National Round Table on the Environment and the Economy | Table ronde nationale sur l'environnement et l'économie

Charting a Path: Water and Canada's Natural Resource Sectors

Discussion Paper

February 2009

Executive Summary

Freshwater resources are critical to Canada's natural resource sector. The natural resource sector is, by far, the largest water user in the country and is thus a major influence on the sustainability of Canada's water resources.

Although Canada has a relative abundance of freshwater resources, it is not free from water management challenges. Rising and competing demands for water resources create water quantity and quality issues as well as allocation challenges. These challenges are expected to intensify as the consequences of climate change and increased demands take hold. They are having, and will continue to have, significant impacts on ecosystems and are predicted to have major implications for the natural resource sectors, including potential serious economic impacts.

The effects of climate change on quantity and quality of Canada's water resources will be profound. Climate change risks and impacts are increasingly being considered in industry planning and policy decision-making alongside other risk factors; however, integrated approaches to finding solutions are still in their infancy.

Adaptation and mitigation of these impacts are in the early stages in Canada. In some cases, firms have already implemented adaptation measures to climate change; however, a mix of policy responses will likely be necessary to achieve the goals of watershed and sector sustainability for the four water-dependent sectors we are examining.

While a wealth of research information related to water and the natural resource sectors exists, gaps remain. As a convener of diverse and competing interests and a catalyst for sustainability solutions, the NRTEE wants to seize this opportunity to advance Canada's public policy knowledge and research and provide recommendations to governments and others on the sustainability of water and the natural resource sectors.

Contents

Framing the workshop (Assumptions):

- Rising and competing demands for water resources create water quantity and quality issues as well as allocation challenges.
- The climate is changing and this will affect groundwater, rivers and streams, lakes and reservoirs, wetlands, land-based and sea ice in different ways.
- Water is expected to act as a constraint on future development and current sustainability in Canada's energy, agricultural, forestry and mining sectors.
- Solutions that are grounded in an integrated approach to water management will be needed to meet competing demands and ecosystem needs.
- Existing policy and governance tools and mechanisms have inconsistent effectiveness – ongoing gaps exist.
- There is much happening across Canada at the ground-level and provincial level – a challenge is connecting policy solutions.

1. Introduction

This workshop is taking place near the beginning of the 2-year NRTEE's Water Program to ensure we engage the appropriate stakeholders and identify the key issues, challenges and opportunities for Canada. The Program (see Annex I), as approved by the NRTEE members, broadly aims to identify the critical sustainability issues and opportunities associated with the water, natural resource sector and climate change interrelationship.

1.1 Objectives of Workshop

In the context of this Program and recognizing the vast scope as it currently stands, the objectives of this workshop are to:

- Confirm current and emerging issues, trends and opportunities in water use and natural resource sectors; and,
- Solicit advice on where the NRTEE can, within the existing Program outline, best contribute to the national water agenda.

1.2 Your Role

Advice from experts will help narrow the Program's focus and shape the outcome and success of our work. Your knowledge and experience will help determine the priority research needs and opportunities for the NRTEE to explore.

1.3 Purpose of Paper

The questions set out in this paper will be used during the workshop to guide the discussions.

This paper presents a snapshot of the issues and challenges identified to date through the NRTEE's initial scoping that fall within the water, climate change and natural resource sector interrelationship. It is not a research paper, but rather a discussion paper which is intended to set the stage for further discussion at the workshop. Therefore, the information presented in the paper remains, by intent, relatively broad and high-level. A key outcome of the workshop will be to determine if the key issues and challenges have been captured, and if not, how they could be better depicted. It will also be important to reflect on any other key issues and challenges that could be currently missing in the document. Only then can they be prioritized during the workshop in the context of vulnerabilities and gaps related to water resources and natural resource sectors' sustainability as well as opportunities for fostering policy and governance changes through the NRTEE's Program. This will help in identifying where the NRTEE can best contribute to Canada's water agenda.

2. Context

The consumption and use of water in Canada is rising. Concurrently, climate change is altering the distribution and availability of water across Canada. Water quality is becoming increasingly degraded, both as a factor of climate and use. In some regions, water supplies are dwindling. In others, the availability of water is less predictable due to storm events, followed by prolonged periods of drought. Together, these drivers are having an impact on the four major natural resource sectors we are studying – agriculture, energy, forestry and mining.

As the steward of 7% of the global renewable water supply and nearly 20% of the world's stock of freshwater, Canada enjoys a relative abundance of freshwater resources. However, the country is not free from water management challenges which are becoming more prevalent, stimulating a quest for policy and resource management alternatives. Droughts are becoming more common in some regions (mainly in the Prairies). Sixty percent of Canada's water resources flow north, away from most population centres and economic activity. As demands for freshwater have increased, so too have Canadians' concerns about water use and quality. Consequently, water has been identified as one of the seven key issues for sustainable development in Canada[1].

Canada was founded and continues to thrive on the basis of our natural resource sector. The natural resource sector has been at the core of the Canadian economy and the prosperity and well-being of Canadians. The sector accounted for approximately 15% of Canada's GDP[2], approximately 50% of total exports[3] in 2006, and directly employs nearly one million Canadians[4].

Water resources, and freshwater resources in particular, are critical to the economic sustainability of the natural resource sectors. The actual value of water as a production input is not known. Nor is its overall contribution to the viability of these sectors. How water is used varies from sector to sector from playing a role in extraction and manufacturing processes to irrigating crops and for cooling in electricity generation. Water also receives discharges from industrial activities and is altered through either heating or polluants.

With population and economic growth on the rise, including increased global demand for Canadian natural resource products, Canada's freshwater resources will be further strained. Climate change and its unpredictable impacts further stress Canada's water resources.

Key Challenges

Challenge #1: To foster the health of aquatic ecosystems in the face of rising and competing demands and a changing climate. The mix of water and sector-oriented policies across the country results in a diverse array of water and natural resource management approaches, some more effective than others, and some seen to work at cross-purposes.

Challenge #2: To contribute to the better understanding of how a changing climate is affecting and will continue to affect water patterns, and identify what this will mean for the economic sustainability of the four sectors.

Challenge #3: To bring about change in policies and governance mechanisms to meet the needs of both ecosystem conservation and the economic sustainability of the natural resource sectors. Water management must consider the tools, governance structures, and processes that would address national, regional and local geographic, climatic and hydrological characteristics.

3. Water and the Natural Resource Sectors

The natural resource sectors highlighted in this program face similar water issues. There are, however, specific use and environmental and economic impacts that vary by sector. The following presents an overview of each sector's water use, impacts on water quality and quantity and anticipated challenges in the face of a changing climate. This section is intended to provide workshop participants with a starting point for being able to examine and prioritize cross-cutting issues and challenges. It is important for the NRTEE to have a solid understanding of each sector's relationship with water. Recognizing that there are numerous facets to this dynamic, we are looking to identify and understand the main issues at this time.

Q. What are the critical water trends and related challenges currently faced by the agriculture, energy, forestry and mining sectors? How well positioned are these sectors to address the current and future water availability and quality concerns?

3.1 Agriculture

Water is used for different activities in agricultural production, including crop irrigation, pesticide application, frost protection, livestock production, and in some cases harvesting (e.g. in the case of cranberries). Estimates of the actual water used within the agriculture sector vary across provinces and are not comprehensive. However, 2001 estimates show that about 9% of all water used in Canada was attributed to agriculture. Although the sector accounts for less water used in Canada than others[5], 74% of this was consumed, meaning

that it is not returned to the source, mainly through evaporative losses.[6] Therefore, agriculture is the largest net consumer of water resources in Canada.

Water consumption is necessary for food production, but crops and livestock vary greatly in terms of their water intensity, and as such dictate their suitability to certain regions. Although best management practices in agriculture are expanding, a trend towards intensive agricultural productions has led to an increase in the risk and incidents of contamination of surface and ground waters by pollutants through run-off of nutrients (nitrogen and phosphorus), pesticides, veterinary pharmaceuticals, and pathogenic organisms as well as eroded soils.[7]

Together, the three westernmost provinces accounted for 92% of total national agricultural water use (2001). In these provinces, about 96% of the water was used for irrigation purposes. The remaining 3% was largely used for livestock.[8]

Agriculture has multiple negative impacts on the quality of both groundwater and surface water sources, affecting its physical, chemical, and biological characteristics, although data on these impacts is inconsistent and dispersed. Many means exist to reduce negative impacts to water quality and inefficient use, but broader implementation of these programs and technologies is required. Water quality impacts from improperly managed agricultural operations are local, but because of the many different and diffuse sources of pollution, these can lead to cumulative impacts across large geographic regions. Key issues for agriculture include eutrophication, acidification and acute toxicity.

Changes in the frequency and intensity of extreme weather events have been identified as the greatest challenge that would face the agricultural industry as a result of climate change. Already climate variability has stimulated the adoption of irrigation to compensate for drought stresses and protect yields[9]. Drought also leads to poorer crops, more damage from insect pests and greater soil erosion. Other potential impacts of climate change on water for Canadian agriculture include a greater need for irrigation due to potentially longer growing seasons for some crops in some areas (which, may result in temporary economic gain), decreased river flows and reservoir levels, and increased conflict over water at peak irrigation times such as the summer months when supplies are likely to be most threatened. Agriculture can be just as threatened by excess water as by shortages. For example, in 1999 hundreds of thousands of acres in Manitoba and Saskatchewan could not be seeded because of excess precipitation. Management practices to deal with surpluses of water have already been tested in some regions.

3.2 Energy

The energy sector is broken down into hydroelectric, fossil fuels, nuclear and biofuels. It is, by far, the largest water user in Canada. It accounts for 76% of natural resource sector water use and 60% of total water use by major sectors[10].

Hydroelectric

Hydroelectric power generation is the greatest 'direct use' of water in Canada, accounting for 44% of the re-circulated water in Canada (2005). Hydroelectric generation is considered an

"instream use" rather than a consumptive one because the water remains in the river system. Although hydroelectric generation is often regarded as a "green" energy source, its impact on water bodies (among other environmental impacts) are considerable. Impacts to ecosystems include: disturbance of flow regime, migration of species, sediment transport, changes in water temperature and quality; and erosion of flood plains.[11] Canada has diverted more water by damming rivers for hydro than any other country. An estimated 85% of the drainage basins contained in whole or in part in the Boreal Shield have been altered by hydroelectric development in one way or another.[12]

One estimate about the impacts of climate change on hydroelectricity suggested that generation would be reduced by as much as 15% by 2050, which may be a conservative estimate as it was based on older climate models.[13]

More extreme weather activity and other hydrologic changes may require changes in design standards and management practices for dams and reservoirs. Most hydroelectric producers have tended to be reactive toward climate changes and events. Observed climate extremes tend to become design targets. The notion of proactive planning is relatively new. Many utilities have undertaken or are undertaking impacts and vulnerabilities assessments and studies. The results are being incorporated as a component of risk management strategies and into existing operating and planning processes.

Fossil Fuels

Large volumes of water are used by this sector for extraction of light and heavy crude and generating electricity required for on-site processing, refining and other aspects of treating resources to improve their properties.[14] In 2004, 7% of the total allocations of surface and groundwater were used in the production of oil and gas. Statistics Canada's 2005 survey of industrial water use shows that 364.8 million cubic metres of water was used for petroleum and coal production—the majority of which came from surface waters.

Alberta is considered the most vulnerable of the western prairie provinces to water shortages largely due to the rapid expansion in Alberta's oil sands-based petroleum industry.[15] Oil sand operations have been responsible for the diversion of water ways to prepare sites, depressurizing ground aquifers to prevent seepage of mine pits, for steam injection used in *in situ* production, and in some cases to be added to oil to maintain pressure needed for oil recovery. Although considerable resources have been allocated to improve efficiencies, draw upon saline water sources, and recycle water, the sustainability of operations have been put into question, mainly as a result of declining water levels in the Athabasca basin.

The energy sector is also responsible for heat discharge which impact ecosystems. In addition, the oil & gas sector can generate water discharge that is often so polluted it must be sequestered indefinitely in tailings ponds or injected into reserves; concerns about carcinogens and toxic substances entering water systems have also been raised.

Nuclear

Nuclear generation in Canada is a growing power source and currently generates about 15% of Canada's electricity.[16] Although nuclear energy is favoured by some as a low-emission

option, it is a major consumer of water. Nuclear power plants use more water than other forms of electric generation.[17] Although there are variations, Environment Canada suggests that, "Production of one kilowatt-hour of electricity requires 140 litres of water for fossil fuel plants and 205 litre for nuclear power plants."[18] In addition to large quantities of water needed for nuclear production, discharged water, in the form of tailings and thermal pollution, contribute to the contamination of surface water and groundwater.

Biofuels

Biofuels are produced from renewable resources (plants, organic waste, etc.) and are being increasingly used as an alternative to fossil fuels (oil, gas). In Canada, ethanol and biodiesel are the two main biofuels widely used and produced. Ethanol is made from wheat in the western provinces, and from corn in Ontario and Quebec.

Both federal and provincial governments are strongly supportive of the development of Canada's biofuel industry, yet it is unclear whether the impacts on water have been fully assessed. However, through new incentives, the Canadian government anticipates that ethanol production will increase to about 2.74 billion litres by the end of 2010[19].

A 2007 report by the US-based National Research Council warned that projected increases in the use of corn for ethanol production in the US would cause considerable harm to both water quality and quantity, unless new techniques and technologies were employed.[20] Water consumed in growing biofuel varies greatly by region, the report stated. For biorefineries, the water consumed for the ethanol production process—although modest compared with the water used growing biofuel crops—could substantially affect local water supplies, the committee concluded. A biorefinery that produces 100 million gallons of ethanol a year would use the equivalent of the water supply for a town of about 5,000 people. However, the report also noted that biofuel crops could draw upon unique opportunities, such as wastewater use, since the crop was not intended for consumption.

Climate change related impacts on water will affect each subset of the energy sector in different ways. The impacts of climate change on water has received more attention by some energy subsectors (hydropower and oil sands) than others due to the significant role water plays in the industrial processes.

3.3 Forestry

Canada's forests play an important role, both in the use, degradation, and regulation of water sources for Canada. Environment Canada notes that, "Forests play a vital role in the hydrologic cycle, influencing patterns of evapotranspiration, runoff and soil moisture. Disturbances caused by forestry operation and fires, however, exert significant impacts on streamflow, water quality, sediment discharge and groundwater recharge."[21]

It is well-known that water is crucial to the production process for forest products. However, there is a lack of readily-available data to quantify water use by the forestry sector as a whole. Little research has been done that examines water use throughout the entire value chain of various forest products, although it is recognized that water is necessary at

many stages of the process, including: forestation, domestic transportation, pulp and paper manufacturing, and exporting transport.

The pulp and paper industry is currently among the top three manufacturing industries in Canada in terms of water use in manufacturing. The majority of research into water use in the pulp and paper industry is directed at controlling toxic effluents that are released into the aquatic environment in order to protect water quality.

Rain and flood events can affect infrastructure that is vulnerable to flooding. Forest industries may need to adapt infrastructure accordingly. In some cases they already are. Some companies are already building higher and wider bridges rather than culverts to accommodate for increases in rain and flood events.[22] Droughts are a major concern in respect to seedling planting and to risks from forest fires and insect pests. It has been suggested there are presently too many unknown variables related to drought to properly respond with risk management recommendations. Waiting to confirm these risks is problematic and opportunities may be missed. However, many of the forest management activities required to address climate change are already part of current practice. The location and intensity of these problems will change and challenge the sector's ability to cope and adapt.[23] A strong case can and should be made for the importance of planned adaptation, in which future changes are anticipated and forestry practices (e.g., silviculture, harvesting) are adjusted.

3.4 Mining (Minerals and Metals)

The most well-recognized issue pertaining to water and mining is the use of natural lakes for tailings disposal, which negatively affect water quality. This option is favoured in some limited and site specific location by the Mining Association of Canada[24] and often contested by environmental and Aboriginal groups. If water scarcity increases, the mining sector will be pressured even more to avoid degrading fresh water sources. In addition to tailings management, other water issues related to mines include managing mine water, acid rock drainage, and pit lakes.[25] Little is known about the volume-related impacts of the mining sector's water use, because it is mainly self-served from available surface water bodies and inadequately measured. Mining sector impacts are long lasting and require long-term management.

A Citigroup Global Mining Report in 2007 concluded that the most significant potential physical climate change impacts on mining companies included more frequent or more severe weather events, freshwater availability, and thawing permafrost impacts on Arctic infrastructure. News stories about the report (which is not publicly available) quote the report as saying, "reduced rainfall, higher evaporation, receding glaciers and shrinking aquifers may reduce water availability. Authorities may become more conscious of ensuring water availability for communities and of environmental flows." The result "could reduce water availability for mining operations, leading to higher costs and cause quality issues (e.g. salinity)." In some areas, higher rainfall could require modification to tailings operations.

Safe water management requires strong predictive capacity. Accurate predictions of drought and flood conditions are needed to ensure adequate water for flooding mine wastes, diluting effluents and retaining dams (as first witnessed in the Arctic).

4. Cross-cutting Challenges

In many regions, the natural resource sectors are already facing significant water challenges individually. There is an even greater concern when these sectors are looked at together and the integrated impacts on specific watersheds are considered. The current state of water in Canada for the natural resource sector already poses challenges for both ecosystems and economic sustainability. Overlay that with rising demand, climate change and the reality that the impacts on water resources are cumulative, and a picture of vulnerabilities across the country starts to emerge.

Q. What are the shared water challenges across the natural resource sectors? Describe and provide examples.

Competition

Competition for water resources both by the natural resource sectors and others (i.e. municipal and international) are important elements of both political and public discussion. As an integral part of industrial operations, water is in high demand as sectors expand and freshwater variability increases. In addition, there is a need for balancing the needs of these sectors with the ecosystems needs. The role of water for ecosystem needs in Canada is generally unknown and underemphasized and it is likely that these competing demands will exacerbate conflicts in the future with a changing climate.

Cumulative impacts

The cumulative effects of the natural resource sectors on the environment are generally unknown since most work to identify and mitigate impacts in a specific sector is done in isolation of other sectors. While this shows individual improvements on ecosystem impacts, it does not account for the cumulative impacts. While each sector has water quality standards to meet, the combined impact on water quality may not be full realized.

Geographic variation

Although natural resource sectors across Canada will be impacted by increasing water variability, there are geographic variations that warrant consideration. These sectors cover the country although their distribution is not equally disbursed. A study of the location of these industries overlaid on watersheds that blanket the country would be a useful illustration of sector density and water demand. Some information already exists that may help better understand such geographic variations in the water issues across Canada. For example, Figure 1 presents the precipitation variations from normal amounts for summer 2008 and Figure 2 shows the distribution of irrigated land in Canada.

Figure 1: Precipitation Departures from Normal (Jun, Jul, Aug, 2008)

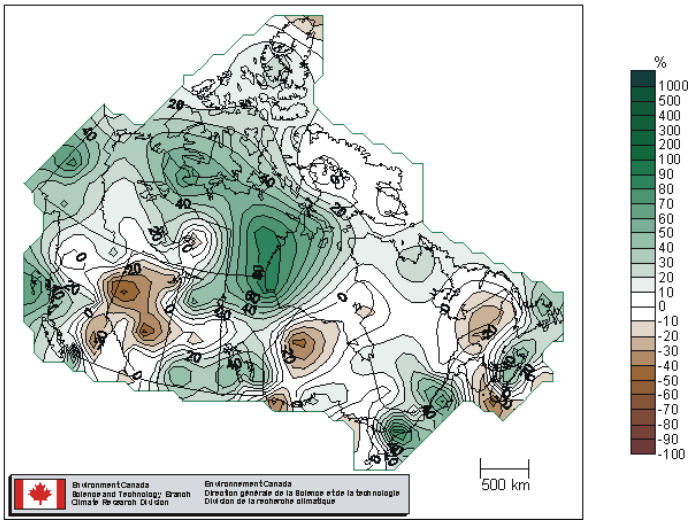
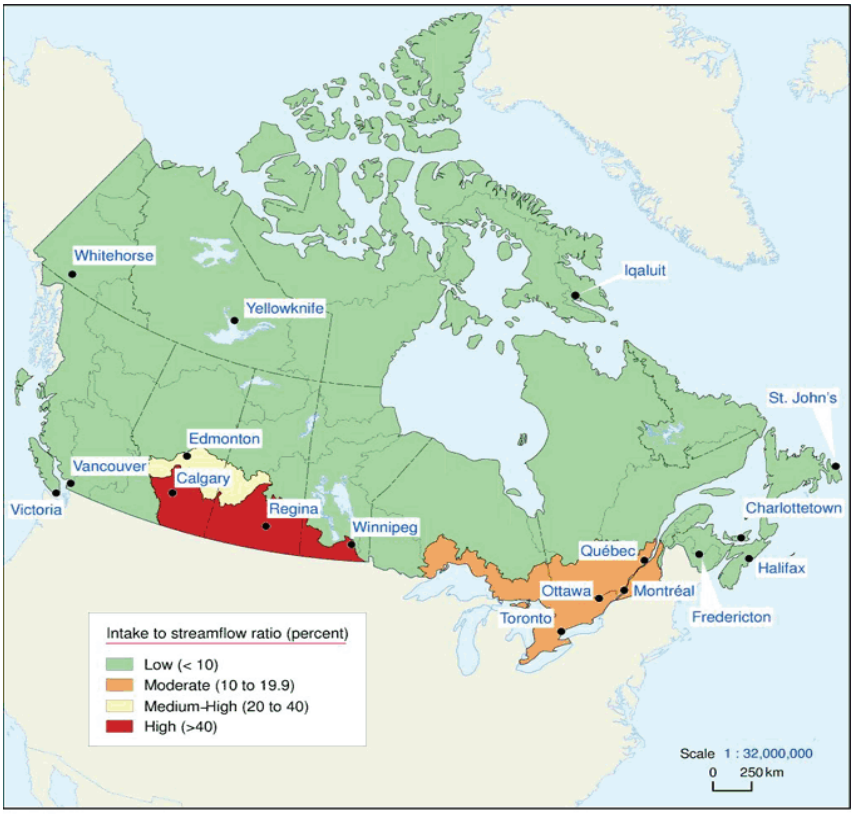


Figure 2: Intake to streamflow ratio[26]



Source(s): Statistics Canada, Environment Accounts and Statistics Division.

Climate Change

Some of the most significant and pervasive impacts of climate change in Canada will be related to water resources. Impacts will be cumulative and frequently synergistic. Water-stressed areas will expand due to decreased runoff in many areas resulting from changes in

precipitation and increased evapotranspiration, while reduced water quality and quantity will be experienced on a seasonal basis in every region of Canada.

It is anticipated that climate change will have the following impacts on water:

- Changes in supply and distribution;
- Increased demand for groundwater;
- Thawing of permafrost;
- More extreme weather events;
- Seasonal variations; and
- Declines in water quality.

Challenges will arise regionally on the basis of a) air and water temperature changes; b) changes in the level and distribution of rainfall and snowfall; c) storm intensity increases; d) sea level rise; and e) changes in coastal/ocean characteristics.

Governance

Water governance is a responsibility shared by numerous actors operating at different scales. It is complex and, in many cases, inefficient. It currently involves more than a dozen federal departments, multiple provincial and territorial agencies, municipalities with decision-making powers for infrastructure and land use planning, Aboriginal decision makers, Canada-U.S. collaboration, and numerous other important stakeholders ranging from businesses to community to consumer groups. Many experts in Canada agree that current water governance arrangements are fragmented, and greater coordination is needed to manage the resource (e.g., Bakker 2006, Conference Board 2006, Morris et al 2007).

Water conservation efforts have seen limited harmonization across levels of government, although several provinces have taken promising steps. Water allocation is one of the most controversial topics in water management. Many water supply challenges in Canada are more a function of water (mis)allocation than of water scarcity.[27] In some areas, water use permits are over-allocated and water conflicts are occurring. This is partly the result of decision-making based on poor or insufficient baseline data.

When different authorities provide competing access to water, there is no holistic understanding of the pressures on a watershed. Sustainable water management requires managers to consider the complex interactions in a watershed.[28]

5. Where do we go from here?

Based on the preliminary research conducted by the NRTEE and others, several challenges and opportunities seem apparent. It is recognized that these issues are not new and have been discussed for some time. In reviewing the challenges and opportunities below, the NRTEE seeks to determine the priority areas where our research and recommendations could best assist and influence Canadian decision-makers. In order to do this, we need to first identify the current gaps (examples are below).

Q. In what areas is change required to address trends and vulnerabilities and leverage responsibilities? What substantive changes are needed to address each of these areas?

5.1 Information for planning and management

There is a need for more and better data on hydrologic systems, processes and resources, water balances, ecosystem water needs and water use by the natural resource sector, in order to inform policy, water allocation and land management decisions.[29] This is essential for informed planning and decision-making both at the firm-level and for sector-wide decision-making, including for evaluating the effectiveness of various water management alternatives.

There is strong agreement that an effective water monitoring system is lacking in Canada. The system needs more monitoring stations, greater coordination and common standards for measurement and reporting. Water resources are managed and monitored by a variety of jurisdictions and for a variety of uses. Access to data can be very difficult. There is no common reporting standard, so there are inconsistencies in the data. For data to be usable, it needs to be accessible and consistent.

5.2 Consideration of climate change in planning and decision-making

Mainstreaming climate change into water resource decisions

Many reports urge policy makers to 'mainstream' climate change considerations into decision making processes. This is an area that could be explored in greater detail for the resource industries in Canada. According to Natural Resources Canada (2004), "Existing water management plans are based on historic climate and hydrological records and 'assume that future will resemble the past." There is a need to incorporate increased climate variability and occurrence of extreme events into water management planning.[30]

Evaluation of the costs of inaction on climate change with respect to impacts on water and the natural resource sectors

As the IPCC notes: "Efforts to quantify the economic impacts of climate-related changes in water resources are hampered by a lack of data and by the fact that the estimates are highly sensitive to different estimation methods and to different assumptions regarding how changes in water availability will be allocated across various types of water uses, e.g., between agricultural, urban, or in-stream uses."[31]

The impacts of climate change will entail social and economic costs and benefits, which are difficult to determine. These include the costs of damages and the costs of adaptation (to reduce or avoid damages), as well as benefits that could result from improved water availability in some areas.

Climate modelling

The need for improved climate models to inform land management and development decisions is broadly documented in water literature. Models may also be useful, but for their application to watershed-level planning and decision-making, but their uncertainties need to

be reduced. Large numbers of modeled scenarios makes scenario planning difficult. Fewer scenarios would make the task more manageable.

Improved flood and drought predictive capacity is very important, both for short-term management and longer-term adaptation[32]. Factoring climate changes into flood frequency analysis and flood risk mapping is a particularly important challenge[33].

5.3 Quantification of water value and water use

Improved water valuation

Although variable across the country, water prices in Canada are lower than in other OECD countries.[34] The undervaluation of Canada's water resources contributes to inefficient water use across the country. More accurate valuation of water resources will encourage more efficient water use and reduce overall water demand.[35]

Water valuation methods could be relatively easily incorporated into the existing decision-making processes but determining the appropriate price is difficult. If structured properly, water valuation can create a fair playing field where water users can compete for the resources on the basis of net social value. Sawyer et al. (2005) notes that full-cost accounting can be useful, as long as all users are subject to the same requirements.[36] He adds that there is often a perceived inequity when one industry is initially targeted as a first step in implementing economic instruments. This ultimately slows the implementation of economic instruments. A broad-based application of economic instruments seems both more acceptable and more expedient.

Including externalities in the full cost is difficult, as different surveys/methods may lead to different results, while measuring the numerous positive and negative externalities can be cumbersome and onerous. The greatest difficulty is the time and place dependency of the environmental costs. There is also a need to distinguish between pricing water as a product and as a service.[37]

Increased awareness of water values in products lifecycle (Water Footprint)

The notion of water consumption associated with the production of outputs is known as "virtual water" and the measurement is the 'water footprint.' For example, drinking one cup of coffee costs 140 litres of water; one hamburger requires 2,400 litres of water. Yet, in Canada, the price of production and sale of products and services do not reflect this water consumption. Nor is there a labeling regime that would enable consumers to consider water use in their decision to buy a product.[38]

5.4 Integrative Governance

Better use of systems thinking

The social-ecological-economic systems within which the natural resource sector operates are complex and highly interrelated. Watersheds do not abide by political boundaries and management approaches should be designed and practiced accordingly.

The greatest challenge for managing water resources stems from the combined uncertainties related to climate change, land use activities, and competing demands from all users. In some regions, water availability (including the timing and nature of recharge and flow) is a key source of uncertainty. A lack of integration and coordination across the various water users exacerbates the management challenge.

The cumulative impacts of multiple land and water uses are generally not well understood. Mining regulations deal with individual mineral industries and do not take into account cumulative effects. In the oil & gas sector, individual projects are monitored for environmental risk, but the cumulative effects of projects in a region are not. Water pollutants are typically regulated by single parameters. Little is known about synergistic, additive and subtractive effects of multiple interacting pollutants. New tools and frameworks are required for assessing and managing these cumulative effects that can operate in an environment of imperfect knowledge.

Communication, collaboration and coordination

There is a great deal of water knowledge and experience within industry, academia, government and communities. While some mechanisms to synthesize and enhance access to this knowledge and experience exist (such as the Atlas of Canada and Geoconnections), additional tools would help facilitate decision-making[39] Web-based interfaces may be useful in facilitating knowledge dissemination and exchange[40].

There is a clear need for improved communications, coordination and collaboration across the diversity of water stakeholders including the public. These improvements are needed, for example, in data management, policy tools, management and operational tools, knowledge translation and systems thinking.

Water governance coordination

To address the challenge of fragmented governance, an integrated structure for more sustainable water management could be proposed. Environment Canada (2006) suggests that further defining jurisdictional roles and responsibilities would facilitate climate change adaptation in the water resource management sector. The report cites the issue of water shortage management in Ontario as an example of this need for jurisdictional clarity, noting that three federal departments and agencies, three provincial departments and agencies, watershed organizations and municipalities all play significant roles in managing this issue in Ontario, and that clarifying responsibilities of these groups for this issue proved effective.

Many parts of Canada are experimenting with collaborative, delegated or 'shared' water governance.[41] In the Okanagan Basin in BC, the local community is considering water and climate change in decision-making. A multi year study recommended an approach that explicitly integrates climate change response and sustainable development initiatives (in this case, the implications of impacts on water supply and demand for regional development).[42]

Water allocation and permitting

Allocation of water to various users is a major issue and one that deserves further exploration. There is a need for laws to be adaptive with regards to allocation and to incorporate the risks of climate change. As Natural Resources Canada (2008) notes: "At

present, most water laws do not take climate change into account, and would therefore be challenged by the projected changes."[43]

Mix of policy instruments

A task could be to examine the best mix of policy tools to achieve water efficiency, reduce demand for water, and promote water conservation in natural resource industries. It is expected that a suite of tools and broad participation is needed to achieve desired outcomes. For example, case studies strongly suggest that economic instruments are more effective when combined with education and advertising.[44]

6. Finding NRTEE's Place

Q. Given the NRTEE's mandate and the other ongoing initiatives in Canada on water, what are the most important research and policy questions that the NRTEE can best address to fill a knowledge and policy gap?

The NRTEE brings together a group of distinguished sustainability leaders active in businesses, universities, environmental groups, labour, public policy, and communities across Canada. Our members are appointed by the federal government for a mandate of up to three years. They meet in a round table format that offers a safe haven for discussion and encourages the unfettered exchange of ideas leading to consensus. This is how we reconcile positions that have traditionally been at odds.

The NRTEE is an independent policy advisory agency that advises governments on sustainable development solutions. We raise awareness among Canadians and their governments about the challenges of sustainable development. We advocate for positive change. We strive to promote credible and impartial policy solutions that are in the best interest of all Canadians.

The NRTEE is in a unique position to contribute to the water and natural resource sector discussion. As a convener of diverse and competing interests and a catalyst for change, the NRTEE wants to seize the opportunity to advance debates, delve into issues not yet or not fully explored and present in-depth, ground-truthed research. Through this program, we strive to generate recommendations to governments, industry and water management authorities on the design of new policies, approaches and mechanisms through which water can be better managed to foster both ecosystem health and the natural resource sector's economic sustainability.

7. Case Study

As noted in the program outline, the NRTEE intends to study a watershed in order to see integrated inputs and effects. In determining which watershed to choose, your advice would be greatly appreciated. The selected watershed will first be evaluated to learn about the cumulative effects of the four natural resource sectors and the anticipated future of the environment and economy based on climate change implications.

Q. What are the criteria for the selection of an appropriate watershed case study site?

Annex I: Program Overview

The National Round Table on the Environment and the Economy (NRTEE) is undertaking a new research program on ***Water and Canada's Natural Resource Sectors***.

The NRTEE will add value to the national water agenda by examining the relationship between the energy, mining, forestry and agriculture sectors and water sustainability in the context of changes in supply, availability and distribution flowing from climate change and rising economic demand.

Throughout the two-year Program, the NRTEE will engage industry sector leaders, representatives of federal, provincial, territorial governments; academia; non-government organizations; Aboriginal and regional groups and, civil society as part of the research process. The following provides a snapshot of the Program.

Purpose

- To identify the critical issues and opportunities associated with the water, natural resource and climate change interrelationship; and,
- Catalyze the design and implementation of new policies, approaches and mechanisms through which water can be managed to foster both ecosystem health and economic sustainability of the sectors.

The Program is guided by the following three research questions:

- *What are the current water quantity and quality impacts on the natural resource sectors and vice versa?*
- *How is/will the changing climate exacerbate existing water quantity and quality issues in Canada's natural resource sectors?*
- *What mix of policy tools and approaches (e.g. ecological governance, technological, economic instruments, regulatory tools) would be most applicable to enable Canadian resource sectors – energy, mining, forestry, agriculture – to value water, and incorporate that value in their production processes thus contributing to enhanced economic sustainability, while concurrently minimizing aquatic ecosystem impacts?*

Program Goals

1. To profile current and projected water consumption patterns and sustainability issues by Canada's principal natural resources sectors and the role and value of water within these sectors;
2. To examine the impact of climate change on water availability, supply and distribution across Canada and its projected impacts on the sustainability of Canada's principal natural resources sectors;
3. To recommend to natural resources sectors and governments the adoption of new and/or adapted policies and innovative mechanisms/approaches to ensure sustainable water management.

Context

- The sustainability of Canada's four selected natural resource sectors - energy, agriculture, forestry, and mining - is heavily dependent on the continued availability of water. Two key drivers are concurrently affecting Canada's water supply and distribution: rising consumption

and climate change. What this means for the future sustainability of these sectors is not yet clear. Nor are ecosystem impacts of this dual driver well understood.

- Under current climate circumstances, water use and consumption are not ecologically sustainable. Water supplies in many areas of the country are already proving to be insufficient or unreliable to meet multiple and competing demands. Communities, farms, and industries have competing needs for surface and groundwater sources that degrade the supply. Issues around scarcity and allocation have already emerged. Water quantity and quality will be further stressed as demand grows and the impacts of climate change increase.

- Climate change adds even greater uncertainty over supply as revealed through recent climate change research. A comparison of total annual water renewal rates versus total annual demands puts Canada in the top tier of countries whose renewable supplies far exceed its current water-use demands. This view of abundance masks other realities regarding the ready availability of these resources for human use.

- With the Canadian economy highly based on the production and export of natural resources, understanding the role water plays, its value as part of the resource development process; and implications of climate change on the security of supply, is critical. Equally important is the need for a better understanding of the ecological impact of the natural resource sectors on water resources in the face of the changing climate as economic growth is predicated in part on the ready availability and sustainability of water resources.

- Canada largely undervalues its water resources and as a result most Canadian companies do not factor water's economic or ecological value into production costs. An opportunity exists to address this policy issue and explore tools that could stimulate greater production efficiencies and reduce risks associated with the changing landscape of water. Environment Canada estimates that water contributes $7.5 to $23 billion annually to Canada's national economy, yet these figures only relate to the 'direct' benefits of water. It should be noted that this figure remains speculative, and is illustrative of water's significant contribution to the Canadian economy.

- It is because of these issues, and the need for change at all jurisdictional levels and across sectors that the NRTEE has chosen to delve into this area of importance to both our natural environment and our economy.

Research will examine:

- Which production processes within the energy, mining, forestry and agriculture sectors are dependent on water;
- How the resource sectors are influencing water sustainability throughout the extraction and development process and their overall aquatic ecosystem impacts;
- The current and anticipated impacts of climate change on water supply, availability and distribution and implications for the natural resource sectors.
- How the current policy and governance tools and approaches are affecting resource development practices and associated water consumption and use;

- How water resources could/should be valued in terms of its role in natural resource production and link with economic instruments as conservation tools;

- What mix of policies, economic instruments, and approaches (e.g. integrated resource management, full-cost accounting, pricing) would be conducive to triggering more efficient water consumption and use; and reduce environmental impacts; and,
- Highlight issues and possible solutions using a case study approach within a specific watershed.

Process

An Expert Advisory Committee (EAC), a NRTEE Water Sub-Committee, and a "virtual" team of experts provide guidance and input into the Program. Chaired by a NRTEE member, the EAC's members are a combination of experts and stakeholders. Its role is to contribute substantively to the Program, assessing research, providing direct input, and validating the key findings throughout the process.

The NRTEE Water Sub-committee guides the Program, taking into consideration the EAC's input. The virtual team of experts will be drawn in as needed on an individual basis depending on the issue areas being explored.

Program Phases *(subject to adaptation as the program evolves)*

Phase I – Scoping and Program Initiation
November 2008 – March 2009
Deliverables:

- Identification of priority issues and refinement of scope through commissioned and in-house research, consultations and an expert/stakeholder workshop.

Phase II - Research and Consultation: Key Issues
March 2009 – December 2009
Deliverables:

- Report on key issues
- Case Study: Initial findings

Phase III – Policy Development and Recommendations
January 2010-December 2010
Deliverables:

- Final Report

Glossary

Natural resource sector: comprised of the agriculture, energy, forestry and mining sectors.

Non-consumptive water use: Water withdrawn for use then returned to the environment.

Re-circulated water (recirculation or recycling): Water used more than once in an industrial establishment.

Water consumption: Water that is not returned to its original source, lost in the production process. The major portions of consumed water are escaped steam, evaporation from irrigation and the incorporation of water into a product.

Water use: Total amount of water used in the production of the product – the sum of total water intake and water recirculation.

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