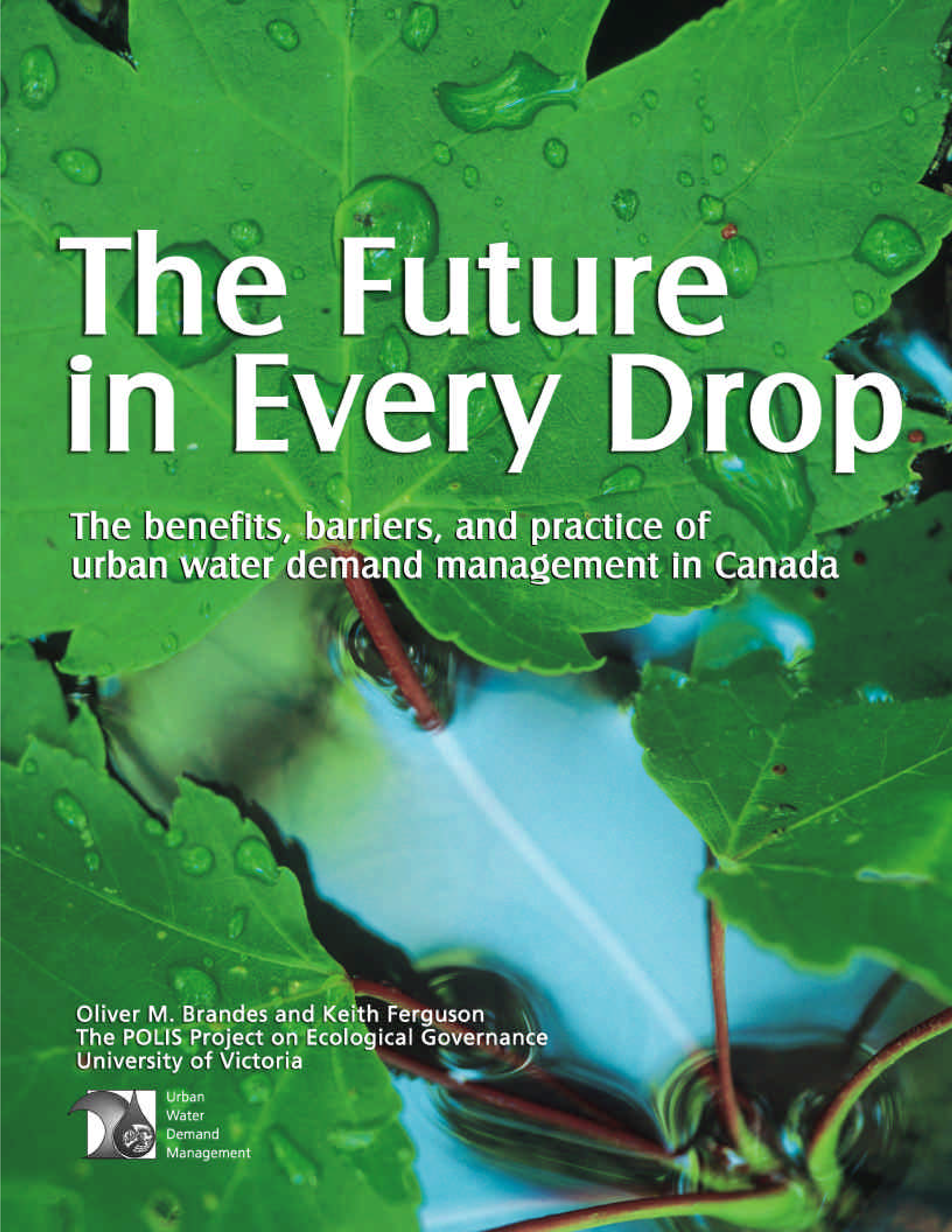

The Future in Every Drop

The benefits, barriers, and practice of urban water demand management in Canada

Oliver M. Brandes and Keith Ferguson
The POLIS Project on Ecological Governance
University of Victoria

Urban
Water
Demand
Management

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BUILDING ON CANADA'S STRENGTHS

Urban Water Demand Management

The Future in Every Drop:

The benefits, barriers, and practice of urban water demand management in Canada

Oliver M. Brandes and Keith Ferguson

April 2004

POLIS Project on Ecological Governance,
University of Victoria,
Victoria, BC

Foreword

Water. Canada. The words are as inextricably linked in our Canadian culture as maple and syrup, or Stanley and Cup. And despite our reverence for the liquid of life, the evidence is compelling that we are over-using and abusing water, to our collective environmental and economic detriment. The fact that one in four Canadian municipalities has endured a water shortage in recent years should be as bracing to us as a large mug of Tim Hortons coffee. A national wake-up call.

Fortunately, the news is not all bad. We know what the problems are, but more importantly we also know what the solutions are, solutions to overcome our short-sighted predilection for waste and pollution.

This vital report by Oliver Brandes and Keith Ferguson provides a series of maps to guide local, provincial, and federal policy makers in moving toward managing urban water use in a smart, sensible, sustainable manner.

The report focuses on the steps that must be taken to implement demand management, an approach that has enabled other industrialized nations to reduce urban water use by as much as 50% without any reduction in the quality or quantity of end-use services. Demand management offers a genuine win-win solution, as communities can reap both environmental and economic dividends from reducing water use.

With this report, the third in a series, the University of Victoria's POLIS Project on Ecological Governance has built a compelling case for the systemic transformation of the way Canadians use and manage fresh water. The science is clear. The urgency is obvious. The laws, policies, and programs that Canada needs, and that have proven successful elsewhere, are outlined here in considerable detail.

What are we waiting for?

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POLIS Project on Ecological Governance
Faculty of Law, University of Victoria
Author of Unnatural Law: Rethinking Canadian
Environmental Law and Policy (UBC Press, 2003)

Acknowledgements

With the publication of this report, the 'water team' at POLIS will have completed a trio of studies introducing Canadians to the problem of overconsumption of water in the country's cities and, now, to a range of potential solutions. This whole body of work has been undertaken under the excellent leadership and guidance of Research Associate, Oliver Brandes. With the thorough research and writing skills of both Oliver and Researcher Keith Ferguson, the present report offers tangible new directions for urban water planning, and detailed techniques for accomplishing it. As Director of the POLIS Project, I would like to acknowledge their achievements, and express my appreciation for them.

Many other people contributed to this report, particularly outside experts Eric Bonham and David B. Brooks who provided detailed comments, valuable advice and undertook a peer review of an earlier draft. Brad Hornick provided layout and design. In addition, many members of the POLIS team also provided assistance: Liz Wheaton supplied unfailing office support throughout the project; David Boyd shared his research, ideas and encouragement, and wrote the foreword; Tony Maas helped develop many of the ideas, offered constant insights, and detailed editing; newcomer, Ellen Reynolds assisted in editing and production while former researcher Emily McNair provided a comprehensive edit, and current researcher Justine Starke undertook a final review. It was my pleasure as well to help give direction and vision to the document. This was truly a team effort!

Finally, I wish to express my personal gratitude to the Walter and Duncan Gordon Foundation, and its director Patrick Johnson, for their generous support, and especially to Project Officer, Brenda Lucas, for her vision and encouragement throughout all our work on this issue of such importance to Canada.

Michael M'Gonigle,
Eco-Research Professor of Environmental Law and Policy,
Director, POLIS Project on Ecological Governance

Executive Summary

Fresh water is critical to the development and well-being of urban society. Yet in Canada, a nation rich in fresh water resources, many communities are experiencing problems with local water supplies. Currently, supply-side management characterizes urban water provision in Canada. This approach responds to rising demands by seeking out new sources of water and expanding infrastructure capacity. The result of this approach is a well-developed system for urban water provision that has brought many benefits to society. However, continuing on this path will be increasingly expensive and environmentally unsustainable.

The potential of urban water demand management

Demand-side management (DSM), or demand management as it is generally called, is a complementary approach that aims to avoid many of the problems associated with high water use by reducing, or at least capping, water demands. Demand management is a comprehensive, integrated and long-term approach that seeks to improve overall productivity of water use and deliver water services matched to the needs of end users. Given the current situation of unsustainably high and inefficient urban water use in Canada, DSM has significant potential to reorient urban water management on to a sustainable path.

Many municipalities in Canada are already undertaking some demand management measures such as education to promote water conservation, rebate programs, and watering restrictions during times of drought. However, these measures are often implemented in a limited and ad hoc manner and are viewed as temporary, until additional supply is secured. Such an approach will not achieve the substantial and reliable long-term water savings and environmental benefits offered by DSM.

Overcoming the gridlock

Some of the many benefits associated with DSM include: the reduction of environmental impacts, an increase in the capacity of utilities to maintain drinking water quality standards, the avoidance of supply limitations, and the deferral of capital costs for infrastructure expansions. Although these benefits are significant, barriers such as overcapitalization, low prices and a supply-side engineering bias, restrict the widespread adoption of urban water demand management in Canada.

Other barriers, such as inadequate data collection, inappropriate government subsidies, lack of funding for DSM, and inflexible policies entrench current practices and result in high urban water use. The interconnected and interrelated nature of these barriers creates a gridlock that resists the adoption of a comprehensive approach to demand management in Canada.

Governance

Overcoming the inertia of the status quo in urban water management is difficult but necessary. Implementation of a comprehensive, integrated and long-term approach will require action by many different groups including all levels of government, professional associations, civil society and end users.

Effective governance and regulation by publicly accountable authorities is critical to ensuring that socially desirable outcomes are forthcoming. 'Good' governance in the urban water context ensures stakeholder involvement, integrated planning, institutional accountability and protection of the watershed environment. Governance must also address the need for departmental capacity for conservation, the nature of utility ownership, and the potential role of private partners as these issues influence the adoption of demand management.

Opportunities for government action

Governance refers to more than just government; it includes broader institutions and social decision-making processes involving business and 'civil society'. However, government still has a critical role. Municipal, provincial, territorial and federal governments must emphasize a comprehensive, long-term and integrated approach. Important themes for the various levels of government are integration of demand management into all aspects of water policy and the critical need for coordination to ensure effective planning and implementation of DSM.

Towards a sustainable society

Urban water demand management is a key element in the transition toward a sustainable society. DSM embodies two of the fundamental shifts that are required to move industrialized societies such as Canada onto a more sustainable path. The first, dematerialization, refers to reducing resource flows through society by increasing efficiency and productivity, for example by installing low-flow fixtures. The second, substitution, involves replacing the use of scarce resources with alternatives and shifting emphasis from commodities to services, for example by replacing potable water with stored rain water for garden irrigation.

Accomplishing the goal of urban water sustainability requires commitment by all segments of society - government, business and civil society. To assist in this endeavour, this report sets out principles of action to guide future strategies.

The wealth of knowledge and experience developed throughout the world in demand management indicates that it is a reliable and increasingly important approach that should be considered by all water resource managers. DSM holds the potential to shift Canadian urban water utilities onto a sustainable path, with significantly reduced costs and environmental impacts.

Principles of Action

• Fair value for water

Eliminate inappropriate subsidies and ensure that full costs, including environmental considerations, are included in the price of water. At the same time, recognize the primacy of fresh water to human life and ecosystem health by ensuring both equitable access for all members of society, and adequate flows for the environment.

• Comprehensive, long-term and integrated approach

Take into account all water uses and water-related activities, and allocate permanent budgets for staff, training, planning and implementation. Investing in such permanent institutional changes will establish demand management as a central feature of water provision and as an ongoing adaptive process. Adopting a watershed-based approach will also ensure that the cumulative impacts of all human activities on ecosystem health are addressed.

• Stakeholder involvement and participatory decision-making

Create processes for meaningful stakeholder participation to ensure community values are expressed and citizens are engaged in identifying and implementing long-term, sustainable solutions.

• Innovation

Foster creative solutions by focusing on the underlying service that water provides, rather than simply delivering water. Improve the *market* for water efficient technology and commence *future proofing* with anticipatory measures that can mitigate uncertainties.

• Leadership

Ensure all institutions lead by example, incorporating best practices and cutting edge environmentally based technologies and processes. Build capacity to effectively advise on existing and emerging domestic and international water management issues. Expand scientific, ecological and socio-economic research through enhanced data collection, technological development and pilot projects.

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Chapter 1

A Comprehensive, Long-Term, Integrated Approach to Water Provision

"Water will become Canada's foremost ecological crisis early in this century" (David Schindler, Killam Memorial Professor of Ecology). "As we peer into the twenty-first century, water conservation is looking far more like an imperative than an option" (Vickers 2001: xv).

1.1. Introduction

Urban water management is undergoing a fundamental shift in many parts of the world. Europe, Australia, parts of the United States and some cities in Canada are now managing freshwater resources in a more integrated way, focusing on maintaining and enhancing ecosystem health and avoiding depletion of water supplies. The emphasis is on curbing demand through demand-side management (DSM), or demand management as it is commonly called. This more integrated approach, however, is not common in Canada.

Most Canadian utilities respond to society's increasing demand for water with traditional supply-side options. This includes constructing or expanding diversion projects, dams, reservoirs, groundwater pumping stations and treatment plants. The results are increasing costs, overstretched water supplies, significant environmental impacts, and a growing concern that future water needs may not be met in many parts of the country.

This report describes the need for a comprehensive, long-term approach to water provision that fully integrates demand management. It discusses barriers to the adoption of DSM measures and outlines practical actions that will facilitate a demand management approach in Canada.

Demand management is a complement to traditional supply-side options. DSM is generally defined as "the planning and implementation of programs to influence the amount, composition, or timing of demand for some commodity or service" (Shrubsole and Tate 1994: 4). For water provision in particular, DSM is defined as "any measure which reduces or reschedules average or peak withdrawals from surface or ground water sources while maintaining or mitigating the extent to which return flows are degraded" (Brooks and Peters 1988).

The DSM approach recognizes that it is possible to influence the demand for water. It is also more sustainable, less environmentally damaging, and often more cost-effective than pursuing traditional supply-side options. Many of the services provided by water, such as sanitation, bathing and aesthetically pleasing landscapes, can be provided just as effectively with less water through technological and behavioural changes.

A common misconception in Canada is that we have more than enough water and that demand management is unnecessary, except in times of drought. In reality, between 1994 and 1999, one in four Canadian municipalities reported problems with water availability, suggesting that an increasing number of municipalities are reaching the limits of their local water supplies and/or the capacity of their current infrastructure (Environment Canada 2001).

The traditional supply-side approach has brought tremendous benefits to billions of people. Throughout the 20th century it has reduced the incidence of water-related disease, expanded the generation of hydropower, increased convenience and comfort in many homes, expanded the potential of irrigated agriculture, and moderated the risks of devastating floods and droughts (Gleick 2003b: 1524). Continuing to use supply-side options, however, may not be a long-term solution.

For many cities the most accessible water sources are already tapped and expanding infrastructure is increasingly expensive. Over-pumping aquifers and the pollution of surface water with municipal wastewater continues to degrade local water supplies. These actions have negative implications for the long-term sustainability of water provision, ecosystem health, and maintenance of drinking water standards. In addition, municipalities face fewer financial resources and increasing pressure to deal with crumbling infrastructure.

A commitment to demand management is necessary to respond to this situation in Canada. Demand management has the potential to improve the sustainability and cost-effectiveness of Canadian water provision. DSM is also a major step toward the broader reorientation of society to live within its ecological bounds. Adopting DSM is also a vital step in reducing the ecological footprints of cities; enabling human activities to better co-exist with ecological processes.

1.2 The Need for a Comprehensive, Long-Term, Integrated Approach

Many Canadian municipalities are implementing some DSM measures, such as outdoor watering restrictions, education campaigns to raise awareness of the need to conserve water, and rebate programs that encourage customers to buy water-efficient fixtures (Waller and Scott 1998: 398). However, these measures are typically implemented in a limited, reactive and *ad hoc* fashion, and usually in response to emergency situations such as drought.

In British Columbia, most communities implement DSM measures incrementally, starting with those that are relatively inexpensive and politically uncontroversial. Only 13% of these communities engaged in any strategic planning, which was likely limited to basic conservation planning (Water Conservation Strategy for BC 1998: 26,30). A study in Ontario found that although individual DSM measures are being implemented, supply-side management continues to predominate. Only one in five of the Ontario municipalities studied had any kind of DSM plan or strategy in place (de Loë 2001: 57,66).

This limited approach to the use of DSM measures is unlikely to produce substantial and reliable long-term water savings. Instead, a comprehensive, long-term, and integrated approach is required to achieve the full potential of demand management.

A ***Comprehensive*** approach considers the full range of available DSM measures in order to choose an appropriate and effective combination. For example, the participation rate in a giveaway program of water-efficient showerheads can be significantly improved by a simultaneous education and marketing campaign. Alternatively, a giveaway program might not be required if the pricing structure is changed to provide financial incentives for households to purchase new showerheads on their own. Unless the full range of DSM measures are considered, the synergies between individual measures and the most effective combinations are unlikely to be captured.

A ***Long-term*** approach considers the impacts of DSM measures over time and the need to include demand management in all long-term planning. Sequencing DSM measures will often increase levels of success. For example, using education campaign to increase public understanding and the acceptability of future pricing changes.

Similarly, some DSM measures may require 'future proofing' to become cost-effective. Installing dual plumbing in new construction, for example, is a relatively cheap option compared to retrofitting existing buildings and would make it feasible to implement municipally-wide water recycling in the future.

Some DSM measures may make others unnecessary in the future. Financial incentives for developers, such as

Box 1: A Comprehensive, Long-Term, Integrated Approach to Urban Water Provision

Comprehensive	Long-Term	Integrated
The full range of DSM measures should be considered to choose the most effective combination.	Careful long-term planning should be undertaken. Including consideration of the sequence of implementing DSM measures over time, especially in light of an analysis of future changes to water availability.	Both demand and supply-side options should be integrated into long-term water provision planning, which should also consider related resources (such as energy, wastewater), ecological demands, actions by other levels of government, and full-cost accounting.

reduced hook-up fees to encourage the installation of water efficient fixtures during construction, can be more effective than subsequently providing financial incentives to homeowners to replace inefficient fixtures.

Another important aspect of long-term planning is a careful assessment of future water availability, including the potential impact of climate change on local water supplies.

An ***Integrated*** approach determines the least-cost combination of activities and may combine demand management measures with differing sectors and other options such as supply-side projects. The least-cost combination is determined by considering all impacts of water use including energy needs for heating or pumping water, costs for potable water and wastewater treatment, and environmental impacts. Unlike standard marginal cost analysis, which externalizes environmental and cumulative impacts, an integrated analysis considers environmental impacts and ecological functions or demands.

Integrating ecosystem needs into water management requires that a certain volume of water (of appropriate quality) remains in the system. This *in situ* water sustains ecosystem function and preserves ecological services such as flood control and aquifer recharge. *In situ* water also provides conventional economic benefits such as transportation, hydro power, fishing and waste dilution.

In addition to considering the full range of impacts and benefits, an integrated approach must integrate the efforts of all levels of government. Measures implemented by one level of government impact the effectiveness of measures taken by another. A provincial plumbing code that mandates water-efficient fixtures, for instance, might make local financial incentives unnecessary.

Taking a comprehensive, long-term and integrated approach to water provision poses challenges, and the complexities are often very different than those encountered in supply-side management. DSM relies on many smaller and decentralized options to increase end use efficiency, ranging from low-flow fixtures and appliances in homes, to wastewater recycling for unique applications, to a diversified pricing structure.

Such an approach provides a flexible portfolio of options, but it contrasts sharply with the more centralized and large-scale projects involved in supply-side management. The required shift in thinking has been analogized to the shift from large, centralized, expensive and single-purpose mainframe computer systems to a network of smaller, on-site systems (FCM 2001: 2). Additionally, DSM requires more direct involvement of end users. Fundamentally, it requires a shift in awareness and a sense of stewardship on the part of water providers, individual homeowners, businesses and industry. Consequently, a different set of skills and resources are required within utilities and government agencies to make an effective shift to demand management.

Box 2: Least-Cost Framework

"Within the least-cost framework of water supply planning, the desirable level of conservation would be reached when the incremental cost of demand reduction would be the same as the incremental cost of supply augmentation. In other words, under this criterion, water utilities would try to meet the projected increases in future demands by investing in water conservation programs until the conserved water would become more expensive than new supplies."

Source: Dziegielewski (1999: 3)

Experience from around the world demonstrates that a comprehensive approach to demand management is effective. Since the 1970s, US urban water managers have increasingly turned to DSM, not just as an emergency measure, but as a package of measures that offers one of the most cost-effective and environmentally sound ways of achieving water security (Platt and Morrill 1997: 285, 286). More recently, some Canadian jurisdictions have also incorporated DSM into their overall water management strategies.

1.3. Purpose and Overview

Strategies to increase water use efficiency and the demand management approach have existed for years. However, demand management measures are still not being thoroughly applied. A recent water use study in California (Gleick et al. 2003b) shows that even with existing technology and current pricing, it is possible to reduce water use by one third.

To address the current *ad hoc* approach, Brooks (2003: 33) suggests that "efforts now need to focus on the institutions that can creatively manage and accelerate the adoption of DSM practices and policies – on governance of demand management."

This report describes why a comprehensive, long-term, and integrated approach to demand management is necessary and how such an approach can be undertaken. The report is divided into two sections. The remainder of the first section discusses in detail the need for DSM and the barriers that have restricted its use in

Canada. The second section discusses issues of governance, planning and coordination, as well as higher-level government action. The report sets out long-term planning procedures, detailed action plans, and is a blueprint to integrate DSM into water management and other resource use options.

Handbook of DSM for Canada

As a companion to ***The Future in Every Drop***, a detailed ***Handbook of DSM*** is forthcoming. Together, these two documents provide a comprehensive two-tiered strategy for implementing urban water demand management in Canadian cities. While the present report addresses the broad issues of institutional design, the Handbook discusses many of the specific efficiency improvements and DSM measures outlined. The Handbook addresses the technical details of implementation, and is a practical tool to assist utilities and water management practitioners in designing a comprehensive, long-term and integrated DSM program.

Box 3: Examples of Reliable Reductions in Water Use from DSM Programs

The Massachusetts Water Resource Authority reduced water requirements in the greater metropolitan Boston area by 25% since the late 1980s.

Alburquerque, New Mexico, reduced per capita demand by 20% since the mid-1990s.

Seattle, Washington, reduced its per capita water demand by 20% over the past decade.

The Metropolitan Water District of Southern California reduced water use by 16% from 1990, despite a 14% increase in population.

New York City's "smart conservation" and "smart watershed management" programs reduced water use by 25% below the level of 1979.

Ashland, Oregon chose an $825,000 conservation program instead of an $11 million dollar dam in 1992. The program consisting of home water audits and rebates for efficient toilets and showerheads, saved 134,000 gallons a day within three years.

Melbourne, Australia recently decided that for the next 50 years all additional water supply will come through DSM programs.

...and in Canada

Waterloo's conservation program, which includes pricing changes, education, and the distribution of water-saving devices, has reduced per capita water use by 10% in its first three years.

Cochrane, Alberta, reduced water consumption by 15% by giving away toilet dams, low-flow showerheads, and faucet aerators and thus deferred a multimillion-dollar pipeline to import water.

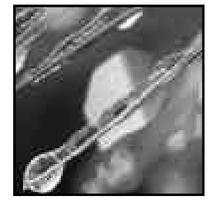
Port Elgin, Ontario, avoided a $5.5 million expansion of its water treatment plant by spending $550,000 to install 2,400 residential water meters, and by implementing an intensive conservation program.

Drumheller, Alberta, reduced wastewater flows through a voluntary retrofit program that installed low-flow showerheads, faucet aerators and new toilet flappers. The $220,000 initiative extended the life of the wastewater plant by 10-12 years, and deferred capital cost expenditure of $2 million.

Sources: Raines (1994: 407,410); Vickers (2001: xvi); Gleick (2003: 3); Postel (1997: 152); Boyd (2003: 51); Liberman (2001), South Island Sustainable Communities Network (1999: 37).

Chapter 2
The Need for DSM in Canadian Urban Water Provision

"Our water is truly precious, …every drop does count, and … the rivers of the country are the report card of our civilization" (Derek Doyle at the end of the Every Drop Counts conference, Canada's first national conference and trade show on water conservation. Doyle 1994: 417).



2.1. Introduction

Despite the widespread belief that Canada possesses an abundance of available water, pressing reasons exist to manage demand. Examples include: high levels of urban water use, a growing number of municipalities facing supply and/or infrastructure limitations, and the increase in capital costs of infrastructure expansions. In addition, urban water withdrawals and wastewater returns have a detrimental impact on the environment and correspondingly negative impacts on drinking water quality (see Box 4).

As a result of these challenges, concerns about water management are increasing, and the situation will worsen as municipal water use continues to rise. Although demand management is not a panacea for all that ails urban water provision and management, it can help to address many of these challenges. Specifically, it can help to reduce, or at least to limit, urban water use and wastewater production, which will, in turn, increase the sustainability and security of water resources.

2.2. High and Rising Municipal Water Use in Canada

Canadians are the second highest water consumers in the world (Dangerfield 1994: 60, Boyd 2003: 42). Total municipal water use is approximately 640 litres per capita per day (lcd), which is two and a half times more than the European average (Luesby 1994: 214, Brandes 2003). Total municipal water use has increased by 6% from 1991 to 1999 (from fig 3.1, Brandes 2003: 21). Overall, total water withdrawals in Canada increased 26% between 1980 and 1997. During the same period, despite economic and population growth, water withdrawals in the United States dropped 5% (Boyd 2003: 43).

Residential use accounts for just over half of the total municipal water use (Brandes 2003: 15). Although Health Canada estimates that each person requires access to 60-80 litres of potable water every day for basic sanitation and health needs, the average Canadian uses 343 lcd (Brandes 2003). After rising almost 50% from 1972 to 1986, average per capita residential water use appears to have levelled out over the last decade, fluctuating between 330 and 350 lcd (Dangerfield 1994: 41; Brandes 2003: 21). However, due to increasing urbanization and population growth, total residential water use has continued to rise, growing by 21% from 1991 to 1999 (Marsalek et al. 2002: 1; Brandes 2003: 21).

Significant potential exists for demand management to reduce per capita use. In this way, total water use can also be reduced, or at least capped, without significant impacts on quality of life or standards of living.

2.3. Supply Limits, Degradation and Uncertainty

Water demand exceeds, or is approaching the limits of natural supply in many parts of Canada, particularly in the Great Lakes region, the Prairie provinces and the Okanagan Valley (Shrubsole and Tate 1994: 2; Dangerfield 1994: 53). Between 1994 and 1999, one in four Canadian municipalities reported problems with water availability.

In Ontario, this stress is even more apparent; 79% of municipal water systems reported at least one water supply problem between 1989 and 1999 (Shrubsole 2001: 4). Similarly, groundwater extraction rates that exceed

Box 4: Some of the Reasons Why Demand Management is Required in Canada

High Urban Water Use	*Supply Limitations*	*Capital Costs*	*Environmental Impacts*	*Drinking Water Quality*
• The average Canadian uses 343 litres per capita per day (lcd) residentially. • Canadians are the 2nd highest urban water users in the world. • Total municipal water use increased 6% during the 1990s. • Total residential water use increased 21% during the 1990s.	• A number of surface waters have reached or are nearing their capacity for withdrawals. • Groundwater extraction is depleting a number of aquifers. • Many water sources are contaminated or are at risk of contamination. • Uncertainties of stream flows and lake levels are increasing due to climate change.	• Significant unmet capital costs (estimated at $23-$49 billion) exist for aging water and wastewater infrastructure upgrades. • Increasing peak water and/or wastewater treatment demands create additional capital costs.	• Urban water withdrawals and wastewater returns are highly geographically concentrated, amplifying their impact. • Water development projects destroy aquatic and land habitat, introduce exotic species, and block fish migration. • Both ground and surface water withdrawals can reduce surface water flows, altering marine habitat and affecting fish populations.	• Reducing water flows allows financial resources to be reallocated to meet higher levels of drinking water standards, while it reduces the amount of water that needs to be treated to these levels. • Decreasing wastewater volume increases the effectiveness of sewage treatment, thus decreasing pollution of receiving waters (often source waters for downstream users). • Reducing demand avoids the development of additional inferior water sources, and protects groundwater sources by reducing overpumping.

natural replenishment are depleting aquifers in central and south-western Ontario (Sharratt et al. 1994: 73). Due to over pumping and resource stress, the Ontario Ministry of the Environment has placed a moratorium on new and expanded water-taking permits for bottled water and other uses that remove water from the watershed (*London Free Press* 2003).

Over the past 30 years, the population of British Columbia's Okanagan-Similkameen river basin has more than doubled and has the fastest growth rate of the 23 major river basins in Canada. This region has 0.1% of Canada's total renewable supply of fresh water, and faces serious water pressures as it continues to grow (Statistics Canada 2003). Over 17% of surface water sources in the province have reached, or are nearing, their capacity to reliably supply water for extractive uses; 25 groundwater aquifers are nearing water use capacity and over one-third of aquifers are vulnerable to contamination (Water Conservation Strategy for BC 1998: 9-12).

Such problems suggest that increasingly municipalities are reaching the limits of their local water supplies and/or the capacity of their current infrastructure (Environment Canada 2001). Many urban water supplies are under additional pressures from nearby agriculture, industry, forestry, and ongoing development.

Residential development affects both ground and surface water flows, with paved surfaces and rooftops reducing infiltration and increasing (usually contaminated) runoff to surface water (Thomson 1994: 178). Contamination of groundwater is also affecting water supplies. Overpumping of groundwater not only depletes aquifers, but may also pull contaminants or salt water towards city wellfields (RMI 1991: 10). Abbotsford, BC was forced to decommission various community wells due to contamination; and in PEI, some 18% of the wells are contaminated with pesticides (Waller et al. 1998: 8,16).

Supply limitations and source degradation are compounded by the unknown impacts of global climate change. An intimate relationship between climate and the hydrologic cycle exists. Changes in climatic regimes will directly affect the average annual water flow, its annual variability, and its seasonal distribution (Environment Canada 2003: 5). For example, the navigability of the St. Lawrence Seaway is at risk because of low water levels. In the 1900s, water levels in the port of Montreal averaged two metres above the long-term average low-water mark. At the end of the century, however, this margin had declined to less than one metre (Statistics Canada 2003). Predicted climate change impacts on the Great Lakes include a further drop in water level of between a half and one metre due to increased evaporation and decreased runoff (Farid, Jackson and Clark 1997: 74).

Greater climatic variability also means changes in the frequency of extreme weather events and increasing incidences of dry and wet year sequences. Water supplies will become more uncertain as this variability combines with increased summer evapotranspiration, reduced snow packs, and higher water use such as increased lawn watering (Environment Canada 2003: 5).

The impact of climate change is already being felt in many western cities such as Calgary, Edmonton and Regina, which rely on mountain snowpack and glaciers as water sources. Since 1850, some 1,300 glaciers have lost between 25% and 75% of their mass, with most of this reduction occurring in the last 50 years. Along the eastern slope of the Rocky Mountains, glacier cover is receding rapidly, and total cover is now close to its lowest level in 10,000 years (Statscan 2003).

Mitigating the impacts of climate change will be a slow process. Climate experts agree that we must be ready to adapt to these impacts. The International Panel on Climate Change urged water managers to begin "a systematic examination of engineering criteria, operating rules, contingency plans and water allocation policies." The IPCC states with "high confidence" that "water demand management and institutional adaptation are the primary components for increasing system flexibility to meet uncertainties of climate change" (IPCC 1996).

With increasing numbers of communities facing supply limitations and climate change uncertainties, long-term planning includes a thorough assessment of DSM options as a necessity. Demand management is an important part of a diversified risk management portfolio, and has the ability to both avoid supply limitations in the short term, and provide flexible responses to climate change in the future.

2.4. Water and Wastewater Capital Costs

Modern water and wastewater systems are the most capital intensive of all public works (Postel 1994: 16). Ratios of capital investment to operating revenue are estimated at between 4:1 and 9:1, and even as high as 30:1, compared to just 3:1 for telephone utilities (Lawson and Fortin 1994: 270; Tate 1997: 52). Efficiently using the existing capital-intensive infrastructure and potentially reducing additional capital expenditures are critical given the tight budgets of most municipalities.

Much of the water supply infrastructure in large Canadian centres is over 50 years old. Estimates of unmet water and wastewater infrastructure needs and the costs of maintaining (repairing and upgrading) them are substantial, ranging from $23-$49 billion (National Round Table on the Environment and Economy 1996; Environment Canada 2003: 16).

Significant upgrades are also required in some areas to meet drinking water quality standards. In BC, upgrading water treatment and filtration systems to Canadian standards is expected to cost approximate $2 billion province-wide, with an additional $1 billion for anticipated costs to upgrade wastewater systems (Water Conservation Strategy for BC 1998: 15).

Given the costs of maintaining current infrastructure capacity, it is clearly beneficial to avoid additional infrastructure expansion. Urban water demand is highly variable with 'peaks' occurring on an hourly, daily and seasonal basis. The highest peaks usually occur during the summer due to lawn watering demands. Maximum hourly use affects water main and sewer capacity requirements and infrastructure must be built to accommodate these peak demands. The result is a large proportion of capacity that lies unused in off-peak times (Harris 1994: 246; Loudon 1994b: 253-259).

While DSM programs can reduce overall water use, they can also specifically target the timing and level of peak demands. This 'peak shifting' approach smoothes out demand, increasing the overall efficiency of infrastructure. Reducing peak demands also defers, and potentially avoids, future infrastructure needs.

In Winnipeg, projections showed that if steadily increasing demands continued, the 159-kilometre aqueduct that brings the city its water would not have the capacity to meet future demands. The $200 to $350 million price tag to augment supply motivated Winnipeg to employ a DSM program (Sacher 1994: 98). Similarly, a comprehensive DSM program undertaken by the Massachusetts Water Resource Authority (MWRA) reduced water requirements in the greater metropolitan Boston area by 25%. As a result, a $500 million plan to further dam the Connecticut River was cancelled.

Increasing municipal water use generally implies increasing quantities of wastewater, unless peak wastewater flows are determined by rainfall infiltration (Gates 1994: 339, 340; Tate 1997: 53). Increased wastewater production can require expenditure on expanded wastewater treatment infrastructure. Avoiding these costs is another rationale for demand management. New York City reduced its water use by over 250 million gallons per day through a comprehensive DSM program, thereby avoiding a billion dollar expansion to its wastewater treatment plant and indefinitely postponing the development of new water supply sources (Vickers 2001: xvi).

2.5. Environmental Impacts

Although municipalities account for only 12% of total Canadian water withdrawals, these demands are concentrated geographically. High-density residential population and the high volume of water needed to support urban economic activities results in the exhaustion of local supplies. As a result, many urban residents depend on water that is imported from distant sources, creating ecological footprints that extend hundreds of kilometres beyond the city limits to the headwaters of streams and rivers (Dziegielewski 1999: 1). The 'footprint' also travels downstream with the pollution created by discharged wastewater. Such combined impacts of development places severe stress on the regional water bodies upon which urban centres depend (Postel 1994: 16).

Twenty seven percent of all North American freshwater fauna are now under threat of extinction, a trend mirrored around the world (Wolff and Gleick 2002: 2, Gleick 2003b: 1524). The American Fisheries Society estimates that 354 species of fish in North America are at risk, primarily due to habitat destruction through the excessive use and mismanagement of water (Postel 1994: 13).

Depletion of underground aquifers also affects the health of surface waters. For example, over-extraction from aquifers in Ontario has resulted in a reduction of water flowing from springs into local streams. This has damaged aquatic ecosystems and especially coldwater fish populations (Sharratt et al. 1994: 73). The process of pumping groundwater at a rate greater than the natural recharge rate is called 'groundwater over-drafting.' It is a modern problem that results from powerful pumps and cheap energy (deVilliers 1999: 48).

The overpumping of groundwater can have severe and lasting effects. Aquifers act like sponges, reducing storm water runoff by absorbing or 'recharging' during periods of heavy rainfall. This water is then released slowly, maintaining surface water base flows during dry periods. Overpumping changes underground flow patterns and can compact aquifer sediment, which impinges upon future capacity for water storage and may permanently reduce an aquifer's absorption capacity. In Mexico City, the water table dropped 20 metres in fifty years, causing large parts of the city to subside. The California Central Valley has experienced similar drops in the water table levels due to groundwater over-drafting (deVilliers 1999: 47).

When withdrawals from surface and groundwater systems are reduced, more water becomes available for maintaining and preserving the ecological balance of streams, rivers, wetlands, and estuaries (Dziegielewski 1999: 2). DSM programs can further reduce the pressure on aquifers and endangered aquatic ecosystems through the avoidance of additional large-scale infrastructure projects such as drilling for new wells, diversions, and dams.

Demand management also improves the effectiveness of wastewater treatment by reducing its volume and increasing detention times, improving discharge quality and reducing the pollution of receiving waters (RMI 1991: 9; Tate 1997: 53). Concerns about future water shortages motivated officials in Vernon, BC to undertake a DSM program. Vernon faced a growing problem with Eurasian water milfoil in the nearby Okanagan Lake. This problem was caused by phosphorous entering the lake from municipal wastewater treatment plants (Jackson 1994: 111, 114). As a result, the city has undertaken a program to reduce water use and to reuse municipal wastewater for local farm irrigation.

2.6. Drinking Water Quality

High volumes of urban water use negatively impact the quality of drinking water in at least three different ways. First, with increased volumes, more water must be treated to drinking water standards, placing greater stress on water treatment plants and resulting in higher costs for chemicals and energy. Second, because increased water use generally leads to increased flows of wastewater, treatment is often less effective due to shorter detention times and less concentrated waste. Inferior treatment results in more polluted receiving waters, which degrades supply sources for downstream users and also damages ecosystem capacity to maintain clean fresh water. Third, the development of additional water sources can result in higher treatment costs, especially if the water source is turbid or has high levels of organic material.

2.7. Additional Benefits of Demand Management

The discussion above outlines the most significant benefits of demand management. A number of additional benefits are listed in Box 5. Some additional benefits are less obvious and depend on specific circumstances. For example, Econometrics Research Limited (1995) reported increased economic activity associated with DSM. In comparing the economic impacts of pursuing a water demand strategy versus a water supply management strategy in the Halton Region of Ontario, the company concluded that the demand management option would translate into $50 million more in employment income provincially, and $28 million more locally due to the more decentralized labour intensive nature of DSM (Shrubsole 2001: 6).

2.8. Summary

Current problems related to urban water provision include high and increasing water use in Canadian municipalities, infrastructure limitations faced by a growing number of municipalities, uncertainties associated with climate change, and the increasing capital costs and environmental impacts that result from continuing on the supply-side management path. Demand management strategies provide a means for dealing with these problems and therefore should be widely adopted and integrated into long-term water planning.

The challenges of water management often overlap, providing further incentives to implement DSM. In Ontario, water conservation efforts were adopted for three primary reasons: to avoid the continuing decline in aquifers and associated effects on fisheries due to over extraction, to reduce municipally generated pollution, and to avoid increased infrastructure costs for water and wastewater treatment plants to meet increasing demands (Sharratt et al. 1994: 73,74). DSM considers such motivations in an integrated approach to water management.

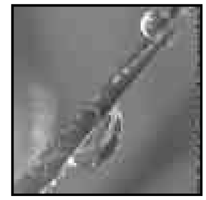
Box 5: Additional Benefits of Demand Management

- Lower energy use such as for household water heating and pumping
- Reduced chemical use in treatment processes
- Reduced need for emergency water restrictions and associated inconvenience during periods of drought
- Improved ability to adapt to uncertainties such as climate change. Investments in DSM programs tend to be diversified and incremental and more flexible than supply-side options which tend to require large, irreversible commitments
- Reduced need for the large, up-front grants or loans required in many supply-side projects
- Improved demand forecasting, and reduced risks associated with demand uncertainty
- Improved participatory approaches leading to better public and stakeholder relationships than currently exist with centralized supply-side decision making
- Enhanced revenue generation from by-product recovery, such as reclaimed water for reuse
- Greater incentives for accounting and monitoring and therefore better control over the throughput of water and wastewater systems
- Increased industrial competitiveness (the incentives in DSM to encourage more efficient water use can lead to lower business costs and an evaluation of other efficiency improvements, thus increasing competitiveness)
- Increased economic activity

Source: Tate (1990: 8); RMI (1991: 8-11); Mackenzie and Parsons (1994: 104); Sacher (1994: 98,99); Sharratt et al. (1994: 74); CRM (1996: 6); Shrubsole (2001: 6)

Currently, a significant proportion of urban water provision in Canada is financially and environmentally unsustainable. Demand management can help move urban water provision onto a more sustainable path. Demand management 'stretches' existing reserves and simultaneously 'frees up' supply to serve potential future needs. Although DSM provides decision makers and local authorities with a broad portfolio of options to address the problems outlined in this chapter, it remains relatively underdeveloped in Canada. Understanding why DSM continues to be neglected as a water management approach is a critical step to encouraging its widespread implementation in the future.

Chapter 3



Barriers to Demand Management

"Many of the solutions that have been proposed for our water problems will require changes in attitudes. Arguments against new solutions have frequently been based on the contention that the public is unwilling to accept them. Another more subtle but perhaps more important aspect of this issue is the unwillingness of water system managers to adopt new points of view" (Holtz and Sebastian 1978: 247).

3.1. Introduction

Acceptance of demand management is relatively widespread among regulated electricity utilities in North America. However, rigorous application of DSM within the water sector, particularly in Canada, remains in its infancy (CRM 1996: 1,3; Tate 1990:49). This lack of application cannot be attributed to deficiencies in technology or know-how. Although ample potential exists for further technical research, most of the methods and tools for demand management have existed for years. For example, modern efficient fixtures and appliances have been on the market for decades (Brooks 2003a: 33). Box 6 summarizes a number of barriers that help to explain Canada's sluggish progress with DSM.

3.2. Attitudinal Barriers

A number of commonly held beliefs or attitudes in Canada impede the transition to demand management.

Myth of superabundance: Many Canadians believe that Canada has ample freshwater resources and that no

Box 6: Barriers that Impede the Adoption of DSM in Canada

Attitudinal Barriers	*Financial Barriers*	*Data and Informational Barriers*	*Administrative Barriers*
• Myth of superabundance • Human economy and human-built infrastructure considered separate from the environment • Ideal of free market society without government intrusion • Belief that reduced water use imposes a reduced standard of living • Concern that DSM savings are unreliable and/or insubstantial • Political preference for high visibility projects	• Subsidies and low pricing • Need for predictable and stable revenues • Need to maintain sufficient revenues (in the face of overcapitalization) • Lack of funding for DSM • Gap in payback	• Wariness about DSM by decision makers • Lack of comprehensive cost/benefit models • Ineffective DSM programs	• Fragmented administration • Centralized engineering bias • Formulaic thinking • Inflexible policies

significant water problems exist (Mitchell and Shrubsole 1997: 1). This faulty perception is partially attributable to confusion between 'renewable water supply' – precipitation that falls and then flows towards the sea – and 'total water' which is the renewable water, plus the stock of fresh water contained in lakes and 'fossil' aquifers (Sprague 2003: 28). Only a small portion of the potentially available 'renewable water supply' is actually accessible without significant impacts on hydrological process and the health of the natural system. It is critical to overcome the myth of superabundance, but it will take a strong focus on public/consumer education to do so (see Box 7).

Box 7: The Myth of Superabundance

"… [I]f we waste our resources, we could soon find ourselves facing the same problems as nations which lack our quantity or quality of water. This vision of inefficient water use is something quite frankly which can be a pretty difficult 'sell.' A major challenge exists to convince Canadians that their water use is a problem. I remember when I was in primary school being taught that Canada had the largest proportion of freshwater in the world. We should not underestimate the effort required to counteract this myth of water abundance."

Jean Charest, then federal Minister of the Environment, at the Every Drop Counts conference in 1994 (Charest 1994: 430).

Human economy and human-built infrastructure considered separate from the environment: Although, the construction of new large-scale water developments, such as dams and diversions, has slowed in recent years in North America, a persistent view remains that the human economy and human-built infrastructure are separate from the environment, and can continue to grow indefinitely (Wolff and Gleick 2002: 5,6). In North America, growth and the associated increases in demand, tend to be "equated with goodness" (Sims 1978: 253). This view has led to the depletion of vital natural resources such as the availability of clean water.

Slowly replacing this view is the recognition that human-built infrastructure is embedded within a natural 'ecological infrastructure.' This natural infrastructure includes wetlands, streams, vegetation and animal life – all of which clean, store and utilize water in productive ways, and contribute to other human activities such as fishing, swimming, and tourism. As Bocking explains, "we cannot pretend that natural systems are plumbing networks that can be endlessly manipulated by humans" (Maas 2003: 7).

Recognition of the benefits associated with the ecological infrastructure provides the foundation for a shift to demand management. In addition, this natural infrastructure must be specifically incorporated into modern watershed management and integrated planning processes (see Chapter 4).

Ideal of free market society without government intrusion: Demand management is perceived by some to be a form of social engineering which could potentially interfere with the free market (Sims 1978: 253,254). This concern is misplaced; supply-side developments are often the recipients of vast government subsidies and artificially low water prices (Wolff and Gleick 2002: 28). In contrast, DSM pricing measures actually remove the need for government interventions by promoting full cost recovery rather than public subsidies.

Additionally, many DSM measures are voluntary, relying on educational and/or financial incentives for implementation. While some DSM programs include a degree of government involvement, it is generally minimal and proactive in nature, particularly when compared with the severe interventions that are required in the face of water shortages such as outright watering bans or expensive remediation projects.

Belief that reduced water use imposes a reduced standard of living: For some Canadians, a reduction in water consumption is associated with reduced prosperity, whether it is a loss of economic growth in the industrial sector or a reduction in the standard of living in the residential sector (Wolff and Gleick 2002: 23,28). In reality, economic growth is not dependent upon increasing water use.

In the US, water use and the economy grew in lockstep until the 1970s when water conservation measures were widely implemented. The economy has continued to grow, while per capita water use has dropped and total water use remains relatively constant (Wolff and Gleick 2002: 23,24; Brooks 2003b: 17,24). Thus, water use and economic growth have been 'decoupled' and water productivity (the ratio of GDP to the volume of water withdrawn) has doubled (Gleick et al. 2003: 21).

In fact, demand management may actually promote economic growth. Evidence from the energy sector demonstrates that demand management approaches provide more jobs than capital-intensive, supply-side approaches, for example, by stimulating small businesses that retrofit residences or re-landscape gardens and lawns

(Brooks 1978). Many aspects of the water sector are analogous to the energy sector and it is reasonable to expect demand-side options to increase small-scale economic activity in the water sector. One such example is outlined in Section 2.7.

Retaining the current standard of living in Canada does not require such high levels of water use. Comparisons between Canadian cities show a fourfold variance in water use between communities with similar standards of living (Brandes 2003: 12, 27). Comparable European cities generally use less than half the water used in Canadian cities.

Water-efficient fixtures and appliances such as showerheads, washing machines and low-flow toilets use significantly less water but work as well (or better) than older and less efficient models. As summarized by Environment Canada, "water conservation doesn't mean cramping lifestyles by doing without: it simply means reducing the amount of water we waste" (Environment Canada 1990: 4).

Concern that demand management savings are unreliable and/or insubstantial: A common misconception is that DSM measures produce only temporary water savings, such as during times of drought. However, where appropriate planning processes are undertaken, demand management can produce long-term, reliable water savings of 20 to 30% per capita in most North American cities, without any sacrifice in economic output or quality of life (Foerstel 1994: 70; Gates 1994: 325; Postel 1994: 14; Vickers 2001: xvi). Comprehensive DSM programs are providing consistent evidence of their long-term savings (See Box 3). A comprehensive analysis of water use in California concluded that demand management could reduce water use by one third with existing technology and at current prices, and that reducing demand would be cheaper than increasing supply (Gleick et al. 2003: 1).

DSM also prevents overcapitalization, a costly side-effect of supply-side approaches. Overcapitalization refers to overly large infrastructure projects, such as reservoirs and diversion projects, compared to what would be needed if demand were reasonably estimated (Wolff and Gleick 2002: 9, 30; Platt and Morrill 1997: 283). Overcapitalization results from overestimated future water demands based on the belief that water demand is relatively independent of other factors, such as technology, prices, and public awareness (Gleick et al. 2003: 18).

Political preference for high visibility projects: Supply-side projects such as dams, reservoirs and pipelines are highly visible. As a result, such developments can create positive media exposure for the politicians and decision-makers responsible, despite the negative cost-benefit ratio in the long-term.

By contrast, demand management is often less visible. From a politician's perspective, there are simply no votes in higher water prices or low-flow toilets, but cutting ribbons on large infrastructure projects makes for good media optics. It is possible to create more media focus on demand management initiatives, but a focus on education is required first to create public interest.

3.3. Financial Barriers

A number of financial barriers impede the adoption of DSM.

Subsidies and low pricing: Municipal water rates in Canada - the retail prices to end-users – are among the lowest in the world. A primary driver of these low prices is subsidies (FCM 2001: 37). The most common pricing structure in Canada is the 'flat rate' where users pay a fixed amount regardless of how much water they use. Similarly, water utilities generally don't pay on a volume basis for the water they withdraw or the discharges they return. By contrast, volume-based pricing charges customers according to the amount of water consumed.

Low prices and flat rate structures encourage high levels of water use and overcapitalization to meet the demand. Furthermore, low prices and overcapitalization fosters the attitude that water is free and abundant and there is little need for conservation. The current pricing structure also eliminates the cost-effective incentive to adopt more efficient technologies. The potential for reforms through appropriate pricing of withdrawals and discharges is discussed in Chapter 6.

Need for predictable and stable revenues: Water utilities must maintain predictable and stable revenues and, because of the perceived risks involved with efficiency improvements, many companies prefer to stick with familiar supply-side approaches (Wolff and Gleick 2002: 11).

Some DSM programs have failed to achieve targeted savings or the savings they have made have been unreliable. Although price increases sometimes lead to initial reductions in demand, demand generally levels out over time (Loudon 1994b: 252). There are risks involved in predicting the results of voluntary incentive measures. However, such challenges are not exclusive to the demand management approach and, with proper planning and implementation, DSM programs can actually allow for more accurate predictions of future demand.

Where DSM programs lead to the widespread use of low-volume alternatives (such as low-flush toilets), more accurate predictions are possible (RMI 1991: 8). In addition, DSM measures that lessen peak demands, such as outdoor efficiency programs, can also improve the stability of revenues throughout the year (Vickers 2001: 151).

Need to maintain sufficient revenues in the face of overcapitalization: For utilities that are overcapitalized and operating under debt burdens from previous infrastructure expansions, a 'conservation conundrum' exists (Tate 1990: 20). The utility must service its debt and cover operating costs with the revenues it receives from billing customers. If volume-based pricing remains in effect, undertaking a DSM program will reduce water demand and decrease the utility's revenues. Because operating costs for water utilities are inelastic relative to demand, such costs decrease little even if demand decreases substantially. Therefore, there is little financial incentive to improve water conservation.

The best option, of course, is to avoid overcapitalization in the first place. Alternatively, DSM measures can be used to reduce per capita water use by an amount that offsets the increasing demand associated with rising populations. In this case, total water demand and total revenue can remain steady[1], allowing future infrastructure expansions to be avoided. To promote this type of situation, future federal and provincial infrastructure grant programs should be firmly tied to DSM, and rigorous design assessments should be conducted to avoid overcapitalization.

Another option to address this revenue challenge is to ensure that some of the benefits from conservation initiatives flow to the utility. In Ontario, the energy sector has experimented with this option by adjusting the rate of return allowed for the utility to the proportion of energy it saves. This cost adjustment places the utility in a cost-neutral position between DSM and supply-side options, removing the disincentive of reduced revenue associated with conservation. Similar models could easily be adapted to the water sector.

Lack of funding for DSM: Lack of funds and appropriate staff are constraining DSM (de Loë 2001: 70). DSM programs require sufficient budgets for staff and planning, and generally have substantial up-front implementation costs. Research by Tate (1997: 53) and Jackson (1994: 116) demonstrates that, to counter these costs, water conservation programs can have high cost-benefit ratios, in some cases exceeding 1:15. In some areas, for every dollar spent on DSM, three dollars are saved in capital expansion costs. Therefore, while increased up-front funding for DSM is required, long-term savings must be considered. This will be further discussed in Section II.

Gap in payback period: An important consideration when comparing demand and supply-side options is the 'payback gap.' The 'payback gap' is the difference between the payback periods required by utilities and those required by end users (RMI 1991: 72). Utilities often make supply investments which may not be paid back for 20 years or more. In contrast, a homeowner or renter investing their own money in an efficiency improvement will typically want their cost repaid within a year or they will not consider it worth their while. Similarly, industrial, commercial and institutional users often look for payback periods of less than two years, even though this time frame represents a return on investment of 45% or more.

As a result of payback gaps, society as a whole misallocates large amounts of capital (i.e. we buy too little efficiency and too much supply). The 'payback gap' can be corrected if utilities use the same investment criteria for demand management as they do for supply side projects. Investing in improved efficiency for consumers in cases where efficiency costs less than supply expansion (through giveaways and rebate or loan programs) will correct the 'payback gap.'

3.4. Data and Informational Barriers

A lack of coordinated data collection, analysis, and dissemination impedes the shift to demand management in Canada. This information gap leads to a variety of challenges.

Wariness about DSM by decision-makers: Better information on the implications of demand management is needed to convince political decision-makers that the risks involved are manageable. Better information can alleviate concerns about municipal liability for promoting DSM retrofit technologies (Gates 1994: 340).

Lack of information about water savings associated with demand management and how these savings will affect revenues means that conservation specialists in

[1]This situation is termed a 'steady state' or 'zero growth' policy.

Canada rely on information derived largely from US case studies (Gates 1994: 334). These case studies may only have limited applicability in Canada. Canadian governments, water utilities, industries, and professional organizations should be undertaking similar studies in this country to resolve the information gap.

Lack of comprehensive cost-benefit models: Saving water typically also saves energy and reduces wastewater, but decision-makers rarely consider these 'indirect' savings. Current cost-benefit models used to assess infrastructure options lack sufficient sophistication and do not account for the potential benefits of more integrated systems (FCM 2001: 37). For example, the costs of wastewater collection, treatment and disposal are often the same as, or greater than, costs related to potable water supply.

Reduction in the required supply saves on operational and eventually capital costs at the wastewater end. Most cost comparisons of demand-side and supply-side measures neglect this additional benefit (Brooks 2004). While some models like IWR Main (discussed in Chapter 5) begin to address these concerns, improved modeling tools that better reflect conditions in Canada are needed to help predict the full impact of DSM.

Ineffective DSM programs: Accurate data on water use and the impact of DSM measures (such as cost savings for households) is essential to encourage the participation of water users. This data can also be used to improve the design of conservation efforts and future DSM programs and to assist in the assessment of existing DSM programs (Foerstel 1994: 66 5).

More information on the local ecological impacts of municipal water use (both current and long-term, and under various climate change scenarios) will improve the effectiveness of local education campaigns. In particular, information about the merits of DSM needs to be prepared for a range of audiences including businesses, industry, politicians, community groups and homeowners. Equally important is stakeholder access to this data and information.

3.5. Administrative Barriers

Administrative barriers are often systemic in nature and significantly impede progress on the adoption of DSM.

Fragmented administration: Water resource management in Canada has been characterized as "a bewilderingly complex administrative galaxy" (Dangerfield 1994: 43; Fitzgibbon 1994: 167). Although it is recognized that water should be managed on an ecosystem basis, in reality, management is divided amongst various levels of government and between different agencies within any given level of government (Shrubsole 2001: 3).

As a result of this vertical and horizontal fragmentation of responsibility, intensive coordination of activities and approaches is required. Some fragmentation of management is inevitable, as surface and ground water often cross political boundaries. However, particular difficulties are encountered in areas where two-tiered municipalities exist – where a regional authority supplies wholesale water to member municipalities. The differing internal structures, information systems, and policies of the authorities can impede communication and information sharing (Maas 2003: 26).

Municipal and provincial levels of government are often unable to coordinate their efforts effectively. Although some municipalities and regional water agencies have requested building code changes to mandate the use of water-efficient fixtures, these requests are often not given priority by the provincial authorities who oversee the relevant jurisdiction (Maas 2003: 26). Furthermore, the vertical organization typical of most provincial departments limits communication amongst the various ministries responsible for infrastructure, funding programs, environmental quality and public health. These challenges impede the effectiveness of comprehensive demand management efforts.

Often demand management measures require action from, or have implications for, multiple departments and levels of government. Thus, the planning and implementation of DSM programs requires integration and coordination amongst all those involved.

Centralized engineering bias: Traditional supply-side approaches have produced an extensive and sophisticated water supply infrastructure with many benefits to cities and their residents. The historical focus has been on physical infrastructure and engineers often dominate water utilities. The engineering approach is most accustomed to meeting undifferentiated demands through large, centralized supply-side options (Wolff and Gleick 2002: 5, 9, 15, 16; Platt and Morrill 1997: 284).

In contrast, demand management shifts the primary focus from engineering logistics to less familiar social strategies, which may be resisted by traditional water managers (RMI 1991: 7). Demand management relies on the direct participation of individual water users, and requires investment in individual homes and businesses. Water providers must consider this investment to be just as valid as centralized supply investments.

Typically, large engineering firms "continue to do most of the thinking and planning with respect to urban water systems" and it is "uncommon for major engineering firms to consider even physical DSM solutions…let alone educational and economic tools…venturing into the institutional and education realm is often difficult for managers who have been trained exclusively in engineering aspects of municipal water supply" (Maas 2003: 25). As outlined in the following section, different professional skills and training are required for DSM planning and implementation.

Formulaic thinking: Engineering and other water management disciplines usually focus on design methods that optimize components in isolation and focus on single, rather than multiple, benefits (FCM 2001: 36). For example, calculating optimal construction and flow requirements relative to a set projected demand is relatively simple.

This formulaic approach is preferred because it provides clear and straightforward solutions. However, it resists more integrated options like demand management because the benefits are more difficult to isolate and calculate. The benefits of demand management are achieved in various aspects of water provision, including energy savings, wastewater reduction, reduction of chemicals for treatment and lower capital costs. Measurement of these benefits (and their ecological implications) is a complex and multi-faceted task.

Inflexible policies: Prescriptive policies can entrench the status quo and limit innovation. For example, wastewater regulations that limit water reuse do not embody the potential offered by new environmental technologies or the value of protecting ecological processes (FCM 2001: 36). Federal and provincial infrastructure programs require more flexibility to encourage the adoption of environmentally sustainable technologies and innovative 'closed-loop' processes.

Similarly, local land use policies (such as regional growth strategies that neglect to consider local water source conditions) can facilitate unsustainable water use when they promote initiatives like 'big-lawn' suburban developments.

3.6. A Model of the Barriers to Demand Management

Many demand management solutions are available to both water providers and end users, yet implementation in Canada has been limited due to the barriers and obstacles set out in this chapter. These barriers produce a kind of conceptual ***gridlock*** that consists of ***root causes***, ***current practices***, and ***entrenching factors***.

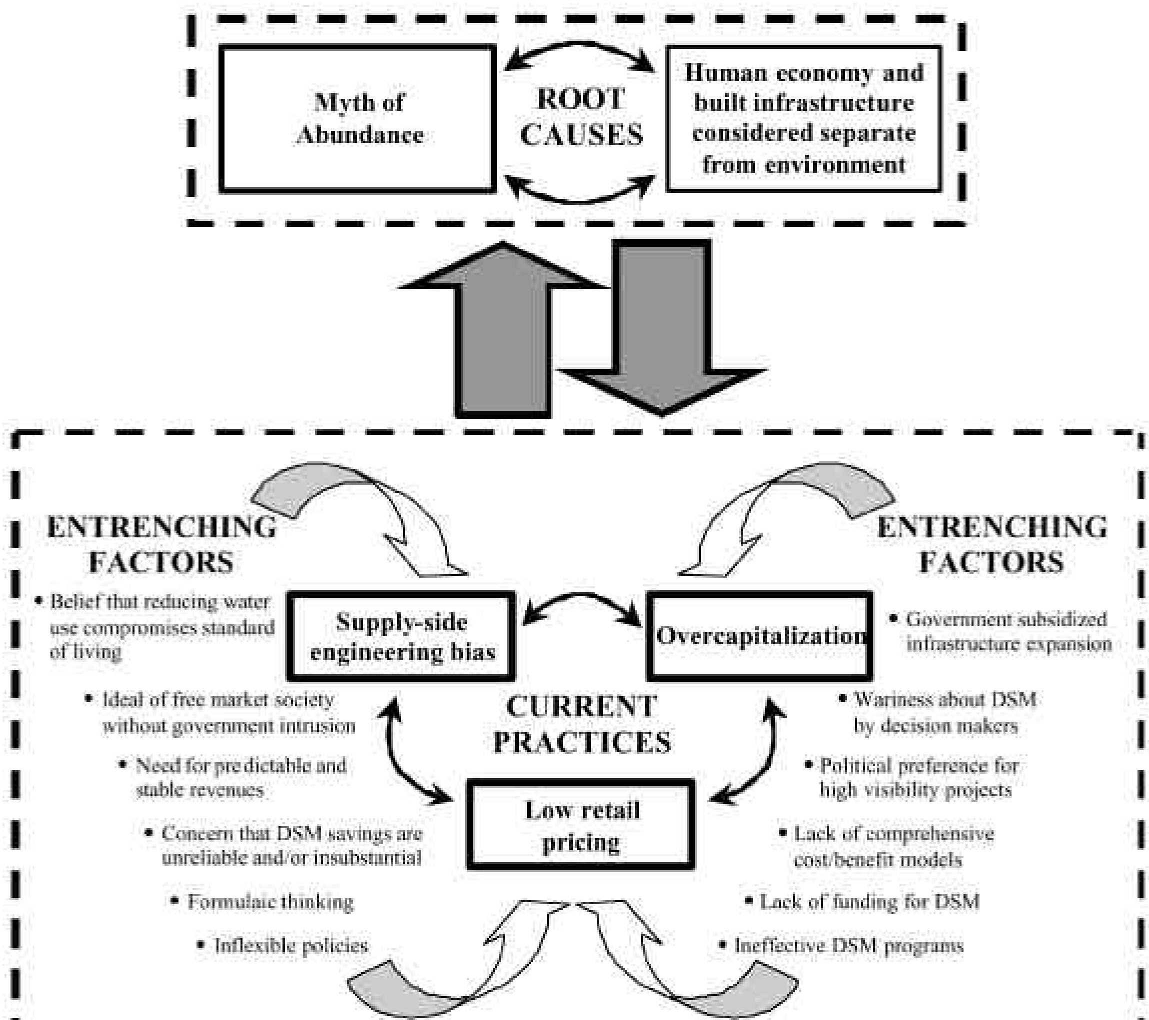
Historical conditions, the evolution of water management in Canada, and the influence of the fundamental root causes have all led to the supply-side focus of current water management. However, with an understanding of the individual barriers and their interrelationships, policy options and action plans will be better positioned to overcome the existing inertia and promote widespread adoption of a comprehensive, integrated and long-term approach to DSM.

The diagram on the following page shows that many of the barriers work together to entrench the current situation. It also shows how these barriers influence, and are influenced, by root causes. This situation reflects what Capra (1982: 25) calls a 'systemic problem' where the individual drivers are closely interconnected and interdependent. This type of situation cannot be fully understood or rectified with the fragmented methodology characteristic of historical approaches. To address this type of 'gridlock' it is necessary to change the structure of the system itself. To do so requires moving beyond isolated strategies and tackling a number of barriers simultaneously, strategically and comprehensively.

Addressing the gridlock will require a new water ethic that motivates comprehensive action. Regulation, legislation, allocation, DSM and innovative environmental technologies are all critical components of water resource protection. However, these efforts must be supported by education and an emphasis on stewardship of water resources. Sandra Postel (1997: 185) captures the significance of such a water ethic:

"Adopting such an ethic would represent a historical philosophical shift away from the strictly utilitarian, divide-and-conquer approach to water management and toward an integrated, holistic approach that views people and water as related parts of a greater whole. It would make us stop asking how we can further manipulate rivers, lakes, and streams to meet our insatiable demand, and instead to ask how we can best satisfy human needs while accommodating the ecological requirement of healthy water systems."

Box 8: Conceptual Model of the Relationships Among the Barriers Impeding Adoption of DSM in Canada



SECTION II:

GOVERNANCE, PLANNING, COORDINATION AND ACTION PLANS

Chapter 4
Governance

"The water crisis is essentially a crisis of governance"(Water for People Water for Life – The United Nations World Water Development Report 2003).

Overcoming the inertia of the status quo in urban water management is difficult but necessary. Progressing to a comprehensive, integrated and long-term approach requires action by many different actors including all levels of government, professional associations, civil society and end users. Section II of this report discusses some of the issues and opportunities for change.

In order to provide context for the chapters that follow, this chapter focuses on governance, considering such issues as integrated planning, stakeholder participation, departmental capacity, utility ownership, and the role of private partners in conservation. Because these governance issues influence most aspects of the water sector and specifically affect future water management strategies, they warrant broad consideration by all levels of government.

4.1. Introduction

Bakker (2003a: 5) defines water governance as "the range of political, organizational and administrative processes through which communities articulate their interests, their input is absorbed, decisions are made and implemented, and decision makers are held accountable in the development and management of water resources and delivery of water services." Governance is more than just government; it includes broader institutions and social decision-making processes such as those involving business and 'civil society'. Encompassing the political system, laws, regulations, social institutions, financial mechanisms, civil dialogue, and consumer behaviour, governance incorporates the rules, norms, values and processes that direct social behaviour.

The physical configuration of urban water supply systems consist of reservoirs, networks of pipes and treatment facilities. The major costs of delivering water are related to the construction, operation and maintenance of this integrated infrastructure. Once the infrastructure is in place, the operational costs to supply an extra unit of water is relatively insignificant. This results in what economists call 'increasing returns to scale' – where the average costs decline as the level of production increases.

In the urban water context, increasing returns to scale are so significant that only one entity, usually a utility, operates in a region – a text book example of a 'natural monopoly' (Stiglitz 2000: 191). Increasing returns to scale reduces competition because as a firm produces more, its costs are lowered until eventually all other firms are driven out of the sector. Limited competition[2] and high profit margins reduce incentives for efficient management, innovation, and maintaining public and ecosystem health (Stiglitz and Boadway 1994: 402; Cooter and Ulen 1995: 250).

Inefficient management of Canadian water resources has led to calls for increased private sector involvement in urban water provision in Canada. However, privatization is a highly contentious issue - in part because of the tendency toward monopolization. Effective governance and regulation by publicly accountable authorities is critical to ensuring stakeholder involvement and socially and environmentally responsible outcomes. The governance issues addressed below are complex and a detailed discussion of each is beyond the scope of this report. However, the overview provided focuses on important issues for a successful and sustainable long-term approach to water provision.

[2]Although direct market competition in urban water provision is conceivable, such as multiple networks of pipes maintained by competing companies, it is unlikely in the water supply industry. Instead, a competitive element might be introduced indirectly through periodic open competitions for the right to operate a monopoly for a limited period of time (Brubaker 2002: 85; Bakker 2002: 40).

4.2. The Need for Careful Planning and Coordination – An Example

In Canada, different levels of government share responsibility for water management and provision. Primary responsibility lies with provinces and territories, although this power is usually delegated to local governments and water utilities. The federal government is less directly involved with urban water services, but still plays an important role by providing valuable data and research, promoting national standards and guidelines, and linking conservation requirements to infrastructure grants.

Ensuring that actions by utilities and each level of government are coordinated is an important governance goal. Coordination and planning is especially important for demand management since many DSM tools are interrelated. Some measures work best in conjunction with other initiatives, while others may be less compatible.

The potential scenarios for replacing inefficient toilets with ultralow-volume models provide an example of

Box 9: Potential Actions in Toilet Replacement

Household	• Replacement of inefficient fixtures (e.g. buy a new ultralow-volume toilet) • Adoption of conservation habits (e.g. less frequent flushing) • On-site reclamation and reuse (e.g. use of grey water for toilet flushing)
Water utility/local government	Encouragements: • Education and marketing (e.g. information on the water savings possible with new toilets) • Giveaway of replacement fixtures (e.g. a free efficient toilet and subsidized installation) • Financial incentives (e.g. a rebate for households that buy an efficient toilet, or installation of meters and volume based pricing where households pay for water according to how much they use) Requirements: • Bylaws (e.g. only efficient toilets can be installed in new construction)
Provincial/ territorial	Direct implementation: • Public education (e.g. information on the state of the province's water supplies) • Plumbing code (e.g. only efficient toilets can be installed in new construction) Encourage local efforts: • Education targeted at municipal councillors and utilities • Imposed utility self-sufficiency (e.g. reduction in infrastructure grants) • DSM grants • Environmental taxes (e.g. volume-based pricing for withdrawals and discharges)
Federal	Direct implementation: • Public education Encourage local efforts: • Guidelines (e.g. model plumbing codes) • Standards and labelling (e.g. efficiency and performance testing for ultralow-volume toilets) • Targeted education, environmental taxes, conditional infrastructure grants • Enforcement of federal legislation such as the Fisheries Act
Other organizations such as water associations (CWWA, CWRA), CHMC, FCM and local NGOs	• Research and disseminate information • Demonstration projects • Education

the synergies associated with DSM measures. This is an important example since toilet flushing is currently the highest end use of water residentially and new efficient toilets provide an opportunity to reduce water use with little impact on the end user. Some of the various actions that can be taken by households and different levels of government are shown in Box 9.

4.2.1. Household

Although a household can simply purchase a new efficient toilet to replace an existing inefficient one, other factors could influence whether they chose to do so. If a household adopts conservation habits such as less frequent flushing or installs a wastewater reclamation system to reuse grey water for flushing, there is less incentive to purchase a new toilet. Some households may voluntarily replace inefficient toilets with little encouragement but many will do so only when water utilities and/or local governments actively encourage or require replacement.

4.2.2. Water Utility/Local Government

A water utility or local government can encourage toilet replacement through education and marketing, giveaways such as offering a free new toilet and subsidized installation, or financial incentives such as rebates or volume-based pricing. Requirements might include a city bylaw requiring efficient toilets in all new developments. The synergistic nature of DSM measures suggests that multiple measures should be implemented simultaneously.

The implementation of a rebate program without an education and marketing campaign is unlikely to succeed. In some cases, combining DSM measures is a necessity. For example, volume-based pricing can only be instituted if individual households are metered. Other DSM measures undertaken at the utility/local government level may actually reduce the incentive for households to purchase a new efficient toilet; for example, giving away retrofits for existing inefficient toilets.

Planning is required to decide whether two DSM measures should be undertaken simultaneously or considered as alternatives. For example, if a city bylaw requires installation of efficient toilets in all new construction, the need to provide financial incentives for developers during construction is reduced. Instead, different incentives might be added to encourage developers to surpass the mandatory efficiency requirements.

4.2.3. Provincial/Territorial

Provincial/territorial governments can undertake DSM measures directly. A provincial government might run an education campaign targeted at the public, or amend the plumbing code to require efficient fixtures in all new construction. These types of initiatives would clearly benefit from coordination with local governments. For example, to improve cost-effectiveness, education campaigns could be coordinated or delivered jointly with local governments, utilities or associations (e.g. CWRA, CWWA, BCWWA etc.) and amending plumbing codes may make local bylaws unnecessary.

Through education, targeted information and granting programs, provincial and territorial governments can encourage local governments and utilities to undertake demand management programs. Provincial and territorial governments can also promote local government and household action through environmental taxes such as volume-based pricing for water withdrawals and wastewater discharges. This type of initiative would encourage optimization of water use by utilities and end users.

4.2.4. Federal

The federal government can also undertake DSM measures to educate the public or to require action at other levels of government. They might produce guidelines or assist in the success of other programs by creating nation-wide standards and labelling requirements.

As with provincial governments, the federal government can also use targeted education, environmental taxes and grants to encourage demand management. A more aggressive approach would be for the federal government to fully enforce federal legislation, such as the *Fisheries Act*. This might result in wastewater treatment upgrades that would in turn encourage local demand management efforts since reduced wastewater production increases treatment efficiency and decreases treatment costs.

4.2.5. Other Organizations

In addition to governments, civil society groups and organizations such as the Federation of Canadian Municipalities (FCM) and the Canadian Housing and Mortgage Corporation (CHMC), can also play an important role in demand management. In the toilet replacement example, these organizations might conduct research and disseminate information to guide households and local governments. They can also provide water efficiency demonstration projects and case studies.

Such organizations also play a critical role in raising awareness and encouraging action. NGOs and community groups, such as watershed authorities, wetland protection organizations and conservation groups can help to protect the larger water system by raising awareness and initiating local solutions.

4.2.6. Summary

As the example in Box 9 demonstrates, involving all stakeholders in implementing demand management implies complexity. Some DSM measures are mutually reinforcing whereas others can be mutually exclusive. It is important for measures to be compatible, which requires planning, coordination and cooperation between levels of government and organizations.[3] This explains why governance issues are a central aspect of demand management strategies.

4.3. Integrated Planning

Careful planning is required in the design of DSM programs. It is equally important to situate demand management within the broader context of social and environmental planning. To consider demand management in isolation is to risk overlooking important relationships. 'Integrated planning' aims to address this concern by addressing all relevant issues.

4.3.1. Incorporating Supply-Side Options and Other Resources

In order to provide water services in the least cost manner, various combinations of demand and supply-side options should be considered (CRM 1996: 13; Beecher 1998). Wolff and Gleick (2002: 29) suggest that "unless demand management is fully integrated with water-supply planning, it will remain an underused and misunderstood part of our water future."

Integrated planning involves assessing the effects of demand and supply-side combinations in areas such as wastewater treatment, energy use and impacts on the watershed environment. Some DSM measures may only be economically attractive when their secondary benefits are taken into account (Shrubsole and Mitchell 1997: 310; Wolff and Gleick 2002: 14, 15). For example, when considering water-heating expenses, water-efficient washing machines and dishwashers are highly cost-effective. Energy conservation also has additional environmental benefits such as reducing emissions of greenhouse gases.

Not only is water resource management generally detached from other sectors, but also differing aspects of water itself are sometimes artificially separated (Fitzgibbon 1994: 167). For example, agency responsibilities for groundwater and surface water management are often divided, even though withdrawals from one can directly influence the other. Similarly, water provision and wastewater management are also handled separately. These examples point to potential opportunities and benefits for improving integrated planning.

4.3.2. Watershed Management

Integrated planning also includes watershed management, also known as integrated water resource management (IWRM). IWRM considers the cumulative impacts of all activities within a region to ensure the overall health of the watershed. The Global Water Partnership (2003: 1) defines IWRM as "a process that promotes the co-ordination, development and management of water, land and related resources." Accordingly, the licensing of municipal water withdrawals and wastewater discharges should be implemented in addition to the permitting of other water uses such agriculture and forestry (Shrubsole and Mitchell 1997: 309).

In licensing consumptive surface withdrawals[4], provinces and territories should ensure an adequate base flow is maintained to preserve both water quality and species habitat (Thomson 1994: 171; Water Conservation Strategy for B.C. 1998: 28, 29). As Justice O'Connor recommended in his Walkerton report, a watershed approach begins with a 'water budget.' This requires calculating whether intakes and outflows from surface water sources for a watershed are in balance, and documenting major sources of contamination (Cooper 2003: 24).

A watershed plan analyzes the water flows in and out of the watershed, and attempts to balance competing needs by allocating the limited resources equitably and sustainably (FCM 2001: 42). Legislation in the Central Valley in California allocated almost a billion cubic meters of water to the environment so that wetlands, rivers and fisheries are assured a minimum amount of water each year, even in times of drought (Postel 1994:

[3]The interrelationships and synergies between the various DSM measures and how best to design a integrated DSM program are more fully addressed in the forthcoming Handbook of DSM.

[4]Consumptive withdrawals are water withdrawals that are not returned to the source. The agricultural sector is a highly consumptive user of water since most of the water withdrawn is used to grow crops and does not return in bulk to the source.

17). In Australia, withdrawals from the Murray-Darling river basin have been capped to "arrest the severe deterioration of that river's ecological health" (Postel and Vickers 2004: 48). South African law requires water to be set aside for basic ecosystem needs. This freshwater 'reserve' is given priority after potable water requirements are satisfied. If properly implemented, this innovative law will ensure water withdrawals remain within ecological limits defined by scientists and communities (Postel and Vickers 2004: 48).

As with surface water, groundwater replenishment rates can be calculated and maximum extraction rates determined to prevent 'groundwater mining' and depletion of aquifers. This ensures that streams, wetlands and other ecologically significant features that receive groundwater discharge are not negatively affected.

In Canada, watershed ecosystem initiatives such as the Fraser River Action Plan, Grand River Basin Initiatives and the Northern River Basins Study attempt to determine the state of aquatic resources within particular watersheds. These initiatives look at the cumulative effects of industrial, municipal and agricultural development, as well as what is required to clean up pollution, restore habitats and rebuild fish stocks (Mitchell and Shrubsole 1997: 15,16; Dorcey 1997: 169).

Some provinces, such as Ontario, have developed guidelines for watershed planning to capture such ecosystem considerations and to promote integrated planning, especially in sub-watersheds experiencing intensive urbanization. A watershed perspective is critical to managing cumulative effects of different activities. However, jurisdictional boundaries for urban planning typically exclude substantial portions of the city's watershed. Policies and long-term planning must be based on reliable predictions of water availability and quality – issues that can only be considered in the context of the watershed (FCM 2001: 42).

Although demand management in urban centres is only one aspect of a broader watershed perspective, conservation in cities is a critical first step that can have positive effects both upstream and downstream. Without an effective watershed plan, a city is unable to optimize investments and address wasteful practices across various sectors such as agricultural, industrial and residential. Putting a watershed or IWRM approach into practice is a long-term process that requires significant changes in the relationship between political decision-makers, regulators, water agencies, civil society, and water users (GWP 2003:1).

4.4. Conservation Staff/Departments

Due to its comprehensive, long-term and integrated approach, demand management involves a different kind of complexity from supply-side projects. DSM also requires increased participation of end users and analysis of their responses to various programs during implementation. DSM planning and implementation requires staff skills and expertise that are fully integrated into the operations of a utility or government agency.

Utilities and governments might choose to create a separate conservation division, or to dedicate staff within existing departments to conservation efforts (Vickers 1994: 95). The Region of Ottawa-Carleton hired a Water Efficiency Coordinator and Edmonton has a full-time Water Conservation Engineer to administer the city's conservation programs (Sharratt et al. 1994: 77; Mackenzie and Parsons 1994: 108). Other Canadian cities and regions have dedicated staff and resources to ensure at least some level of DSM is provided. Many advantages exist in having dedicated conservation departments and/or staff.

Box 10: Potential Advantages of Creating Dedicated Conservation Departments and/or Staff Positions

- Conservation staff can reduce water use more effectively through improved planning and implementation of long-term DSM programs.
- Conservation staff can design, implement and enforce water-rationing programs in critical periods of drought, or when water demands threaten to exceed available supply.
- Conservation staff can build relationships with, and directly involve, the community.
- By developing an understanding of community concerns, conservation staff can help to guide the planning of DSM programs and the implementation of measures requiring citizen participation.
- Conservation staff can monitor DSM programs over the long term, adapting and improving them over time.
- Conservation staff can gather and analyze information about local patterns of water use and how households value water in a broader context.

Understanding which water uses are most important to citizens will help to ensure that DSM measures are appropriately targeted. For example, general water researchers have a good understanding of the average person's valuation of a small amount of water for drinking each day (through studies tracking the recent rapid increase in bottle water sales). However, much less is known about how households value other uses of water such as showering, lawn watering and clothes washing (Renzetti 2003: 4). By gathering such information, DSM measures can be improved through more effective targeting or more appropriate rate setting.

4.5. Stakeholder Participation

Decision-making processes for DSM adoption and planning are also fundamentally issues of governance. For example, what role should residents and local conservation groups have in influencing plans for reservoir expansion? This is not a straightforward issue; it relates to the nature of participatory democracy and how decision-makers weigh the values of society at large. Community participation is particularly important for demand management because without end-user involvement, program effectiveness can be seriously undermined.

Three general types of decision-making have been identified in Canadian water management (Shrubsole and Mitchell 1997: 311-314):

Decide-Announce-Defend: the public agency considers and decides on a course of action with little or no opportunity for others to participate. Conventionally, cities delegate responsibility for future water planning to engineering firms with little public consultation – a process that commonly results in supply-side solutions (Maas 2003: 37). Controversial decisions often result in a public dispute, forcing the agency to defend its position in an adversarial setting.

Consultation: the dominant decision-making process since the early 1970s. The public agency seeks input from relevant stakeholders through meetings, polls and/or surveys. The agency then announces the approach, which is seen to best serve the public interest. When consultation is used, agencies are surprised when efforts to obtain public input are unappreciated or decisions are questioned. However, stakeholders may disagree with the decision or feel that their primary concerns were inadequately addressed. The result is that agencies may again be required to justify decisions in an adversarial setting.

Collaborative: all relevant stakeholders – including water managers, planners, engineers, the public, businesses, environmental interests and policy makers – work together to define the problems, search for agreement, and implement solutions. The key public agency plays the role of facilitator rather than the focal point for decision-making. This collective process can be incremental and ongoing. Although demanding in terms of process design and the initial time invested, this approach directs energies toward problem-solving rather than solution-defending. Avoiding adversarial situations means that time, money and energy are saved.

The appropriate decision-making approach will vary according to circumstance. Currently, water professionals frequently operate in isolation from other stakeholders (Shrubsole and Mitchell 1997: 314, 315). However, because demand-side management depends on changes in consumer behaviours, DSM is a prime candidate for collaborative approaches (Vickers 2001: 3). Indeed, as Wallace et al. (1997: 129) suggest: "the hope for achieving sustainability in water management lies in the establishment of interdependent, community-based partnerships and increased stakeholder involvement."

Box 11: Benefits of Public Participation in DSM

- Gathering public input to guide and provide imaginative solutions for planning processes
- Producing a stronger consensus for action
- Helping to educate, engage and inspire the public
- Determining public support and concern over particular measures
- Alleviating public concerns and scepticism
- Legitimizing programs by building relationships and increasing community ownership
- Creating ambassadors for the program
- Generating media interest
- Increasing participation in monitoring programs
- Reducing the likelihood of future conflict

Source: Wallace et al. (1997: 120-123)

One avenue for increasing participation is for municipalities and senior governments to form citizen advisory committees that include broad representation (such as plumbers, homebuilders, environmentalists, and citizens-at-large) and that have meaningful terms of reference (RMI 1991: 20; Marsalek et al. 2002: 28; Mee 1998: 198).

4.6. Business and Ownership Models

An important governance issue is the business and ownership model chosen by the water utility. Most familiar models lie on a public-private spectrum. At one end of the spectrum is the government owned and operated public utility, the most common arrangement in Canada (Bakker 2002). The utility is often a municipal department, although some institutional separation could be created by setting up a board or commission as a financially independent legal entity with the government continuing to own the infrastructure, which the board or commission operates.

At the other end of the spectrum is the fully privatized water utility that is owned and operated by a private company. At present, this form of ownership does not exist in Canada (Bakker 2002). Between these two extremes are corporatized utilities which are run like private companies but retain government ownership and/or management and public-private partnerships, where a publicly-owned utility out-sources tasks to private sector companies.

In contrast to the models along the public-private spectrum is the cooperative utility, which is owned and managed by the water users themselves. This type of model is common in Scandinavia, but can also be found in rural Quebec, Manitoba and Alberta (Bakker 2003). Although not explored in detail here, this model is a promising alternative to the predominant water provision paradigm – and the tension between utilities captured by either public agencies or private entities.

Box 12 summarizes business and ownership models and their key features, many of which may influence the adoption and implementation of DSM. For example, increasing separation of a utility from public oversight and accountability can mean that the interests of the public and NGOs have less impact. This can impede the pursuit of sustainability, and make it more difficult to implement integrated planning. Introducing a profit motive may encourage private companies to increase water throughput to maximize revenues. Alternatively, increasing separation often entails financial self-sufficiency, which will create an incentive to increase retail prices that may, in turn, reduce water demand.

4.6.1. Government Owned and Operated

Most water provision in Canada is by utilities that are government owned and operated. In large urban areas, multiple municipalities may jointly manage water service, with a regional authority providing water wholesale to member municipalities that in turn retail to end users. Utilities range from municipal departments that exist within the Mayor's office and have no separate financial budget, to boards or commissions that are financially independent entities with control over management and strategic planning.

In practice, most utilities fall between these two ends of the spectrum. These utilities in particular often have mixed mandates, including maintaining affordable rates, complying with regulations and taking into account issues such as local economic development (Bakker 2003a: 9).

Determining the effects of government ownership and operation of a utility on water use and conservation is difficult. Brandes (2003) found a fourfold variance in water use across such utilities in a sample of 20 municipalities in Canada. These cities also varied widely in their commitment to DSM, ranging from a high level of integration in Winnipeg and Waterloo, to almost nonexistent implementation in Montreal and St. John's. With such significant differences between utilities, it is difficult to assess the effects of this business/ownership model on water conservation and DSM implementation. One generalization that can be made is that this model leaves a great deal to the discretion of the local utility.

4.6.2. Corporatization

A corporatized utility is a publicly owned corporation that operates like a private company, usually under the direction of a management board and with the local government acting as the sole shareholder (Bakker 2003: 12). In Canada, the primary examples are in Edmonton and Kingston. In 1997, the City of Edmonton corporatized its water services by transferring ownership, operations and maintenance of its water supply assets to EPCOR, a municipally owned corporation.

The City of Edmonton is the sole shareholder of EPCOR. The City appoints the directors and auditors and sets dividend policy. All remaining authority is devolved to EPCOR's board. In addition to its role as shareholder, the City acts as a regulator for those portions of EPCOR's activities falling within the City of Edmonton[6].

Determining the effects of corporatization on water

[5]The potential for cooperatives as an alternative water governance model and a more sustainable water provider will be explored in the next report of the Urban Water Demand Management Project, to be released in the fall of 2004.

[6]EPCOR also operates elsewhere in Canada, such as in Canmore, Alberta, and Port Hardy, BC in more of a public private partnership role.

Box 12: Business and Ownership Models for Water Utilities

Model	Local government owned and operated	Local government owned utility; managed and operated by separate board or commission	Government owned corporation
	← PUBLIC - PRIVATE		
Description	• Utility owned and operated by local government, usually one or more municipal departments • Regional authority can be created to act as water wholesaler for member municipalities	• Board or commission is a separate legal entity that manages and operates infrastructure • Members elected or appointed by Council	• Local governments may corporatize utility or a higher-level government may create a Crown corporation • Government acts as the primary or sole shareholder (appoints directors) of a corporation that manages, operates and may own infrastructure
Revenue	• Utility may receive some indirect revenue, such as property taxes, in addition to user rates	• Board or commission is financially self-sufficient so it must generate all revenue through user rates • Municipal Council usually approves budget and rates	• Generally financially self-sufficient • Government may retain authority over key issues such as rates (as well as policy and acquisitions, etc.)
Advantages	• Municipal department has clear and direct political accountability· • Management can be easily integrated with other departments • Potential for economies of scale (especially with regional wholesalers)	• Full cost recovery easier to implement • May improve financial accountability	• Full cost recovery required • Autonomous management, commercial discipline, and external auditing can promote efficiency
Disadvantages	• Small municipalities may have limited resources and expertise • Sub optimal rates may result from lack of requirement for full cost recovery • May be limited incentive to operate efficiently	• Public accountability may be weakened	• May decrease public accountability and the potential for integrated management • Commercial confidentiality may limit access to information • Capital costs may be higher • Requires effective regulation to avoid abuse of monopoly power
Examples	• Greater Vancouver Regional District • Regional Municipality of Waterloo	• Peterborough	• SaskWater - provincially owned Crown corporation • EPCOR - corporatized utility owned by the City of Edmonton

	Delegated management/ public private partnerships (PPPs)	Fully privatized utility	Cooperative
	SPECTRUM →		
	• Government owned infrastructure • Management and/or specific services (e.g. construction, maintenance, customer service) contracted out for a period of time (e.g. 1 to 30 years) to a concessionaire (e.g. private sector company)	• Private sector corporation owns and operates infrastructure, usually operating as monopoly suppliers on a licensed basis	• Utility is owned and managed by the users of the service
	• Concessionaire will be financially self-sufficient, which may extend to entire utility with full-delegated management of utility	• Financially self-sufficient	• Likely financially self-sufficient
	• Can make flexible use of external expertise • Concessionaire has potential access to increased financing. • Possibly increased efficiency and innovation by concessionaire	• Can make use of external expertise • Potential access to increased financing • Possibly increased efficiency and innovation	• High degree of accountability to end users • High degree of involvement by end users • Very flexible
	• Capital costs for concessionaire may be higher • Temporary concessionaires may have less incentive to maintain infrastructure • Potential loss in accountability • Requires effective contract administration and regulation, which may be costly	• Full privatization is difficult to reverse • Private interests may lie with short term profits over long term sustainability • Requires complicated and costly regulation to avoid abuse of monopoly power	• Usually small scale and may lack resources and expertise
	• Hamilton • Halifax • Moncton • Port Hardy	• England • No examples in Canada	• Rural Alberta • Quebec • Manitoba

Adapted from: Bakker (2002); Bakker (2003b)

use and DSM is as difficult as understanding the impacts of full government control. In Edmonton, per capita water use appears to have increased in the years following corporatization. Although between 1996 and 1999 there was little change in system leakage, total per capita water use increased by 4.3% after two periods of consecutive decline. More significantly, domestic per capita water use was reported as increasing by 35.4%, also following consecutive periods of decline (Brandes 2003: 28).

Such a dramatic change should be viewed with caution. However, it may be partially, or even entirely attributable to changes in accounting methods. This clearly demonstrates the need for consistent data collection in Canada. It is also equally likely that the increases were due to a range of other factors such as climate, pricing, or demographics rather than exclusively the business/ownership model applied.

4.6.3. Public-Private Partnerships (PPPs)

Public-private partnerships (also called Private-Sector Participation) involve the outsourcing of activities such as construction, operations and maintenance, and/or customer services, to private companies (Bakker 2003: 13). Where management activities are out-sourced, they are sometimes referred to as 'delegated management.' PPPs are differentiated from full privatization because a private company does not usually extend to ownership of the utility's assets. A wide variety of potential relationships and contract types are possible. These range from management contracts, as in Hamilton, to 'build-operate-transfer' (BOT) agreements, as in Halifax and Moncton, where a private company is contracted to build infrastructure, manage and operate it for a period of time, and eventually transfer it to the City.

Given the diversity of PPPs, it is difficult to generalize about their effect on performance, water use and DSM. In France, for example, where 75% of the population is supplied water by some form of PPP, limited evidence suggests that once differences in raw water quality are accounted for, there is minimal difference in performance between direct and delegated management (Menard and Saussier 2000; Buller 1996; Renzetti 2002: 9,10; Brubaker 2002: 56).

Hamilton provides the clearest and longest-running example of a delegated management contract in Canada. The City of Hamilton's water and wastewater treatment facilities are currently operated by a private company under the terms of a 10-year delegated management contract that will end in 2004 (Bakker 2002). Within the terms of the contract, the city retains asset ownership, responsibility for rate collection (which has been contracted out to a municipal corporation responsible for setting rates), and the provision of capital investment. The external operator is responsible for day-to-day operations and management of plants, staffing levels, and some aspects of equipment maintenance (Bakker 2003: 27).

In Hamilton, per capita water use increased in the years following private sector involvement. From 1996 to 1999, total per capita water use and domestic per capita water use were reported as increasing by 17.8% (Brandes 2003: 28). Additionally, in 1999, unaccounted-for water was about 20%, an increase from 1996 levels. Although such increases suggest poor performance with respect to conservation, as noted above in the Edmonton example, the increases may be due to other factors.

The Hamilton model does not appear to have performed well from a conservation perspective; however,

Box 13: Privatization and Leakage

Despite the promises of greater efficiencies and 'smart management' systems that are supposed to come with privatized water systems, a number of investor-owned water companies fail to account for the massive volumes of water their systems lose to leaks and other unmeasured or unexplained uses.

The much-touted water loss reduction goals for the privatized British water system have yet to be realized, and according to a report by the House of Commons, the reality is that some "companies have still not achieved their economic level of leakage." The report states that measuring leakage accurately is difficult because only 20 percent of households in the United Kingdom are metered, which makes company leakage estimates "subject to manipulation."

Following the 1989 privatization of water systems, leakage levels across the UK had risen to an average of 30 percent by 1995. The Office of Water Services, which regulates the water and sewerage industry in England and Wales, intervened and set mandatory leakage reduction targets. Several companies with high loss levels, notably Thames Water Utilities LTD, serve areas facing supply shortfalls. In 2003, water leakage and losses by Thames Water accounted for over 25 percent of all water leakage in England and Wales, yet the company provides water services to only 15 percent of billed customers.

Source: Postel and Vickers (2004: 57)

not all PPPs will perform poorly. It is likely that a partnership in some non-core areas such as billing, plant maintenance, meter installation, or leak detection and repair could have beneficial impacts.

4.6.4. Full Privatization

At present, no Canadian governments have fully privatized their water utilities (Bakker 2003: 16, Brubaker 2002). However, England provides a clear example of full privatization. In 1989, the English government sold off the assets of the 10 regional water and wastewater authorities in England and Wales; although rate setting remained regulated by government through the Director General of Water Services (DGWS) (Brubaker 2002: 41; Watson 1997: 217, 218).

Controversy exists over whether or not privatization in England has been a success. In some areas, performance did improve following privatization (Watson 1997: 222,232). For example, an increase of 66% in the average household water bill between 1989 and 1994 allowed for similar increases in capital expenditures to improve infrastructure. This, in turn, led to improvements in the treatment of sewage, less pollution in receiving waters, and improvements in the quality of drinking water.

Such improvements have led some to suggest that privatization in England "has brought striking economic, environmental, and public health benefits" (Brubaker 2002: 44). However, in other areas performance suffered following privatization. The private water companies did little to reduce system leakage; in some cases, leakage even increased. Given the low operating costs to treat water, most companies found it cheaper to treat water and allow relatively high rates of leakage rather than undertake expensive operational repairs (Watson 1997: 222-232; Bakker 2002: 40).

The impact of not repairing system leakage was highlighted during the Yorkshire drought of 1995 when an unusually dry summer, combined with record leakage levels, threatened the water supply to a region of nearly 3 million people. In response, the regional private water company increased withdrawals from local rivers and refilled reservoirs by tanker truck at a total cost of over $100 million. Only after government intervention, and the imposition of targets to require companies to reduce leakage, did this wasteful situation change (Bakker 2000).

The private water companies also opposed the implementation of widespread water metering, a requirement for conservation-based pricing structures, arguing that its costs outweighed the value of the water saved (Bakker 2000). This opposition resulted in the government eventually relaxing its initial requirement that billing shift from a flat rate structure, even though it had previously argued that metering was economically viable.

Given the experience in England, many Canadian observers remain sceptical of the benefits of privatization (Barlow 2002; Bakker 2003; Renzetti 2003). Furthermore, Renzetti (2002: 9) indicates that "a recent review of the literature demonstrates there is little evidence that the change in ownership, per se, has led to measurable improvements in performance."

Presiding over the Walkerton inquiry, Justice O'Connor concluded that full privatization of municipal water supply systems was not desirable for a variety of reasons. In his report, he stated:

"In not recommending the sale of municipal water systems to the private sector, my conclusion is based on several considerations: the essentially local character of water services; the natural-monopoly characteristics of the water industry; the importance of maintaining accountability to local residents; and the historical role of municipal governments in this field. I see no reason, as a practical matter, why municipal ownership should not be continued" (O'Connor 2002: s.10.4.3, 323).

4.6.5. Cooperatives

Cooperative utilities are enterprises that are owned and managed by the users of the service provided and are generally characterized as not-for-profit and self-sufficient 'water associations' (Baker 2003a: 11). Although this model is not common in Canada, a number of small water supply cooperatives do exist, generally in rural areas of Alberta, Quebec and Manitoba (Bakker 2003a: 11). Cooperatives are more common internationally, in developed countries such as Denmark and Finland, and in some developing countries such as Bolivia.

Once again, assessing the effects of this model on water use is difficult due to a lack of research and the numerous other factors that influence water use. However, it may be relevant to note that water withdrawals on a per capita basis in Denmark are approximately five times lower than in Canada (OECD 2003; Boyd 1999). Finland also has substantially lower per capita water use than Canada. It seems likely that such low use is partly a function of the governance system, as well as local environmental conditions and cultural attitudes and behaviour.

4.6.6. Summary: The Privatization Debate

Although a growing interest in moving towards the privatization of water provision exists, the private sector involvement in Canada has been limited to public private partnerships (PPPs). The interest in this approach is driven by the argument that private management and ownership leads to improved performance, better responsiveness to customer needs, compliance with regulation, and overall operating efficiency (Brubaker 2001; Bakker 2002; Bakker 2003b; Renzetti 2002; Gleick et al. 2002; Bond 2003). The commonly held view is that this superior performance is the result of market discipline, more efficient allocation of finances, and independent regulation.

Yet privatization remains a highly contentious topic and it is unclear whether superior performance necessarily follows. There is also concern about the deeper implications of privatization. With a publicly owned and operated utility, water users are viewed as citizens with access to accountability through political processes. Water is viewed as a public resource, and its provision a basic human right (Bond 2003; Bakker 2002: 38).

In contrast, when utilities are privatized, water users are viewed as customers or ratepayers, and utilities are accountable to customers and shareholders. Water becomes a commodity to be sold to those who can afford it. Partial privatization, as with public-private partnerships, is sometimes seen as the first step on the path to full privatization, and therefore may be similarly resisted.

In addition to the specific examples described above, a growing body of literature suggests that the performance of the private sector is not necessarily superior. Empirical studies lack conclusive evidence that privately owned water utilities are more efficient than comparable publicly owned ones (Sepala et al. 2001; Renzetti 2002). The literature also suggests that efficiency may depend as much on the structure of the market (i.e. the level of competition) as it does on ownership (Renzetti 2002; Bakker 2002; Rees 1998; Vickers and Yarrow 1989).

The comparative efficiency of privatized versus publicly owned water utilities is still uncertain. With respect to DSM, privatization may create the potential for increasing prices to reflect the full economic costs of service provision, which in turn would generally lead to demand reduction. On the other hand, many privatization watchdogs are concerned that conservation programs are typically ignored or even cancelled by private companies taking over public utilities (Gleick 2002: 38). Other concerns specific to privatization of water provision include the loss of service to smaller communities, a decrease in affordability of water, and a reduction in public participation (Gleick et al. 2002).

Conservation programs are usually less capital intensive than supply-side infrastructure and therefore may create fewer opportunities for private investors. With fewer capital-intensive opportunities, conservation may be neglected relative to more traditional, centralized water-supply projects such as new reservoirs and treatment plants.

The overall effect privatization would have on DSM is unclear. However, "regardless of organizational structure, level of governance, or ownership model, there are systems that operate well and others that operate poorly in their overall performance" (Cameron 2002: 8). Therefore, both private and public water utilities have the potential to generate sub-optimal results if they ignore the full impacts and costs of high water use and instead rely on subsidies – ecological, social or public.

Before selecting the best model for water management, decisions about the goals of water management must be made. Regardless of ownership, requirements remain for intensive regulation or mechanisms that will guarantee high quality water, environmental protection, equitable prices, full access, and sustainability (Bakker 2002:20). Instead of privatization creating an option for 'de-regulation,' a void where government once existed, it is important that government remain active and that principles of good governance and 're-regulation' are applied (Bakker 2003b).

4.7. Public Private Partnerships (PPPs) for DSM

Interesting and innovative opportunities for private sector involvement in DSM do exist. From planning and implementing entire programs, to helping to implement specific DSM measures, the creation of new markets related to water conservation may be possible.

Electric utilities have introduced competition and innovation into demand management by establishing a competitive bidding process (RMI 1991: 69). Applying this approach to the water sector, a utility would set a savings goal and consumers or third parties would bid against one another for the chance to meet all or part of that goal with cost-effective methods. Third parties might offer water savings by undertaking conservation programs that target various end users. Such an approach would resemble 'savings financing,' another idea from the energy industry, where a private sector company pays the upfront costs for efficiency improvements for customers in return for some proportion of the resulting water (and energy) savings (Foerstel 1994: 66).

In Kelowna, BC, a competitive bidding process was used to outsource conservation efforts (Waller and Scott 1998: 382). The city invited the private sector to submit creative proposals for a 15-year DSM program, where a company would invest its money upfront and regain it over time. Unlike a traditional design-tender-build process, where the details of a program are specified before inviting bids, Kelowna's approach encouraged proponents to submit plans with the most innovative and least expensive ways to achieve the water reduction objectives. The city subsequently entered into a $3.9 million PPP with Schlumberger Industries, the company handling all facets of meter operations (installation, replacement, maintenance, and reading), undertaking a 2½ year comprehensive public education campaign and providing 15 years of financing.

Kelowna calculated the costs of this winning proposal to be less than the projected costs of the works being undertaken by city employees. According to Waller and Scott (1998), the city also benefits from Schlumberger's state-of-the-art technology and from the transfer of risk to the company. The projected benefits of universal metering, increased rates, and the public awareness campaign are a 20-30% decrease in water use, deferral of a $10 million investment for wastewater treatment, and savings of at least $600,000 in reduced water pumping costs over 20 years.

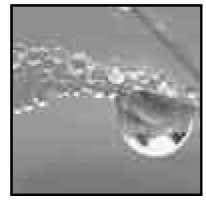
PPPs might also involve the simple contracting-out of an already designed DSM program. For example, Barrie, Ontario contracted with a community-based organization called 'Be Green Barrie' to deliver a residential fixture replacement program (Waller and Scott 1998: 377, 378). Municipalities might offer developers the option of reducing their water connection fees by retrofitting nearby existing buildings with water efficient fixtures. These examples highlight the potential for involving the private sector in demand management with benefits including access to outside expertise, competition, and innovation.

4.8. Summary

The topic of governance is wide ranging and influences most aspects of water management and provision. 'Good' governance in the water sector ensures that suitable mechanisms exist for long-term planning, appropriate levels of integration, and the achievement of identified goals. Overall goals can vary widely, from reducing water use and increasing long-term sustainability, to promoting economic growth and innovation and guaranteeing equity and access for all. Although it is difficult to generalize about these goals, this chapter has outlined some of the most important considerations from a demand management perspective.

Embedded in the concept of governance is more than just government. But governance necessarily includes the government policies, oversight, and regulation that are critical to ensuring a range of public needs are met. Fundamental to meeting these needs is the integration of an appropriate level of demand management in all aspects of water provision. The following chapters discuss some of the opportunities for action to better integrate DSM into water management in Canada, at the regional/municipal, provincial and federal government levels.

Chapter 5
Municipal & Regional Action Plan



5.1. Introduction

Local governments, operating under provincial legislation, deliver water services to most Canadians. Although variation exists between, and even within, provinces, water utilities play the primary role in urban water provision, wastewater treatment, stormwater management, and retail price setting. In addition, utilities are often primarily responsible for implementing water demand management programs.

In those urban centres where they exist, regional water authorities may also play an important role in demand management. A tiered relationship exists in which regional authorities act as wholesalers, treating and delivering water to member municipalities that in turn act as retailers, delivering water to end users such as homes, businesses and local industries. The additional fragmentation of tiered water delivery requires government to coordinate their involvement in the planning and implementation of conservation measures.

This chapter describes some of the basic principles and steps involved in demand management planning processes at the local level.

5.2. Conservation Planning

Conservation planning can be beneficial to all water providers, not just those facing impending infrastructure expansion. Even areas that consider supplies plentiful and infrastructure capacity adequate will find that con-

Box 14: Key Principles and Steps in Developing a Successful Water Supply and Conservation Plan

Planning principles

- ***Integrated management***
  i.e. include consideration of all related resources/services, including water, wastewater, and energy.
- ***Stakeholder participation***
  i.e. include all stakeholders during DSM planning.
- ***Focus on underlying services***
  i.e. focus on providing services such as bathing and sanitation rather than water provision per se. By keeping the true objective in focus, creative alternatives may appear.

Planning steps

- ***Demand management study***
  Predicts future water and wastewater demands and infrastructure requirements, and so determines where to focus conservation efforts
- ***Identification of goals***
  Specific conservation goals can help to focus a planning process, provide guidance and a benchmark for evaluation.
- ***Inventory of options***
  From a comprehensive study of available DSM measures and supply-side options, create an initiatial list of feasible combinations.
- ***Cost-benefit analysis***
  Compare and assess the various combinations.
- ***Water conservation and supply plan***
  Develop a blueprint for action.
- ***Implementation and evaluation***
  Evaluation is critical to determine the impacts of the program and necessary changes on a continuous basis.

Sources: Vickers (1994: 94,95); CRM (1996: 8-16); Water Conservation Strategy for B.C. (1998:31); Opitz and Dziegielewski (1998); Vickers (2001: 2-4, 405-407)

servation planning encourages efficient resource use and may result in cost savings over the long term, potentially deferring future capital projects indefinitely.

As previously mentioned, many communities in Canada have already implemented some DSM measures. However, the majority of communities apply DSM incrementally and outside of long-term planning processes. The tendency is to start with low cost and politically acceptable measures such as public information and watering restrictions (Water Conservation Strategy for BC 1998: 26, 30). This approach is unlikely to result in long lasting or substantial water savings. A comprehensive, long-term and integrated planning process is required to fully reap the benefits of DSM.

Every community is unique and must tailor planning processes to specific local needs, taking into consideration variables such as biophysical limitations and social values. However, the basic planning principles and steps described in this chapter are applicable to most situations, and provide a basic framework for achieving substantial and reliable long-term reductions in water use.

5.2.1. Focus on Underlying Services

The first two planning principles in Box 14 – integrated management and stakeholder participation – have already been discussed in some detail (see Chapter 4). However, integrated planning, stakeholder participation and water planning in general can all focus on the issue of underlying services.

Integrated Resource Planning (IRP) and 'soft path' analysis, both developed in the energy sector and now gaining acceptance in the water sector, suggest that the focus of planning should be on meeting underlying needs, such as bathing, sanitation and attractive yards, rather than on water provision as an end in itself (CRM 1996: 13; Wolff and Gleick 2002: 3, Brooks 2003). This approach represents a significant shift for many utilities, which have traditionally been concerned only with selling water.

Such a change in focus creates the potential to provide more efficient and innovative services (Wolff and Gleick 2002: 3). For example, rather than simply delivering water for consumers to water lawns, a water utility could deliver assistance to create attractive yards, thereby meeting the underlying desire of the consumer.

In addition to delivering fresh water in some situations, utilities might also provide recycled water and institute a water-efficient landscaping program. This type of program could include educational literature and workshops, demonstration projects, and collaborations with local nurseries and landscapers. Similarly, toilets provide the service of sanitation. This service, however, can use less water to provide similar performance. By changing the focus of planning to address underlying services, many options for reducing water may be discovered with little impact on the end user's standard of living.

5.2.2. Forecasting Models

Throughout the planning steps described below, computer simulation packages, such as the Water Use Analysis Model (WUAM) developed by Environment Canada, and the IWR-MAIN Water Demand Analysis Software developed by the US Army Corps of Engineers, can help simulate the effects of different combinations of conservation measures (Kassem and Tate 1994: 191, 197; RMI 1991: 96). Some utilities, such as EPCOR in Edmonton, have developed their own forecasting and simulation programs to ensure that local considerations are included in water demand forecasts.

The water demand software currently used by many US water utilities – known as IWR-MAIN – can forecast changes in demand resulting from specific DSM measures such as pricing and plumbing codes. This forecast is done on a disaggregated basis; it can distinguish between seasons and different types of dwellings, and accounts for various end uses (Opitz et al. 1998). This type of forecasting allows targeted conservation measures to be evaluated and compared with supply-side alternatives.

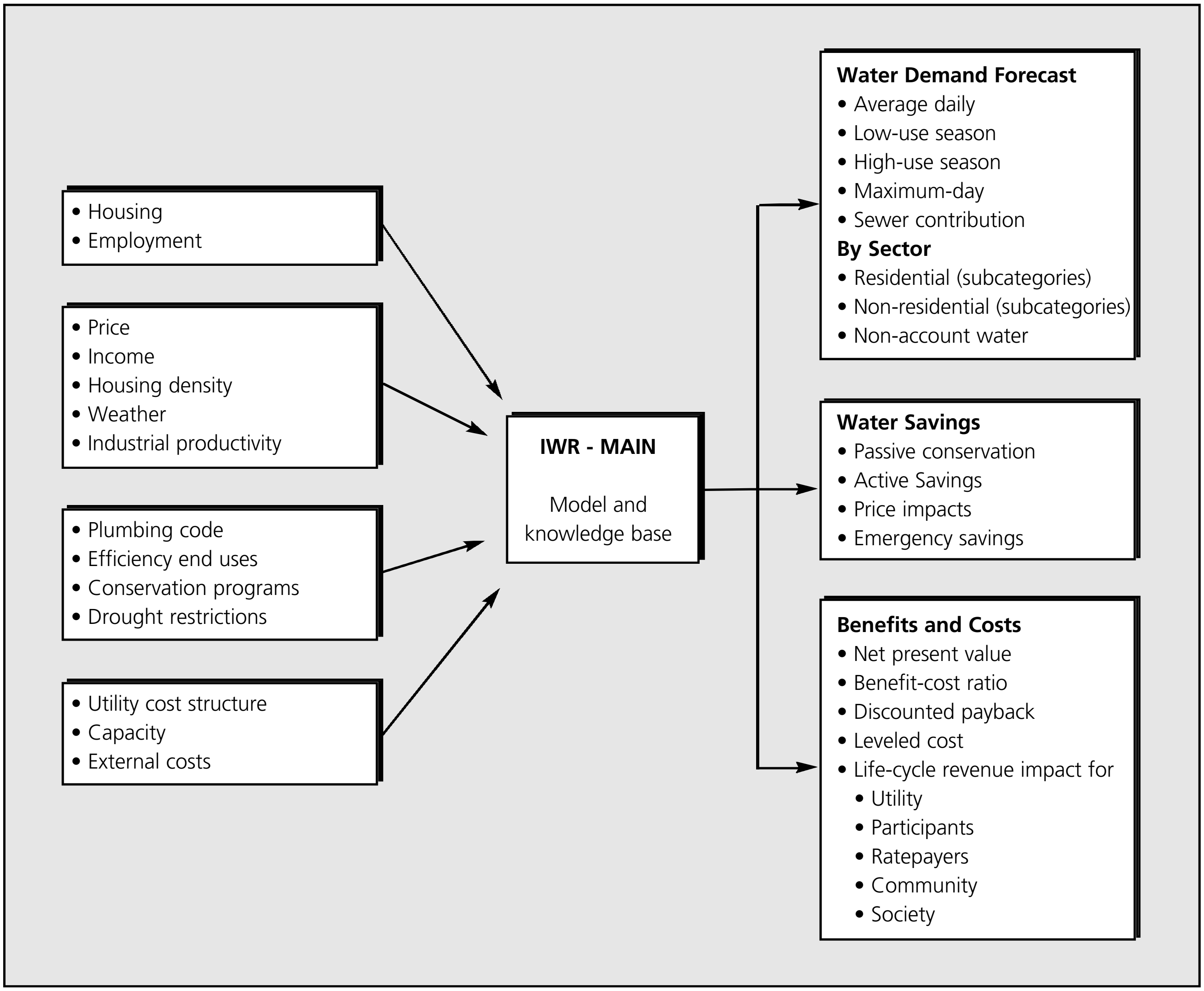
Accurately forecasting future demands within a DSM program is important. Forecasts can assist in tailoring a program to the needs and circumstances of a given area and provide useful information for demand studies. Accurate forecasts also avoid the need for reactive and sometimes contradictory future actions. For example, underestimating the reduction in water use due to a conservation initiative may lead to revenue shortfalls and "the rather vexing public relations problem" of having to raise water and sewage rates as occurred in Los Angeles – not the kind of reward or message municipalities want to send residential customers after a successful DSM campaign (Gates 1994: 336).

5.3. Demand Study

The first planning step is to conduct a demand study. The study should analyze a range of factors including: existing water supply sources and production capacities, historical and projected water demands, unaccounted-for water, current pricing and rate structures, the effect of previous conservation efforts, and predictions for future conservation initiatives.

Such a study helps to determine where to focus con-

Box 15: The IWR-MAIN Forecasting Model - Inputs and Outputs



Source: Baumann et al. (1998: 109); EPA (1998: 112)

servation measures and identifies areas for reliable water savings. A demand study in Winnipeg indicated that annual changes in per capita water use increased by 2% in the residential sector and 0.5% in the commercial sector, while it decreased by 0.3% in the industrial sector. These findings suggest that the residential sector should be the primary target for demand management (Sacher 1994: 98).

Ideally, demand studies and forecasts should be disaggregated, forecasting for each category of user such as single-family homes versus multi-family homes, and for specific end uses, such as showers versus sanitation. This separation allows for consideration of different demand and/or supply-side combinations to meet the specific needs of each category and each service. Additionally, identification of the quality of water required will allow for consideration of alternative sources, reclamation, reuse and recycling options (Wolff and Gleick 2002: 27).

5.4. Identify Goals

The second planning step is to develop clear and organized conservation goals. These goals should include explicit water and wastewater reduction targets as well as planning and implementation time frames. Conservation goals can take many forms, but measurable goals are considered best for evaluating the overall program. One approach employed by many US water systems is to identify specific water-use reduction goals

Box 16: Common Water Conservation Planning Goals

- Eliminating, downsizing, or postponing the need for capital projects
- Improving the utilization and the longevity of existing facilities
- Lowering variable operating costs
- Avoiding new source development costs
- Improving drought or emergency preparedness
- Educating customers about the value of water
- Improving reliability and margins of safe and dependable yields
- Protecting and preserving environmental resources (restoring stream flows by decreasing water withdrawals and reducing pollution by decreasing wastewater discharges)

Source: EPA (1998: 103)

as a percentage of current water use.

Preparing a statement of conservation goals helps to focus the planning process, guide program activities, and establish benchmarks for evaluation. At the same time, determining how much efficiency is desirable is a community choice, and all costs and benefits cannot be quantified. Therefore, social objectives are best determined through a democratic and participatory decision-making process (Wolff and Gleick 2002: 17). An open and transparent process involving all affected stakeholders is vital, particularly because community involvement in developing goals will enhance the success of conservation programs.

5.5. Inventory of Options

Once the goals have been identified, a comprehensive list of DSM measures should be compiled and their basic feasibility determined. Local community characteristics may favour specific measures, so creating a community profile is helpful. Relevant characteristics should be identified, including: whether the community water resources are stressed, the history of droughts and water emergencies, whether the system has excessive unaccounted-for water and anticipated future construction, water demand and population growth. Such characteristics can provide

Box 17: Community Characteristics that Suggest Specific DSM Measures

Community characteristic		DSM measure
Old or leaking distribution system	-----	System audit, leak detection and repair
Numerous bleeders due to cold climate	-----	Bleeder replacement
Older residences	-----	Home audits, retrofit indoor fixtures
Peak summer demand significantly higher and close to infrastructure capacity	-----	Outdoor efficiency measures (e.g. water efficient landscaping), metering + peak rate pricing structure
Overextended wastewater treatment system	-----	Indoor efficiency measures, reclamation, reuse and recycling
Rapid growth	-----	Measures aimed at developers and new construction, such as reduced hook-up fees for installation of efficient fixtures and landscapes, and plumbing codes
Significant ICI sector	-----	Audits of major water users
Many parks, golf courses, and other large turf areas	-----	Reclamation and reuse

Source: adapted from (FRMI 1991: 20,22).

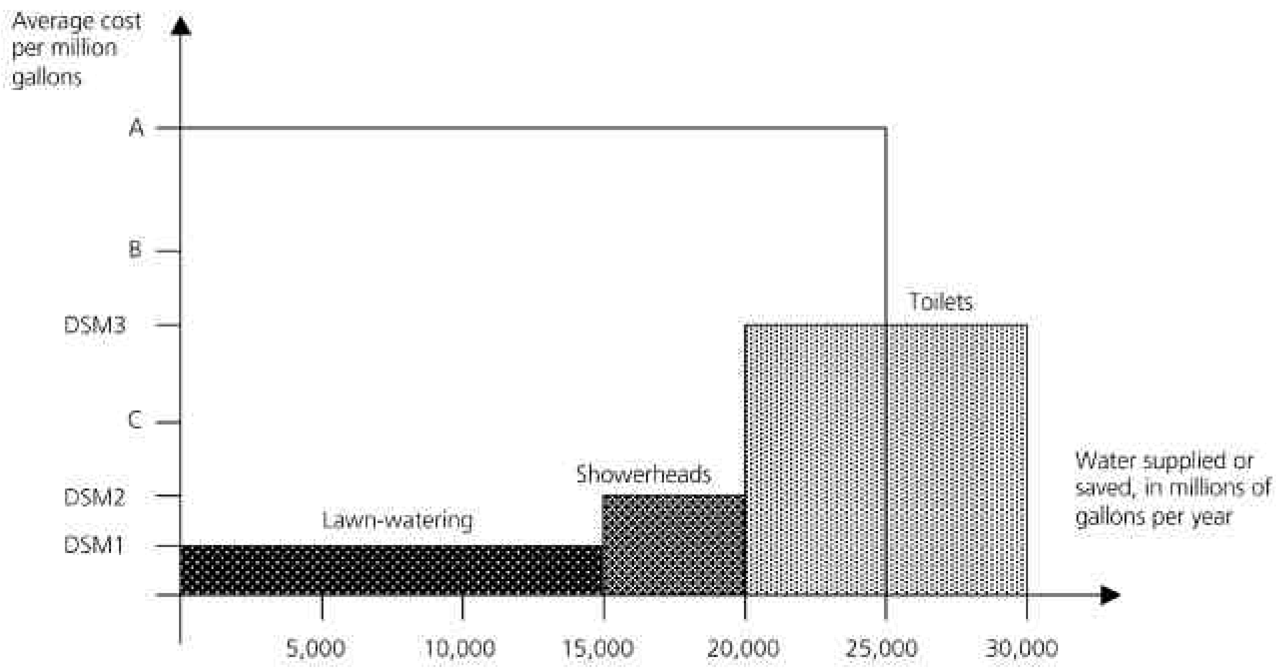
[7]See Ferguson and Brandes (forthcoming) Handbook of DSM for a detailed discussion of the most appropriate situations for specific DSM measures.

initial direction for appropriate DSM measures. Some measures, such as education and improved pricing, will likely be applicable in all locations.

The potential impact of climate change is another important community-specific issue to consider. Climate change will affect many local conditions such as water availability and water demands. For example, glaciers and snow melt that feed source waters may be reduced and, as local summer temperatures rise, outdoor watering demands will increase to maintain lawns and gardens.

Many approaches to DSM planning suffer from a narrow focus on individual measures or 'spreadsheet thinking' (Wolff and Gleick 2002: 29). Experience shows that the most effective programs include integrated packages that capture the synergies among measures, many of which are mutually-reinforcing and more effec-

Box 18: Hypothetical 'Supply Curve' Comparing Supply-Side and DSM Options



In this hypothetical example, a DSM program considers three measures. The first, a lawn-watering reduction measure, is projected to save 15,000 million gallons per year at a program cost of DSM1 dollars per million gallons, averaged over the lifetime of the project (the area of the horizontally lined lawn-watering rectangle is thus the total cost of the lawn watering measure). Similarly, replacing showerheads saves 5,000 gallons at a cost of DSM2 per million gallons. Replacing toilets saves 10,000 gallons at a cost of DSM3 per million gallons. Total projected water savings of the DSM program are therefore 30,000 million gallons at an average weighted cost of C dollars per million gallons. The total cost equals the sum of the three shaded rectangles.

For comparison, a new supply-side project is also shown (e.g. a reservoir expansion or diversion project). This is projected to create a new supply of 25,000 million gallons per year at a cost of A dollars per million gallons (and so the total cost is the area of the large unshaded rectangle).

This hypothetical DSM program 'supplies' more water than the new supply project at a significantly lower cost (i.e. C is less than A). Thus, if the water utility were approaching its current capacity, the DSM program would be preferable to the new supply side project. Further, if the current cost of water per million gallons, shown as B, is higher than C, it makes economic sense to implement the DSM program, even if the utility is not approaching its current infrastructure capacity.

Note that this diagram does not show the additional benefits of DSM measures, such as reduced energy costs and environmental impacts, which can make DSM approaches even more favourable than supply side options.

Source: RMI (1991: 16,17)

tive when implemented jointly (CRM 1996: 9; RMI 1991: 15; Postel 1985: 42). Higher water rates combined with rebates for efficient fixtures and landscaping can improve the acceptability of pricing increases and encourage consumers to install water saving options. Concurrent educational programs can explain to households the cost-effectiveness of doing so.

Through integrated planning, various packages of measures and implementation sequences can be considered, and different combinations of demand management and supply-side options explored. By viewing all of the options in a holistic way, the most effective combination can be implemented to meet local requirements for underlying services.

5.6. Cost-Benefit Analysis

A cost-benefit analysis should be conducted for all of the relevant combinations of DSM and supply-side options identified in the previous step. This provides detailed cost estimates and estimates of the expected benefits, such as peak and average water demand reductions, reduced operating costs, and deferred capital expansion expenditures. Program costs should include allocations for staff, consultation and training, hardware, educational and media materials, and financial incentives. To determine the cost-benefit estimates, information such as the number of eligible customers and estimated participation rates is required.

An integrated approach considers both conventional benefits such as savings in capital and operating costs, and secondary benefits, such as energy savings and reduced environmental impacts (Cook 1994: 320). For a thorough example of how to estimate savings from efficiency improvements and how to calculate their cost effectiveness, see Gleick et al. 2003.

Both quantitative and qualitative criteria should be used to select the most appropriate DSM options. A variety of assessment tools are commonly used, but generally DSM packages are measured based on their economic efficiency. An economically efficient outcome is achieved when the incremental cost of demand reduction is the same as the incremental cost of supply augmentation, taking into account all costs of conservation and supply, including environmental and social ones (Wolff and Gleick 2002: 17).

A 'supply curve' helps compare the cost effectiveness of DSM and supply-side options. Creating a supply curve illustrates whether the water saved through a DSM program is equivalent to the additional water that would be supplied through infrastructure expansions (RMI 1991: 13, Gleick et al. 2003: 115, 116). Other decision-making techniques such as Multi-Attribute Trade-Off Analysis (MATA) may be helpful if program goals, such as environmental quality improvements, are measurable in monetary terms.

In order to assist in the selection of a preferred package, a cost-benefit analysis should explicitly include risks and uncertainties. By including risks and uncertainties, combinations of DSM measures can be assessed against various future scenarios. This will ensure choices that are viable in a range of possible future conditions. For example, the risks and uncertainties created by climate change should be considered in the development of a cost-benefit analysis.

Climate change impacts may necessitate a number of potential costs: reduced withdrawals and/or repositioning of infrastructure (e.g. intake pipes), reduced wastewater discharges or improvements in treatment, intensified demand management strategies for outdoor water use, and costs associated with infrastructure damage due to flood damage.

Supply-side options alone will not guarantee reliable urban water supplies during climate change. Furthermore, large-scale manipulation of water resources may be unable to accommodate future in-stream water needs. Instead, adaptable methods are required to allow for the unanticipated impacts of climate change. The precautionary principle can provide guidance because it recognizes the importance of uncertainty in resource management, yet does not use this as a rationale for inaction (Shrubsole and Mitchell 1997: 316). In addition, cost-benefit analyses may require pilot projects or surveys to evaluate measures and determine how they can be most successfully implemented.

5.7. Water Conservation & Supply Plan

The process outlined above should lead to preferred DSM-supply option combinations. A formally approved conservation and supply plan can then serve as the program's blueprint for action. This blueprint may include: time schedules for implementation, expected effects on revenue and rate adjustment projections, budgets, staff and consultation needs, and evaluation requirements. Some utilities develop more additional annual action plans to guide implementation (Platt and Morrill 1997: 303).

In anticipation of unusual events or emergencies, a contingency plan is also valuable. Ideally, effective long-term planning will help to prevent emergencies, however, there may be unavoidable situations that require a contingency plan that includes a sequence of emergency

DSM measures, such as price increases or mandatory restrictions during a severe drought.

5.8. Implementation and Evaluation

When the implementation process has been underway for some time, it is essential to evaluate its impact on levels of water demand and wastewater discharge, as well as its cost-effectiveness (Dziegielewski and Opitz 1998). Without rigorous monitoring and evaluation, it is difficult to assess the potential of ongoing or future DSM programs and to provide data on cost savings.

Evaluation is also important to determine when program modifications are required. Through ongoing evaluation, the impact on water and wastewater demands can be incorporated into demand forecasting and future rate setting to maintain stable revenues. In addition, results can be regularly reported to the public, which will help maintain interest and awareness.

Measuring the impacts of a program may require weather monitoring, field-testing, control groups, and/or sampling and statistical analysis to reduce some of the uncertainty in attributing changes to the program. Evaluation methods should be planned prior to implementation, so that baseline studies and control groups can be arranged. Hiring an independent reviewer for evaluation can also be helpful, especially if the program has contentious elements.

Cost-effectiveness of programs can be examined from a number of perspectives. A purely financial analysis will determine the net benefits for consumers and municipalities in terms of reduced and avoided costs. The rate of return on investments from these benefits can then be compared with the opportunity cost of the capital invested (Tate 1990: 6,7).

Cost-effectiveness evaluation should also include non-financial costs and benefits, such as public support for future conservation measures, changes in environmental impacts, and equity issues such as the distribution of subsidies and costs.

5.9. Summary and Action Plan

Planning is a means of anticipating the future and selecting an appropriate course of action in response. Planning for conservation can help water providers catalogue their existing efforts, refine their efforts to ensure maximum benefits, and identify new opportunities to reduce water use. Ultimately, planning can help utilities and local jurisdictions manage competing goals and costs, including: increasing water quality requirements, infrastructure needs, the effects of climate change, and future population and demand growth.

Flexibility is important to the planning process. The focus should not be on the specific approach, but on doing it in a comprehensive, integrated and long-term way. Jurisdictions can adapt plans to suit their size, population, water availability, water system characteristics and social and environmental conditions. The diversity of options means there is no one single way to craft the planning process.

While this chapter has described many of the important features of the planning process, the following Action Plan identifies specific actions that municipal and regional authorities can implement immediately (where they have not already done so).

Box 19: Municipal DSM Action Plan

- ***Develop permanent budgetary allocations for demand management staff, training, planning and implementation***

Critical to the success of demand management is a thorough understanding of its potential and applicability. By increasing capacity for demand management, water providers will ensure that programs have the maximum effect. Dedicating financial resources to demand management recognizes it as an important element of water provision, and acknowledges that many DSM measures, such as education, leak detection and repair, and program evaluation, must be ongoing.

- ***Create participatory decision-making and planning processes***

These processes may take many forms, such as citizen advisory committees or public forums, and are critical to ensuring that community values are expressed and citizens are engaged in finding innovative, long-term and sustainable solutions.

- ***Determine local water supply availability and anticipated impacts of climate change***

This information is critical. It includes short-term (e.g. 10 year) and long-term (e.g. 100 year) water withdrawal limits, and integrates ecological water requirements into planning.

- ***Initiate long-term, integrated planning for water management using a DSM approach***

Water providers must consider DSM as integral to water supply planning, and must incorporate a planning process as outlined in this chapter. In a demand-focused paradigm of water management, all opportunities to cost-effectively reduce demand are investigated prior to expansion of supply-side infrastructure. By considering a full range of possible options to meet water needs, water supply planning will create more sustainable outcomes.

- ***Evaluate key DSM measures for local applicability and effectiveness***

Eliminating waste and maximizing efficiency are critical to DSM. Adopting universal metering provides valuable information for adaptive planning and is a necessary condition for an effective, efficient volume-based pricing structure.

- ***Review existing water supply plans, community plans, by-laws, standards, policies and procedures to ensure efficient and sustainable delivery, use and pricing of water***

By reviewing all water management options – both demand and supply – local authorities can identify and rectify inefficiencies and ensure that a comprehensive strategy is employed.

- ***Explore opportunities for 'future proofing'***

Future proofing actions include the provision of supplementary plumbing to allow for reuse or recycling of water. Such anticipatory measures should be promoted as a cost-effective way to address future uncertainties.

- ***Lead by example, implementing DSM measures in all government facilities and using government procurement programs to improve the market for water efficient technologies***

By demonstrating the importance of water conservation and the potential for innovative solutions, governments can help create a lasting 'water ethic' amongst citizens and support new technologies

Chapter 6

Provincial/Territorial Action Plan

6.1. Introduction

Under the Canadian Constitution, regulating and administering fresh water use is primarily a provincial responsibility[8]. The resulting regulatory and policy regime sets the context within which all water providers and consumers – industry, municipalities, farmers, businesses, utilities, and residential consumers – are able and motivated to initiate and adopt conservation options. Provinces and territories have the power to influence water use in many ways.

Specifically, they can encourage demand management by:

- coordinating and promoting regional approaches;
- regulating and pricing withdrawals and discharges;
- empowering communities to undertake local demand management initiatives by providing resources, guidance and/or legislative authority;
- mandating efficiency requirements, for example by amending plumbing codes; and
- using financial incentives such as limiting supply infrastructure grants or applying conservation conditions to such grants.

Other examples of the ways provinces and territories can influence water use include:

- actively enforcing existing laws and regulations;
- promoting full-cost accounting for municipalities;
- enacting regulations and guidelines for reclamation and reuse;
- setting province or territory-wide targets; and
- allocating grants specifically for DSM programs.

Provincial governments can also directly implement DSM measures. For example, provincial education programs targeting the general public, specific users or municipal governments can be established. In addition, pilot projects and specific demonstration sites can be developed and water audits and retrofit programs can be initiated in government buildings and public housing.

6.2. Coordination and Regional Approaches

As discussed in section 4.2, implementation of demand management is complicated by the existence of overlapping and fragmented jurisdictions in the Canadian water sector. Coordinating water conservation efforts is therefore an important role for provincial and territorial governments. This coordination involves links within and between governments as well as with NGOs, professional associations and the private sector.

At the institutional level, coordination can range from simple efforts such as ensuring that all parties communicate clearly with one another, to more complicated initiatives like creating collaborative institutional mechanisms. These mechanisms could include: developing a permanent multi-agency taskforce or working group, establishing a water efficiency coordination centre, organizing relevant workshops and conferences, and sponsoring research and the development of guidelines for best practices. The creation of new institutions is not necessary. Instead, functional policy councils consisting of officials who have the authority and capacity to coordinate the work of their existing water organizations could be created.

Coordination at the geographic level is also important. Today, water management is based primarily on municipal boundaries that often disregard the surrounding landscape, particularly watershed boundaries. Promoting coordination and cooperation between neighbouring municipalities based on natural drainage systems creates a more integrated and effective approach.

Beyond recognizing geographic interdependence,

[8]Although the federal government, specifically Indian and Northern Affairs Canada, has the overall responsibility for the management of water resources in the North, the Northwest Territories Water Act, the Yukon Waters Act and the Nunavut Water Act provide a unique framework for managing water resources, such as establishing a water board in each territory that is responsible for conservation, development, and use of water resources (Environment Canada 2003: 46).

watershed-based integration can provide increased financial efficiency through economies of scale. Collectively, more resources would then be available to cope with regulatory changes, such as more stringent drinking water quality guidelines and regulations. Regional planning enables comprehensive planning and implementation of demand management strategies.

An example of a regional approach is the Greater Vancouver Water District (GVRD). As an agency specifically designed to manage the watersheds of the region, it is responsible for the supply and treatment of drinking water for all of its member municipalities. The regional nature of the GVWD allows its DSM programs to be more comprehensive and to influence a larger area, from providing incentives to use rain barrels to implementing water rationing bylaws and public awareness programs.

6.3. Regulating and Pricing Withdrawals and Discharges

Provinces generally require major water users, such as municipal water utilities, to obtain licences or permits before withdrawing water (Fitzgibbon 1994: 164). This process allows users to withdraw (or 'abstract') water from surface and underground sources. Another part of this process is the eventual discharge of treated wastewater into receiving waters, which may be the same as the source, although usually downstream. The current system of water resource allocation does little to promote DSM or to ensure that water resources are used efficiently.

6.3.1. Conservation Pricing for Withdrawals and Discharges

In general, provincial licensing fees for water are not set according to conservation pricing principles (Environment Canada 2003: 16). Often no fee is charged for water permits, as in Ontario, or fees are nominal and merely cover administration costs, as in British Columbia, Manitoba, Saskatchewan and Nova Scotia (Renzetti 2002; Dangerfield 1994: 50).

The lack of appropriate withdrawal charges is one of the primary causes of artificially low retail prices for water. These low prices create a chain of over-consumption, starting with primary users, such as industry, farmers and municipalities. Low withdrawal prices eventually result in water utilities overcapitalizing. With the increased capacity to supply water, utilities then have an incentive to maintain low prices and high levels of use to ensure that capacity is being maximized.

The result is yet further over-consumption by individual consumers and end users. The lack of withdrawal fees translate into a form of subsidy which distorts a host of decisions throughout the water-use chain. Ultimately, "the inefficient price of the resource becomes embedded in the stock of industrial capital and in the design of municipal water utility systems" (Renzetti 2002: 495).

A more appropriate pricing system would ensure abstraction charges reflect local conditions. One option is for abstraction charges to consist of a flat rate *licensing fee* to cover administrative costs in combination with an *availability charge* that reflects the capital and environmental cost of providing the supply and an *actual charge* based on the volume of water withdrawn (Watson 1997: 230). A similar pricing approach could apply to the discharge of treated wastewater into receiving waters, whereby users would pay based on both the quantity and quality (i.e. concentration or level of pollutants) of the discharge. Integrating wastewater charges into pricing creates further incentives for conservation.

Another benefit of this type of pricing system is the generation of additional provincial or territorial revenue. This revenue could be used to cover the costs of conservation efforts, to restore damaged aquatic ecosystems, and to help fund local DSM programs. Ensuring revenue neutrality would be an important consideration for the political acceptability of such a program.

6.3.2. Maintaining Base Flows

The current water allocation system rarely considers environmental needs when allocating licenses and permits. For example, when licensing surface withdrawals, provinces and territories do not ensure that adequate base flows are maintained (Thomson 1994: 171; Water Conservation Strategy for BC 1998: 28, 29). Minimum flow levels are vital to the preservation of water quality and species habitat.

Although some wildlife legislation requires sufficient in-stream flows in times of drought, these considerations are not effectively incorporated into decision-making. As discussed in section 4.3.2, sufficient flows need to be maintained on a watershed basis, starting with the calculation of a 'water budget.' Equally important to ecosystem health is the timing and volume of water flow.

The overall health of a watershed is negatively impacted by excessive water withdrawals, which may result when withdrawals are poorly regulated. However, large infrastructure projects such as inter-basin transfers can also severely disrupt watersheds. Although this approach seems to be changing, Canada currently diverts more water from one river basin to another than any other country. Most provinces now have legislation prohibiting large-scale diversions of water between major watersheds, albeit with some loopholes (Boyd 2003: 14, 59). Prohibiting and strictly enforcing such transfers not only protects watersheds but also forces regions to balance local actions with the needs of water systems (Arlosoroff 1994: 25; Postel 1994: 20; Mitchell and Shrubsole 1997: 14).

6.3.3. Requiring Local Demand Management

DSM can be promoted directly by attaching conditions to the provincial and territorial water allocation process. Licences and permits should include terms and conditions that require DSM programs or at least the submission of conservation plans (Doyle 1994: 413; Thompson 1994a: 89). Although this approach is not common in Canada, many other jurisdictions use it.

Some US states restrict withdrawals of fresh water if reclaimed water could be used instead. For example, the *California Water Code* disallows the use of water suitable for potable domestic use for non-potable uses, if suitable reclaimed water is available (Marsalek et al. 2002: 8). Similarly, the *Florida Mandatory Reuse Program* requires the reuse of reclaimed water where economically, environmentally and technically feasible within 'water resource caution areas,' which are designated areas with critical water supply problems.

Florida's *Antidegradation Policy* prohibits new or expanded surface water discharges from wastewater treatment facilities unless the facility can demonstrate that the new discharge is "clearly in the public interest." Despite this broad caveat, the policy has proven an effective means of encouraging the reuse of reclaimed water (Marsalek et al. 2002: 8). The US-based examples could be modified and adopted by willing Canadian jurisdictions.

Another persistent disincentive for local conservation is the existence of prior water rights. Most provinces and territories allocate water use rights on a use-it-or-lose-it basis, meaning that unless a licence holder uses their full allocation of water, they may lose some of their rights. This creates a perverse incentive for over-use. Alberta leads the way in recognizing and addressing this problem by allowing the trading of water rights.

6.3.4. Tradable Water Rights

Tradable water rights are common in the western United States, Australia and New Zealand (Thompson 1994a: 88; Memon 1997: 277, 278; Howe 1998: 182). Proponents of tradable water rights argue that they encourage wise use and conservation by creating a financial incentive for water rights holders to use less than their allotted quantity, since the surplus can be sold. The final allocation of water is determined by the market and can be more efficient and innovative than government allocations, which are often criticized for being politically-motivated subsidies for select groups.

Tradable water rights remain highly controversial. They represent a shift from treating water as a basic human right to valuing it as a commodity that can be sold to the highest bidder. This commodification potentially undermines efforts to retain water as a community and ecosystem resource. Nevertheless, in the US, tradable water rights have produced some interesting conservation solutions. For example, municipalities that help irrigation districts finance technology changes, such as lining canals and ditches to reduce seepage and installing water-saving irrigation devices, in exchange for the water that is saved (RMI 1991: 49, 50, 51; Thompson 1994a: 88).

6.3.5. Summary

By undercharging for water withdrawals and wastewater discharges, and by failing to incorporate environmental needs into permitting and licensing decisions, provinces and territories create a significant concealed subsidy. Although no actual money is exchanged, users are receiving benefits they have not paid for. This situation results in distortions both in how water is viewed and in how it is used. The result is over-exploitation of the resource, which passes environmental restoration costs onto those upstream and downstream, and on to future generations. The subsidies result in the degradation of water sources, overcapitalization of infrastructure and low prices, which further entrenches excessive consumption and ultimately obstructs the widespread adoption of DSM.

6.4. Empowering Communities

Although provinces and territories could legislate communities to implement DSM, this approach is viewed as heavy-handed and is generally not seen to be politically feasible. Alternatively, provinces and territories can ensure that local governments are suitably empowered to undertake DSM measures. If they possess the authority to require water-efficient fixtures in new buildings, local governments can enact bylaws to promote conservation. Similarly, local governments can be required to recover the full costs of providing water, including the costs of source protection as well as treatment and distribution.

Ontario's *Sustainable Water and Sewage Systems Act* is an example of an attempt to provide incentives for local governments to recover some of the costs of water provision. Provincial/territorial legislation can also ensure that municipalities have sufficient authority and guidance to undertake reclamation and reuse projects. Currently, only British Columbia and Alberta have regulations that set standards for the reclamation and reuse of wastewater (Marsalek et al. 2002: 9, 13).

Provinces and territories can also develop resources to promote DSM. Specifically, they can provide training, education, guidelines, data and information, and financial resources that link directly to conservation goals. Training and education can range from providing resources for municipal leaders about demand management benefits and best practices, to offering detailed workshops and seminars for water managers on how to plan and implement effective DSM programs.

Senior levels of government can produce and implement detailed guidelines and worksheets to help local authorities assess water capacity and develop DSM planning procedures for utilities. The EPA Water Conservation Plan Guidelines (EPA 1998) is a good model that can easily be adapted by Canadian governments, either federal or provincial[9].

An important caveat when considering guidelines is that they are not enforceable. To date, Canada's track record for following national guidelines, such as the Canadian Drinking Water Quality Guidelines, and National Ambient Air Quality Objectives, has been poor. Some environmental advocates question the value of guidelines, suggesting that their primary objective is to appease the public with little actual commitment to change (Boyd 2003).

Provinces can also promote DSM indirectly by encouraging and supporting local governments as they exercise leadership to protect their watersheds. Many of the challenges in watershed management are the result of the pressures of industrial, agricultural and community development. Local governments play a key role in these activities; facilitating their proactive involvement is vital to a successful watershed management system. For example, provinces can promote watershed protection by encouraging and supporting Watershed Advisory Councils and Protection Groups.

Watershed-based approaches are becoming more common. Alberta's provincial water strategy advocates a watershed approach (Alberta Environment 2003) and Ontario's conservation authorities, under the *Conservation Authorities Act*, bring a watershed perspective to planning and development (Wallace 1997: 116).

As described in Chapter 3, a lack of accurate and standardized information about the potential for water use and conservation is a significant handicap to effective conservation action. Data is critical to assessing viable options and making estimates of future water availability and savings. Although much of this type of data – water use by sector and specific end uses – is the responsibility of local and regional officials, senior governments have an important role to play in ensuring that information is collected and reported in a regular, standardized and accessible manner.

In addition, gathering general information on water source health is an important role for senior government. This data includes measurement of flow levels and water quality, potential impacts of climate change, and identification of water withdrawal limits from intensively used water sources. Collecting such information remains an important role for senior governments since they are one of the few institutions with the resources and capacity to perform this function in an ongoing manner.

6.5. Mandatory Efficiency Requirements

Requiring the installation of efficient indoor fixtures in all new construction and major renovations is an important tool to reduce domestic indoor water use. Such mandatory requirements are common in the United States, with Massachusetts being the first state (in 1989) to require ultralow-volume toilets. Due to federal regulations, this type of requirement now applies across

[9]The EPA is required under the Safe Drinking Water Act (SDWA) to publish a set of water conservation planning guidelines. The EPA views these guidelines as a tool "to help bring conservation into the mainstream of water utility capital facility planning." States can also require water utilities to prepare a water conservation plan consistent with the federal guidelines in order to qualify for a loan under the Drinking Water State Revolving Loan Fund (SRF).

Box 20: Water-Efficient Plumbing Fixtures in the US

"Over the next 20 to 25 years, US water utilities are expected to see reductions in water demand by plumbing fixtures as a result of national water-efficiency requirements established by the US Energy Policy Act of 1992 (EPAct). This landmark legislation set maximum water-use levels for toilets (1.6 gallons per flush), urinals (1.0 gallons per flush), and showerheads (2.5 gallons per minute). The efficiency standards apply to plumbing fixtures in new and renovated residential and non-residential facilities. The EPAct standards will have a cumulative, long-term impact on indoor water use, as existing high-volume fixtures are gradually replaced, particularly in the residential sector. The water savings that EPAct is expected to produce among US residential and non-residential customers have been projected from 6 to 9 billion gallons per day by 2020, by which time most exiting fixtures will have been replaced with ones that comply with EPAct. Studies of 16 US localities showed that the EPAct standards will reduce water demand enough to save local water utilities $166 million to $231 million as a result of deferred or avoided investments to expand drinking water treatment or storage capacity."

Source: Vickers (2001: 20)

the US and is proving to be a valuable component in a comprehensive demand management strategy (Vickers 2001: 17; Doyle 1994: 413).

In Canada, both Ontario and BC have included some efficiency requirements in their plumbing codes (Dangerfield 1994: 47; Sharratt et al. 1994: 82, 83; Mitchell and Shrubsole 1997: 19). The *Ontario Plumbing Code,* which applies to all permitted renovations and new construction, has created increasingly strict conservation requirements over time. Efficient faucets (max 8.4 lpm) and showerheads (max 9.8 lpm) were required after January 1993, low-volume toilets (max 13.2 lpf) were required after August 1993, and ultralow-volume toilets (max 5.9 lpf) were required after January 1996. The City of Toronto estimates that total water demand for the period of 1996 to 2011 will be reduced by 62 million litres per day based on these building code changes alone (City of Toronto 2002: 37).

A revision of the national code is expected to prescribe the installation of high efficiency fixtures for all new buildings. However, the onus will still be on provincial and territorial authorities to adopt and enforce these changes (Maas 2003: 21). Mandatory measures from other sectors can also be adapted and applied to the water sector.

In some jurisdictions legislation requires automobile manufacturers to guarantee that a minimum percentage of vehicle sales meet designated standards for low or no emissions (Boyd 3002: 316). Similar requirements could be applied to manufacturers of fixtures and other water using technologies such as irrigation systems. Another relevant example is the Danish requirement that industry must implement energy-efficiency measures that pay for themselves through reduced energy costs in less than four years (Boyd 2003: 332). Again, such requirements could be adapted to apply to water use efficiencies in Canada.

6.6. Linking or Reducing Infrastructure Expansion Grants

Funding transfers from provincial governments to municipalities should shift away from their traditional focus on supply-side solutions to promotion of demand management. One option is for provinces and territories to link infrastructure grants to conservation plans. The Alberta Municipal Water Supply and Sewage Treatment Grant Program imposed a 10% reduction in the size of grants for municipalities that have higher than normal water use, do not have meters, or do not have conservation-oriented rate structures (Dangerfield 1994: 55, 59). In BC, to be considered for provincial infrastructure funding municipalities are required to submit water conservation plans with grant applications for water and wastewater infrastructure (Maas 2003: 17).

Another option is to reduce or eliminate supply-oriented infrastructure expansion grants in all but the most vital of situations. This type of policy would force local governments to seriously consider full-cost retail pricing as well as how to remedy their own water wastage, for example, through repairing system leaks.

A revenue neutral option for provincial and territorial governments is to simultaneously reduce grants for infrastructure expansions while increasing grants for DSM programs. The latter may help to fund universal metering, replace old and leaky water mains, and assist with short-term revenue shortfalls associated with aggressive local conservation programs. By creating a Lost Revenue Adjustment Mechanism (LRAM), as is being proposed for the energy sector in Ontario, provinces can assure utilities that conservation initiatives will be revenue and profit neutral.

An even better instrument is the Shared Savings Mechanism (SSM) that provides utilities with a fraction of the total savings achieved by the conservation programs (Pollution Probe 2004: 3). This type of mechanism would promote aggressive conservation efforts by utilities, since they would gain profits as they achieve increasing levels of conservation. An SSM would also benefit ratepayers since reduced water use would, with the appropriate pricing structure, lead to decreased water bills.

Linking conservation to funding is helpful in efforts to integrate water efficiency into long-term water planning and demand management in municipalities. Currently, however, agencies that provide and administer funding for major infrastructure projects seldom enforce conditional water conservation plans, since no mechanism exists to withdraw funds that have already been issued (Maas 2003: 17). Stricter funding practices, and enforcement are critical to ensure that municipalities follow through on proposed plans.

6.7. Future Proofing

Provincial governments often have a longer-term perspective than many local governments. The potential for a longer term perspective allows the provinces to promote options and measures that may not necessarily have short-term paybacks. Research and development is an obvious example of 'future proofing' since technological innovation may create future solutions.

Provinces can also ensure that appropriate 'future proofing' is undertaken at the municipal level. Water reuse and recycling is a significant means for reducing local water use. However, in any given community, it may not be feasible in the short term. To improve the future economic feasibility of water reuse and recycling, simple and relatively cheap pre-emptive actions can be undertaken in the present. For example, the installation of dual plumbing to facilitate future grey water reuse in new developments, as well as installing 'shunt pipes' in new construction to reduce the future costs of metering (Water Conservation Strategy for BC 1998: 20).

A simple way for provinces and territories to plan for the future is by looking to jurisdictions that are already water stressed, such as Israel, California and Australia. Understanding how these jurisdictions are overcoming their current water challenges will help to direct future water conservation initiatives.

6.8. Summary and Action Plan

Provincial and territorial governments play an important role in encouraging or enforcing demand management approaches. Effectively regulating and pricing water withdrawals and discharges, as well as mandating efficiency improvements (including 'future proofing') are important elements of government leadership. However, provinces and territories must also empower utilities and local governments to become more responsive to these changes.

Empowerment tools range from providing education and training through to linking funding and resources to conservation initiatives. Providing and sharing information, not only data such as minimum flow levels and the impacts of climate change, but also examples of successful DSM programs and initiatives in other jurisdictions, is also important.

Provinces and territories can take a variety of steps to ensure that DSM is appropriately incorporated into the water management process. The following Action Plan lists some of the basic actions that provinces and territories should pursue.

Box 21: Provincial and Territorial DSM Action Plan

- ***Create a water use efficiency task force to advise government on existing and emerging water management issues and to coordinate water conservation efforts***

This committee should include representation from all levels of government and diverse departments (such as environment, energy, municipal affairs and public works), professional and industry associations, citizen groups and NGOs.

- ***Undertake demand management education campaigns targeted at municipal officials and the general public***

These campaigns will educate decision-makers, planners, and consumers about the importance of water, the need for careful use and the opportunities for improved efficiencies.

- ***Initiate integrated planning for all watersheds and groundwater aquifers affected by urbanization***

By planning now, comprehensive, long-term solutions can be developed.

- ***Review all subsidies – economic, social and ecological – to the water sector***

Authorities need to develop full-cost pricing for water withdrawals and wastewater discharges, and to alter the structure of subsidies for water supply infrastructure.

- ***Link infrastructure funding to conservation criteria***

New fiscal policies should reorient public funds away from infrastructure expansion and toward demand management programs. By linking funding to DSM or creating Lost Revenue Adjustment Mechanisms (LRAM), provinces can ensure water conservation programs will not reduce utility revenue and can provide incentives for DSM by sharing benefits associated with successful conservation programs.

- ***Amend building and plumbing codes to require water-efficient fixtures in all new construction and renovations***

Although the benefits are not immediate, these amendments will ensure that the residential sector incorporates high efficiency infrastructure over time, spreading costs and providing incentives for further conservation-based innovation.

- ***Ensure that relevant data is gathered regularly and is easily accessible to all stakeholders***

Such water-related data should include: types of end uses, health of the source ecosystem, flow requirements of ecosystems, and savings associated with conservation measures. Coordination with other levels of government is critical to ensure efficient and effective use of resources to identify and fill data gaps.

- ***Produce detailed guidelines, worksheets and planning procedures for incorporating comprehensive DSM programs into water management***

These resources will help local authorities to assess water capacity and supplies, and to ensure that demand management is part of their long-term strategies.

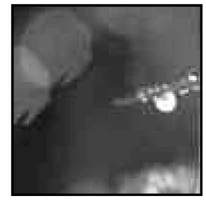
- ***Ensure suitable 'future proofing' is undertaken, such as metering and research and development of reuse and recycling opportunities***

'Future proofing' actions and investing in research and development will foster widespread and cost-effective implementation of appropriate technology as conditions and circumstances warrant and as new technologies emerge.

- ***Lead by example, implementing DSM measures in all government facilities using government procurement programs to improve the market for efficient technology***

By demonstrating the importance of water conservation and the potential for innovative solutions, governments can help create a lasting 'water ethic' in citizens, and support new technologies.

Chapter 7
Federal Action Plan



"Canada is behind other countries in providing consistent codes, guidelines, regulations, and policies affecting water use efficiency" (Canadian Council of Ministers of the Environment, 1994, quoted in Boyd 2003: 45).

7.1. Introduction

Federal jurisdiction over water is limited to water on federal lands, matters related to fisheries and navigation, and the management of international boundary waters. Federal lands include national parks and wildlife areas, migratory bird sanctuaries, military bases, federally-owned land, Indian reserves and in some cases, the land in the territories. In general, the federal government is not directly involved with urban water services except through infrastructure funding. However, more than 20 federal Acts and regulations pertain to water in Canada.

To promote efficiency and conservation of urban water resources, the federal government can:

- invigorate federal activity in water policy;
- create guidelines and standards, such as a national plumbing code;
- ensure information standardization, and the collection and distribution of data;
- improve enforcement of existing legislation, such as the *Fisheries Act*;
- link grants and funding for infrastructure to demand management requirements; and
- demonstrate leadership by improving water use efficiency in federal facilities.

Similar to provincial government, federal government resources and capacity can also be used to empower communities to undertake local demand management initiatives. This assistance extends from simply providing information and guidance, to creating new federal programs and offices for promoting demand management for water.

Federal agencies could undertake primary ecological and social research and even partner with universities and relevant associations to examine international best practices. Local solutions should be promoted through a national approach. A strong federal presence is definitely needed within the water sector in Canada.

7.2. Invigorating the Federal Water Policy

The *Federal Water Policy*, tabled by Parliament in 1987, represents the high point of federal government interest in water management. The overall objective of the policy is to encourage the use of fresh water in an efficient and equitable manner, consistent with the social, economic, and environmental needs of present and future generations.

The policy was premised on the dual goals of protecting and enhancing the quality of water resources and promoting the wise and efficient management and use of water. It also eliminated funding for new water or sewer infrastructure to encourage realistic pricing for both services (Environment Canada 2003: 48; Dangerfield 1994: 55; Hillard 1994: 118; Shrubsole and Tate 1994: 8).

Following the creation of the *Federal Water Policy*, the federal *Green Plan* emphasized the need for water demand management. Additional water policy instruments since then include the federal *Guidelines for Canadian Drinking Water Quality, the Water Conservation Plan for Federal Government Facilities* in 1993, and the *National Action Plan to Encourage Water Use Efficiency* in 1994 (Foerstel 1994: 63-66; Mitchell and Shrubsole 1997: 19; Boyd 2003: 50). More recently, federal involvement in water management has declined significantly. Some experts have gone so far as to state that with respect to water, the federal government is "for the most part irrelevant at this point" (Maas 2003: 27).

The majority of recommendations in the *Federal Water Policy* were never implemented (Boyd 2003: 15; Pearse 2002: 15-2). A simple first step for the federal government would be to re-visit these past initiatives, to re-evaluate their priorities, and to move ahead with implementation. However, implementation requires sufficient skills, staffing and funding within the relevant federal departments.

To ensure that sufficient capacity exists, the federal government must reverse the reduction in staff and budgets of federal water departments. This reduction has included: the dissolution of the Inland Waters Directorate, a lack of follow-up reports on the *Federal Water Policy*, a budget reduction (from $9 million in 1990 to $0.5 million in 1997) for administering the *Canada Water Act*, a 55% cut to the Department of Fisheries and Oceans Freshwater Science program, and the termination of the Water Advisory Committee (Pearse and Quinn 1996: 335).

In light of these changes, the federal government's ability to administer even a modest water policy is unclear. In any event, "even in a reduced role, it is important that policy be coherent and consistent, and that the administrative structure have the scientific capacity, support and organization to implement it properly" (Pearse and Quinn 1996: 339).

7.2.1. National Water Commission for the 21st Century[10]

By creating a national entity, such as a water commission, the federal government can ensure a leadership role in water resource issues. A National Water Commission could direct an aggressive effort to protect national water resources and play an advisory role in addressing the global water crises[11]. A commission could refresh the federal water policy by exploring: a workable strategy to deal with pressing infrastructure needs; improvements to water resource and aquatic ecosystem protection; and, an evaluation of the potential for other modes of water service delivery, including cooperatives and private partners.

While recognizing that effective water management entails provincial and local action, national policies and actions are also critical to ensure that efforts are coordinated and productive. A non-partisan commission would draw from many disciplines including the natural and engineering sciences, economics and public policy. The Commission could also include representation from all levels of government, public interest groups, and the private sector.

7.3. Guidelines and Standards

An important role for the federal government is to develop guidelines. While not legally binding, guidelines can serve to create national uniformity and a certain economy of scale in policies and implementation (Kassem and Tate 1994: 198). Despite the excessive flexibility of national guidelines and Canada's poor track record in following them, the federal government should, nonetheless, foster comprehensive and workable program goals. In particular, the creation of legally binding and enforceable standards is critical to ensuring successful incorporation of (the voluntary) guidelines (Boyd 2003: 21)

As shown in Box 20 (above), the United States has had some success with the 1992 federal *Energy Policy Act* (Platt and Morrill 1997: 289; Vickers 2001: 17, 18, 20, 40). Other countries, such as Australia, Denmark and Singapore, have set even stricter requirements, allowing toilets that use no more than 3.0 to 4.5 lpf (Vickers 2001: 24). Although the division of powers in Canada gives primary responsibility for such legislation to the provinces, the federal government can assist by updating the *Canadian Plumbing Code* to reflect the best available technology.

Guidelines are also an important complement to planning. As mentioned previously, the EPA's water conservation planning guidelines for water utilities have proven effective in promoting demand management programs (EPA 1998) and could easily be adapted for Canada. The Canadian federal government can also develop model reuse and reclamation regulations. Currently, there are no national guidelines for wastewater reuse, and the *Canadian Plumbing Code* makes no allowances for reclaimed water (Marsalek et al. 2002: 7,13,26). In contrast, the US federal government has developed a set of *Guidelines for Water Reuse* to aid those regions without criteria or standards of their own.

Lack of information is often a barrier to environ-

[10]A similar idea has been proposed before the Legislative Hearing of the Subcommittee on Water and Power of the Committee on Resources in the US Congress by Peter Gleick and the Pacific Institute (Gleick 2003c).

[11]Globally, the realization is growing that the failure to meet basic human and environmental needs for water is the greatest development disaster of the 20th century (Gleick 2003c: 1). Despite a range of threats to water resources across the world, Canada has not offered adequate leadership in providing resources, education, and technological and financial assistance to address these problems. Instead, world leadership on these issues is being provided by the Netherlands, Japan, France, UK and Germany.

mentally responsible behaviour (Boyd 2003: 331). By improving standardization, performance testing and labelling of water-efficient fixtures and appliances, the federal government can increase confidence and promote action amongst lower levels of government and end users.

Currently, deficient CSA certification procedures create uncertainty for consumers and reluctance among provincial governments to mandate their use. For example, despite obtaining CSA certification, independent testing has demonstrated that four of the ten most popular ultralow-flow toilet models currently sold in Canada fail to meet maximum flush volume and/or waste removal performance standards (Maas 2003: 12). Efforts to improve certification processes are currently driven by associations like the CWWA. Government leadership and guidance can facilitate more credible and reliable water efficiency eco-labelling programs, similar to the program for household appliances under the federal *Energy Efficiency Act* (Boyd 2003: 331).

Other national standards relating to urban water also require updating. For example, mandating efficient fixtures could lead to smaller piping requirements, which would require additional changes to provincial plumbing codes. Standards committees, such as the Standing Committee on Plumbing Services of the Associate Committee on the National Building Code can assess issues on a national level to avoid provincial duplication (Gates 1994: 337).

7.4. Data Collection and Analysis

The 1987 *Federal Water Policy* states, "scientific and socio-economic research, technological development, and data collection are essential tools for dealing with the increasing scope and complexity of the emerging water problem." Despite explicit statements about federal responsibilities, the current lack of detailed and standardized data on Canadian water use and the effects of conservation programs are hindering water planners and researchers (Thompson 1994b: 210; Kassem and Tate 1994: 196; Brandes 2003: 28, 33, 34). For example, without sufficient data it is difficult to understand the local price elasticity of demand for water. The consequent lack of information about how consumers respond to price changes makes it difficult to predict revenues when DSM pricing programs are being contemplated. Water flows, ecological needs, and climate impacts are other areas requiring more detailed and standardized data.

The federal government can take a leadership role to develop a national set of water-use categories and definitions. Standardized information collection and analysis is described as "fundamental to achieving the development and implementation" of water conservation strategies (Doyle 1994: 413). Standardization and broad accessibility of data will assist in creating a common base of understanding among researchers and data users in Canada.

7.5. Improved Enforcement of Federal Legislation

The federal government has powerful legal tools at its disposal – the *Fisheries Act* and the *Canadian Environmental Protection Act* – to protect aquatic ecosystems from damaging infrastructure expansions, excessive withdrawals and pollution discharges. However, the enforcement of such legislation has been severely criticized.

Although significant funds were spent during the 1990s on upgrading sewage treatment facilities, many Canadian communities still discharge raw or inadequately treated sewage into receiving waters with little consequence (Boyd 2003: 237-240). "Charges are rarely laid against municipalities, which like foreign diplomats, seem to be immune from prosecution" (Boyd 2003: 35).

Two recent prosecutions, *R. v. Dawson City* and *R. v. Iqaluit* affirm the notion that increasing enforcement of existing laws can motivate improved sewage treatment. In these cases, convictions under the *Fisheries Act* are changing current practices. In Dawson City, part of the court order specifically includes a requirement to install secondary treatment.

These recent cases demonstrate that the courts are indeed willing to protect the environment. Even the federal government admits that, "legislation and regulation are only as good as their enforcement." Yet most governments in Canada fail to properly enforce existing environmental legislation (Boyd 2003: 237). The lack of enforcement has been well documented by Boyd (2003); Friends of the Earth (2001); Sierra Legal Defence Fund (2001); Christie (2000); and Benidickson (2002). Even Parliament's Standing Committee on Environment and Sustainable Development concluded in 1998 that, "Environment Canada and indeed some provinces are not enforcing environmental laws when they could and should. This failure to act is of deep concern."

Stringent enforcement of legislation like the *Fisheries Act* or *CEPA* creates strong incentives for municipalities to raise funds for improved sewage treatment. When faced with higher costs for treatment, municipalities are motivated to decrease their wastewater production and hence their water use. For example, the city of Whitehorse was required to upgrade its sewage treatment to a secondary level but initial cost estimates were well in excess of what the city could afford or what higher levels of government were willing to fund (Raines 1994: 408). In response, the city initiated a water conservation program designed to reduce per capita water use by almost 50%.

7.6. Linking or Reducing Infrastructure Expansion Grants

As with the provinces, grants from the federal government to municipalities should shift from their traditional priority of supply-side solutions to promoting demand management.

Linking conservation to funding is potentially very useful for integrating water efficiency into long-term water planning and demand management in municipalities. Annual federal grants for upgrading water and sewage treatment infrastructure represent substantial sums of money. The motivation to implement demand management for provinces and communities would increase significantly if these funds were allocated only after provinces or communities proved an acceptable level of action on DSM.

7.7. Summary and Action Plan

Like the provincial and territorial governments, the federal government has an important role in promoting demand management. Although the direct jurisdiction of the federal government is limited, it can still provide incentives and enable provinces and local governments to implement DSM.

Box 22: Federal DSM Action Plan

• Ensure sufficient capacity exists within the federal government to administer and implement federal water policies

To maintain even a modest presence in the water sector, Environment Canada must focus some of its energies on rebuilding institutional capacity. Assessing and implementing relevant portions of past federal water initiatives, in particular the 1987 Federal Water Policy, should be a policy priority.

• Create a National Water Commission for the 21st Century

The Commission would provide guidance, direction and coordination for government in addressing domestic and international water resource protection and management issues. This would include representation from all levels of government, professional and industry associations, citizen groups and NGOs.

• Improve data standardization, collection and analysis

Data improvements are required to understand: the nature of end use, the health of source ecosystems, minimum flow requirements for ecosystems, and water savings associated with conservation measures. Improving Environment Canada's MUD database and providing general water withdrawal statistics will improve understanding of water use and the potential for conservation.

• Undertake demand management education campaigns targeted at municipal officials and the general public

Such campaigns will emphasize the cultural, economic and ecological importance of water, the need for careful use, the benefits of DSM (with real world examples) and the opportunities for improved efficiencies.

• Develop and update guidelines, such as model plumbing codes and model reuse/reclamation regulations, to assist lower levels of government

Although these guidelines are not binding, they can provide valuable assistance to local and provincial authorities that are attempting to implement regional initiatives and develop legislation.

• Improve certification of water-efficient technology and develop and promote mandatory labelling

Certification and labelling enables citizens and consumers to make informed decisions and promotes the adoption of innovative conservation-focused alternatives.

• Improve the enforcement of federal legislation related to urban water

Simply enforcing existing national laws creates incentives for many municipalities and other primary water users to conserve through appropriate local solutions.

• Review all federal subsidies to the water sector

Fiscal policies should reorient public funds away from infrastructure expansion and toward demand management programs. Linking infrastructure funding to demand management is a powerful lever of change. Also, by reducing supply-side subsidies, the federal government can promote full-cost accounting for water utilities.

• Produce and implement detailed guidelines, worksheets and planning procedures to incorporate comprehensive DSM programs

These resources will help local authorities assess water capacity and supplies, and ensure demand management is part of their long-term strategies.

• Continue to lead by example, implementing DSM measures in all government facilities using government procurement programs to improve the market for efficient technology

By demonstrating the importance of water conservation and the potential for innovative solutions, governments can help create a lasting 'water ethic' amongst citizens, and support a new foundation for innovation.

Chapter 8
Conclusions

"[W]e have so much knowledge about water that we are not using; we know what we should be doing, it's just a matter of getting on with it" (Richard Bocking, quoted in Maas 2003: 25).

Developing sustainability in the industrialized world is no longer optional. Situating human activity, including the economy, within the ecological context is an imperative. At a fundamental level, the excessive demand for energy and resources must be reduced. Dematerialization and substitution are two broad strategies to achieve ecological sustainability.

Dematerialization refers to reductions in total material flows through society by improving the efficiency and productivity of resource use. ***Substitution*** refers to the replacement of scarce resources with alternatives or a shift in the emphasis of the economy from commodities toward services. Numerous demand management measures and technologies embody both of these approaches.

Encouraging or mandating the use of water-efficient outdoor landscaping and reducing system leaks are examples of dematerialization, since the actual throughput of water is reduced. The use of non-potable water sources, such as rainwater for garden irrigation, is an example of substitution since rain-water is replacing potable water. Some measures fall into both categories, such as water reclamation, reuse and recycling projects that reduce the amount of water extracted from natural sources and substitute treated wastewater for appropriate end uses.

As Boyd (2003: 350) notes, "the most fundamental roadblock to achieving a sustainable future is Canada's failure to acknowledge that there are physical limits to the amount of resources the Earth can provide and the amount of waste the Earth can assimilate." Similarly, Canadian cities generally ignore the physical realities of their watersheds and the impacts of heavy water use on aquatic ecosystem health.

Beyond making urban water use more sustainable, demand management embodies part of the shift required in 'developing sustainability' in our society. 'Developing sustainability' inverts the outdated notion of 'sustainable development.' Instead, economic growth ('developing') is promoted with the view of fostering new systems that are inherently sustainable ('sustainability'). Immense potential exists with this juxtaposed approach to eventually replace market-based practices and institutions with new institutions that require less resource throughput for self-maintenance (M'Gonigle 1989).

Complexity of a different variety

DSM requires both the involvement of end users and detailed strategic planning in order to choose appropriate mix and timing of measures for a particular municipality or region. These activities involve a different type of complexity and a different way of thinking from traditional supply-side approaches to management.

Addressing this complexity requires sufficient funds, trained staff, proper planning and appropriate incentives to design a successful demand management program. When done in an integrated and comprehensive fashion, demand management for urban water will produce substantial and reliable savings over the long-term.

With sufficient resources and planning, the benefits of a DSM program can exceed its upfront costs – especially when ecological considerations are included. In addition, DSM programs enable communities to defer or avoid expensive and environmentally damaging supply-side projects and can provide adaptive responses to uncertainties such as climate change and population growth.

The potential of green infrastructure

'Green infrastructure' is a concept used by the Federation of Canadian Municipalities (2001) to highlight the natural infrastructure that underpins sustainability in Canadian municipalities. This infrastructure is able to reduce resource flows through a city, for example,

Box 23: Features of Green Infrastructure

Feature	Description	Example
Distributed	Centralized facilities are replaced with a variety of smaller scale systems distributed throughout the service area.	Investment in customer's fixtures, appliances, and reclamation systems, rather than reliance on centralized large-scale supply-side projects.
Clustered	A distributed network is structured into clusters, with the scale of each element chosen to match the resource base and service requirements.	Reuse and recycling projects undertaken at multiple scales - on-site, neighbourhood and municipal-wide. Some water sources can be distributed, such as with on-site rainwater collection.
Interconnected	The various end uses of resources are inter-connected rather than considered separately, creating a 'circular metabolism' for a city.	Domestic wastewater can be reclaimed and reused for nearby industrial or agricultural uses.
Integrated	The infrastructure system is developed in relation to the surrounding built or natural environment.	Water sources and withdrawal amounts are chosen according to in-stream ecological flow requirements.
Service orientated	A shift in emphasis from providing a resource per se, to providing the services that the resource is used for.	Giveaway showerheads to provide the service of bathing with much reduced water and energy requirements.
Responsive	Infrastructure should be designed to respond to local opportunities and constraints.	Programs that promote the use of locally-appropriate landscaping, depending on water availability.
Renewable, low-impact	Infrastructure should minimize environmental impacts, and maximize the use of existing on-site resources.	Reduced impacts through reductions in supply-side infrastructure projects, water withdrawals, and discharge of polluted wastewater.
Appropriate (or well-matched)	The choice of technologies should be appropriate for the users' requirements and the local context.	The use of water of appropriate quality for each end use through alternative supplies and reclamation. The use of appropriate materials like native drought-resistant plants for landscaping.
Multi-purpose	Each element of the infrastructure can provide a range of services.	The use of efficient technologies to reduce water and energy use, including cascading water use such as bathing water reused for irrigation or toilet flushing.
Adaptable	The ability to accommodate substantial change.	DSM is small in scale and widely distributed; it is inherently more adaptable to economic and ecological uncertainties in comparison to one-time investments in large supply-side projects.

Source: FCM (2001: 4-14)

by looping and cascading those flows and reducing the ecological footprint of urban areas. Demand management for urban water is clearly a key component of this infrastructure.

Time for Action

The time has come for demand management of water in Canada. Communities, water providers, governments, and the environment face increasing challenges as the already high levels of urban water use continue to rise. Canadian water providers can no longer afford to pursue a reactive 'meeting demands through large supply infrastructure' approach. DSM fosters sustainability through innovative measures designed to meet our needs for the many services that water provides, while simultaneously reducing water throughput.

Significant experience from around the world has shown that demand management can produce substantial and reliable reductions in per capita water use. When appropriately incorporated into an integrated and long-term term approach, DSM can offset increasing water needs associated with rising populations, or may even reduce total water use.

The first section of this report reviewed key barriers that must be overcome for demand management to be widely adopted in Canada. Widespread education is critical to deconstructing myths, in particular the belief that an overabundance of renewable water exists and that reduced water use imposes a lower standard of living. The current supply-side engineering bias must also change, accompanied by a whole shift in approach. Investment in consumers, such as through education and rebates for efficient indoor fixtures, must be considered as valid as investment in large, centralized supply projects.

The provision and management of water must look beyond simply increasing the efficiency of water use. With a focus on the services that water provides, there may be opportunities for eliminating water altogether. For example, the services of sanitation and providing attractive yards and public areas can both be met *without water* through composting toilets and indigenous drought-resistant natural landscaping.

A focus on services, coupled with the appropriate quality of water matched to each service, are two critical components of the emerging 'soft path' for water (Brooks 2003b). The soft path for water establishes a vision (or multiple scenarios) for the future of the economy *and* the ecosystem. Once the critical needs for water – ecological demands, human needs and economic stability – have been estimated, a process known as 'backcasting' finds a feasible and desirable way (a soft path) to meet this desired future condition. "This renders impossible a common reversal of cause and effect whereby the future (as revealed in forecasts) is treated as the cause of present events (i.e. policy decisions)" (Brooks 2003b: 50).

All levels of government can and should be involved in improving sustainable water use in Canada. Local governments can ensure their water utilities fully consider DSM in long-term water provision planning. Provincial and territorial governments can encourage or mandate local efforts, and can also undertake measures such as the enactment of efficiency requirements in building and plumbing codes. The federal government can aid local governments by linking infrastructure grants to DSM programs, improving data collection, and developing guidelines and standards.

All levels of government can promote DSM by enforcing environmental laws and ensuring that subsidies and grants are allocated to initiatives that decrease, rather than increase, water use and environmental damage. Environmental tax shifting and leading by example through the implementation of DSM measures at all public facilities are powerful ways to reorient Canadian society towards more sustainable water use.

Given the wealth of ideas and experience with DSM programs around the world, there is an excellent opportunity to undertake these activities on a broad scale in Canada. Using the principles of action outlined below, governments, business, and civil society can work collectively to overcome the systemic impediments that block the widespread adoption of urban water demand management.

Canadians have the technological capacity and human capital to create a sustainable water future. The first step is to make the necessary changes needed to move water management onto a sustainable path through the comprehensive application of demand management. The solutions offered in this report can avoid "elevating trend to destiny" (Brooks 2003b: 50).

Box 24: Principles of Action

- **Fair value for water**
Eliminate inappropriate subsidies and ensure that full costs, including environmental considerations, are included in the price of water. At the same time, recognize the primacy of fresh water to human life and ecosystem health by ensuring both equitable access for all members of society, and adequate flows for the environment.

- **Comprehensive, long-term and integrated approach**
Take into account all water uses and water-related activities, and allocate permanent budgets for staff, training, planning and implementation. Investing in such permanent institutional changes will establish demand management as a central feature of water provision and as an ongoing adaptive process. Adopting a watershed-based approach will also ensure that the cumulative impacts of all human activities on ecosystem health are addressed.

- **Stakeholder involvement and participatory decision-making**
Create processes for meaningful stakeholder participation to ensure community values are expressed, and citizens are engaged in identifying and implementing long-term, sustainable solutions.

- **Innovation**
Foster creative solutions by focusing on the underlying service that water provides rather than simply delivering water. Improve the market for water efficient technology and commence future proofing with anticipatory measures that can mitigate uncertainties.

- **Leadership**
Ensure all institutions lead by example, incorporating best practices and cutting edge environmentally-based technologies and processes. Build capacity to effectively advise on existing and emerging domestic and international water management issues. Expand scientific, ecological and socio-economic research through enhanced data collection, technological development and pilot projects.

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POLIS Project on Ecological Governance: An Organization for Transformative Solutions

Created in 2000, The POLIS Project on Ecological Governance, seeks to discover and implement solutions to pressing issues that can build healthy and sustainable communities. Among the many research centres investigating and promoting sustainability world-wide. POLIS is unique in its focus on multidisciplinary research and action and in that its work strives to blend academic research with community engagement.

The concept of ecological governance is exciting in that it offers an alternative to extractive, linear and un-sustainable systems that continue to level ancient forests, displace indigenous and local communities and clog and choke our global cities. Instead ecological governance asks how we might foster circular systems in which we reduce our demands on distant (and local) ecological systems.

Whether it be through investigating the shift from supply to demand management in our use of minerals or water, re-imagining new forms of urban 'smart growth' such as the eco-innovative university campus, or reforming local land tenures for indigenous and local community, re-vitalization or overhauling national environmental laws, the thrust of all of our research is guided and informed by the concept of ecological governance.

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