Regional Case Studies

Best Practices for Water Conservation in the Great Lakes-St. Lawrence Region

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Great Lakes Commission
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Preface

This case study analysis is one of three reports developed through the project, *Developing Water Conservation "Tool Kit" for the Great Lakes-St. Lawrence Region*, supported by the Great Lakes Protection Fund and authored by the Great Lakes Commission. The objective is to illustrate the best conservation practices within the Great Lakes region. In so doing, it informs the work of the Great Lakes states and provinces in implementing the 2001 Annex of the Great Lakes Charter of 1985. This project particularly addresses the Annex provision to establish a decisionmaking standard based on the principle of "preventing or minimizing basin water loss through return flow and implementation of environmentally sound and economically feasible water conservation measures."

The Great Lakes Commission's involvement in this project reflects its long-term interest in Great Lakes water resources management activities consistent with its mandate to "promote the orderly, integrated and comprehensive development, use and conservation of the water resources of the Great Lakes Basin" (Article I, Great Lakes Basin Compact). The principal author of this paper is Rebecca Lameka, Great Lakes Commission, Program Specialist. Ongoing project consultation and oversight has been provided by a Project Advisory Committee comprised of representatives from federal, state and provincial government and other interested groups. This paper has benefited from the significant input and collaboration of the members of this group. The membership list is included in Appendix A.

The Commission also extends its appreciation to the Project Advisory Committee, Council of Great Lakes Governors and its Annex 2001 Working Group, staff of the city of Chicago and the region of Waterloo, and the staff of the Great Lakes Protection Fund for the guidance, input and support throughout the project.

Executive Summary

This paper is one of several products being developed by the Great Lakes Commission under a project titled: Developing Water Conservation "Tool Kit" in the Great Lakes Region. The project is supported by the Great Lakes Protection Fund of Evanston, Illinois and is one of a suite of projects supported by the Protection Fund to guide and inform the Great Lakes states and provinces as they begin to implement the provisions of the 2001 Annex of the Great Lakes Charter of 1985. The purpose of this paper is to present in greater detail examples of the best water conservation practices in the public water supply sector in the Great Lakes region through a case study approach. There were two case studies selected, one each from the United States and Canada. The first case study is the city of Chicago, Illinois and the second is the region of Waterloo, Ontario. Two case studies have been chosen from a pool of municipal water supply facilities surveyed about water conservation practices implemented in their service area and builds upon the *Water Conservation Briefing Paper: Current Water Conservation Practices in the Public Water Supply Sector in the Great Lakes-St. Lawrence Region.* The city of Chicago and the region of Waterloo were chosen as case studies of best water conservation practices because of their comprehensive approach to water management planning. These plans include a variety of water conservation activities such as financial incentives and disincentives, water audits, public education and outreach, and storm water management. This report presents each case study in a detailed summary. General characteristics of each locale are described including geographic area, water supply, population trends, and other influential characteristics on water management. Then, water conservation practices are summarized in topical categories. Finally, the best water conservation practices for application to regional water management in the Great Lakes-St. Lawrence River region are highlighted. The table below summarizes the conservation plans and programs presented in the case studies.

Water Conservation Planning Characteristics		
Characteristics	**Chicago Water Agenda 2003**	**Region of Waterloo Water Efficiency Master Plan**
Latest Publishing Date	May 2003	November 1998
Audience	General Public	Water Resource Managers/Regional Staff
Goal	To guide water-related decisions for many years.	Establish a long-range water demand strategy for the Region.
Objectives	[No explicit objectives listed]	• Identify specific goals for water-use reductions over the next 20 years • Identify a set of detailed water-efficiency programs and initiatives including budgets and schedules for the first 10 years • Identify methods for monitoring the effectiveness of each program
Water Conservation Programs	• Water distribution upgrades • Conservation in city buildings • Water audits for industrial users • Residential metering • Education and Outreach	• Public awareness • Education curricula • Rain Barrel Day • Toilet replacement program • Conservation in regional buildings • Industrial/Commercial/Institutional initiatives
Other Water Management Issues Addressed	• Water demand • Water quality management (wastewater discharge, beach testing, contaminated sediment remediation, invasive species) • Storm water management (green infrastructure design, downspout disconnection, wetlands rehabilitation)	• Water demand (historic and projected) • Conservation impacts (water supply and wastewater treatment systems, municipalities, and environment) • Existing regulations • Public attitude toward water conservation • Water rate structure • Staffing needs

Introduction and Background

Water Conservation and the Great Lakes Charter Annex 2001

Water conservation can alleviate problems of inadequate water supplies and reduce stress on aquatic ecosystems. Communities can benefit from water conservation as they seek to address increasing water demand and to preserve ecosystem integrity. Water conservation is practiced in arid regions of the United States and Canada, where growing communities must manage finite water supplies. Most local governments in the Great Lakes-St. Lawrence River region, where water supplies appear to be abundant, have not promoted the conservation of water to the same level as communities in arid regions. Nonetheless, in recent years, certain areas within the Great Lakes-St. Lawrence River region have had to address issues related to water supply shortages.

On a regional level, the Great Lakes governors and premiers have recognized the importance and utility of water conservation in managing the Great Lakes water resources. In 2001, they developed and adopted the water management principles set forth in the Great Lakes Charter Annex. In agreeing to this Annex, the governors and premiers commit to further implement the principles of the Great Lakes Charter to protect, conserve, restore, and improve the biological and hydrologic resources of the Great Lakes-St. Lawrence River basin. Furthermore, the governors and premiers commit to develop and implement a new common, resource-based conservation standard and apply it to new water withdrawal proposals from the Great Lakes-St. Lawrence River basin. The standard will also address proposed increases to existing water withdrawals and existing water withdrawal capacity from the waters of the Great Lakes-St. Lawrence River basin.

Directive #3 of the Great Lakes Charter Annex calls for a water resources decisionmaking standard that includes water conservation measures. The directive states:

> "The new set of binding agreement(s) will establish a decision making standard that the States and Provinces will utilize to review new proposals to withdraw water from the Great Lakes Basin as well as proposals to increase existing water withdrawals or existing water withdrawal capacity.
>
> The new standard shall be based upon the following principles:
>
> - Preventing or minimizing Basin water loss through return flow and implementation of environmentally sound and economically feasible water conservation measures; and
> - No significant adverse individual or cumulative impacts to the quantity or quality of the Waters and Water-Dependent Natural Resources of the Great Lakes Basin; and
> - An Improvement to the Waters and Water-Dependent Natural Resources of the Great Lakes Basin; and
> - Compliance with the applicable state, provincial, federal, and international laws and treaties."

As communities in the Great Lakes-St. Lawrence River basin begin to develop, implement and improve their water conservation programs, they need to have access to appropriate knowledge of what measures are best suited to their individual needs. Furthermore, knowledge of best water conservation practices will inform public water systems working under the Great Lakes Charter Annex framework. This paper provides information on the current best water conservation practices in the region to better inform these communities and their water resource managers.

Project Overview

This paper on cases studies of best water conservation practices is one of several products developed through the Great Lakes Commission's *Developing a Water Conservation "Tool Kit" for the Great Lakes-St. Lawrence Region project*. This project is supported by the Great Lakes Protection Fund as part of a set of projects designed to provide practical and scientific support to the governors' and premiers' commitments made in the Great Lakes Charter Annex.

This project builds upon the outcomes of a larger Great Lakes Project Fund-supported project, titled *Toward a Water Resources Management Decision Support System* (WRMDSS), and the work pursued by its Water Withdrawal and Use Technical Subcommittee (TSC) in support of that effort. In the section on state and provincial water use and conservation programs, the WRMDSS report finds that while conservation programs exist in all jurisdictions, they vary widely in scope and content, and are usually part of state and provincial drought contingency plans. Otherwise, Great Lakes jurisdictions currently have limited involvement in water conservation activities.

This water conservation project adds greater definition to these findings from the WRMDSS project. With support from the Great Lakes states and provinces through the Water Withdrawal and Use TSC, the project has developed a regional "tool-kit" for water conservation, featuring several products in addition to this paper:

- *Water Conservation Briefing Paper: Summary of Current Conservation for the Public Water Supply Sector in the Great Lakes-St. Lawrence Region*
- *Public Sector Water Conservation: Technology and Practices outside the Great Lakes – St. Lawrence Region*
- An Online Directory of Water Conservation Tools, Data and Information

Case Study Development

This paper presents two case studies in best water conservation practices in the Great Lakes-St. Lawrence River basin: one case study is the city of Chicago, Illinois, and the other is the Region of Waterloo, Ontario. These case studies were chosen from a pool of municipal water supply facilities surveyed about water conservation practices implemented in their service area and build upon the *Water Conservation Briefing Paper: Summary of Current Conservation for the Public Water Supply Sector in the Great Lakes-St. Lawrence region*. One hundred thirty-six water facilities participated in the summary from Illinois, Michigan, Minnesota, New York, Pennsylvania, Ohio, Ontario, and Quebec. The survey results provided a sample of conservation activities across the region and among different community sizes. Topics covered by the survey include water conservation activities, formal conservation plans, financial incentives, guidelines, regulations, future trends in conservation activities and education. A few trends in the responses to the survey are worth noting. Leak detection and repair is the most practiced conservation activity by water systems surveyed in the Great Lakes region. In addition, more than half (65 percent) of the facilities who responded do not operate under any formal conservation plan.

The city of Chicago and the region of Waterloo were chosen as case studies for best water conservation practices because of their comprehensive approach to water management planning. These plans include a variety of water conservation activities such as financial incentives and disincentives, water audits, public education and outreach, and storm water management.

The case studies also illustrate the application of water conservation plans to different situations and at various stages of implementation. The city of Chicago, as well as other Lake Michigan water allocation permittees in the region, began water conservation planning in 1989 in response to the Illinois Department of Natural Resources regulation to reduce unaccounted-for water. In 2003, the city released a more comprehensive water management plan, titled the *Water Agenda 2003*, which is just beginning implemented. In contrast, the region of Waterloo has a long history of water conservation with the establishment of its Water Efficiency Department in 1974. The region of Waterloo has approached water conservation through a comprehensive plan developed in 1991, titled the *Long Term Water Strategy*. Water conservation programs are assessed and updated periodically through Waterloo's planning process. Furthermore, the case studies present water conservation practices from different geographical locations, community sizes and governmental structures. The city of Chicago is a large municipality of nearly 2.8 million people, located at the southern tip of Lake Michigan. The region of Waterloo is a regional government of three urban municipalities and four rural townships, serving 465,000 people in the Grand River watershed of southwestern Ontario, Canada. These differences are important to the understanding of how water conservation can be applied to meet various water management challenges.

Much of the data used to develop these case studies were gathered from the local governmental agency responsible for managing these water conservation activities. For the case study on the region of Waterloo, the Water Efficiency Department offered many documents (*Long Term Water Strategy, Water Efficiency Master Plan*, internal memos and reports) that described their conservation practices in great detail, provided updates on the progress of these conservation practices, and proposed future conservation practices and improvements on existing practices. For the case study on the City of Chicago, the Chicago Department of Water Management and the Department of Environment offered the *Water Agenda 2003* as the primary source for information on existing and proposed water conservation practices.

This report presents each case study in a comprehensive summary. General characteristics of each locale are described including geographic area, water supply, population trends, and other influential characteristics on water management. Water conservation practices are then summarized in topical categories. Finally, the best water conservation practices for application to regional water management in the Great Lakes-St. Lawrence region are highlighted.

Case Study: City of Chicago, Illinois, United States

Background

The city of Chicago is located at the southern tip of Lake Michigan in the state of Illinois. It was established in 1837 with a population of 4,170. At present, the city's population is approximately 2.9 million people. In the 1990s, the population grew by about 4 percent. Two hundred seventy-three suburban communities, spanning six counties and home to an additional five million people, constitute the greater Chicago metropolitan area. The Northeastern Illinois Planning Commission predicts the population for the region to grow by 25 percent from 1990 to 2020.

Approximately 13 percent of the water demand for public supply from the Great Lakes comes from the northeast region of Illinois (Great Lakes Commission, 1999). Lake Michigan is the primary source of water for both the city of the Chicago and its metropolitan area. In 2000, almost 200 public water suppliers in the metro area used Lake Michigan water as their principal water supply, with total domestic consumption in the region reported by the Office of Water Resources (OWR) of the Illinois Department of Natural Resources at 1095.8 million gallons per day (mgd) [4148.07 million liters per day (mld)]. The city of Chicago is the largest water supplier in the metro area, selling water to 118 of the 197 suburbs and water districts in the entire region given state allocation permits by OWR. (Jaffe, 2001)

Facts About the City of Chicago

Service Population: 2,896,000

Households: 1,153,000

Average Household Size: 2.51people

Growth Rate from 1990 to 2000: +4%

Area: 228.5 mi^2 (591.8 square kilometers)

Gross Domestic Product: $303.56 billion (US)/$396.79 billion (CA)

Major Industries: professional services, health care, finance, manufacturing and retail trade

Per Capita Water Use: 118 gallons/day (446 liters/day)*

Water Source: Lake Michigan

* Estimation of residential water use for the 2002 water year by the city of Chicago. Note that the majority (70 percent) of Chicago's residential water connections are not metered.

Chicago Diversion

The city of Chicago's drinking water is obtained from Lake Michigan by the Chicago diversion. This diversion reverses the flow of the Chicago River, diverting water from the Lake Michigan watershed to the Mississippi River watershed. This diversion was developed in response to major storms in the late 1800s that caused the release of raw sewage into Lake Michigan, contaminating the city's water supply and causing the outbreak of disease. The diversion was constructed by the Sanitary District of Chicago as a sewage works project. It reversed the flow of the Chicago and Calumet rivers so that sewage would flow away from the city's water supply intakes in Lake Michigan. Sewage would be diluted and flushed through a new, larger Chicago Sanitary and Ship Canal (CSSC). This project was designed to support a flow of 10,000 cubic feet per second (cfs)

[6,463 mgd or 24,465 mld] and to allow Chicago's diluted sewage to flow via the Des Plaines River into the Illinois River, which itself discharges into the Mississippi River. Figure 3 depicts the location of the Lake Michigan diversion and outlines the Lake Michigan watershed in the Chicago metropolitan area.

The sewage works project received a permit from the U.S. Army Corps of Engineers in 1899, which set a limit on the flow of water through the CSSC to 4,167 cfs (2,693 mgd or 10,194 mld) although the District designed the project for a 10,000 cfs flow. Since the reversal of the Chicago River and the completion of the CSSC in 1900, Lake Michigan water is withdrawn by public water facilities in northeastern Illinois for domestic use, for navigational purposes, and for the dilution of sewage treatment plant wastewater discharges.

Throughout the 20th century, the diversion outflows have been regulated by federal legislative action and Supreme Court decrees. These decrees limit the amount of water which Illinois may divert each year from Lake Michigan and provide the allocation authority to the state of Illinois. In the first half of the century, the diversion flow limit established by these decrees fluctuated, prompting further federal litigation. However, since 1967, the U.S. Supreme Court has limited diversion to 3,200 cfs (1,722 mgd or 7,829 mld).

Despite the U.S. Supreme Court decreed 3,200 cfs diversion limit in 1994, the U.S. Army Corps of Engineers reported that Illinois had exceeded its diversion limit over a 14 year period – from 1980 to 1994. After being notified by the Corps of this finding, the Great Lakes states of Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania and Wisconsin, and the U.S. government agreed to mediation as an alternative to litigation before the U.S. Supreme Court. After federal mediation, the eight Great Lakes governors and the U.S. Department of Justice signed the Great Lakes Mediation Memorandum of Understanding (MOU) in July 1996, in which Illinois not only agreed to limit its withdrawals to its 3,200 cfs limit under the Court's decrees, but to further limit its diversion to repay the excess amount of water taken in the past. In addition, it agreed to take steps to ensure that its municipalities using Lake Michigan water comply with their state allocation limits and conserve water.

The federal flow restriction and the state water allocation program of the Chicago diversion, along with the limited supply of groundwater sources, constrains Chicago and its greater metropolitan communities in meeting the needs of a growing water demand in the future.

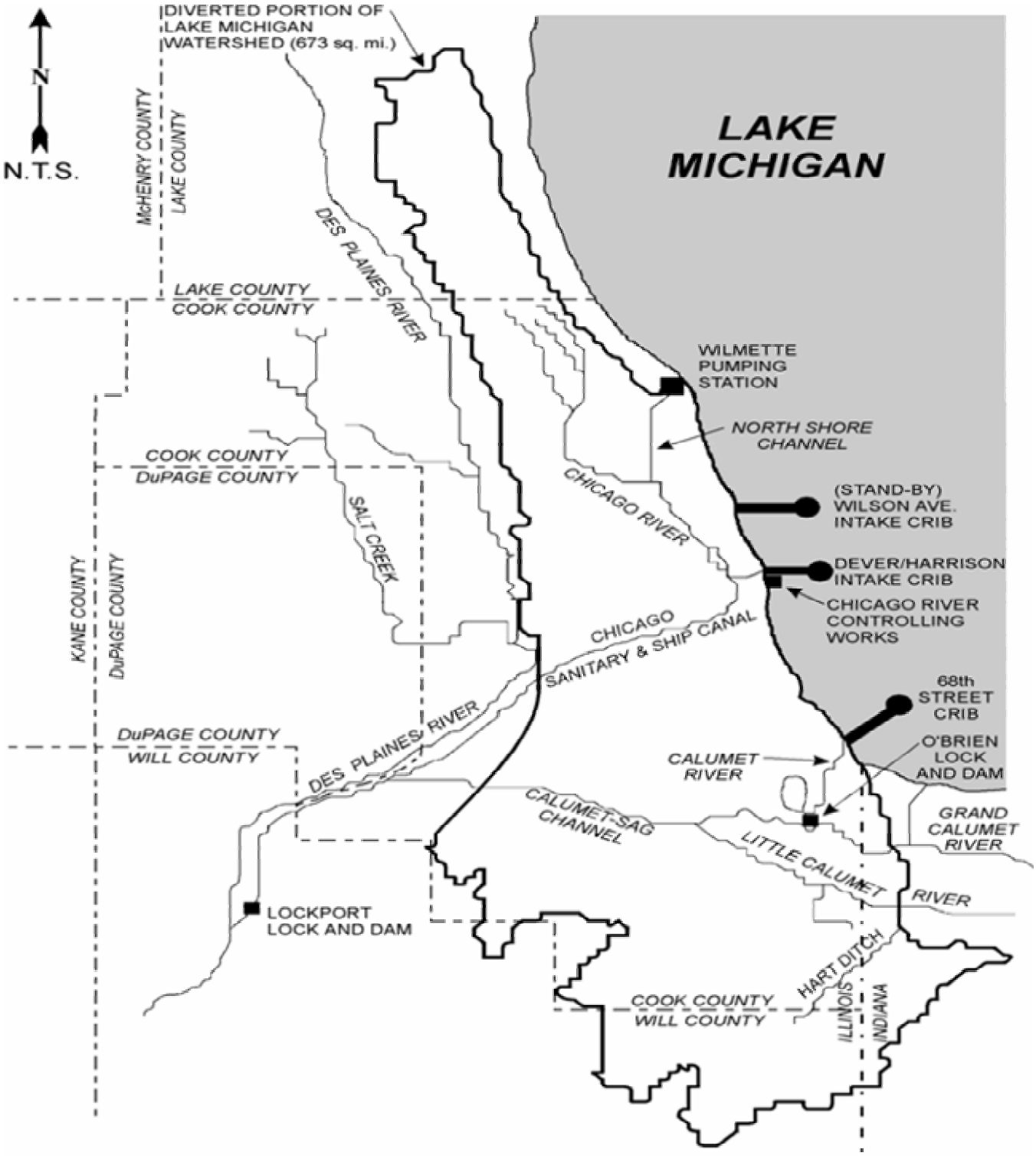


Figure 3 Lake Michigan Diversion Location and Lake Michigan Watershed Boundaries at Chicago
Created by U.S. Army Corps of Engineers, Chicago District, 1998

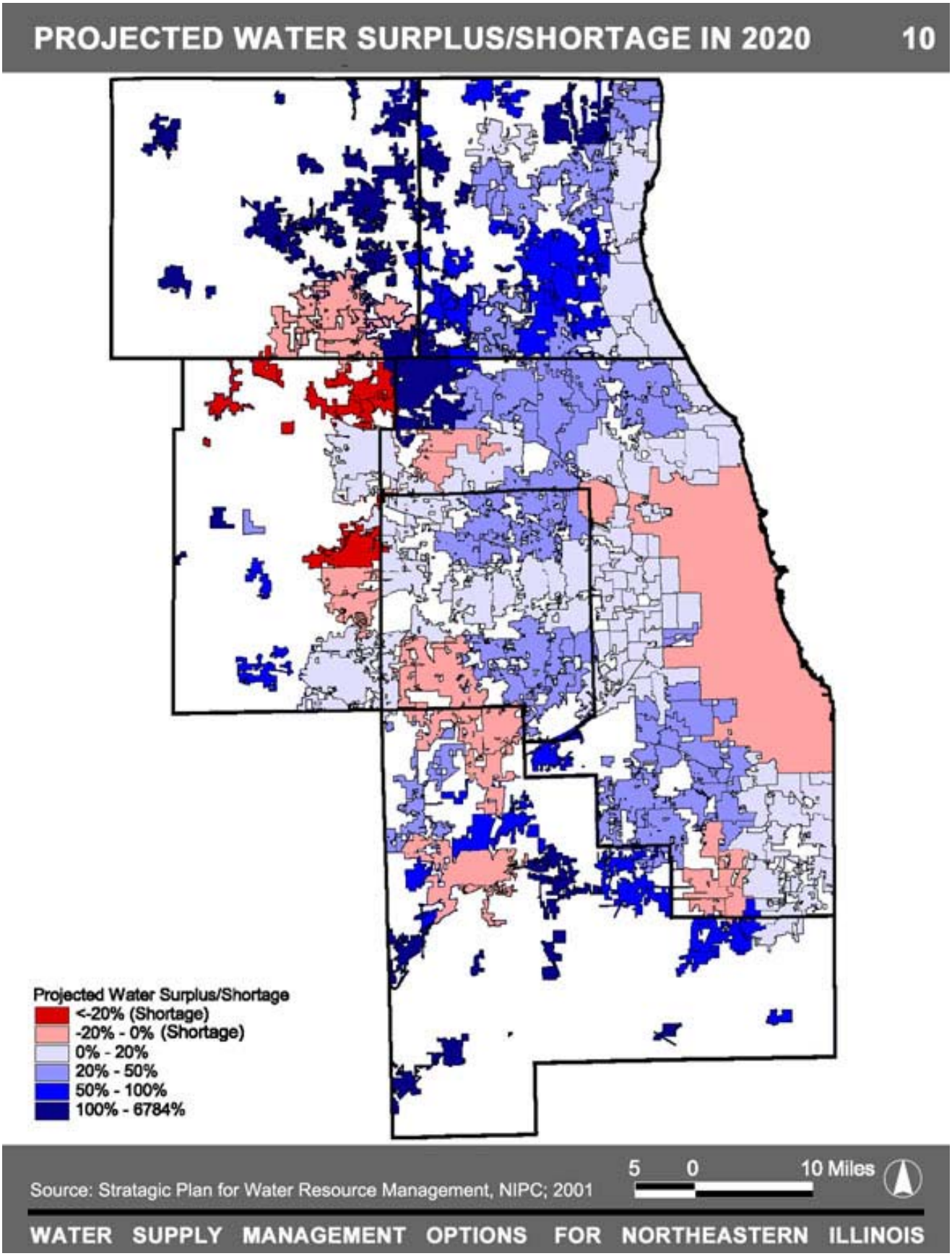
Surface Water and Groundwater Resources

The Chicago metropolitan area's water resources include Lake Michigan, inland lakes and waterways, and deep and shallow aquifer systems. While research on the region's water resources has been conducted, little is yet scientifically known about the exact nature of the numerous complex hydrological interrelationships. This include questions on how groundwater affects Lake Michigan water levels; how surface water contributes to groundwater resources; and how the region's new growth and increased urbanization will affect local and regional groundwater recharge, change the pattern or amount of precipitation as a result of urban heat island and global warming impacts, or modify storm water discharges into the region's surface water resources. (Jaffe, 2001)

Historically, most Chicago area inland suburbs met their water needs by tapping groundwater resources. Communities drew their well water from both the region's shallow aquifer system and a deep Cambrian-Ordovician aquifer system. Over the years, excessive over pumping of water from the deep Cambrian-Ordovician bedrock aquifer system led to significant declines in aquifer pumping levels.

The deep Cambrian-Ordovician aquifer is the region's major groundwater resource, and has an estimated practical sustainable yield of around 65 mgd (246 mld) (Schict et al., 1976). By 1979, however, withdrawals from the Cambrian-Ordovician aquifer by these inland suburbs reached an all-time high of 182.9 mgd (692 mld), leading to lowered aquifer levels and the need for ever-deeper wells. After Lake Michigan water became more accessible to these communities in 1980, after the U.S. Supreme Court modified its 1967 diversion decree to allow Illinois to expand its Lake Michigan service area, withdrawals declined to around 67 mgd (253 mld) by 1994. With the region's shift to Lake Michigan water and the concurrent abandonment of wells tapping the deep aquifer system, the Cambrian-Ordovician aquifer's levels increased an average of 15 feet between 1991 and 1994. (Viscocky, 1997)

An analysis of projected water demand and available supply, supported by the Illinois-Indiana Sea Grant College Program, suggests that there may be future localized water shortages in the Chicago metro region (Jaffe, 2001). The region's access to Lake Michigan water is legally constrained, while the use of inland surface water resources is also limited by competing navigational, recreational and environmental needs. The analysis finds that the deep aquifer system is still being used at an unsustainable rate, leaving the shallow aquifers as the region's primary future water supply resource. However, little is known about the extent, capacity and characteristics of the shallow aquifer system. Figure 4 depicts projected water supply surpluses and shortages for the region.


PROJECTED WATER SURPLUS/SHORTAGE IN 2020
10
Projected Water Surplus/Shortage
<-20% (Shortage)
-20% - 0% (Shortage)
0% - 20%
20% - 50%
50% - 100%
100% - 6784%
Source: Stratagic Plan for Water Resource Management, NIPC; 2001
5
0
10 Miles
WATER SUPPLY MANAGEMENT OPTIONS FOR NORTHEASTERN ILLINOIS

Illinois Lake Michigan Water Allocation Program

By state law, the city of Chicago, as a Lake Michigan Water Allocation permittee, must comply with state regulations of the Illinois Lake Michigan Water Allocation Program. The allocation program was established by the state of Illinois under its Level of Lake Michigan Act of 1996, 615 ILCS 50. This law authorizes the OWR of the Illinois Department of Natural Resources to manage the allocation of Lake Michigan water among regional organizations and municipalities. Part of these regulations is the requirement for permittees to implement water conservation activities as a condition to their water use permit. The conservation requirements are designed to meet Illinois' obligation under state law and the U.S. Supreme Court Decree. According to *17 Ill. Admin. Code,* Part 3730.307 all permittees are mandated to:

- "Submit to the Department proposals designed to reduce or eliminate wasteful water use and to reduce unaccounted-for flows to 8 percent or less, based on net annual pumpage, and procedures used to determine efficiency of water metering or accounting in permittee's system.
  (In 1999, OWR reviewed the allocation permits of 31 communities with unaccounted-for flows exceeding 8 percent; these included Chicago, Buffalo Grove, Calumet City, Glenview, Highland Park, Lockport and Skokie.)

- Submit evidence of adoptions by the permittee of the following conservation practices as applicable to the particular user:

  1. Leakage monitoring and correction for storage, transmission and distribution systems.

  2. Metering of all new construction.

  3. Metering of existing nonmetered services as part of any major remodeling.

  4. The adoption of ordinances which require installation of the following water efficient plumbing fixtures based on a pressure at the fixture of 40 to 50 psi in all new construction and in all repair or replacement of fixtures or trim[1]:

Fixtures	Maximum Flow
Water Closets, tank type	3.5 gal per flush
Water Closets, flushometer type	3.0 gal per flush
Urinals, tank type	3.0 gal per flush
Urinals, flushometer type	3.0 gal per flush
Shower Heads	3.0 gal per minute
Lavatory, sink faucets	3.0 gal per minute

  5. The adoption of ordinances which require the installation of closed system air conditioning in all new construction and in all remodeling.

  6. The adoption of ordinances which require that all lavatories for public use in new construction or remodeling be equipped with metering or self closing faucets.

[1] These flow rates are in the process of being reviewed to reflect lower flow rates specified in the National Plumbing Fixtures Standards.

7. The adoption of ordinances which require that all newly constructed or remodeled car wash installations be equipped with a water recycling system.

8. The adoption of ordinances which restrict non-essential outside water uses to prevent excessive, wasteful use. As a minimum, these restrictions shall provide that unrestricted lawn sprinkling will not be allowed from May 15 - September 15 of each year.

9. Development and implementation of public programs to encourage reduced water use.

- Reduce to a reasonable minimum, and to accurately account for, water used for navigational, lockage, and leakage purposes; and pollution treatment, control or abatement purposes.

- Each permittee which uses any water from deep aquifer pumpage shall submit a phased program designed to end this practice, other than for emergency or standby use, within five years of the receipt of Lake Michigan water.

- Limit hydrant uses to 1 percent or less of net annual pumpage in each annual accounting period.

- Adopt water rate structures based on metered water use and that water rate structures be developed which will discourage excessive water use."

The key issue facing the region is accommodating projected growth in the region while meeting the requirements in the Great Lakes Mediation MOU, an agreement that requires Illinois to reduce its diversion of Great Lakes water in the future in order to make up for exceeding the diversion in the past. OWR projects water demand in the Lake Michigan water service area to increase by 12 percent by 2020. At the same time, Illinois must not only adhere to the 3200 cfs limit it agreed to under the U.S. Supreme Court Decree, but is obligated to further scale back Lake Michigan water diversion by an amount needed to balance the amount that the state overdrew. Balancing these issues provides a renewed impetus for water conservation in the region.

Past Water Conservation Practices

Since 1989 the city of Chicago has implemented an extensive leak correction and water conservation program. It was developed to comply with the Illinois Lake Michigan Water Allocation Act and to help the state comply with the 3,200 cfs water withdrawal limit. The main objectives of the program are to increase water loss control, improve water accounting and increase maintenance in the water meter program. The program was designed to reduce its unaccounted-for flow by:

- Installing devises on hydrants to reduce unauthorized hydrant use
- Educating school children and the community about fire hydrant security
- Maintaining the existing meter repair and replacement program
- Turning services off to vacant or abandoned buildings
- Eliminating unused water services
- Improving billing and account management
- Establishing a closed survey program to monitor leakage and suspected leakage in the entire distribution system
- Replacing 23 miles of water main each year

In an evaluation of the *1989 Water Conservation Plan*, the city estimated that the program will reduce 1995 water pumpage by 100 mgd from 1988 pumpage rates.

Based on review and evaluation of the *1989 Water Conservation Plan*, the *1996 Water Conservation Plan* was developed. Its goal is to provide the highest quality water at the lowest cost possible to the water user. The plan contains the assessment of the 1989 programs, modifications of existing programs, and descriptions of new programs. In addition to continuing the programs introduced in 1989, new developments in the 1996 plan include:

- Expanding the water main replacement program to replace 40 miles of pipe per year at the cost of $400 million over 10 years
- Establishing a water loss accounting and control program
- Expanding the leak detection and repair program
- Requiring all industrial or large quantity users to develop a water conservation plan to meet the minimum goals and objectives established by the city
- Expanding the public education program to include the promotion of water-efficient plumbing devices, reducing water use and detecting leaks

Most of programs listed above, along with newly created programs, are part of *the Chicago's Water Agenda 2003* and will be discussed in greater detail in the next section.

Current Conservation Efforts - Water Agenda 2003

In the spring of 2003, the city of Chicago released its comprehensive water resources management plan, titled *Chicago's Water Agenda 2003*. Its purpose is to guide the city's water-related decisions and to provide a strategy for the wise management of water resources. It presents a vision toward increasing the stewardship of water resources. The primary driving force for the development of the Water Agenda is the mayor's leadership in making clean, potable water a priority for the city.

It presents several water conservation programs in the form of action items under four priority areas: water conservation, water quality protection, storm water management, and education and outreach. The action items expand current water conservation programs and propose new programs as described below. The Agenda will be further developed into individual plans for various action items. For example, a plan for the action item concerning an increase in residential meeting is current being developed. The progress of the various action items is reviewed by an internal committee named the Greening Steering Committee. This committee is charged to review many of the environmental programs implemented by city departments.

The Water Agenda is written in a concise format for a public audience and is posted on the web site of the Chicago Department of Water Management as an educational tool (www.cityofchicago.org/WaterManagement/wateragenda.pdf).

Capital Improvement Program (Water Main Replacement Program)

Because of its large impact on the reduction of unaccounted-for flow and water pumpage, the city places high priority on replacing water main pipe as a key component to its water conservation program. Beginning in 1994, the Department of Water Management is implementing an on-going, capital improvement program that includes replacing 50 miles (80 kilometers) of old, leaking

water mains every year - equivalent to 1 percent of the water system's 4,230 miles (6,808 kilometers) of pipe. In 2002, the city invested $50 million and installed nearly 47.8 miles (77 kilometers) of water main. The selection of water main replacement is based on the history of pipe breakage. Additionally, the Department is assisting other local governments in examining their distribution system for leaks.

Water Conservation in City-owned Buildings

Building upon past efforts, the city continues to review it procedures and implement water conservation measures wherever possible. Programs to reduce water use in city buildings are underway. The Chicago Park District is implementing several water conservation programs:

- Ensuring that all new drinking fountains have on/off controls.
- Retrofitting 43 swimming pools so that they re-circulate water, and upgrading an additional 10 pools.
- Installing splash fountains that re-circulate water.
- Disconnecting downspouts that connect to the sewer system on park district facilities so that storm water is used for irrigation and for recharging groundwater.

In addition to reducing water use in city buildings, the city is researching ways that residents and businesses can save water by:

- Examining the building code for opportunities to allow for the installation of efficient plumbing fixtures
- Exploring the potential of installing gray water systems to irrigate landscaping or for flush toilets in public buildings
- Planting native species that are drought tolerant to reduce the need for watering

In partnership with OWP & P, a consulting firm specializing in architectural design and an internal city working group, the city is examining building code barriers to a range of sustainable design techniques. As a component of this study, various impediments to water conservation are being assessed including the prohibition of waterless urinals, grey water systems and composting toilets. All code barriers will be identified and then changes to the code will be recommended to the City Council.

Water Audits for Industrial Users

The city of Chicago assists businesses in developing their own conservation plans through the Chicago Department of Environment's (DOE) Industrial Energy Efficiency Program. This program provides large industrial energy users with an energy-and-process audit and interest-free loans to implement the audit's recommendations. The DOE started the audit program with the metal casting industry. Seventeen metal casting companies were audited. The audits identified 79,313,340 gallons per year (300,233,650 liters per year) in water savings. The DOE is finishing audits of the chemical industry and completed audits for half of the businesses in the confectionary industry. Seventeen out of 20 chemical companies have been audited, identifying 96,506,450 gallons per

Industry	# of Audits	Water Savings (gal/yr)	Water Savings (liter/yr)
Metal Casting	17	79,313,340	300,233,650
Chemical	17	96,506,450	365,316,650
Confectionary	5	25,667,760	97,163,040

year (365,316,650 liters per year) in water savings. Five of 10 candy companies have been audited, identifying 25,667,760 gallons per year (97,163,040 liters per year) in water savings.

Residential Metering

Currently, a little over 30 percent of the total water service connections are metered. Approximately 350,000 residential water customers still pay for water through a flat, semiannual fee. To increase the percentage of metered connections, the city requires new and rehabilitated housing to have water meters. For 2002 alone, the city has replaced and installed 15,007 new meters as well as repaired 7,826 meters. The Department of Water Management is also developing a comprehensive plan to meter all residential water users. The plan will include the timing and cost of installing meters to all residential connections. The plan will also analyze the impacts of metering on service and operational issues including water pumpage rates, water consumption, billing procedures, meter reading procedures, operational electrical needs, chemical treatment needs, financial strategies, customer and technologies associated with meters, meter reading and data processing.

Public Education and Outreach

Currently, the Water Department's education program includes the distribution of brochures, rulers, coloring books and conservation booklets and flyers at various community meetings as well as a sixth grade curriculum. These materials are designed to educate families on the importance of saving water. Through the Water Agenda, the city plans to launch a citizen education campaign in the summer of 2004, highlighting the importance of water issues including water conservation. The campaign aims to change the public perception of a limitless water supply in Chicago; to explain the connection between storm water and water quality of lakes and rivers; and to educate users about the importance of good stewardship. Mass media and area schools will be utilized to spread the campaign's message. Posters, advertisements on the Chicago Transport Authority buses and trains, and advertisements on the community cable station will be used in the campaign.

In addition to the citizen education campaign, the Department of Environment provides educational tours of best practices in green technology for buildings through the Chicago Center for Green Technology Program (Chicago Green Tech). Chicago Green Tech is the third building in the United States designed with the best green technology available. It is the only one of the three model buildings that is a renovation of an existing building. The building houses environmental businesses and organizations. It is open to the public to demonstrate the use of green technologies (including water-saving technologies), their benefits, and how to apply these technologies to their own home or business.

Chicago Green Tech uses a four-part water conservation system that consists of:

- *Green Roof* – A third of the building's roof is covered with plants that absorb rainwater
- *Cisterns* – Four 12,000 gallon cisterns capture rain that flows off the rooftop, which can be later used to water the landscape.
- *Disconnected Downspouts* – In Chicago, downspouts are typically connected to the sewer system. Disconnecting the downspouts allows rainwater to directly flow into the landscape
- *Bioswales and a wetland* – Rainwater falling on the grounds surrounding the building flows from the parking lots and sidewalks into bioswales and then into the wetland. Bioswales are ditches that support water-loving plant species.

The water conservation system retains over half the rain water that falls on the building's site. For a storm event producing the equivalent of 3 inches of rain in a 24-hour period, the system is estimated to save 90,000 gallons.

Other Conservation Programs

Hydrant Custodians

In addition to the programs presented in the Water Agenda 2003, Chicago continues to install devices on hydrants to reduce unauthorized hydrant use. These devices, commonly known as hydrant custodians, deter people from wasting water by opening hydrants during hot summer days. In 2002, the city reported 17,000 of a total 47,000 hydrants have custodians.

The city continually develops new devices to keep a step head of vandals determined to remove hydrant custodians. One of these newer technologies is the "NEO" version of the custodian that operates with a stronger magnet than older devices. Approximately 6,800 of the 17,000 have the "NEO" and the city planned to install 1,200 more in 2003. Since 1998, the city has found this version to have a significant impact on preventing illegal hydrant openings. In areas where the "NEO" has not been successful, an additional spider guard retrofit will be installed.

Leak Detection and Repair

For the detection of leaks, the Water Department uses electronic leak correlators, aquaphones, and geophones. Leaks make noise because the pressurized water forced out through a leak loses energy to the pipe wall and to the surrounding soil area. This energy creates sound waves in the audible range, which can be sensed and amplified by listening devices. These devices include listening rods, aquaphones, geophones (ground microphones) and electronic leak correlators.

Since 1998, the Water Department has employed newer correlator models that are more sensitive in detecting leaks and have better noise filtering capabilities. Through a pilot study, the city has refined the application of a new acoustic logging system (Permalog), developed by Palmer Environmental, to selected areas of the distribution system. This technology monitors leak noise at night and transmits leak information to a mobile receiver. In 2002, the city planned to install more than 300 of these devices. They have been proven successful in locating leaks that may have been undetected using conventional methods. Another new technology used by the city for leak detection is the Radcom SoundSens. It combines sound logging and correlation by installing three or more correlating units within an area. These units pick up sound during the night, and the data are analyzed the next day by downloading the sounds to a central correlator. A multi-point correlation between the units results in a higher accuracy of leak detection.

For repairing leaks in the system, the city is researching and evaluating the best technology offered by various vendors. Furthermore, in the spring of 2002, the city completed a cleaning and cement lining project on 8,000 feet (2,440 meters) of 36-inch cast iron pipe. Cleaning and cement lining of water mains is the most common rehabilitation method of water mains. Cleaning and lining improves the hydraulics and capacity of the existing pipes by eliminating the buildup of corroded material and mineral deposits on the inside walls.

Case Study: Regional Municipality of Waterloo, Ontario, Canada

Background

The Regional Municipality of Waterloo (RMOW) is located in the Grand River watershed of southwestern Ontario. It was created in 1973 from the county of Waterloo and a small section of the county of Wentworth. Presently, three urban municipalities – Cambridge, Kitchener and Waterloo – and four rural townships – North Dumfries, Wellesley, Wilmot and Woolwich – make up the Waterloo Region. With a combined population of more than 465,000 and a growth rate of 8 percent over the last five years, the Waterloo Region is one of the fastest growing areas in Ontario. 80 percent of the public water supply is derived from groundwater, and the balance comes from the Grand River.

Facts About the Region of Waterloo

Service Population: 465,000

Households: 164,700

Average Household Size: 2.89 people

Growth Rate from 1998 to 2003: +8%

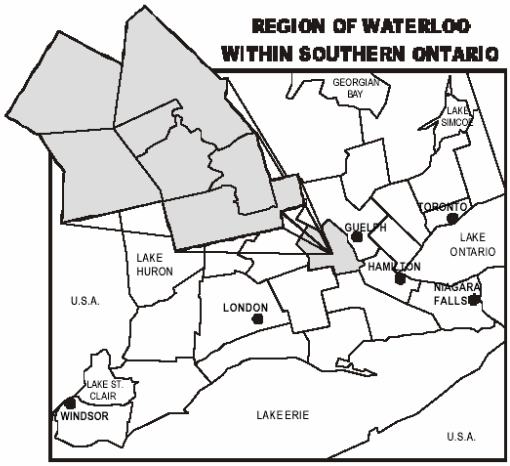
Area: 533.6 mi^2 (1,382 square kilometers)

Gross Domestic Product: $12.38 billion (CA)/$9.47 billion (US)

Major Industries: manufacturing, retail, health care and education P

Capita Water Use : 56.80 gallons/day (215 liters/day)

Water Source: 80% groundwater, 20% surface water – Grand River



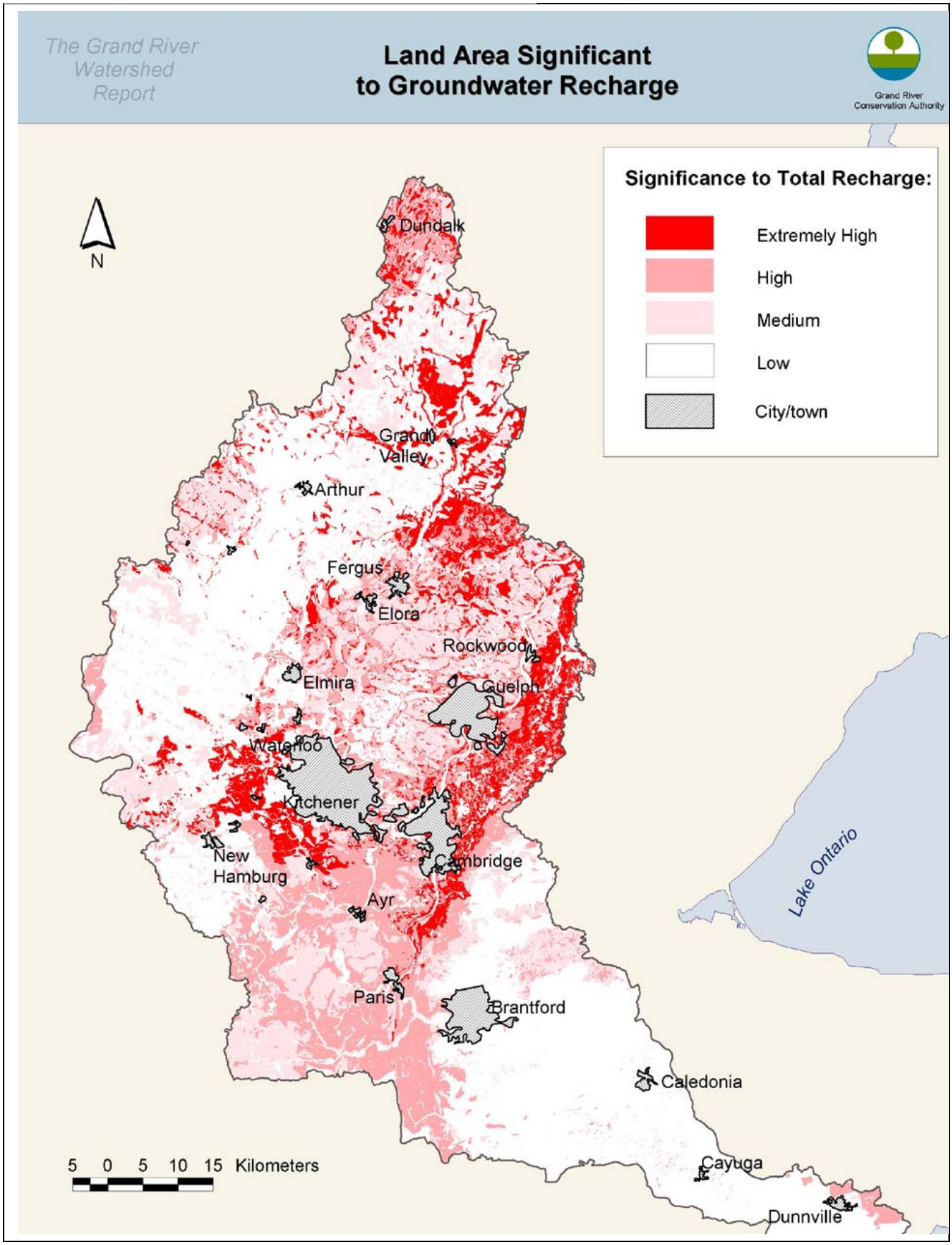
Map created by the Regional Municipality of Waterloo

The RMOW oversees the planning, monitoring, operation and maintenance of the region's water supply and wastewater treatment facilities. The Water Services Division of RMOW sells treated water to member municipalities which, in return, distribute it to residential and commercial customers at retail rates. The wastewater flows back to region-owned facilities for treatment. The Water Services Division also develops and implements water efficiency, water resource protection and sewer-use control programs. The Integrated Urban System (IUS) serves as the region's water supply source. It is a complex network of 67 wells, reservoirs, pumping stations and trunk water mains[2] that supplies water to residents of Cambridge, Kitchener, Waterloo, Elmira, St. Jacobs, Baden and New Hamburg.

The largest water use sector in the region – the municipal water supply – makes up 43 percent of the total water use and is heavily dependent on groundwater. In the Grand River watershed, which encompasses 7,000 square kilometers or 2,600 square miles, about 80 percent of the recharge takes place in 30 percent of the territory. Each of the major cities of the watershed is growing into major recharged areas. Figure 1 is a map published in the Grand River Conservation Authority's Watershed Report that depicts land area significant to groundwater recharge.

[2] Trunk water mains are large, region-owned water mains that deliver large volumes of treated water from one area to another. Water from these mains will then enter the area municipality distribution systems.

Figure 1: Land Area Significant to Groundwater Recharge



Water quantity concerns in the Grand River watershed have become increasingly important in recent years because of drought conditions. Over the period from 1997 to 2002, the Grand River watershed has experienced a string of dry summers, raising concerns about climate change and the potential short- and long-term impacts of weather. During this time period, annual precipitation levels across the watershed have been below the average by 11 percent, or about two feet (61 centimeters) of rain. The shortfall is equivalent to eight months worth of rain. 2003 was wetter than 2002, yet the effects of the drought continue. Much of the rainfall came from short, localized rain showers. As a result, water from these storms contributed to surface water runoff and did not add much to the groundwater supply. These concerns also include the ability of the river and groundwater system to meet the growing water demand while maintaining river water quality and health; the capacity of the Grand River to receive additional wastewater; and the resiliency groundwater resources and sensitive habitats under the stresses of urbanization.

The quantity of water available in the Grand River watershed is finite. Because numerous water users exist in the watershed, ensuring adequate water for all users, including the natural environment, becomes an increasing challenge. The Grand River watershed is one of the fastest growing areas in Ontario. Its population, which includes the region of Waterloo, is expected to grow by 37 percent over the next 20 years. Coinciding with the expected population growth is the growing concern about the region's water resources. The ability for the region to meet high water demands during the summer months illustrates this challenge. Since the construction of the Mannheim Water Treatment Plant in 1993, the region has become more reliant on this plant to meet daily water demands. Currently, the existing water supply system without the Mannheim Plant can barely meet average daily water demands and only if all the wells in the system are functioning. During summer 2002, the maximum weekly water demand peaked at approximately 50 mgd (189 mld). This is close to the system capacity, and the failure of even one well could have resulted in demand exceeding supply. The region also reported relatively high water demands in smaller rural systems during summer 2002, requiring the trucking of water to maintain adequate water supply during peak periods.

History of Conservation

Beginning in the mid-1970s, the region of Waterloo began water conservation initiatives that focused on the residential sector. 1974 marked the beginning of the Water Efficiency Department (of RMOW). Pilot projects promoting the installation water-efficient plumbing devises were initiated, and lawn watering restrictions were established for the cities of Kitchener and Waterloo. Since the early 1980s, the region of Waterloo has implemented various water conservation programs. Because the residential, public supply water use sector is approximately 43 percent of the region's water demand and more than 50 percent of daily indoor water use is accounted by toilet and shower use, these conservation programs concentrated on the distribution of toilet retrofit devices and water-efficient showerheads. Since 1994, more than 35,000 older toilets have been replaced with water-efficient, 6-litre toilets through the Regional Toilet Replacement Program. In the city of Waterloo, part of the Waterloo region, conservation efforts cut domestic water use by 13 percent between 1991 and 1999.

Long Term Water Strategy

Until the 1990s, the region's conservation programs have been largely initiated on an adhoc basis and lacked a comprehensive plan with specific water reduction targets. To reconcile the water needs of a growing population with the limited supply of groundwater over the next 50 years, the initiative to develop a comprehensive *Long Term Water Strategy* (LTWS) started in 1991. In 2000, the Waterloo Regional Council approved the LTWS. The strategy is a water supply plan to ensure adequate water supply to the region into year 2041. The goals of the strategy include the efficient use of existing water supply infrastructure; the best use of local water resources; the deferment of capital expenditures; and the flexibility to adapt to changing water demands in the future. It contains five components described below; the first three pertain to the development of the region's water supply (if required due to water shortages), and the last two address water demand and water quality and quantity assessments:

1. Additional groundwater extraction: 14 to 23 mld (3.7 to 6 mgd) are proposed to be extracted between the years 2018 to 2020. A study to identify the preferred locations to supply the required water amount for the LTWS started in 2003.

2. Aquifer storage and recovery (ASR): 46 mld (12 mgd) from ASR facilities will be developed by 2008. The ASR system consists of specially constructed wells that allow the injection of treated water into the ground during periods of low demand for storage in deep aquifers and the recovery of water during periods of high water demand.

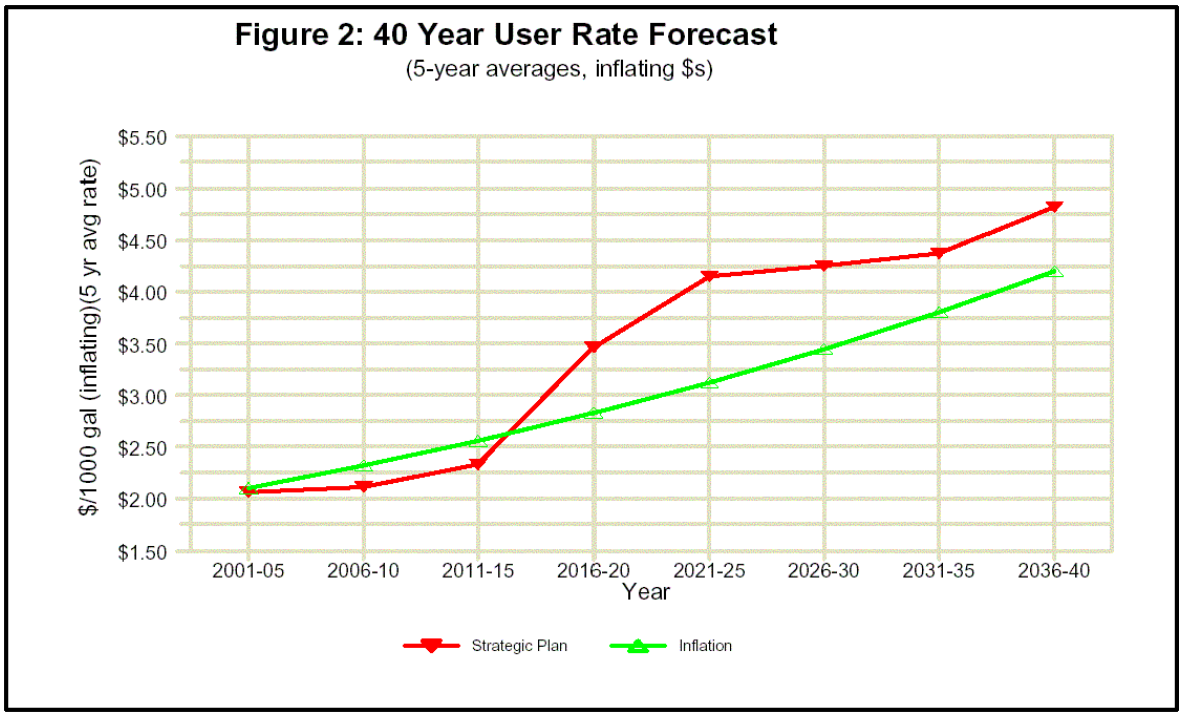
3. Pipeline construction to one of the Great Lakes: 431 mld (114 mgd) would be withdrawn from either Lake Huron or Lake Erie by the year 2055. The estimated total capital costs of either option would be approximately $500 million dollars (CA) or $381 million dollars (US).

4. *Water Efficiency Master Plan*: The plan identifies specific goals or targets for water use reductions over the next 20 years, a set of detailed water conservation programs including timetables and budgets for the first 10 years, and methods for monitoring the effectiveness of each program. The water demand projections developed for the LTWS rely on at least 10 percent reduction in current water usage, resulting from the implementation of the Water Efficiency Master Plan to meet the future supply targets. Programs addressed by this plan will be discussed in the *Current Water Conservation Efforts* section of this paper.

5. *Water Resources Protection Strategy*: This strategy includes water level monitoring and reporting programs to assess the impacts of existing and future land uses on municipal water supplies. It achieves this through (i) identifying and mapping sensitive areas; (ii) identifying potential threats and sources of contamination to sensitive areas; (iii) developing programs and policies to protect sensitive areas from threats; and (iv) increasing awareness of water resources protection issues and of regional programs to address these issues to local residents.

Forecasted Impacts of Long Term Water Strategy

The regional government developed a few forecasting models to determine the impacts of the LTWS on user rates and water demand. In a 2000 Regional Council of Waterloo report, the impacts of the LTWS on the user rates are forecasted over the first 10 years of implementation. Figure 2 depicts user rates forecasted over 40 years. Under the LTWS, modest rate increases are predicted over the first 10 years, and after 2015 the user rate increases significantly. The rate was predicted to increase approximately 2 percent in 2001 with an additional 1 percent increase in 2002. The wholesale water rate of $2.08 (CA) per 1000 gallons would remain constant until 2009. The rate after 2009 is predicted to rise significantly (refer to Figure 2). The region will consider these impacts during the development of a 20-year capital forecast for water supply.



From the Regional Municipality of Water Council 2000 Report, Recommendations on the Long Term Water Strategy

Under the implementation efforts of the LTWS, the region of Waterloo uses demand forecasting as a tool to anticipate future water needs and to design the water supply system's capacity to meet those future needs. The *Long Term Water Strategy – Phase III Report* (2002) identifies future water demand and compares the effects of the water conservation programs, as called for in the LTWS, on future water demand. This assessment was accomplished by calculating unmodified and modified water demand projections. Unmodified water demand projections were calculated using population and land use projections together with unit consumption and peaking factors. These projections did not account for reductions in water usage due to the implementation of water efficiency measures. Table 1 presents water demand projections if no water conservation programs are in place.

Table 1 Unmodified Average Day and Maximum Week Water Demand Projections (MIGD)[3]											
	1991	1996	2001	2006	2011	2016	2021	2026	2031	2036	2041
Average Day	30.47	32.32	34.15	36.40	38.70	40.97	42.77	44.47	46.16	47.72	49.19
Maximum Week	44.55	47.42	50.34	53.78	57.35	60.98	63.92	66.68	69.30	71.65	73.80

The modified water demand projections were calculated similarly to the unmodified water demand projections, but they considered potential effects of water efficiency measures identified in the *Water Efficiency Master Plan* (WEMP). The modified projections included reductions in water demands due to the 1996 changes to the Plumbing Code, natural replacement of inefficient fixtures with efficient ones, implementation of the Toilet Replacement Program (TRP), and implementation of other recommendations from the WEMP. Table 2 presents water demand projections if water conservation programs are in place.

Table 2 Modified Average Day and Maximum Week Water Demand Projections (MIGD)											
	1991	1996	2001	2006	2011	2016	2021	2026	2031	2036	2041
Average Day	30.47	32.16	33.69	35.11	36.93	38.74	40.11	41.53	43.06	44.56	45.93
Maximum Week	44.55	47.26	58.86	50.40	52.94	55.60	57.63	59.77	62.04	64.20	66.14

The water demand projections in Table 1 and 2 illustrate the amount of water savings that can be achieved through water conservation programs. Thus, these programs are an integral part of LTWS, delaying capital expenditure in water supply expansion.

Current Conservation Efforts

Most of the region's water conservation efforts stem from the WEMP of the Long Term Water Strategy. The WEMP is the vehicle through which most of the region's water conservation programs listed below are periodically reviewed and modified and new conservation programs are proposed. In 2002, the Regional Municipality of Waterloo Water Efficiency Section received an Ontario Water Works Association Award for the delivery of its comprehensive, highly successful water conservation programs. Initiatives recognized include the Toilet Replacement Program, the distribution of 6,000 rain barrels, the launch of its second and eight grade water education curricula, and its work in helping large companies like Toyota implement water efficiency programs.

Public Awareness Campaigns

The region's public awareness campaigns consist of public speaking events and presentations; informative brochures on a variety of water conservation topics; educational web sites; radio announcements; and displays at home shows and other functions. In addition, the region of Waterloo is an active participant in the Children's Groundwater Festival and Earth Day. Various informational displays and activities are highlights at these events.

A radio campaign promoting reduced outdoor water use starts in late spring, with regular newspaper advertisements throughout the summer. Should there be a significant increase in demand or change in the level of implementation of the region's Outdoor Water Use Bylaw, the radio campaign will announce the particular outdoor watering restrictions applicable to that time.

[3] MIGD is million imperial gallons per day.

Any changes to water restrictions in the smaller rural systems will be communicated using direct marketing, face to face visits and advertisements in local newspapers. The *Lawn Water Bylaws* section of this report describes, in greater detail, the implementation stages at which certain watering restrictions apply.

The Waterloo-Wellington Children's Groundwater Festival is an opportunity to educate young people about how personal water saving practices is key in sustaining water supplies and meeting future water needs. The festival offers hands-on activities, demonstrations and displays that explain to both children and adults the source and importance of water to themselves, their society and the natural environment. The festival is a cooperative effort between the region of Waterloo, the city of Guelph, the Grand River Conservation Authority, local corporations, small businesses, secondary schools, post secondary institutions and the broader public sector. The goal of the weeklong festival is to raise environmental awareness in an educational and fun setting, for more than 4,000 students from the region of Waterloo and Wellington County. Affiliated with the Children's Groundwater festivals is the Children's Water Education Council. The council acts as coordinating body for the Children's Groundwater festivals across Ontario. Their web site, www.cwec.ca, contains information about the festivals, online resources for educators and a Kids Corner section.

The Region demonstrates best water conservation practices in gardening through its Greenbook Gardens. The Greenbrook Gardens is an education tool for regional residents on maintaining landscapes while using less water. A wide variety of natural landscaping principles are presented in a demonstration plot that encompasses two woodlands, a prairie garden and a rock garden, with some examples of native species. In addition to teaching water conservation principles, the gardens show a unique way of recycling materials. Part of the walkway at the garden is made from 14 tons of crushed toilets from the region's Toilet Replacement Program.

The Water Efficiency Department's web site is another means of communicating its conservation programs, goals, laws and policies, and the importance of water conservation. The web site contains a fact sheet of most commonly asked questions, program contact information, and the latest status of outdoor watering bylaws. Additionally, the web site provides present and past issues of *Environews*, the RMOW's biannual water and waste publication. This publication conveys information and news about water conservation practices, source water protection, and regional water conservation and water management programs. Regional residents can not only access *Environews* from the Internet in PDF format, but they can also receive the publication by mail.

The region of Waterloo Water Services developed a set of educational interactive web pages. The Conservation House web page presents many indoor and outdoor water conservation tips using multimedia

interactive applications. The user can navigate through the rooms and the yard of the house to find how to save water. Other animated pages include a demonstration of the hydrologic cycle and an interactive area map of the Waterloo region, showing the well-head sensitivity areas in the region. These animation pages can be accessed by visiting the RMOW front page, www.waterloo.on.ca. From under the Living banner on the front page, click Water Services, and then Animations.

The region of Waterloo offers a variety of promotional materials on water conservation. These materials include:

- The "40 Ways to be Water Wise" brochure contains tips to save water in and around the home.
- "A Guide to Water Softeners" provides information on water softeners, emphasizing water conservation.
- The "Health, Lawns and Gardens with Less Water" brochure offers tips on water efficient lawns and gardens.
- A "Naturescaping" brochure identifies suitable soils, plants and irrigation systems to create water efficient landscapes.
- The "Rain Barrels" brochure describes the benefits of rain barrels and lists suppliers.
- "Shower Bags" determine the rate of flow of showerheads in liters per minute and gallons per minute, indicating its efficiency.
- "Shower Timers" are five-minute hourglass/timers that suction to the shower stall to encourage shorter showers.
- "Toilet Tank Leak Detector Tablets" are green dye tablets that can detect silent leaks. If green dye is found in the bowl after 3 to 8 minutes of the tablet being placed in the tank, the toilet has a leak. If the water in the bowl remains clear, the toilet does not have leak.

Education Curricula

The Region of Waterloo Curricula Supplement for Grades 2 and 8 – One Drop at a Time was launched jointly by the region and local school boards in fall 2001. The curricula provide teachers with a variety of resources to help educate children about a broad spectrum of issues related to water. The curricula provide information on what water is, how water cycles through the environment, local and global water issues, how to save water, its many uses and how to preserve it for future generations. They also contain sections to help teachers develop learning experiences for the students. During the 2001-02 school year, 46 classes of second grade students used the curricula in the public school system alone. Twenty-nine second grade classes registered to use it in the 2002-03 school year. Teachers in the Waterloo Region District School system can borrow copies of the curricula through their local teaching resource libraries. The region provides complimentary copies to private schools. Curricula booklets and CDs can be purchased through the Water Efficiency Department.

Toilet Replacement Program (TRP)

The RMOW has been promoting the replacement of old toilets with more efficient toilets since the beginning of its water efficiency programs in 1974. At present, the TRP provides $40 rebates to region residents, who are on municipal water and are replacing an old toilet (13 liter or larger) with a new 6-liter flush toilet. The region of Waterloo has allotted 5,000 rebates per year, and this rate is predicted to continue into 2005. In 2002, 3,890 toilets were replaced, taking the region's total to more than 35,000 toilets replaced since 1994. This represents a cumulative water savings of nearly 500,000 liters (132,000 gallons) of water each day. Table 3 presents the cumulative toilet replacement and water savings over the past five years.

Table 3 1998 to 2001 Cumulative Toilet Replacements and Water Savings (Ayr Water Efficiency Program included)

	1998	1999	2000	2001	2002	2003
Total cumulative # of toilets	2,140	6,255	8,785	12,293	16,169	19,534
Total cumulative water savings (gallons/day)	72,452	211,770	297,430	416,195	547,423	660,958
Target water saving under TRP (gallons/day)	70,930	159,230	265,620	372,012	478,405	N/A

In 2003, the TRP was promoted through displays at retail stores, point of purchase literature, local home shows, newspaper and radio advertisements, Environews, and direct marketing flyers. Recently, the program expanded to include non-profit and small business facilities built before 1996 that contain residential-type toilets to be eligible for the $40 rebates. This expansion includes the issuance of a maximum of 1,000 rebates for non-profit and small business toilet replacements. The program also expanded the household rebate limit from two to three rebates per household. Additionally, the program was expanded to provide $60 rebates for 3/6-liter dual flush toilets. The new dual flush toilet is the next generation in water-efficient technology. The Australian-made "Caroma" dual flush toilet features buttons to flush at three liters or six liters, depending on the user's requirements. A 2002 performance study conducted by Canada Mortgage and Housing Corporation concluded that the dual flush toilet is reliable, and will save approximately 26 percent more water than a 6-liter toilet. The Canada Mortgage and Housing Corporation study, along with other toilet performance studies, is posted on the region's web site.

Ayr Water Efficiency Program

In late 2001, the region of Waterloo launched an aggressive water efficiency program in the community of Ayr to address a water and wastewater treatment capacity shortage. Ayr's population increased from 2,870 in 1994 to 3,843 in 2001. The population is projected to increase to 4,630 by 2011. Expansion of the Waterloo region's water supply and wastewater facilities will begin in 2004 and 2005. In order to accommodate this growth, the region of Waterloo's Ayr Water Efficiency project featured a $200 rebate for each 6-liter toilet residents installed to replace older units. Residents were encouraged through advertising to register the number of toilets they wished to replace. Once replacements were done, region staff would visit participating homes to verify installation and educate residents about other ways to conserve water. The region then issued a maximum of $200 toward the purchase and installation of each water efficient toilet. At the close of the program in early 2003, 711 toilets have been replaced. Additionally, 132 water efficient showerheads and 373 low-flow faucet aerators were installed. This represents 38.7 percent of the target 1,839 toilets in Ayr and a cumulative water savings of over 90,000 liters per

day (24,000 gallons per day) from the toilets alone. The number of toilets replaced was not sufficient to allow deferral of any capital projects, but it did achieve some short term capacity and overall reductions in water use. If a toilet replacement rate of 80 percent were achieved in Ayr, the water supply plant expansions could have been deferred by 4 to 7 years, an estimated cost savings of $949,000.

Rain Barrel Day

The region of Waterloo has a 5-year program to distribute 25,000 rain barrels to residents who want to save water and be more environmentally conscious. 2002 was the second year of the program, and 6,000 barrels were sold for $20 per unit, including accessories and taxes. The region of Waterloo distributed 5,000 rain barrels in April 2003. The program is promoted through newspaper and radio advertisements, posters and flyers. Rain barrels are distributed on certain days for a few hours at various retail malls. These locations provide ample room for distribution day activities and parking. Residents who arrive too late to purchase a rain barrel have the opportunity to view informative displays and other attractions inside the malls. The rule of one barrel per household has helped to increase the number of households that obtained a rain barrel. Since the start of this program a total of 12,053 rain barrels have been distributed. Based on the distribution totals, the region staff calculated a total water savings of 14,463,000 liters (3,820,720 gallons). This amount is about equivalent to filling 579 swimming pools.

Lawn Watering Bylaws

Summer water demand is driven primarily by outdoor water use. Traditionally, the region and the area municipalities try to reduce the peak water demand by placing time and odd-even address restrictions on outdoor water use. Residents of odd-numbered addresses water on odd-numbered days, and residents of even-numbered addresses water on even-numbered days. This traditional approach to outdoor watering restrictions has weaknesses. It applies strictly to the urban water system. In recent years, some smaller water systems have experienced water shortages during the summer, and the region did not have the authority to prohibit non-essential water use in those areas. In addition, it lacked the flexibility to allow staff the discretion in activating and deactivating the different Outdoor Water Use Bylaw response levels. To overcome these deficiencies, the region of Waterloo has implemented a new Outdoor Water Use Bylaw, taking a more proactive approach to managing water demand since 2003. The new bylaw further restricts outdoor water use proportional to the severity of the water situation. Advertisement of water conditions and outdoor water use bylaws is part of the region's plan to raise awareness and reduce water demands.

The new outdoor water use bylaw is based on staged outdoor water use restrictions that come into effect when there is a drought or when water storage is low. Rules for using water outside change depending on the severity of the water shortage. The new bylaw is applicable to both urban and rural water users, as well as to business and institutions that water their lawn and gardens. The bylaw consists of three stages of implementation. A set of outdoor water use rules applies to each stage.

Stage 1 is the status quo. Drought conditions do not exist and the water demand is not stressing water supplies. At this stage, residents are asked to abide by the odd-even outdoor water use rules. This rule is in effect year-round in the Waterloo region under normal water supply conditions.

The responsibility for enforcing the bylaw at this stage is left to the individual city or township. Wasting water is restricted. The bylaw defines wasting water as permitting an irrigation system to run during a rainstorm; permitting water to pool or run off any lawn, garden or other outside plant; directing water onto a paved surface, including driveways, sidewalks, or roadways during irrigation; operating a fountain or pond without recirculating water; washing any vehicle or the outside of a building with the use of a hose not equipped with a shut-off nozzle; and the use of flowing water instead of dry sweeping to remove loose debris from a residential driveway.

Stage 2 is announced when drought conditions occur, or if water supplies are low. Residents are asked to follow a once-per-week watering schedule. Residents are permitted to water one day per week, according to the number of their house address. Watering on the specified day must take place between the hours of 7 - 8 a.m. and 7 - 11 p.m. No resident will be permitted to water outdoors on Saturday or Sunday. Regional Bylaw Enforcement officers will enforce the rules at this stage and issue fines for non-compliance. The restrictions are as follows:

- Lawns, trees, shrubs, flowers and gardens are to be watered once a week.
- Newly planted sod or seed can be watered within 24 hours of planting or treatment, then according to the once-per-week schedule.
- Residential vehicle washing is subject to the once-per-week watering rule.
- Washing streets, driveways, walkways and buildings is completely restricted.
- Wasting water is completely restricted.

Stage 3 comes into effect if a water emergency is not prevented during Stage 2. At this stage all outdoor water use is completely restricted, including lawn watering. Regional Bylaw Enforcement officers enforce the rules at this stage and issue fines for non-compliance.

Water Conservation in Region-owned Buildings

The region continues to apply water efficient devices and principles in regional facilities, including process changes, naturescaping, low-flush plumbing devices, leak detection and repair, and water-efficient behaviors of regional staff. Examples of past efforts are:

- Retrofitting 63 washrooms with low-flush or water-efficient toilets/urinals
- Installing an underground drip water irrigation system for landscaping at the Regional City Hall
- Changing water treatment chemicals in cooling towers at Regional City Hall and the Community Health and Social Services building, which reduced water usage by 35 to 40 percent

Industrial/Commercial/Institutional (ICI) Customer Initiatives

The region of Waterloo is working with large local industries to identify ways that they can save water. To date, organizations like Toyota Motor Manufacturing Canada, Conestoga College, Derlan Aerospace Canada and others have initiated major process changes that translate into large water savings in the region. The organizations' combined savings was more than 1 million liters per day (264,000 gallons per day), which is enough to supply the daily needs of over 3,000 residents or over 1,000 households. The region has supported information sharing seminars, developed training manuals, and created newsletters for the ICI sector.

In 2003, a water use efficiency audit was completed for the Cambridge Memorial Hospital. It found that the hospital's water consumption was considerably higher than comparable hospitals, and a list of recommended water conservation measures are being considered for implementation. The audit report also identified that more than 40 percent of water use in the hospital is from domestic washing and water use. As a result, the hospital purchased and installed 31 of the 3/6-liter dual flush toilets and 31 of the 6-liter flush toilets to replace obsolete toilets. The estimated annual savings from these installations is 9.4 million liters per day (2.5 million gallons per day).

Future Conservation Projects

In addition to all the programs currently underway, the region has proposed conservation projects in the near future. One of them is the Community Housing Water Efficiency Project. The proposed project would test dual flush 3/6-liter toilets in community housing. The project would gather baseline information about the efficiency of toilets currently installed in community housing to determine both water savings and long term maintenance costs associated with using dual flush toilets.

Another future project is a series of groundwater protection studies to update the Water Resources Protection Strategy Implementation Plan. These studies will also update previous work and fill data gaps. The component parts of these studies are Aquifer Characterization/Regional Groundwater Assessment; Wellhead Protection Areas; and the Development of an Action Plan for Groundwater Source Protection.

More information on RMOW's water conservation activities is available on the region's web site: www.region.waterloo.on.ca/web/region.nsf/form?OpenForm.

Best Practices for Regional Applications

On a regional level, the Great Lakes governors and premiers have recognized the importance and utility of water conservation in managing Great Lakes water resources. In 2001, the governors and premiers developed and adopted the Great Lakes Charter Annex, a supplementary agreement to the Great Lakes Charter of 1985. In agreeing to this Annex, the governors and premiers committed to further implement the water management principles of the Great Lakes Charter in order to protect, conserve, restore and improve the biological and hydrologic resources of the Great Lakes – St. Lawrence River basin.

The Great Lakes Charter Annex process calls for the development of a decisionmaking standard to assess water withdrawal proposals. As the Great Lakes governors and premiers continue to develop and refine a decisionmaking standard through the Annex process, the methods of conservation described in these two case studies as well as their approach toward implementing these programs should be considered.

In considering a conservation plan requirement for proposals, plans already developed in the region should be examined. A comprehensive water conservation/management plan – such as Chicago's *Water Agenda 2003* and the region of *Waterloo's Water Efficiency Master Plan* and *Long Term Water Strategy* – is a useful tool for developing and applying water conservation actions within the larger context of water resources management. The U.S. Department of Interior, Bureau of Reclamation promotes the development of water conservation plans as an effective means for managing water resources. Developing a thorough water conservation plan is an opportunity for every water user to identify water management problems, evaluate options, highlight accomplishments and plan for improvements. The programs and activities developed through conservation plans can:

- improve reliability of existing water supplies
- reduce overall operating costs for water users
- postpone the need for new or expanded water supplies, storage capacity, treatment works or drainage remediation
- reduce soil erosion and drainage problems
- reduce the impacts of drought
- yield conserved water for additional agricultural, urban, or environmental needs

In addition, these efforts will result in other benefits that include improved and protected surface and groundwater quality through the reduction of non-point and point sources of pollution; and energy conservation (U.S. Bureau of Reclamation, 2003).

Opportunities for water management and efficiency improvements vary greatly from system to system. Many factors can contribute to whether or not specific water conservation measures may be locally effective or feasible. Therefore, a plan can be tailored to meet the specific needs of a water system. The case studies described in this paper illustrate how water conservation planning can be applied to various water resources challenges.

Although the plans presented in each case study are different in their stage of implementation and audience to which they are directed, both plans present their conservation programs as part of a

greater effort to manage their water resources wisely. The characteristics of each plan are summarized in the table below.

Water Conservation Planning Characteristics		
Characteristics	**Chicago Water Agenda 2003**	**Region of Waterloo Water Efficiency Master Plan**
Latest Publishing Date	May 2003	November 1998
Audience	General Public	Water Resource Managers/Regional Staff
Goal	To guide water-related decisions for many years.	Establish a long-range water demand strategy for the region.
Objectives	[No explicit objectives listed]	• Identify specific goals for water use reductions over the next 20 years • Identify a set of detailed water efficiency programs and initiatives including budgets and schedules for the first 10 years • Identify methods for monitoring the effectiveness of each program
Water Conservation Programs	• Water distribution upgrades • Conservation in city buildings • Water audits for industrial users • Residential metering • Education and Outreach	• Public awareness • Education curricula • Rain Barrel Day • Toilet replacement program • Conservation in regional buildings • Industrial/Commercial/Institutional initiatives
Other Water Management Issues Addressed	• Water demand • Water quality management (wastewater discharge, beach testing, contaminated sediment remediation, invasive species) • Storm water management (green infrastructure design, downspout disconnection, wetlands rehabilitation)	• Water demand (historic and projected) • Conservation impacts (water supply and wastewater treatment systems, municipalities, and environment) • Existing Regulations • Public attitude toward water conservation • Water rate structure • Staffing needs

More details about each plan are available on the following web sites:

Chicago Water Agenda 2003
http://www.cityofchicago.org/WaterManagement/wateragenda.pdf

Region of Waterloo Water Efficiency Master Plan November, 1998
http://www.region.waterloo.on.ca/web/Region.nsf/0/e77db2b756915ce785256b030066a029?OpenDocument

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