Water Efficiency Planning and Capacity Development for Water and Wastewater Utilities

A handbook for water conservation and efficiency
prepared by the Iowa Association of Municipal Utilities
through a grant from the Iowa Energy Center
June 2002

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WATER *WISE*

was prepared by the

IOWA ASSOCIATION OF MUNICIPAL UTILITIES

The Iowa Association of Municipal Utilities (IAMU) represents 549 cities with municipal water, wastewater, electric, gas, and telecommunications systems.

Mission: To support and strengthen Iowa's municipal utilities
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PREFACE -- How to Use This Handbook

This handbook is intended to provide an introduction to water efficiency and conservation planning as part of overall system management. The handbook provides an overview of the planning process and discusses various methods for saving water and associated energy, including system improvements and end-user conservation programs and technologies.

This handbook also updates a previous publication, *Water Conservation for Small Utilities: A Practical Guide to Local Water Conservation Planning*, published in 1989 by the Iowa Association of Municipal Utilities and the Iowa Department of Natural Resources. The updated information discusses water shortages and emergencies and state-mandated conservation measures.

Accompanying this printed handbook is a CD-ROM which contains important resource and reference materials. The materials included on the CD-ROM provide legal and regulatory references, planning guidelines, customer education materials, and other resource information. References are often made in the text of the handbook to materials on the CD-ROM.

The CD-ROM is set up as an interactive Web site to make it easy to find and navigate through the materials. A Web browser is required to navigate through the menu. If the user is working on-line while using the CD, it will provide automatic links to other Internet Web sites. Individual files may also be accessed by viewing the file directory without using a Web browser.

Utilities without computer or Internet access may also request printed copies of any materials included on the CD from IAMU. The complete menu of files on the CD is included in the handbook's table of contents.

References and Resources on the WATER WISE CD-ROM

- **U.S. Environmental Protection Agency Water Conservation Plan Guidelines**
- **Excerpt from Iowa Administrative Code on Water Conservation**
- **Municipal Water Efficiency and Conservation Practices**
- **Residential Water Efficiency**
- **Commercial/Industrial Water Efficiency**
- **Water Emergency Materials**
- **Capacity Development Training Manuals**
- **Water and Energy Efficiency**

INTRODUCTION

What determines a water or wastewater system's capacity to deliver services? First, its technical capacity: Does it have adequate source water, well-functioning infrastructure, and technical knowledge? Second, its managerial capacity: Are staff and managers knowledgeable and well-trained? And third, its financial capacity: Does the system have sufficient revenues and adequate fiscal management and controls?

Water efficiency and conservation are integral parts of a water or wastewater system's capacity development and overall utility operational efficiency. Strategic use of water efficiency and conservation can help a system:

- **Defer or reduce the need for expanded water supply facilities or wastewater treatment facilities;**
- **Reduce utility operating costs; and**
- **Reduce water withdrawals, protecting water resources.**

This handbook uses two terms – "efficiency" and "conservation." These terms do not mean the same thing, but can complement each other in an integrated resource plan. "Conservation" means a reduction in water use. "Efficiency" means using the minimal amount of water necessary to accomplish a goal. Although at times pure conservation measures may be called for, we have emphasized efficiency to promote the idea that it is possible to reduce quantity without sacrificing quality. That is, the same "quality of life" can be achieved, at a lower cost, by careful examination of the nature of water use within utility systems.

Water efficiency and conservation can provide alternatives for meeting drinking water needs or need for wastewater treatment. Here are some hypothetical examples:

- For a small water utility, construction of a main for purchasing wholesale water from a nearby community is the most affordable option. However, quantities of available water are limited. A comprehensive water conservation program that reduces water requirements could make the wholesale option feasible and defer new facilities.

- A medium-sized water utility experiences extreme peaks every summer due to lawn watering although average daily demand is within the system's capacity. The community's older water treatment facility is being replaced. A water conservation program focusing on water-efficient landscaping education and seasonal rate adjustments would allow the utility to optimize the size and design of the new facility and allow for growth.

- A community's wastewater system is increasingly short of capacity and faces potential violations of discharge permits. The water utility and wastewater utility could

work together to encourage accelerated use of water-saving toilets, showerheads, and washing machines, deferring the need for new waste treatment capacity.

Water and wastewater utilities can incorporate water efficiency into their planning whether or not they are facing shortages. Water conservation has been viewed as a temporary strategy enforced during times of drought or other emergencies. This view is changing. First, there is a growing recognition of the cyclical nature of drought events. Second, water and wastewater managers increasingly are viewing basic water efficiency and conservation as part of prudent, on-going, utility management.

Water and wastewater utilities are beginning to adopt an integrated resource planning approach. Electric utilities have been using this approach for many years, doing least-cost analyses of the contributions of both the supply and the demand side to system capacity.

Endorsed by the American Water Works Association and the U.S. Environmental Protection Agency (EPA), the integrated resource planning approach considers the cost-effectiveness and reliability of water conservation measures to reduce demand. Even the smallest water or wastewater facilities can use aspects of an integrated resource approach to plan for meeting current and future needs.

The EPA's guidelines for water conservation plans can provide a basis for integrated resource planning. The guidelines can be used by all systems. The water conservation plan guidelines can be directly linked to the three elements of capacity – technical, managerial, and financial — as shown below.

Common Elements of Capacity Development and Water Conservation Planning

Type of Capacity	Elements of Capacity Development	Elements of Basic Water Conservation
Technical	▪Source water adequacy ▪Infrastructure adequacy ▪Technical knowledge and implementation	Universal metering ▪Source water metering ▪Service-connection metering and reading ▪Meter public-use water Water accounting and loss control ▪Account for water ▪Repair known leaks
Managerial	▪Staffing and organization ▪Effective external linkages ▪Ownership accountability	Information and education ▪Understandable water bill ▪Information available
Financial	▪Revenue sufficiency ▪Fiscal management and control ▪Credit worthiness	Costing and pricing ▪Cost-of-service accounting ▪User charges ▪Metered rates

Source: U.S. Environmental Protection Agency, Water Conservation Plan Guidelines*, 1998.*

Water conservation plans are required by the State of Iowa under Chapter 52.9(3). They are most often considered in the issuance of water allocation permits or permit renewals. In addition, there is a small scoring bonus on State Revolving Loan Fund (SRF) applications for communities that have passed water conservation ordinances and implemented programs.

WATER EFFICIENCY AND CONSERVATION PLANNING

Note on Worksheets:

The worksheets on the following pages are included in Water Conservation Plan Guidelines, *U.S. EPA, Part 3, which is included on the CD-ROM which accompanies this manual, or on the U.S. EPA web site. Also included are detailed instructions for using the worksheets. Utilities over 10,000 population should use the materials in the Intermediate or Advanced Guidelines, also included on the CD-ROM.*

The preparation of a water efficiency and conservation plan can meet several objectives, including:

- **To create strategies for more efficient operation of a water or wastewater system.**
- **To address water shortages or emergencies.**
- **To qualify the utility for bonus points in the scoring of an application for the State Revolving Loan Fund (SRF) through the DNR.**
- **To show that the utility meets viability criteria, which require a water conservation plan.**
- **To satisfy the Iowa Department of Natural Resources (DNR) requirement for a plan to be submitted with an application for a new water use permit or renewal of an existing permit.**

The steps described below are part of the U.S. Environmental Protection Agency (EPA)'s 1998 basic guidelines for conservation planning for smaller utilities. The full set of instructions for following these guidelines are included on the CD-ROM which accompanies this handbook. In addition, the CD contains the EPA's intermediate and advanced guidelines, which provide greater detail for larger utilities.

The first step in preparing a plan is to decide on the utility's goals. Water efficiency and conservation planning goals could include some of the following:

- Eliminating, downsizing, or postponing the need for capital projects;
- Improving the utilization and extending the life of existing facilities;
- Lowering variable operating costs;
- Avoiding new source development costs;
- Improving drought or emergency preparedness;
- Educating customers about the cost and value of water and wastewater treatment;
- Improving reliability and margins of safe and dependable yields; and
- Protecting and preserving water resources.

The process of developing goals should include input from a cross-section of the community. This input could come from a few town meetings or brainstorming sessions, or from more extensive community research and involvement.

The next step in the plan is to develop a system profile to assess current conditions. It should also consider future needs. The worksheet on the next two pages can help in compiling information for a system profile.

Water System Profile

SUMMARIZE SYSTEM CHARACTERISTICS

A	SERVICE CHARACTERISTICS	Number
1	Estimated service population	
2	Estimated service area (square miles)	

B	ANNUAL WATER SUPPLY	Annual volume	Percent metered
3	Total annual water supply		%

C	SERVICE CONNECTIONS	Connections	Percent metered
4	Residential, single-family		%
5	Other		%
6	Total connections		%

C	WATER DEMAND	Annual volume	Percent of total	Per connection
7	Metered residential sales			
8	Metered nonresidential sales			
9	Other metered sales			
10	Unmetered sales			
11	Nonaccount water [a]			
12	Total system demand (total use)			

D	AVERAGE & PEAK DEMAND	Volume	Total supply capacity	Percent of total capacity
13	Average-day demand			%
14	Maximum-day demand			%

F	PRICING	Rate structure [b]	Metering schedule [c]	Billing schedule [c]
15	Residential rate			
16	Nonresidential rate			
17	Other rate			

G	PLANNING	Prepared a plan ✓	Date	Filed with state ✓
18	Capital, facility, or supply plan			
19	Drought or emergency plan			
20	Water conservation plan			

(Worksheet continues)

Worksheet 3-1 (continued)

SUMMARIZE SYSTEM CONDITIONS

H	PLANNING QUESTIONS	Yes	No	Comment
21	Is the system in a designated critical water supply area?			
22	Does the system experience frequency shortages or supply emergencies?			
23	Does the system have substantial unaccounted-for and lost water?			
24	Is the system experiencing a high rate of population and/ or demand growth?			
25	Is the system planning substantial improvements or additions?			

SUMMARIZE CURRENT CONSERVATION ACTIVITIES

Water conservation measures	Approximate annual water savings (if known)	Implemented since (date)	Is continued implementation planned?

[a] Nonaccount water is water not metered and sold to customers (including authorized and unauthorized uses). See Appendix A, figure A-7 and Worksheet A-2.
[b] Uniform, increasing-block, decreasing-block, seasonal, or other.
[c] Quarterly, monthly, or other.

Source: U.S. Environmental Protection Agency, Water Conservation Plan Guidelines*, Part 3, Worksheet 3-1.*

Step three is to prepare a demand forecast for five and ten-year periods, including forecasts for the entire system as well as for separate user classes. The worksheet below provides a simple water demand forecasting methodology based on population.

Water Demand Forecast [a]

Line	Item	Current Year	5-Year Forecast	10-Year Forecast
A	**TOTAL ANNUAL WATER DEMAND**			
1	Current total annual water demand (from Worksheet 3-1) [a]			
2	Current population served [b]			
3	Total water demand per capita (line 1 divided by line 2) [b]			
4	Projected population [b]			
5	Projected total annual water demand (line 3 multiplied by line 4)			
6	Adjustments to forecast (+ or -) [c]			
7	Adjusted total annual water demand (line 5 plus line 6)			
8	Current annual demand (line 1) and adjusted annual water demand forecast (line 7 for forecast years)			
9	Current and projected annual supply capacity (from Worksheet 3-1) [d]			
10	Difference between total annual water demand and total annual supply capacity (+ or -) (subtract line 8 from line 9)			
B	**AVERAGE-DAY AND MAXIMUM-DAY DEMAND**			
11	Current and forecast average-day demand (line 8 divided by 365)			
12	Current maximum-day demand (from Worksheet 3-1)			
13	Maximum-day to average-day demand ratio (line 12 divided by line 11)			
14	Projected maximum-day demand (line 13 multiplied by line 11 for all forecast years)			
15	Adjustment to maximum-day demand forecast [c]			
16	Current (line 12) and adjusted maximum-day demand forecast (add lines 14 and 15)			
17	Daily supply capacity (line 9 divided by 365)			
18	Ratio of maximum-day demand to daily supply capacity (line 16 divided by line 17)			

[a] Separate forecasts should be prepared for large-volume users, as well as for nonaccount water (water not billed to customers) if nonaccount water is a significant amount (such as more than 10 percent of total production).
[b] Managers can use connections instead of population and per-connection water use instead of per-capita water use.
[c] Please explain adjustments to your forecast (lines 6 and 15), including effects of installed conservation measures and rate changes.
[d] Supply capacity should take into account available supplies (permits), treatment capacity, or distribution system capacity and reflect the practical total supply capacity of the system, including purchased water.

Source: U.S. Environmental Protection Agency, Water Conservation Plan Guidelines*, Part 3, Worksheet 3-2.*

CONSERVATION PLANNING

Some utilities may have more precise methods already in place for demand forecasting.

Step four involves identifying and evaluating conservation measures. The U.S. EPA identifies three levels of measures that utilities can implement. Level 1 measures are practices that all utilities should implement.

Level 1 measures include:

- Universal metering – source-water metering, service-connection metering, metering public-use water;
- Water accounting and loss control – accounting for water, repairing known leaks;
- Costing and pricing – cost-of-service accounting, user charges, metered rates; and
- Information and education – understandable water bills, conservation information available.

Level 2 and 3 measures may be appropriate and cost-effective for systems whose goals include making significant improvements in water efficiency and conservation. Level 2 measures include:

- Water-use audits;
- Retrofits, such as showerheads, toilets, etc.;
- Pressure management; and
- Landscape efficiency.

Level 3 measures include:

- Replacements and promotions
- Reuse and recycling
- Water-use regulation
- Integrated resource management

Many electric and gas utilities in Iowa have Level 2 and 3 measures in place as part of their energy efficiency programs. They have promoted water and energy-efficient technologies such as low-flow showerheads, horizontal axis clothes washers, and faucet aerators. Water utilities should consider partnering with energy utilities to offer end-user conservation measures and to make their own systems operate as efficiently as possible.

A cost-effectiveness analysis can be performed for each measure chosen, in order to compare various measures in terms of dollars per gallon of water saved. Using the table and the worksheet on the following pages, planners can establish a budget that will allow the utility to meet its conservation goals.

Note on Worksheets:

The materials on the following pages are included in Water Conservation Plan Guidelines, *U.S. EPA, Appendix B, and Part 3, which are included on the CD-ROM which accompanies this manual, or on the U.S. EPA web site.*

Benchmarks for Savings from Selected Conservation Measures

Category	Measure	Reduction in end use	Life span (years)
LEVEL 1 MEASURES			
Universal metering	Connection metering	20 percent	8 to 20
	Submetering	20 to 40 percent	8 to 20
Water accounting and loss contro	System audits and leak detection	Based on system	na
Costing and pricing	10% increase in residential prices	2 to 4 percent	na
	10% increase in nonresidential prices	5 to 8 percent	na
	Increasing-block rate	5 percent	na
Information and education	Public education/behavior changes	2 to 5 percent	na
LEVEL 2 MEASURES			
End-use audits	General industrial water conservation	10 to 20 percent	na
	Outdoor residential use	5 to 10 percent	na
	Large landscape water audits	10 to 20 percent	na
Retrofits	Toilet tank displacement devices (for toilets using > 3.5 gallons/flush)	2 to 3 gpcd	1.5
	Toilet retrofit	8 to 14 gpcd	1.5
	Showerhead retrofit (aerator)	4 gpcd	1 to 3
	Faucet retrofit (aerator)	5 gpcd	1 to 3
	Fixture leak repair	0.5 gpcd	1
	Governmental buildings (indoors)	5 percent	na
Pressure management	Pressure reduction, system	3 to 6 percent of total production	na
	Pressure-reducing valves, residential	5 to 30 percent	na
Outdoor water-use efficiency	Low water-use plants	7.5 percent	10
	Lawn watering guides	15 to 20 percent	na
	Large landscape management	10 to 25 percent	na
	Irrigation timer	10 gpcd	4
LEVEL 3 MEASURES			
Replacements and promotions	Toilet replacement, residential	16 to 20 gpcd	15 to 25
	Toilet replacement, commercial	16 to 20 gpcd	10 to 20
	Showerhead replacement	8.1 gpcd	2 to 10
	Faucet replacement	6.4 gpcd	10 to 20
	Clothes washers, residential	4 to 12 gpcd	12
	Dishwashers, residential	1 gpcd	12
	Hot water demand units	10 gpcd	na
Reuse and recycling	Cooling tower program	Up to 90 percent	na
Water-use regulation	Landscape requirements	10 to 20 percent	na
	Graywater reuse, residential	20 to 30 gpcd	na
Integrated resource management	Planning and management	Energy, chemical, and wastewater treatment costs	na

Source: U.S. Environmental Protection Agency, Water Conservation Plan Guidelines*, Appendix B, Table B-4.* Compiled from various sources. Actual water savings can vary substantially according to a number of factors. These data are provided for illustrative purposes only and may not be current or applicable. To the extent practical, planners should regionally appropriate or system-specific assumptions and estimates. na = not available

CONSERVATION PLANNING

Selection of Conservation Measures

Line .	Measure	Already implemented ✓	Plan to implement ✓	Primary criteria for selecting or rejecting the conservation measure for implementation [a]
Universal metering [B]				
1	Source-water metering			
2	Service-connection metering			
3	Meter public-use water			
Water accounting and loss control [A]				
4	Account for water			
5	Repair known leaks			
Costing and pricing [B]				
6	Cost-of-service accounting			
7	User charges			
8	Metered rates			
Information and education [B]				
9	Understandable water bill			
10	Information available			
Other Measures [b]				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20…				

[a] This space may also be used to note special issues related to this measure, including legal or obstacles to its use that preclude further consideration.
[b] See Appendix A for additional information on water conservation measures.
[A] = measure affects average-day demand
[P] = measure affects maximum-day (peak) demand)
[B] = measure affects average and peak demand

Source: U.S. Environmental Protection Agency, Water Conservation Plan Guidelines*, Part 3, Worksheet 3-4.*

The fifth and final step in the planning process is to specify strategies and timetables for implementing the plan. Some of the questions to be answered are:

- **What issues need to be addressed before the plan can be implemented?**
- **What specific actions will the utility take to carry out its conservation measures?**
- **What will the utility do to address the impact of conservation on revenues?**
- **How will the utility gain support from key stakeholders and policymakers?**

Another part of this step is to consider how the success of the plan will be evaluated. The utility should think about:

- What data will be available?
- What new kinds of data will need to be collected?
- How will the results of the water conservation program be incorporated into future demand forecasting?
- What will be the means of adjusting the conservation program if needed?
- How will the results of the program be communicated to the public?

The following sections of the handbook provide more detail about specific efficiency and conservation measures and how to incorporate them into a water efficiency and conservation plan.

WATER ACCOUNTING

Water efficiency and conservation starts not on the customer side of the meter but on the utility side. The first step in addressing water efficiency on the supply side is to implement a system of water accounting. Without accurate water accounting, water loss cannot be estimated or controlled.

When all water services are metered and recorded, the difference between the water produced and the total water metered in the system is called water loss or unaccounted-for water. Unaccounted-for water includes water that is metered but not billed as well as all unmetered water.

Water that is metered but not billed may be used by city departments for authorized uses such as main flushing, storm drain flushing, street cleaning, public areas landscaping, swimming pools, and other public uses.

Some unmetered water may be used for the authorized public purposes listed above. The American Water Works Association Committee on Unaccounted-for Water recommends that no more than one percent of total annual pumpage be used to cover these uses.

Unmetered water may also be consumed through illegal connections and water leaks. Malfunctioning system controls, inaccurate meters, or accounting system errors may be preventing the utility from metering and billing some water.

The worksheet on the following page provides a simple means of water accounting.

With an accurate picture of the system's financial conditions through a water accounting process, the utility can more accurately figure the cost of water and convey that cost, through pricing, to the customers. The Iowa Association of Municipal Utilities offers a new water unbundling service that will help you allocate and understand the costs related to your water utility.

Unbundling sorts out and puts into categories the costs for the services a utility provides. For water utilities, costs are allocated to meter charges, distribution costs (dollars/gallon), and treatment plant costs (dollars/gallon).

A water unbundling spreadsheet has been developed and IAMU provides technical support for utilities using the software. The spreadsheet tool can be used for the initial attempt to unbundle costs, and then updated periodically to reflect new budgets, changes in customer classes, or other changes. The spreadsheet can also be used for "what if" scenarios for future budgeting.

For more information on water unbundling, please contact IAMU.

Note on Worksheet:

The worksheet on the following page is included in Water Conservation Plan Guidelines, *U.S. EPA, Appendix A, Worksheet A-2, which is included on the CD-ROM which accompanies this manual, or on the U.S. EPA web site.*

Water Accounting and Loss Control

Line	Item	Volume (gallons)		% of Amount in Line 1
1	**Total Source Withdrawals and Purchases**			100%
2	*Adjustments to source water supply [a]*			
2A	Adjustment for source meter error (+ or -)			
2B	Adjustment for change in reservoir or tank storage (+ or -)			
2C	Adjustment for transmission line losses (-) [a]			
2D	Adjustments for other source contributions or losses (+ or -) [a]			
3	Total adjustments to source water (add lines 2A through 2D))			
4	**Adjusted Source Water (subtract line 3 from line 1)**			%
5	*Metered Water Sales*			
5A	Metered residential sales			
5B	Metered commercial sales			
5C	Metered industrial sales			
5D	Metered public sales			
5E	Other metered sales			
6	Total metered sales (add lines 5A through 5D)			
7	Adjustment for meter reading lag time (+ or -)			
8	Adjustment for meter errors (+ or -) [a]			
9	Adjusted total meter sales (add lines 6 through 8)			
10	**Nonaccount Water (subtract line 9 from line 4)**			%
11	*Metered and accounted-for but not billed*			
11A	Public-use water metered but not billed			
11B	Other water metered but not billed			
12	*Authorized unmetered water: operation and maintenance*			
12A	Main flushing			
12B	Process water at treatment plant			
12C	Water quality and other testing			
13	*Authorized unmetered water: public use*			
13A	Storm drain flushing			
13B	Sewer cleaning			
13C	Street cleaning			
13D	Landscaping in large public areas			
13E	Firefighting, training, and related maintenance			
14	*Other authorized unmetered use*			
14A	Swimming pools			
14B	Construction sites			
14C	Other unmetered uses			
15	Total authorized unmetered water (add lines 11A through 14C)			
16	**Total Unauthorized Losses (subtract line 15 from line 10)**			%
17	*Identifiable water losses and leaks*			
17A	Accounting procedure errors [a]			
17B	Malfunctioning distribution system controls			
17C	Illegal connections and theft			
17D	Meter inaccuracy			
17E	Unavoidable water leaks			
17F	Avoidable water leaks			
18	Total identifiable water losses and leaks (add lines 17A through 17F)			
19	**Unaccounted-For Water (subtract line 18 from line 16)**			%

[a] Methodology subject to industry and regulatory standards.

COSTING AND PRICING

Pricing can be an important part of a water conservation plan when it helps customers place a true value on the water they consume.

There are several basic principles that systems should follow in developing their rate structures:

- Rates should cover the full costs of production, treatment, storage, and distribution of water;
- Rates should be fair and equitable; and
- The rate structure should be easy to understand and customers should know and understand the justifications for rates.

There are four basic types of rate structures:

- Uniform flat rate, in which customers pay the same amount regardless of quantity used;
- Single block rate, in which customers are charged a constant price per gallon regardless of quantities used;
- Decreasing block rate, in which the price of water declines as the amount used increases; and
- Increasing block rate, in which the price of water increases as the amount used increases.

If the utility's goal is to encourage water efficiency and conservation, only the last rate structure, the increasing block rate, will be effective. The other types of rate structures actually encourage high consumption.

More complex methods of advanced pricing can be used to fine-tune the ability of the rate structure to encourage conservation. Advanced pricing can include factors such as seasonal usage, dual meters so nonsewage use is not penalized, customer classes, marginal costs, and cost-recovery mechanisms.

Utilities should not ignore the issue of the impact of efficiency and conservation on their revenue streams. Conservation will help the water utility reduce variable costs (such as energy, chemical, and purchased water costs) and could allow for better accounting. In the long term, conservation also will help the utility reduce fixed costs (associated with new capital facilities). In the short term, however, reductions in water use can lead to a shortfall in revenues needed to cover fixed costs and sustain the financial viability of the water system.

Rate design should allow the system to achieve demand reductions while still recovering water system costs. When rate increases are offset by usage reductions, customer bills and utility revenues can be maintained.

SYSTEM IMPROVEMENTS

Unaccounted-for water in a system, including municipal uses, should not exceed 15 percent. One area to target is water loss through leaks. Any amount of water loss may have adverse effects on operation and revenue. Many systems believe that fixing the larger leaks, those that can be visibly identified when they bubble to the surface, is sufficient. However, smaller leaks are just as big of a concern. A ¼ inch diameter hole in a main will probably not have enough force to surface, but it may cause a water loss of over 8,400 gallons of water per day and over 261,000 gallons per month (at 60 psi).

Not only do leaking pipes cause water loss, but they also create openings for contamination in the distribution system. Almost a quarter of the water-borne disease outbreaks reported in community water supplies in the past 10 years were not caused by poor treatment but by contaminants that entered vulnerable parts of water distribution systems.

A leak detection survey should be routinely budgeted for and performed to minimize water loss.

Meter calibration, repair, and replacement is another important part of a water efficiency and conservation strategy. Inaccurate meters can be a significant contributor to unaccounted for water, since meters seldom over-register but will generally under-register or run slower. Meters may also be improperly sized.

Periodic calibration of system supply meters will provide more accurate measurement of the water being pumped into the system. Field-testing of customer meters consists of randomly replacing an old meter with a new one, and then testing the old meter with a calibrated test bench. Some meters on larger customers may need more routine inspection and calibration for accuracy.

System efficiency is also important for wastewater systems. Inflow and infiltration into the system, causing flows to increase, can tax the system's capacity. Increased inflow and infiltration flows result from groundwater seeping into the collection mains through loose joints, main breaks or cracks, runoff from rainfall events that enters manholes, or illicit connections from sump pumps or others.

Replacing cracked mains found through camera inspections and fixing manholes to reduce inflow and infiltration will reduce flows into the system, allow the system to operate more efficiently, and possibly forestall the need for additional capacity. Routine inspections of customer meters and piping might turn up unmetered connections or improper discharges, such as residential sump pumps, to sewer lines.

Leak Detection

Leak detection strategies may include regular on-site testing using electronic-assisted leak detection equipment, a sonic leak-detection survey, water audits, or other methods for detecting leaks along water distribution mains, valves, services, and meters. The Iowa Association of Municipal Utilities has information on leak detection methods and services.

SYSTEM IMPROVEMENTS

It is also important not to overlook the potential for energy and dollar savings in the operation of water and wastewater treatment and distribution systems. Pumping systems alone comprise 70-90% of electrical energy costs for municipal water and wastewater systems. In the United States as a whole, municipal water pumping accounts for nearly 2.5% of national electric use.

In wastewater facilities, energy use increases with the level of needed treatment. Ponds and lagoons are relatively low energy users, while activated sludge, oxidation ditch, and extended aeration plants are more energy intensive.

A system approach should be taken to addressing concerns about energy use and identifying improvements. The ultimate goal of the process should be to maximize the overall efficiency of the system.

Cost-saving measures in wastewater facilities may come in the form of energy efficiency and/or load management measures. Energy efficiency measures reduce energy consumption, while load management shifts energy use into off-peak periods.

The most important areas to examine in a wastewater facility are:

- **Pumping system efficiency.** This includes pump sizing and selection of high efficiency motors, impellor efficiency, and pump system design (e.g. parallel pumping).
- **Control systems.** Many wastewater facitilies use control systems to continuously monitor the system and to assist with load management.
- **Variable frequency drives.** VFDs enable motors to accomodate fluctuating demand, running equipment at lower speeds and drawing less energy while meeting lower pumping needs. They can be used to vary flow more efficiently than valve positioning.
- **Regular maintenance.** Routine maintenance of pumping systems and other equipment can cut energy use and prolong operational life.
- **Treatment processes**. Identifying more energy efficient processes can present sizable cost savings in some systems.
- **Sludge processing**. Analysis of sludge processing options should include the energy costs of each option. In the case of land disposal, this should include transportation costs.
- **Disinfection.** There are cost and environmental tradeoffs with different types of disinfection. Although chlorination is less energy intensive, there are concerns about chlorine residuals in treated wastewater. Ozonation and UV irradation are options that are becoming more accepted.
- **Co-generation.** Anaerobic digesters for sludge stabilization produce biogas that can be burned to heat facilities or generate electricity.

Note on Resources:

More information on energy efficiency in water and wastewater facilities is included on the CD-ROM that occompanies this manual. Check for Watergy: Taking Advantage of Untapped Energy and Water Efficiency Opportunities in Municipal Water Supplies*, by the Alliance to Save Energy, and* Tap Into Savings, *by the Iowa Association of Municipal Utilities.*

In water systems, the primary energy use is in pumping. Therefore, the first place to look for energy savings in an existing water system is in the pumps and motors used. Other places to look for savings include control systems, the disinfection process, and distribution system design.

Greater efficiency in pumping and motor use can be achieved by using variable speed pumps and motors, using the highest efficiency equipment that can be considered cost-effective, and keeping pumps and motors maintained.

Adjustable speed pumping increases efficiency by matching flows with pump operation. Adding variable frequency drives can reduce costs and increase the efficiency of system operation.

Premium efficiency motors used to drive pumps in water systems cost more than typical motors, but can often have a payback of two to 10 years.

Control systems in water facilities can help manage energy use by controlling pump operation, monitoring pump efficiencies, shifting loads to off-peak periods, and controlling variable speed drives or pumps.

Water and wastewater utilities can track the efficiency of their system by developing baseline information and periodically monitoring their numbers.

The Alliance to Save Energy studied the way water utilities around the world track system efficiency and developed a set of typical metrics for what they call "watergy" -- water and energy efficiency, shown in the table below.

Typical Metrics for Tracking Watergy Efficiency

Cost	Supply	Demand
Total Water Delivered Total Cost * *Example: gallons per dollar*	**Total Water Delivered** Total Amount of Energy Used *Example: gallons per kWh*	**Total Water Delivered** Total Population *Example: gallons per person*
Total Cost Total Water Delivered *Example: dollars per gallon*	**Total Cost** Total Input Water *Example: Gallons per gallons entering system*	**Total Cost** Number of Connections *Example: gallons per connection*

* Including energy, water, capital depreciation, and maintenance

Source: Alliance to Save Energy. Watergy: Taking Advantage of Untapped Energy and Water Efficiency Opportunities in Municipal Water Systems. *Washington, D.C. 2002.*

MUNICIPAL WATER EFFICIENCY AND CONSERVATION

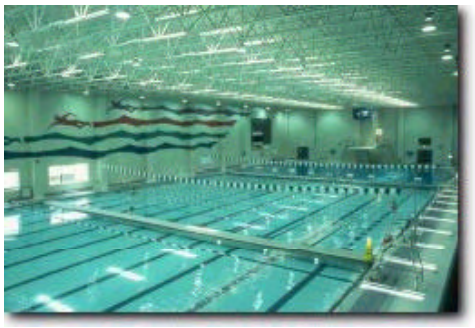
Utility and city governments can initiate water-efficient practices, saving water and setting an example for customers. Some of the areas cities can explore include swimming pools, landscaping, and water consumption in public facilities.

Municipal swimming pools and recreation centers, whether indoor or outdoor, are large water users but can save water through some simple techniques. Saving water can add up to energy and cost savings for the city as well.

The major source of water and heat loss from swimming pools is from evaporation. For both indoor and outdoor pools, evaporation accounts for 70% of total energy loss. An average uncovered outdoor pool loses about an inch of water a week during the summer.

Covering the pool is the single most effective way of reducing water and heat loss. On a typical municipal pool, a manually operated pool cover will pay for itself in water and energy savings in less than one year. The more expensive automated covers have paybacks of about 4-5 years. For indoor pools, pool covers have the added benefits of reducing the need for ventilation and decreasing the amount of chemicals and cleaning.

Other water-saving techniques for swimming pools are:



- Buy a pool vacuum that returns water to the pool instead of sending it down the drain.
- Backwash pool filters only when needed.
- Wait 30 minutes to backwash pool filters after the circulation system has been shut off. Half as much water will be needed to clean the filter.
- Lower the pool's water level to reduce the amount of water that can be splashed out.
- Check the pool regularly for leaks and cracks and make repairs promptly.
- Consider lowering pool temperatures slightly, depending on swimmer comfort, to reduce evaporative losses. Lower pool temperatures when the pool is not in use.
- Install low-flow showerheads in shower facilities.

Another area municipalities can address to demonstrate water efficiency and conservation is in landscaping of city facilities, public parks and golf courses. A typical public golf course uses more than 8,000

Note on Resources:

More information on saving water and energy in swimming pools is included on the accompanying CD-ROM. Refer to the RSPEC Fact Sheets from the U.S. Department of Energy.

gallons of water per day, about the same as an average hospital. Water-wise landscaping can save water and money for city governments.

The benefits of landscape water conservation for cities include:

- Lowering the peak water demand for the water utility;
- Lowering the cost of installing and maintaining city landscaping;
- Reducing the use of lawn chemicals; and
- Creating attractive and diverse natural areas.

Water-efficient landscaping for cities typically means three things:

- Rethinking the amount of turf areas that are needed;
- Using native plantings where possible; and
- Keeping irrigation to a minimum and making sure it's efficient.

Landscaping and open spaces maintained by cities have typically focused on expanses of turf grass. Unfortunately, turf grass is not well adapted to the Iowa climate and thus takes large amounts of water, chemicals, and labor to maintain. If turf grass can be limited to only the most practical uses, cities can significantly reduce landscape water use.

This idea of "practical turf areas" can be incorporated into city design and operation of landscaping around buildings and on city streets, in parks, and on golf courses. Turf grass can probably be completely eliminated where it's hard to mow or water, on steep slopes, and in densely shaded areas. Turf areas should be large enough to be functional and as small as possible. For example, a small area of turf grass outside the public library could hold a table or benches for reading, surrounded by a butterfly garden established on the rest of the lawn area.

City parks can provide open, grassy spaces needed for playgrounds, picnic areas, and ball playing, with other areas converted to native plantings. Golf courses also could convert turf grass outside playing surfaces to native plantings or groundcovers, increasing the challenge of the course at the same time they are saving water.

Native plantings can take the place of turf grass in certain areas and create significant cost savings for cities. Installing turf grass is expensive, about $12,000 per acre for sod and $4,000-$8,000 for seeding. This compares with about $2,000 to $4,000 per acre for seeding native prairie plantings. Maintenance of turf grass areas can cost $2,000 per acre per year, while maintenance on native landscaping is minimal once it is established.

While turf grasses require water or they will go dormant, native plant species have evolved to use water efficiently in Iowa's summer climate. Grasses and wildflowers indigenous to Iowa require little watering, mowing, or other maintenance. Many native plantings need to be mowed only once or twice per year, versus weekly or bi-weekly for turf grass.

Note on Resources:

An excellent guide to native landscaping is A Sourcebook on Natural Landscaping for Public Officials *published by the U.S. Environmental Protection Agency. It is included on the CD-ROM which accompanies this handbook.*

MUNICIPAL CONSERVATION

By limiting turf grass to "practical turf areas" and installing native landscaping where appropriate, irrigation can be kept to a minimum. Where watering is needed, following the practices below will make it as efficient as possible.

- Group plants with similar watering needs so that some are not over-watered while others are under-watered.
- Schedule irrigation for early morning or evening hours to reduce water wasted through evaporation during the day.
- Use drip irrigation or bubbler/ soaker systems.
- Maximize the efficiency of irrigation systems through use of controllers, rain shutoff devices, and soil moisture sensors. Make sure the system is operating properly. Check for misdirected or blocked sprays; broken heads, seals, pipes, or valves; and clogged or stuck heads.
- Reuse reclaimed water for irrigation.

Cities can also set an example for citizens by using water conservation practices in community facilities. The municipal government can implement some of the same measures recommended for its residents and businesses, and reap the same rewards in cost-savings.

First, the city should determine where its water is being used. If the city has carried out a water accounting process, staff will have a good idea of the types and amounts of public water consumption. Next, the city should implement the appropriate efficiency and conservation measures, which may include:

- Appointing a senior staff member to be responsible for water efficiency in city facilities;
- Preparing a water-efficiency maintenance plan based on the city's goals for saving water;
- Regularly checking equipment, piping, and connections to identify leaks and make repairs promptly;
- Installing water-saving devices in community facilities, including low-flush toilets, low-flow showerheads, and faucet aerators;
- Regularly inspecting plumbing fixtures for leaks and drips;
- Minimizing water used for washing vehicles, driveways, or sidewalks; and
- Educating city staff and residents about the city's efforts to use water wisely.

Additional information on efficiency and conservation technologies and measures appropriate for city facilities is contained in the chapters on the residential and commercial sectors.

RESIDENTIAL WATER EFFICIENCY

In Iowa, the average expected per capita per day usage of water is 150 gallons, according to the Department of Natural Resources. About one-half to two-thirds of that water is used indoors, with the remainder going to outdoor uses. For most public water systems in the U.S., residential water use typically represents 50 to 80% of billed water demand.

The table shows the results of a national survey conducted by the American Water Works Association. Actual flow measurements were collected on 1,188 single family homes in North America. Without conservation measures, a total of 72.5 gallons per capita per day are consumed in indoor uses in a typical home.

The AWWA study also projected possible typical water savings through conservation measures. According to the study, the average home can reduce inside water use by approximately 32% or by 22.9 gallons per capita per day.

The conservation measures needed to achieve the savings above include:

- Installing toilets that use 1.6 gallons per flush;
- Using low-flow showerheads rated at 2.5 gallons/minute;
- Using 2.2 gallons/minute faucets;
- Replacing standard clothes washers with high efficiency clothes washers that use 30% less water; and
- Practicing routine, common sense leak detection and control.

The savings figures above show changes from a case of no conservation to a full range of conservation measures. In reality, many homes have some conservation measures already installed, particularly if they have new or recent replacement fixtures. There have been steady improvements in the efficiency of plumbing fixtures and appliances since the 1980s. In 1992, the Energy Policy Act established national maximum allowable water-flow rates for toilets, urinals, showerheads, and faucets.

The efficiency of clothes washers and dishwashers is also improving as new models reach the market. Energy Star, a national standard and marketing program, allows consumers to easily choose the most efficient models. Saving heated water provides consumers with a double benefit in water and energy savings.

Utilities that need to reduce long-term water consumption or flows at wastewater facilities can find savings through residential conservation measures. A combination of public education, retrofit and replacement programs, and pricing signals is usually required to be effective.

Primary Indoor Residential Water Uses *(in gallons per capita per day [gcd])*

Toilets	**20.1 gcd**
Clothes washers	**15.1 gcd**
Showers	**12.6 gcd**
Faucets	**11.1 gcd**
Leaks	**10.1 gcd**
Other	**3.7 gcd**

Source: American Water Works Association

RESIDENTIAL EFFICIENCY

The accompanying CD-ROM contains a variety of public education materials that your utility can customize for your use. A public education campaign can use news releases, utility publications, flyers, brochures, TV and radio advertising, door hangers, community presentations, and many other means to reach customers with information about water conservation.

Retrofit and replacement programs target certain measures and provide incentives to customers to adopt them. Retrofit and replacement programs can include giveaways of lower cost items such as showerheads, faucet aerators, and toilet dams; rebates on higher efficiency appliances; and direct installation programs.

The following table shows some of the potential savings from retrofits and replacements of existing toilets, showerheads, faucets, clothes washers, and dishwashers with more efficient devices or models. These figures are based on assumptions about the age and condition of existing fixtures and appliances and actual savings can vary substantially.

Some of the factors that should be included when planning a retrofit or replacement program are:

- **What is the current penetration of high efficiency measures in your community?** What types of conservation measures are already being used by your customers?

- **Availability of high efficiency appliances**. Are they available through local vendors or will the utility have to supply them?

- **Training of local contractors**. Are local contractors knowledgeable about the installation and operation of high efficiency appliances or will the utility need to provide some training and support?

Potential for Water Savings from Selected Measures

Measure	Reduction in water use in gallons per capita per day (gcd)	Life span (years)
Toilet tank dam/displacement device	2-3 gcd	1.5
Showerhead retrofit (aerator)	4 gcd	1-3
Faucet retrofit (aerator)	5 gcd	1-3
Residential toilet replacement (1.6 gallon/flush)	16-20	15-25
Showerhead replacement (2.5 gallons/minute)	8.1 gcd	2-10
Faucet replacement (2.2 gallons/minute)	6.4 gcd	10-20
Residential clothes washer (Energy Star model)	4-12 gcd	12
Residential dishwasher	1 gcd	12

Source: U.S. Environmental Protection Agency, Water Conservation Plan Guidelines*, 1998.*

- **Determining incentives**. What rebate amount will be necessary to achieve the needed participation and savings?

- **Cost-effectiveness**. Will the cost of the program be outweighed by its benefits to the utility and its customers?

- **Partnering.** Who are the potential partners that can support or enhance the water or wastewater utility's efforts?

Many electric and gas utilities in Iowa have given away or heavily discounted low-flow showerheads and faucet aerators to promote both water and energy savings. A few utilities are also rebating high efficiency clothes washers. Water or wastewater utilities could consider partnering with their gas or electric utility to offer additional water-saving measures.

The use of pricing signals may be necessary to change customers' water use behaviors beyond the use of other voluntary incentives. The previous chapter on *Costing and Pricing* provides more information on conservation pricing strategies.

Outdoor water use varies greatly by the season, climate zone, and amount of rainfall each year. On average, outdoor water use by single-family homes in the U.S. is 31.7 gallons per capita per day, according to a study by the American Water Works Association. The vast majority of that use is for watering lawns, plants, and gardens.

Outdoor water use has typically become an issue in Iowa communities only during times of drought or other water constraints (see the chapter on *Water Shortages and Emergencies* for more information). However, encouraging different landscaping practices in order to reduce water demand long-term may also be part of a utility's water efficiency and conservation planning.

As discussed in the previous chapter on *Municipal Water Efficiency and Conservation*, cities can promote the use of native landscaping, practical turf areas, and efficient irrigation in residential areas. Municipal officials can help remove some of the barriers to native landscaping through more progressive weed ordinances.

The Trouble With Toilets

The Energy Policy Act of 1992 mandated low-flush toilets as a water conservation measure. Since then, there have been many complaints about the new toilets. Legislation has even been introduced to repeal the requirement.

A survey in 1999 by the National Association of Home Builders Research Center found that roughly four out of five respondents had experienced problems with the low-flush units in the past year. Builders reported that they had more callbacks on low-flush toilets than on any other problem.

When the low-flush toilet is unable to clear the bowl, users resort to double flushing. This can defeat the goal of water conservation and skew the estimates of water savings from low-flush toilets.

The low-flush units are improving, and some models may work better than others. In an article on the WaterWise CD-ROM, a plumber rates the low-flush toilets and recommends the models that work best.

RESIDENTIAL EFFICIENCY

Note on Resources:

An excellent source for information on municipal weed ordinances and policies on native landscaping is A Sourcebook on Natural Landscaping for Public Officials *published by the U.S. Environmental Protection Agency. It is included on the CD-ROM which accompanies this handbook.*

According to the U.S. Environmental Protection Agency's *Sourcebook on Natural Landscaping for Public Officials,* there are three main approaches to crafting or modifying a weed law:

- **Require a setback**. This addresses concerns about height and appearance of native plants by requiring that a setback or buffer strip on the periphery of the property be maintained at a maximum height (such as 12 inches). Vegetation behind the setback and within the yard is unregulated except for control of listed noxious weeds.
- **Include broadly worded exceptions for natural landscaping**. These exceptions may accommodate plantings that achieve the following positive outcomes: Native plantings, wildlife plantings, erosion control, soil fertility building, biological control, and public education.
- **Encourage natural landscaping for homeowners** through design assistance, selling native plants and seeds, specifically targeting certain neighborhoods, creating recognition programs, and others.

COMMERCIAL/INDUSTRIAL WATER EFFICIENCY

This chapter will examine the potential for saving water in small and large commercial businesses, industry, and institutional facilities. The commercial/industrial sector typically makes up 20 to 40% of billed water demand for a municipal utility. On a per-customer basis, though, commercial/industrial facilities are significant water users.

While there are some similarities in water use and equipment across the commercial/industrial sector, generally different types of commercial/industrial facilities have different water-use characteristics and different opportunities for conservation and efficiency.

For commercial customers, which provide or distribute a retail service or product, water is typically used for domestic purposes, cooling and heating, cleaning and sanitation, and landscape irrigation. Hotels and motels are large water users, for example and can also benefit by installing water-saving measures.

Industrial customers, involved in manufacturing and processing activities, use water for heating and cooling, processing, washing, landscape irrigation, for domestic use, and as an ingredient.

Institutional customers are government facilities, schools, colleges and universities, hospitals and clinics, prisons, military installations, and places of worship. They use water primarily for heating and cooling, domestic purposes, and landscape irrigation.

Some residential-type water conserving fixtures and appliances, such as toilets, showerheads, faucets, clothes washers, and dishwashers, are also applicable in commercial, industrial, or institutional settings. In fact, the greatest water and cost savings in some facilities may come from plumbing fixtures – more efficient toilets, urinals, showerheads, and faucets.

Some of the other common ways that businesses, industries, and institutions can conserve water and/or impact sewage flows are:

- **Determining where water is used**. Sub-metering may be needed to determine specific uses and costs.
- **Leak detection and repair**. Periodic shutdown may be needed to identify leaks and fix them.
- **Water reuse and recycling**. Water reuse is the use of wastewater or reclaimed water from another application.

Note on Resources:

The WaterWise CD-ROM includes a number of fact sheets and other materials on water conservation for businesses, industries, and institutional facilities.

- **Cooling water recirculation**. The use of water for cooling in industrial applications represents one of the largest water uses in the U.S. Recycling water with a recirculating cooling system can reduce water use by using the same water to perform several cooling operations. Technologies include evaporative cooling, ozonation, and air heat exchange.

- **Rinsing.** The use of deionized water for rinsing contaminants from products can be reduced by eliminating some plenum flushes, converting from a continuous-flow to an intermittent-flow system, and improving control of the use of deionized water.

- **Water efficient landscaping.** Reducing turf grass and replacing it with low-maintenance native plantings can significantly impact the need for watering.

In some cases, particularly in process-oriented industries, a customized approach may be necessary. A water audit conducted by a trained engineer or technician can help larger or more specialized facilities identify problems, calculate savings, develop a facility water conservation plan, and monitor results.

Water Conservation Can Mean Big Savings to Companies Large and Small

Besides reducing the cost of purchased water, water conservation can help commercial, industrial, and institutional facilities in reducing other costs as well, including:

- Sewage fees;
- Wastewater treatment;
- Energy for heating and cooling water;
- Chemicals; and
- Purchase of new equipment and/or expansion of treatment systems.

A water audit to determine potential improvements should include the following:

- Establishment of an internal team, including management, environmental, production, maintenance, engineering, and other important personnel;
- Identification of points of use, including all uses and piping;
- Idenfication of sources of all incoming water streams (city, surface, ground);
- Identification of discharge destinations for each water source;
- Measurement of actual flow rates used in each process or from each source, with tracking conducted for at least one month or long enough to determine a reasonable average;
- Examination of water and sewer bills and attempting to reconcile measured use with records to find unidentified sources of usage; and
- Assessment of current water expenditures for entire facility and individual points of use.

The information gathered in the water audit will provide a starting point for finding areas for water, energy, and cost savings.

Source: "Water Conservation Can Mean Big Savings to Small Companies." www.manufactersmart.com/Features/April98/AprEdit18.html

WATER SHORTAGES AND EMERGENCIES

The earlier portions of this handbook laid out the case for incorporating water efficiency and conservation into the day-to-day as well as long-term operations of water and wastewater utilities. There may occur, however, immediate water emergencies that necessitate quick action and measures to conserve.

What constitutes a water shortage or emergency? A water shortage or emergency can result from a lack of raw water supplies or lack of pumping capacity from a treatment plant. Contamination of the water supply or equipment failure can also result in a water emergency. Any of these can require the timely implementation of water conserving measures.

Discussed below are three basic plans, based on the severity of the shortage or emergency, for addressing quick action for water conservation in your community.

The level at which your system is operating can serve as an indicator to determine the appropriate level of conservation required from your customers.

- **75% of pumping capacity – *"Water Watch."*** At this point, voluntary conservation may be implemented as described in Action Plan 1.
- **85% of pumping capacity – *"Water Warning."*** At this point, restricted water use activities may be implemented as described in Action Plan 2.
- **95% of pumping capacity – *"Water Emergency."*** At this point, water rationing may be implemented as described in Action Plan 3.

Indicators of a declining raw water supply include:

- **Decrease in the normal pumping water level of the well**
- **Declining water recovery rate of water level in well**
- **Decreasing reservoir levels measured in number of feet below spillway**
- **Decreasing reservoir levels measured in number of feet above intake**

When indicators move back into safe ranges, conservation controls can be eased or lifted.

Action Plan 1 – "Water Watch"

Action Plan 1 uses a voluntary approach to gaining cooperation, with a goal of reducing water use by 10%. Early voluntary cooperation can protect your utility against a worsening situation. Customer education and information is crucial to making this approach work.

Step 1: Assess System Conditions

- Determine specific capacities of your constrained system, whether water or wastewater or both.
- Review usage patterns of residential customers.
- Review usage patterns for commercial and industrial customers.
- Alert the utility governing body to the potential for a water emergency.

Step 2: Initiate Water Conserving Practices

- Keep pumps and other equipment in good working condition. Keep good records of what types of pumps are used, who the suppliers of the pumps are, where the pumps can be repaired in a short time, and where available parts are in inventory. An "open" purchase order, for use only under emergency conditions, will allow repairs without going through the purchasing agent for repair parts.
- Initiate leak detection and repair for your distribution system.
- Encourage the use of water saving equipment appropriate for addressing the particular area of shortage.
- Work with other city departments to conserve water, such as water used for maintenance.
- Meet directly with your largest customers, review their water use patterns, and assist them to create voluntary conservation programs.

These activities can increase the amount of water conserved and help you address the system constraint.

Step 3: Initiate a Public Information Program for Your Customers

A customer education and information campaign will help your customers understand the need for voluntary conservation. Their understanding is crucial to gain their support and compliance. Some of the ways to publicize the need for conservation include:

- Including information with customers' bills;
- Publishing ads in local newspapers or shoppers;
- Posting reminders around the community;
- Advertising on local radio or TV stations or on local cable access;
- Printing information in community publications;

Note on Resources:

A sample residential flyer, sample commercial letter, and news release are including on the accompanying CD-ROM. They are in Word format and can be customized for use by your utility.

- Making presentations to community groups; and

- Involving the local leaders, such as school administrators, religious leaders, organization presidents, and others.

Action Plan 2 – "Water Warning"

If the situation addressed in Action Plan 1 worsens, or the actions taken are not adequate, Action Plan 2 is the next step. This plan does not require rationing, but it does involve mandatory restrictions on the way customers use water. The goal of the measures in Action Plan 2 is to reduce water use by an additional 11-20%.

The elements of Action Plan 2 are:

- Implement and evaluate Action Plan 1 measures.

- Reassess system conditions.

- Analyze and establish appropriate restricted water use activities through board/council resolution.

- Establish penalties and appeal procedures.

- Educate/inform utility customers.

The following are lists of activities that could be prohibited during a water or wastewater shortage or emergency. The first tier addresses moderate to serious situations, and the second addresses severe system emergencies.

Tier I Restricted Activities – Moderate to Serious Shortage or Emergency

- Use of water-consuming comfort air conditioning equipment which consumes in excess of five percent of the water circulating in such equipment.

- Watering or irrigation of lawns and all other outside vegetation except that direct applications of water not exceeding 1 inch per week are permitted before 8:00 a.m. and after 8:00 p.m. on flower and vegetable gardens, trees and shrubs less than 4 years old, and areas which were newly seeded or sodded prior to issuance of the emergency resolution.

- Washing of cars, trucks, trailers, boats, and other mobile vehicles or equipment except at commercial establishments which provide that service.

- Washing of outdoor surfaces including buildings, sidewalks, driveways, patios, and porches.

- Nonessential cleaning of commercial and industrial equipment, machinery, and interior spaces.

- Filling, re-filling, or adding of water to provide swimming pools, wading pools, reflecting pools, ornamental fountains, or any other structure making similar use of water.

- Permitting the loss of water through defective plumbing or fixtures, except where the customer can provide proof of prompt repair of the defect.

- Serving water by restaurants except when it is specifically requested by customer.

- Use by a business or industry of an amount of water exceeding the amount used during the corresponding month of the previous year except where the business or industry is declared by resolution of the board or council to be necessary for public health, safety, and welfare. Where there is no corresponding period of use, the utility will work with the customer to establish an equitable base quantity.

None of these restricted activities would apply when water has been reclaimed or recycled after an essential primary use.

WATER EMERGENCIES

Tier II Restricted Activities – Severe Water Shortages

- All outside water use except for domestic, sanitation, and fire.
- All commercial and industrial uses of water not essential in providing products and services.
- Irrigation of agricultural crops that may pose an immediate threat to the utility's available supply.
- Recreational and leisure water uses including lawn and golf course watering.
- Water used but not necessary for the preservation of life or the general welfare of the community's economic base.

Penalties for Violating Restricted Activities

Penalties for use of metered water in violation of the restricted water use activities need to be established by council ordinance.

When restricted water use activities have been adopted by council ordinance, penalties for violations can take the form of a fine imposed by the city. These violations are called "municipal infractions." Under Iowa law, violations to city ordinances are punishable by civil penalties of up to $100 for the first offense and up to $200 for each repeat offense. An "order to abate" may also be issued.

Interruption of service is another option for enforcement of restricted water use activities. For example, if after first and second offense penalties have been levied, the customer continues to violate the restrictions, the utility can initiate immediate interruption of service. Reconnection would be scheduled only after payment of a reconnection fee.

Because health and safety issues are of specific concern, reducing water flow to a minimum should be the alternative to disconnection. This can be done at the shut-off valve or by installing a flow restrictor on the customer's supply line.

Enforcement and Appeal Procedures

Standard enforcement procedures for interruption of service should be established. When restricted water use activities have been adopted through city ordinance, violations can be charged as municipal infractions. Local law enforcement personnel can then be called upon to assist in enforcing civil penalties.

When a violation is charged as a municipal infraction, it is tried in the district court. For other sanctions imposed by the utility, an appeal procedure must be established. For example, an Appeal Board may consist of one member from your utility's governing board, the mayor or city manager, and three citizens.

Public Notice

Information on the restricted water use activities and the reasons the city is implementing them, should be part of a public education effort similar to the one in Action Plan 1. Customers should be notified of the restrictions, the penalties for violations, and the appeal process. Direct notification to customers should be used in addition to other information methods.

Note on Resources:

A sample ordinance for water emergencies and enacting restricted use activities is included on the accompanying CD-ROM.

Action Plan 3 – "Water Emergency"

In Action Plan 3, water is rationed to customers according to class of service. This plan requires that all customers be allocated a monthly water allotment and that regular meter readings be taken to determine customer compliance. The quantity allotted is generally considered to be the minimum required for interior use.

Like in Action Plan 1, voluntary cooperation and voluntary conservation are still essential. The Tier I and Tier II restricted water use activities from Action Plan 2 can also be incorporated into a water allocation approach.

The elements of Action Plan 3 are:

- Implement Action Plan 1 activities.
- Establish restricted water use activities as described in Action Plan 2.
- Establish penalties and appeal procedures as described in Action Plan 2.
- Determine customer classes and base allocations.
- Determine premium charges.
- Adopt and publish final plan.

Monthly meter readings will be necessary for a water rationing program. Among your largest users, weekly meter reading will be useful. Access to service connections and water meters must be assured at all times.

Base Allocation Determination

A base allocation amount for each customer class must be determined. Classes may be generally divided into residential, commercial, and industrial.

Special classes for nursing homes, hospitals, motels, car washes, and other businesses where water is basic to the operation will need to be identified. You may want to offer the largest customers off-peak incentives to delay high usage during peak hours.

Two types of base allocation are:

1. Base allocation is a percentage of a typical winter month's usage, e.g. March billing, or the corresponding month's usage from the previous year.
   a. Residential single-family (80% of previous usage)
   b. Commercial (90% of previous usage)
   c. Industrial (demonstrate conservation activities)
   d. Nursing homes/hospitals (90% of previous usage)
   e. Motels (90% of peak season usage)
2. Base allocation is per household amount, e.g. 3,000 gallons

per month per single family household. Allotments given to all other classes of service are based on individual water-use histories.

Base Allocation Notice and Appeal Process

A notification process will be necessary to advise customers of their base allocations and penalties for overuse of water. See Action Plans 1 and 2 for background on public notification.

An appeal process allowing adjustment of the base allocation is also necessary. The appeal board discussed in Action Plan 2 may be designated to hear allocation appeals. For example, allocation adjustments may be needed for large families or changes in the number of building occupants. Adjustments may also be needed for commercial and industrial customers with conservation practices already in place, since the capacity for additional conservation may be limited.

Premium Rate Surcharge

A premium rate surcharge for metered water consumption in excess of the base allocation should be established. An example would be a surcharge of $1.00 per 100 gallons of water used in excess of the base allocation.

Adjustment of the premium rate may be allowed. This would occur in the case of a mechanical error such as leaky pipes. The customer, however, must provide proof of repair such as a plumber's statement or materials receipt. The adjusted rates would apply only to the billing period prior to the correction of the failure.

REFERENCES

Alliance to Save Energy. "To Cope with Drought Conditions, Summer Electric Reliability, Alliance to Save Energy Offers Consumers Combined Water, Energy Saving Tips." Web site at www.ase.org/media/newsreel/waterwater.htm.

_____. *Watergy: Taking Advantage of Untapped Energy and Water Efficiency Opportunities in Municipal Water Systems*. Washington, D.C. 2002.

Anderson, Michael K. "Drought Response and H2O Conservation – IDNR Perspective." Powerpoint presentation. Summer 2000.

Angers, Jim. "How Can a Utility Best Conserve Water?" *Opflow*. May 2002.

Beecher, Janice A. "Integrated Resource Planning Fundamentals." *AWWA Journal*. Vol. 87, No. 6/June 1995.

Buie, Leslie M. "Accounting for Lost Water." *AWWA Journal*. Vol. 92, No. 7/July 2000.

City of Los Angeles Water Services. "Water Conservation Tips for Your Business: A 10 Step Approach for Your Business." Web site at www.ladwp.com/water/conserv/business/index.htm. July 2001.

Iowa Association of Municipal Utilities/Iowa Department of Natural Resources. *Water Conservation for Small Utilities: A Practical Guide to Local Water Conservation Planning*. Ankeny, IA. 1989.

_____. *Capacity Development Training: Financial Issues*. Ankeny, IA. 2001.

Makar, Jon and Chagnon, Nathalie. "Inspecting Systems for Leaks, Pits, and Corrosion." *AWWA Journal*. Vol. 91, No. 7/July 1999.

Manufacturers Mart. "Water Conservation Can Mean Big Savings to Small Companies." Web site at www.manufacturersmart.com/Features/Apr98/AprEdit18.html. April 1998.

Pekelney, David M., Chestnutt, Thomas W., and Mitchell, David L. "Cost-Effective Cost-Effectiveness: Quantifying Conservation on the Cheap." *Proceedings of the American Water Works Conferenc*e. Toronto, Canada. June 1996.

REFERENCES

Note on Resources:

Many of the materials listed in the references are included on the CD-ROM which accompanies this manual.

Ploeser, Jane H. "Conservation and the Industrial Customer." *AWWA Journal*. Vol. 88, No. 1/January 1996.

Tafuri, Anthony N. "Locating Leaks with Acoustic Technology." *AWWA Journal*. Vol. 92, No. 7/July 2000.

U.S. Environmental Protection Agency. *Water Conservation Plan Guidelines* (EPA 832-D-98-001). 1998.

_____. *Cleaner Water Through Conservation* (EPA 841-B-95-002). April 1995.

U.S. General Accounting Office. *Water Infrastructure: Water Efficient Plumbing Fixtures Reduce Water Consumption and Wastewater Flows* (Report to Congressional Requesters GAO/RCED-00-232). August 2000.

Vickers, Amy. *Handbook of Water Use and Conservation*. Amherst, MA: Waterplow Press. 2001.

WaterWiser-The Water Efficiency Clearinghouse. "Household Use of Water." Web site at www.waterwiser.org. March 2001.