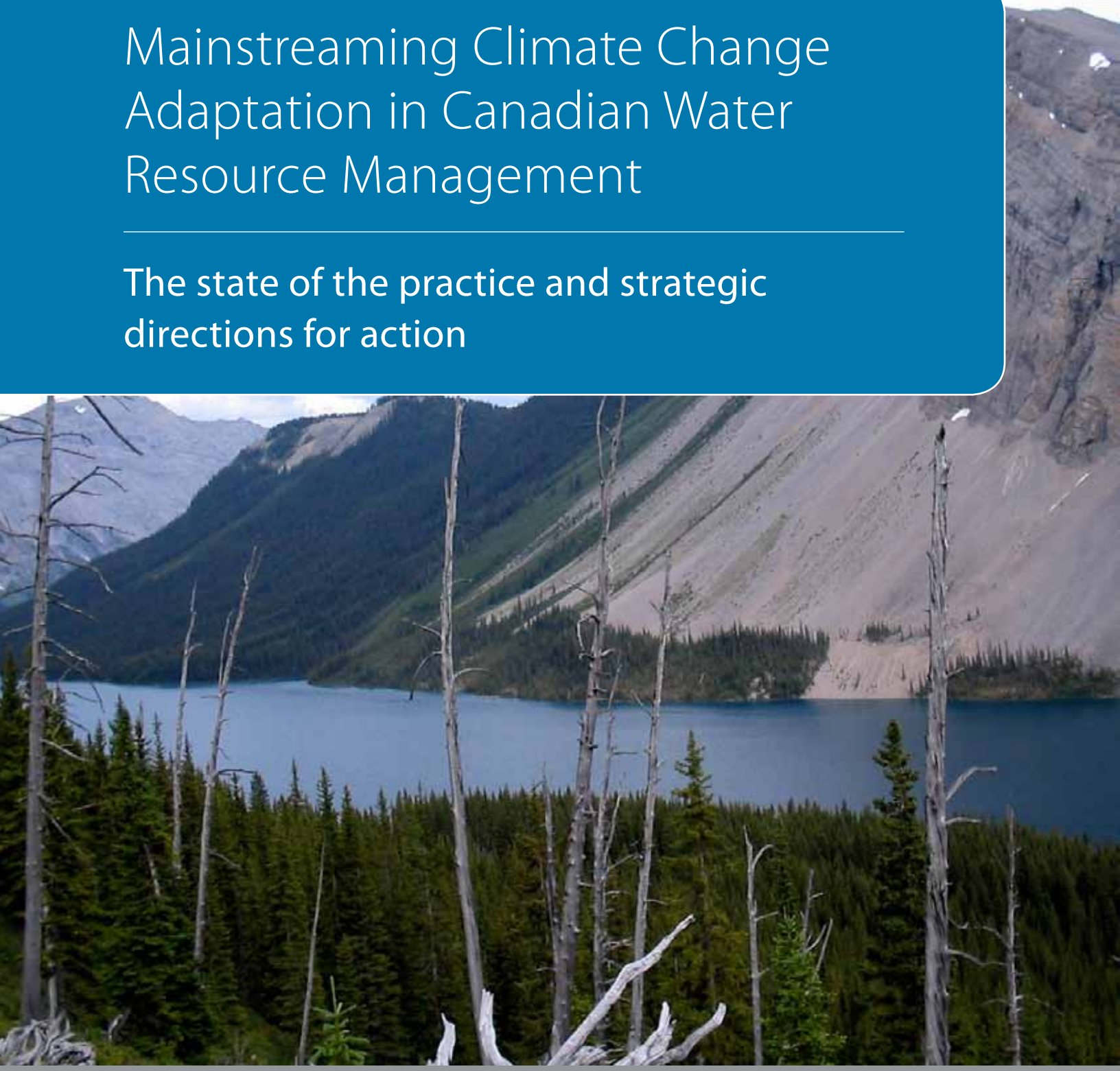
Mainstreaming Climate Change Adaptation in Canadian Water Resource Management

The state of the practice and strategic directions for action



Executive Summary

http://waterandclimate.ca

WHY WATER AND CLIMATE?

The sustainability of policies, infrastructure and technology in a wide range of areas – including municipal works natural resource extraction and allocation, land use planning, food and energy security, and economic development – is directly dependant on healthy ecosystems and the availability of good quality water. Water-related hazards, such as flooding, drought or quality degradation, also pose direct threats to the health of ecosystems and well-being of communities. Many of these hazards are the direct result of weather or climate events, including climate change. These same weather and climate influences affect the hydrologic cycle, the water budget of an area, and the availability of water (see Box 1).

To date, water management decisions around the globe have been based on the assumption that the likelihood of extreme weather events and climate trends is constant – for example, that the chances of a 100-year storm or drought occurring does not change from year to year, or decade to decade. The reality of climate change requires looking beyond historical trends to plan for the future. Evidence is already being accumulated from across Canada (and internationally that 100-year storms and droughts are rapidly increasing in frequency. In other words, the most severe weather and water hazards we experience are occurring more often.

BOX 1: WEATHER, CLIMATE AND WATER RESOURCE MANAGEMENT

Climate represents the long-term pattern in weather over a defined geographic area (e.g., the average daily temperature over a season for Canada), while weather refers to atmospheric conditions over a shorter time period. Water security is greatly dependant on both weather and climate. The availability, quality and uses of water resources are all directly affected by both sudden weather events (e.g., storms or extreme heat) and climate (e.g., the gradual loss of snow-pack over several years due to increasing temperature).

Community and ecosystem resilience to climate change requires water management to be adaptive, flexible and risk-based, and to provide integrated analyses of systems that affect and are affected by water resources, like drinking water and wastewater infrastructure. In some cases, effective adaptation will require a rethinking of how we design our policies and infrastructure. In other cases, the path to maintaining resilient communities will require adopting small, but critical shifts in our day-to-day management practices.

Addressing the reality of climate change means we need to be ready to manage water in the context of greater uncertainty about the future, an increased risk of hazards, and the emergence of new weather and hydrologic conditions. Adaptation must be mainstreamed into all aspects of water resource management (see Box 2).

BOX 2: WHAT IS "MAINSTREAMING" ADAPTATION INTO CANADIAN WATER RESOURCE MANAGEMENT?

Mainstreaming adaptation into water resource management means that we must incorporate (or integrate) our understanding of climate change impacts and risks into existing decision-making on water policies and projects in a way that is flexible, responsive and adaptive over time. Elaborating on a few keywords in this description:

- "Climate change" (and the related changes in weather that affect the hydrologic cycle) means that mainstreaming is not business as usual. Although many current water management activities are relevant to mainstreaming, some new activities may be needed (e.g., climate forecasting and downscaling). Existing policies and water management practices will need to be adjusted to allow for a greater consideration of the effects of future climate.
- "Existing" means that mainstreaming should fit within prevailing or emerging (as opposed to creating new or isolated) models of governance, institutional frameworks and decision-making processes. Adaptation should not create competing governance and institutions, but should be incorporated into broader water resource management systems to make them resilient to climate change and extreme weather.
- "Incorporate (or integrate)" means that mainstreaming should break down silos within and among geographic regions, management sectors, water interests, and technical disciplines so that there is better coordination, communication, information management, and allocation of water resources.
- "Adaptive" means that mainstreaming should follow the principles of adaptive management. Management efforts should be flexible and based on the idea of 'learning by doing'. Adaptive management provides managers with the ability to understand the effects of climate change and continually improve the effectiveness of the adaption measures or projects.

REPORT OVERVIEW AND OBJECTIVES

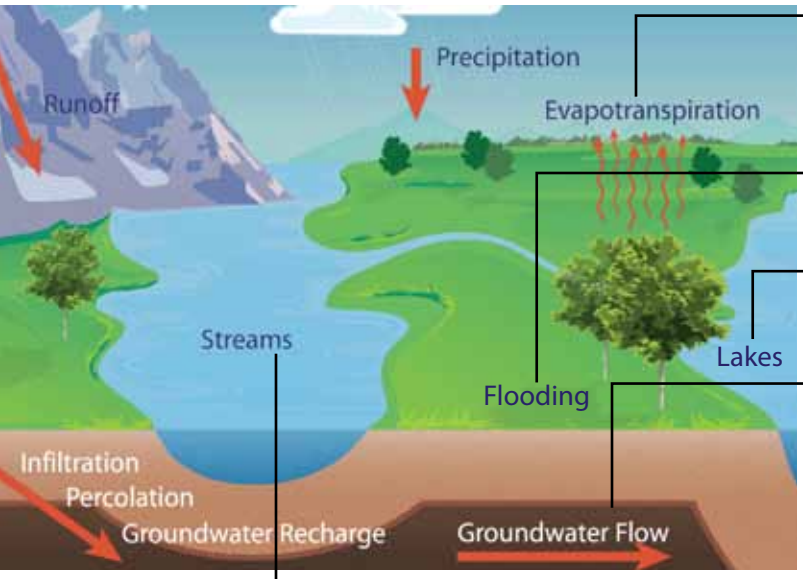
Mainstreaming Climate Change Adaptation in Canadian Water Resource Management is a significant national-scale effort to examine how water resource management practices across the country could and should be modified to adapt to the challenges posed by changing weather patterns and global climate change. The purpose of the report is to:

1. Provide a snapshot of the current state-of-practice with respect of climate change adaptation in water resource management across Canada; and

2. Present a set of strategies and recommendations for effectively integrating climate change adaptation into the practice and policies of water resource management.

The report explores how policies, projects and community actions have supported adaptation in water resource management across Canada. Strategic directions for further supporting adaptation are also presented. These findings are examined across a variety of water issues (e.g., flooding, drought, etc.), user groups (e.g., managers, technical, economic sectors and management levels). The analysis was driven by results from the National Forum on Water Adaptation to Climate Change and an extensive review of existing literature and programs on water adaptation implemented across Canada. Based on this research, the National Compendium of Water Adaptation knowledge was assembled as an on-line, easily searchable database of projects and policies that demonstrate effective adaptation. The database is meant to highlight best-practices in adaptation and facilitate mainstreaming by providing managers with information on actual adaptation practices. A link to the compendium is currently available at http://waterandclimate.ca.

STATE OF PRACTICE BY WATER ISSUE



Evapotranspiration - Issues of **drought and aridity** are largely reactive and driven by public pressure to respond to extreme drought events. Adaptation activities have focused on the assessment of impacts and generation of knowledge to better understand the circumstances that lead to drought.

Flooding - Overall, the issue of **flooding** remains in the early stages of mainstreaming, with an emphasis on knowledge generation and impact assessment. Implementation is concentrated in coastal areas.

Lakes - Research on this issue has tended to focus on describing historical changes in **lake and ice levels**. There is a current gap in investment in detailed models/methods for predicting changes to sea ice and snow cover, which support adaptive governance in Northern Canada.

Groundwater Flow - There is a limited understanding of the relationship between **groundwater** resources and climate change. Understanding is greater in inland regions where mapping and modelling is less complex, than in areas where characterization of the resource is more challenging. Beyond water source protection, implementation of adaptation measures appears limited.

Streams - The baseline understanding of **streamflow** is advanced relative to other issues. There is, however, a limited understanding of adaptation measures that might be appropriate and effective.

FINDINGS AND STRATEGIC DIRECTIONS

1.1. Water Data, Monitoring and Information Management

- Water quantity monitoring data tend to be more extensive and better coordinated than water quality monitoring data.
- Information on water usage is also weak and fragmented, with little quantitative and accurate data.
- Physical surface water data needed for planning and modeling are much more comprehensive than groundwater data, resulting in an incomplete picture of watersheds.
- Accessibility of data is generally increasing; however, information management systems that combine data across jurisdictions and programs are limited.
- The design of monitoring networks and information management systems are insufficient in geographic coverage, time series duration and spatial scales to support robust climate change impact assessment.
- Climate datasets require in-filling of gaps and significant effort and resources to process in order to be useful in policy analysis and adaptation planning.
- Several effective guidance tools for evaluating and improving existing water monitoring networks are identified in the report and compendium.

Strategic directions

- Develop a national-scale program to fill data gaps, improve spatial and temporal resolution, strengthen standardization and enhance access.
- Recognize that a desire for more data should not be endless. Scientific uncertainty is inevitable in planning for the future, and management efforts should strive to use risk-based approaches to address this challenge.
- Implement improvements to water resource monitoring networks and information management systems, particularly in areas with constrained capacity or limited baseline monitoring.

1.2. Knowledge and Awareness

- Our knowledge and understanding of surface water issues related to climate change is much more advanced than our knowledge of groundwater issues.
- There is a high level of baseline knowledge about the impact of climate and weather risks on drought and soil moisture, particularly in the Prairies.
- There is a limited understanding of the impacts of climate change and effective adaptation responses.
- The power generation, municipal works, agricultural and transportation sectors appear to be leaders in generating knowledge on the water-related effects of climate change.
- Significant gaps exist in our knowledge of the effects of climate change on tourism and recreation, rural community adaptation, and ecosystem resilience.
- In general, traditional, indigenous and local knowledge are not being integrated well into decisions on adaptation.
- Information on the social and economic impacts of climate change and the benefits of adaptation in water management is sparse but improving.
- Many knowledge-sharing networks exist. However, none operate at a national scale, are supported with long-term funding, and focus on water adaptation specifically.

Strategic Directions

- Address the most critical gaps in knowledge by first identifying needs or priorities across regions, sectors and issues. The focus should be on building capacity where it is currently limited.
- Take leadership to coordinate climate change adaption policies across water resource management disciplines (e.g., integrating natural sciences with engineering, indigenous knowledge, social sciences and economics).
- Practitioners and policy makers should deliberately adopt the principles and practices of integrated water resources management (IWRM) as a guiding framework, since the nature of climate change adaptation requires a holistic and multilateral response.

1.3. Infrastructure

- Canada has one of the highest rates of water consumption in the world due, in part, to losses through infrastructure, technological inefficiencies and wasteful use.
- Increases in the frequency and intensity of extreme weather events linked to climate change have led to higher public health risks and economic losses.
- There is growing concern about an "adaptation deficit," which represents the gap between damages to infrastructure arising from water-related climate events or shifting demand and a correspondingly slow rate of investment for upgrades and improvements.
- Greater resiliency of engineered systems is expected to minimize costs; catastrophes will result in fewer impacts, leading to faster recovery and lower risks.
- On-the-ground implementation of guidelines for structural adaptation measures remains limited.
- Practitioners have both the motivation and the capacity to move forward with pilot projects in several key sectors / regions in order to advance infrastructure work.
- Regulatory agencies have begun to update design codes and standards to incorporate climate change risk. Where implemented, these efforts have led to acceleration of adaptation and mainstreaming.

Strategic Directions

- Implement more pilot projects and case studies that illustrate and promote alternative engineering designs and technologies, particularly in areas where adaptation has been slow or capacity is constrained.
- Identify priority infrastructure vulnerabilities and strive to apply emerging technologies, design approaches, and/or updated standards (e.g., strategies for protecting communities from drought or rising sea levels, or enhancements to municipal stormwater and drinking water systems).
- Showcase case studies and monitor their effectiveness to heighten awareness of the options for adaptation.

1.4. Capacity and Awareness

- Awareness varies across sectors, issues and regions, driven largely by the degree to which an individual or organization has experienced the effects of climate change and related impacts on water resources.
- Awareness by the public and policy makers is lower in urban and more populated areas, where citizens are less directly connected to the hydrologic cycle.
- Technical experts tend to have a high level of awareness about the problem, although decision-makers tend to still struggle to understand vulnerability and how current trends in weather are changing.
- Currently, there exists a community of practitioners, organizations and businesses with significant technical capacity in adaptation, but they represent a small proportion of all those who have a role to play.
- In mainstreaming specifically, there is a disparity in the capacity between the leaders that have emerged over the last five years and those who have not had the opportunity to work on adaptation.

Strategic Directions

- There is an opportunity to use and expand current dialogue forums, investment formulae and policy direction to close the gap between leading and lagging regions or sectors. This should start by identifying those practitioners and organizations that are operating in the most vulnerable settings.
- Resources can be invested strategically in other areas (e.g., by expanding knowledge networks, developing resilient technology and infrastructure, and strengthening monitoring and infrastructure) in order to build capacity.

Box 3: Investing in Adaptation

The near-term cost of pursuing climate change adaptation today, given uncertain future benefits, has been cited as one of the key barriers to action among provincial and municipal governments and businesses. However, investing in adaptation will help contain the risk of climate and extreme weather-related events, as well as reduce the associated insurance costs. By working together collectively, the insurance industry, business, professional organizations and the public sector can pool scarce resources, identify strategic opportunities and take advantage of economies of scale. Investing in disaster prevention also represents an opportunity to expand new technological and service sectors in the economy.

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