestry: Water Management Division	*Environmental Protection Act* (R.S.P.E.I. 1988, c. E-9)	Water Well Regulations (P.E.I. Reg. EC188/90)	Agricultural Irrigation Policy (1995), Sustainable Resource Policy (2002)
QC	Ministère du Développement durable, de l'Environnement et des Parcs	*Environment Quality Act* (R.S.Q. c. Q-2, 2005), Protection Policy for Lakeshores, Riverbanks, Littoral Zones and Floodplains (R.S.Q. 2005, c. Q-2, r.17.2), *Water Resources Preservation Act* (R.S.Q., c. P-18.1, 2001), *Watercourses Act* (R.S.Q. c. R-13, 2003)	Groundwater Catchment Regulation (R.R.Q. 2002, c. Q-2, r.1.3), Regulation Respecting the Water Property in the Domain of the State (R.R.Q. 2003, c. R-13, r.1.1), Regulation Respecting the Application of the Environment Quality Act (R.R.Q. 2003, c. Q-2, r.1.001)	Québec Water Policy: Water Our Life, Our Future (2002)
SK	Saskatchewan Watershed Authority	*Saskatchewan Watershed Authority Act* (S.S. 2005, c. S-35.03), *Water Appeal Board Act* (S.S. 1983-84, c. W-4.01)	Ground Water Regulations (Sask. Reg. 172/66)	Saskatchewan's Wetland Policy (1995), Sask Water's Water Export Policy (1999), Water Management Framework (1999)
YT	Yukon Water Board	*Waters Act* (S.Y. 2003, c.19), *Yukon Environmental and Socio-economic Assessment Act* (S.O. 2003, c. 7.)	Waters Regulation (O.I.C. 2003/58)	N/A

Table A2: Summary of Water Ownership and Water Allocation Basis, Priorities and Duration by Jurisdiction

Jurisdiction	Water ownership vested in Crown	Basis of allocation	Priorities for water use		Duration of Allocations
			Doctrine	Priority of Use	
AB	Yes	Licenses for both surface and groundwater, based on use (household, licensable, and traditional agricultural use) and amount. Household riparian users no license required. Traditional agricultural users register, but do not require a license.	prior allocation	First in time first in right (FITFIR). Water sharing agreements in some tributaries during low water levels.	10 or 25 years (depending on use).
BC	Yes	Licenses for surface water withdrawals, not for groundwater withdrawals (though latter is permitted by the Act). Approvals (permits) for shorter term uses (<1 year).	prior allocation	FITFIR	Water licenses have no expiry dates.
MB	Yes	Licenses for groundwater and surface water, based on use and volume.	prior allocation	Modified FITFIR, Priority: 1.domestic, 2.municipal, 3.agricultural, 4.industrial, 5.irrigation, 6.other	20 years
NB	Yes	Permits required for water withdrawal from watercourse or groundwater source based on classification of water, amount/rate, and use.	No explicit doctrine	No specific priorities provided within legislation.	Conditions may be imposed. Emergency permits no more than 90 days.
NL	Yes	Licenses for surface, ground and shore water, based on the availability of water, existing uses, potential water use conflicts, potential pollution or impairment of water quality, and downstream impacts among other considerations.	regulated riparian rights	a) domestic b) municipal c) commercial and industrial d) water power e) recreation f) other purposes	Max 50 years, depending on source and use. Typically licenses for 5-10 yrs.
NT	Yes	Type of license (A or B) for both surface and groundwater, based on amount and type of water use.	prior allocation	First in Time	Max. 25 year terms.

Jurisdiction	Water ownership vested in Crown	Basis of allocation	Priorities for water use		Duration of Allocations
			Doctrine	Priority of Use	
NS	Yes	Water withdrawal approvals for surface and groundwater, based on water volume and type of water use.	regulated riparian rights	1-sustainability, 2-minimise conflicts, 3, 1st come 1st serve (priority to drinking water, priority to existing over new applications), 4-based on current not future need	10 years
NU	Yes	License for both surface and groundwater, based on category of water use.	prior allocation, Aboriginal Rights	First in time. Inuit use priority over licensed use or mineral right.	25 years
ON	No	Permits for taking both surface and groundwater based on potential impact on natural ecosystem function, water availability, use of water, and other issues deemed relevant.	regulated riparian rights	Highest priority: domestic, farm, fire. Next priority: municipal, Last priority: industrial, commercial, irrigation	10 years
PE	No	Watercourse alteration permits required for withdrawing surface water and groundwater extraction permits required for withdrawing groundwater, based on volume, quality, and use.	regulated riparian rights	No prioritization scheme in legislation. In practice, priorities given to (in order): Domestic, commercial, irrigation. Watershed priority lists. No priority scheme for groundwater.	Allotted by amount
QC	Yes	Certificates of authorization are required for surface and groundwater withdrawals, based on amount and use.	Civil code "common to all"	No water priorities, but plan is to establish priorities to reflect heritage value.	No limits specified
SK	Yes	License for both surface and groundwater, based on available water volumes and uses (including instream needs).	No explicit doctrine	No established system of priority uses.	5-20 years
YT	Yes	Type of license (A or B) for both surface and groundwater, based on amount and type of water use.	prior allocation	First in time	Max 25 year terms

Table A3: Prohibition of Bulk Water Exports by Jurisdiction

Jurisdiction	Institutional Arrangement	Threshold	Note
AB	*Water Act* (2000)	———	Watershed approach (7 major river basins defined). Removal restrictions do not apply to processed or municipal waters.
BC	*Water Protection Act* (1996)	20 litres	
MB	*Water Resources Conservation Act* (2005)	25 litres	
NB	Accord for the Prohibition of Bulk Water from Drainage Basins (1999)	———-	No outright ban, but approval required on a case-by case basis (Water Quality Regulation – *Clean Environment Act*, Regulation 82-126, s. 3(5)).
NL	*Water Resources Act* (2002)	30 litres	
NT	A Policy Respecting the Prohibition of Bulk Water Removal from Major River Basins in the Northwest Territories (2003)	40 litres	Watershed approach. Potential environmental impacts of removal of freshwater as "bottled water" are addressed through the environmental assessment process.
NS	*Water Resources Protection Act* (2000)	25 litres	Prohibition applies to both groundwater and surface water, including ice.
NU	A Policy Respecting the Prohibition of Bulk Water Removal from Major River Basins in Nunavut (2003)	40 litres	Watershed approach. Potential environmental impacts of removal of freshwater as "bottled water" are addressed through the environmental assessment process.
ON	*Water Taking and Transfer Regulation* (2004) *Ontario Water Resources Act* (1990)	20 litres	Watershed approach. (3 major watersheds defined).
PE	*Environmental Protection Act* (1988)	25 litres	Prohibition applies to both groundwater and surface water.
QC	*Water Resources Preservation Act* (2001)	20 litres	
SK	*Saskatchewan Watershed Authority Act* (2005)	———-	Does not apply to water "packaged in containers that have a capacity that is less than the maximum prescribed capacity" (s.56).
YT	Accord for the Prohibition of Bulk Water from Drainage Basins (1999), Adopted NT and NU 2003 policies	———-	

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Table A4: Summary of Water Fees, Monitoring of Water Use, and Enforcement, by Jurisdiction

Jurisdiction	Fees/Charges	Water Use Monitoring	Enforcement of allocations	
			Responsibility	**Mechanism**
AB	One time license fee. Fees go into general revenue.	Licensees in water short areas keep detailed water use records.	Ministry appointed Inspector or Director	Via dispute complaints (reactive).
BC	Application and annual water rental fees. Fees go into general revenue.	Larger surface water users report water usage annually.	Ministry of Environment conservation officers, government engineers or water bailiffs	Auditing (proactive) is rare. Typically via complaints (reactive).
MB	One time license fee and annual volumetric fees based on use. Fees to general revenue.	Provisions for licensee to monitor groundwater (using flow measuring devices) and surface water usages and report annually.	Minister of Water Stewardship	Via complaints (reactive) and water audits (proactive).
NB	One time license fee. Fees go into general revenue.	Provisions to request info at any time. Provisions for stream water monitoring via staff gauge exists. Government department monitors provincial water levels monthly.	Inspectors may be designated.	Periodic inspections (proactive) and when inspector reasonably believes non-compliance of Act (reactive).
NL	One time license fee. Fees go into related revenue.	Provision for monthly monitoring. Responsibility of licensee to report usage regularly.	Inspector	Inspections (proactive) and investigating complaints (reactive).
NT	One time license fee and annual water allocation fee based on quantity and use. Payable to Crown.	Licensee responsible for detailed water use monitoring and for reporting annually.	Minister designates inspector	Inspections to ensure compliance (proactive).
NS	One time license fee and annual water allocation fee based on volume and use.	Surface water: Avg. and Max. water withdrawals recorded daily. Groundwater: rate and volume recorded daily. Compliance monitoring by the approval holder.	Minister of the Environment	Inspections upon receipt of complaint (reactive) or to ensure compliance (proactive).
NU	One time license fee and annual water allocation fee based on quantity and use. Payable to Crown.	Applicant responsible for detailed water use monitoring and reporting upon Board's request.	INAC	Inspections to ensure compliance (proactive).

Jurisdiction	Fees/Charges	Water Use Monitoring	Enforcement of allocations	
			Responsibility	**Mechanism**
ON	One time license fee-varies according to permit category (agric. exempt). Fees go into general revenue.	Provisions for groundwater and surface water monitoring by permit holder (flow meter via volume), including daily recordings and annual reporting. Online Water Taking Reporting System.	MOE Abatement Office	Via complaints (reactive), monitoring records assessed (reactive), and inspections to ensure compliance (proactive).
PE	Application fees and annual water rental fee. Revenue offsets monitoring costs.	Stream flow monitoring. Metering for groundwater extraction possible.	Minister, environment officer, PEIPP, RCMP, PEI game officer, Canadian fisheries officer	Inspections when the inspector reasonably believes non-compliance of Act (reactive).
QC	One time license fee. Fees paid to the "Fonds national de l'eau" for intended purpose.	Generally not required, may be requested by Minister. Some municipalities have reporting requirements for groundwater.	Not stated	Not evident, although some provisions are present under the EQA and *Groundwater Catchment Regulation*.
SK	Application and industrial water use charge based on volume and source of water. Fees go into general revenue.	Industrial surface water and groundwater allocations monitored monthly.	Saskatchewan Watershed Authority	Inspections for industrial users (proactive).
YT	One time license fee and annual water allocation fee based on quantity and use. Payable to Government of Yukon. Fees go into general revenue.	Licensee responsible for monitoring and for reporting annually.	Ministry of Environment (Water Inspections Section), Ministry of Energy Mines and Resources	Inspections when inspector reasonably believes non-compliance of Act (reactive).

Table A5: Summary of Transferability of Allocations by Jurisdiction

Jurisdiction	Transferability of Allocations		
	Conditions	**Institutional Arrangement**	**Compensation If Allocations are Reduced**
AB	Yes, with approval	*Water Act*, s.81	Compensation may be payable under some conditions (*Water Act*, s.55(2), s.54(2), s.158).
BC	Possible with approval of amendments to license	*Water Act*, s.19	Compensation for lost revenue for power generators identified in *Water Regulation* (s.23.1 and s.23.2).
MB	Only if conditions are the same and Minister approves	*Water Rights Act*, s.11	If cancelled for higher priority use, higher priority user pays the compensation.
NB	Not transferable	*Watercourse and Wetland Alteration Regulation*, s.10(3)	N/A
NL	Yes, ,with Minister's approval	*Water Resources Act,* s.28	Initial license holder may be compensated by subsequent license holder but not against the Crown.
NT	Yes, with board approval	*Northwest Territories Waters Act*, s.19	No clause for compensation mentioned.
NS	Yes, with Minister's approval	*Environment Act*, s.59 (1) and *Approvals Procedure Regulations,* s.12 (1)	No clause for compensation mentioned.
NU	Yes, with board approval	*Nunavut Waters and Nunavut Surface Rights Tribunal Act*, s.44	Applicant pays existing users and adversely impacted compensation deemed appropriate by the Board.
ON	No evidence of transferability	n/a	No clause for compensation mentioned.
PE	Not unless associated with storage ponds.	Agricultural Irrigation Policy, p. 4	Groundwater extraction permit holders are liable for adverse effects to any party.
QC	Non-transferable unless Minister authorises transfer and specifies conditions	*Environment Quality Act*, s.24	No clause for compensation mentioned.
SK	Groundwater, only with approval and payment of transfer fee	*Ground Water Regulations*, s.36	Compensation under some conditions.
YT	Yes, with board approval	*Waters Act*, s.17	No compensation if agency reduces the assigned allocation.

Table A6: Summary of Participatory Mechanisms in Water Allocation by Jurisdiction

Jurisdiction	Provisions for Stakeholder Input	Notification of Allocation Decisions		Dispute Resolution	
		Method	To Whom	Authority	Type
AB	Public consultation.	Application and decision notification in newspapers and/or registry.	Public	Environmental Appeal Board	Appeals, mediation or formal hearings
BC	Objections may be filed within a prescribed time. Public consultation provisions for environmental assessments, recovery plans, water management plans, etc.	a) Notification of license applications b) Newspaper	a) To those whose rights may be affected. b) Public.	Environmental Appeal Board	Appeals, Hearing Also water use planning
MB	Provisions for public hearings under *Water Rights Act*. Also for large volume users input through *Environmental Act*.	Notification of applications. If EIA, then decision notification via EIA process.	Public	Municipal Board	Appeals possible but rare
NB	Written objections indicated within 30 days of notice of application.	Notice of applications, but not decisions.	N/A	Minister	Appeals possible
NL	As deemed necessary by Minister. Includes application notification via registry.	Registry.	Public	Minister, Trial Division, Court of Appeal	Appeals possible
NT	Outlines conditions under which public hearings are required.	Yes, written reason for license allocation. Registry.	Public	N/A	No formal appeal process
NS	Consultative process with Minister/Administrator requirement.	a) If denied, written notification and appeal process info provided. b) Registry.	a) To applicant. b) Public.	Independent party or neutral third party	Alternative dispute resolution mechanisms recommended
NU	Yes, advertise for 30 days, if significant objection then public hearing.	a) Copy of decision b) Registry	a) To applicant, designated Inuit organisation, and others with right for compensation. b) Public	Nunavut Surface Right Tribunal	Negotiation
ON	Open and consultative process.	Notification of license applications.	To applicant only	Environmental Review Tribunal	Appeals and hearings possible
PE	Consultation.	Notification.	To applicant only	No appeal right granted by statutes	In practice, issues are negotiated
QC	Limited for most allocations. Public hearing required for environmental	No set procedure for allocation decision notification.	N/A	Administrative Tribunal of Québec	Appeals possible

Jurisdiction	Provisions for Stakeholder Input	Notification of Allocation Decisions		Dispute Resolution	
		Method	To Whom	Authority	Type
	assessments.				
SK	If potential for conflict then may have public consultations.	Written notice if denied license.	To applicant only	Water Appeals Board	Appeals possible
YT	Public hearings.	Yes, written reason for license allocation. Registry.	Public	Supreme Court	Appeals under certain conditions