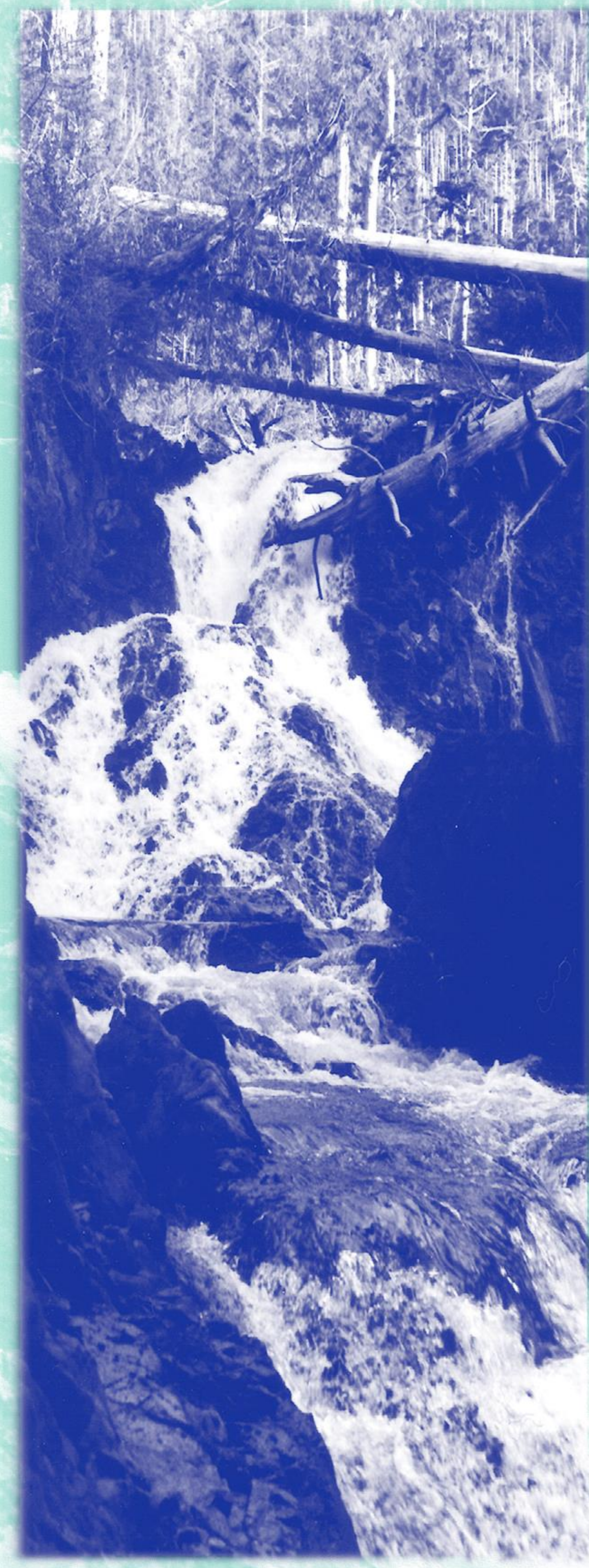
Water Efficiency: A Guidebook for Small & Medium-sized Municipalities in Canada



Ontario Water Works Association

A Section of AWWA

~2006~

The information contained in this publication comprises current research results available to OWWA and is intended as an aid to decision making only. Readers are advised to evaluate the information for themselves and to consult professional resources where appropriate to determine whether the information and techniques are applicable for their municipality. Local factors such as available municipal resources, current water efficiency initiatives, and costs must be taken into consideration in designing and implementing a water efficiency program.

Cover photo: Ottawa Engineering Ltd.

ACKNOWLEDGMENTS

This guidebook is a Canadian adaptation of a publication that was originally developed by the Pacific North West Section of the AWWA in 1993, (*Water Conservation Guidebook for Small and Medium-Sized Utilities*). Special thanks to the Pacific North West Section for developing an excellent publication and a good model to follow.

The Water Efficiency Committee of the Ontario Section of the AWWA initiated a project in 1999 to develop a Canadian version of the guidebook. The committee would like to thank the AWWA and the Ontario Ministry of the Environment for financial support that made the project possible.

Production of the guidebook was supervised by a sub-committee composed of: Kingsley Blease and Chris Webb of the Ontario Water Works Association (OWWA) Water Efficiency Committee and Phyllis Miller representing the Ontario Ministry of the Environment. Research, writing, editing, design and illustration were contracted to REIC Ltd.

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For more water efficiency information, please visit the Water Efficiency Committee web page at http://www.owwa.ca/activities/committees.php and click on committee page under the Water Efficiency Committee. For information on best management practices for water efficiency, consult the publication developed by the Water Efficiency Committee entitled Water Efficiency-Best Management Practices. This publication is available from:

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PREFACE

HOW TO USE THIS GUIDEBOOK

This guidebook is primarily written for the small and medium-sized Canadian water municipality (under 100,000 population) that is thinking about starting a water efficiency program. Regional municipalities are also featured in the guidebook to provide a wide range of program examples that could be adapted by smaller municipalities. It will provide a general overview of water efficiency planning, and describe the specific steps you can follow to design the best program for your community. The guidebook offers a "menu" of possible water efficiency techniques and approaches from which you can choose. In this way, it can be used by municipalities in all parts of Canada, operating under various circumstances.

This guidebook can be of benefit if you:

- need to reduce water use to manage limited supply in a sustainable manner;
- would like to reduce water use in response to public or environmental concerns;
- would like to downsize, delay, or eliminate the construction of capital facilities;
- would like to reduce operation and maintenance costs;
- would like to design a water efficiency program that is appropriate and useful for your particular water situation; and
- would like to comply with Ontario's new Permit to Take Water (PTTW) regulations.

Planning and implementing a water efficiency program will require a certain amount of time and effort. The goal of this guidebook is to give you a useful tool that can make the job as easy as possible.

The water efficiency measures that are described are generally feasible for smaller communities, and are commonly used in existing efficiency programs. An attempt has been made to keep the planning process straightforward and within the resources of the smaller community.

In some parts of the guidebook, the planning process is divided into 2 levels. Level I provides guidelines for a basic analysis, which can be performed by any small or medium-sized municipality. Unless otherwise noted, everything in the guidebook applies to Level I. Level II identifies additional procedures that can be used by municipalities that want to perform a more detailed analysis.

The differences between Level I and Level II are:

- Level II involves more detailed forecasts of water demand, which require more data than Level I methods;
- Level II shows how to estimate water savings for planned water conservation measures;
- Level II includes a benefit-cost analysis of alternative water conservation measures; and
- Level I shows how to select measures for the plan without this evaluation.

This guidebook also identifies additional references for municipalities that wish to obtain even more technical information or pursue more detailed methodologies. In particular, you may wish to consult the publication entitled "Water Efficiency Best Management Practices" developed by the Ontario Water Works (OWWA) Water Committee and available from the OWWA at www.owwa.ca.

It provides practical information and references for 12 best management practices including metering, full cost pricing, public education and water loss management.

The Ontario Water Works Association (OWWA) strongly encourages water utilities to adopt policies and procedures that result in the efficient use of water, in their operations and by the public, through a balanced approach combining demand management and phased source development. To this end, OWWA supports the following water efficiency best management practices.

1. Meters for all water users.
2. Full cost pricing.
3. Public information and education programs.
4. School programs.
5. Compile a water-use database.
6. Water loss management.
7. Developing a water efficiency program/plan.
8. Implementing a utility/municipal water efficiency program.
9. Industrial/commercial/institutional water efficiency.
10. Indoor residential water conservation.
11. Landscape water efficiency program.
12. Reducing the flow in the wastewater system.[1]

ORGANIZATION OF THE GUIDEBOOK

Chapter 1*: *Introduction defines water efficiency and identifies the kinds of water efficiency activities addressed in the guidebook. It discusses the reasons for conserving water and the possible effects that conservation may have, from a variety of perspectives. As well, it describes water efficiency programs from several municipalities and regional governments.

Chapter 2: Evaluate Your System shows you how to put together information for a better understanding of your municipality's supply and demand characteristics. Worksheets are provided for you to determine your current water usage patterns and forecast your future water demand. You will be using this information when you get to Chapter 9, which shows you how to design your water efficiency program.

Chapter 3: Set Goals and Targets discusses ways to define your program goals and presents the considerations involved in selecting appropriate goals and targets for your situation.

Chapters 4, 5, 6, 7: gives an overview of potential ***Operating and Maintenance, Customer and General Measures*** that can be part of a water efficiency program. Each type of measure is described in terms of general feasibility, costs, benefits, and other considerations.

Chapter 8: Screening Water Efficiency Measures summarizes the overall water savings that can be achieved by applying the types of measures described in Chapters 4 through 7. It also discusses screening measures for applicability, feasibility and acceptability.

[1] "Water Efficiency Best Management Practices", OWWA Water Efficiency Committee, September 2005

This section is intended to help you form some ideas about the kind of program you may want for your municipality, and the kind of approach that best fits your system's needs.

Chapter 9: Design Your Water Efficiency Program shows you how to use the information you have gathered to this point to create your own program. It provides step-by-step guidelines for designing a plan, including ways to combine measures into an effective program, and estimate benefits and costs. Worksheets are included to help you evaluate potential efficiency measures.

Chapter 10: Implement Your Water Efficiency Program discusses the process required to put your program into place and to monitor its progress.

The ***Glossary*** is provided to help you use this guidebook.

The ***Appendices*** contain material that supplements the information in Chapters 1 through 10.

CHAPTER 1

1.0 INTRODUCTION

Summary

This chapter provides an introduction to water efficiency and water efficiency planning; it:

- defines water efficiency;
- distinguishes between water efficiency and "curtailment";
- distinguishes between long-term water efficiency and short-term emergency management;
- discusses reasons for conserving from a variety of perspectives; and
- gives examples of water efficiency programs.

1.1 WHAT IS WATER EFFICIENCY?

The supply and use of water is receiving increasing attention from utilities, regulatory agencies, the media, and the public throughout the country. Growing population, concern for the environment, occasional droughts (in some parts of the country), changing weather patterns and economic considerations, such as savings on operating costs or capital cost deferment, all point to the need for wise stewardship of this most important resource. Water efficiency is one tool that can be used effectively to help meet these challenging constraints and opportunities.

Water efficiency or water conservation has been described as "any socially beneficial reduction in water use or in water loss."[1]

[1] Baumann, D.D., J.J. Boland and J.H. Sims. (1984). "Water Conservation: The Struggle over Definition". *Water Resources Research.* 20(4): 428-434.

This can be achieved in a variety of ways, including:

- technology improvements (such as water-saving fixtures, efficient irrigation systems, and reduction of water losses in the system);
- process or use changes (such as more efficient industrial processes, water reuse, and low water-use landscaping);
- monetary incentives (usually to support technology improvements or process use changes);
- regulatory action;
- fiscal measures such as pricing policies or development charges; and
- public education.

Municipal water utilities operate under varying needs and conditions. The reasons for conserving water and the ways to accomplish water efficiency will differ, depending on circumstances such as geography, climate, infrastructure and number of customers. Not all options are appropriate for all situations, and municipalities can choose the type and extent of measures that best fit their requirements.

It is important to distinguish between efficiency/conservation and "curtailment". Curtailment (mandatory reduction in water use) is only necessary during drought or emergency situations, and requires measures that can achieve immediate results.

As the name implies, short-term measures such as water restrictions are applied over a limited period to address emergency situations that may arise from time to time. When the emergency is over the restrictions are lifted.

Water efficiency measures are employed to reduce a community's long-term water needs. They are aimed at achieving ongoing results over a longer period of time, and can be undertaken as part of a long-range planning process.

With water efficiency, it is possible to reduce water use without changing the level of customer service. As Environment Canada describes it, "Water conservation means doing the same with less, by using water more efficiently or reducing where appropriate, in order to protect the resource now, and for the future."[2]

Water efficiency can be used to reduce both annual average demand and peak demand (monthly, daily, or hourly). For example, water efficiency measures that can help reduce peak summer demand include low water-use landscaping and seasonal pricing changes. Changes in indoor plumbing fixtures reduce average demand, but generally do not affect summer peak use. Peak and average demand have different effects on the need for capital facilities.

For example, average demand affects water storage requirements, while peak demand controls pumping, treatment, and distribution system storage costs. This guidebook shows how to determine both average and peak demands, identify reduction goals, and select appropriate efficiency measures to meet these goals.

[2] Environment Canada website. www.ec.gc.ca/water/en/manage/effic/e_intro.htm May 2006.

1.2 WHY CONSERVE WATER?

Water Utility Perspective

Municipalities from the Territories to British Columbia and Newfoundland have demonstrated that water efficiency can be an important component of an overall water supply plan. Reducing water requirements by decreasing demand and increasing system operating efficiencies can have numerous benefits to the municipality, as identified below. These benefits can apply to communities of all sizes, in all parts of the country:

Construction of capital facilities for water supply, transmission, storage, and treatment may be downsized or delayed.

Where new capacity is required, in order to meet the demands of development and growth, the new water capacity can be "found" quickly and cost-effectively, allowing new development to proceed.

Operation and maintenance costs that are linked to demands like; pumping, chemical costs and wastewater treatment can be reduced through water efficiency.

The municipality can demonstrate responsible stewardship of a limited supply through the development and implementation of a long-term water efficiency plan.

In some parts of the country, high-quality surface and ground water supplies are becoming harder to find at reasonable cost. Water efficiency can stretch existing supplies of fresh water.

Lowering water production and consumption saves energy, money and lowers greenhouse gas emissions. In fact, water efficiency is the cheapest source of new water. It is cheaper to save a litre of water than to produce it.

The general public is becoming increasingly aware of the need to use natural resources wisely. Responsible public agencies can address their community values and expectations by developing and implementing efficiency measures that make sense for the local area.

Wastewater Utility Perspective

Lower residential water use and decreased industrial/commercial consumption will result in reduced wastewater flows. This helps reduce costs by saving energy (i.e. pumping costs), decreasing the amount of treatment chemicals, and possibly reducing capital costs for some treatment and collection facilities. These savings are typically realized for systems with separate storm water and sewage collection facilities. As well, reducing wastewater flows reduces environmental impacts from treatment chemicals and effluent released into the receiving body of water.

Customer Perspective

If water efficiency is successfully implemented, it can result in lower annual water and sewer costs to the consumer. Customers may also experience lower energy costs because of decreased use of water heaters. Septic tanks will function better. Industrial customers may have lower pre-treatment costs as a result of reduced water use.

Concerns about the environment may also be important to many customers.

Legislative Mandates

Some provinces have adopted laws that require a degree of water efficiency. For example, effective January 1, 1996 Ontario mandated that all toilets, showerheads and faucet aerators used in new construction conform to efficient water use standards. Some provinces may require a water efficiency plan before authorizing the development of new water sources or participating in joint funding for new capital works.

In 2004, Ontario's Ministry of the Environment strengthened the regulations for obtaining a permit to take water. The Ontario Water Resources Act and the Water Taking and Transfer Regulation requires anyone taking more than a total 50,000 litres of water per day, from a lake stream or groundwater source, is required to obtain a Permit to Take Water (PTTW). The permit can only be issued to a maximum of 10 years. The purpose of the PTTW is to ensure the conservation, protection and wise use and management of the waters of the province. [3]

Ontario's water taking rules have been strengthened so that anyone applying for a permit must document to the MOE all water efficiency measures and practices that have already been undertaken or will be undertaken for the duration of the permit. The aim is to encourage wise and efficient use. The new regulations also have provisions for protecting watersheds, notifying local water managers and require annual water use monitoring and reporting to the MOE. For more specific information, visit the MOE website listed below.

Federally, through the Canada Water Act, the government is involved in joint undertakings in water resources management with the provinces, and it also encourages water conservation through research and public education. Environment Canada is the lead federal agency in promoting water efficiency nationally.

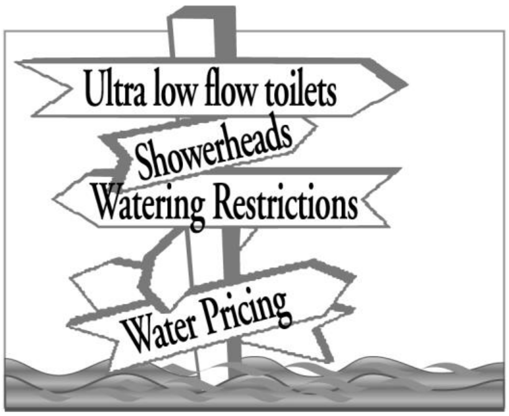
Environmental Perspective

The public is becoming increasingly knowledgeable and concerned about water supply and treatment issues and the impact of water use on the environment. Water efficiency planning demonstrates the municipality's commitment to environmental stewardship in several ways. Water efficiency supports sustainable use of limited groundwater resources and shared surface water. Wise use of water also reduces the amount of chemicals that are introduced into the water cycle through treatment of potable water and of wastewater.

3 Ontario Government Website:
www.ene.gov.on.ca/envision/water/pttw.htm
July 2006.

1.3 EXAMPLES OF WATER EFFICIENCY PROGRAMS

Many municipalities across Canada have developed successful water efficiency programs. This section briefly describes a few programs that demonstrate the diversity of circumstances and approaches to water efficiency.



Kelowna, British Columbia

Demographics:
The City of Kelowna is located in the semi-desert interior of British Columbia. The city services approximately 12,000 households and 1,000 apartment units, representing about 70% of the population. (The remaining population is serviced by 4 private utilities that also provide irrigation services to the surrounding agricultural community.)

Why Water Efficiency?:
With Lake Okanagon on the doorstep, a source of water supply is not a problem. The City initially began a water efficiency program as part of a 25 year plan to reduce infrastructure costs. In Kelowna, the summer lawn watering season runs from March to August, with average household consumption at 75-80 m^3/month. The intent of the program was to encourage water efficiency by moving households to metered consumption and a volumetric rate, while providing public education on water efficiency methods.

Implementation & Results:
The new rate was calculated so that a customer's water bill would stay at the same amount if they reduced consumption by 20% and the rate was designed to be revenue neutral for the municipality. The rate consists of a standard monthly service charge of $8.00 and a volumetric rate of $0.21 for every cubic meter used.

Public education included co-op advertising with local retailers and 4 seasonal promotions each year. As well, the City did not enact the new rates in the first year after metering was complete. Instead, they sent quarterly mock billing letters to each customer. The letter compared the customer's present water bill with what the bill would be under the new rate. The mailing also included information on the seasonal promotions and other ways to save water.

Unresolved Issues:
After the water efficiency program began, the City encountered a threat to the water supply in the form of an outbreak of cryptosporidia and giardia. As a result, a large capital outlay is now required for more intensive water treatment, making the water efficiency program even more timely.

Fenelon Falls, Ontario

Demographics:
The Village of Fenelon Falls is primarily a residential community with a total permanent population of 2,040. Located just 170 km north of Toronto, tourism is a major economic activity and the village provides services to residents of the surrounding cottage country.

Why Water Efficiency?:
Faced with the demands of growth, in 1997 the Village decided to expand the water treatment plant. However, development was also restricted by the Ministry of the Environment because of the limited capacity of the wastewater treatment system. The options were to add capacity, repair sewers and reduce the infiltration rate and/or undertake a water efficiency program.

Implementation & Results:
The Village decided to include water efficiency as part of their overall strategy. The water efficiency program implemented in 1996 -97 consisted of installation of residential water meters and faucet aerators. Low flow showerheads and early-closing flappers were also installed where needed. With metering complete, the Village switched to a volumetric rate.

Lasting Benefits:
As a result of these changes, maximum day use per capita was reduced 44% from a 6-year average of 1224 Lcd to an average of 681 Lcd. Average day use also fell by 32% from the 6-year average of 605 Lcd to 411 Lcd. Since the water efficiency program was undertaken after the sewer repairs, it was possible to distinguish the relative contribution to reductions in wastewater flows. Flows have declined by 25%, when both sewer repairs and water efficiency are considered or by 15% from water efficiency alone.

Meaford, Ontario

Demographics:
The Town of Meaford is located on the southern shore of Georgian Bay (part of Lake Huron). The water system serves a population of approximately 4,900 persons and is managed by the Meaford Public Utilities Commission (PUC).

Why Water Efficiency?:
Georgian Bay provides an abundant quantity of excellent quality water. Local shortage of raw water supply has never been an issue and water demand never exceeded 40% of treatment capacity. There were no critical bottlenecks in the system. The Commission did recognise that diminishing resources (funding and environmental) and a need to plan capital expenditures for "right sized" water and sewage systems were and continue to be realities. The concept of simpler and fairer user pay charges for water (and ultimately sewage) services appealed to the Commission, Council and the majority of Meaford customers as well.

Implementation & Results:
The Public Utilities Commission elected to install water metering in 100% of customers' premises in early 1990. Prior to this time, approximately 60 general service (IC&I) large users were metered. A public information campaign advised customers on the merits of metering and the project was completed over a 5-month period in 1990. Universal metering charges for water were initiated in January of 1991 and Town Council implemented user-pay sewage charges in February 1992.

The implementation of universal metering in 1991 resulted in a reduction of 11.4% in total treated water from 1990 to 1991. The loss of a major water consuming industry in the same year is not included in this reduction. With the commencement of sewage charges based on water consumption in 1992, water pumpage dropped an additional 14.9%. Over the next 5 years, water consumption continued to drop as public awareness increased. Customers were encouraged to adopt other efficiency measures through sale of water saving devices at a small fee and the introduction of a "Green Home Tune-up Program". During the period from 1990 to 1997, annual water production at the Water Treatment

Plant decreased by almost 36%. During the same period, Meaford's population increased by approximately 5%.

Lasting Benefits:
In 1998, the PUC decided to undertake major upgrading at the Water Treatment Plant. As a result of the water efficiency program, the service life of the existing filters, system storage and other plant facilities has been extended and the design capacity of new equipment and components has been reduced, thereby avoiding additional capital costs. These savings have already more than justified the cost of the original meter installation.

Port Colborne, Ontario

Demographics:
The City of Port Colborne (population 18,500) is located on the north shore of Lake Erie.

Why Water Efficiency?:
Prior to 1994, the City had relatively high per capita water consumption as a result of an aging water main system and a residential sector that was not metered. The municipality developed a comprehensive water efficiency plan to address both unaccounted-for water and system leakage as well as residential consumption.

The water efficiency plan included:
ongoing leak detection:

- quantification of all current water uses; e.g.: flushing, fire fighting, temporary services;
- calibration and/or retrofit of all existing industrial meters;
- implementation of universal metering for all water users;
- water efficiency devices supplied to each home; and
- implementation of sewage charges by volume.

Implementation & Results:
After implementing the universal metering program with associated industrial meter retrofit and distribution of residential water efficiency kits, the City undertook a Water Distribution Needs Study. The purpose of this undertaking was to:

- locate and reduce unaccounted-for-water usage;
- produce an updated inventory of the water distribution system;
- assess the system performance to ensure an adequate level of service;
- review existing and future demands;
- ensure adequate fire protection in the City; and
- plan rehabilitative measures for the water system.

The District Meter Area (DMA) method was used to address the issue of unaccounted-for water. The Municipality was divided into specific metered zones, isolated by existing water main control valves and temporary zone meters. The City intended to convert the temporary meters to permanent installations, upon completion of the Study. This would allow staff to compare metered consumption within the zones to zone meter readings and actual water Treatment Plant distribution readings.

Lasting Benefits:
The initial study resulted in a detailed report on the potential sources of leakage and recommended measures to reduce the unaccounted-for water. As well, following the initial Study, the City purchased 5 zone meters to establish permanent district meter areas (DMAs). With the aid of a Leakage Control Operation Manual, provided by the engineering consultants, staff are now better able to monitor and control unaccounted-for water on an ongoing basis.

Port Alberni, British Columbia

Demographics:
The City of Port Alberni, British Columbia (population approximately 18,500) is located on Vancouver Island beside the Alberni Inlet.

Why Water Efficiency?:
The residents of Port Alberni were faced with a potential cost of $50 million to develop a new water source. Port Alberni presently draws water from a reservoir fed by a mountain stream. A water supply study showed that slow but steady population growth would necessitate finding a new source of supply. The preferred source is a mountain lake; developing it would involve acquisition of a right of way and 20 km of piping.

Implementation & Results:
The City decided to implement a comprehensive water efficiency program to defer development of the new supply source until there is a larger population base to support the cost. The water efficiency program includes leak detection, metering, a residential retrofit program, lawn watering restrictions, public education and school resource material.

A metering study in 1997 was followed by installation of over 7,000 meters (primarily residential) from 1997 through 1999. The City plans to institute a volumetric rate early in 2000. The metering program costs included the metering study ($40,000), installation of residential meters ($2.1 million) and installation of commercial and industrial meters ($500,000).

Current residential use is approximately 395 Lcd. The voluntary residential retrofit program and public education program are designed to help residents to reduce their water consumption prior to implementation of the volumetric rate. The residential retrofit program provides low flow showerheads, faucet aerators and early closure toilet devices for a total budget of $50,000. Initially, the devices were installed by the plumbing contractor responsible for the meters. Later, the City elected to simply distribute the devices to homeowners. Approximately 70% of homeowners accepted some efficiency device.

The public education program includes bill stuffers, community events, promotion of voluntary watering restrictions, a conservation library and provision of resource materials to the schools. The total cost of public education activities is $7,500/year.

The leak detection program was carried out by City staff using the sonic method. A budget of $10,000 is estimated for annual expenses relating to ongoing leak detection work.

Drumheller, Alberta

Demographics:
The city of Drumheller, Alberta (population approximately 6,600) is located 150 km east of Calgary in the heart of Alberta's badlands.

Why Water Efficiency?:
The City of Drumheller found that the water treatment plant was operating at near capacity and building a new plant would cost over $2 million.

Implementation & Results:
The City decided to defer expansion of the treatment plant by retrofitting existing homes with water efficiency devices. The program engaged plumbers to install low flow showerheads, faucet aerators and new toilet flappers at no cost to the homeowner.

By the end of the first year of the program, approximately 75% of the residents had participated, 10% had refused and the remaining 15% of homes were scheduled for installation in the following year. Total cost of the retrofit program was $220,000.

In addition, the City now requires all new homes to have water efficient fixtures. This provision is implemented through the building inspection department.

Lasting Benefits:
Since beginning the retrofit program, Drumheller has experienced a reduction of 25% in water use in participating households. This has enabled the City to defer the construction of the new water treatment plant for 10 to 12 years.

Whitecourt, Alberta

Demographics:
The town of Whitecourt, Alberta (population 8,008) is located 177 km northwest of Edmonton. It has a thriving economy based on the forestry, oil, gas and tourism industries.

Why Water Efficiency?:
The Town of Whitecourt has been implementing a comprehensive water efficiency program for several years. The overall objective is to defer expense associated with increasing the supply system to meet the demands of a growing population.

Implementation & Results:
As a first step, a committee was formed to review and determine policy and measures for the Town. With metering already in place, the Town adopted further efficiency measures including leak reduction, meter testing, infiltration testing, plant improvements and lower water pressures.

Not content with best management practices, the Town has adopted some innovative measures including a bylaw requiring water efficient fixtures in new homes. With efficient fixtures installed in all new homes the Town estimates that the cost of associated supply has been reduced from $3,000 to $2,400 and the off-site levy charged to new home buyers has been reduced accordingly.

Through monitoring, the Town recently discovered that household water consumption at the mobile home park was 25% higher than the average household use in other homes in the town. The 150 units at the mobile home park were served by 1 bulk meter. After installing individual meters the Town noted a reduction of 24% in water use from the park.

In addition to special projects such as the mobile home park, Whitecourt maintains ongoing water efficiency programs; the Town's distribution system is checked regularly for leaks and each year Town staff give water efficiency presentations to grade 4 and 5 students.

Lasting Benefits:
Before the water efficiency programs began in 1989, Whitecourt was anticipating that $4.5 million would be needed in 1995 to double the capacity of the water treatment plant. Through water efficiency, the Town has effectively increased water treatment capacity by nearly 30%. The original water treatment facilities, designed for a population of 6,500, are now serving over 8,000 people. Instead of a $4.5 million treatment plant, Whitecourt now plans only a $1 million reservoir to store water for peak demand periods.

Barrie, Ontario

Demographics:
The City of Barrie (population 135,000) is a rapidly growing community located about 75 km north of Toronto.

Why Water Efficiency?:
In the city of Barrie, further growth was restricted by waste water treatment capacity. The City's options were to freeze new development, expand the treatment plant for a cost of $41 million or reduce wastewater flows through water efficiency.

Implementation & Results:
From 1995 to 1999, Barrie elected to reduce wastewater flows through a household fixture replacement program. The goal was to convert 15,000 of the City's 26,000 households to 6 Litre ULF toilets, thereby reducing water use in participating households by 50 Lcd. To accomplish this, the City offered householders a rebate of $145 per toilet, effectively providing the fixtures for free. Homeowners were responsible for paying the set cost of installation by qualified contractors ($53 for 1 toilet or $85 for 2.
During the first 2 years of the program the City replaced a total of 10,643 toilets in 8920 households. Participating households also received low flow showerheads and faucet aerators at no extra charge

Before and after monitoring of 1,866 households showed an average reduction of 62 litres per person per day, well over the target of 50 Lcd. After correction for lawn watering in the summer months, wastewater flow reductions were calculated at 55 Lppd. In the fourth year of the program additional monitoring was done by reading meters in twenty households for 1 month prior to installation of toilets, showerheads and aerators and for 1 month after. These results indicated 61 litres per person were saved in each household.

The total cost of the program was $3.6 million dollars (about 55% for fixtures, 17% installation, 4% for rebates, and 24% for administration. In the first 2 years of the program, costs totalled $3.1 million, (about 56% for fixtures, 18% for installation and 26% for program delivery). An average of 1.1 toilets and 1.6 showerheads were installed per household at a total program cost of just under $283 per household.

At the end of Year 2, the City was on track to defer expansion of the Water Pollution Control plant to 2011. The City then decided to continue with fixture replacement, but on a more modest scale. Rebates were reduced to $75 per toilet with a limit of 2 toilets per household. An additional 3,804 households were recruited for a total of 12,724 households participating in the toilet replacement program. In total, 14,203 toilets were installed in the 4 years the program ran.
In June of 1998 the City initiated a rebate program for high efficiency washing machines. The City offers a rebate of $140 for front loading or qualifying high efficiency top loading machines and promotes the offer through point-of-purchase advertising at appliance stores. Typically, washing machines are replaced at the rate of about 10% per year, (or in Barrie about 3,000 machines a year). The City expected to recruit a small fraction of those purchasers, perhaps 2% to 3%. In the first year of the program, recruitment far exceeded expectations, with some 600 high efficiency machines installed, representing about 20% of the machines replaced that year. The program ran until January 2002 and the city supplied 3160 rebates representing 9% of the homes in Barrie at the time.

Lasting Benefits:
Looking to the future, Barrie plans to continue with a comprehensive water efficiency program, supporting savings on both indoor and outdoor water use.

New Glasgow, Nova Scotia

Demographics:
The town of New Glasgow, located east of Halifax, is a regional service centre for the surrounding rural population of 60,000 to 70,000 people. The town itself has a population of about 10,000 and draws water from a nearby lake.

Why Water Efficiency?:
In the early nineteen eighties, studies showed that the Town's demands on the supply source were nearing the safe yield limit of 2,250,000 imperial gallons a day. To develop another source would require a capital investment of $20 to $30 million. New Glasgow turned to demand management as an option and initiated, what has come to be, an ongoing water efficiency program.

Implementation & Results:
As a first step, the Town extended metering to the residential sector and put residents on a constant unit rate. Together with public education, the metering program resulted in a decrease in household water use of about 8%.

The Town then developed a new rate structure for the IC&I sector, decreasing the number of declining blocks from 3 to 2. At the same time the Town began to work with local businesses and manufacturers to make them aware of the long-term water supply issues and to help them identify opportunities to save water and operating expenses. For example, 1 major manufacturer has reduced water use by 90% over a 5 year period with help from the Town.

In the mid-nineties, the Town undertook a 1 year demonstration toilet replacement program with the Clean Nova Scotia Foundation. Residents were offered installation of a ULF toilet, a low flow showerhead and a faucet aerator for $75 plus taxes. Three hundred of the town's 3,000 households enrolled in the program.

Lasting Benefits:
As a result of these and other initiatives, New Glasgow managed to reduce demand from 2.2 ML/day in 1984 to 1.5 ML/day in 1995. With these savings, the Town then elected to sell water (within the safe yield limit) to a nearby municipality. The sale of water has enabled the Town to finance a new $6 million treatment plant and defer the $20 million cost of developing a new supply source for another 20 years.

To maintain the savings, New Glasgow continues with an ongoing water efficiency program that focuses on public education and individual customer contact. The Town works with large IC&I customers on an individual basis to identify new opportunities for savings. Quarterly residential bills are monitored. If there is a sudden increase a Town representative visits the customer to check for leaks, and advise the homeowner on other ways to save water.

Repentigny, Quebec

Demographics:
The city of Repentigny, about 10 km east of Montreal, developed during the nineteen fifties and sixties to provide housing for the growing City of Montreal. The present population is approximately 57,000.

Why Water Efficiency?:
In the Province of Quebec, only a small percentage (about 10 to 12%) of communities are fully metered. Repentigny began installing residential meters in the nineteen sixties in anticipation of moving to a conservation based rate structure. However, the city continued to sell water on a declining block rate basis well into the nineteen seventies and eighties.

Implementation & Results:
During the nineteen eighties the community needed to make major modifications to the water filtration plant. About 2/3rd of the $60 million cost was for improvements in water quality and 1/3rd of the expense was required to expand the plant capacity from 50,000 m^3/day to 87,000 m^3/day. The plant expansion was completed between 1989 and 1992. After this investment, the city determined to initiate measures to encourage water efficiency.

With metering in place, Repentigny decided to change the rate structure from a declining block system to an inclining block rate. At the same time, the city initiated an extensive public education program, using some of the resources available through Reseau Environment. Each spring and summer the city mounts a promotion campaign including TV and radio spots, press coverage and distribution of conservation devices to households.
Repentigny also maintains an active leak detection program. Nightly average flows are monitored and if any are too high, the area is investigated for leaks.

Lasting Benefits:
These measures have combined to reduce Repentigny's daily water use to 250 - 300 Lcd (including both IC&I and residential use). This compares with the Quebec average consumption of 400 to 500 Lcd across all sectors.

Repentigny's water efficiency program has enabled the city to defer construction of a new water reservoir for 15 to 20 years. However, the city's population is still growing and the new water reservoir will soon be needed to provide additional capacity.

Looking to the future, Repentigny plans to continue to develop its water efficiency capacity. The next project is conversion of the community's 70,000 meters to automatic meter reading technology. This technology will allow meters to be read from a central location and will enable closer monitoring of water consumption.

Toronto, Ontario

Demographics:
Toronto, Ontario, lies on the north shore of Lake Ontario and has a population of 2.5 million people. The city provides water and wastewater services to 450,000 households, and over 408,000 apartment units, and 15,000 industrial, commercial, and institutional customers.

Why Water Efficiency?:
Toronto's population is expected to increase by 1/4 of a million people in 6 years. The population growth poses a potential challenge for the City of Toronto's existing water infrastructure. Currently, the system provides sufficient water for its present population and it was designed with additional capacity to meet the needs of a larger population in the future. However, current water demand is higher than initial estimates, especially during the summer when residents water lawns, fill pools, and wash driveways. At this rate, the City estimates that it must begin expanding its water systems (includes water filtration plants, wastewater treatment plants, and new watermains) to accommodate its growing population.

Expanding the water system is an extremely expensive venture and could potentially cost $220 million. Staff research shows that a system expansion could be avoided if the "average daily" and "peak day" (the 1 day in the year when water use is highest) demands were reduced by 15% by 2011. Toronto's water system was built to accommodate the "peak day" demand.

Implementation & Results:
In 2002, Toronto Council adopted a Water Efficiency Plan to help with water demand management across the city. The plan identifies initiatives that would help the City to reduce the water demand of its existing population and defer or reduce the capital costs associated with constructing or expanding water and wastewater infrastructure by $150 million.

Lasting Benefits:
The Water Efficiency Plan goes beyond just reductions in water demand. It includes many other benefits such as:

- avoided energy and chemical costs associated with the supply and treatment of water;
- reduced carbon dioxide emissions; and
- opportunities for customers to reduce water demands and save on their water bill.

There are environmental benefits associated with reduced chemical and energy use. The electricity used in treating and pumping water is produced partly by gas and oil fired generating stations, resulting in smog and carbon dioxide (CO_2) emissions. For each mega litre of water saved, about 0.31 tonnes of CO_2 will be avoided.

The implementation of water efficiency programs may also result in a net benefit to the environment through reductions in contaminant loadings from wastewater treatment facilities to Lake Ontario and Toronto's waterfront, and corresponding reductions in energy production (as a result of reductions in treatment and pumping requirements).

Finally, the Plan offers participants the opportunity to reduce their water consumption and, thereby, reduce their water billing costs. Program incentives are offered by the City to help reduce the pay back periods associated with customers purchasing water efficient fixtures.

1.4 Regional Municipality Case Studies

Region of Waterloo, Ontario

Demographics:
The Region of Waterloo is located in south-central Ontario along the Highway 401 corridor approximately 100 km west of Toronto. The current population of the Region is approximately 450,000 persons in 7 municipalities: the cities of Cambridge, Kitchener, and Waterloo; the townships of Woolwich, Wellesley and North Dumfries. Over the next 40 years the population is expected to increase by 250,000 persons and employment levels are expected to increase by 170,000 jobs.

Why Water Efficiency?:
The Region's water supply system is a complex network of wells, water treatment plants (WTP), reservoirs, pumping stations and trunk watermains. Prior to 1992 all of the Region's water supply was derived from groundwater wells. The Mannheim WTP, which was commissioned in 1992, treats water taken from the Grand River and pumps it into the water supply system. Even with 20 % of its water coming from surface water, Waterloo Region remains the largest municipality in Canada to rely so heavily on groundwater supply. New water sources in the Region have become scarce, and the current long-term plan is to build a pipeline to Lake Erie by the year 2035. The long term plans are now being revised as growth has surpassed projections, and the potential pipeline may be built sooner. A recognized part of the solution is to implement water efficiency measures.

Implementation & Results:
The Regional Municipality of Waterloo has been actively promoting and implementing water efficiency programs since 1974. Early programs focused on education, awareness, and retrofit

distributions (toilet dams, tap aerators, do-it-yourself home auditing). In 1994, a water efficient toilet rebate program was implemented, and by the end of 2005, over 40,000 rebates were paid to people installing low-flush toilets.

Water efficiency programs were expanded with the approval of the Water Efficiency Master Plan (1998), and enhancements (2001). The 1998 master plan goal is to save 1.5 million gallons per day (MGD) by 2009. An updated Water Efficiency Master Plan (WEMP) was approved in July 2006, with new/updated programs and water conservation targets to cover years 2007 to 2015.

Recent initiatives that support both the WEMP and enhanced water efficiency programs are listed below.

Intensive Ayr Toilet Replacement & Water Efficiency Program	2001-2003
Residential Toilet Replacement Program (TRP)	Ongoing
Subsidized Rain Barrel Truckload Sales	2001 - 2006
Curriculum Supplements for Grades 2 and 8	2001 - Ongoing
Environews and General Public Awareness Campaigns	Ongoing
Outdoor Water Use By-Law Update & Promotion	2003 - Ongoing
Naturescaping Demonstration Gardens & Promotion	Ongoing
Efficient Region Facilities (setting an example)	Ongoing
Industrial, Commercial & Institutional Program	Ongoing
Research, Development & Lobby for Legislative Reform	Ongoing

The target 1.5 MGD reduction in projected water use represents a reduction of approximately 4% of projected 2009 average-day demand (approximately 36 MGD). The WEMP also provides cumulative efficiency targets for each program on an annual basis to measure progress toward achieving the long term goal. The water savings target for 2005 is 1.12 MGD and the estimated actual savings achieved was 1.21 MGD, which is ahead of target even before 2005 outdoor water use savings are included. With reductions achieved through outdoor water use restrictions, the water savings achieved in 2005 is over 2 MGD.

Lasting Benefits:
Although no immediate capital deferrals have been noted, the Region of Waterloo recognizes the need to continue with water conservation in order to delay construction of a great lakes pipeline.

The proposed 2007-2015 Water Efficiency Master Plan has set a goal of saving 1.8 MGD in baseline consumption alone. Through outdoor water use reductions, peak demand reductions may double the projected savings.

The proposed updated Region of Waterloo program will focus on innovation and leadership in the following areas.

- General Public Education
- Outdoor Water Use Reduction
- Efficient Toilet Replacements
- Industrial, Commercial and Institutional Efficiencies
- Municipal Leak Reduction
- Research and Development

Regional Municipality of York, Ontario

Demographics:
The Regional Municipality of York is located directly north of the City of Toronto. Composed of 9 area municipalities, the Region has a

population of approximately 904,000 and covers an area of 1,756 km^2. York Region enjoys one of the fastest rates of growth in the Greater Toronto Area. Its population is expected to reach 1.3 million by 2031. Its current average day water demand of 330 million litres is also expected to increase proportionally.

Why Water Efficiency?:

Although Canada has an abundance of fresh water and even though York Region is literally surrounded by the Great Lakes, the servicing challenge that faces York Region is that it has no direct access to the Great Lakes. As a result, York obtains the majority of water and wastewater service for its southern urban area via negotiated agreements with adjacent municipalities.

Faced with an enormous amount of growth, limited existing service agreements and potentially huge capital costs for major new infrastructure outside its boundaries, York embarked on a Master Plan Study in 1996. The study objective was to develop a comprehensive long term strategy to serve York's water supply needs to 2031. As an outcome of the Master Plan, Regional Council adopted a Long Term Water Supply Strategy in December 1996 which included among other initiatives, the design and implementation of a comprehensive water efficiency plan.

Despite the requirements to construct a new water treatment plant and to negotiate new supply agreements, water use efficiency is an essential part of York's Long Term Strategy. Water use efficiency represents the lowest cost "source" of supply, at approximately ¼ the cost of new infrastructure. Supply obtained from water efficiency measures permit deferral of other, more costly capital components of the long term plan. Aside from financial considerations, York's comprehensive program demonstrates to the public and to government regulators that it is taking a responsible approach to water supply by making the best use of existing resources. In addition water supplied from water use efficiency has the smallest environmental footprint of all supplies and reduces greenhouse gases.

Implementation & Results:

In September 1998, the Regional Municipality of York launched *Water for Tomorrow*, York Region's water-use efficiency project. The overall 8 year project consisted of 6 components; Residential/Commercial Retrofit Program, Industrial/Institutional Audit and Capacity Buyback Program, Distribution Leakage Reduction Program, Broad-scale Public Education, Youth Education and Summer Water Use Reduction Program. The original target of the project was to save over 19 million litres of water per day. The 8 year project is saving over 22.75 million litres of water per day… enough water to supply a town of 86,000 residents. In addition, due to the installation of low flow showerheads, the project is saving 7.6 million cubic metres of natural gas annually and is reducing carbon emissions by 3,809 tonnes and carbon dioxide emissions by 13,947 tonnes annually.

The largest component of *Water for Tomorrow,* from both a savings and budget perspective, is the Residential/Commercial Retrofit Program. Through this program, York Region provided and installed free low-flow showerheads and early closing toilet flappers in qualifying homes, schools and businesses within the Region. Showers and toilets are among the largest users of water in homes, comprising approximately 40 to 50% of indoor water use. Over 118,000 home visits have been completed with over 61% of those visits resulting in a retrofit of a toilet or showerhead. 10,479 high rise residential apartments, 14,311 commercial businesses and 195 schools have participated. In total, over 245,000 early-closing toilet flappers and 106,000 water-saving showerheads have been installed since the program was launched September 1998.

As part of *Water for Tomorrow*, York Region offered, free of charge, to industrial and institutional water customers, the services of a professional engineering consultant to conduct a "water-audit". The facilities that participated underwent an extensive review by the consultant. A report was provided which detailed the water saving measures which could be undertaken. The report included estimated cost to implement the measures, associated water savings, impact on the utility bills and the many other benefits attributed to water-use efficiency. Over the 6 year period, audits were completed at the 60 highest water users in York Region.

More than 2.1 million litres per day of potential water savings have been identified with paybacks usually less than 2 years. Three companies have implemented recommendations resulting in actual water savings of 431,000 litres per day. The program was enhanced with a capacity-buy back component in the form of a rebate. The rebate of $0.40 per litre/day saved was available to qualifying companies. This component generated an additional 215,000 litres/day of saved water.

Depending on the age and condition of the infrastructure, municipalities typically lose 10% or more of the treated water through system leakage. This is costly for municipalities as they cannot bill customers for the lost water. In York Region, system leakage was estimated at 11.5 million litres a day at a cost of $1.8 million annually to the local area municipalities. The Leakage Reduction Program targeted the leakage in the municipal systems, water that the municipality had paid for but unable to sell. The target of the Leakage Reduction Program was to reduce system leakage by 50%. This service was provided at no cost to the area municipalities.

Over 1,800 km of water main was tested in the 9 municipalities. All of the municipalities have been completely surveyed utilizing the district meter area (DMA) methodology. In addition to the 65 temporary DMAs established, 10 permanent flow-modulated DMAs were constructed. The leakage that has been identified and repaired represents over 8.13 million litres of water per day.

An important element of *Water for Tomorrow* is public outreach and education. These activities are intended to educate and change the water-use attitudes of York Region residents. Booklets, information leaflets, newspaper advertising and bill inserts explain the *Water for Tomorrow* project and work to solicit support from residents in lowering the Region's demand for water. The program also recognises the need to change the attitudes and actions of young residents, hence, the development of a grade 7 and 8 curriculum module.

The module, includes a Teacher's Manual and Student Workbook, a "made-in York Region" video which takes the students on a tour of the regional water system, and an interactive web page. Each September new student workbooks are distributed to the elementary schools, including a French version of the curriculum package for French immersion schools. The annual drawing contest resulting in the *Water for Tomorrow* Calendar continues to be popular with students.

The largest demands on a water supply system occur during the summer when outdoor uses can increase significantly; particularly during dry spells, when people are watering their lawns and gardens. Municipalities have to build extra capacity to meet this peak summer demand – even though it only occurs for a short period. Sometimes even that extra capacity isn't enough and temporary outdoor water bans are implemented. *Water for Tomorrow*'s goal is to get residents of York Region to reduce outdoor water use by encouraging water efficient gardening and landscaping.

Residents can receive free water efficient landscape visits and learn water wise gardening techniques from the many water efficient garden demonstrations at participating garden centres, conservation areas and local college, workshops and newspaper advertising. Program information and services helped residents beautify their lawn and gardens while lowering maintenance and watering requirements. The creation of drought tolerant gardens and the implementation of low-water lawn maintenance techniques were particularly helpful during the mid-summer dry spell when many municipalities had implemented outdoor watering bans. In order to make maximum use of the program budget, the approach emphasizes the development of program ambassadors and partners who carry the message into the community. Display booths offering information on lawn watering and water efficient gardening are set up at many events including community days, festivals, home shows and fairs.

Over 22,000 Grade 4 and 5 students have learned about water in the out-of-doors at the annual York Children's Water Festival. Held every year at Bruce's Mill Conservation Area, 5,000 children attend the 5 day event where they learn by participating in over 50 curriculum based activities about water and the environment.

Lasting Benefits:
As a part of its 8 year project design, a capital investment plan was implemented in the first 6 years followed by 2 years of maintenance. *Water for Tomorrow*'s maintenance period is an innovative and proactive approach that will ensure that all water saving devices and methods implemented as a result of the capital plan will be repaired or replaced as needed. This innovative and unique approach to sustaining savings is generally not practiced by most water or energy utilities. York Region considers the water supplied from water use efficiency no different from water supplied from a treatment plant. The treatment plant would require ongoing maintenance to ensure its effectiveness to supply water. Water use efficiency requires similar diligent proactive maintenance.

Region of Peel, Ontario

Demographics:
The Region of Peel is located on the shores of Lake Ontario west of the City of Toronto, east of Halton Region and south of Dufferin County. The Region has a population of approximately 1 million and covers 1,241 square kilometres. Environmentally significant land features such as the Oak Ridges Moraine and Niagara Escarpment are located in Peel, as are the watersheds of the Humber and Credit Rivers.

Peel is made up of 3 local municipalities; Mississauga, Brampton and Caledon. There are approximately 368,000 households in Peel; 129,000 in Brampton, 220,000 in Mississauga and 19,000 in Caledon. Peel Region is responsible for the treatment and distribution of water to the many residents and businesses within the region.

Households in the city of Brampton and Mississauga as well as Bolton in the Town of Caledon are supplied with water from Lake Ontario, treated at 1 of Peel's 2 water treatment plants. The treatment plants are operated by the Ontario Clean Water Agency under contract for the Region. Ground water supplies the many resident of Caledon in the settlement areas with 18 wells serving 7 communities. Outside the settlement areas homes are supplied by private wells.

Why Water Efficiency?:
Peel is one of the fastest growing regions in Canada. The population is expected to increase 23% by 2015. This growth will require Peel to make a significant investment in water and wastewater infrastructure. The Water Efficiency Plan saves water, reduce capital costs, lessen the impact on the environment, and maintain the current level of water and wastewater services provided in Peel.

Reducing water consumption through a Water Efficiency Plan demonstrates sound environmental stewardship for Peel and is considered by leading water efficiency agencies and experts to be a best management practice. Water efficiency measures complement Peel's existing best management practices such as universal water metering, water meter calibration and replacement, water main replacement, and public outreach programs.

In addition, the Water Efficiency Plan measures are cost effective. The total cost of implementation and the estimated water savings are calculated for each measure. In turn, these values are compared with the cost of supplying an equivalent volume of water through infrastructure expansion. The overall cost of the water efficiency initiatives are less than a third of the cost of expanding Peel's water and wastewater infrastructure.

Further, the Province has taken a strong stand on protecting our water resources, developing a revised Water Taking and Transfer Regulation (O. Reg. 387/04), which took effect January 1, 2005. This revised regulation sets tough new rules and requires comprehensive reviews of how much water is used, what it is used for, and how efficiently it is used. The Province has clearly linked water conservation to Permits to Take Water.

Peel's Water Efficiency Plan will satisfy the water conservation-related requirements of the new regulation.

Implementation & Results:
The objectives of the plan are to reduce average annual day demand by up to 10 per cent, peak day demand by up to 10 per cent, and wastewater flows by 7 per cent by the year 2015.

In 2005, 4 water efficiency measures were successfully implemented, including: Residential Toilet Replacement Pilot Program, Peel Living Water Efficiency Retrofit Project, System Leak Detection Audit, and an Outdoor Water Education Program. The 2005 water efficiency measures contributed to a yearly saving of 292 Million Litres of water.

The plan will be enhanced with the following measures: Industrial, Commercial and Institutional Indoor and Outdoor Water Audit Pilot Projects, Industrial, Commercial and Institutional Toilet Replacement Program, School Water Efficiency Retrofit Pilot Project and a Restaurant Pre-Rinse Spray Valve Replacement Pilot Project.

Lasting Benefits:
Looking to the future, Peel plans to continue with it's comprehensive water efficiency plan evolving it to meet the changing needs of the consumer. The program will focus on savings on both indoor and outdoor water use as well as system efficiency.

The water efficiency plan will also be tailored to meet the needs of the Oak Ridges Moraine Water Conservation Plan and to meet the requirements for each well-based systems permit to take water.

CHAPTER 2

2.0 EVALUATE YOUR SYSTEM

Summary

This chapter will help you to gather information that you will use when you get to Chapter 8, which shows you how to design your water efficiency program. It includes:

- an outline for you to describe your service area;
- a method to determine your system's current water usage;
- a list of planning issues that you should consider; and
- methods to forecast future water demand.

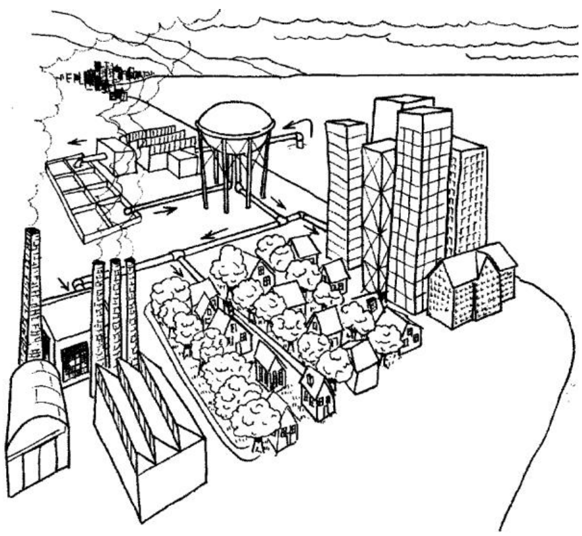
Accurate information is essential for making decisions about your water efficiency program. You must have a good understanding of your municipality's supply and demand characteristics before you can set goals for the program and select the most promising and cost-effective water efficiency measures.

The first part of this chapter provides an outline of key characteristics of your service area that will affect water efficiency planning. The second shows how to determine current water usage, and the third suggests some planning issues that you should consider. The final chapter discusses how to forecast future water demand.

You can then summarize the information that you have developed on the worksheets that are provided. The worksheets provide general guidelines for the information needed to assess water efficiency options. Modify them as needed to fit the format of the data available and the specific purposes of your evaluation.

Level I steps will provide you with basic information about your system. Level II steps are intended for municipalities that want to complete a more detailed analysis of water efficiency options in Chapter 9.

2.1 DESCRIBE YOUR SERVICE AREA (Worksheet #1)



The information in this chapter will provide a "snapshot" showing the characteristics of your community and of its water and wastewater systems. Using the worksheet as a guide, gather as much information about your service areas as possible.

Community Characteristics

The planning department or latest census data can provide population figures and area size. Municipalities usually have the number of service connections broken down by type of account. Note the number and percentage of metered connections for each type of account.

System Characteristics

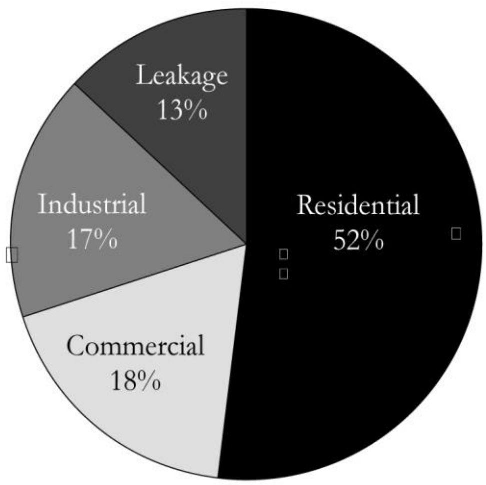
Municipality records can provide information on the amount of water supplied per year from various sources. Use an average figure based on the total water supplied for the past 5 years. Exclude any drought years when unusual water restrictions were in effect or any extremely wet years - water usage may be far from typical under those circumstances. Shorten the averaging period if growth in recent years has been rapid. Also note any significant events or changes in the community that may have influenced demand, e.g., a recession or a new industry.

If the water production system is not metered, use the readings from the electric power supply meter to calculate water production. The formula and detailed instructions are included in the Appendix.

In the description of system capacity, include any other information that may affect system capacity such as reservoir capacity, pumpage capacity, etc.

For the chapter on pricing, note whether the system includes a flat service charge in addition to a volumetric rate. Also note whether wastewater costs are billed as a surcharge on the water bill or on the tax base.

2.2 DESCRIBE WATER DEMAND LEVEL I (Worksheet #2)



Municipal water use by sector, 1994

Figure 2.1[1]

Water Demand

This chapter documents how the water supplied is used in the community. The recorded demand from the residential and Industrial, Commercial, Institutional (IC&I) sectors, plus unaccounted-for-water (UFW) will equal the total amount of water supplied.

Similar to establishing system characteristics, use a 5 year average for the volume supplied to the various sectors. The average UFW in Canadian municipalities exceeds 10-15%.[2] In most municipalities, IC&I use is metered, even where residential use is not. Where the IC&I water use is known, the residential use can be estimated as follows: the total demand, subtract the IC&I demand and an estimate for UFW of 10-15%. The balance will be estimated residential demand.

To calculate the volume per connection, divide the volume supplied by the number of service connections from **Worksheet #1.**

Average Day and Maximum Day Demand

For average day demand, divide the average annual demand by 365. For maximum day demand, identify your peak use day from water production records. The peak day usually occurs in July or August.

Estimated Seasonal Use

"Non-seasonal" uses are assumed to be constant over the year. These uses are typically associated with indoor water usage from appliances, plumbing fixtures, and other items that are not dependent on weather. "Seasonal" uses rise and fall throughout the year in response to weather conditions and are typically associated with outdoor activities such as lawn watering. Seasonal use typically peaks during months with maximum temperature and minimum rainfall.

Seasonal Use, %
= 100-((low month x 12/annual use) x 100)

Use the following steps for determining seasonal use:

1. Identify the month with the lowest water demand. Demand occurring in this month is defined as the non--seasonal use. Seasonal use is defined as zero in this month.
2. Identify the average demand in this month.
3. Multiply the average demand in the lowest month by 12 to get non-seasonal annual water use.
4. Divide the non-seasonal annual water use by average annual water use. Multiply by 100 to get a percentage.

[1] Environment Canada Web Site: www.ec.gc.ca/water/images/manage/effic/a6f2e.htm. May 2006.

5. Subtract the non-seasonal percentage from 100 to determine the seasonal annual use percentage.

Uncertainties in Estimating Usage

A number of uncertainties may exist in the numbers that are generated to describe water usage in your service area.

Municipal water records may shed little light on water use characteristics. In the residential use category, housing characteristics are difficult to determine from municipality records alone. While single-family accounts are a good indication of the number of these homes, it is difficult to estimate the number of multi-family units served by 1 multi-family account. Similarly, the number and type of commercial and industrial users may be difficult to determine.

The difficulty of distinguishing user characteristics is compounded for unmetered or partially metered systems.

Finally, it is difficult to estimate accurately the magnitude of seasonal fluctuations in water demand, and to assume that these translate into indoor and outdoor water usage.

These data limitations may make it difficult to obtain an accurate characterization of your system and to develop a well-targeted water efficiency program. It is important to recognize the limitations and accept the fact that some uncertainty will exist. As more data about water uses and customer behaviour is developed, it will become easier to generate more precise information. In the meantime, the steps described above can provide you with a better knowledge of your system and help you design your efficiency program for maximum impact.

If you cannot obtain some of the data you need, or wish to check the data you have, Figure 2.1 and Figure 2.2 may be useful for checking or estimating some of the information categories.

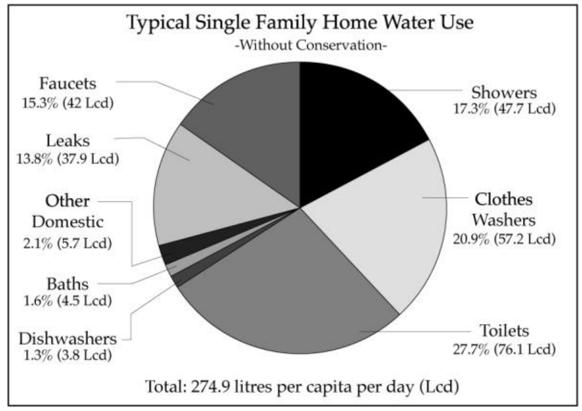


Figure 2.2[2]

[2] AWWA Residential Water use Summary, AWWA Web Site: www.awwa.org/Advocacy/pressroom/statswp5.cfm. May 2006.

2.3 DESCRIBE WATER DEMAND LEVEL II (Worksheet #2)

Revenue and Non-Revenue Water

A utility receives its revenue from a combination of billed metered, and billed non-metered customers. These revenues are termed Revenue Water.

Water losses in the past were commonly referred to as "Unaccounted For Water" (UFW). A more updated term is "Non-Revenue Water" (NRW). However, there is a whole range of types of NRW that could be significant for each individual supplier of water. Environment Canada's 2004 Municipal Water Use Report (2001 statistics) found that system water losses averaged 13%, and varied from 6% to 25% across Canada.

Management of this Non-Revenue Water should now be part of every utilities normal method of working. The best approach involves completing a water audit and balance, to identify and quantify all areas of revenue and non-revenue water. This helps to focus on the most cost effective techniques for each individual water system. Section 4.1 provides more detail of this Water Loss Management methodology. The most current water balance technique being used in North America is the AWWA/International Water Association (IWA) Water Loss Control methodology. Software is available on the AWWA web site to complete the AWWA/IWA Water Balance. In addition, the AWWA "Water Audit and Leak Detection Manuel", M36, Is being re-written, to include the AWWA/IWA Water Audit and Balance.

Average Annual Water Use by Customer Category

The average annual water use by customer category may or may not be available from customer billing records. Determine the annual average water use for the categories listed below.

Residential:

- Single-family residential (cubic meters per year, m^3/yr.)
- Multi-family residential (m^3/yr.)

(Combine residential users if it is not possible to distinguish between single-family and multi-family users.)

IC&I:

- Industrial (m3/yr.) users are those industries that require large amounts of water for industrial process.
- Commercial (m3/yr.) facilities include retail businesses, restaurants, hotels, office buildings, and car washes.
- Institutional (m3/yr.) facilities include schools, hospitals, governmental offices, parks, landscaped roads, and cemeteries. (Separate out parks and general municipal use if possible).

Note: Combine all IC&I users together if it is not possible to distinguish between the various sectors.)

If customer category information is not available from your billing records, you can also use meter sizes to distinguish between residential, commercial, and industrial users. Single-family homes and small businesses are typically served by 5/8-inch and 3/4-inch meters. Large businesses and industrial customers are served by larger meters (greater than 1 inch). This type of analysis is fairly inaccurate, however, because meter sizes can overlap between categories.

You may also be able to use estimates from communities similar to yours. If these communities have per-unit usage figures for the various categories, multiply their per-unit number by the number of units in your service area. This is particularly useful if not all types of customers are metered. Use production records to check that assumed water use does not total more water than is produced.

It is important to check the data to make sure it is reasonable. The following guidelines may be useful to check the data or fill in missing data.

- Average municipal use by sector is shown in Figure 2.1.
- The AWWA 1998 Residential End-Use Study in 12 North American cities (including Waterloo Region in Ontario) has characterized residential usage. (See Figure 2.2).
- Single-family per capita use is almost always more than multi-family per capita use.
- Commercial/industrial water use rates vary considerably.

2.4 NOTE PLANNING CONSIDERATIONS

(Worksheet #3)

In this worksheet any other significant factors affecting water efficiency planning should be recorded. If quantitative information is not available, include a qualitative assessment.

System Limitations and Constraints

These include physical limitations on the source of supply, such as the system safe yield, limitations on any purchase agreements or any infrastructure limitations.

System safe yield is defined as the amount of water that can be withdrawn annually without resulting in depletion of the water source. System safe yield is usually determined by hydrologic studies conducted when evaluating the feasibility of a source. Safe yields should be updated after a drought.

Limitations on the wastewater system should also be noted, including any regulatory requirements which are affecting new development in the municipality.

Infrastructure

Note here the age and condition of the infrastructure as well as any planned system improvements and additions.

Demographics

Note here any community characteristics that have a bearing on water planning. For example, is the community predominantly a retirement town, a regional centre or a bedroom community close to a large urban centre? Are there any very large volume users such as bottling or photo processing plants?

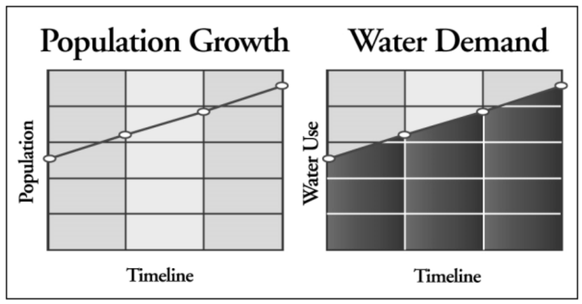
Water Efficiency Programs

Describe any existing water efficiency programs, when implemented, and their impact on water demand.

2.5 FORECAST FUTURE WATER DEMAND LEVEL I

(Worksheet #4)

In addition to understanding current water usage, it is important to plan for future water needs. A Municipality that cannot estimate its future demand risks overly conservative facility construction on the one hand, or the inability to meet demand on the other. By forecasting demand, you can assess the importance of water efficiency as a tool for meeting future water demand, and can design a water efficiency program that best fits your needs.



Future water demand typically depends on a number of factors. These include:[3]

- resident and seasonal population;
- number, value, and type of housing units;
- landscaped area;
- landscaping practices;
- employment;
- water and wastewater pricing;
- agricultural use;
- personal income;
- climate and weather conditions; and
- water efficiency activities.

[3] Planning and Management Consultants Ltd., Brown and Caldwell Consultants; Spectrum Economics; Montgomery Watson Consulting Engineers. Evaluating Urban Water Conservation Programs: A Procedures Manual. California Urban Water Agencies, Sacramento, CA. 1992.

Future water demand can be estimated using a number of methods, which vary in complexity. All forecasting methods rely on the changes in one or more of the variables listed above to predict the corresponding change in water usage. Three forecasting methods are described below. Selection of the best method depends on the intended use of the projections and the type of data available. More detailed methods generally result in better forecasts, but require more data and effort.

Method 1: Per Capita Water Use

The simplest forecasting method assumes that growth in water use will be directly proportional to population growth and that unit demands won't change in the future. It predicts future demand by coupling historical data on water use patterns with population change. Using Worksheet #4, you can calculate this projection as follows:

Future water use (m^3/d) =
current per capita water use × future population.

<u>Where:</u>

Current per capita water use
average annual water use ÷ current population served

<u>And where:</u>

m^3/d = cubic meters per day

While relatively simple, this method is of limited accuracy and may not produce information in sufficient detail for water efficiency planning.

2.6 FORECAST FUTURE WATER DEMAND LEVEL II

(Worksheet #5)

Method 2: Projection by Customer Class

This method allows for different growth rates in different water use categories. For example, if employment is growing faster than population, non-residential water use may grow faster than residential use. This forecasting method is more sensitive than the per capita water use method, but it also assumes that unit water use does not change over time.

Using **Worksheet #5**, you can use the following procedure to develop this type of projection:

Step 1

Develop unit water use factors for each customer class in the water billing system. There are several ways to develop a factor for residential use. For example, divide the total water use in this billing category by population or dwelling units. The result will be "X" litres per person per day, or "Y" litres per dwelling unit per day. Alternatively, divide the water use by corresponding land use in hectares. The result will be in litres per hectare per day.

For non-residential water use, use employment statistics or land use data to develop use factors. For example, use in the commercial sector may be "Z" litres per employee per day; industrial may be "U" litres per hectare per day; and public may be "V" litres per hectare per day.

Step 2

For the planning period in which you are interested (5 years, 10 years, etc.), obtain projections on population, employment, and land use from the local planning agency. Multiply unit water use (Step 1) times projected number of units.

For example:

Projected residential water use =
future number of dwelling units x unit water use.

Step 3

Total all categories to get total water demand, and add an allowance for unaccounted-for-water.

Worksheet #5 may need to be adapted, depending on the type of unit factor that is used (i.e. based on dwelling units, population, or land use), the time used for the future projections, etc.

Method 3: Projections Using Available Computer Models

Various computer forecasting methods have developed over the last 20 years, beginning with the creation of the IWR-MAIN system. This model was originally developed by Hittman Associates, Inc. (1970) for the U.S. Army Corps of Engineers' Institute for Water Resources. It was updated for use on personal computers in 1988, and again in 1993. The IWR-MAIN model is the most widely used forecasting model developed to date. (For more information on this software, and a demo see www.pmcl.com). In general, this model relates several parameters specific to an individual municipality (such as water and sewer pricing, housing values, and number of users) to average daily water use. It produces a demand forecast specific to many subsets of residential and non-residential users in a service area, permitting an estimate of future water demand in all sectors.

Another model, Water Plan, is available to forecast water savings from water conservation measures. It is described in Section 9-6.

WORKSHEET No. 1 ~ DESCRIBE YOUR SERVICE AREA

COMMUNITY CHARACTERISTICS

- Population ______________
- Size of Area (hectares or km^2) ______________
- Service Connections

	#	% metered
Residential	______	______
Single detached	______	______
Multi-Family	______	______
ICI	______	______
Industrial	______	______
Commercial	______	______
Institutional	______	______

SYSTEM CHARACTERISTICS

- Average Annual Water Supply ______________
  - Groundwater ______________
  - Surface Water ______________
  - Purchased ______________
- # km Water Mains ______________
- System Capacity

	#	Capacity
Water Treatment Plants	______	______
Wastewater Treatment Plants	______	______
Other	______	______

- Interconnection with Other Systems ______________
- Pricing

	Rate Structure	Service Charge	Wastewater Charge	Metering Frequency	Billing Frequency
Residential	______	______	______	______	______
Non-residential	______	______	______	______	______

NOTES

WORKSHEET No. 2 ~ DESCRIBE WATER DEMAND

WATER DEMAND

	Annual Volume	% of Total	Per Connection
Residential	________	________	________
Single detached	________	________	________
Multi-Family	________	________	________
ICI	________	________	________
Industrial	________	________	________
Commercial	________	________	________
Institutional	________	________	________
Unaccounted-for-Water	________	________	________
Authorized	________	________	________
Unauthorized	________	________	________

AVERAGE DAY AND MAXIMUM DAY DEMAND

	Volume	Total Supply Capacity	% of Total Capacity
• **Average Day Demand**	________	________	________
• **Average Daily Summer Demand** (over 5 years — June through August)	________	________	________
• **Maximum Day Demand**	________	________	________
• **Peak Day to Average Day Ratio**	________	________	________

ESTIMATED SEASONAL USE

- Month with Lowest Water Demand ________
- Average Demand in this Month ________
- Non-seasonal Annual Water Use ________
- Non-seasonal Use, Percent of Total ________
- Seasonal Annual Use, Percent of Total ________

WORKSHEET No. 3 ~ PLANNING CONSIDERATIONS

SYSTEM LIMITATIONS AND CONSTRAINTS

- Supply

  ____

- Wastewater

  ____

INFRASTRUCTURE

____

DEMOGRAPHICS

- Rate of Population Growth ______________
- Rate of Growth in Demand ______________
- Large Volume Users: Number and Type ______________ ______________

CURRENT WATER EFFICIENCY PROGRAMS

____

PLANNED IMPROVEMENTS

____

WORKSHEET No. 4 ~ FORECAST FUTURE WATER DEMAND LEVEL I

CURRENT DEMAND

- Population ________________
- Average Annual Demand ________________
- Demand/Capita ________________
- Average Day Demand ________________
- Maximum Day Demand ________________
- Average Day/Maximum Day Ratio ________________

PROJECTED DEMAND

	Year 5	Year 10	Year 20
• **Average Annual Demand** (population x demand capita)	____________	____________	____________
• **Average Day Demand** (annual demand/365)	____________	____________	____________
• **Maximum Day Demand** (average day demand x ratio)	____________	____________	____________

CAPACITY

	Year 5	Year 10	Year 20
• **Annual Supply Capacity**	____________	____________	____________
• **Daily Supply Capacity**	____________	____________	____________

WORKSHEET No. 5 ~ FORECAST FUTURE WATER DEMAND LEVEL II

CURRENT DEMAND

- Residential ______
  - Residential Demand ______
  - Population ______
  - Residential Demand/Capita ______
- ICI ______
  - ICI Demand ______
  - # employees ______
  - ICI Demand/Employee ______
- Unaccounted-for-Water ______
- Total Annual Demand ______
- Average Day Demand (annual demand/365) ______
- Maximum Day Demand (average day demand x ratio) ______
- Average Day/Maximum Day Ratio ______

PROJECTED DEMAND

	Year 5	Year 10	Year 20
• **Residential**	______	______	______
Projected Population	______	______	______
Projected Residential Demand	______	______	______
(projected population x residential demand/capita)			
• **ICI**	______	______	______
Projected # Employees	______	______	______
Projected ICI Demand	______	______	______
(projected # employees x ICI demand/employee)			
• **Projected Unaccounted-for-Water**	______	______	______
• **Total Projected Annual Demand**	______	______	______
• **Projected Average Day Demand**	______	______	______
• **Projected Maximum Day Demand**	______	______	______
• **Average Day/Maximum Day Ratio**	______	______	______

CAPACITY

- Annual Supply Capacity ______
- Daily Supply Capacity ______

CHAPTER 3

3.0 SET GOALS AND TARGETS

Summary

This chapter assists you in establishing your water efficiency goals through a series of questions that help determine the measures that will meet your municipal needs. In addition this section:

- sets out the criteria for developing effective goals and targets; and
- identifies the means to provide for public involvement.

3.1 MATCH WATER EFFICIENCY GOALS TO YOUR NEEDS

In Chapter 2, you collected data to help define your municipality's supply and demand characteristics. You can now use that information to answer the following questions, which will enable you to establish water efficiency goals for your program and select measures that best fulfill these goals.[1]

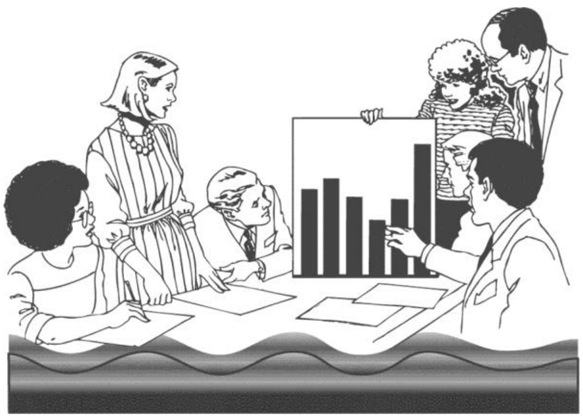
Do you face a long-term water supply shortfall due to increasing population?
Is the long-term shortfall expected as a shortage in the source of supply or a shortfall in capacity of the system to treat and distribute water?
Is your goal to secure a sustainable source of water supply or to defer capital costs for system expansion?

If you have a long-term water supply shortfall.

- Is it limited to 1 portion of the service area, or is it a region-wide shortfall?
- Is the shortfall here now or is it
- Is it projected to occur in the future?
- Does the supply shortfall occur during peak demand periods each day, during high water use seasons of the year, or is it spread throughout the year?
- Is there an expected shortfall of capacity in your treatment system? Is it your goal to defer capital costs for wastewater system expansion?

[1] Maddaus, William O. *Water Conservation*. American Water Works Association, Denver CO, 1987.

- Do you need to reduce water use in order to meet provincial or federal regulatory or funding requirements?
- Do you need to reduce water use in response to public or environmental concerns? If so, what sectors should be targeted?
- In your plans, do you need to achieve a small, medium, or large use reduction? Typically, a 1-10% reduction is considered small, 10-20% is medium, and more than 20 % is large.
- When do you need to achieve these savings?



In defining your program's goals, consider the answers to these questions, the information you gain from public discussion of water efficiency, and your initial evaluation of potential efficiency measures (as discussed in Sections 4, 5 and 6).

Some sample statements of goals are noted below.

- Increase public awareness of conservation methods, and encourage municipality customers to undertake these measures voluntarily. Contact "X" % of all customers by the year _____.
- Decrease water use of existing customers by:
    1) reducing landscape water use; and
    2) retrofitting existing dwellings and commercial facilities with water-saving fixtures. Reduce existing customer residential water use by "Z" % by the year _____ .
- Reduce the water use of new customers by encouraging efficient indoor and outdoor water use. Reduce new customer residential water use by "Y" % by the year _____.
- Reduce peak-day water use by "Q" % by the year _____ by focusing on landscape water use reduction.
- Defer the need for expansion of water supply system. Reduce maximum day demand by "X" percentage from base line year or __ML/d.
- Defer the need for wastewater capital works. Reduce average day demand by "X" percentage from base line year or __ML/d.
- Maintain aquifer withdrawals at sustainable levels while allowing for new development. Reduce average day demand by "X" percentage from base line year or __ML/d and maximum day demand by "X" percentage from base line year.

3.2 SET EFFECTIVE GOALS AND TARGETS

Water efficiency goals and targets will help to mobilize community action. They will also be used to evaluate progress. To be effective goals and targets must meet the following criteria:

- **Measurable**: The goal must be expressed in sufficient detail that it is possible to measure progress over time.
- **Achievable**: Unrealistic goals foster discouragement and apathy. Set realistic targets that will effectively motivate people.
- **Reflect community values**: For effective community participation, goals must address community concerns as well as the concerns of the municipality.
- **Address the key issues**: Goals and targets must address the core problem or issue, not just peripheral issues.
- **Communicable**: Goals must be stated in a manner that is understandable and that can capture the imagination of the community.

3.3 PROVIDE FOR CITIZEN INVOLVEMENT

Water efficiency can save municipalities money by delaying the construction of capital facilities, reducing energy consumption, and reducing wastewater flows. Water efficiency can also help extend inadequate water supplies and can alleviate future water demand caused by population growth. Consumers can benefit by saving money on water and energy bills. Although you know all these things about water efficiency, the public does not. The first important step in designing your water efficiency program is to enlist the involvement and support of your community. Water efficiency is a participatory endeavour that must have widespread support to be fully effective.

Public involvement is most effective when it is enlisted early in the planning stage. Citizens and stakeholders groups will have valuable insights to offer regarding water efficiency goals and they will be more committed to realise goals that they have helped to identify.

There are many techniques for involving individuals, groups, and agencies in your program. In small communities where communication is relatively easy, you may not need formal mechanisms of public involvement. For example, close communication between the municipality and elected officials, plus the formation of an informal advisory panel, may be sufficient. In larger urban areas where close informal contact is more difficult to maintain, you may need to form an official committee to advise your municipality on the water efficiency program and to provide feedback. Whichever method you choose, some important members should be included in your conservation network.

These include:[2]

- elected officials from jurisdictions affected by water efficiency programs;
- staff from private water companies, (where they exist);
- staff from local governmental agencies;
- staff from provincial agencies;
- representatives from major interest groups likely to be affected by water efficiency: industry, the Chamber of Commerce, builders' associations, farm organizations, fisheries, cooperatives, tourism boards, Realtor boards, and landscape contractors;
- community representatives: civic associations, neighbourhood associations, local press, and media owners;
- local environmental interest groups;
- local professionals with some technical credibility: economists, engineers, and planners; and
- representatives of major water users, such as food processing plants and homeowners associations.

For larger municipalities, it is wise to develop a public consultation plan. This will ensure that public meetings and publicity are scheduled at key points in the planning process to permit discussion and input on the decisions being made.

In particular, the public discussion of possible conservation program alternatives is important, because the chosen program will have a much smaller chance of succeeding if it is not supported by major sectors of the community. Communities have different histories, political climates and municipal ways of doing things. Measures that are acceptable in one community may be rejected outright in another. Public consultation is the key to assessing the acceptability of different water efficiency measures before they are implemented.

Remember to allow for staff time to set up and conduct public meetings and to prepare publicity information about the program. A public survey may also be a productive way to solicit input from the public on water efficiency goals and to measure attitudes toward various measures.

In your efforts to have the public listen to you, don't forget to listen to them. A program that doesn't satisfy their needs will be difficult to maintain.

[2] ibid

CHAPTER 4

4.0 OPERATING AND MAINTENANCE MEASURES

Summary

This section describes potential water efficiency measures that can be carried out in the operation and maintenance of the municipality's water system. These include:

- water loss management
- universal metering

The information in this section on water loss management and universal metering is condensed from the publication entitled "Water Efficiency Best Management Practices". This document was developed in 2005 by the Ontario Water Works Association (OWWA), Water Efficiency Committee and is available from the OWWA website (owwa.ca).

With the exception of universal metering, these measures do not necessarily involve direct contact with water customers or customer participation, in order to gain savings.

4.1 WATER LOSS MANAGEMENT

A utility receives its revenue from a combination of billed metered, and billed non-metered customers. These revenues are termed Revenue Water.

Water losses in the past were commonly referred to as "Unaccounted For Water" (UFW). A more updated term is "Non-Revenue Water" (NRW). However, there is a whole range of types of NRW that could be significant for each individual supplier of water. Environment Canada's 2004 Municipal Water Use Report (2001 statistics) found that system water losses averaged 13%, and varied from 6% to 25% across Canada.

The Non-Revenue Water can be divided into:

Unbilled Authorized Consumption

- Fire fighting
- Flushing of mains and sewers
- Cleaning storage tanks
- Filling water tankers
- Water taken from hydrants
- Street cleaning
- Parks irrigation
- Public fountains
- Frost protection
- Building water

Apparent Losses

- Unauthorized consumption
  - Theft from hydrants
  - Illegal connections
- Metering inaccuracies
  - System input meters
  - Under/over registration of customer meters
  - Accounting procedure errors

Real Losses

- Leakage on distribution and transmission mains
- Leakage and overflows at storage tanks
- Leakage on service connections up to the point of customer metering

As water utilities become larger, and more complex with amalgamations, there is added potential for increases in Unbilled Authorized Consumption and Apparent Losses. Furthermore, as water systems become older there is normally an increase in Real Losses of water from main breaks and service leaks.

Management of this water loss should now be part of every utilities normal method of working. The best approach involves completing a water audit and balance, to identify and quantify all areas of revenue and non-revenue water. This helps to focus on the most cost effective techniques for each individual water system. The most current water balance technique being used in North America is the AWWA/International Water Association (IWA) Water Loss Control methodology.

Non-Revenue Water can have a significant impact on the budgets of utilities. Operating budgets can directly be reduced, as Apparent Losses are accounted for. Capital budgets can be affected, in the medium to longer term, as Real Losses of water are found and eliminated. Capital improvements can either be deferred for a period, or kept on program for increased water supply capacity, and future growth.

Reducing infiltration into the sewer system from Real Losses of water can also have a positive effect on wastewater treatment quality and capacity

The traditional approach of giving percentages of "Unaccounted For Water" is being moved away from. A number of performance indicators are now recommended to establish the relative levels of NRW, and hence potential savings. However, it is reasonable to assume that most utilities will have NRW that is economical to find and eliminate. Furthermore, reducing NRW is normally extremely cost effective, when compared with other water efficiency measures.

Normally, Real Losses form a key part of water loss management. Real Losses reduction programs can include the following 4 areas:

- Active leak detection
- Speed and quality of repairs
- Pressure management
- Pipeline and asset management

Photo courtesy of York Region

Active Leak Detection

Leaks occur because pipes corrode with age; the extent of corrosion depends on the age of the pipes, water chemistry and surrounding soil chemistry. Leaks are also caused by soil settlement, and freeze thaw cycles that can cause pipes to crack or joints to separate.

By quantifying the authorized uses of unaccounted-for-water, the amount of leakage can be estimated.

If the AWWA/IWA water audit indicates significant real losses of water, you may decide to conduct a leak detection and repair program. Underground leaks do not always surface and may be found by means of sonic leak detection or district meter area (DMA) methodology.

Sonic leak detection involves 'listening' for leak noises throughout the entire system. Operators use sensitive microphones to pick up sounds from leaking pipes, valves etc. It is easiest to pick up sounds from metallic piping.

The district meter area method uses system operation and engineering analysis combined with sonic detection to identify areas of suspected leakage. The method involves dividing the water distribution system into large meter areas. The flow into an area is monitored and compared with a calculated value based on the number of households and businesses in the area. If the monitored flow is considerably larger than expected, the meter area is subdivided and the exercise repeated. When the location of the leak has been narrowed down in this way to a small area, sonic equipment is brought in to pinpoint its exact location.

The American Water Works Association has published the following books on leak detection:

- Water Audit and Leak Detection Manual 36 - describes how to do a water audit and leak detection procedures - to be updated in 2007 to include the IWA methodology
- Economics of Leak Detection: A Case Study Approach - describes several success stories of municipalities that have reduced unaccounted-for water.

See Appendix for AWWA address.

Speed and Quality of Repairs

Once leaks have been identified it is key to complete the repairs as soon as possible, to reduce the time the leak is running. This applies to both watermain leaks, and service pipe leaks, which can amount to significant volumes of water lost if left un-repaired.

Pressure Management

In addition to large breaks, small pinhole leaks in the system can account for a significant portion of unaccounted-for-water. Since they are usually distributed throughout the system, these small leaks are difficult to find and repair.

Pressure management is widely used in Europe but is relatively new to North America. The method involves mitigating losses from background leakage, until such time as the piping is replaced through a routine replacement program. Pressure control is based on the principle that decreasing the water pressure will decrease the leakage through an opening.

In practice, pressure control involves reducing excess system pressures to reduce leakage flow rates. Excess pressures may exist at specific points in the distribution system or during periods of low demand, e.g., overnight.

Designing and implementing a pressure management program requires detailed knowledge of the system operation.

The York Region water efficiency plan included the implementation of pressure management, once the leak detection and repair program was completed.

Other O&M procedures such as meter calibration, valve maintenance, and corrosion control can result in additional water savings. These actions may also result in secondary benefits such as reducing wastewater flows due to infiltration, reducing the municipality's liability for property damage in the event of a major distribution system leak, and correcting under-registration of meters for large customers.

Pipeline and Asset Management

Replacement of the old watermains will lead to a reduction in real losses of water, in addition to an increase in hydraulic capacity. Watermain replacement is an expensive option, so great care must be taken to identify the most cost effective sections of watermain to replace. In addition, cathodic protection of metallic pipelines can help slow the rate of corrosion, and hence reduce that component of leakage related to pipeline corrosion.

York Region has reduced leakage by approximately 9.0 MLd, over the 6 years of their program. They have 55 Temporary District Meter Areas (operated for short periods), and 10 Permanent District Meter Areas (which have pressure management). They are currently in the second year of maintenance of those savings. It is an 8 year program from 1998 to 2006.

4.2 UNIVERSAL METERING

Metering is tied to water efficiency in several ways. They include:

- immediate savings realized through metering as customers became more aware of the water used;
- the possibility to charge for water on a volumetric basis; and
- the municipality can monitor water use by sector and even by neighbourhood – thereby allowing the municipality to target water efficiency programs more effectively.

Initially, many municipalities only metered IC&I accounts because the larger volumes involved justified the cost of the meter. In 2001 61% of Canada's urban population was on metered service up from 56% in 1999 and 1996.[1] Increasingly, municipalities are moving to meter residential accounts for the reasons cited above. Often, universal metering is the first major water efficiency initiative undertaken.

Municipalities may implement metering on an incremental or full program basis. Incremental programs result in only a fraction of the accounts receiving meters in any given year. An incremental meter program may be voluntary or it may only require meters in new homes or on resale of existing homes. Full metering programs involve mandatory metering over a very short time period with the goal of metering 100% of the accounts.

Generally, implementing full metering programs result in a sharp decrease in water use. A State of the Environment Bulletin, based on a national survey covering 26.6 million residents, reported that, "In 2001 Canadian residential water users

[1] Environment Canada Web Site: www.ec.gc.ca/water/en/info/pubs/sss/e_mun2001.htm. May 2006

paying for water by volume (metered) used 272 litres per person per day - 43% less water than residential users paying a flat rate (largely unmetered), which used 474 litres per person, per day."[2]

Photo courtesy of Neptune Technology Group Ltd.

Public education accompanying the metering program and continuing after meter installation is required in order to maintain lasting savings.

It is less expensive to install water service meters at the time of construction than to retrofit a home with a meter later. Most municipalities require meters for new services even if billing is not yet based on volume usage. Meter installation cost for a new service is approximately $175.00, while retrofitting can cost from $200-$225 per meter. Labour costs are the biggest factor in meter retrofit programs, and account for the cost variation. Other factors include manual versus machine excavation and the cost of landscape and driveway replacement.

[2] Environment Canada, Urban Water: Municipal Water Use and Wastewater Treatment, Environment Canada Web Site: www.ec.gc.ca/water/en/info/pubs/sss/e_ mun2001.htm. May 2006

CHAPTER 5

5.0 RESIDENTIAL EFFICIENCY MEASURES

Summary

This chapter describes potential water efficiency measures for reducing residential water usage both indoors and outdoors.

Indoor measures include:

- water efficient toilets;
- toilet retrofit devices;
- low flow showerheads;
- tap aerators, and
- water efficient washing machines.

Outdoor measures include:

- landscape audits;
- community gardens; and
- education.

Notes on program delivery methods are provided for both indoor and outdoor measures.

Because residential water use usually accounts for a high percentage of total municipal water sales through most of the year, the water efficiency potential from the residential sector can be significant. The AWWA Residential End-Use Study of 14 North American cities showed that indoor water use averaged 280 Lcd in homes without efficiency measures. The same study showed that efficiency measures could reduce indoor water use by about 30% to 196 Lcd. (See Table 5.1)

Residential outdoor water use is unpredictable depending on climate, weather, soil, landscape type, watering practices, as well as the billing and regulatory practices of the municipality. However, it is very significant during summer months when outdoor use may even equal or exceed indoor use . Outdoor water use is a major contributing factor to peak day demand that can double average day demand in many medium and smaller sized municipalities leading to the need for costly infrastructure expansions just to meet this short term demand. Reducing peak day demand has major benefits to a municipality by postponing costly capital expansions or by allowing new expansions to be downsized.

Many utilities target indoor water use first because indoor measures focus largely on fixture upgrades rather than solely on behavioural change, making savings easier to achieve.

The results of the system evaluation that you completed in Chapter 2 should give you an idea of the relative importance of outdoor *vs.* indoor residential use for your municipality and will help focus your efforts.

Table 5.1: Household End Use of Water (Lcd*)[1] Without and With Water Conservation, Potential Savings

	Without Conservation**		**With Conservation**		**Savings**	
End Use	Share	Lcd*	Share	Lcd*	%	Lcd*
Toilets	27.7%	76.1	19.3%	36.3	52%	39.74
Clothes Washers	20.9%	57.2	21.4%	40.1	30%	17
Showers	17.3%	47.7	20.1%	37.9	21%	9.8
Faucets	15.3%	42	21.9%	40.9	2%	1.14
Leaks***	13.8%	37.9	10.1%	19	50%	19
Other Domestic	2.1%	5.7	3.1%	5.7	0%	0
Baths	1.6%	4.5	2.4%	4.5	0%	0
Dish Washers	1.3%	3.8	2.0%	3.8	0%	0
Inside Total	100%	274.9	100%	188.2	32%	86.68

* Lcd= litres per capita per average day of the year.

** Based on the average inside uses measured in 1,188 in 14 North American cities including an additional 5% to account for estimated "in place" savings due to existing conservation. The latter is based on analysis of data obtained in the Residential End Use Study that reveals that there is a high probability that penetration of existing water conservation measures is 35 % for 9.45 Lpm showerheads, 14.8% for 6 Lpf toilets, and 2.3% for high efficiency (mostly horizontal axis type) clothes washers and judgment by the author that penetration of 8.3 Lpm faucet aerators is 50%, and that leak repairs are running 10% higher than historic averages due to conservation efforts.

*** The leakage rate shown is an average for the large population of homes monitored in the Residential End Use Study. Nearly 60% of leakage volume was found to be explained by less than 10% of the homes.

[1] AWWA Residential Water Use Summary, AWWA Web Site: www.awwa.org/Advocacy/pressroom/statswp5.cfm May 2006.

5.1 INDOOR RESIDENTIAL MEASURES

Photo Courtesy of York Region

As shown in Table 5.1, homes with water efficient fixtures can reduce indoor water by about 30%. The reduction in indoor water use will also save the customer energy costs, since water heating constitutes about 20% of an average home's total energy requirements. Current water saving plumbing fixtures and retrofit devices are described below.

Water Efficient Toilets

Toilets in homes built before 1980 use 20 litres or more per flush, while 13 litre toilets are more commonly found in homes built between 1980 and 1995.

On January 1, 1996, the Ontario Plumbing Code mandated the installation of 6 litre toilets and water efficient fixtures in new construction. Other provinces are considering similar regulations. In addition to the water efficient 6 litre toilets (previously referred to as Ultra Low Flow or ULF toilets), the Ontario market has seen an increase in the availability of high efficiency toilets (HET). HET include 3 litre /6 litre dual flush toilets, and other units that flush at volumes significantly lower than 6 litres per use. Water savings from 6 litre toilets are estimated at 39.7 Lcd (see Table 5.2).

Unfortunately, 13 litre toilets are still available for purchase in the province of Ontario.

Experience has shown that not all 6 litre water efficient toilets perform equally when flushing. In recognition of this problem, the Maximum Performance (MaP) toilet testing protocol was developed that considered toilet flushing performance and water use. Many makes and models were tested using this protocol. The performance ranking can be found on the California Urban Water Conservation Council website: www.cuwcc.org

One of the hindering factors for the widespread installation of water efficient toilets is the current patchwork of toilet specifications, requirements and "approved toilet lists". To reduce this confusion in the marketplace, a diverse North American committee formed in January 2004 to develop a uniform set of minimum requirements for toilets that are subsidized through water conservation programs. The result of their work is called the Uniform North American Requirements (UNAR) for toilet fixtures.[2]

UNAR is a voluntary qualification system that has the following goals:

Assist and work with the plumbing industry in the development of superior products that:

[2] California Urban Water Conservation Council www.cuwcc.org/Uploads/product/UNAR_05-10-18.pdf July 2006

meet customer expectations for flushing performances, and sustain water savings over the life of the fixtures by restricting maximum flush volumes and requiring chemical-resistant trim components.
Measure performance and water savings against a scientifically based set of criteria.
Serve as a possible pre-cursor to a water-efficient product labelling system for toilet fixtures.

UNAR incorporates elements of the Maximum Performance (MaP) toilet testing protocol that considers flush performance, water exchange and flapper setting to ensure significant water savings for water utilities and satisfied customers.

Water efficient toilet installation can be promoted through:

- regulations requiring efficient toilets in new construction or on resale;
- financial incentives (usually in the form of rebates); and
- public education.

Water efficient toilets have become more accepted in Ontario as consumers have gained confidence in the technology, and municipalities have raised performance standards for the toilets they will rebate. Municipalities now offering rebates suggest that if the provincial and/or federal governments prohibit the sale of 13 litre toilets, as is the case in the United States, there may be a reduced need to continue with rebates. By providing rebates, municipalities also hope to encourage quicker updating of high volume toilets that are otherwise functioning properly. Generally, programs requiring a high participation rate use extensive public education, combined with a rebate incentive. Rebates range from $40 per unit to the municipality paying the full cost of the toilet and installation. Door-to-door canvassing is sometimes used to recruit participants. In some municipalities, performance contractors act as the delivery agent for rebate programs in the multi-residential sector.

In addition to water savings, conversion to HET toilets can have significant impact on wastewater flows. Some municipalities undertake HET replacement programs for this reason.

Some regional municipalities have ongoing toilet replacement programs. For example, from 1994 to 2005, Waterloo Region installed over 40,000 toilets at a reported savings of over 5,000 m^3 per day of water. Their program began with a rebate of $75.00 then reduced to $40.00 per 6 litre toilet and $60 per HET. Waterloo's current plan is to continue the program until the year 2015.

The Region of Peel introduced a Residential Toilet Replacement Program in November 2005 aimed at encouraging residents to replace their inefficient toilets with a Peel-approved water efficient model. There is a rebate of $60 for 6 litre models and $100 for HET toilets. Since the program's implementation, the Region has issued over 4,200 rebates to residents and property owners of single and multi-family dwellings. This translates to approximately 460,000 litres (460 m^3) of water saved per day.

The City of Toronto has replaced over 160,000 toilets since 1999 through its Residential Toilet Replacement Program and the Multi Unit/Industrial, Commercial and Institutional Program. The program offers rebates of $60 for 6L toilets and $75 for HET and Dual Flush toilets for both residents and businesses. To date the City has saved approximately 33,000 m^3 per day.

New Glasgow, Nova Scotia (population 9,812) undertook a water efficient toilet replacement program as part of their plan to defer capital costs of water treatment. In 1996, toilets were replaced in 300 households with support from the Clean Nova Scotia Foundation. The program provided installation of the replacement toilet, a low flow showerhead and faucet aerator for a total cost to the homeowner of $75.00 plus taxes.

Toilet Retrofit Devices

Cheaper and easier to install than toilets, some municipalities promote toilet retrofit devices for water savings, for example:

- tank displacement devices;
- dual flush devices; and
- early closing flappers;

Although the industry trend is more in favour of toilet replacements, there is continued potential to achieve water savings at moderate costs with retrofits.

Tank Displacement Devices

Tank displacement devices consist of toilet dams or tank bags. Once installed in the toilet tank, dams reduce the water used per flush by up to 5 litres per flush in high volume toilets. Displacement bags reduce the flush by about 1 litre per flush. These devices are relatively inexpensive and easy to install by the householder - making them ideal components of a retrofit kit program. Because tank displacement devices can be easily removed by the resident, however, their long-term effectiveness is questionable. They also have a limited life, estimated at 3 to 5 years, so the water savings will not be permanent unless the devices are periodically redistributed.

Dual Flush Devices

This type of device provides for 2 flushing modes. The first is a full-volume flush for solid waste, while the second provides a smaller volume for clear liquids. They are somewhat complicated to install and require a behaviour change by the user to be effective. Projected savings are expected to average 3-4 litres per flush in high volume toilets.

The City of Toronto currently includes dual flush toilets as part of its Residential Toilet Replacement Program. Over 480 dual flush toilets have been installed in residential homes since 2003. In the Multi Unit Sector, 381 dual flush toilets have been installed.

Early-Closing Flappers

Early-closing flappers operate by altering the force acting on the toilet tank flapper valve. This shortens the bowl wash time, and reduces the flush volume. Also called variable flush time devices, they commonly use a float attached to the flapper valve. Many 6 litre toilet models use an early-closing flapper with a 13.5 litre tank to provide a 6 litre flush. An average savings of 4 litres per flush is typical for retrofit applications.

Toilet flappers are subject to deterioration and over time, this causes the flapper to leak around the valve seat. Whether in a new water efficient toilet or installed as a retrofit, toilet flappers need to be replaced every 3-5 years for optimum performance.

Early-closing flappers are relatively easy to install but do require field adjustment by the installer to maximize water savings while providing a satisfactory flush. As well, the type of early closure device needs to be matched to the toilet model for satisfactory performance.

The Region of York recently completed one of the largest toilet retrofit programs in Canada as part of the Region's long-term water efficiency program. The Region's overall water efficiency program has saved 22.7 million litres of water per day, enough water to service a town of 84,000

Table 5.2: Use Rate and Per Capita Savings of Fixture Measures (Lcd*)[3]

Fixture Measure	Use Rate	Savings in lcd*
Low flush toilets	6 Lpf**	39.74
Horizontal axis (tumble type) clothes washers	(varies)	17
Low flow showerheads	9.5 Lpm***	9.8
Faucet aerators (installed on kitchen sink and bathroom faucets)	8.3 Lpm***	1.14
Leak repair	(varies)	19
Total (if all measures installed)		88.68

* Lcd = litres per capita per average day of the year ** Lpf = litres per flush *** Lpm = litres per minute

people. The objective of the residential program was to retrofit 50% of the Region's 160,000 households with early-closing flappers and low flow showerheads.

The 6 year program resulted in 245,000 early-closing toilet flappers and 105,000 low flow showerheads being installed. To achieve these high penetration rates, the Region promoted the program extensively and offered free professional installation of the devices on a door-to-door basis.

The town of Montrose, B.C., also provided free installation of early-closing flappers and low flow showerheads. In this town of 1,137 population, a partnership was established with the Fire Department to install the retrofit devices, while at the same time completing a fire prevention check.

Low Flow Showerheads

Low flow showerheads reduce the amount of water used during showering by restricting the flow through the showerhead. (In Ontario, regulations were established effective January 1, 1996 that mandate low flow showerheads with a maximum flow rate of 9.5 litres per minute for use in new construction.) Typical non conserving showerheads, installed prior to 1996 in Ontario, have a rated flow of 18 - 30 litres per minute, The North American Residential End-Use Study showed that approximately 9.8 litres per capita per day could be saved by installing low flow showerheads in Ontario premises with showerheads installed prior to 1996. (See Table 5.2)

Low flow showerheads can be promoted by municipal giveaway programs, public education, incentive programs or regulation. Distribution of low flow showerheads is often combined with toilet replacement or retrofit programs. In some municipalities, the gas or electric utilities also promote low flow showerheads because of the consumer energy savings. Low flow showerheads are also readily available to the consumer in hardware and plumbing stores.

3 P.W. Mayer and W.B. DeOreo, Residential End Uses of Water. Denver, CO, American Waterworks Association Research Foundation, 1999.

Faucet Aerators

Non conserving faucets have a rated flow capacity of up to 11.4 litres per minute[4] while water saving kitchen and lavatory faucets, mandated for new construction in Ontario since January 1, 1996, must use no more than 8.3 litres per minute. (See Table 5.2) Faucets can be adapted to low flow with the addition of a faucet aerator.

These small devices are very inexpensive and simple to install, making them an ideal component of a water retrofit kit.

Leak Repair

The North American Residential End Use Study found that, on average, 13.8% of indoor household water (or 38 litres per person per day) is lost to leaks. Even more startling is the finding that nearly 60% of the leakage was found in less than 10% of the homes. Leaking toilets are a major water waster, often consuming more water through leakage than through flushing. Most of these leaks are the toilet flappers.

Toilets can be easily checked for leaks by dropping a dye tablet or a few drops of food colouring into the toilet tank; if the tank leaks, a bright-coloured dye will appear in the toilet bowl. Also, a toilet that continually refills indicates that the float should be adjusted to stop tank refill at an earlier time.

Leak repair can be promoted through retrofit kits, through customer mailings and public education. Regulatory programs can also require leaking toilets to be repaired at the time of home resale.

Water-Efficient Clothes Washers

Clothes washers account for over 20% of indoor water use. Front-loading or horizontal axis clothes washers use 35 to 45% less water than top loading models, resulting in average savings of 17 Lcd.[5] Energy savings of over 50% are also reported since less hot water is used.

Water-efficient clothes washers can be promoted through public education and rebates. Some municipalities offer a rebate to all residential customers while others limit the rebates to locations where machines are used frequently, e.g., laundromats, multi-residential buildings and institutions.

The City of Barrie, Ontario initiated a high efficiency washer program in June of 1998. The City offers a rebate of $140 for qualifying resource efficient top loading machines or high efficiency front loading washers and promotes the program through point-of-purchase advertising at appliance dealers. Approximately 10% of the washing machines in a community are replaced each year. With about 30,000 households in Barrie, the City expected to capture about 2 to 3% of the yearly turnover or about 60 to 90 machines. In the first 4 years the program far exceeded expectations, accounting for over 3,100 rebates.

The City of Toronto launched a Washer Replacement Program for residential properties in 2002 with a rebate amount of $60 per washer installed. In 2004, a Multi Unit Clothes Washer Replacement Program was launched with a rebate of $125. Since 2002, there have been over 14, 900 water efficient washers installed in the City of Toronto, saving approximately 1.06 ML/d.

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[4] Duane D. Baumann, John J. Boland, and W. Michael Hanemann, *Urban Water Demand Management and Planning,* New York, McGraw Hill, 1998, pg. 254.

[5] P.W. Mayer and W.B. DeOreo, Residential End Uses of Water. Denver, CO, American Waterworks Association Research Foundation, 1999.

This type of program may not immediately return an amount of water equivalent to program costs but accelerates the demand for resource-efficient washers, and thus increases the rate at which manufacturers produce and market these appliances. When municipalities collaborate among themselves and with manufacturers in this way they can influence "market transformation" over a period of 5-10 years instead of waiting 20 years or more for passive customer demand to change the type of product produced.

Program Delivery Notes

Water efficiency programs targeting indoor residential use range from modest to aggressive. The simplest programs typically involve distribution of public education materials and the sale of retrofit kits at cost. This type of program is effective in public relations for the municipality and in enlisting the participation of early adopters in the community.

More aggressive programs use intensive public education and promotion, direct customer contact and incentives such as free installation of retrofit devices or low flush toilet rebates to achieve higher participation rates.

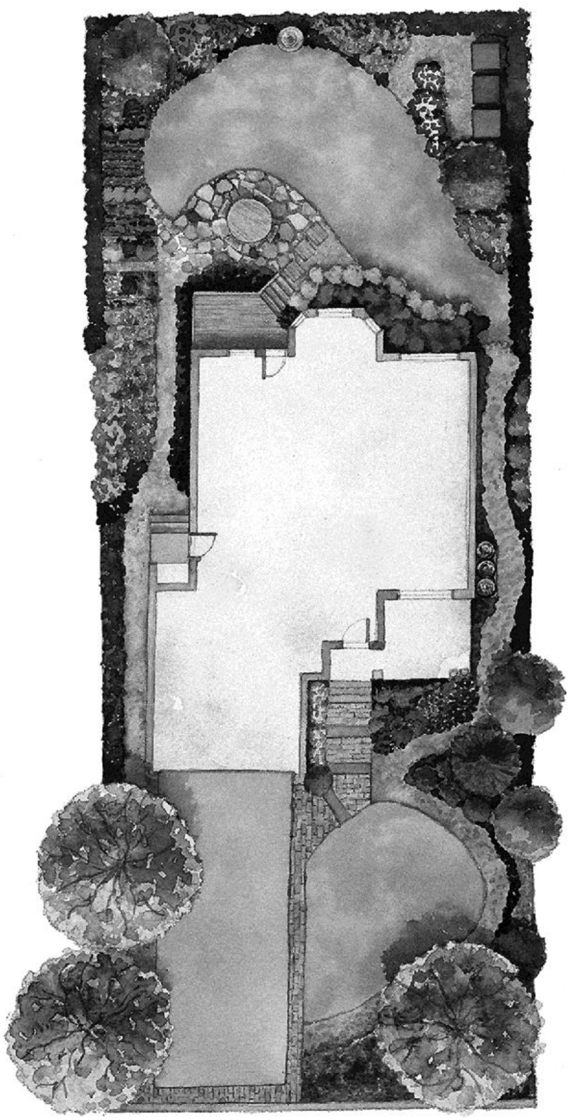
Most toilet retrofit and replacement programs also distribute low flow showerheads and tap aerators. This is especially appropriate where a technician or plumber is in the home to install retrofit devices or a new low flush toilet. Installation of the showerhead by a technician allows for accurate measurement of the flow rate of the old showerhead for monitoring purposes and removal of the old showerhead from the house - ensuring that the customer will not replace it later.

Comprehensive water efficiency programs often combine measures that focus on indoor fixtures with the adoption of new water rates and/or the installation of residential meters.

A sample procedure for conducting a residential retrofit is included in Appendix D.

5.2 OUTDOOR RESIDENTIAL MEASURES

Water use can double in summer in smaller systems due to outdoor water use. The majority of outdoor water use involves landscape irrigation. The major factors that affect the amount of water used for landscape irrigation are soil quality, climate, the landscape design, plant culture techniques, watering equipment and watering practices.



Residential Water Efficient Landscape Visit

A water efficient landscape visit can be as simple as an unsolicited door to door campaign providing literature with the offer to answer homeowner questions. Or, it can be more complex involving setting an appointment to conduct a walk about the yard with the homeowner. The visit can involve: identifying water uses; checking irrigation equipment; and, providing advice to the homeowner on water efficient landscape design and maintenance, plant choice, equipment and techniques that can reduce water use.

In designing a landscape visit program, municipalities may offer full or partial subsidy of the cost of the visit. They may also limit visits to property owners with large lots.

Actual water savings will only result if action is taken by the homeowner to reduce water use. The chances that a resident will institute efficiency measures are much higher if a visit has been conducted.

Residential water efficient landscape visits are typically conducted by municipal staff or contractors and normally take about an hour. Costs of a visit program include the advisor's time and scheduling, information packages, follow-up and monitoring. Landscape visits can be promoted by public information campaigns, web and media coverage.

See Appendix E for procedures for conducting a residential water efficient landscape visit.

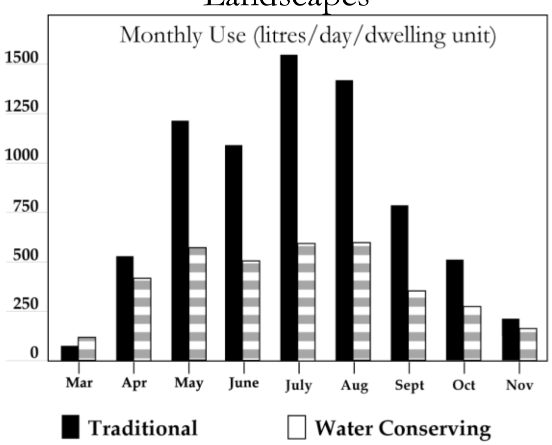
Water-Efficient Landscaping

Water-efficient landscaping combines basic principles of good gardening:

- soil preparation and conditioning;
- planning and design;
- mulching;
- use of native and low water-use plants;
- smaller turf area; and
- proper watering.

Data collected from landscape programs carried out in warm, dry climates indicate that the theoretical potential for water-use savings from applications of these techniques ranges from 40 to 60%.[6]

Figure 5.1: Monthly Water Use of Conserving and Non-Conserving Landscapes[7]



Water-efficient landscaping has been promoted through service connection fee discounts offered by the municipality, cash incentives for conversion of landscapes and public education initiatives such as demonstration gardens and distribution of information.

[6] Maddaus, William O., Water Conservation, American Water Works Association, Denver, CO., 1987.
[7] ibid

Water-efficient demonstration gardens have been developed by the water efficiency staff throughout municipalities across Canada. In Waterloo, the pathways in the demonstration garden are paved with aggregate made from old toilets that were removed from households as part of the Region's toilet replacement program. In York, over 18 demonstration gardens have been constructed as part of its water efficient landscaping campaign. As partners in the program, local garden centres provide discounts on water efficient plants and materials and distribute expert advise on water efficient lawn care landscaping. In Peel the demonstration gardens are used to promote Regionally produced compost and as a site to conduct "lawn and garden workshops" for the Public.

Two references for xeriscaping in Canadian climate zones are:

- Williams, Sara, Creating the Prairie Xeriscape: Water-efficient Gardening, University Extension Press, University of Saskatchewan, Saskatoon, 1997.
- Bennet, Jennifer, Dry-Land Gardening: A Xeriscaping Guide for Dry-Summer, Cold-Winter Climates, Firefly Books, Toronto, 1998.

Irrigation

Today a vast array of irrigation equipment is available to assist homeowners, businesses and even municipalities in their own parklands to water effectively.

It is up to you to educate homeowners and business owners on correct watering methods and equipment. Messages can include:

- "Never in the heat of the day" - as water is lost to evaporation "1 inch per week" - because home lawns need approximately this amount of water to survive through summer heat. Peel has broken the watering down to

½" twice a week to accommodate the predominantly clay soils in the Region.

- "Even Odd Day Watering" -If municipality supports this system
- "Just Add Rain" - let nature do some of the work
- Effective Watering

A sprinkler attached to the garden hose provides adequate coverage for an average size lawn despite the inconvenience in moving it. Generally speaking sprinkler styles that shoot water close to the ground, have less loss due to evaporation. A fan sprinkler can provide the best water coverage to a lawn, but as with all sprinklers a lot of water can be wasted; due to incorrect watering methods, times and application rates.

A soaker hose placed at the base of plants on the ground applies water to the soil where it is needed. Soaker hoses are excellent when used in garden beds as they apply water directly to the roots of plant material, reducing water loss and increasing water absorption by the plant.

Underground Irrigation Systems

An underground irrigation system is the most expensive, but also the most efficient method for watering very large lawns or municipal, commercial, institutional and industrial properties. One of the problems with "automatic" irrigation systems is the tendency of the user to "set it and forget it." This can result in water waste due to the system operating when water is not needed by the turf or plants.

An automatic sprinkler system, should include a controller, timer and moisture sensor and/or rain sensor.

Moisture Sensor

The moisture sensor conserves water by disabling the sprinkler system from operating when the soil moisture content is high. Soil moisture sensors are placed beneath the soil surface at a specified depth around the garden to measure the amount of moisture in the soil. When the moisture level drops below a predetermined level it allows the irrigation controller to operate. By bypassing watering cycles the landscaping is never over-watered by excessive irrigation cycles or during a rain storm.

Studies conducted have shown water savings up to 66% over a conventional timed system. These sensors have been freeze tested in Canada.

Rain Sensors

A rain sensor will turn off the automatic irrigation system during wet weather, preventing over watering and saving money. A rain sensor can be connected to most electronic automatic controllers. These sensors have been freeze tested in Canada.

Weather Based Irrigation Systems

No matter how efficient an irrigation controller is, it does not take into account constantly changing weather conditions; specifically evapotranspiration (ET) and rainfall. ET is the amount of water lost from the soil through evaporation plus the plant's water loss (known as transpiration), both of which are affected by weather conditions. ET is affected by solar radiation, temperature, relative humidity and wind.

Weather based irrigation systems operate in accordance to changing evapotranspiration (ET) rates. The controller works by determining the ET rate and adjusting irrigation system run times to ensure the proper amount of water is being applied to turf and or gardens. Increased watering schedule control means your irrigation system delivers water only when the landscape needs it.

Weather based irrigation is an emerging technology, used mainly in turf management applications. It is excellent for use in parks and where high quality playing fields need to maintained for sporting events.

Drip Irrigation Systems

Not to be confused with underground sprinkler systems, drip irrigation systems are laid under mulch in garden beds. The flexible irrigation tubing is fitted with emitters that release water slowly to the plant root zones. The results are that plants require less water to remain healthy and less water is lost to evaporation or run-off. As well, weed growth and erosion are eliminated.

Drip irrigation systems are commonly used in plant nurseries and for commercial crops but they are also suitable for residential gardens. Drip systems require more maintenance than typical automated irrigation systems because the fine tubing and pores can become clogged.

Drip irrigation systems can be promoted through residential landscape visits and public education. Municipalities may also use rebates and connection fee discounts to promote these systems.

Strathmore, Alberta has a unique non-potable water system for lawn watering. The separate lawn watering system is connected to a nearby agricultural irrigation system and developers are required to provide connections for new building lots. The irrigation water is billed on a flat rate and the system is purged each fall.

Rain Water Re-Use (Rain Barrels)

In urban areas, most rain water flows directly from the house roof to the storm sewer system or to a combined storm/sanitary sewer. Some municipalities promote the use of rain barrels as part of a down spout disconnection program to reduce peak storm flows for areas with combined sanitary and storm sewers or as part of a general outdoor water use campaign.
Modern rain barrels are made of durable plastic and are equipped with a connection to the downspout, a tight fitting lid, a screen to filter out debris and prevent mosquitoes from breeding, a hose bib attachment and an overflow tube to redirect water when the barrel is full.

Calculations have shown that, on a system-wide basis, the potential water savings from a rain barrel program are negligible.[8] However, rain barrels bring other benefits and are often promoted as part of a broad outdoor use campaign:

- rain water is best for watering plants as it is the ideal temperature and is low in minerals;
- use of rain barrels promotes greater awareness of the water cycle and water use in general; and
- the program provides good public relations for the municipality, especially when outdoor water use is restricted through by-laws.

Program Delivery

While significant reductions in indoor water use can be achieved by simply changing fixtures, reductions in outdoor use depend in large part on changing householder attitudes and practices regarding lawn and garden care. For this reason, public education figures prominently in delivery of outdoor residential programs.

Municipalities can use advertisements, the web, printed materials such as lawn care and garden

[8] REIC ltd. and Veritec Consulting, "Profile #19, Rainwater Re-Use," *City of Toronto Water Efficiency Study*, 1999.

guides, public displays, give-aways such as rain gauges, and demonstration gardens to promote water-efficient landscaping and watering techniques. Some municipalities also work in partnership with trade allies such as plant nurseries, garden centres, landscape companies and horticultural societies to promote water efficient landscaping. Collaboration with the area landscape industry will ensure that customers receive a consistent message about landscapes and water use, provide the industry with additional profile and offer many more opportunities for the municipality to present the message about water-efficient landscaping.

Peel Region's outdoor campaign included a series of advertisements, information and the creation of a web site with messaging focused on reduced watering. The campaign included "Water Wise Wednesday", a day for residents to "not water" to allow the reservoirs to recover, and visits by the "Water Efficiency Team" a trained student labour force employed by Peel to spread the message of wise watering and proper lawn and garden care (gardening with the environment in mind).

In 2005 the Team targeted areas of high water use and provided information on proper landscaping techniques and distributed information. In the summer of 2006 the Team provided "Lawn and Garden Consultations Services" with a target of 500 home visits and key focus on proper watering.

An integral part of the outdoor campaign is the partnership with local conservation authorities, local garden centres and water wise lawn and garden workshops for residents.

CHAPTER 6

6.0 IC&I WATER EFFICIENCY MEASURES

Summary

Fully 35% of water supplied by municipalities in Canada is used in the IC&I sector with industry accounting for 17% and commercial and institutional facilities using 18%.[1]

This chapter outlines water efficiency measures for the Industrial, Commercial and Institutional Sector, including measures relating to:

- the facility;
- the landscape; and
- industrial processes.

Photo Courtesy of York Region

6.1 INDUSTRIAL WATER EFFICIENCY

Water is used by industries for domestic uses in the facility (sanitation, showers, cafeteria), for building cooling, and to maintain the building's landscape. However, by far the largest industrial water use is for industrial processes and cooling. For this reason, opportunities for water efficiency in the industrial sector are often site-specific or specific to the type of industry. In general, however, efficiency can be achieved by eliminating water waste, optimizing flow rates and maximizing recycle of process water. For example, water used for cooling that is not significantly degraded in quality may subsequently be used for irrigation, sanitation (toilets), or other processes at the same facility or at nearby industrial facilities.

Industry has significant incentive to conserve water. The economic benefits of water efficiency include reduced water charges, lower costs for pre- treatment and wastewater treatment because of reduced wastewater flows, and reduced energy costs for hot water.

Municipalities can promote water efficiency in industry by:

- developing a relationship with high volume users;
- promoting water audits through incentives and customer education; and
- providing incentives for best management practices.

[1] Environment Canada Web Site: www.ec.gc.ca/water/images/manage/effic/a6f2e.htm May 2006.

Key Accounts

The Key Account concept recognizes that very high volume users (key accounts) have requirements on a different scale than the majority of water subscribers. The role of the municipality with key accounts is to ensure that water is there in the quantity and quality needed and to help the customer use water more efficiently.

Many of the barriers to industrial water efficiency relate to issues such as:

- lack of familiarity with leading edge efficiency equipment and processes;
- concerns over lost production time as new measures are introduced;
- the length of time required to plan and implement changes;
- contracts requiring minimum/maximum water use; and
- rates.

The key account relationship addresses these barriers effectively with a combination of sales and customer education, delivered on a person-to-person basis over an extended period of time. In its role of key account advisor, the municipality can assist the industry with an on-site audit, identify easy-to-implement measures and help the industry to access information on new water-saving equipment and processes. In a small to medium-sized community, the key account relationship may only apply to 1 or 2 very large volume industrial users.

Industrial Water Audits

A complete industrial water audit involves an examination of the industrial processes as well as a study of the usual domestic, cooling and landscape water uses. An initial assessment of water use patterns could be made by municipal staff. Detailed audits are usually carried out by engineering firms.

Municipalities can promote industrial water audits by subsidizing all or part of the audit cost. However, since every industrial process is different and since the industrial process involves proprietary information, audit results for industrial sites cannot be directly shared with other industries or even within the same industry.

Industrial water audits can be promoted through customer education and collaborative advertising programs that recognize participating customers, especially those who achieve significant savings.

6.2 COMMERCIAL AND INSTITUTIONAL MEASURES

Although commercial and institutional facilities do not use the huge volumes of water required for some industrial processes, there are still opportunities for large savings in

- domestic water use;
- cooling systems; and
- landscape maintenance.

A US study[2] that included water audits of commercial and institutional water users in 13 metropolitan areas found that the largest water users also have the largest potential for savings. The largest water users are:

- health care;
- offices;
- hotels and accommodations;
- sales;
- eating and drinking;
- education;
- laundries; and
- landscape irrigation.

While not on the list of largest users, meeting and recreation facilities also showed great potential for water savings.

Facility Audits

Water audits of commercial and institutional facilities are a key to capturing potential savings in this sector. The audit process helps the facility manager to set appropriate water efficiency targets and implement measures that have a positive payback. Depending on the size and complexity of the facility, the audits may be performed by an independent engineering firm, a water efficiency performance contractor or facility staff. Municipalities can promote water audits to the commercial / institutional sector through targeted advertising, an IC&I newsletter, workshops, seminars, and personal contact.

In Ottawa-Carleton, the municipality subsidized the cost of audits for a limited number of facilities. As a condition of funding, the recipient agreed to share the audit results with others. The municipality used the results from typical facility audits to publicize the effectiveness of water efficiency. As a result, many other facilities undertook audits and retrofit programs on their own.

The City of Toronto IC&I WaterSaver program offers rebates to facilities in the industrial, commercial, and institutional (IC&I) sectors that permanently reduce their water use. If a water customer implements water consumption reduction improvements, the City will pay that water customer a one-time (incentive) payment of $0.30 per litre for the reduced water and wastewater usage on an average day.

This 4 phase program is designed to help IC&I facilities/buildings to save water.

Phase 1 – Assessment consists of a high level review that will identify water-saving technologies and estimated savings.

Phase 2 – Data Validation is to confirm/validate the potential water use reductions by installing temporary flow monitoring and/or detailed engineering analysis.

Phase 3 – Implementation consists of installing new water-saving technologies.

[2] Pike, Charles, W., Which Customers Use the Most Water, Conserve 99', AWWA, Denver, CO.

Phase 4 – Savings Verification: after the installation of new technologies and equipment is completed, the actual water savings will be verified in order to calculate the water customer's rebate.

The water customer receives an assessment report that identifies potential measures, potential savings, and estimations of associated costs. The City of Toronto will pay the full cost of the assessment. Depending on the conclusions from the assessment report, the work may proceed into the subsequent Data Validation and Implementation phases. The City will share the costs of the Data Validation (and monitoring) Phase. Implementation costs are the sole responsibility of the water customer. The City also pays for the savings verification report.

Domestic Uses

Domestic uses include toilets, showers, food service operations and laundries. The measures used to reduce domestic use in commercial buildings are the same as for the residential sector, i.e., toilet replacement or retrofit, low flow showerheads and efficient appliances. In some municipalities, residential efficiency programs are extended to cover toilet replacement or retrofit in institutional and commercial settings, particularly high-use toilets.

A water audit may also reveal opportunities for savings through leak repair and through changes to employee practices. Educating employees on water conservation is the easiest measure a commercial facility manager can do, sometimes with the assistance of the municipality.

Cooling Systems

Cooling systems present one of the largest opportunities for water savings in the commercial / institutional sector. In once-through cooling systems, water is used to remove heat from a space or process and is then discharged to the sewer after a single use. Alternatives to once-through cooling include reusing the cooling water in a closed-loop system or converting equipment from water cooling to air cooling.

Landscape Audits

Commercial and public facilities may have large landscaped areas that require irrigation. The same techniques listed above for reducing outdoor residential water use are applicable, only on a larger scale. Water-efficient landscaping and efficient watering techniques can easily be applied to larger facilities.

Large-scale landscape water users may also benefit from centralized control of automatic sprinkler systems, and may be better able than residential users to afford the costs of drip irrigation or underground sprinkler systems. A major issue in both small and large commercial sites is effective use of automatic irrigation systems. An effective automatic irrigation system requires good design and a program that matches watering to monthly changes in weather and evapotranspiration rates.

Large Irrigation Systems

Sites larger than 3 hectares with an existing irrigation system may benefit from an audit that focuses on the performance of the irrigation system. Typically these are performed by municipal staff or qualified irrigation contractors. Auditors examine the current irrigation system for leaks, mismatched sprinkler heads and over spray and prepare a customized irrigation schedule for the site. The objective of the program is to provide landscape managers with the information they need to perform timely equipment maintenance and to apply accurate amounts of water throughout the year.

Irrigation Scheduling and Lawn Watering-Guides

Simple irrigation scheduling for small sites can be accomplished by the use of lawn-watering guides provided by the municipality. The landscape manager or property owner can perform a simple water audit by measuring the precipitation rate of the existing sprinkler system. The lawn-watering guide can then be used to determine the time required for watering.

Program Delivery

Water efficiency and programs in the IC&I sector can be promoted through customer education directed to managers and owners of businesses, industries and institutions. An education program for this sector typically includes:

- a regular newsletter acknowledging water savings made by businesses in the community;
- seminars or workshops for landscape managers;
- an annual award for water efficiency;
- certificates acknowledging water efficiency efforts; and
- public presentations to Chamber of Commerce and Service Clubs in the community.

Two publications available from the OWWA are useful resources for municipalities planning water efficiency programs.

- Water Efficiency Guide for Business Managers and Facility Engineers dated 1994 from the California Department of Water Resources, and
- Helping Business Manage Water Use - A Guide for Water Utilities sold by the AWWA.

As part of the Federal Green Plan, Environment Canada conducted a series of water audits in 1992 and used the results to develop a manual for conducting water audits at commercial facilities.

The Manual for Conducting Water Audits and Developing Water Efficient Programs is available through the Environment Canada Web Site.

CHAPTER 7

7.0 GENERAL WATER EFFICIENCY MEASURES

Summary

General water efficiency measures apply across all customer categories, affecting the community as a whole.

General measures include:

- rates;
- regulations;
- public education; and
- school programs.

These initiatives are used to encourage and support water efficiency by customers. General measures are implemented in an ongoing basis and are often considered as best management practices.

7.1 Full-Cost Pricing

In 2002 the Ontario provincial government drafted new legislation call the "Sustainable Water and Sewage System Act, S.O. 2002, c. 29".[1] In this legislation full-cost pricing is proposed as a sustainable method of water management. Many forward thinking municipalities have already started implementing full-cost pricing.

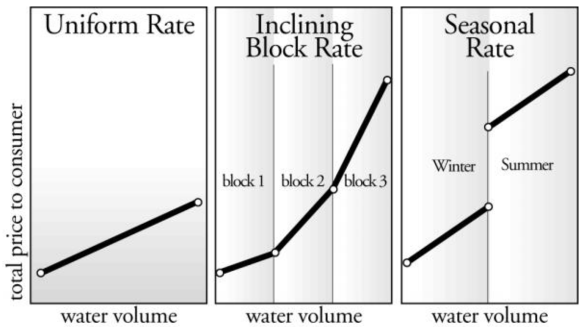
Full-cost pricing has two fundamental components, costs and pricing. Through these two components sufficient revenue should be generated to pay for the full cost of water and sewage systems including operating, maintenance and administration (OM&A) expenditures and capital investment.

As water systems age with time, the cost of infrastructure will grow. Central to the establishment of full costs is the identification and funding of the investment levels needed to meet system standards.[2]

[1] Ontario Provincial Government Web Site: www.e-laws.gov.on.ca:81/ISYSquery/ IRL6739. tmp/3/doc. May 2006

[2] Ontario Water Works Association. *Water Efficiency: Best Management Practices*, OWWA water efficiency committee, 2005

7.2 RATES



In the past, water was commonly priced using a declining block rate, where customers were charged less per unit of water as consumption increased. In some systems, customers were charged a flat monthly rate that was not tied to consumption. These types of rate structures actually discourage water efficiency by rewarding high water users.

Today, the most common pricing mechanism is the uniform commodity or constant unit rate, where customers are charged by volume but the unit price remains the same, regardless of the amount consumed.

Water efficiency can be encouraged by increasing the unit price for water as consumption increases. This type of rate structure is known as an increasing block rate or inverted block rate.

Seasonal changes in water rates further discourage water consumption during peak use months by imposing higher rates during these periods. Winter/summer rates charge all customers more for water used in the summer, even if they use the same quantity per month in summer as in winter. Summer excess rates are designed so that only customers who actually use more in the summer pay a premium.

A 2001 rate study by Environment Canada showed the following distribution of rate types among Canadian municipalities in 1999.[3]

Type of Rate	% of Population Served
Declining block	12%
Flat	43%
Constant Unit	36%
Increasing Block	9%

In 1989 only 55% of Canada's population was on metered service. Increasingly as municipalities move to residential metering they are shifting from a flat or declining rate to a constant unit rate.

The Canadian Water and Wastewater Association's (CWWA) approach to rate setting deals with both water and wastewater rates and recommends a two part rate structure featuring a constant unit charge plus meter charges that vary by size of service.

The CWWA rate approach is presented in two publications:

- Municipal Water and Wastewater Rates Primer; and
- A Municipal Water and Wastewater Rate Manual.

The Manual comes with a fully documented rate setting software model.[4]

The exact amount of water savings resulting from a change in rate structure is difficult to predict and will be affected by climate, population, characteristics (for example, whether the population is willing to pay the higher prices), and the effects of other conservation measures. Often,

[3] Environment Canada Web Site: www.ec.gc.ca/water/en/manage/effic/e_rates.htm. May 2006

[4] CWWA Web Site: www.cwwa.ca/publicationorder_e.asp May 2006

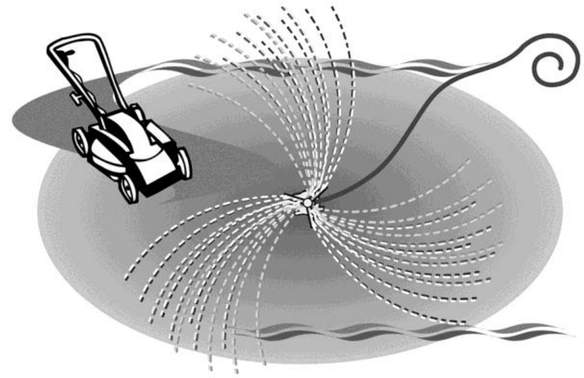
introduction of new rates results in a temporary decrease in water use followed by an increase in usage as the effect of the price increase wears off and consumption returns to previous levels. Programs that combine rate changes with extensive public education, particularly on water efficiency techniques, have the most lasting effect.

In Kelowna, British Columbia, the utility did not enact the new rate for the first year after meters were installed. Instead it sent consumers a quarterly "mock billing" letter. The letter advised customers what their bill would be under the new rate and provided information on water efficiency measures that customers could take to reduce their bill.

Costs involved in implementing a rate change include staff or consultants time to research and develop the new rate and implement billing system updates as well as costs associated with public involvement and public education.

7.3 BY-LAWS

By-Laws affecting water use range from temporary lawn-watering restrictions to landscaping by-laws affecting new development.



Lawn-watering Restrictions

Summer lawn-watering restrictions are designed to ease the summer peak caused by outdoor water use. Restrictions are enacted through a municipal by-law. One typical form is the odd-even system which allows householders to water every other day; which day depends on whether their house is even-numbered or odd-numbered.

In Ottawa-Carleton, watering restrictions implemented during a drought in 1988 reduced maximum demand by up to 30%.[5] The Greater Victoria Water District has also experienced a 20% reduction from watering restrictions.[6]
The Region of Waterloo in Ontario currently has a two tier by-law system for reducing outdoor water use. Normally, Regional cities and townships have "Stage 1" restrictions in effect. The main requirement is that homes are only allowed to water lawns on alternate days. During times of drought, water supply shortage, or when threats to the system are identified, Regional Stage 2 or Stage

[5] Region of Ottawa Carleton, *Water Demand Study*, RMOC, Ottawa, Ontario, 1994.

[6] Hull, J.S., *Special Report on Watering Restrictions By-law*, Greater Vancouver Water District, 1995.

3 restrictions may be announced. During the advanced stages, the Regional by-law supersedes local municipal by-laws. The main rule during Stage 2 restrictions is a limit of once per week for irrigating lawns.

In 2005 the Region of Waterloo successfully implemented Stage 2 Outdoor Water Use Restrictions to keep peak demands within safe levels. In 2001 and 2002, when summer temperature and precipitation levels were similar to 2005, peak demands were approximately 52 million gallons per day (MGD). In 2005, with the Stage 2 Outdoor Water Use Restrictions in effect, the maximum day demand was 47.6 MGD, representing a significant reduction considering population increases. By conserving water during the summer, Region of Waterloo residents ensured there was sufficient water in storage to help fight fires and supply other emergencies. A summary of the Region of Waterloo's outdoor water use by-law is detailed in Appendix H.

The effectiveness of watering restrictions in curbing peak demand depends on the manner of their implementation. Restrictions that are well publicized, that are accompanied by public education explaining the reason for the restriction and describing effective watering practices, and which are enforced, if necessary, have greater chance of success.

Some municipalities in areas with extremely dry summers and potential water shortages, implement a multi-stage water restriction by-law. The first stage is usually odd-even watering restrictions and the degree of restriction may be increased, as needed, to the point where no outside water use is permitted at all.

Case studies of municipalities with various types of outdoor water use restriction may be found on the following web sites listed in Appendix A:

- British Columbia Ministry of the Environment Water Use Catalogue;
- Canadian Water and Wastewater Association;
- The Pembina Institute.

Landscaping By-laws

Some U.S. utilities have developed landscaping by-laws that limit the area of turf grass allowed in new development. Some also require that the landscape design incorporate other water efficient landscape principles.

At the time of writing, no Canadian examples of this type of by-law were found.

Resale and New Construction By-Laws

Some municipalities have used the point of home resale to trigger a requirement for water efficiency upgrades such as meter installation. Others have adopted by-laws requiring the use of water efficient toilets and showerheads in new construction.

For example, the Town of Whitecourt, Alberta (population 8,000), instituted a new construction by-law in 1995. The by-law required builders to install only 6 litre or better toilets and showerheads with a maximum flow rate of 10 litres/minute. About 60 homes a year are built in the town. Over the 5 year period since the by-law was implemented, new subdivisions show a 25% reduction in water consumption compared to older subdivisions.[7]

[7] Canadian Water and Wastewater Association database: www.cwwa.ca. May 2006

7.4 PUBLIC EDUCATION

Photo courtesy of City of St. John's

Public education can be used to motivate voluntary customer water efficiency on an ongoing basis, or it can be used to support and promote specific water efficiency programs such as metering, rate changes, residential retrofit campaigns or temporary watering restrictions. Public education can help to achieve both peak-use and year-round reductions. Even where a municipality does not need to achieve water savings, an ongoing program serves to raise awareness and set the stage for customer acceptance for the time when more aggressive efficiency programs are required.

St. John's, Newfoundland carries out an ambitious public education campaign, advising residents to "Use Water Wisely", even though there is no shortage of supply or capacity for the present. The program includes a major public education initiative during Drinking Water Awareness Week, with poster contests, displays and "Water Witches" who assist with the weather broadcasts on local TV stations.

Public education most often plays a supporting role to other water efficiency measures. It is needed to support behavioural / lifestyle changes such as accepting low water-use landscaping instead of a front lawn. While direct effects of public education usually cannot be measured, it can be invaluable for promoting these other measures, and should be used in combination with them.

What follows is a shorter version of a longer article on public and school education best management practices that appears the publication entitled "Water Efficiency Best Management Practices. This was developed in 2005 by the Ontario Water Works (OWWA) Water Committee and available from the OWWA at owwa.ca.

Ongoing Public Education Programs

An ongoing public information program should raise awareness of water supply resources, including source of supply, availability, protection, treatment requirements, and distribution issues. Most water consumers are not well informed about these issues. They often don't know where their water comes from. A public information effort should also help to educate consumers about wasteful water use practices, such as over-watering lawns, wasting water while washing cars, not running full loads in dishwashers and washing machines, and running indoor water unnecessarily.

Residential, commercial, and industrial customers can be targeted individually to accomplish conservation objectives specific to those sectors.

Components of a successful public education program typically include the following:[8]

- Statements about why water efficiency is important. The municipality's water supply picture should be explained clearly, and the specific objectives for the program should be stated (for example, peak-use reduction during the summer months to avoid having to build a costly storage reservoir).

[8] Maddaus, William O., *Water Conservation*, American Water Works Association, Denver, CO, 1987.

- A slogan or logo that will be used consistently throughout the program and will become readily identifiable by the public.
- Efforts aimed toward specific sectors of the audience.
- Potential target groups include single-family homeowners, apartment dwellers, business and industry (particularly large users), and local governmental agencies.
- Water efficiency committee to help to design and implement the water efficiency program. Typically a water efficiency committee includes elected officials, local business people, interested citizens, agency representatives, and concerned local groups. The function of the committee in the design process is discussed in Chapter 3. During implementation, the committee can provide feedback to the municipality about various aspects of the program, including public education. The committee can help to develop new material and ideas about public education, and to support water efficiency in the community.
- Identification of communication techniques and resources.
- Communication can be accomplished by a variety of methods, such as print media, radio, television, or public speaking forums. Print media can include newspaper articles, newsletters, utility bill stuffers, and paid advertisements. Free public service announcements by the media may be available. The staff person should choose the methods most likely to reach particular target groups. Volunteers and youth organizations may be available to help distribute education materials. The American Water Works Association as well as Environment Canada have various camera-ready public education materials, such as bill inserts, available for purchase or free. Larger municipalities will often share their materials. Regional coalitions can be used to reduce the cost of developing materials.
- A campaign strategy.
- Public education is most effective as an ongoing aspect of the municipality's overall water efficiency program. The public will soon forget messages that are only delivered once. The first year of the public education program should be thought out completely and budgeted adequately. The first year may justify more effort and resources than subsequent years, when a maintenance-level approach can be taken.
- The municipal staff should make an effort to keep timely and up-to-date information by including new materials and ideas every year. Obtaining community feedback about the program's effectiveness may also be helpful.

The municipality must be able to commit a certain amount of staff time and resources to a public education program for it to be effective. The size of the program is limited only by the municipality's budget and imagination. Some larger municipalities with aggressive programs budget $1.00 per person per year. Small municipalities may need to use a higher unit cost to generate a sufficient budget. Cost sharing with the wastewater department or other local water agencies in the same media area (television, newspaper) can reduce costs.

> Environment Canada has various camera-ready public education materials, such as bill inserts, freely available. Larger municipalities will often share their materials. Regional coalitions can be used to reduce the cost of developing materials. Appendix C contains sources and examples of additional public education materials.

Public information, as a water efficiency measure on its own, is likely to save the least amount of water compared to the other measures discussed in this section. When it is the only efficiency measure offered by a municipality, typical estimates of water savings range from 2 to 5% during non-crisis periods.

7.5 IN-SCHOOL EDUCATION

The best way to achieve long-term water efficiency results may be to educate youth about efficient water-use practices.

Photo Courtesy of City of Laval

They are the next generation of water users and, they can carry the water efficiency message to their parents.

Previous programs have shown that in-school education about water efficiency is most effective when targeted at children eager to learn new concepts.

Some municipalities offer water based educational programs for school aged children. For example, Peel Region staff visit grades 2, 7 and 8 classrooms and provide water based educational program that complements the Ontario Curriculum. The visits are solicited in the fall by direct mail to the schools through the school boards. The visits are limited to two days per week to accommodate staffing.

A classroom program should educate the students about:

- the source(s) of their drinking water;
- source protection;
- water treatment processes;
- quality assurance (laboratory testing);

- the safety of the drinking water (public health aspect);
- The link between water quantity and water quality, wastewater treatment, the proper disposal of hazardous waste and storm sewers (all pipes lead to the lakes, rivers etc); and
- water efficiency and conservation.

The program can be complemented with guided visits to a water or wastewater treatment facility or hosting a Children's Water Festival. Water Festivals bring together different parties with a stake in water education (e.g. water service providers, teachers, academics, Conservation Authorities, local environmental groups, private individuals, etc) to plan and deliver an educational event in the outdoors (usually near a watercourse) using fun, hands-on experiential learning. There are currently more than 10 water festivals in the province of Ontario targeting children in grade 2 through 5.. For more information on how to start a Water Festival, visit the Children's Water Education Council web site at: www.cwec.ca/eng/Festivals/HowToStart.asp.

Interactive water festival activities can provide students with the opportunity to learn about:

- the physical properties of water;
- treatment and distribution systems;
- surface water and groundwater as natural resources;
- the interactions between people and water and its effects on the environment;
- source water and environmental protection;
- environmental stewardship; and
- waste disposal alternatives.

A school education program is an excellent means of maintaining contact with users and building support for various future utility initiatives including water efficiency programs. It reaches families through children and fits within the context of science and technology and social studies curricula.

For example, in Laval, Quebec, elementary students take part in "The Water's Journey", an awareness program on drinking water. As part of the program, students take the Blue Thumb pledge, vowing to change personal habits and reduce water use.

Though no measurable water saving can be attributed to educational programs in schools, like general public education, it is a means of reaching users and building support for the programs.

For a typical school program, the municipality's responsibilities include the following tasks:

- obtain permission from school authorities to introduce education program materials;
- provide a teacher guidebook or teacher education materials on the subject and coordinate teacher training;
- provide a student workbook, or other student materials, as needed;
- estimate the number of schools, teachers, and students participating in the program; prepare and distribute the necessary materials; and
- offer tours of water facilities, participate in school information fairs, and do follow-up on teacher response to the materials provided; and make it fun!

See Appendix B for a list of Canadian municipalities and organizations that have developed in-school programs.

The California Department of Water Resources has prepared a useful guidebook for conducting in-school education, called "*How To Do An In-School Education Program"* (Water Conservation Guidebook 2, California Department of Water Resources, Sacramento, Ca., 1984).

CHAPTER 8

8.0 SCREENING WATER EFFICIENCY MEASURES

Summary

Once potential measures have been identified, the next step involves screening the measures to determine which ones will be most suitable for your particular circumstances. In general, you should choose measures that are the easiest to apply, meet your goals at minimum cost, and indicate the greatest potential for savings in your area.

This chapter presents tools and guidelines to assist you in screening measures. It includes:

- an overview of the potential savings available from the measures described in Chapters 4 through 7, guidelines for screening measures for
- applicability, feasibility and social acceptability, and
- Level II guidelines for developing detailed estimates of the savings potential of water efficiency measures as applied to your service area.

8.1 POTENTIAL SAVINGS FROM EFFICIENCY MEASURES

The potential for water use savings through efficiency will vary by geographical region and by demographic characteristics. In Canada as a whole, the average per capita water use for public water supplies is 622 Litres (Lcd) per capita per day of which 335 Lcd are for residential and public uses and 219 Lcd are for commercial and industrial uses. The balance goes to leakage and non-recorded uses. Water use is lower in rural areas with little commercial or industrial activity and without the lush landscaping found in some suburban areas. Per capita water use is higher in areas of the country where landscape irrigation is used extensively.

Residential water use accounts for approximately 52% of total municipal water sales in Canada.[1] This fact illustrates the importance of water efficiency measures that target residential users. Industrial users account for approximately 16% of municipal water demand, while commercial and institutional users account for 19%. The number of non-residential accounts in municipalities is relatively small, so the potential savings per account is relatively high.

Operating and Maintenance Measures and General Measures By Municipalities

Water savings from municipal operating and maintenance initiatives depend on the current

[1] Environment Canada Web Site: www.ec.gc.ca/water/Images/manage/effic/a6f2e.htm, May 2006

system condition. Areas of potential water savings or revenue loss recovery could include:

- Customer meter under registration;
- Real losses of water (leakage) from the water distribution and storage system; and
- Universal metering, along with education and appropriate pricing, to reduce customer use.

Customer meter under registration can vary from a low percentage (1 to 2%) to 10% or more, and it very much depends on the meter age, volume metered and water conditions.

Water Loss Management, which includes real losses of water is covered in Chapter 4, where the focus is on reducing non revenue water down to economic levels. However, real losses of water, or leakage, can vary from 5% to 10%, or more, of the water supplied to a system, and the amount depends on the age, material, ground conditions, and operating pressures of the water distribution system.

If a community is not metered, metering can reduce consumption by up to 30% or more, but appropriate education and pricing must be in place to achieve the savings, and maintain them over time.

The above potential savings are not additive and depend on the specific situation.

> The Ontario Ministry of the Environment has published a "Guide to Resource Conservation to Cost Savings Opportunities in the Municipal Water and Wastewater Sector."

Residential Water Efficiency Measures

In the past, it has been very difficult to estimate the amount of water savings that could be achieved through the use of specific residential efficiency measures. Recent studies have shed light on this topic, however. As shown in Table 5.1, indoor residential water use can theoretically be reduced by approximately 32% (87 l/c/d) through the use of ULF toilets and low-flow showerheads and faucets.

The technical potential for savings from residential efficiency measures will depend in part on the age of the community's housing stock and the number of inefficient fixtures in place in the community. How much of the potential savings are captured depends on program design and implementation and the degree of participation achieved.

Ontario municipalities have reported mean water savings of 15%.[2] This would indicate that a saving of 7% to 10% in the residential sector would be a reasonable goal for a water efficiency program. Higher goals are appropriate for un-metered communities and lower goals for communities where extensive efficiency is already in place.

Industrial, Commercial and Institutional Measures (IC&I)

Commercial and institutional facilities often have the same opportunities to conserve as residential users. Much of commercial and institutional water use is for domestic uses such as toilets, cooling water requirements, and landscaping.

One of the primary motivating factors for business and industry is reducing the cost of producing goods and services. The combined savings potential from water, wastewater and energy costs can be a significant motivating factor for making process changes. For example, reducing water use may involve reducing hot water requirements with associated energy savings.

[2] Krentzwiser, Reid, Rob de Loe, Liana Moraru, "Municipal Water Conservation in Ontario: Report on a Comprehensive Survey", Environment Canada, Ontario Region, August 1998.

Also, efficiency potential is high where the combined water and wastewater costs are high.

Because of the wide variety of activities in the IC&I sector, savings are site specific and difficult to predict. The potential savings from IC&I water efficiency in any given community will depend on the number, type, and size of businesses and institutions located there.

Summary

Table 8-1 provides a summary of potential savings from the measures discussed in Chapters 4 through 7. Note: the savings potential refers to individual measures only. Because some measures overlap, program savings cannot simply be aggregated.

Chapter 9 provides more detailed information on how to assess the efficiency potential of specific measures for your municipality.

Table 8.1 Water Saving Potential of Various Measures

Measure	Lcd	L/Employee/Day	Household/ Facility	System-wide AADD
Utility O&M Measures				
Leak Detection				1% – 3%[3]
Pressure Control				
Universal Metering				13% - 30%[4]
General Measures				
Rates				3%[5]
Regulations				4.5%[6]
Residential Measures				
ULF Toilets	39.7[7]			
Early-Closing Flappers	18.2 L/flush[8]		25% of toilet use	
Low-Flow Showerheads	9.8[8]			
Faucet Aerators	1.1[8]			
Leak Repair	19[8]			
Efficient Clothes Washers	17[8]			
Water Efficient Landscaping			10% - 20%[9]	
ICI Measures				
Domestic Uses: Employees Only		20[10]		
Hotels / Restaurants, etc.			15%[11]	
Landscape				
Industrial Process			10% - 20%[12]	

[3] Leakage in Canadian municipalities is 7-11%. Large breaks account for approximately 50% of leakage (or 5% of total water use) with underground breaks at 75% of that (or 3.75%). From 25% to 75% of leakage from underground breaks (or 1-3%) is recoverable, depending on the extent of the program. Source: City of Toronto Water Efficiency Plan.

[4] Kreutzwiser, Reid, Rob de Loë and Liana Moraru, Municipal Water Conservation in Ontario, Environment Canada, Ontario Region, 1998.

[5] ibid: mean overall savings reported were 15.7% & 20.9% of that was attributed to rates.

[6] (20-30% savings during peak periods - 4.5% AADD) Region of Ottawa Carleton, Water Demand Study, RMOC, Ottawa, 1994 & Hull, J.G., Special Report on Watering Restrictions By-Law, Greater Vancouver Water District, 1995.

[7] AWWA Residential End-Use Study, AWWA Web Site :www.waterwiser.org/wtruse. July, 1999.

[8], ibid

[9] Bennett, R.E., & Hazinski, M.S., Water Efficient Landscape Guidelines, AWWA, Denver 1993.

[10] Male employees use urinals twice daily and toilets once. Females use toilets 3 times daily. Assuming 10L/flush savings from toilets and no savings from urinals, the average saving per employee per day is 20L. Source: City of Toronto Water Efficiency Plan.

[11] Leblance, Lisa, EIT, & Frank Hubert, P.Eng., Water Consumption & Conservation Potential at Hotels: A Case Study of Hotels in the Greater Vancouver Region, Greater Vancouver Regional District, Burnaby, B.C.

[12] Bennett, R.E., & Hazinski, M.S., Water Efficient Landscape Guidelines, AWWA, Denver 1993.

8.2 SCREENING FOR APPLICABILITY, FEASIBILITY AND ACCEPTABILITY

Applicability

In evaluating possible water efficiency measures, you must decide which are applicable to the service area. For example, landscaping measures may not be appropriate if there is no significant increase in water use from irrigation during summer months. Measures should also be chosen to meet the goals of your water efficiency program. For example, if a goal is to reduce wastewater inflows to an overburdened treatment plant, landscape measures may be ineffective if the system is served by a separate stormwater collection system. You should also consider which efficiency measures, if any, are already in place in your service area. Water efficiency measures that exist in only some localities may be readily extended to cover the entire service area.

Feasibility

Selected water efficiency measures must also be technically feasible. For the most part, the devices and methods that were described in Chapters 4 through 7 are technically feasible for the small municipality. One exception may be water recycling in industrial facilities that do not currently have this capability; it may be beyond the municipality's ability to promote recycling and the use of new technologies in that situation. As well, some measures such as greywater reuse may not be permitted by provincial regulation. Others, such as regulations requiring efficient fixtures in new construction, may be beyond the mandate of your municipality.

Acceptability

Conservation measures must also be acceptable to the municipality's customers and the community as a whole; otherwise, their success rate will be low. The measures requiring customer participation or involving customer costs must be attractive to the individual customer in order to achieve the desired participation level or market penetration. Customer acceptability for individual measures can be gauged by tools such as surveys and focus groups.

Community concerns are more difficult to quantify, but they may be as significant as economic impacts. The degree to which any particular measure will be accepted by the community must be generally estimated by the municipality. Municipal staff can use their knowledge of the demographics and historical water use habits of the area to eliminate potentially unacceptable measures. Again, the measures discussed in Chapters 4 through 7 are commonly used in other parts of the country and have not been found to be overly intrusive.

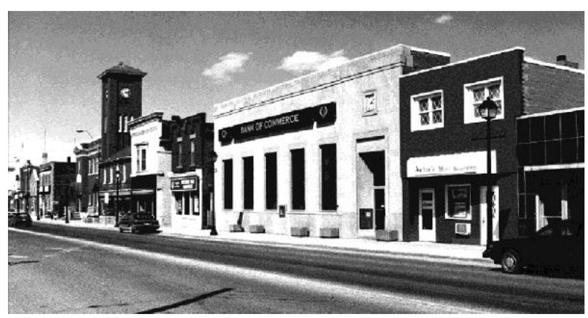


Photo courtesy of REIC Ltd.

In general, community impacts fall into the following categories:

- social/political;
- environmental;
- technical; and
- customer/public.

A common approach to evaluating community concerns or non-economic impacts is to make a comprehensive lists of possible community concerns, and then decide whether a particular measure has a positive, negative, or no impact. A sample analysis showing some of the measures discussed in this guidebook is shown in Table 8.2.

In evaluating non-economic impacts, use your judgment and your familiarity with the service area. Identify the most important considerations, and bring these issues up for public discussion. Identifying potential impacts and determining which impacts are more important is a task where the public advisory committee can provide valuable insight in the planning process. Remember that while some things cannot be measured or assigned a value, they may still be very important to the people whose support you are seeking. A non-economic negative impact may be significant enough to stop a program that has an otherwise favourable benefit-cost ratio, as evidenced by the growing number of engineering projects that are halted because of environmental concerns.

Table 8-2: Non-Economic Impacts of Conservation Measures

	Toilet Rebates	Retrofit Kits	Industrial Audit	Landscape Audit	Landscaping Ordinance	Public Education
Environmental / Technical						
New source development postponed or reduced	+	+	+	+	+	+
Reduced homeowner energy consumption		+				
Reduced utility energy consumption	+	+	+	+	+	
Increased life of water / wastewater treatment facilities	+	+	+	+	+	+
Increased stream flows	+	+	+	+	+	
Social / Political						
Create new jobs locally	+	+	+	+	+	
User & special interests groups opposed to program			–		–	
Requires mandatory ordinances					+	
Cooperation of enforcement authority to implement program may be difficult					–	
Cooperation with school department / community department may be difficult		–		–		–
Fairness of measure					–	
Requires landscaping attitude change					–	
Customer costs not equally shared between existing and new customers				–	+	
Costs not equally shared between customer classes		–	–	–	–	
Users who conserve will have lower energy bills	+	+	+			+
Health and safety				+		+
Significant customer expense if mandatory	–			–	–	

Source: Planning and Management Consultants, Ltd., et al. Evaluating Urban Water Conservation Programs: A Procedures Manual, Report prepared for the California Urban Water Agencies, Sacramento, CA. 1992.

Note: Plus (+) = Positive impact Minus (-) = Negative impact Blank Cell = No discernable impact

8.3 DETAILED ESTIMATES OF SAVINGS POTENTIAL FOR SPECIFIC MEASURES (LEVEL II)

The work you have done so far has helped you evaluate the various efficiency measures and focus on those options that seem most promising. You can now prepare estimates of potential water savings for the specific measures that remain on your list of possibilities. By estimating potential water savings, you can choose the measures that will give you the most return from your investment.

Savings resulting from water efficiency measures will depend on:

- the reduction in water use as a result of implementing the measure; and
- the degree of coverage that the measure can achieve (also known as "market penetration").

The following formula can be used to determine how effective a specific efficiency measure is in a given year, for a particular group of water users.

$$E = R \times C \times Q$$

Where:

E = reduction in water use as a result of the measure, (in millions of litres per year for calculation.)

R = reduction in water use as a result of the measure, expressed as a fraction of 1. (See below for calculation.)

C = percent coverage of the measure for the group of water users under consideration (market penetration), for the year of interest. Also called the installation rate. (See below for calculation.)

Q = baseline water use for the group of interest, before efficiency measure was put into place (in millions of litres per year), for the year of interest (from Worksheet 3, page 2-12).

How to Determine R, the Fraction of Reduction in Water Use

The factor R is the fractional reduction in water use that is expected to result from a particular conservation measure. To estimate this reduction, you need information on actual water savings as well as information about the average water use for the user group in question. The fractional water savings can then be estimated by the formula:

$$R = S/W$$

Where:

R = fraction water reduction for the year of interest

S = water savings resulting from the measure, in litres per day

W = average water use without the measure in place (in litres per day), for the year of interest.

The data you collected in Chapter 2 of this manual will give you information on W, the average water use without the water efficiency measure in place for your major water users. It is not always easy to find information on the factor S, the actual water savings resulting from a particular water efficiency measure. This type of information is becoming more readily available, however, as more data are collected. Chapters 4 through 7 present the expected water savings (S) for many of the more common water efficiency tools and a summary is presented in Table 8.1. You can use these values to calculate the expected percent reduction.

For example, Table 8.1 shows that the expected average water savings resulting from the use of low flow showerheads is 9.8 Lcd. If the work you did in Chapter 2 shows that your average annual residential water use (without the use of low flow showerheads) is 270 Lcd then:

$$R = 9.8/270 = 0.036 \text{ or } 3.6\%$$

Therefore, the expected fractional reduction in water use resulting from replacing a high flow showerhead with a low flow showerhead is 0.036 for each household.

How to Determine C, the Market Penetration

The overall reduction in water use resulting from low-flow showerheads must also account for the number of households using these devices in the year of interest, or the factor C (market penetration). The factor C may be estimated by figuring what percent of a user group is actually using the measure (through a telephone survey, for example). For efficiency measures that are enforced by state or local regulations (such as the use of low flow plumbing fixtures for new construction), the coverage is close to 100% of the applicable market. For voluntary measures, the coverage factor C is much lower.

For measures that are not legally enforced, one approach can be to estimate the factor C based on the experience of other municipalities. Another approach is to set a value for C based on the desired coverage of the conservation program. For example, the municipality may decide that a coverage of 70% is the goal for implementation of residential fixture retrofit kits based on described savings, and the water efficiency program will be designed to achieve this goal. In this situation, then, the factor C is 70%, or 0.7. This method of working backwards is used when specific efficiency savings are required.

How to Determine E, Overall Reduction in Water Use

The factors R and C that have been determined above estimate the water reduction that can be expected from a given measure for a particular user group. The overall reduction for a particular measure is just the product of these two factors or,

$$E = R \times C.$$

For example, if the fractional reduction in water use resulting from installing low flow showerheads is 0.094, and the estimated coverage of these devices for residential users is 0.7 (70%), then the overall percent reduction will be:

$$E = 0.094 \times 0.7 = 0.066 \text{ (or 6.6\%)}$$

You can use this formula to compare the expected impact of various efficiency measures, so that your conservation program is designed for maximum effectiveness.

By adding the factor Q you can then calculate a hard figure for water savings in millions of litres per year:

$$E = R \times C \times Q$$

For example, if the baseline water use (without conservation) for the group of interest is 1,000 MLy, then the total reduction in water use resulting from the installation of low flow showerheads is:

$$E = 0.094 \times 0.7 \times 1{,}000 = 66 \text{ MLy. /}$$

Worksheet 7, (page 9-15) is included to help calculate efficiency potentials for measures and devices.

A school education program is an excellent means of maintaining contact with users and building support for various future utility initiatives including water efficiency programs. It reaches families through children and fits within the context of science and technology and social studies curricula.

For example, in Laval, Quebec, elementary students take part in "The Water's Journey", an awareness program on drinking water. As part of the program, students take the Blue Thumb pledge, vowing to change personal habits and reduce water use.

Though no measurable water saving can be attributed to educational programs in schools, like general public education, it is a means of reaching users and building support for the programs.

For a typical school program, the municipality's responsibilities include the following tasks:

- obtain permission from school authorities to introduce education program materials;
- provide a teacher guidebook or teacher education materials on the subject and coordinate teacher training;
- provide a student workbook, or other student materials, as needed;
- estimate the number of schools, teachers, and students participating in the program; prepare and distribute the necessary materials; and
- offer tours of water facilities, participate in school information fairs, and do follow-up on teacher response to the materials provided; and make it fun!

See Appendix B for a list of Canadian municipalities and organizations that have developed in-school programs.

The California Department of Water Resources has prepared a useful guidebook for conducting in-school education, called "*How To Do An In-School Education Program"* (Water Conservation Guidebook 2, California Department of Water Resources, Sacramento, Ca., 1984).

CHAPTER 9

9.0 DESIGN YOUR WATER EFFICIENCY PROGRAM

Summary

In this chapter you will make use of all the information you have gathered to design a water efficiency program that meets the goals identified for your service area. The chapter covers several steps including:

- reviewing goals and objectives,
- selecting measures and developing alternative approaches;
- conducting a cost benefit analysis of your suggested program; and
- finalizing your plan.

9.1 REVIEW GOALS AND OBJECTIVES

At this point you have developed a short list of potential measures that are applicable, feasible and acceptable to the community and you have an understanding of the expected water savings to be gained from them. Before selecting specific measures to form your program it is wise to revisit the goals and objectives. Because communities and their needs are different, no two water efficiency programs will be identical. To be effective, your program should produce the required amount of water savings when and where needed.

For example, a municipality with a capacity shortage in the near-term will design a much different program than one which is simply aiming to adopt best practices and raise public awareness or a municipality which is counting on efficiency gains as part of long-term capacity planning. Similarly, measures selected to address maximum day demand will be much different than those required to produce savings in average day demand.

9.2 DEVELOP ALTERNATIVE APPROACHES

The water efficiency measures that were described in Chapters 4 through 7 can be grouped into 5 general categories:

- the use of water-saving fixtures and hardware;
- incentives to support the adoption of more efficient hardware and practices;
- voluntary measures that depend on public education, such as water efficient landscaping;
- changes in the rate structure; and
- by-laws.

In designing your plan, you will want to consider all categories in order to have a full "menu" from which to select. As well, it is important to consider how different types of measures can reinforce and support each other. For example, public education that reinforces lawn watering regulations will result in greater compliance. Incentives in the form of rebates may be required to achieve the desired market penetration for new fixtures and hardware such as ULF toilets. Free landscape audits are a form of incentive that can result in greater take-up of voluntary actions such as irrigation scheduling.

You are not limited in the number or combination of measures that you may incorporate into your program. A mixture of approaches will help build flexibility into the program and will prevent too much dependence on any 1 technique. It is important, however, that each individual measure make sense in terms of achieving your overall efficiency goals, and that the measures you are considering have real potential for water use reduction in your area.

Three Levels of Water Efficiency

You may find it helpful to develop 3 alternative water efficiency plans for internal and external review. This approach will encourage discussion and increase understanding of the choices that must be made. This type of dialogue is useful because your municipal governing board, municipal council or regulatory agency and the public must support the program if it is to work.

Your 3 levels of water efficiency could include:

- A "minimum plan"
  - It would illustrate projected demand and estimate future capital facilities and operating costs without any additional water efficiency in place. This scenario assumes that basic programs of best management practices and public education are maintained. This scenario can be produced by simply estimating future water usage, based on current water use practices and future growth (population, economic development, etc.).
- A "moderate plan"
  - Water would be saved using measures that are acceptable to the public. This plan may be your preferred option.
- A "maximum plan"
  - This would result in large water savings, but might also carry the risk of strong public opposition or might be too expensive.

EPA Plan Guidelines

The US Environmental Protection Agency (EPA) has produced a set of Water Conservation Plan Guidelines (see page 9-4) that organizes measures into 3 general categories: Level 1 measures are that are recommended best practices for all systems, regardless of their need for water efficiency savings; they represent the minimum plan. Level 2 and Level 3 measures are for systems with significant water efficiency needs and interests. They represent the moderate and maximum plans.

The EPA Guidelines also categorize initiatives appropriate for municipalities of various sizes. Basic measures are suitable for implementation by utilities serving a population of 10,000 or less, intermediate measures apply to utilities between 10,000 and 100,000 population, while advanced measures are suitable for large urban areas. It should be noted, however, that these are only guidelines. Many Canadian municipalities with a population under 10,000 have implemented intermediate or even advanced measures with considerable success.

Table 9.1: EPA Water Conservation Plan Guidelines[1]

Level		BASIC Under 10,000	INTERMEDIATE 10,000 – 100,000	ADVANCED Over 100,000
Level 1 Measures (minimum)	Universal Metering	• Source-water metering • Service-connection metering and reading • Meter public use water	• Fixed interval meter	• Test, calibrate, repair and replace meters
	Water Accounting and Loss Control	• Account for water • Repair known leaks	• Analyze non-account water • Water system audit • Leak detection and repair strategy • Automated sensors/ telemetry	• Loss-prevention program
	Costing and Pricing	• Cost-of-service accounting • User charges • Metered rates	• Cost analysis	• Advanced pricing methods
	Information and Education	• Understandable water bill • Information available	• Informative water bill • Water-bill inserts • School program • Public education program	
Level 2 Measures (moderate)	Water Use Audits		• Audits of large volume users	• Selective end-use audits
	Retrofits		• Retrofit kits available	• Distribution of retrofit kits
	Pressure Management		• Systemwide pressure management	• Selective use of pressure-reducing valves
	Landscape Efficiency		• Promotion of landscape efficiency • Selective irrigating submetering	• Landscape planning and renovation • Irrigation management
Level 3 Measures (maximum)	Replacements and Promotions			• Rebates and incentives (non-residential) • Rebates and incentives (residential) • Promotion of new technologies
	Reuse and Recycling			• Industrial applications • Large-volume irrigation applications • Selective residential applications
	Water-Use Regulation			• Water-use standards and regulations • Requirements for new developments
	Integrated Resource Management			• Supply-side technologies • Demand-side technologies

[1] www.ec.gc.ca/water/en/info/pubs/action/e_action.htm

9.3 ESTIMATE BENEFITS AND COSTS OVERVIEW

Estimating benefits and costs is an important task, allowing you to evaluate the economic impacts of your selected water efficiency plan or compare the economic impacts of alternative efficiency plans. In addition, cost information will be required to some extent during the public discussion and review period, since the public and the decision-makers need economic information to make informed choices. To have a feasible water efficiency plan, the total positive effects (benefits) of the plan must be greater than the total negative effects (costs).

Benefit-cost analysis will permit you to compare the value of demand reduction measures (through efficiency) with supply enhancement measures (such as increased system capacity or other structural solutions). Planners can use the analysis to measure the impact of water efficiency on the capital facilities program, in order to plan more accurately for future facilities requirements. The analysis will also help justify budget requests to fund the water efficiency program.

A positive benefit-to-cost ratio will not always drive the solution, however. In some cases, you may implement water efficiency whether it makes financial sense or not. Conversely, the cost may be beyond the municipality's means, no matter how great the potential benefits may be. In general, however, most situations will fall into a middle category, in which a sensible water efficiency program can be developed that has a positive economic impact.

For municipalities of all sizes, calculating the cost of water saved (as described in Level I below) is the first step in a benefit cost analysis. Rather than undertaking a full Level II analysis, smaller municipalities will find it easier just to calculate the cost of water saved, (Level 1 Method) as described in Section 9.4, and select plan measures based upon comparing these costs.

A full benefit-cost analysis is not trivial; it is described in Section 9.6 Level II analysis. Medium-size communities that want to justify significant water efficiency budgets or are involved in water supply planning will want to undertake a Level II analysis to compute benefits and costs in detail.

9.4 ESTIMATE COSTS OF WATER EFFICIENCY (LEVEL I)

Informal Cost Estimates

While a detailed analysis is helpful for informed decision-making, especially when a large budget increase is being requested, it is not necessary in order to have a successful program. A more informal assessment of economic impacts may be adequate for the municipality to make comparisons and decisions.

You can do an informal assessment of economic impacts by comparing your program with another municipality's program, one that is successful in achieving goals similar to yours. Program budgets can be scaled using a dollars per person cost. This approach works where the size of the municipality used for comparison is not too different from your own. For example, if a nearby community with 5,000 connections has a successful public education program similar to the one you would like to implement for your system of 7,500 connections, and that community's program cost is $10,000 per year, you should budget about (7,500 ÷ 5,000) x $10,000 = $15,000 per year.

Detailed Costing of Efficiency Measures

Costs of water efficiency programs fall into 2 main categories:

- the cost for program implementation itself (borne by the municipality and sometimes indirectly by the customer). Program costs will result from staff time, cost for hardware and public information materials, the costs of consultants and any contracted work relating to program implementation, and the cost of any monetary incentives that may be offered; and
- the cost to the municipality of reduced revenues resulting from decreased demand.

Other costs could include increased staff time for other municipal departments, such as planning or parks departments responsible for overseeing by-laws related to landscape water use.

Municipality Costs

Direct costs to the municipality can be expressed as follows, considering both in-house staff costs and contracted costs (where a private contractor performs some of the work).

In-House Cost =
administration cost +
(Field labour hours × labour hourly rate, including overhead) +
(unit costs × number of units) +
publicity cost +
evaluation and follow-up

Contracted Cost =
administration cost +
(number of sites × unit cost per site, includes program unit costs) +
Publicity cost +
Evaluation and follow-up

Administration Costs

This is the staff time required to oversee staff, the work of consultants, or contracted field labour. Administration costs will be higher for new programs and for large consultant contracts. Administration costs are typically 10-15% of total program costs.

Field Labour Costs
In addition to administrative staff time, the municipality must supply labour or contract to perform water efficiency work in the field. Field activities include water audits, leak repair and fixture installation, follow-up site visits, and door-to-door canvassing.

Typically, 3 to 6 residential water audits can be performed in 1 day by trained municipal personnel.

Commercial/industrial water audits may be more time consuming and will require more specialized knowledge on the part of the auditor. Costs will vary, depending on the complexity of the site; each audit may require from a few days to a week or more. Although these audits may require more effort, they may be worthwhile if the facility is a significant water user. After base labour is determined for a commercial/industrial site, allow a factor of safety for items such as missed appointments, data interpretation, and follow-up visits. Unanticipated labour costs can double the original labour estimate, particularly for new programs.

Unit Costs
Many measures can be estimated on a unit cost basis, or as cost per participant. Examples include retrofit kits, water audit programs, and rebate programs. Small programs typically have higher unit costs than larger programs because of the smaller number of participants.

Publicity Costs
All water efficiency programs should contain a public education element. Vehicles for public information include radio and television spots, local newspaper advertisements, flyers and bill stuffers, billboard advertising, workshops and seminars, and special demonstrations (for example, booths at community events). Larger municipalities often employ public relations professionals to handle this aspect of their water efficiency program for maximum effect, but this is not always necessary for smaller programs. Costs will be roughly proportional to the number of customers contacted. Collaborative promotion efforts with community stakeholders will maximize impact and budgets regardless of program size.

Evaluation and Follow-up Costs
Typically, 2 types of program follow-up need to be performed. The municipality must record the impact of the water efficiency measure. The municipality should also monitor the performance of the measure(s) and compare results with program goals. Chapter 10 discusses how to conduct these follow-up activities. Costs associated with follow-up activities may include the staff time needed to calculate water savings, and the costs of conducting public surveys to measure customer participation and satisfaction.

The best source of information for the above costs is the experience of communities that have run similar programs. Costs can be expressed on a unit basis (for example, $/dwelling unit or $/audit) and then transferred to your area, taking account economies of scale for different-sized programs.

Worksheet 6, (page 9-14) can help you calculate the annual in-house costs for conservation measures.

Costs of Decreased Water Revenues
Reduced revenues can be viewed as a cost of water efficiency. Typically, decreases in water revenues resulting from efficiency (as distinguished from curtailment or mandatory reductions), are small and occur over a long time period, allowing the municipality time to incorporate these changes into budget forecasts. Generally speaking, long-term efficiency programs reduce water revenues ½ to 2% per year over the

life of the program. This is on average less than inflation in other utility costs. Cost savings from the short-term benefits of water efficiency (reduced energy, chemical, and treatment costs) help offset these revenue decreases. Periodic rate increases can recover the lost revenue, so that the actual cost will be insignificant.

Temporary curtailment due to drought or system failure can reduce consumption and revenues by 10% or more. Municipalities that are susceptible to these periodic events need to accommodate them within their rate structure.

Estimating the Cost of Water Saved
The cost of water saved is a useful number that is relatively easy to calculate. It is expressed in dollars per ML. Expressed this way, water conservation costs can then be compared to the costs of new water supply, expressed the same way. There is no accepted formula to calculate the cost of water saved, but the following is suggested.

Total water efficiency program costs over planning period ($) ÷
Total volume of water saved over planning period (ML)

In some cases, discounted program costs are used if the planning period is long and significant costs occur later in the period. This formula would be as follows.

Average annual program costs (dollars per year) ÷
Average annual water saved (ML per year)

9.5 ESTIMATE BENEFITS (LEVEL II)

Typical Benefits

The major types of benefits resulting from water efficiency are summarized in this section.

Strictly speaking, a benefit-cost analysis performed by the municipality only has to consider the benefits and costs to the municipality. The guidelines provided in this subsection are for performing this kind of analysis. In addition, secondary impacts on wastewater municipalities may occur, such as reduced wastewater flows, lower cost of treatment, and cost savings from delayed facility construction. While these impacts need not be included in the benefit-cost analysis, they should be recognized and discussed during the public review phase of water efficiency planning. As well, environmental costs and benefits may be a key factor in obtaining public support for water efficiency.

Customer benefits and costs should also be considered. These are discussed under Chapter 9.7 “Consideration of Other Perspectives on Benefits and Costs”. If the measure has a favourable benefit-cost ratio for the customers, they are more likely to implement it.

Benefits to the municipality result both from savings on operating costs and long-term savings on capital requirements.

- Savings on operating costs tend to result immediately from conservation activities. These include the reduced costs of treatment chemicals, energy, and labour and materials required to handle reduced water production.
- Long-term savings are associated with capital facilities (i.e. decreased cost for water and wastewater facilities because of reduced demand) or reduced water purchases.

How to Determine the Benefits of Water Efficiency Measures

Savings to the municipality result from reduced water purchases, lowered operation and maintenance expenses; and delayed, downsized, or eliminated capital facilities.

Cost Savings from the Reduced Purchase of Water

You can determine the unit cost of purchasing water from a wholesaler by the following expression:

Unit Cost of Purchased Water =
Annual Water Purchase Cost ÷
Units of Water Purchased per Year

You can then calculate the amount of savings by multiplying the unit cost of water by the units of water that you will not need to purchase as a result of a conservation measure.

Cost Savings from Reduced Operation and Maintenance Expenses

Water efficiency measures can reduce energy and chemical costs for water system operation. Typically, energy will have both variable costs (those costs that are dependent on the amount of water used) and fixed costs associated with them. Only variable costs will be affected by efficiency activities. Fixed costs are unaffected by changes in water usage.

To calculate the variable cost of energy, use the following relationship.

Unit Cost of Energy =
((Annual energy bill – (12 × monthly fixed charges)) – (Energy costs not related to water production)) ÷*
Units of water used

(*These costs are independent of actual water production, such as building heating, cooling, and lighting and process equipment use.)

Cost savings are calculated by multiplying the unit cost of energy by the units of water saved per year as a result of an efficiency measure.

Worksheet 8, (page 9-16) can help you calculate cost savings from reduced energy use for each potential measure.

In most cases, all chemical costs are variable; there are few fixed costs. To calculate the variable cost of chemicals, use the following relationship:

Unit Cost of Chemicals =
((Annual chemical bill – (12 × monthly fixed costs)) – Chemical costs not related to water production) ÷
Units of water used

Cost savings are calculated by multiplying the unit cost of chemicals by the units of water saved per year as a result of an efficiency measure. **Worksheet 9**, (page 9-17) can help you calculate cost savings from reduced chemical usage for each potential measure. The benefits derived from wastewater operations for energy and chemical savings can be calculated in a similar manner.

Cost Savings from Delayed, Downsized, or Eliminated Capital Facilities

Water efficiency can affect both the requirements for existing facilities and planning for future facilities. To evaluate the impacts of water efficiency, both peak-day and average-day water use must be considered. Peak-day water use usually occurs in hot weather, in response to outdoor (landscape irrigation) water requirements.

The types of facilities most likely to be affected by efficiency activities are those that are dependent on water demand, particularly peak-day demand. These include:

- raw water storage reservoirs;
- raw water transmission lines;
- water and wastewater treatment
- plants; and
- distribution system storage and pumping.

The municipality will realize economic benefits from the delay, downsizing, or elimination of capital facilities according to the following relationships:

The project is downsized:

Cost savings =
Cost at original size ÷ Cost at reduced size

The project is delayed:

Cost savings =
(Cost in original year ÷ ((1+i) x n)) –
(Cost in delayed year ÷ ((1+i) x n))

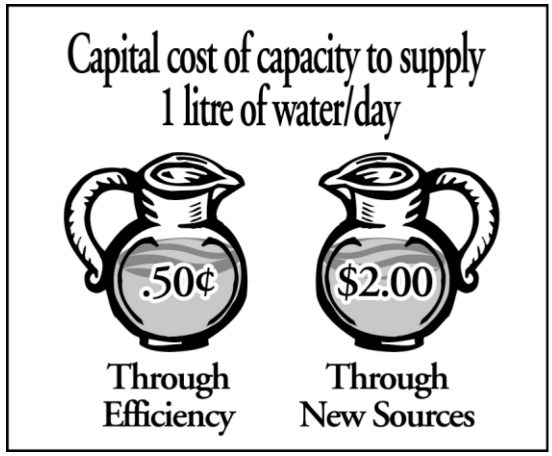
<u>Where:</u>
n = number of years project is delayed
i = interest rate (rate of return that could be earned by project funds)

The project is eliminated:

Cost savings = construction cost

Appendix F provides more information about calculating cost savings from delayed construction, plus an example calculation.

9.6 HOW TO PERFORM A BENEFIT-COST ANALYSIS: LEVEL II



There are several methods for estimating the relative costs and benefits of a potential measure. Only the simplest method is discussed here.

This method calculates the ratio of the present value of benefits to the present value of costs. If the ratio is greater than 1, the benefits outweigh the costs and the measure is favourable.
The expression is given as:

(Sum of Benefits in year t ÷ ((1+i) x t)) ÷
(Sum of Costs in year t ÷ ((1+i)x t))

<u>Where:</u>
i = selected interest rate, as a decimal 10% = .10.

Worksheet 10, (page 9-18) can help you calculate the benefit-cost ratio for a conservation measure.

The California Department of Water Resources has developed the "*Water Plan*" software package to help municipalities design conservation programs and estimate the cost effectiveness of these programs. *Water Plan,* and is designed for use with any IBM-compatible personal computer.

Water Plan can help you perform all of the calculations described in previous sections, and can integrate this information into a benefit-cost analysis as described above. A computer program has the advantage of being able to perform the necessary calculations quickly, and accurately. Therefore, you can easily change specific input variables or assumptions and immediately see their impact on overall program effectiveness.

Water Plan requires detailed input data to calculate water savings, costs, and benefits. The data includes:

- information about the measures, including unit water savings, types of customers that would receive the measure, projected installation rates, and a breakdown of the costs of measures;
- service area information, including existing and projected dwelling units, and indoor and outdoor water use forecasts; and
- marginal cost data, including the rate for water, sewer, electricity and natural gas, and the value of water saved. (Marginal cost is the incremental cost of new supplies.)

Copies of *Water Plan* software and manuals can be obtained for a small fee through the AWWA.

9.7 CONSIDERATION OF OTHER PERSPECTIVES ON BENEFITS AND COSTS

The previous subsection has focused on economic benefits and costs to the municipality. It is important not to select just the water efficiency measures with the highest benefit-cost ratio. This could be called "cream-skimming", since the measures with the highest ratios may not save very much water. Water savings goals should be met first, hopefully with measures that have a benefit-cost ratio greater than 1.0.

It is also important to evaluate benefits and costs from other perspectives. This will help determine how other sectors might be encouraged to participate in the program. The most obvious group to consider is the customers, who will be either voluntary or involuntary participants in the program. Be aware that this evaluation may point to different alternatives than were suggested by the municipality benefit-cost analysis.

The following discussion shows how to obtain information about customer benefits and costs.

Customer Benefits

Savings to the customer will result from reduced utility bills for water, wastewater, and energy.

Water Bill Savings
Customer savings in this area are calculated by multiplying water savings resulting from water efficiency by the customer's water billing rate. This calculation can become complicated, depending on the type of water rate system in place. It is simplest for the constant unit or uniform commodity rate structure, where the unit charge for water is the same, regardless of the amount of water consumed.

Some municipalities may also charge different rates for different classes of customer, so that savings must be calculated separately for each customer class. In addition, there may be different rates within each class. In this case, the simplest procedure may be to find the billing rate for the "average" customer in each class. To determine the average billing rate, divide the total water consumption in each customer class by the number of customers in the class. Then identify the appropriate rate for each customer class, corresponding to the average water use per customer.

The unit cost per million litres can then be multiplied by the water savings (per ML) resulting from the efficiency measure(s) to arrive at the total cost savings to customers.

Wastewater Bill Savings

If residential customers are billed on a flat rate, they will not realize savings from water efficiency efforts. Residential customers will benefit from water efficiency if they are billed according to a fixed monthly charge plus a unit charge per unit of water use. If this billing method is used, wastewater bill savings can be estimated by multiplying indoor residential water use reduction by the unit surcharge for wastewater. This method is appropriate because the reduction in wastewater flows is approximately equal to the reduction in indoor water use. Non-residential customers are typically billed in this manner, so this method of calculating savings is appropriate for them as well.

Energy Bill Savings

Customer energy savings result from reduced water heating costs. These savings can be significant for residential customers, as well as for certain commercial and public users.

Energy companies often promote low flow showerheads and efficient clothes washers for their energy saving potential. Local energy companies or utilities will have information on the expected energy savings resulting from reduced use of hot water.

Customer Costs

Most water efficiency programs will result in some cost to the utility customer. Customer costs result from the purchase of special fixtures or other water-saving devices. The purpose of utility rebates and incentive programs is to offset the purchase and installation costs of these materials. Obviously, if customers' costs are too high, they will be reluctant to participate. Increased costs can also occur in commercial or industrial facilities where the installation of water-saving equipment requires additional operation and maintenance expenditures.

9.8 FINALIZE YOUR PLAN

At this point, you have:

- reviewed goals and objectives;
- identified conservation measures that achieve water savings goals, are appropriate for your system, and have favourable non-economic impacts;
- developed alternative approaches;
- performed a benefit-cost analysis, or made an informal assessment of economic impacts; and
- obtained public input during the planning process.

You can now finalize the water efficiency plan you will present to the public and decision-makers. As discussed previously, you might want to present more than 1 level of plan for discussion (for example, a preferred option, plus a more conservative and a more aggressive approach).

The plan review process may point out alternate solutions or may identify water efficiency alternatives that are unacceptable to the public. The draft plan should be modified based on these comments, in order to gain maximum public support for the program. The final plan should be resubmitted to the review group(s) for final approval.

See Appendix G for a Typical Water Conservation Plan Outline to assist you in compiling your plan.

Your plan should cover the following topics:

- Introduction and Summary
- Study Area Characteristics
- Water Supply
- Current Water Efficiency Program
- Review of Water Efficiency Measures
- Evaluation of Measures
- Recommended Water Management Plan

WORKSHEET 6~ Determine Annual Costs (In-House) (Level II)

MEASURE DESCRIPTION: ____________________

- **Administration Costs**

1. Staff hours to administer the measure _________hrs/yr
2. Staff hourly rate, including overhead $ __________/hr
3. **Administration costs** (Line 1 x Line 2) $ __________/yr

- **Field Labour Costs**

4. Field labour hours _________hrs/yr
5. Field labour hourly rate, including overhead $__________/hr
6. **Field labour cost** (Line 4 x Line 5) $ __________/yr

- **Unit Costs**

7. Unit cost of materials (i.e. retrofit kits, lawn watering kits) $ __________/unit
8. Number of units distributed __________/yr
9. **Total materials cost** (Line 7 x Line 8) $ __________/yr

- **Publicity Costs**

10. Materials cost (i.e. printing, outside services) $ __________/yr
11. Advertising cost (i.e. newspaper, radio, TV) $ __________/yr
12. **Total publicity costs** (Line 10 + Line 11) __________/yr

- **Evaluation and Follow-up Costs**

13. **Labour costs** $ __________/yr

- **Total Costs** (Line 3 + Line 6 + Line 9 + Line 12 + Line 13) $ __________/yr

WORKSHEET No. 7 ~ EVALUATE WATER EFFICIENCY POTENTIAL (LEVEL II)

- MEASURE DESCRIPTION: ______________________
- Fraction reduction in water use, **R**:

  W*here* R = S/W

  Water savings from measure, **S** (litres per day) ______________________

  Average use without conservation, **W** (litres per day) ______________________

  Fraction reduction in water use, **R** ______________________
- Fraction coverage of measure, **C** ______________________
- Baseline water use, **Q** ______________________MLy
- Overall reduction in water use, **E**

  W***here*** **E = R x C x Q** ______________________MLy
- Percent reduction in water use:

  W***here*** **% reduction = (E/Q) x 100** ______________________ %

WORKSHEET 8 ~ Determine Cost Savings From Reduced Energy Use (Level II)

- MEASURE DESCRIPTION: ____________________
- **Variable Cost of Energy**

1. Annual energy costs — $____________/yr
2. Monthly fixed charges — $____________/yr
3. Annual fixed charges (Line 2 x 12) — $____________/mo
4. Annual energy costs not related to water production (i.e. lighting, heating/cooling) — $____________/yr
5. **Variable cost of energy** [Line 1 - (Line 3 + Line 4)] — $____________/yr

- **Unit Cost of Energy**

6. Variable cost of energy (from Line 5) — $____________/yr
7. Average annual water use (from Worksheet 2) — ____________/MLy
8. **Unit cost of energy** (Line 6 ÷ Line 7) — $____________/ML

- **Energy Cost Savings**

9. Overall reduction in water use ("E"" from Worksheet 4) — ____________/MLy
10. Unit cost of energy (from Line 8) — $____________/ML
11. **Energy cost savings** (Line 9 x Line 10) — $____________/yr

Note: Lines 1-8 will be the same for all measures

WORKSHEET 9~ Determine Cost Savings From Reduced Chemical Use (Level II)

- **MEASURE DESCRIPTION**: ____________________

- **Variable Cost of Chemicals**

1. Annual chemical costs $ __________/yr

2. Monthly fixed costs $ __________/mo

3. Annual fixed costs (Line 2 x 12) $ __________/yr

4. Annual chemical costs not related to water production $ __________/yr

5. **Variable cost of chemicals** [Line 1 - (Line 3 + Line 4)] $ __________/yr

- **Unit Cost of Chemicals**

6. Variable cost of chemicals (from Line 5) $ __________/yr

7. Average annual water use (from Worksheet 2) __________ MLy

8. **Unit cost of chemicals** (Line 6 ÷ Line 7) $ __________/ML

- **Chemical Cost Savings**

9. Overall reduction in water use ("E" from Worksheet 4) __________ MLy

10. Unit cost of chemicals (from Line 8) $ __________/ML

11. **Chemical cost savings** (Line 9 x Line 10) $ __________/yr

Note: Lines 1-8 will be the same for all measures

WORKSHEET 10 ~ Determine the Benefit-to-Cost-Ratio (Level II)

- **MEASURE DESCRIPTION:** ____________________
- **Sum of Benefits for year** __________

1. Savings from reduced purchase of water $ __________
2. Energy cost savings $ __________
3. Chemical cost savings $ __________
4. Savings from downsized facilities $ __________
5. Savings from delayed facilities $ __________
6. Savings from eliminated facilities $ __________
7. **Total benefits** (sum of Lines 1-6) $ __________

- **Sum of Costs for year** $ __________

8. **Municipal program costs** $__________

- **Benefit Cost Ratio**

9. Interest rate, *i* __________
10. Number of years in the future for which ratio is being calculated, *t* __________
11. Numerator term (sum of benefits) ÷ $(1+i)t$ __________
12. Denominator term (sum of costs) ÷ $(1+i)t$ __________
13. **Benefit: cost ratio** (Line 11 ÷ Line 12) __________

CHAPTER 10

10.0 IMPLEMENT AND MONITOR YOUR WATER EFFICIENCY PROGRAM

Summary

This section discusses how to carry out and monitor the program you have spent so much effort designing. It includes:

- a review of implementation management;
- suggestions re: ongoing system monitoring; and
- guidelines for program monitoring and evaluation.

10.1 IMPLEMENTATION TASKS AND RESPONSIBILITIES

A water efficiency program can involve a diverse set of activities and tasks, ranging from advertising to engineering. The following list illustrates specific tasks that could be performed as part of a comprehensive water efficiency program.

Operating and Maintenance Measures:

- oversee system-wide leak reduction program;
- oversee meter installation / testing program; and
- measure and evaluate unaccounted-for-water.

General Measures:

- revise local codes or by-laws to require water-saving fixtures;
- develop a public information and in-school education program;
- form and conduct a speakers bureau program; and
- disseminate information and conduct public relations activities.

Customer Measures:

- supervise retrofit device distribution;
- develop water-efficient landscaping program;
- develop incentives to encourage indoor and outdoor water efficiency; and
- coordinate with programs run by other agencies and neighbouring municipalities and organizations with similar interests.

Tasks required for your program will depend on the specific measures you have chosen and your program design. For each of these tasks, the program manager should prepare a description of staff responsibilities, estimate budget requirements, and determine a schedule. It is important to remember to include the cost of start-up materials and staff training in budget estimates.

In a small municipality, the water efficiency program manager will likely be responsible for performing these tasks and may only be available to work on water efficiency on a part-time basis. Larger municipalities have the option of assigning other staff to individual tasks, while the manager coordinates the overall program.

Other Program Participants

In addition to the water efficiency program manager, other individuals and groups that may be involved in program implementation for a medium-sized municipality include:[1]

- **Water system manager:** The water system manager approves the final water efficiency plan and authorizes budget and hiring requests. The manager will also extend formal requests for participation on a water efficiency advisory committee if one is desired.
- **Water efficiency advisory committee:** An advisory committee is generally not employed for small municipalities or for moderate-level programs. If an advisory committee is used, its function is to advise the water system manager on water efficiency in the community.
- **Consultant:** Consultants are sometimes used to determine water savings that result from water efficiency and help in the development of a comprehensive water efficiency plan. They can also be employed to undertake aspects of program implementation, e.g., leak detection, installation of retrofit devices or IC&I audits.
- **Public information specialist:** This person can handle all aspects of the program relating to publicity and public relations. This task can be handled in-house for a small municipality.

Regional Water Efficiency Network

In implementing your program, don't overlook the opportunity to form partnerships with other agencies and municipalities in your area that may already be involved in water efficiency. Local, provincial, or federal agencies can provide a valuable source of technical expertise and perhaps funding for your program. Neighbouring municipalities may be able to provide invaluable “how-to” information, as well as data on actual water savings and market penetration that you need to calculate costs and benefits of specific measures.

A coordinated regional effort among municipalities with a common desire to implement water efficiency programs has several advantages. It can:

- achieve greater public visibility for programs;
- avoid duplication of effort;
- provide regional consistency; and
- reduce costs for common programs such as public education.

[1] Maddaus, William O. *Water Conservation,* American Water Works Association, Denver, CO., 1987

10.2 SYSTEM MONITORING

Even if you decide not to implement a water efficiency program at this time, it is good practice to collect some basic information about your system on an ongoing basis. A good information base will enable you to spot trends in water use as they emerge and to effectively plan and carry out a water efficiency program when it is needed.

Much of the information that should be gathered is discussed in Chapter 2. Municipalities of all sizes should routinely track:

- the amount of water supplied each year from various sources;
- the population of the service area;
- the number of service connections; and
- any significant changes in employment characteristics of the service area.

The municipality should also record:

- water use by sector (IC&I, residential and an estimated amount for unaccounted-for-water);
- average day demand; and
- maximum day demand.

Larger municipalities may also wish to undertake a system audit to more exactly determine the amount of unaccounted-for-water. If billing systems permit, larger municipalities should also track water use by sub-sector:

- single household and multi-family use in the residential sector; and
- industrial, commercial and institutional demand in the IC&I sector.

10.3 PROGRAM MONITORING AND EVALUATION

A water efficiency program should be regarded as dynamic. You may need to make changes to the program based on what you are observing about water savings from specific measures, customer satisfaction, and updated forecasts of water supply and demand. For example, if water savings from efficiency are not as large as was initially expected, estimated construction dates for additional capital facilities may need to be adjusted forward, and annual budgets may need to account for revenues that are higher than expected. The water efficiency industry is rapidly changing, and the program should be reviewed periodically to take advantage of new techniques to save water.

Typically, 2 types of program follow-up need to be performed:

1. **Impact:** The municipality must keep good records of the impact the conservation program is having (i.e., measure water savings). Water use data should be saved before, during, and after implementation of a measure.
2. **Effectiveness and Process:** The municipality should monitor how well the program is performing and whether it is achieving its program goals (which may need to be revised).

Measuring Water Savings

There are some inherent difficulties in measuring water savings and several ways to approach the task.

The simplest community-wide measure is water use per capita, requiring only knowledge of the amount of water supplied and the number of customers or actual population, but the impact of water efficiency programs can be obscured by several factors. For example, this measure is taken on an average of the whole year and outdoor water use can vary considerably from year to year, depending on weather. As well, this measure does not distinguish between residential and IC&I use. A change in 1 major industrial water user can affect demand significantly.

A better measure of savings would distinguish between residential, IC&I and unaccounted-for-water. This would allow for comparison of program goals in each sector with results achieved.

It is more difficult to calculate the amount of reduction in 1 sector, e.g., residential, due to a specific measure. Data logging equipment installed on a sample of homes can be used to monitor water use by fixture, before and after a retrofit or replacement program. The resulting information can be used to calculate the average household savings and per capita savings for specific measures such as showerhead replacement or toilet retrofit. System-wide savings can then be calculated based on the number of units completed.

Savings in the IC&I sector can be monitored on a facility by facility basis using before and after metering data. Where a number of similar facilities are located in a community, e.g. motels or restaurants, average savings per customer or per room can be calculated from a sample of the facilities and the result applied to all completed facilities to calculated the total savings in that market segment.

Estimating Program Effectiveness and Process

You also need to estimate the effectiveness of the program with respect to achieving program goals and the manner in which the program was conducted. Some important considerations for evaluating program effectiveness and process are:

- customer participation rate;
- types and amount of customer contacts;
- customer satisfaction;
- satisfaction of staff and contractors; and
- a description of problems and how they were overcome.

Public surveys are a good way to measure customer satisfaction and participation rates as well as attitudes to water efficiency before and after the program. Customer surveys can also be used to collect specific data on water savings for use in calculating the overall impact of the program.

Public surveys conducted by telephone typically consist of 20 to 40 questions. The cost of a telephone survey will depend on the number of people contacted and the degree of data manipulation required. The cost of a mail survey for the same population will be less, depending on the cost of mailing.

It is important to remember that citizen involvement should not stop as soon as a water efficiency program has been put into place. You will have formed a valuable network of informed supporters who can provide feedback and support. Periodic workshops, seminars, and demonstrations can help keep the public interested in and informed about your water efficiency activities. You should also use your existing public network to modify and adapt your program to the public's needs and wants.

In summary, the questions you should periodically ask yourself about your program are:

- Are the program goals being achieved? If not, why not?
- Is public response to the program positive? If not, why not?
- Are the specific conservation measures contained in the program effective? If not, why not?

If you are getting negative answers to any of the questions posed above, you need to revise your program by:

- considering alternative efficiency measures;
- modifying existing measures; and
- re-focusing efforts, away from areas that are not showing much savings and towards other potential water-saving areas.

You should expect that your water efficiency program will require some modification after the first year of operation. You will continue to learn from experience, and your ongoing efforts will increase the program's effectiveness and benefits over the years.

The California Urban Water Agency has commissioned a manual on program evaluation, *Evaluating Urban Water Conservation Programs: A Procedures Manual* that provides guidance on evaluating the impact of water efficiency programs

It also includes guidance on conducting public surveys.

GLOSSARY

Average Annual Demand: The amount of water required to meet demand in a typical year, usually expressed as millions of litres per year or as cubic metres per year. Also termed "average demand" or "average annual water delivery".

AADD, Average Annual Day Demand: The amount of water required to meet demand on a typical day.

Benefit-Cost Analysis: An evaluation of the benefits and costs of a proposed water efficiency plan. In general, an attractive efficiency program requires that total positive effects (benefits) be greater than total negative effects (costs).

Capital Facilities: Physical facilities required for municipality operation. These may include water supply storage, transmission, and treatment facilities. Wastewater facilities may include collection, storage and treatment.

Commercial Facilities: A customer category that includes retail businesses, restaurants, hotels, office buildings, and car washes.

Constant Unit Rate (Uniform Commodity Rate): A water pricing structure where customers are charged the same unit price regardless of the amount of water used.

Declining Block Rate: A water pricing structure in which customers are charged less per unit of water as consumption increases. This pricing structure discourages water efficiency by rewarding high water users.

Demand Forecasting: A projection of future water use. Demand forecasting allows municipalities to evaluate and plan for appropriate actions to either meet future demand (for example, by increasing water supply) or reduce future demand (for example, by conservation activities).

Evapotranspiration: Loss of water from the soil both by evaporation and by transpiration from the plants growing thereon.

Fixed Costs: Operation and maintenance costs (such as energy for building operation) that are independent of the amount of water used. Fixed costs are not affected by water efficiency activities, while variable costs (defined below) are influenced by conservation.

Increasing Block Rate: A water pricing structure in which customers are charged more per unit of water as consumption increases. This type of pricing structure encourages water efficiency by penalizing high water users.

GLOSSARY

Industrial Facilities: A customer category that includes industries that require process water.

Institutional Facilities: A customer category that includes schools, hospitals, nursing homes, governmental offices, parks, landscaped roads, and cemeteries.

Long-Term Reductions: Water efficiency measures undertaken to reduce water use over the long term (more than one year). Long-term reductions are the focus of this guidebook.

Market Penetration: The degree of actual usage that a water efficiency measure achieves among the intended user group, or market.

Maximum Day Demand, MDD: The amount of water required on the day of maximum demand during the year.

Peak Demand: The maximum amount of water required to meet demand during a specified time period, usually expressed in terms of monthly, daily, or hourly peak demand.

Per Capita: Per person.

Present Value: Also termed "net present worth," this is the value of future costs and benefits in terms of current dollars. In order to compare costs and benefits occurring at some time in the future, these dollar amounts must be brought back to the present time. The adjusted, or present, worth is dependent on the interest rate used and the point in time at which future costs and benefits occur.

Retrofit: To furnish with new parts or equipment not available at the time of manufacture or original installation.

Seasonal Water Rates: A water pricing structure that discourages consumption during peak use periods by imposing significantly higher rates during these periods.

Short-Term Reductions: Water efficiency measures undertaken to reduce water use over the short term (i.e., in response to drought or emergency conditions). Short-term emergency measures are not addressed in this guidebook.

System Safe Yield: The amount of water that can be withdrawn annually without depleting the water source. Safe yield is usually determined by hydrologic studies conducted at the time the adequacy of the source is evaluated.

GLOSSARY

Unaccounted-for-Water: The difference between the amount of water entering the distribution system and the amount of water supplied to customers. Sources of unaccounted-for-water include authorized uses (such as fire hydrants and main flushing) and unauthorized uses (illegal connections). The remaining unaccounted-for-water results from meters out of calibration or from leaks in the distribution system. Unaccounted for water is more commonly referred to as Revenue and Non-Revenue Water.

Uniform Commodity Rate: A water pricing structure where customers are charged the same unit price regardless of the amount of water used.

Unmetered Supply: A water supply system that does not use meters to measure water usage by individual service connections.

Variable Costs: Operation and maintenance costs (such as energy and chemicals) that are dependent on the amount of water used. Variable costs are affected by water efficiency activities, while fixed costs are not.

Water Audit: An analysis of customer water use practices. A water audit typically involves identifying water uses, discussing water use practices with the customer, and providing information and assistance with water-saving measures.

Water Efficiency: Any socially beneficial reduction in water use or in water loss.

Water Meters: Instruments for measuring and recording the amount of water used by municipality customers. Water billing based on metered usage can be an effective efficiency tool because customers tend to conserve water when they pay for what they use.

Xeriscape™: Low water-use landscaping, which includes design, plant selection, proper soil preparation, plant culture and an efficient irrigation system.

APPENDIX A

CONTACTS FOR FURTHER INFORMATION

FEDERAL

General Information
National Water Issues Branch
Ecosystems and Environmental Resources Directorate
Environmental Conservation Service
Environment Canada
315 St. Joseph Boulevard
Hull, Quebec
K1A 0H3
Tel:: (819) 997-2307
Fax: (819) 994-0237
Website: www.ec.gc.ca/water

Publications
Enquiry Centre
Environment Canada
Ottawa, Ontario K1A 0H3
Toll free: 1-800-668-6767
Local: 997-2800
Fax: (819) 953-2225

PROVINCIAL

Alberta Environment
www.gov.ab.ca/env

British Columbia Ministry of the Environment
1-2975 Jutland Road
P.O. Box 9339
Stn Prov Gov't
Victoria, B.C., V8W 9M1
Tel: 250-387-9422
Fax: 250-356-6464
www.env.gov.bc.ca

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British Columbia Ministry of the Environment Water Use Catalogue:
www.env.gov.bc.ca/wat/wrs/waterusecat/

Manitoba Environment
Water Quality Management
123 Main Street, Suite 160
Winnipeg, Manitoba R3C 1A5
Tel: 204-945-7030
Fax: 204-948-2357
www.gov.mb.ca/environ

Newfoundland Department of Environment and Labour
Water Resources Division
P.O. Box 8700
St. John's Newfoundland A1B 4J6
Tel: 709-2563
Fax: 729-0320
www.gov.nf.ca/env

NorthWest Territories Department of Resources, Wildlife and Economic Development
www.gov.nt.ca/RWED

Nova Scotia Department of the Environment
P.O. Box 2107
Halifax, Nova Scotia B3J 3B7
Tel: 902-424-5300
Fax: 902-424-0503
www.gov.ns.ca/envi

Ontario Ministry of the Environment
135 St. Clair Ave. West
Toronto, Ontario M4V 1P5
Tel: 416-325-4000
Toll free: 1-800-565-4923
www.ene.gov.on.ca

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Prince Edward Island
Department of Technology and Environment: Water Resources
4th Floor, Jones Building
11 Kent Street
P.O. Box 2000
Charlottetown, Prince Edward Island C1A 7N8
Tel: 902-368-5000
Fax: 902-368-5830

Quebec
Reseau Environnement
911, rue Jean-Talon, #200
Montreal, PQ H2R 1V5
Canada
Phone: 514-270 -7110
Fax: 514-270-7154
Web Address: www.reseau-environnement.com

Sask Water
4th Floor, Victoria Place
111 Fairford Street East
Moosejaw, Saskatchewan S6H 7X9
Tel: 306-694-3900
Fax: 306-694-3944
www.gov.sk.ca/skwater

Yukon Territory
Department of Renewable Resources
10 Burns Road
Whitehorse, Yukon Y1A 2C6
Tel: 867-667-5237
Fax: 867-393-6213

APPENDIX A

PROFESSIONAL ORGANIZATIONS

Atlantic Canada Waterworks Association
P.O. Box 22159
Halifax, N.S. B3L 4T7
Tel: 902-479-0168
Fax: 902-477-7245
www.acwwa.ns.ca

British Columbia Water and Wastewater Association
#342-17 Fawcett Road
Coquitlam, British Columbia V3K 6V2
Tel: 604-540-0111
Fax: 604-540-4007
e-mail: Bcwwa@bcwwa.org
Web Site: www.bc.wwa.org

Canadian Water and Wastewater Association (CWWA)
45 Rideau Street, Suite 402
Ottawa, Ontario
Tel: 613-241-5692
Fax: 613-241-5193
Email admin@cwwa.ca
Website: www.cwwa.ca

Ontario Water Works Association
675 Cochrane Drive, Suite 630
East Tower, Markham, Ontario L3R 0B8
Tel: 905-530-2200
Fax: 905-530-2135
www.owwa.com

Northern Territories Water and Waste Association
www.fsc.ca/ntwwa

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Western Canada Water and Wastewater Association
301-14 th Street N.W., #203
Calgary, Alberta T2N 2A1
Tel: 403-283-2003
Toll free: 1-877-283-2003
Fax: 403-283-2007
www.wcwwa.ca

American Water Works Association
6666 West Quincy Avenue
Denver, Colorado 80235
Tel: 303-794-7711
www.waterwiser.org

OTHER

The Pembina Institute for Appropriate Development
Box 7558,
Drayton Valley, Alberta T7A 1S7
Tel: (403) 542-6272
Fax: (403) 542-6464
www.pembina.org/eeci

Environmental Protection Agency
Office of Water (WH-595)
Washington, D.C. 20460
(202) 382-7251
www.epa.gov/

Water Plan Software
California Department of Water Resources (CDWR)
Conservation Office
1416 Ninth Street
P.O. Box 942836
(916) 322-9989

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IWR Main Software
Planning and Management Consultants
www.pmcl.com
email: iwrmain@pmcl.com
(618) 549-2832

APPENDIX B

SUPPLEMENTARY PUBLIC INFORMATION MATERIALS

PUBLIC EDUCATION MATERIALS

Environment Canada
Environment Canada makes public education materials freely available in electronic format for reprinting by the municipality. Individual brochures, booklets etc. may simply be downloaded from the Environment Canada website: www.ec.gc.ca/water

The list of materials includes six brochures on various aspects of water, sample bill stuffers, a 30 page booklet "Water No Time to Waste", and a Water Wise curriculum. Environment Canada also has available a slide presentation. The speaker's kit includes a 49 page guide and 33 slides.

Provincial Governments
Many of the provincial departments responsible for water issues have developed public education materials on wise water use. See the listings above for address and website.

AWWA
The American Water Works Association has a variety of public education materials for sale through their web site: www.waterwiser.org

Other Municipalities
Several larger municipalities in Canada have developed extensive public education materials and may make copies available to others on a cost recovery basis. Booklets on indoor water use and xeriscaping might be of special interest to smaller municipalities.

SCHOOL PROGRAMS

Environment Canada
Environment Canada has developed a Water Wise curriculum. It is available through their Web Site at www.ec.gc.ca/water

APPENDIX B

AWWA
The AWWA has also developed a water efficiency curriculum. See their web site for a description and ordering information: www.waterwiser.org

Municipalities

Below is a list of some Canadian Municipalities and organizations that have developed water based education programs.

Region of York:

Water For Tomorrow
www.water4tomorrow.com
Long Term Water Project Office, Regional Municipality of York
17250 Yonge Street, Box 147, Newmarket, Ontario L3Y 6Z1
Michael Brooks, Consultant Project Manager
Phone: (905) 830-4444 ext 5729
Email: mbrooks@rmsi.ca

Region of Waterloo:

One Drop at a Time
www.region.waterloo.on.ca/web/region.nsf
Regional Municipality of Waterloo
150 Frederick St.
P.O. Box 9051 Station 'C'
Kitchener, Ontario N2G 4J3
Phone: (519) 575-4021
Email: watercycle@region.waterloo.on.ca

Region of Peel:

The Peel Water Story
www.region.peel.on.ca/pw/waterstory/
Region of Peel
10 Peel Centre Dr., 4th Floor
Brampton, ON L6T 4B9
Phone: (905) 791-7800 x4548
Email: pablas@peelregion.ca

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Saskatchewan:

Project Wet
www.swa.ca/WatershedEducation/ProjectWet.asp
Lizabeth Nicholls , Environmental Education Specialist
Saskatchewan Watershed Authority
Park Plaza, Suite 420 - 2365 Albert Street
Regina, Saskatchewan S4P 4K1
Phone:(306)787-5242
Fax:(306) 787-0780
Email: ProjectWET@swa.ca

Canada:

This is the umbrella agency for water festivals:

Children's Water Education Council
www.cwec.ca
C/o Doon Heritage Crossroads
Susan Reid
(519) 748-1914 ext. 3265
Email: rsusan@region.waterloo.on.ca

APPENDIX C

ESTIMATING WATER USAGE FROM AN UNMETERED SUPPLY

If your system is not metered, you can use the readings from your electric power supply meter to calculate water production, using the following formula.

Pumping Volume = (Pumping Rate × Time of Operation)

Follow these steps:

3. Calculate the water pumping rate by measuring pump output flow rate. (Measure time to fill a water tank and compute rate in gallons per minute.)
4. Calculate the time of pump operation from the electric meter reading. Procedure:

a) Record the beginning and ending power meter dial readings for the period of interest (day, month, year). Figure the total kWh produced (final minus initial dial meter reading).

b) Multiply the kWh supplied during the period times the scale factor printed on the face of the meter.

c) Record the KWh factor from the meter face.

d) Using pump operation, time the rotation of the meter disc by counting revolutions (for more than 10 revolutions), and record the number of revolutions and the total time in seconds.

e) Compute the instantaneous kilowatt demand with the following formula:

kW (inst) =
(number of revolutions × (Kh factor × 3.6)) ÷
total time in seconds measured in step d

f) Compute the time of pump operation (in hours) with the following formula:

Pumping Time = (Total kWh ÷ kW (inst))

5. Multiply pumping rate (Step 1) by time of pump operation (Step 2) to arrive at volume of water per period (day, month, year).

APPENDIX D

PROCEDURES FOR CONDUCTING A RESIDENTIAL WATER RETROFIT

Water efficiency programs that include installation of retrofit devices provide the municipality with a more accurate record of the number of devices installed, in contrast to a retrofit program in which devices are delivered by mail or picked up and installed by the customers.

When informing the public about the availability of free installation of retrofit devices, the municipality should emphasize the potential for lower water bills as a result of the retrofit.

Although 1 staff person can conduct an audit it is preferable if audits are carried out by a team of two. Audit staff should have a set route based on appointments made with customers. Staff should carry identification cards and show them to residents. Audit staff should **always** explain the tasks they will be performing before they begin. They should also ask the resident's permission before altering any fixtures.

The following outline suggests the types of activities that are performed as part of a residential retrofit installation.

Service Meter

(Optional if a program of regular maintenance is already in place)

Calibration/Flow Test

Leak Test

- Ask customer to turn off all water-using appliances in the home.
- Check the meter dial. If it is still moving, there is a leak in the water using fixtures that should be repaired promptly.

Kitchen

Check the rate of flow from the faucet.

- Turn the faucet fully open.
- Using a watch with a second hand or a stopwatch, time how many seconds it takes to fill a 1-litre jug.
- Divide 60 by the number of seconds it took to fill the jug. For example, if it took 15 seconds to fill the jug, divide 60 by 15. The rate of flow is 4 litres per minute.

APPENDIX D

Offer to install an aerator or restrictor for the customer if one is not already in place.
Check for drips and leaks in the fixture. If the flow rate is above 9 it is not efficient.

Bath

Shower

- Check shower flow rate with a jug as described above.
- Offer to install a low flow showerhead or flow restrictor if one is not already in place. If the flow rate is above 9.5 Lp, than the shower is not efficient.
- Check for drips and leaks.

Sinks

- Check sink faucet flow rate.
- Offer to install an aerator or flow restrictor if one is not already in place.
- Check for drips and leaks.

Toilets

- Check for leaks.
- Place a dye tablet or a few drops of food coloring in the tank. Do not flush the toilet.
- After ten minutes, look in the bowl. If coloured water is present, there is a leak.
- Replace the flapper that controls the entrance of water from the tank to the bowl. Use an early closing flapper to also reduce the flush volume.
- Check the adjustment of the float arm to ensure that no water is running down the overflow tube.
- Offer to install toilet retrofit devices, or offer information on rebates for ultra low flow toilets if appropriate.
- Check the quality of flush, and if the toilet flushes poorly, do not reduce the volume of flush with an early closing flapper.
    - If the toilet is an "American Standard" type, it may require a longer flush handle if an early closing flapper is installed.

Not all toilets are suitable for the installation of retrofit devices.

APPENDIX E

RESIDENTIAL LANDSCAPE AUDIT

A. Measure the flow rate of the sprinklers.

B. Check for leaks in the sprinkler, hose, or sprinkler system.

C. Check the position of the sprinklers. Determine whether the sprinklers cover only the area to be watered or whether the sprinklers need adjustment to prevent water from falling on homes, sidewalks, and other areas.

D. Instruct the customer on how to figure the length of time necessary for water to reach the root zone of lawns.

   1. Show the customer how to identify the root zone.

   2. Inform the customer that water should be applied slowly (to prevent runoff) until the water has reached the bottom of the root zone.

   3. Instruct the customer to time how long it takes for water to reach the roots.

E. Help the customer develop a watering schedule in which the following items are identified:

   1. Any restrictions on watering imposed by the local government.

   2. The best time of day to water - either early morning or after the sun has gone down.

   3. The numbers of days each week to water.
      a. Water only when the lawn does not spring back when stepped on.
      b. Apply water to reach the root zone once a week for temperate climates.

   4. The length of time to water. This will depend on how long it takes or the customer's sprinkler to apply the correct amount of water to penetrate the root zone.

F. Inform customers about low water-use landscaping (which plants use little water, where to buy such plants, and how to group plants on the site).

Adapted from: Washington Department of Ecology, *Water Conservation Planning Handbook for Public Water Systems*, Publication number 91-39,1991.

APPENDIX F

CALCULATING COST SAVINGS FOR A DELAYED CONSTRUCTION PROJECT

A water treatment facility scheduled for construction in year 10 (10 years from the present) can be delayed until year 15 due to reduced water usage from conservation. Savings will be realized in construction and operation/maintenance expenses. How are these cost savings calculated?

In general

1. Determine cost of construction in year 10.

2. Determine cost of construction in year 15:

   Cost in year 15 = (cost in year 10 + inflation)*

   **where the cost in year 15 is dependent on the inflation rate*

3. Determine the cost of the facility built in year 10 in terms of current dollars (this is called present worth):

   *Present Worth at year 10 = Cost at year 10 × (*P/F, i=*Z%,* n=*10)*

Where:

i= interest rate, Z%

n= number of years between year 10 and present

P/F = Single Payment Present Worth Factor

4. Determine the cost of the facility in year 15 in terms of current dollars (present worth):

   *Present Worth at year 15 = Cost at year 15 × (*P/F, i=*Z%,* n=*15)*

Where:

i= interest rate, Z%

n= number of years between year 15 and present

5. Determine capital cost savings. Savings will be the difference in cost between the facility at year 10 and the same facility at year 15, or:

   Savings = Present Worth (yr 10) - Present Worth (yr 15)

APPENDIX F

6. Determine present worth of delayed operating costs. Savings will result from the absence of annual expenses between year 10 and year 15. To determine these savings, find the present worth of annual costs in year 10:

$$\text{Present Worth (yr 10)} = \text{Annual cost} \times (P/A, i{=}Z\%, n{=}5)$$

Where:
i= interest rate, Z%
n= number of years between year 10 and year 15
P/A = Uniform Series Present Worth Factor

7. Determine present worth of the annual cost savings in terms of current dollars:

$$\text{Present Worth} = \text{Present Worth (yr 10)} \times (P/F, i{=}Z\%, n{=}10)$$

Where:
i= interest rate, Z%
n= number of years between year 10 and present
P/F = Single Payment Present Worth Factor

8. Total cost savings are equal to the sum of capital cost savings (Item 5) and annual cost savings (Item 7).

APPENDIX G

TYPICAL WATER CONSERVATION PLAN OUTLINE

I. INTRODUCTION AND SUMMARY

A. Objectives and scope of plan

1.
2.
3.
4.

B. Summary of the plan

1. Projected growth in the study area
    a. Population
    b. Water demands without conservation
2. Water supplies
    a. Local sources of water
    b. Limitations or opportunities for additional water
    c. Proposed reclaimed water facilities
3. Short-term *vs*. long-term conservation opportunities
4. Cost-effectiveness of additional conservation (Level II)
5. Recommended additional conservation measures
6. Items for immediate action

C. Acknowledgments

II. STUDY AREA CHARACTERISTICS (SEE SECTION 2)

A. Demographic Characteristics

1. History of your water
2. Current and projected population
    a. Local planning agency methodology
    b. Allocation of projected figures to study area
    c. Population by housing type

Note: Section numbers refer to where topics are covered in this guidebook

3. Projected nonresidential development (Basis can be either land use or employment)
    a. Land use projections (if available)
    b. Maps of current and future land use
    c. Employment projections if available)

APPENDIX G

B. Existing and historical water use

1. Residential water use
   a. Methodology to separate single and multifamily use
   b. Methodology to separate indoor/outdoor use
   c. Indoor water use patterns
   d. Outdoor water use patterns
2. Industrial water use
3. Commercial water use
4. Institutional water use
5. Unaccounted-for water
6. Total Maximum Day Demand and Average Annual Day Demand
7. Peaking factor
   a. Ratio of maximum day use to average day use (Max day to AADD)

C. Projected water demands

1. Methodology
2. Residential
   a. Single family
   b. Multifamily
3. Industrial
4. Commercial
5. Institutional
6. Unaccounted-for-Water
7. Table showing totals, 5 year increments through 2010
   a. Breakdown by type of use
   b. Average and peak

III. WATER SUPPLY (SEE CHAPTER 2)

A. Groundwater supply

1. Existing wells
2. Plans to expand capacity
3. Water quality problems

B. Existing surface water sources

1. Safe yield of each source
2. Need for and plans to expand capacity
3. Impact of surface water drinking water standards

APPENDIX G

C. Reclaimed water program (if applicable)

1. Current projects and planned projects
    a. Treatment
    b. Distribution system
    c. Amount of irrigation water to be supplied
    d. Long-range strategy (expand service area)

D. Alternative new supplies

1. Availability and timing
2. Unit cost of new supply

E. Existing water system

1. Capacities
2. Deficiencies
3. Water treatment facilities
4. Schedule of improvements
    a. Cost estimates
    b. Capital Improvement Program

IV. CURRENT WATER EFFICIENCY PROGRAM (SEE CHAPTER 2)

A. Summary of company's activities over last few years

1. Municipality conservation measures
    a. Metering
    b. Leak detection
    c. Pricing
    d. Public Information
2. Residential measures
3. Commercial/Public measures
4. Industrial measures

B. Expanded program during recent droughts (if any)

1. Description of short-term measures during drought
2. Water-use reductions achieved

APPENDIX G

V. REVIEW OF WATER EFFICIENCY MEASURES (SEE CHAPTERS 4 TO 7)

A. Measures appropriate for study area

1. Opportunities apparent from water-use data
2. Results of customer surveys
3. Measures in use in other jurisdictions

B. Description of Municipality O&M measures

1. Metering
2. Leak detection and repair

(Follow outline as for chapters 4 through 7.)

VI. EVALUATION OF MEASURES (SEE CHAPTER 8)

A. Criteria

1. Water savings
2. Costs and cost-effectiveness
3. Applicability, Feasibility and Acceptability

B. Results of evaluation

1. Qualitative evaluation of applicability, feasibility and acceptability
   a. Comparison and ranking of alternatives
   b. Selection of measures for further analysis
2. Water savings for potential measures **(Level II)**
   a. Table showing water savings for 2000 and 2010
   b. Table showing wastewater flow reductions
3. Benefit-cost ratios for potential measures **(Level II)**
   a. Derivation of marginal cost of water for Company
   b. Definition of benefit-cost from three perspectives
      (1) Municipality
      (2) Customer
      (3) Community
   c. Results in table

4. Comparison of alternatives *vs*. criteria **(Level II)**
   a. Residential
   b. Nonresidential
   c. Municipality

APPENDIX G

5. Discussion
    a. Measures that could be designed into (required for) new developments
    b. Measures that do not apply
    c. Measures with unreliable water saving estimates
    d. Compliance with any provincial guidelines
    e. Suggested strategy to minimize water use and:
        (1) Be cost-effective
        (2) Maintain new developments' marketability
        (3) Be environmentally sound

VII. RECOMMENDED WATER MANAGEMENT PLAN (SEE CHAPTER 9)

A. Recommended water efficiency program
1. Implementation of additional measures
    a. Description and justification of measures
    b. Incentives and regulations
        (1) New development (if applicable)
        (2) Retrofit
    c. Implementation schedule
    d. Staffing needs
    e. Budget
    f. Financing
2. Management of the program
    a. Program leader
    b. Monitor implementation
    c. Measure water savings **(Level II)**
    d. Expand (reduce) program as needed

B. Recommended near-term action

APPENDICES

A. Provincial Guidelines
B. Chronology of Current Water Efficiency Program
C. Worksheets Used to Develop Program
D. Background Data on Water Use

APPENDIX H

REGION OF WATERLOO'S OUTDOOR USE OF WATER BY-LAW

This is an office consolidation of the Region's Respecting the Outdoor Use of Water By-law No. 33-90 as amended by By-law Numbered 38-92, 03-025, 05-015, 05-036 and 06-013 prepared for reference and information purposes only. If there are any discrepancies between this consolidation and Bylaws 33-90, 38-92, 03-025, 05-015, 05-036, 06-013, and 06-043 the By-laws shall prevail.

BY-LAW NUMBER 03-025
OF
THE REGIONAL MUNICIPALITY OF WATERLOO

A By-law Respecting the Outdoor Use of Water
and to Amend By-laws 33-90 and 38-92

WHEREAS section 2(c) of the *Municipal Act, 2001*, S.O. 2001, c. 25 states that The Regional Municipality of Waterloo is given powers to foster the municipality's current and future economic, social and environmental well-being;

AND WHEREAS section 11 of the *Municipal Act, 2001*, S.O. 2001, c. 25 gives The Regional Municipality of Waterloo the power to pass by-laws respecting water production, treatment and storage;

NOW THEREFORE, the Council of The Regional Municipality of Waterloo hereby enacts as follows:

Definitions

1. In this By-law:

   "Commissioner" means the Region's Commissioner of Transportation and Environmental Services or his or her designate;

   "Council" means the Council of The Regional Municipality of Waterloo;

   "hand-watering device" means a container that is not connected to a watering device, is used to apply water and is operated by muscular power only;

   "OLWR" means Ontario Low Water Response;

   "owner" means the occupant or the owner of premises or their agent;

“person” includes, but is not limited to, an individual, sole proprietorship, partnership, association or corporation;

“Region” means The Regional Municipality of Waterloo;

“sports field” means an outdoor grassy area used for multi-participant sporting events and practices;

“water”, except as otherwise defined in this By-law, means water produced, treated or stored by the Region and obtained through a metered water distribution system;

“water for essential uses” includes, but is not limited to, any water, whether or not produced, treated or stored by the Region and obtained through a metered water distribution system, for drinking and sanitation, health care, public institutions and public protection and safety (e.g. wastewater treatment, fire protection and schools) and basic ecological functions; and

“watering device” includes, but is not limited to, a hose bib, hose, pipe, sprinkler, in-ground or above-ground irrigation system or drip irrigation system used to apply water, but does not include a hand-watering device.

Stage 2 Water Supply Emergency

2. The Stage 2 water supply emergency water-use restrictions set out in sections 5 to 11 of this By-law shall be in effect or shall cease to be in effect for any one or more of the Region’s urban or settlement water systems listed in Schedule “A” attached to this By-law as determined by the Commissioner. *[Amended by By-law 05-036]*

3. When making his or her determination that Stage 2 water supply emergency water-use restrictions are in effect or are no longer in effect, the Commissioner shall have regard to the existence or likelihood of any one or more of the following:
   (a) an OLWR Level II condition;
   (b) a water storage capacity of between 60% and 80% for urban water systems only; or
   (c) pumping at greater than 80% capacity for settlement water systems only.

1. The Commissioner shall give notice of his or her determination under section 2 to the public by declaring his or her determination by any one or more of the following means:
   (a) publication of notice in a local newspaper or newspapers;
   (b) announcements giving notice on radio or television;
   (c) delivery of notice to affected premises; or
   (d) any other means of giving notice that has a reasonable likelihood of coming to the attention of persons who are affected.

Sections 5 to 11 – Water Use Restrictions – Stage 2 Water Supply Emergency

5. deleted *[Deleted by By-law 06-013]*

6. No owner shall permit any person to irrigate with a watering device and no person shall irrigate with a watering device any outdoor grass, turf or lawn except between the hours of 7:00 a.m. and 10:00 a.m. and between the hours of 7:00 p.m. and 11:00 p.m., provided that the outdoor grass, turf or lawn is located on premises or on the road allowance immediately adjacent to and within the extension of property lines of premises with municipal addresses ending in the numbers:
   (a) 0 or 1 may be irrigated within the designated times only on Mondays;
   (b) 2 or 3 may be irrigated within the designated times only on Tuesdays;
   (c) 4 or 5 may be irrigated within the designated times only on Wednesdays;
   (d) 6 or 7 may be irrigated within the designated times only on Thursdays;
   (e) 8 or 9 may be irrigated within the designated times only on Fridays." *[Amended by By-law 06-013]*

6.1. No owner shall permit any person to irrigate with a watering device and no person shall irrigate with a watering device any outdoor plant, flower, tree, shrub or garden except:
   (a) between the hours of 7:00 a.m. and 10:00 a.m. and between the hours of 7:00 p.m. and 11:00 p.m. on even numbered calendar days if the outdoor plant, flower, tree, shrub or garden is located on premises or on the road allowance immediately adjacent to and within the extension of property lines of premises with a municipal address ending in an even number; or
   (b) between the hours of 7:00 a.m. and 10:00 a.m. and between the hours of 7:00 p.m. and 11:00 p.m. on odd numbered calendar days if the outdoor plant, flower, tree, shrub or garden is located on premises or on the road allowance immediately adjacent to and within the extension of property lines of premises with a municipal address ending in an odd number *[Amended by By-law 06-013]*

7. Notwithstanding section 6, irrigation with a watering device is permitted for the following:
   (a) newly planted sod or grass or seed forming part of a lawn:
      (i) at any time during the twenty-four (24) hours immediately after planting or seeding; and
      (ii) immediately thereafter, on each of the six (6) consecutive calendar days between the hours of 7:00 a.m. and 10:00 a.m. and between the hours of 7:00 p.m. and 11:00 p.m.; and
      (iii) (A) immediately thereafter, during the further seven (7) consecutive calendar day period, between the hours of 7:00 a.m. and 10:00 a.m. and between the hours of 7:00 p.m. and 11:00 p.m. on even numbered calendar days if the newly planted sod or grass or seed forming part of a lawn is located on premises or on the road allowance immediately adjacent to and within the extension of property lines of premises with a municipal address ending in an even number; or

(B) immediately thereafter, during the further seven (7) consecutive calendar day period, between the hours of 7:00 a.m. and 10:00 a.m. and between the hours of 7:00 p.m. and 11:00 p.m. on odd numbered calendar days if the newly planted sod or grass or seed forming part of a lawn is located on premises or on the road allowance immediately adjacent to and within the extension of property lines of premises with a municipal address ending in an odd number;

provided a sign, in the form as prescribed in Schedule "B" attached to this By-law, is posted at the entrance to the property in a location visible to all persons that sets out the date when the planting or seeding occurred.

(b) outdoor grass, turf or lawn treated with any pesticide, herbicide or fertilizer that require irrigation while being treated and during the twenty-four (24) hours immediately following the treatment." *[Amended by By-law 06-043]*

8. Notwithstanding sections 6 and 6.1, irrigation with a watering device is not prohibited or restricted when necessary for retail and wholesale nurseries, bowling greens or golf courses to continue to operate. *[Amended by By-law 06-013*]

9. No owner shall permit any person to clean with water and no person shall clean with water the exterior of a building, a driveway or a walkway.

10. No owner shall permit any person to clean with a watering device and no person shall clean with a watering device any vehicle parked on residential premises or on the road allowance immediately adjacent to and within the extension of property lines of residential premises except:

(a) between the hours of 7:00 a.m. and 10:00 a.m. and between the hours of 7:00 p.m. and 11:00 p.m. on even numbered calendar days if the vehicle is parked on residential premises or on the road allowance immediately adjacent to and within the extension of property lines of residential premises with a municipal address ending in an even number; or

(b) between the hours of 7:00 a.m. and 10:00 a.m. and between the hours of 7:00 p.m. and 11:00 p.m. on odd numbered calendar days if the vehicle is parked on residential premises or on the road allowance immediately adjacent to and within the extension of property lines of residential premises with a municipal address ending in an odd number. *[Amended by By-law 06-013]*

10.1. No owner shall permit any person to top-up with a watering device and no person shall top-up with a watering device any permanent swimming pool on residential premises except:

(a) between the hours of 7:00 a.m. and 10:00 a.m. and between the hours of 7:00 p.m. and 11:00 p.m. on even numbered calendar days if the permanent swimming pool is located on residential premises with a municipal address ending in an even number; or

(b) between the hours of 7:00 a.m. and 10:00 a.m. and between the hours of 7:00 p.m. and 11:00 p.m. on odd numbered calendar days if the permanent swimming pool is located on residential premises with a municipal address ending in an odd number. *[Amended by By-law 06-013]*

11. No owner shall permit and no person shall:
(a) irrigate with water during a rainfall;
(b) irrigate with water a driveway, walkway or roadway;
(c) operate a decorative fountain without recycling any water used;
(d) clean with water any decorative fountain or any residential swimming pools, hot tubs or garden ponds; or
(c) waste water when using it outdoors.

Stage 3 Water Supply Emergency

7. The Stage 3 water supply emergency water-use restrictions set out in sections 15, 16, 17, 18, 19, 20, 21 and 22 of this By-law shall be in effect or shall cease to be in effect for any one or more of the Region's urban or settlement water systems listed in Schedule "A" attached to this By-law as determined by the Commissioner.

8. When making his or her determination that Stage 3 water supply emergency water-use restrictions are in effect or are no longer in effect, the Commissioner shall have regard to the existence or likelihood of any one or more of the following:
(a) an OLWR Level III condition;
(b) a water storage capacity of less than 60% for urban water systems only; or
(c) pumping at greater than 90% capacity for settlement water systems only.

7. The Commissioner shall give notice of his or her determination under section 12 to the public by declaring his or her determination by any one or more of the following means:
(a) publication of notice in a local newspaper or newspapers;
(b) announcements giving notice on radio or television;
(c) delivery of notice to affected premises; or
(d) any other means of giving notice that has a reasonable likelihood of coming to the attention of persons who are affected.

Sections 15 to 22 – Water Use Restrictions – Stage 3 Water Supply Emergency

7. No owner shall permit any person to irrigate with water and no person shall irrigate with water any sports fields with a watering device except between the hours of 7:00 a.m. and 10:00 a.m. and between the hours of 7:00 p.m. and 11:00 p.m. provided that sports fields located on premises with municipal addresses ending in the numbers:
(a) 0 or 1 may be irrigated within the designated times only on Mondays;
(b) 2 or 3 may be irrigated within the designated times only on Tuesdays;
(c) 4 or 5 may be irrigated within the designated times only on Wednesdays;

(d) 6 or 7 may be irrigated within the designated times only on Thursdays;
(e) 8 or 9 may be irrigated within the designated times only on Fridays.

7. No owner shall permit any person to irrigate with water and no person shall irrigate with water any lawn, including newly-planted sod or grass seed forming part of a lawn, newly-planted lawn alternative and lawns treated with any pesticide, herbicide or fertilizer.

8. No owner shall permit any person to irrigate with water and no person shall irrigate with water any garden, tree, shrub or other outdoor plant except with a hand-watering device.

9. Notwithstanding sections 16 and 17, irrigation with a watering device is not prohibited or restricted when necessary for retail and wholesale nurseries, bowling greens or golf courses to continue to operate, provided that no owner shall permit any person to irrigate with water and no person shall irrigate with water any part of a golf course other than the teeing grounds and the putting greens.

10. No owner shall permit any person to clean with water and no person shall clean with water the exterior of a building, a driveway or a walkway.

11. No owner shall permit any person to clean with water and no person shall clean with water a vehicle parked on residential premises or on the road allowance immediately adjacent to and within the extension of property lines of residential premises.

12. No owner shall permit and no person shall:
(a) irrigate with water during a rainfall;
(b) irrigate with water a driveway, walkway or roadway;
(c) operate a decorative fountain without recycling any water used;
(d) clean with water any decorative fountain or any residential swimming pools, hot tubs or garden ponds; or
(e) waste water when using it outdoors.

7. No owner shall permit any person to fill with water and no person shall fill with water any decorative fountain or any residential swimming pools, hot tubs or garden ponds.

Regional Emergency Plan

8. When the Commissioner is satisfied that the availability of water for essential uses may not be ensured by a Stage 2 water supply emergency or a Stage 3 water supply emergency, he or she may recommend that the Region's Chief Administrative Officer implement the Regional Emergency Plan to ensure the availability of water for essential uses.

Penalty

9. Every person who contravenes a provision of this By-law is guilty of an offence and upon conviction is liable to a fine not exceeding five thousand dollars ($5,000.00) exclusive of costs, for each offence, recoverable under the provisions of the *Provincial Offences Act*, R.S.O. 1990, c. P.33.

Administration and Enforcement

10. The Commissioner is responsible for the administration of this By-law.
11. This By-law may be enforced by a Municipal Law Enforcement Officer or a Police Officer.
12. If any section or sections of this By-law or parts of it are found by any Court to be illegal or beyond the power of Council to enact, such section or sections or parts of it shall be deemed to be severable and all other sections or parts of this By-law shall be deemed to be separate and independent and shall continue in full force.
13. This By-law may be cited as the Regional Outdoor Water Use By-law.
14. This By-law comes into force on the date of its final passage.
15. Sections 7 and 8 of By-law Number 33-90, and Sections 2, 3, 4, 5 and 6 of By-law Number 38-92 of the Region shall be repealed effective on the coming into force of this By-law.

By-law 06-043 read a first, second and third time and finally passed in the Council Chamber in the Regional Municipality of Waterloo this 14th day of June, A.D., 2006.

By-law 06-013 read a first, second and third time and finally passed in the Council Chamber in the Regional Municipality of Waterloo this 22nd day of March, A.D., 2006.

By-law 05-036 read a first, second and third time and finally passed in the Council Chamber in the Regional Municipality of Waterloo this 8th day of June, A.D., 2005.

By-law 05-015 read a first, second and third time and finally passed in the Council Chamber in the Regional Municipality of Waterloo this 23rd day of March, A.D., 2005.

By-law 03-025 read a first, second and third time and finally passed in the Council Chamber at the Regional Municipality of Waterloo this 14th day May, 2003.

By-law 38-92 read a first, second and third time and finally passed in the Council Chamber at the Regional Municipality of Waterloo this 14th day May, 1992.

By-law 33-90 read a first, second and third time and finally passed in the Council Chamber at the Regional Municipality of Waterloo this 24th day March, 1990.

SCHEDULE "A"

THE REGIONAL MUNICIPALITY OF WATERLOO SETTLEMENT WATER SYSTEMS

Integrated Urban Water System

Kitchener
Waterloo
Cambridge
Elmira
St. Jacobs
Breslau
Lloyd Brown (Orr's Lake)
Mannheim – Victoriaburg (Shingletown)

Settlement Systems

Ayr
Branchton Meadows
Roseville

Heidelberg - Hahn
Linwood
St. Clements
Wellesley

Baden
New Dundee
New Hamburg
St. Agatha
St. Agatha - (Sararas)
St. Agatha – (Swarzentruber)
Foxboro Green

Conestoga Golf Course
Conestoga Plains
Heidelberg - Huehn
Maryhill
Maryhill – Village Heights
West Montrose – Montrose Heights

SCHEDULE "B"

PRESCRIBED SIGN

THE SOD OR GRASS SEED ON THIS PROPERTY WAS PLANTED ON

____

________, 20__

(Day, Month)

(Year)

Region of Waterloo

SIGN POSTED PURSUANT TO THE REGIONAL OUTDOOR WATER USE BY-LAW (03-025, as amended)

Minimum of 20 cm

Minimum of 15 cm

NOTE: Each sign to be made of water resistant material

STAGE 2 OUTDOOR WATER USE RESTRICTIONS
EFFECTIVE MAY 31 – SEPTEMBER 30, 2006

REGION OF WATERLOO OUTDOOR WATER USE BY-LAW
SUMMARY OF RESTRICTIONS

Program Levels	Status Quo Stage 1 (on all time, voluntary 10% reduction)	Stage 2 (voluntary 20% reduction)	Stage 3 (mandatory 20% reduction)
Wasting Water	Local Municipalities' Odd-Even By-Laws	Prohibited	Prohibited
Watering Lawns		Once Per Week With Time Restrictions*	Prohibited
Watering Treated Lawns		Water Within 24 Hours	Prohibited
Watering New Lawns		*7 days with time restrictions**	Prohibited
Watering Trees, Shrubs, Flowers, Gardens		**Alternate Day With Time Restrictions***	Hand Watering Devices Only
Water Sports Fields		**No Restrictions**	Once Per Week With Time Restrictions
Top-Ups, Permanent Residential Swimming Pools		**Alternate Day With Time Restrictions***	Limited or Prohibited
Residential Vehicle Washing		**Alternate Days With Time Restrictions***	Prohibited
Decorative Fountains		Must Recirculate Water	Prohibit Filling
Washing Streets, Driveways, Walkways, Buildings		Prohibited	Prohibited
Fines		$150 per offence	$225 per offence

DOCS#266255

*Time restrictions are 7:00-10:00 a.m. and 7:00-11:00 p.m.

*Alternate days means addresses with even numbers can water on even-numbered dates and odd-numbered addresses water on odd dates.

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