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Integrated Water Resources Management


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Integrated Water Resources Management

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Contents

Preface

Preparation of this overview report and accompanying CD on integrated water resources management was led by Environment Canada, in close collaboration with Canada's provincial and territorial governments and in consultation with federal government departments and agencies with responsibilities for water management. The overview report and CD supplement other recent federal publications on water resources management:

- *Threats to Sources of Drinking Water and Aquatic Ecosystem Health in Canada* (Environment Canada, 2001)
- *Water and Canada. Preserving a Legacy for People and the Environment* (Government of Canada, 2003)
- *Threats to Water Availability in Canada* (Environment Canada, 2004)

The Government of Canada will continue to work with its partners to encourage and promote integrated water resources management in Canada and abroad.

Water and Canada

Integrated Water Resources Management

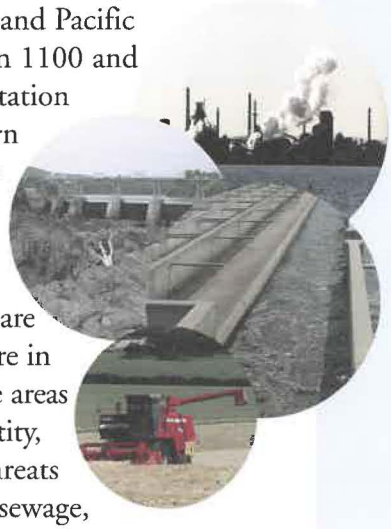
An Overview of Perspectives, Progress, and Prospects for the Future at Home and Abroad

CANADA is pleased to present its first review of how the Government of Canada and our country's 10 provincial and 3 territorial governments are implementing integrated water resources management (IWRM), both domestically and internationally. Canada looks forward to sharing these experiences and to learning from other countries as we cooperate in raising the profile and expanding the practice of IWRM domestically and around the globe. A more interactive edition of this review is available on a CD, with Website links and concrete examples of initiatives being used to apply IWRM. The symbol CD will be used throughout this document to indicate information that is published in its complete form on the CD only.

Canada has been engaged in IWRM for many years, adjusting our thinking, creating new tools for the job, and putting these tools to work in a wide array of IWRM initiatives across the country. Readers will be particularly interested in the variety and scope of case studies that illustrate specific initiatives or components of IWRM taking place across Canada. These on-the-ground examples are vital to understanding how Canada uses governance mechanisms to manage shared water resources, scientific research to support decision-making, and public communication of water-related information to increase awareness and knowledge. The case studies were selected to portray approaches to water management in large geographical areas, such as major river basins, in smaller areas, such as local watersheds and aquifers, and in other water management settings. Canada has learned many important lessons along the way, and we offer insights on what directions may be taken to advance IWRM even further, domestically and abroad.

SOME BASIC FACTS ON WATER IN CANADA

Canada is a large country, occupying 7 percent of the Earth's land mass and accounting for 7 percent of its renewable supply of fresh water. Canada also holds 25 percent of global wetlands and has the longest marine coastline of any nation, the second largest continental shelf, and a total offshore marine area equal to 40 percent of the Canadian land mass. Although Canada's water resources are considerable, they are not always — from the perspective of human use — in the right place at the right time and in the right form. Much of our water wealth is locked up as ice or deep underground, and the rest is unevenly distributed throughout the country (see Figure 1). Whereas some parts of Canada receive moderately heavy rainfall and are subject to flooding, others are semiarid and susceptible to drought. For example, Canada's Atlantic and Pacific coastal areas receive between 1100 and 1400 millimetres of precipitation each year, while the southern portions of Canada's Prairie provinces receive less than 50 millimetres per year.



Canada's major water issues are broadly the same as anywhere in the world — falling into the areas of water quality, water quantity, supply, use, and hazards. Threats to water quality stem from sewage,

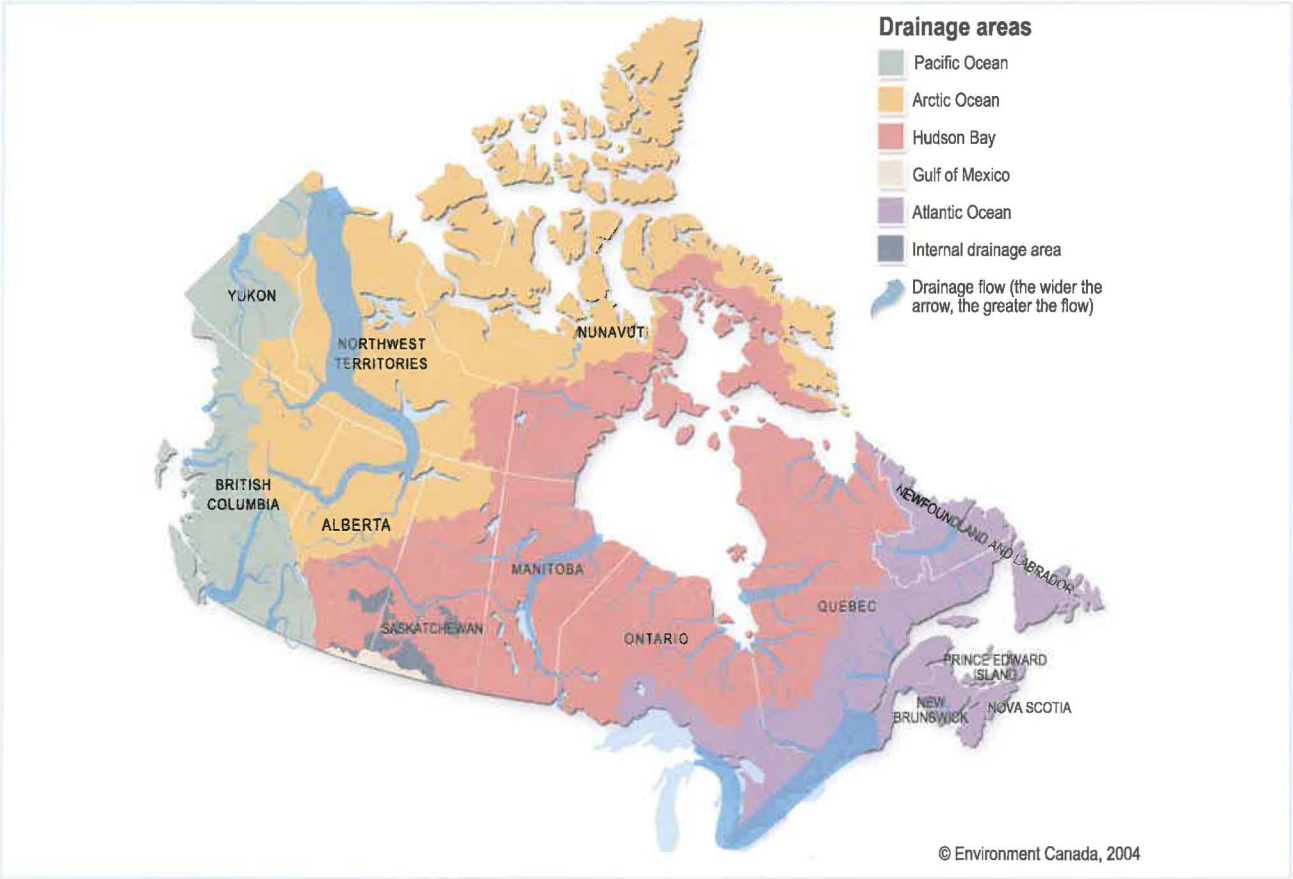


Figure 1. Canada's freshwater drainage areas. Approximately 60% of Canada's fresh water drains to the north, while 85% of the population lives along the southern border with the United States.

industrial waste, and agricultural and urban runoff, which have important implications for both ecosystem and human health. In terms of quantity, pressures on the Canadian resource are growing, and water scarcity is a real issue in some regions of the country. The cost of bringing water to, and treating water for, cities is growing. The Federation of Canadian Municipalities estimates that water infrastructure needed in Canada will cost $40 billion over the next 11 years. With multiple uses of water throughout the country, the potential exists for conflict between competing users, including agriculture, electric power generation, primary resource industries, manufacturing, municipalities, and recreational users. Floods and droughts are two of Canada's costliest natural disasters.

Because Canada is a federation, it is essential that all jurisdictions collaborate to address water issues and challenges. All of Canada's 14 jurisdictional authorities have responsibilities for water and watersheds that cross jurisdictional boundaries. Primary responsibility for the management and protection of water quality falls to the provincial and territorial governments, and they, in turn, may delegate certain authorities to municipalities, including the treatment and distribution of drinking water and the treatment of wastewater. The federal government also plays a significant role in protecting water by collecting and distributing water and climatic information, regulating toxic substances, conducting water quality research, and promoting pollution prevention. Federal jurisdiction extends to the conservation and protection of oceans and their resources, fisheries and fish habitat, navigation and shipping, international waters, and federal facilities and lands, including the territories.

Figure 2. Canada – United States transboundary basins

Source: Environment Canada

Canada shares important watersheds with the United States (see Figure 2). The Great Lakes – St. Lawrence River system and major rivers such as the Columbia, Yukon, Red, and Saint John are among the almost 300 waterways and aquifers that cross or form the Canada – United States border. The majority of the Canadian population lives within these watersheds, with much of Canada's economy directly dependent on the industrial, agricultural, transportation, and recreational benefits these resources bring. Canada also shares many coastal, estuarine, and freshwater ecosystems with the United States (e.g., Gulf of Maine and Puget Sound).

Canada and the United States cooperate on these boundary and transboundary waters to protect navigation, hydroelectric, and irrigation interests, as well as to meet the domestic and sanitary needs of communities dependent on these waters. Today, management of shared waters is increasingly evolving towards an ecosystem approach. In most cases, transboundary issues are addressed and resolved through bilateral cooperation, often using existing mechanisms involving federal, provincial/territorial, and state governments of both countries. In some instances, a comprehensive investigation is required in order to develop recommendations to best address a cross-border issue in an integrated and coordinated manner.

"Integration" is the operative word for IWRM in Canada

As Canada's population expands and the pressures on our water resources grow, the need for an integrated approach to managing these resources is being increasingly recognized within and across federal, provincial, and territorial jurisdictions. IWRM is viewed as a multidisciplinary and iterative process that seeks to optimize the contribution of aquatic resources to the social, environmental, and economic welfare of Canadians, while maintaining the integrity of aquatic ecosystems, both now and into the future. Resource managers in Canada have come to recognize that the integration on which this approach depends happens at many levels. Globally, many principles have been deemed important to achieving IWRM, and these are being used to help guide the design and application of IWRM approaches in Canada (Table 1).

Table 1. Key principles guiding outcomes for IWRM in Canada

Guiding Principles	The desired enabling environment
	Governance
Recognition of the values of water to environment, economy, and society	Market and non-market values for aquatic resources
Stakeholder representation, support, and involvement	Inclusive and transparent governance and coordination mechanisms (boards, authorities)
	Instruments and tools
Reflection on relationship with land use, other environmental issues, and ecosystem linkages	Integrated policies, programs, and water management plans that address multiple issues and their linkages
	Integrated models for trade-off and optimization analysis
Defining the right balance of actions for effective implementation	Design and deployment of a mix of measures (voluntary, regulatory, and market-based instruments)
	Science
Clear focus and orientation toward results and evidence-based decision-making	Measurable outcomes, goals, targets
Basis in scientific principles, sustainable management, and precautionary approaches	Sound scientific and economic data and information
	Information
Realistic performance evaluation and continuous improvement	Monitoring, assessment, reporting, feedback systems
	Sound scientific and economic data and information

IWRM in Canada brings together the work of federal and provincial/territorial governments, Aboriginal peoples, and other stakeholders — municipalities, industry, energy, agriculture, non-governmental organizations, community groups, and research teams — into full partnership in the processes of planning, decision-making, management, and implementation. This cooperation fosters an enabling environment that encourages action and creates the expectation for results. At the ecological level, the interdependence of all components of the land–water–air system is recognized, and the inherent integration of Canada's fresh waters and coastal waters, water quality and water quantity, surface water resources and groundwater resources, land uses and water uses, and upstream and downstream uses is better understood.

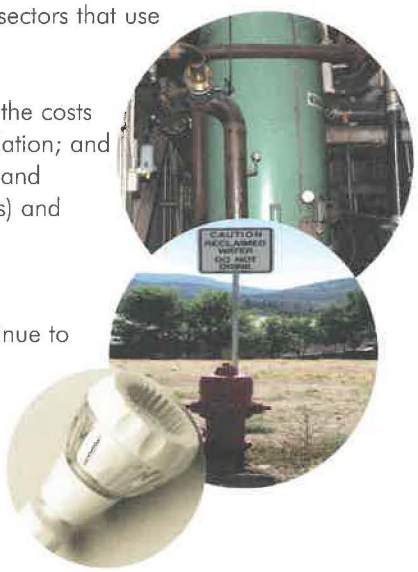
To ensure sustainable use of Canada's water resources for all users, there is growing recognition of the need for conservation and efficiency (see box). To this end, an approach beginning to receive greater attention in IWRM is to increasingly focus on demand management to complement supply management approaches.

Water Efficiency and Conservation: An Integral Part of IWRM in Canada

Canada's growing population and accompanying industrial expansion are placing ever-increasing demands on the country's water supplies. At the same time, Canada faces many challenges related to the supply of water, including changing water availability in some areas due to changing weather patterns, loss of potable water supplies because of contamination, and water shortages in areas where the demand is greatest, such as areas affected by water withdrawals for irrigated agriculture on the prairies. Methods to augment the water supply, such as building new dams and reservoirs, expanding water and wastewater infrastructure, and sourcing new supplies of water, will entail high costs and may have negative impacts on other users and the environment. More efficient water use can curb the growing demand on existing water sources and lessen the burden of finding new sources. It may also make better use of existing infrastructure, thereby delaying expenditures needed for improvements and new developments.

All levels of government in Canada are working towards greater water efficiency and cooperating with stakeholders to formulate long-term strategies for water conservation. Steps being taken to reach this goal include:

- changing the public perception in Canada that water is an unlimited resource;
- educating citizens, including school children, on the need for water efficiency and conservation;
- investing in research to improve the technology of the physical devices that use water and to improve the efficiency of industrial processes that use water;
- using more efficient production processes and technologies in key industrial sectors that use and consume water (e.g., agricultural irrigation systems);
- obtaining better information on actual water use through metering;
- initiating full-cost accounting programs at the municipal level to account for the costs of maintenance and replacement of infrastructure and environmental degradation; and
- introducing new tools to encourage positive behavioural change in business and individuals, such as economic incentives (e.g., tax breaks or rebate programs) and disincentives (e.g., effluent charges).



Progress towards these goals is advancing in Canada. Environment Canada, in conjunction and consultation with other jurisdictions and departments, will continue to work towards these goals through such mechanisms as:

- the Water Conservation and Economic Task Group of the Canadian Council of Ministers of the Environment; and
- the National Agri-Environmental Standards Initiative under the Agricultural Policy Framework.

Primary strategies for IWRM actions in Canada

Designing governance mechanisms within and across jurisdictions

Effective mechanisms for governance of water are essential to fostering an integrated management approach, and many such mechanisms are in use in Canada. One example of an international governance mechanism is the International Joint Commission, which was established under the 1909 Boundary Waters Treaty between Canada and the United States to help anticipate, prevent, and resolve water disputes over boundary and transboundary waters, in particular the Great Lakes. The Commission, a model of binational cooperation for these waters, serves as an independent and objective advisor to governments, typically addressing and recommending ways to resolve transboundary water issues through bilateral arrangements that often use existing mechanisms at the federal and provincial–state levels of the two countries. Furthermore, for specific water issues or watersheds, Canadian provinces and U.S. states are working together in various binational initiatives and forums. For instance, Ontario and Quebec are associate members of the Great Lakes Commission, an American organization created by joint legislative action of the eight Great Lakes states in 1955. The Lake Champlain Basin Program is another example of such a province–state joint effort towards IWRM (see box).

Promoting similar cooperation at the national level, the Canadian Council of Ministers of the Environment provides a formal mechanism for effective intergovernmental discussion and coordinated approaches to regional and national environmental issues, including water management. The federal and provincial/territorial governments also cooperate on the national collection of water quantity information through national hydrometric agreements. Regional cooperation in water management is also achieved through bodies such as the Prairie Provinces Water Board, created to ensure that interprovincial surface waters and groundwaters are equitably shared by Canada's Prairie provinces and to prevent potential conflicts.

Innovative governance mechanisms for water management are actively encouraged. For example, Manitoba was the first jurisdiction in

Lake Champlain Basin Program

Through the Lake Champlain Basin Program, the governments of New York, Vermont, and Quebec are working in partnership with other stakeholders to restore and protect Lake Champlain and its watershed. Partners include federal agencies, research institutes and universities, watershed organizations, community groups, and individuals. The program is guided by the Lake Champlain Steering Committee, which was initially created in 1988 by the Memorandum of Understanding on Environmental Cooperation on the Management of Lake Champlain, signed by the Governors of Vermont and New York and the Premier of Quebec and periodically renewed (most recently in 2003). The Steering Committee serves as a forum for information exchange and a mechanism to coordinate provincial and state policies and programs. The Steering Committee is in turn advised by six committees: the Technical Advisory Committee, the Cultural Heritage and Recreation Advisory Committee, the Education and Outreach Advisory Committee, and three Citizen Advisory Committees. The first three committees provide information, identify emerging issues, oversee program implementation, and interpret program results related to their areas of interest and expertise. Citizen Advisory Committees in Quebec, New York, and Vermont make recommendations to the Steering Committee on the condition and management of Lake Champlain. The Lake Champlain Basin Program (*www.lcbp.org*) is carried out according to the plan "Opportunities for Action / An Evolving Plan for the Lake Champlain Basin." Updated in 2003, this plan was built on findings from public input meetings, citizen perception surveys, focus group discussions, technical workshops, research, monitoring, and demonstration projects. This partnership between Quebec, Vermont, and New York to protect the water quality and ecosystems of the Lake Champlain Basin is a good example of a regional integrated water management approach in the context of an international watershed.

Canada to combine all water and aquatic resource functions into one department: Manitoba Water Stewardship. There is also much activity under way to strengthen governance at the watershed level in Canada. Ontario's Conservation Authorities, for example, have been promoting IWRM on a watershed basis since 1946. Under the *Conservation Authorities Act* (1946), watershed municipalities can cost-share water management activities, including flood control, dam maintenance, floodplain management, soil erosion, reforestation, recreation and education. Today, there are 36 Conservation Authorities in all major populated watersheds in Ontario. Watershed councils are being established in Alberta, Saskatchewan, Manitoba and Quebec. Numerous non-governmental watershed stewardship groups are also active in many areas.

The following case studies on the accompanying CD demonstrate intergovernmental arrangements for water management in Canada:

- International Joint Commission — The mechanism that oversees equitable and sustainable use of transboundary waters shared by Canada and the United States.
- Canadian Council of Ministers of the Environment — A formal mechanism to promote effective intergovernmental cooperation on regional and national environmental issues.
- Prairie Provinces Water Board — A water-sharing mechanism to resolve interprovincial conflicts between upstream and downstream water uses.
- Great Lakes Water Quality Agreement and Great Lakes Charter — Two governance mechanisms concerning the Great Lakes waters.
- St. Croix International Waterway Commission — An independent body creating and implementing a heritage management plan for the international boundary waters of the St. Croix River.
- Mackenzie River Basin Transboundary Waters Master Agreement and the Mackenzie River Basin Board — A governance structure for water management in a vast river basin in northwestern Canada.
- Lake Champlain Basin Program — An international partnership to protect Lake Champlain and its watershed.

Applying the right mix of instruments and tools to achieve results

IWRM must be grounded in a strong legal and regulatory framework and carried out by designing and using an appropriate mix of instruments and tools. Canada's 1987 Federal Water Policy incorporates integrated planning as a key strategy and contains many of the recognized components of IWRM. Key examples of current federal initiatives that support IWRM include the First Nations Water Management Strategy 2003, which applies a multi-barrier approach to the protection of source and drinking water quality for First Nations communities; Infrastructure Canada provides funds to construct and upgrade municipal water and wastewater treatment systems and encourages watershed planning and demand management; and the Agricultural Policy Framework, which includes measures to improve the environmental performance of Canada's agriculture sector. Also, the federal ecosystem initiatives (Atlantic Coastal Action Program,

St. Lawrence Action Plan, Great Lakes Action Plan 2000–2005, Northern River Basins Study/ Northern Rivers Ecosystem Initiative, Northern Ecosystem Initiative, Georgia Basin Ecosystem Initiative), which are implemented in partnership with stakeholders, promote IWRM in key areas across Canada.

Beyond single policies such as these, there is a strong need for an integrated national approach to key water issues. A good example is how jurisdictions have collaborated to address bulk water removal, including diversions from major watersheds. For its part, the Government of Canada has prohibited the bulk removal of water from the Canadian portions of boundary waters, and provincial governments have extended similar protection to provincial waters. For example, the Province of Newfoundland and Labrador introduced an Act to prohibit bulk water removal from the province in 1999, incorporating the Act in its 2002 *Water Resources Act*. However, removal of water in containers of not more than 30 litres and for safety or humanitarian purposes is permitted. For their part, the provinces of Ontario and Quebec and the eight riparian states of the Great Lakes have been working together since June 2001 to jointly manage water withdrawals (see box). National collaboration is also under way to develop specific water management tools, such as water quality guidelines, and a national environmental sustainability framework is being developed, with IWRM as a key component.

At the provincial/territorial level, important strides are being made towards implementing IWRM, with recently introduced water policies promoting source-to-tap drinking water protection plans or broader watershed management planning (see box on page 8). In all cases, the move is towards improved governance, integrated management, better data and information, greater transparency and accountability, full stakeholder involvement, and an emphasis on clear goals and results. Many provinces are introducing new policies and/or legislation to support changes in governance. For example, the Province of Alberta's new Water for Life strategy introduces a transition from traditional water management planning (focusing on water allocation issues) to integrated watershed management planning supported by a shared governance model, and Ontario is moving forward with a comprehensive approach to protecting sources of drinking water. This fast-moving trend of policy and legislative reform is expected to continue as jurisdictions more fully come to terms with the need to manage their water resources for sustainability.

At the ground level, many tools are being used to support an integrative approach to water management, including diagnostic indicators, integrated modelling, water balance models, multi-barrier action plans to protect water from source to tap, and improvements in information for decision-making. The traditional focus on enforcement and compliance is being complemented by more collective solutions that

Great Lakes Charter Process

The Great Lakes Charter, signed in 1985, is a voluntary agreement through which the Great Lakes provinces (Ontario and Quebec) and states (Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, and Wisconsin) cooperatively manage the waters of the Great Lakes, led by the premiers and governors of these jurisdictions (Council of Great Lakes Governors; *www.cglg.org/projects/water/index.asp*). In the 2001 Annex to the Charter, the Parties agreed to develop a new set of binding agreements in order to establish a new decision-making standard for all water withdrawals and diversions and for all user sectors within the Great Lakes and St. Lawrence River Basin (surface waters, tributaries, and groundwaters). This process is characterized by strong stakeholder participation through an Advisory Committee, and drafts of the Annex Implementing Agreements are systematically submitted to a basin-wide public consultation. Great Lakes and St. Lawrence watershed protection, control of diversions, water conservation, public participation, assessment of cumulative impacts, and dispute resolution mechanisms are central topics of this recent initiative.

Examples of Recent Federal, Provincial, and Territorial Water Policy Initiatives

British Columbia

- *Water Sustainability Action Plan for British Columbia*: to encourage province-wide implementation of fully integrated water sustainability policies, plans, and programs linking water management with land use, development, and resource protection
- *Drought Management Action Plan*: coordinated measures to address immediate drought-related issues and to provide direction for longer-term review of provincial water policy focusing on allocation, use, and conservation
- *Action Plan for Safe Drinking Water*: multi-barrier, source-to-tap approach; increases the basic expectations around assessing water sources and systems, certifying operators and suppliers, and monitoring and reporting on water quality; strengthens the existing drinking water protection framework by focusing on preventing and treating contamination and identifying and addressing risks for communities

Alberta

- *Water for Life: Alberta's Strategy for Sustainability*: healthy, sustainable ecosystems; safe, secure drinking water supply; reliable, high-quality water supplies for a sustainable economy; knowledge necessary for effective water management decisions; watershed initiatives and promotion of IWRM

Saskatchewan

- *Water Management Framework*: a partnership among all levels of government and citizens in developing and implementing water management solutions; full-cost pricing for the supply of water
- *Safe Drinking Water Strategy*: safe and reliable water supplies within healthy and diverse aquatic ecosystems through prevention of risks to drinking water quality, with human health as the primary concern

Manitoba

- *Manitoba Water Strategy*: development of an integrated water planning and management system; review and consolidation of water legislation; development of mechanisms for financing water management and planning

Ontario

- *Watershed-based Source Protection Planning* (in consultation): proposed watershed-based drinking source water protection program, including stakeholder involvement at the local level; proposed legislative framework for the development and approval of source water protection plans

Quebec

- *Quebec Water Policy*: full integration of the different aspects of water management (2002); five years of research, consultations, and recommendations; governance reform by adopting an integrated watershed management approach relying on citizen involvement; integrated management of the St. Lawrence River; recognition of water as an integral part of the collective heritage of the citizens of Quebec; joint development and harmonization of various uses and practices with a view towards sustainable development; over 50 associated government commitments

New Brunswick

- *Water for Life Strategy*: a strategy for managing water sustainability
- *Source Drinking Water Protection Program*: drinking water supply protection, including areas to protect surface water and groundwater sources designated by legislation and co-managed by the province and municipalities
- *Water Treatment and Distribution Program*: multi-barrier approach to water treatment and distribution systems

Nova Scotia

- *Nova Scotia Drinking Water Strategy*: comprehensive management of drinking water based on the multi-barrier approach; builds on current legislation and the philosophy of continuous improvement; first step of a comprehensive approach to effectively manage all water resources in Nova Scotia

Prince Edward Island

- *P.E.I. Drinking Water Strategy*: a multi-barrier approach to protect drinking water from ground to glass; focused on source protection, system design and operation, and monitoring and reporting

Newfoundland and Labrador

- *Newfoundland and Labrador Multi-barrier Strategic Action Plan*: source protection; water treatment; operation and maintenance of water supply systems; comprehensive drinking water quality monitoring and reporting to public; appropriate inspection; abatement and enforcement measures; and operator education and training in communities

Yukon

- *Rural Public Drinking Water Access Consultation*: drafting of guidelines for new regulations that reflect source-to-tap protection of public drinking water systems and bulk water delivery systems

Northwest Territories

- *Northwest Territories Framework for Management of Drinking Water Quality*: source water management shared with Indian and Northern Affairs Canada; a cooperative initiative among several territorial departments; communication of information to water users; and review of roles and responsibilities framed in a source-to-tap approach

Nunavut

- *Northern Strategy*: a comprehensive strategy for the North to strengthen governance, partnerships, and foundations of the economy, to protect the environment, to promote healthy communities, and to expand scientific knowledge (also covers Northwest Territories and Yukon)

Canada

- *Federal Water Policy (1987)*: Comprehensive policy promoting sustainable water management in Canada
- *Indian and Northern Affairs Canada*: First Nations Water Management Strategy
- *Federal Bulk Water Removal and Water Export Policy*: a comprehensive, long-term approach that protects Canada's water resources by prohibiting the bulk removal of boundary waters from Canada's five main ocean drainages
- *Infrastructure Canada*: making strategic investments in infrastructure: achieving a New Deal for Cities and Communities
- *Canada's Oceans Action Plan*: a plan that will enable government-wide action to develop Canada's oceans resources for the benefit of coastal communities while protecting fragile marine ecosystems
- *Agriculture Policy Framework*: a comprehensive policy with accompanying measures for strengthening Canada's agriculture sector, including for improving its environmental performance

Note: Additional information on these initiatives is available from the Websites listed at the end of this document.

emphasize participation, cooperation, and behavioural change through a combination of regulatory and non-regulatory instruments. New investments are being made in municipal water infrastructure, and economic instruments, such as municipal water pricing, are also being pursued. Education and outreach are complementary instruments that are often used in combination with other tools to encourage compliance with water conservation and water quality protection measures. Informational and educational materials are used extensively by municipalities and provinces/territories to promote responsible behaviour and to inform consumers of the water situation and its impacts. Public awareness campaigns, comprehensive Websites, information workshops, dissemination of educational programming and materials, and a wide range of field activities are among the many ways in which Canadians and their communities receive information and learn how to act on it.

The following case studies on the accompanying CD provide examples of instruments and tools used to support IWRM in Canada: CD

- Key Legislation — A table listing key legislation under which water is managed by Canada's provincial, territorial and federal governments.
- First Nations Water Management Strategy — A federal strategy targeted at improving drinking water in First Nations communities.
- Integrated Watershed Modelling of the South Saskatchewan River Basin — A model to analyze water use and predict future water demands.
- Designation of Source Waters for Drinking Water Protection (Province of New Brunswick) — A program designed to protect drinking water quality, beginning at the source.
- Water Balance Model (Province of British Columbia) — An interactive online tool that can be used to evaluate the effectiveness of strategies for storm water source control.
- Implementation of a Multi-Barrier Strategic Action Plan for Drinking Water Safety (Newfoundland and Labrador) — An action plan to ensure adequate safeguards at each stage of the water supply system.
- Labrador Inuit Land Claims Agreement including Water Management and Inuit Water Rights — A modern-day treaty between the Labrador Inuit Association, the Province of Newfoundland and Labrador, and the Government of Canada.

Pursuing science to inform decision-making

Many of Canada's universities house specialized centres for water science, and both federal and provincial/territorial governments undertake research on an extensive range of water issues.

Freshwater Science at Canada's National Water Research Institute (NWRI)

Working with partners in the Canadian and international science communities, NWRI conducts a comprehensive program of ecosystem-based research and development in the aquatic sciences, generating and disseminating scientific knowledge needed to resolve environmental issues of regional, national, or international significance to Canada and to sustain our natural resources and freshwater ecosystems.

On the global scene, NWRI provides leadership to international science committees and research programs, sharing knowledge on global issues such as the impacts of climate change on water quantity and quality; persistent organic pollutants; the impacts of urbanization, industrial development, and agriculture on water quality; contaminated sediments; and aquatic restoration. As well, NWRI operates the program office for the United Nations Environment Programme's Global Environment Monitoring System Water Programme (GEMS/Water), a multifaceted water science program oriented towards understanding freshwater quality issues throughout the world. Additional information on NWRI is available at *www.nwri.ca/*.

Water-related expertise resides in all of the Government of Canada's science-focused departments, and specialized research organizations, such as the National Water Research Institute (see box on page 10), carry out comprehensive research and development in the aquatic sciences in partnership with Canadian and international science communities. The collaborative work of Canada's water research partners has contributed to two integrated national assessments of the state of water quantity and quality in Canada: *Threats to Water Availability in Canada* and *Threats to Sources of Drinking Water and Aquatic Ecosystem Health in Canada*. It has also contributed to the development of new water-related technologies, such as methods and equipment to reduce or eliminate undesirable substances from drinking water and wastewater, remediate contaminated groundwater and sediment, and promote the production of clean water.

Canadian researchers use baseline data from databases developed from national surveys of water and climate and maintained by the federal government. In many cases, data collected by provincial agencies are maintained by the provinces or contributed to the federal database, thereby providing research with a solid basis. Research and development efforts made by governments, businesses and universities (e.g., the Canadian Water Network; *www.cwn-rce.ca*) have resulted in the introduction of technologies that address various water issues and concerns. Canadian industry includes a number of companies that develop and produce technologies that are used to reduce or eliminate substances that may be harmful to human health or the environment from either drinking water or wastewater. The National Water Research Institute has also developed advanced technologies for the remediation of contaminated groundwater and sediment. In partnership with industry, governments also play a key role in the development of clean technologies. As an example, the Technology Partnerships Canada technology investment fund supports the development of environmental technologies, including both water and wastewater treatment.

The following case studies on the accompanying CD are offered as examples to illustrate scientific work associated with IWRM in Canada:

- South Tobacco Creek Project (Province of Manitoba) — Research to gain a greater understanding of a watershed's hydrology to inform management practices.
- Turkey Lakes Watershed Study — A study into the effects of anthropogenic pollutants and ecological perturbations in the Canadian Shield region.
- Canadian Environmental Quality Guidelines — Nationally endorsed, science-based objectives for the quality of aquatic and terrestrial ecosystems.

Creating a reliable and accessible information base

Good environmental monitoring, data collection, comprehensive assessments and interpretation, and sound management and distribution of information are needed to support the many levels and types of decision-making involved in

IWRM. Currently in Canada, water information is held in many different databases by many agencies located across the country, and decision-makers are looking at how to improve the systems that permit access to the information they need.

Water quantity and climate monitoring are carried out across the country through national programs under the responsibility of Environment Canada. Water quantity monitoring is undertaken through Environment Canada's hydrometric program and carried out under formal agreements with the provinces and territories. Work is devoted to the collection, interpretation, and dissemination of surface water quantity data and information.

For water quality monitoring, several federal–provincial/territorial agreement-based networks exist, and some provinces have their own networks in place; however, a more coordinated and comprehensive approach is needed. To that end, collective efforts are being made through the Canadian Council of Ministers of the Environment to revitalize capacities and build a Canada-wide integrated network for water quality monitoring. The long-term goal is to achieve a national, scientifically sound measurement and assessment network for aquatic ecosystems, one that is responsive to a wide range of current and emerging water quality and water use issues.

With respect to drinking water quality, Health Canada, provincial/territorial health departments, and their partners are monitoring waterborne disease under the National Enteric Surveillance Program. Health Canada and the provinces/territories also collaborate in the development of the Guidelines for Canadian Drinking Water Quality. Health Canada provides the scientific and technical expertise to these efforts, the results of which are used by every jurisdiction in Canada and are the basis for establishing drinking water quality requirements for 31 million Canadians. Similarly, over 300 Canadian Environmental Quality Guidelines, which are related to the protection of aquatic ecosystems, the quality of sediment and soil, and the assessment of contamination in aquatic life, have been developed collaboratively by jurisdictions. Efforts are currently under way to connect these health and environmental guidelines with other assessment tools (e.g., indices) to establish strategies for the protection of drinking water sources.

Work is under way to build a comprehensive information system for the environment that will mobilize existing networks, interconnect different water databases, and provide one-window access to users seeking water information. Another broad source of water information is Statistics Canada's national environmental reports, which summarize trends in water quantity, water quality, water use, and human impact on important waterways.

Government and non-government groups alike are making greater efforts to keep Canadians better informed about water issues and sustainable practices. Public awareness campaigns, information workshops, and a wide range of field activities are among the many ways in which Canadians and their communities receive information and learn how to act on it. One initiative to improve communication and reporting aims to develop a new National Water Quality Indicator. This indicator will use the Canadian Council of Ministers of the Environment water quality index as a tool to report on the quality of Canada's water at a national scale.

The following case study on the accompanying CD is offered to illustrate efforts to improve

communication of water-related information to the public:

- Improvements in Public Access to Water-Related Information (Province of Saskatchewan and Province of Newfoundland and Labrador) — A pair of Websites and information systems that provide information on water management to the public.

Key examples of IWRM in action across Canada

A large number of locally based initiatives are taking place in Canada to put IWRM into practice. Some of this work covers large geographical areas with the involvement of many jurisdictions, while other work centres on small watersheds and aquifers. In all cases, effective partnerships and local action are keys to success. In recent years, the trend has been to involve stakeholders in water management, from the earliest stages of planning to the many and varied activities of implementation. At the watershed level, management generally involves a local advisory board with members from provincial/territorial and local municipal governments, Aboriginal peoples, industry, educational institutions, local stewardship groups, development groups, wildlife groups, environmentalists, landowners, and the concerned public.

The following case studies on the accompanying CD are offered as examples to illustrate IWRM principles at work in Canada.

Large watersheds

- Fraser Basin Council — A non-profit, non-governmental organization with the mandate to promote the economic, environmental, and social sustainability of a large and heavily populated river basin in the province of British Columbia.
- Mackenzie River Basin Transboundary Waters Master Agreement and the Mackenzie River Basin Board — A governance structure for water management in a vast river basin in northwestern Canada.
- Great Lakes Action Plan 2000–2005 — A framework organizing the activities of eight federal departments around conserving and protecting human health and environmental quality in the Great Lakes Basin.
- Lake Erie Lakewide Management Plan — A component of the work to manage the Great Lakes, shared by Canada and the United States.
- Georgia Basin Action Plan — An integrative plan for broad sustainability, including water management, in inland and coastal British Columbia.
- St. Lawrence Action Plans — Cooperative initiatives of the governments of Quebec and Canada to protect, conserve, and restore the St. Lawrence River.

- South Saskatchewan River Basin (Province of Alberta) — A basin-wide plan to manage a river shared by the provinces of Alberta and Saskatchewan.

Small watersheds

- Grand River Conservation Authority (Province of Ontario) — A highly active authority comprising member municipalities that cooperate in water management at the watershed level in the province of Ontario.
- Upper Assiniboine River Basin Study (Provinces of Saskatchewan and Manitoba) — A comprehensive study that led to the development of a framework for water management of a river shared by the provinces of Saskatchewan and Manitoba.
- Lower Souris River Watershed (Province of Saskatchewan) — A priority watershed planning area in the province of Saskatchewan for which source water protection plans are being developed at the sub-watershed level by watershed advisory committees with the support of technical committees, all under a master provincial strategy.
- Corporation d'aménagement et de protection de la Sainte-Anne (CAPSA) (Province of Quebec) — A group that undertakes many field projects to restore a local river in the province of Quebec, under the direction of a board comprising a wide variety of stakeholders.
- Eastern Charlotte Waterways Inc. (Province of New Brunswick) — An organized group of concerned citizens working under the federal Atlantic Coastal Action Program in partnership with the province of New Brunswick to manage surface watersheds in their region through New Brunswick's water classification program.
- Big Shell Lake Community Watershed Management Project (Agriculture and Agri-Food Canada) — A pilot project to demonstrate that management by watershed stakeholders would be a viable approach in Saskatchewan.

Water conservation and sustainable use

- Municipal Action in Kelowna, Province of British Columbia; Thunder Bay, Province of Ontario; and Toronto, Province of Ontario — Illustrations of how small, medium-sized, and large communities in different parts of Canada achieved greater water efficiency at the municipal and domestic levels.
- Water Conservation Plan (Province of Saskatchewan) — A plan, still under public consultation, to conserve water in a Prairie province where water supply can be uncertain.
- Water Use Planning (Province of British Columbia) — A plan related to the practices of hydroelectric plants in the province of British Columbia to give greater consideration to competing water uses.

Federal infrastructure initiatives

- Infrastructure Canada — Public funding for new construction and upgrades to municipal water and wastewater treatment systems.

Industry initiatives

- Water Savings at Tate and Lyle Canada — Measures taken to increase water efficiency at a plant (Tate and Lyle Canada) in Toronto.
- Multi-Stakeholder Approach (Alcan) — Organization of a multi-stakeholder council to discuss and build consensus on watershed issues in British Columbia.

- Membrane-Treated Wastewater at Petro-Canada — Using wastewater from Edmonton's treatment plant to reduce intake from the North Saskatchewan River.

- Unilever's Commitment to Clean Water — A series of initiatives put in place by Unilever Canada to ensure that Canadians continue to have access to clean water.

Some domestic lessons learned and prospects for the future

Lessons learned

Canada's experience to date confirms the importance of fostering an enabling environment based on the IWRM principles described previously in this document (see Table 1). The following are highlights of some of the key lessons learned based on domestic experience:

- **Governance and coordination mechanisms are critical, particularly at the watershed level, for fostering transparency, accountability, and stakeholder involvement and collaboration.** Adoption of IWRM at the local management level is vital and is in fact spreading across Canada and establishing a new standard for governance. As trends in watershed management continue, effective leadership will help energize stakeholders, recognize contributions made and celebrate community successes.

- **A wide spectrum of tools needs to be applied — a "one size fits all" approach is not effective to deal with the increasing complexity of water management issues.** While legal and regulatory tools act as a strong backstop, more tailored instruments can be used to suit various situations and challenges. Application of voluntary guidelines, promotion of targeted water policies and consensus-based tools such as accords and protocols, are an expanding part of the toolbox. There is also increasing recognition of the impacts that economic and information instruments can have, as well as the value of having transparent and structured planning processes to further lever integrated actions on water.

- **Water science is a major building block for applying IWRM.** Water research plays an important role in helping develop environmental policy, regulations and guidelines, and instruments and tools, and in decision-making in general. Efforts continue to be made to strengthen linkages between researchers and decision-makers across governments and disciplines, as well as with other countries.

- **Water management information and reporting systems are needed to help guide and assess priorities and emerging IWRM issues.** Jurisdictions have collaborated in many ways, such as developing guidelines to assess water quality, building data collection networks, modelling, and developing indicators to report on water resource trends.

Prospects and challenges

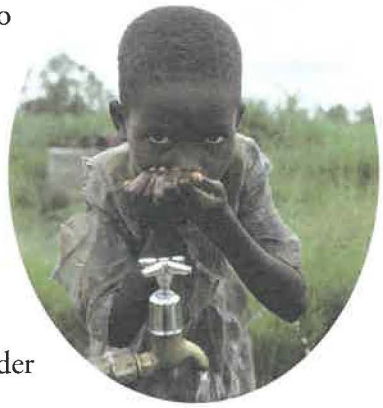
Canada's prospects for enhancing the adoption of IWRM rest on success in boosting capacity at all levels to further implement an integrated approach

to water management. To meet this challenge and build on the lessons outlined above, particular efforts will be needed in the following key areas:

- Build on current momentum and maintain a sustained and ongoing effort to both establish and strengthen governance mechanisms for integrated water management.
- Develop and improve decision support tools to analyze and guide water management decisions, particularly at the watershed scale, through research and the development of integrated models.
- Undertake and further the evaluation of instrument mixes and approaches to better understand what works, where, and under what circumstances, with a view to sharing information on best practices.
- Enhance the availability of data and information on factors important to IWRM — such as land use and cover and water quality, use, and availability — through surveys, monitoring, and enhancement of databases.
- Improve measurement and reporting systems to help guide and assess progress, through monitoring, modelling, and the development of indicators.
- Better account for the full economic, social, and ecological value of water and ensure appropriate weighing in decision-making, through valuation research and by using integrated approaches for decision-making.
- Strengthen and improve socioeconomic and physical science for water management, as a key strategy for helping address the challenges listed above.

Canada's contribution to IWRM abroad

Canada is committed to global sustainable development — that is, development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Water is a critical development issue, related to attempts to alleviate poverty, improve food security, protect human health, preserve ecosystem services and environmental sustainability, and promote greater gender equality.



The United Nations estimates that currently over 1 billion people lack access to safe drinking water and a further 2 billion lack access to adequate sanitation. Canada is committed to doing its part to reduce the proportion of people without access to clean water and sanitation. Canada has been active in developing and has agreed to work towards achieving the Millennium Development Goals and the Johannesburg Plan of Implementation.

Canada has much to contribute to making a difference in the implementation of IWRM abroad. The Canadian International Development Agency (CIDA) contributes to fulfilling Canada's international commitments to

meet the Millennium Development Goals. Activities supported through the Official Development Assistance and Official Assistance programs include capacity building for the adequate delivery of water services, improving access to clean water and sanitation, waste management and disposal, agricultural water resource development, river development and flood prevention and control. Canada's expanded assistance for sustainable development in Africa through the G8 Africa Action Plan and the Canada Fund for Africa supports efforts by African governments to improve water management and access to clean water and sanitation.

Since its creation in 1970, the International Development Research Centre (IDRC) has supported water-related research. An initial focus on developing water supply has since evolved to encompass water treatment and quality control. More recently, the focus has shifted to demand management and the devolution of water management to lower levels of government and communities. The IDRC works in partnership with local scientists and communities in Africa, the Middle East, Asia, Latin America, and the Caribbean, supporting research projects and related activities designed and proposed by institutions in these developing areas.

The following case studies on the accompanying CD are offered as examples to illustrate Canada's contribution to IWRM abroad:

- Water-Related Research at the International Development Research Centre (IDRC) — IDRC projects cover a range of water topics, from quality control to water demand management.

- Tarim Basin Desertification and Water Management, China (IDRC) — Parallel micro and macro research in a watershed in a threatened ecosystem in China.

- WaDImena: Water Demand Management in the Middle East and North Africa (IDRC) — A research project that promotes the implementation of water demand management.

- National Water Quality and Availability Management in Egypt — Development of a coordinated national system for sustainable water resources management in Egypt.

- Honduras — Sustainable Water and Sanitation Project II (PASOS II) (CIDA) — Integrated community managed health–hygiene–water sanitation projects in approximately 35 communities.

- Bangladesh Environmental Technology Verification (CIDA) — A project to strengthen the capacity of the Government of Bangladesh and civil society to improve national health through the validation and certification of arsenic mitigation technologies, capacity building, and related policies governing the use of these technologies.

- Support for IWRM in Africa (CIDA) — Strengthening African countries through a multi-pronged approach to the development and implementation of IWRM.

- CIDA's Contribution to the Nile Basin Initiative (CIDA) — A basket of programs aimed to achieve sustainable socio-economic development of the Nile River Basin through the equitable utilization of, and benefit from, the Nile water resources.

Canadian perspectives for advancing IWRM internationally

Canada intends to continue its active participation in IWRM internationally and to make a contribution to the global implementation of IWRM. Canada will be promoting the importance of governance, the contribution of

science to global monitoring and assessment, the role of technology and expertise, and the activities supported through its Official Development Assistance and Official Assistance programs. The following is an overview of Canadian positions and perspectives for IWRM advancement globally in the future:

- **There is still a need to overcome existing gaps in current international water governance.** Although governance and coordination mechanisms are improving, there are significant gaps in the areas of analysis and policy integration, decision-making and political engagement, international coordination, and monitoring and reporting. At the regional level, finding effective means of implementing the commitments made at the multilateral level is a challenge.

  Canada will work to develop a feasible multilateral process to address the identified gaps in international water governance and seek agreement on the follow-up model. There will be more emphasis placed on working with what already exists, such as the Ramsar Convention, and building and strengthening regional policy networks for more effective implementation.

- **The world needs to continue to build a better body of knowledge on water issues.** Research into water issues plays an important role in decision-making from the multilateral level to the local level. Water science contributes to the identification and selection of tools for action, such as legislation and regulation, standards, and guidelines.

  Canada intends to contribute to increasing the level of global water knowledge, particularly on water quality monitoring and assessment. This will be done in part through the Canada – United Nations Environment Programme Global Environment Monitoring System's Water Programme (GEMS/Water) and will be complemented by ongoing peer-to-peer dialogue, exchanges, contributions to global conferences, and knowledge building.

- **Local managerial and technical capacity needs to be strengthened.** One of the biggest challenges is matching solutions to problems. Canada believes that the application of appropriate technologies, together with the matching investment in human resources, can be a powerful tool for advancing progress in IWRM.

  Canada recognizes that greater efforts must be taken to expand access to the types of technologies that will have a positive impact on alleviating water resource management issues, but that these technologies will need to be complemented by long-term training and human development initiatives. Working with partners to deliver these services is an important next step.

- **Official development assistance must be supplemented with other forms of activity.** IWRM principles need to be applied while recognizing the challenges of implementation among varying economic, social, and environmental contexts in developing countries.

  Consistent with its policies on strengthening aid effectiveness and private sector development, Canada recognizes the contribution of the water sector to national development. Through the Canadian International Development Agency (CIDA), Canada will

continue to respond to developing countries' priorities identified in locally owned frameworks, particularly through the Poverty Reduction Strategy Papers, where CIDA is satisfied that this process involves a legitimate participatory process.

Conclusion

Sustainable water use and management are fundamental to Canada's and the world's social, economic, and ecological health, and there are clear signs that all Canadian jurisdictions are moving to adopt IWRM as a central water management strategy. A shared understanding of IWRM principles is emerging, and these are increasingly being put into practice through policies, programs, and efforts on the ground. Canada's experience to date confirms the importance of an enabling environment based on effective governance, sound science, appropriate instruments, and relevant information. Ongoing progress in Canada and abroad will require that key challenges in each of these areas be addressed.

To obtain copies of the CD

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Telephone: (819) 997-2800 or 1 800 668-6767
Fax: (819) 994-1412
TTY: (819) 994-0736 (Teletype for the hearing impaired)
E-mail: enviroinfo@ec.gc.ca

List of key Websites

Provincial/Territorial Websites

Alberta

Environment – Water
www3.gov.ab.ca/env/water/index.cfm
Alberta's Water for Life Strategy
www.waterforlife.gov.ab.ca/

British Columbia

Water, Land and Air Protection
www.gov.bc.ca/wlap/
Sustainable Resource Management – Water Resource Information
srmwww.gov.bc.ca/wat/index.html
Health Services – Drinking Water Protection Plan
www.healthplanning.gov.bc.ca/protect/water.html

Manitoba

Water Stewardship
www.gov.mb.ca/waterstewardship/
The Manitoba Water Strategy
www.gov.mb.ca/waterstewardship/waterstrategy/index.html

New Brunswick

Environment and Local Government – Water
www.gnb.ca/0009/0003-e.asp
A Guide to New Brunswick's Watershed Protected Area Designation Order
www.gnb.ca/0009/0371/0004/0001-e.asp
A Guide to New Brunswick's Wellfield Protected Area Designation Order
www.gnb.ca/0009/0371/0001/0001-e.asp

Newfoundland and Labrador

Environment and Conservation – Water Resources Management
www.gov.nf.ca/env/Env/water_resources.asp
Source to Tap – Water Supplies in Newfoundland and Labrador
www.gov.nl.ca/env/sourcetotap/SourceToTap/Report.asp

Northwest Territories

Health and Social Services – Drinking Water Quality
www.hlthss.gov.nt.ca/Features/Programs_and_Services/env_health/waterquality/index.htm
Indian and Northern Affairs – Water Management In Northwest Territories and Nunavut
www.ainc-inac.gc.ca/ps/nap/wat/watmannwt_e.html

Nova Scotia

Environment and Labour – Water and Wastewater
www.gov.ns.ca/enla/water/
A Drinking Water Strategy for Nova Scotia
www.gov.ns.ca/enla/rmep/h2ostrat.pdf

Nunavut

Environment
www.gov.nu.ca/Nunavut/environment/Index.html
Indian and Northern Affairs – Water Management In Northwest Territories and Nunavut
www.ainc-inac.gc.ca/ps/nap/wat/watmannwt_e.html

Ontario

Environment – Water
www.ene.gov.on.ca/water.htm
Safe Drinking Water Act, 2002
www.ene.gov.on.ca/envision/water/sdwa/index.htm
Water Taking and Transfer Regulation
www.e-laws.gov.on.ca/DBLaws/Source/Regs/English/2004/R04387_e.htm
Conservation Ontario
www.conservation-ontario.on.ca

Prince Edward Island

Environment and Land – Water Resources
www.gov.pe.ca/infopei/index.php3?number=43340&lang=E&PHPSESSID=176b2f0a71f4ec932739c766be76d915
Drinking Water Strategy
www.gov.pe.ca/infopei/index.php3?number=50234&lang=E&PHPSESSID=27b70dfe0cbafbbe12b2d70154d3aed8

Quebec

Sustainable Development, Environment and Parks – Water
www.menv.gouv.qc.ca/eau/inter_en.htm
Quebec Water Policy
www.menv.gouv.qc.ca/eau/politique/index-en.htm
Regulation respecting the quality of drinking water
www.menv.gouv.qc.ca/eau/potable/brochure-en/index.htm

Saskatchewan

Watershed Authority – Water Conservation
www.swa.ca/WaterConservation/default.asp
Water is Life – Sask H_2O
www.saskh2o.ca
Safe Drinking Water Strategy
www.se.gov.sk.ca/environment/protection/water/2005-06PerformancePlan-DrinkingWater.pdf
Environment – Water Management Framework
www.se.gov.sk.ca/ecosystem/water/framework/

Yukon

Environment – Water Resources Section
www.environmentyukon.gov.yk.ca/epa/waterresources.html
Health and Social Services – Yukon's Public Drinking Water
www.hss.gov.yk.ca/prog/eh/water.html

Federal Websites

Agriculture and Agri-Food Canada
www.agr.gc.ca/pfra/water/intro_e.htm

Atlantic Coastal Action Program
atlantic-web1.ns.ec.gc.ca/community/acap/default.asp

Canada's National Programme of Action for the Protection of the Marine Environment from Land-based Activities (NPA)
www.npa-pan.ca

Environment Canada – Freshwater
www.ec.gc.ca/water/e_main.html
Environmental Acts and Regulations
www.ec.gc.ca/enviroregs/eng/default.cfm

Fisheries and Oceans Canada
www.dfo-mpo.gc.ca/canwaters-eauxcan/index_e.asp
Acts, Orders and Regulations
www.dfo-mpo.gc.ca/communic/policy/dnload_e.htm#Canada%20shipping%20act
Science – About Science
www.dfo-mpo.gc.ca/science/main_e.htm

Government of Canada – Sustaining the Environment and Resources for Canadians
www.environmentandresources.gc.ca

Health Canada
www.hc-sc.gc.ca/waterquality

Indian and Northern Affairs Canada
www.ainc-inac.gc.ca/ps/nap/index_e.html
First Nations Water Management Strategy
www.ainc-inac.gc.ca/H2O/bkg_e.html

Infrastructure Canada
www.infrastructure.gc.ca/index_e.shtml

Natural Resources Canada
ess.nrcan.gc.ca/pri/env_e.php

Statistics Canada
142.206.72.67/01/01b/01b_002d_e.htm

International Websites

Canadian International Development Agency
www.acdi-cida.gc.ca/index-e.htm

International Development Research Centre
www.idrc.ca/water/

International Joint Commission
www.ijc.org

Protection of the Arctic Marine Environment
www.pame.is/

Additional information

Bay of Fundy Ecosystem Partnership (BoFEP)
www.bofep.org/

Canadian Council of Ministers of the Environment
www.ccme.ca/
Canadian Council of Ministers of the Environment, Source to Tap
www.ccme.ca/sourcetotap/

Canadian Water Network
www.cwn-rce.ca/

Council of Atlantic Premiers
www.cap-cpma.ca/

Council of Great Lakes Governors
www.cglg.org

Great Lakes Commission
www.glc.org

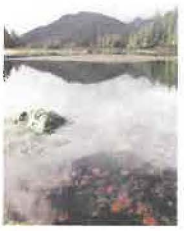
Gulf of Maine Council on the Marine Environment
www.gulfofmaine.org/

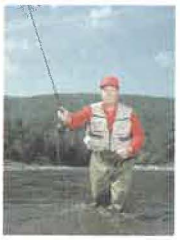
Lake Champlain Basin Program
www.lcbp.org

Mackenzie Global Energy and Water Cycle Experiment (GEWEX) Study
www.usask.ca/geography/MAGS/index_e.htm

Prairie Farm Rehabilitation Administration
www.agr.gc.ca/pfra

Southern Gulf of St. Lawrence Coalition on Sustainability
www.coalition-sgsl.ca/





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