# WATER CONSERVATION

## PROFESSIONAL DEVELOPMENT
## CONTINUING EDUCATION COURSE

Technical Learning College

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**Do not solely depend on TLC's Approval list for it may be outdated.**

Most of our students prefer to do the assignment in Word and e-mail or fax the assignment back to us. We also teach this course in a conventional hands-on class. Call us and schedule a class today.

## Precept-Based Training CEU Course

This training course is made of "micro-content" or "precepts"– small chunks of information that can be easily digested. Using bite-size pieces of technical information is considered to be one of the most effective ways of teaching people new information because it helps the student to retain knowledge easier.

Micro-learning or precept-based training doesn't rely on the student to process a large amount of information before breaking it down. Our method includes short modules with clearly defined learning goals for each section. This method allows a student to hone in on a particular skill, then demonstrate their knowledge in the final assessment.

## Copyright Notice



### Contributing Editors

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**Dr. Pete Greer** S.M.E., Retired biology instructor, chemistry and biological review.

**Jack White**, Environmental, Health, Safety expert, City of Phoenix. Art Credits.

Inside the tank of the *Flapperless* Low-Use Toilet made by Niagara.

## TOILET COST-EFFECTIVENESS STATISTICAL ANALYSIS

| Performance | Typical Existing Unit | New Unit | Best Available Toilet |
|---|---|---|---|
| **Gallons per flush** | 3.6 gpf | 1.6 gpf | 1.6 gpf |
| *Annual Water Use* | 27,300 gallons | 12,500 gallons | 11,700 gallons |
| *Annual Water Cost* | $110 | $50 | $45 |
| *10-year Water Cost* | $910 | $420 | $390 |
| *Lifetime Water Cost Savings* | - | $490 | $520 |

*1. The flush rate of the new unit just meets the current federal standards for toilets.*

## *Cost-Effectiveness Assumptions*

- The 10-year Water Cost is the sum of the discounted value of annual water costs, based on average usage and an assumption that early replacement of the toilet occurs at the midpoint of a 20-yr. useful life. Future water and wastewater treatment costs are conservatively assumed to increase only at the rate of inflation.
- Savings estimates are based on an existing flush rate of 3.5 gpf.
- Usage assumption: 30 flushes per day, and 260 days per year.
- Assumed combined water and waste-water price: $4.00/1000 gallons.

This irrigation control valve was leaking for 6 months and no one reported it. The property owner didn't blink an eye at the outrageous water bill. You can see the strength of the leak in this photo. The leak created a small swamp inside a desert city that has a strong water conservation staff.

The wasted water (Fugitive) was absorbed by the land and was diverted to a storm drain to the west and to the street to the east.

This leak should have been discovered and reported by several water employees including the meter reader, customer service staff, possibly a police officer and last but not least the distribution repair crews.

# Technical Learning College’s Scope and Function

Welcome to the Program,

Technical Learning College (TLC) offers affordable continuing education for today’s working professionals who need to maintain licenses or certifications. TLC holds several different governmental agency approvals for granting of continuing education credit.

TLC’s delivery method of continuing education can include traditional types of classroom lectures and distance-based courses or independent study. TLC’s distance-based or independent study courses are offered in a print - based distance educational format. We will beat any other training competitor’s price for the same CEU material or classroom training.

Our courses are designed to be flexible and for you to finish the material at your convenience. Students can receive course materials through the mail or electronically. The CEU course or e-manual will contain all your lessons, activities and instruction to obtain the assignments. All of TLC’s CEU courses allow students to submit assignments using e-mail or fax, or by postal mail. (See the course description for more information.)

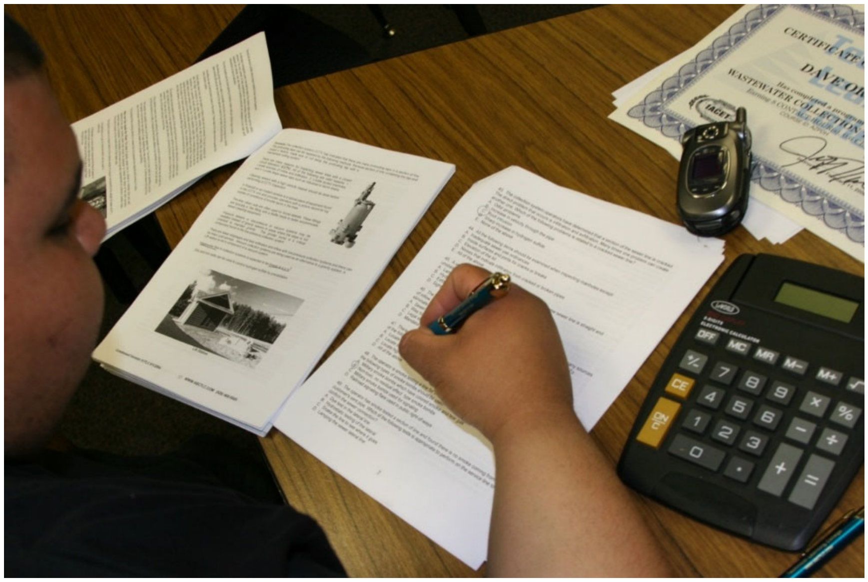
Students have direct contact with their instructor—primarily by e-mail or telephone. TLC’s CEU courses may use such technologies as the World Wide Web, e-mail, CD-ROMs, videotapes and hard copies. (See the course description.) Make sure you have access to the necessary equipment before enrolling; i.e., printer, Microsoft Word and/or Adobe Acrobat Reader. Some courses may require proctored closed-book exams, depending upon your state or employer requirements.

**Flexible Learning**
At TLC, there are no scheduled online sessions or passwords you need contend with, nor are you required to participate in learning teams or groups designed for the "typical" younger campus - based student. You will work at your own pace, completing assignments in time frames that work best for you. TLC's method of flexible individualized instruction is designed to provide each student the guidance and support needed for successful course completion.

**Course Structure**
TLC's online courses combine the best of online delivery and traditional university textbooks. You can easily find the course syllabus, course content, assignments, and the post-exam (Assignment). This student-friendly course design allows you the most flexibility in choosing when and where you will study.

**Classroom of One**
TLC offers you the best of both worlds. You learn on your own terms, on your own time, but you are never on your own. Once enrolled, you will be assigned a personal Student Service Representative who works with you on an individualized basis throughout your program of study. Course specific faculty members (S.M.E.) are assigned at the beginning of each course providing the academic support you need to successfully complete each course. Please call or email us for assistance.

**Satisfaction Guaranteed**
We have many years of experience, dealing with thousands of students. We assure you, our customer satisfaction is second to none. This is one reason we have taught more than 20,000 students.



We welcome you to do the electronic version of the assignment and submit the answer key and registration to us either by fax or e-mail. If you need this assignment graded and a certificate of completion within a 48-hour turn around, prepare to pay an additional rush charge of $50.

We welcome you to complete the assignment in Word.

Once we grade it, we will mail a certificate of completion to you. Call us if you need any help.


## Contact Numbers

**Fax (928) 468-0675**
**Email Info@tlch2o.com**
**Telephone (866) 557-1746**

# CEU Course Description

## WATER CONSERVATION CEU TRAINING COURSE

This is a review of the EPA's Water Conservation guidelines and the Safe Drinking Water Act's Water Conservation guidelines. Review of water conservation ideas, methods and water audits.

Sec. 1455. (a) Guidelines. —Not later than 2 years after the date of enactment of the Safe Drinking Water Act Amendments of 1996, the Administrator shall publish in the Federal Register guidelines for water conservation plans for public water systems serving fewer than 3,300 persons, public water systems serving between 3,300 and 10,000 persons, and public water systems serving more than 10,000 persons, taking into consideration such factors as water availability and climate.

### Course Procedures for Registration and Support

All of Technical Learning College's correspondence courses have complete registration and support services offered. Delivery of services will include e-mail, web site, telephone, fax and mail support. TLC will attempt immediate and prompt service.

When a student registers for a distance or correspondence course, he/she is assigned a start date and an end date. It is the student's responsibility to note dates for assignments and keep up with the course work.

If a student falls behind, he/she must contact TLC and request an end date extension in order to complete the course. It is the prerogative of TLC to decide whether to grant the request. You will be required to pay a $50.00 fee.

All students will be tracked by a unique number will be assigned to the student.

### Instructions for Written Assignments

The Water Conservation CEU Training course uses a multiple choice/True/False answer key.

### Feedback Mechanism (examination procedures)

Each student will receive a feedback form as part of their study packet. You will be able to find this form in the front of the course or lesson.

### Security and Integrity

All students are required to do their own work. All lesson sheets and final exams are not returned to the student to discourage sharing of answers. Any fraud or deceit and the student will forfeit all fees and the appropriate agency will be notified.

### Grading Criteria

You will be required to pass the final exam with a 70% or better in order to obtain your required certificate for your credits.

### Required Texts

The ***Water Conservation Course*** comes complete. No other materials are needed.

**Recordkeeping and Reporting Practices**
TLC will keep all student records for a minimum of five years. It is the student's responsibility to give the completion certificate to the appropriate agencies. TLC will not release any records to any party, except the student.

**ADA Compliance**
TLC will make reasonable accommodations for persons with documented disabilities. Students should notify TLC and their instructors of any special needs.

Course content may vary from this outline to meet the needs of this particular group.

**Mission Statement**
Our only product is educational service. Our goal is to provide you with the best possible education service possible. TLC will attempt to make your learning experience an enjoyable opportunity.

You will have 90 days from receipt of this course to complete it in order to receive your Professional Development Hours (**PDHs**) Continuing Education Credits (**CEU**) or Training Credits. A score of 70% or better is necessary to pass this course.

**Educational Mission**
**The educational mission of TLC is:**
*To provide TLC students with comprehensive and ongoing training in the theory and skills needed for the environmental education field,*

*To provide TLC students with opportunities to apply and understand the theory and skills needed for operator certification,*

*To provide opportunities for TLC students to learn and practice environmental educational skills with members of the community for the purpose of sharing diverse perspectives and experience,*

*To provide a forum in which students can exchange experiences and ideas related to environmental education,*

*To provide a forum for the collection and dissemination of current information related to environmental education, and to maintain an environment that nurtures academic and personal growth.*

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## Water Conservation Terms

**Bioretention** - Depressed areas that slow stormwater which reduces local flooding. These areas also filter stormwater removing some pollutants including sediment and bacteria. Filtered stormwater makes streams and rivers healthy for plants and animals.

**Cisterns -** Storage containers that detain stormwater which reduces local flooding. Cisterns also allow the captured stormwater to be slowly released to porous planted areas where plants and soils are able to filter out the pollutants and clean the water before it reaches the river.

**Evapotranspiration** - Process by which water is transferred from the land to the atmosphere by evaporation from the soil and other surfaces and by transpiration from plants.

**Field capacity (FC)** - Amount of soil moisture or water content held in the soil after excess water has drained away and the rate of downward movement has decreased.

**Groundwater** - Water that exists underground in saturated zones beneath the land surface.

**Hydrogeology and water flow** - Science concerned with the properties of the earth's water, and especially its movement in relation to land.

**Irrigation Scheduling** - Process used by irrigation system managers to determine the correct frequency and duration of watering.

**Permanent wilting point (PWP) -** Minimal amount of water in the soil that the plant requires not to wilt.

**Readily available water** - Water that a plant can easily extract from the soil.

**Reclaimed Wastewater -** Wastewater-treatment plant effluent that has been diverted for beneficial uses such as irrigation, industry, or thermoelectric cooling instead of being released to a natural waterway or aquifer.

**Recycled Water -** Water that is used more than one time before it passes back into the natural hydrologic system.

**Restoration** - Ecology is the scientific study of repairing disturbed ecosystems through human intervention.

**Sediment -** Fine particles suspended in stormwater. Sediment from stormwater makes streams and rivers appear cloudy which affects the health of all river plants and animals. Other pollutants such as nutrients, metals and bacteria attach to sediment and are deposited at the bottom where they can harm plants and animals.

**Surface water** - Water on the surface of continents including lakes, streams, wetlands, aquifers and springs.

**Total available water** - Amount of water that can be stored in a soil profile and be available for growing crops.

**Treated Stormwater -** Water runoff that is detained and/or filtered by green infrastructure to remove pollutants including sediment and bacteria. Treated Stormwater volume is measured in cubic feet (1 cubic foot = 7.5 gallons).

**Water Conservation-** Water conservation refers to the preservation, control and development of water resources, both surface and groundwater, and prevention of pollution.

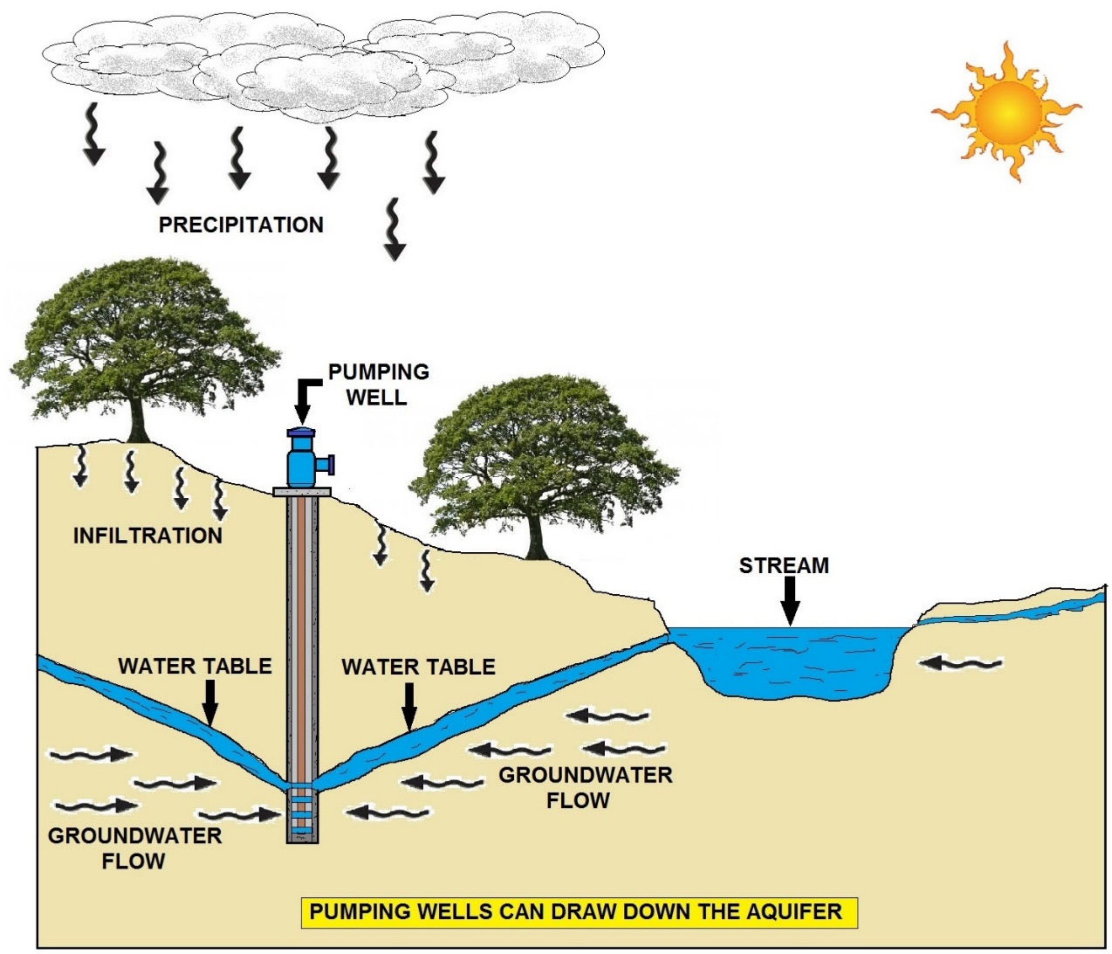
**Water productivity** - As crop yield per some measurement of water consumption.

**Water table** - The upper surface of the saturated zone.

**Watershed** - Watershed is an area of land that drains all the streams and rainfall to a common outlet.

**Wetland** – Ecosystem lands consisting of marshes or swamps or saturated lands.

**Xeriscaping -** A method of landscaping that uses plants that are well adapted to the local area and are drought-resistant. Xeriscaping is becoming more popular as a way of saving water at home.



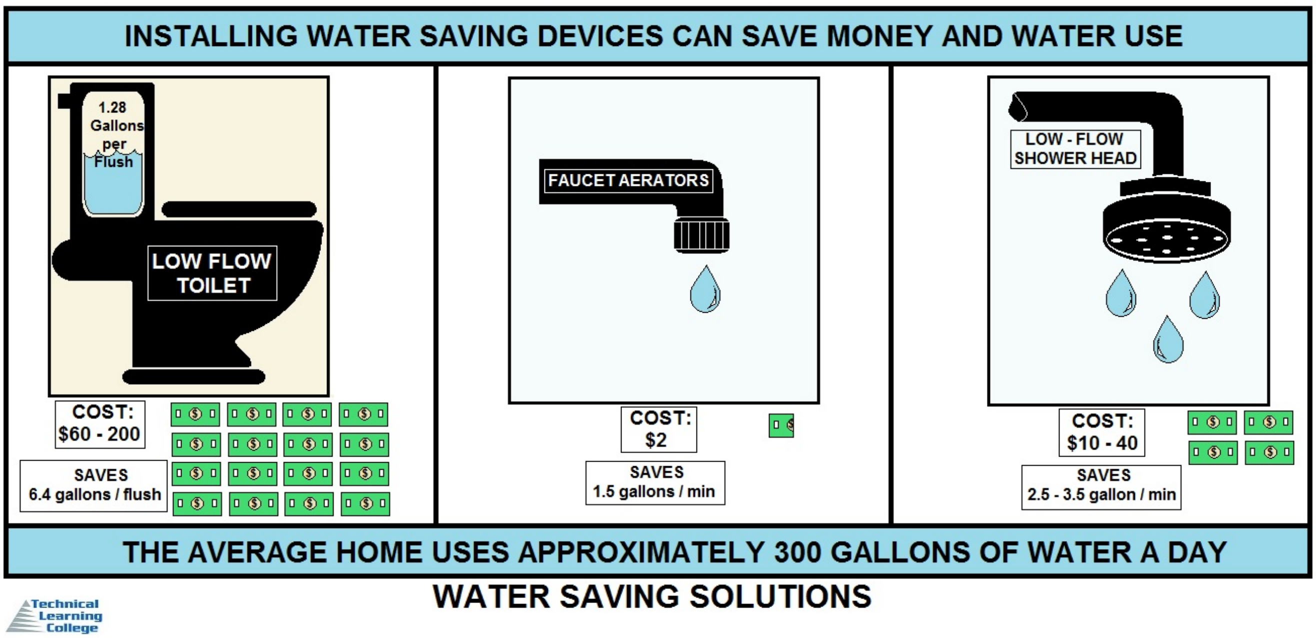

**WATER TABLE DIAGRAM**

## Introduction

## What is Water Conservation?

Water conservation is the practice of using water efficiently to reduce unnecessary water usage. Water conservation is important because fresh clean water is a limited resource, as well as a costly one. As a homeowner, you're probably already well aware of the financial costs of inefficient water use. Conservation of this natural resource is critical for the environment — and our wallets.

America's population has doubled over the last half century, and our demand for water has tripled. Water conservation is more important than ever, and the world is looking for tips on saving water. The great news is that with just a few simple changes, you can reduce your water footprint.




### Conservation of Water

Conservation of Water refers to preserving, controlling and developing water resources, both surface water and groundwater, and preventing water pollution. Water conservation is known as using water efficiently to reduce unnecessary water usage and avoid its wastage. We should understand the importance of water, figure out ways to save water, ways to conserve water and treat it as an asset to our planet.

### What are the Water-Related Problems?

The main problems with water are **water shortage**, **shortages of clean water**, and **waterborne diseases**. A lack of access to safe water caused 80% of all deaths worldwide. More than 5 million people die each year from water-related diseases such as hepatitis A, dysentery, and severe diarrhea.

Approximately **900 million to 1.1 billion people** worldwide **lack clean drinking water**, and 2.4 billion lack basic sanitation. Water demand is increasing at a rate faster than population growth. Over the past 70 years, while the world's population has tripled, water demand has increased six-fold. The United Nations estimates that in 2025, that 5 billion of the world's 8 billion people will live in areas where water is scarce. Many of these people will have difficulty accessing enough water to meet their basic needs.

**Increasing populations, growing agriculture, industrialization, and high living standards have boosted water demand.** All this while drought, overuse, and pollution have decreased the supplies. To make up for this shortfall, water is often taken from lakes, rivers, and wetlands, causing serious environmental damage. According to a 2003 United Nations report, "Across the globe, groundwater is being depleted by the demands of megacities and agriculture, while fertilizer runoff and pollution are threatening water quality and public health."

It seems there are alarming predictions every week related to water, such as disease, crop disasters, starvation, famines, and war. **Safe drinking water and sanitation are major challenges in many developing countries**, from shanty towns and areas to urban poor cities. At least in rural areas, the poor can dig wells and take care of the sanitation in their fields.

***Key Facts about our water:***
Water is the most important natural resource that living things need. But at the same time, it has also been misused and wasted.

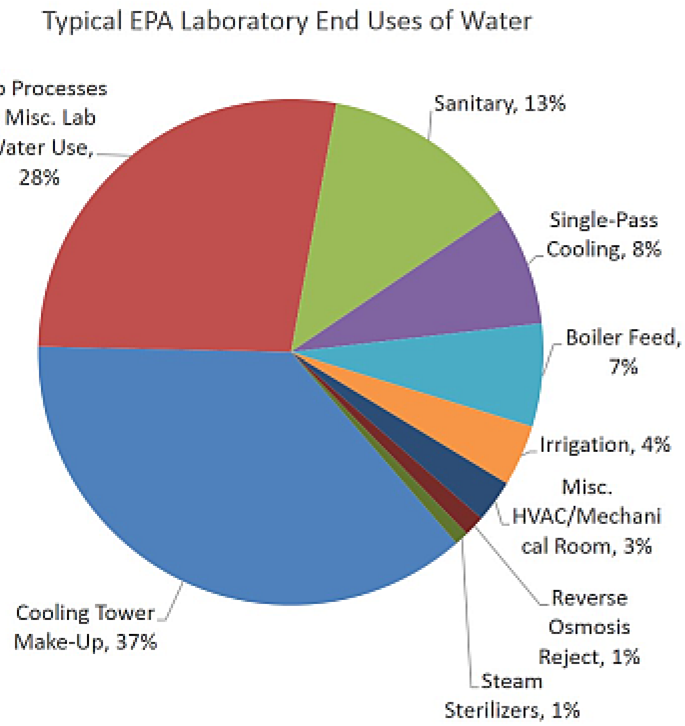
To better grasp the full significance of water conservation, take a look at the few yet key facts about water:

- The average adult human body comprises 50-65 percent of water. They are averaging around 57-60 percent. With infants, they have a higher percentage. Often around 75-78% water, dropping to 65% by one year.
- The Earth has a limited amount of water. The water we have now is all we get, and it is recycled repeatedly. The water cycle can help you understand this condition.
- Water is the basic demand for every food. It grows our fruits and vegetable, and each livestock consumes it.
- A plant's life is dependent on water. Plants help the ecosystem and produce the oxygen necessary to keep us healthy. Additionally, trees are generally used for housing, paper, and a lot more.
- Ninety-seven percent (97%) of all water on Earth is saltwater- that is not suitable for drinking.
- Only three percent (3%) of water on Earth is freshwater. Only 0.5% is available is suitable for drinking.
- The other 2.5% of freshwater is found in glaciers, ice caps, the atmosphere, soil, or under the Earth's surface or is too polluted for consumption.

## USEPA Water Conservation - Introduction

The U.S. population has doubled over the past 50 years, while our thirst for water has tripled. With at least 40 states anticipating water shortages by 2024, the need to conserve water is critical. EPA strives to integrate water management best practices at all of its facilities.

EPA occupies two main types of facilities: offices and laboratories. Plumbing, heating/cooling and irrigation needs comprise a large percentage of typical office water use. The Agency has minimized those uses by installing high-efficiency plumbing fixtures and eliminating irrigation.

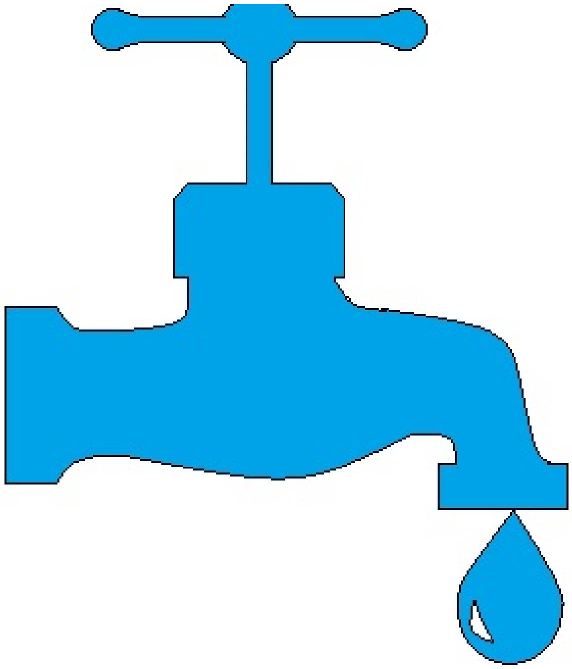



Laboratories use water for laboratory processes, water purification and steam sterilization. Laboratories also have significant heat loads, so a significant amount of water is used as cooling tower make-up. EPA has focused much of its water-saving efforts on laboratory facilities.

In 2002, EPA began reducing its water footprint, prior to any federal requirements mandating water conservation. EPA's water management planning and water use reduction efforts have produced significant results.

EPA water reduction strategies include:

- Monitoring water meters and tracking use
- Installing WaterSense labeled and other high efficiency restroom fixtures
- Eliminating single-pass cooling
- Optimizing cooling tower efficiency
- Minimizing or eliminating landscape irrigation.



| | |
|---|---|
| TOILET | 20% |
| CLOTHES WASHER | 19% |
| SHOWER | 19% |
| FAUCETS | 19% |
| LEAKS | 14% |
| BATH | 5% |
| DISHWASHER | 1% |
| OTHER | 3% |

**AVERAGE HOUSEHOLD INDOOR WATER USE**

Technical Learning College

## Drought - Introduction

**Defining Drought**
Drought is generally defined as "a deficiency of precipitation over an extended period of time (usually a season or more), resulting in a water shortage."

As the different definitions next pages, illustrate, though, drought can be difficult to define—so difficult, in fact, that in the early 1980s researchers found more than 150 published definitions of drought, reflecting differences in regions, needs, and approaches.

**Drought Severity Classifications**

| | | Ranges | | | | | |
|---|---|---|---|---|---|---|---|
| **Category** | **Description** | **Possible Impacts** | **Palmer Drought Index** | **CPC Soil Moisture Model (Percentiles)** | **USGS Weekly Streamflow (Percentiles)** | **Standardized Precipitation Index (SPI)** | **Objective Short and Long-term Drought Indicator Blends (Percentiles)** |
| **D0** | Abnormally Dry | Going into drought: short-term dryness slowing planting, growth of crops or pastures. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered | -1.0 to -1.9 | 21-30 | 21-30 | -0.5 to -0.7 | 21-30 |
| **D1** | Moderate Drought | Some damage to crops, pastures; streams, reservoirs, or wells low, some water shortages developing or imminent; voluntary water-use restrictions requested | -2.0 to -2.9 | 11-20 | 11-20 | -0.8 to -1.2 | 11-20 |
| **D2** | Severe Drought | Crop or pasture losses likely; water shortages common; water restrictions imposed | -3.0 to -3.9 | 6-10 | 6-10 | -1.3 to -1.5 | 6-10 |
| **D3** | Extreme Drought | Major crop/pasture losses; widespread water shortages or restrictions | -4.0 to -4.9 | 3-5 | 3-5 | -1.6 to -1.9 | 3-5 |
| **D4** | Exceptional Drought | Exceptional and widespread crop/pasture losses; shortages of water in reservoirs, streams, and wells creating water emergencies | -5.0 or less | 0-2 | 0-2 | -2.0 or les | |

Some drought definitions are conceptual—an idea or concept—which can be important in establishing drought policy. Others are operational, describing how drought functions or operates in ways that can be measured (NDMC).

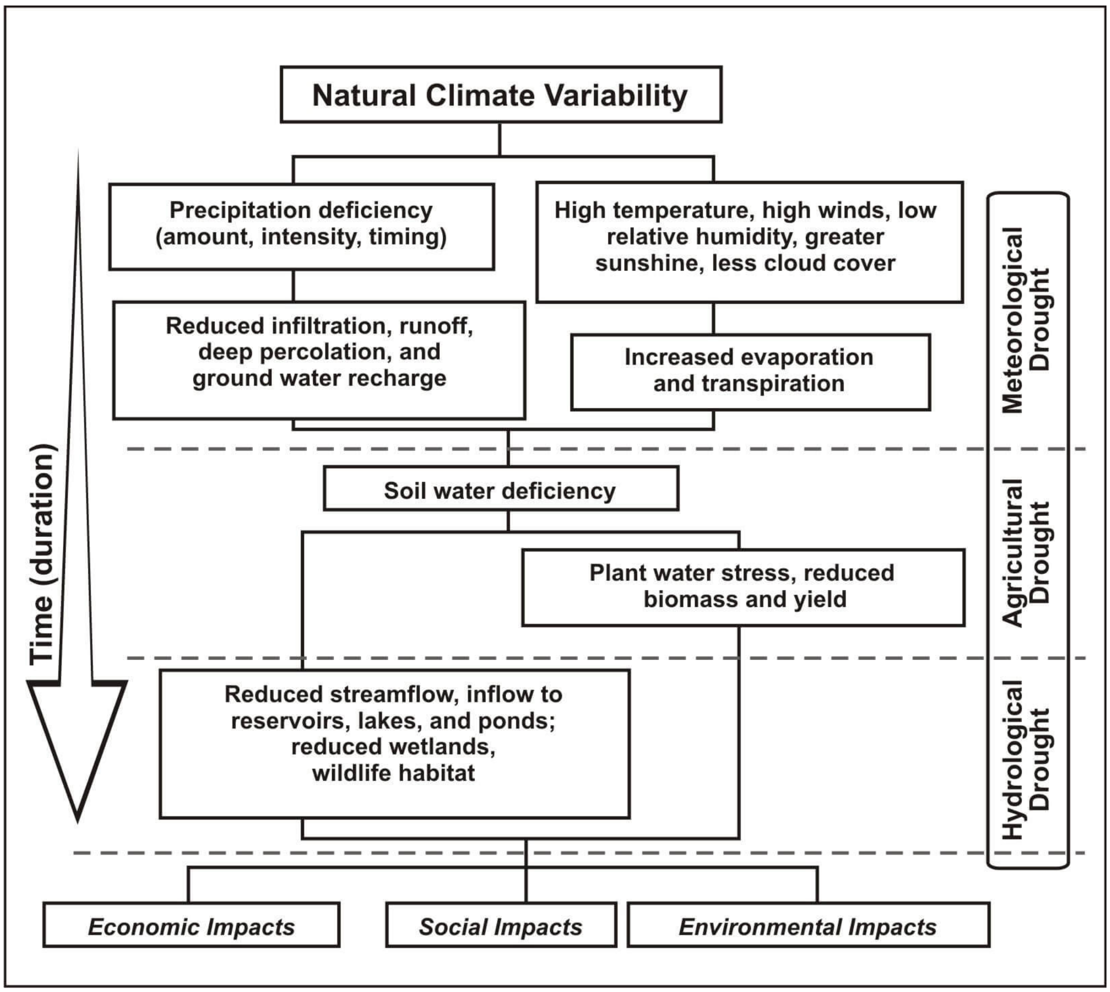
Research in the early 1980s uncovered more than 150 published definitions of drought. The definitions reflect differences in regions, needs, and disciplinary approaches.

Wilhite and Glantz categorized the definitions in terms of four basic approaches to measuring drought: *meteorological*, *hydrological*, *agricultural*, and *socioeconomic*. The first three approaches deal with ways to measure drought as a physical phenomenon. The last deals with drought in terms of supply and demand, tracking the effects of water shortfall as it ripples through socioeconomic systems.

**Another Definition**
A drought is a reduction in precipitation over an extended period. This creates a water shortage that damages crops, livestock, and the environment. Since droughts adversely impact the agricultural industry, those that depend on the commodities from the industry suffer as well. Food becomes scarcer, and demand exceeds supply. Prices go up, and the commodities markets waiver.

If the economy is already in a state of depression or recession, a drought can increase that state. Climate change can also amplify the effects of a drought. A drought can further cause damage by increasing the risk of large-scale wildfires, and it can cause populations to begin tapping into their emergency reserves of water—the aquifers that collect water underground.

It helps to understand how droughts can deepen the effects of a changing climate, and how they have played a part in environmental and human circumstances in the recent past—so that one day, humans can move past destroying fragile ecosystems and still survive in comfort on the planet.




Sequence of drought occurrence and impacts for commonly accepted drought types. All droughts originate from a deficiency of precipitation or meteorological drought but other types of drought and impacts cascade from this deficiency. (Source: NDMC)

## Other Drought Definitions

**Meteorological drought**
Meteorological drought is defined usually on the basis of the degree of dryness (in comparison to some "normal" or average amount) and the duration of the dry period. Definitions of meteorological drought must be considered as region specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

For example, some definitions of meteorological drought identify periods of drought on the basis of the number of days with precipitation less than some specified threshold. This measure is only appropriate for regions characterized by a year-round precipitation regime such as a tropical rainforest, humid subtropical climate, or humid mid-latitude climate.

Locations such as Manaus, Brazil; New Orleans, Louisiana (U.S.A.); and London, England, are examples. Other climatic regimes are characterized by a seasonal rainfall pattern, such as the central United States, northeast Brazil, West Africa, and northern Australia. Extended periods without rainfall are common in Omaha, Nebraska (U.S.A.); Fortaleza, Ceará (Brazil); and Darwin, Northwest Territory (Australia), and a definition based on the number of days with precipitation less than some specified threshold is unrealistic in these cases. Other definitions may relate actual precipitation departures to average amounts on monthly, seasonal, or annual time scales.

**Agricultural drought**
Agricultural drought links various characteristics of meteorological (or hydrological) drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapotranspiration, soil water deficits, reduced groundwater or reservoir levels, and so forth.

Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil. A good definition of agricultural drought should be able to account for the variable susceptibility of crops during different stages of crop development, from emergence to maturity.

Deficient topsoil moisture at planting may hinder germination, leading to low plant populations per hectare and a reduction of final yield. However, if topsoil moisture is sufficient for early growth requirements, deficiencies in subsoil moisture at this early stage may not affect final yield if subsoil moisture is replenished as the growing season progresses or if rainfall meets plant water needs.

**Hydrological drought**
Hydrological drought is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (i.e., streamflow, reservoir and lake levels, groundwater). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale.

Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and groundwater and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors.

For example, a precipitation deficiency may result in a rapid depletion of soil moisture that is almost immediately discernible to agriculturalists, but the impact of this deficiency on reservoir levels may not affect hydroelectric power production or recreational uses for many months.

Also, water in hydrologic storage systems (e.g., reservoirs, rivers) is often used for multiple and competing purposes (e.g., flood control, irrigation, recreation, navigation, hydropower, wildlife habitat), further complicating the sequence and quantification of impacts. Competition for water in these storage systems escalates during drought and conflicts between water users increase significantly.

### Socioeconomic drought

Socioeconomic definitions of drought associate the supply and demand of some economic good with elements of meteorological, hydrological, and agricultural drought. It differs from the aforementioned types of drought because its occurrence depends on the time and space processes of supply and demand to identify or classify droughts.

The supply of many economic goods, such as water, forage, food grains, fish, and hydroelectric power, depends on weather. Because of the natural variability of climate, water supply is ample in some years but unable to meet human and environmental needs in other years. Socioeconomic drought occurs when the demand for an economic good exceeds supply as a result of a weather-related shortfall in water supply.

For example, in Uruguay in 1988–89, drought resulted in significantly reduced hydroelectric power production because power plants were dependent on streamflow rather than storage for power generation. Reducing hydroelectric power production required the government to convert to more expensive (imported) petroleum and implement stringent energy conservation measures to meet the nation’s power needs.

In most instances, the demand for economic goods is increasing as a result of increasing population and per capita consumption. Supply may also increase because of improved production efficiency, technology, or the construction of reservoirs that increase surface water storage capacity.

If both supply and demand are increasing, the critical factor is the relative rate of change. Is demand increasing more rapidly than supply? If so, vulnerability and the incidence of drought may increase in the future as supply and demand trends converge.

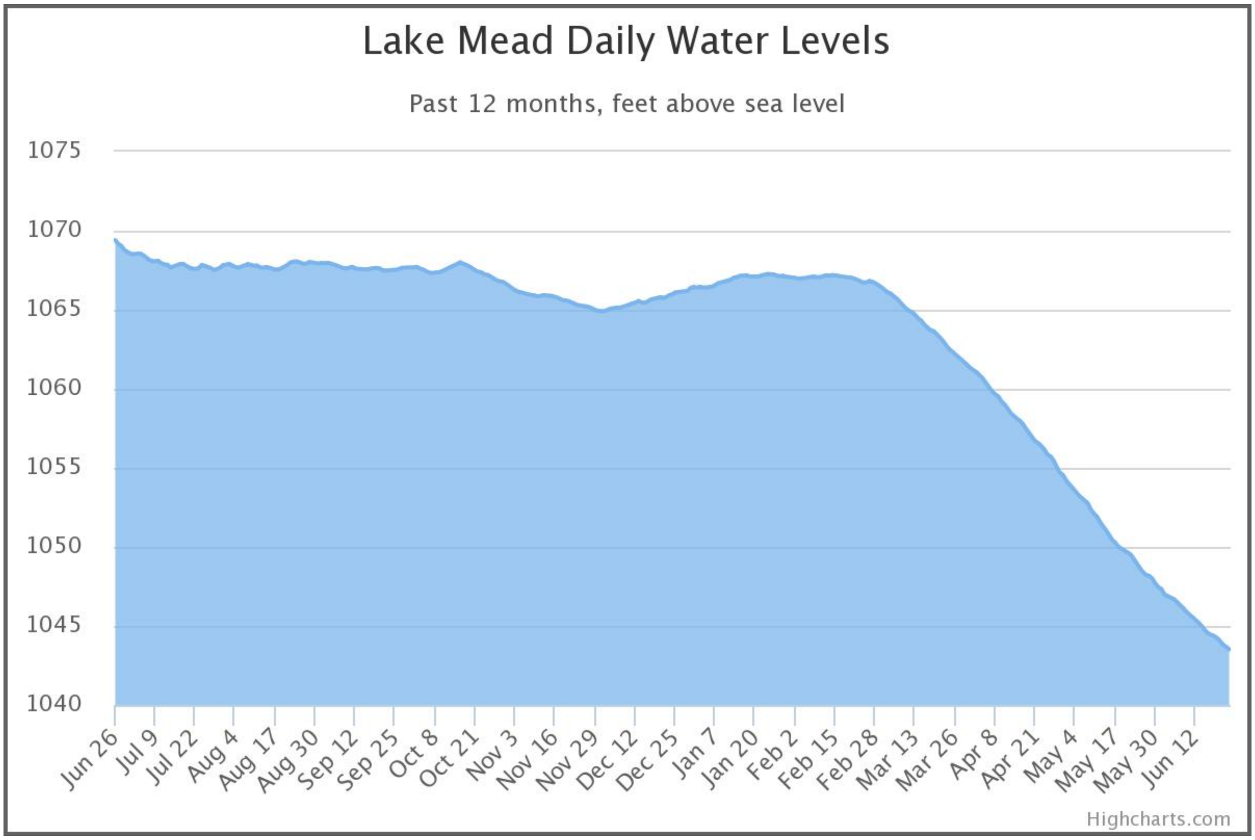
Wilhite, D.A.; and M.H. Glantz. 1985. Understanding the Drought Phenomenon: The Role of Definitions. *Water International* 10(3):111–120.

### Ecological drought

A more recent effort focuses on ecological drought, defined as "a prolonged and widespread deficit in naturally available water supplies — including changes in natural and managed hydrology — that create multiple stresses across ecosystems."

## Lake Mead

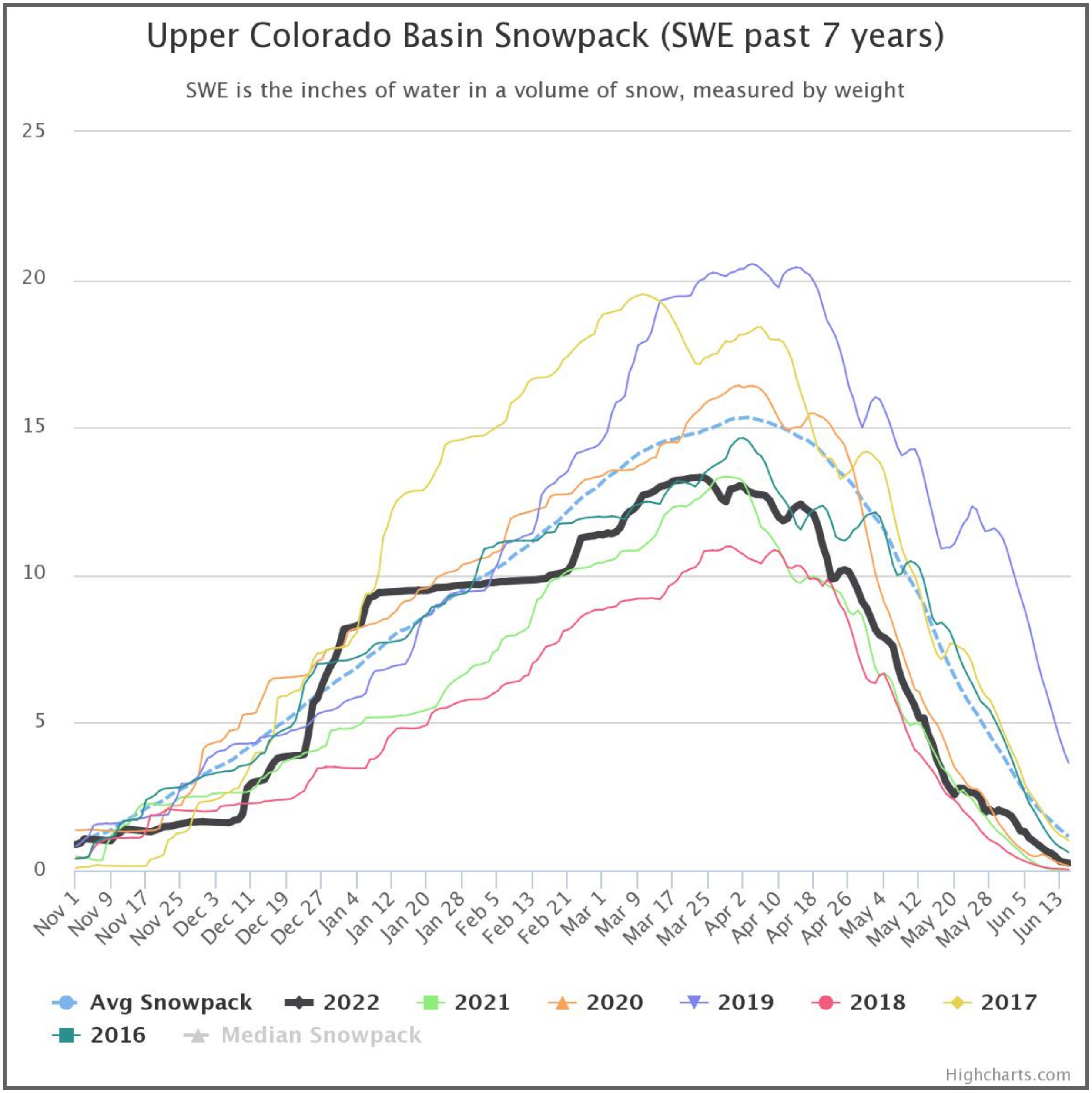
June 24, 2022 (UPI) -- Water levels at Lake Mead dropped to historic lows this week with persistent drought exacerbated by climate change and increased water demands driving the reservoir closer to becoming a "dead pool."




The nation's largest reservoir on 6/24/2022 measured at 1,043.8 feet, its lowest level since the lake was filled in the 1930s.

The minimum elevation to generate power at Hoover Dam is 1,050 feet, according to the National Park Service. Below this level, the reservoir would be considered an "inactive pool." However, Patti Aaron, public affairs officer for the Bureau of Reclamation's Lower Colorado region told the Boulder City Review back in May that Hoover Dam will still be able to produce hydropower below this level. She stated the new threshold where the dam would no longer be able to produce power is at 950 feet.

Should the water levels fall below 895 feet, the reservoir will become a dead pool, meaning water levels will be too low to reach the lowest water outlet at Hoover Dam and flow downstream. While it may take years to reach this status, the reservoir provides water to millions of people across Nevada, Arizona, California and parts of Mexico, many of whom have already seen a cut in supply due to efforts to reserve water. "This is deadly serious stuff," Robert Glennon, an emeritus professor at the University of Arizona, told NBC News. Glennon specializes in water law and policy.


Upper Colorado Basin Snowpack (SWE past 7 years)
SWE is the inches of water in a volume of snow, measured by weight
25
20
15
10
5
0
Nov 1
Nov 9
Nov 17
Nov 25
Dec 3
Dec 11
Dec 19
Dec 27
Jan 4
Jan 12
Jan 20
Jan 28
Feb 5
Feb 13
Feb 21
Mar 1
Mar 9
Mar 17
Mar 25
Apr 2
Apr 10
Apr 18
Apr 26
May 4
May 12
May 20
May 28
Jun 5
Jun 13
Avg Snowpack
2022
2021
2020
2019
2018
2017
2016
Median Snowpack
Highcharts.com

## Southern California Water Restrictions

### June 1, 2022

**A nearly empty Lake Oroville is seen from above in Oroville, California on September 5, 2021.**

Sweeping restrictions on outdoor water use go into effect on Wednesday for more than 6 million residents in Southern California as officials work to conserve water amid a severe drought.

The new rules, set by the Metropolitan Water District of Southern California, limit outdoor watering to once a week in many jurisdictions. The megadrought in the U.S. West has produced the region's driest two decades in at least 1,200 years.

Sweeping restrictions on outdoor water use go into effect on Wednesday for more than 6 million residents in Southern California as officials work to conserve water during a severe drought.

The conservation rules, among the strictest ever imposed in the state, were set by the Metropolitan Water District of Southern California, one of the largest water distributors in the country.

Households are now forbidden from watering their lawns more than once a week in many jurisdictions. The goal is to slash water use by 35% as the state enters its third straight year of drought. The rules come after California officials in March announced they were cutting State Water Project allocations from 15% to 5% of normal amid declining reservoir levels and reduced snowpack. California's two largest reservoirs have already dropped to critically low levels, and the state this year experienced its driest January, February and March on record.

“The amount of water we have available to us right now is not going to be enough to carry us through the entire year unless we do something different,” MWD general manager Adel Hagekhalil said at a news conference in April. “This is a wake-up call.”

The megadrought in the U.S. West has produced the driest two decades in the region in at least 1,200 years. Conditions are likely to continue through 2022 and could persist for years. Researchers publishing in the journal Nature Climate Change have estimated that 42% of the drought’s severity is attributable to human-caused climate change.

As the summer months approach, curbing outdoor water usage is the most effective way to conserve water. Landscape watering represents about half of all urban water use in California.

During the state’s drought from 2012 to 2016, former Gov. Jerry Brown ordered a mandatory 25% cutback in water use, during which many residents responded by switching to drought-tolerant landscaping.

**California Governor’s Order Published: May 24, 2022**
SACRAMENTO – Governor Gavin Newsom issued the following statement after the State Water Resources Control Board adopted emergency water conservation regulations today in response to the Governor’s March Executive Order:

“California is facing a drought crisis and every local water agency and Californian needs to step up on conservation efforts. I am hopeful the measures enacted by the State Water Board will lead to a reduction of water use across the state. These conservation measures are increasingly important as we enter the summer months. I’m asking all Californians to step up, because every single drop counts.”

The State Water Resources Control Board voted unanimously today to implement a statewide ban on watering of non-functional turf in the commercial, industrial, and institutional sectors, as well as regulations requiring local agencies to implement water use restrictions amid the possibility that water supplies may be up to 20% lower due to extreme weather.

# Chapter 1 - Water Conservation Plan Guidelines

The Safe Drinking Water Act (SDWA, 42 U.S.C. 300j-15), as amended in 1996, requires the United States Environmental Protection Agency (EPA) to publish guidelines for use by water utilities in preparing a water conservation plan. At their discretion, states may require water systems to prepare a plan consistent with the guidelines as a condition of qualifying for a loan under the Drinking Water State Revolving Loan Fund (SRF).

These Water Conservation Plan Guidelines are addressed to water system planners, but use of the Guidelines is not required by federal law or regulation. States decide whether or not to require water systems to file conservation plans consistent with these or any other guidelines.

Although voluntary, the Guidelines may help bring conservation into the mainstream of water utility capital facility planning. The infrastructure needs of the nation's water systems are great. Strategic use of water conservation can help extend the value and life of infrastructure assets used in both water supply and wastewater treatment, while also extending the beneficial investment of public funds through the SRF and other programs.

This document is organized into six parts. The first part of the document introduces the Guidelines and provides information to the States about their nature and possible use. A number of topics are addressed: integrating water conservation and infrastructure planning, water conservation planning criteria, guidelines and measures, State roles, and current State programs.

Also discussed is a capacity-development approach for very small systems, suggesting that conservation planning and implementation assistance be provided as part of a State's capacity building efforts required by SDWA. The second part of the document, written for water systems, is an overview to the organization, content, and use of the Guidelines.

**The next three parts contain the water conservation plan Guidelines: Basic, Intermediate, and Advanced.**

- ✓ The Basic Guidelines are designed for use by water systems serving populations of 10,000 or fewer. Some water systems, especially those serving fewer than 3,300 people, may be included in a capacity-development approach, described above, instead of having a plan requirement. Systems should check with their state primacy agency for information and guidance about capacity development.

- ✓ The Intermediate Guidelines are designed for water systems serving between 10,000 and 100,000 people.

- ✓ The Advanced Guidelines are designed for water systems serving more than 100,000 people.

- ✓ The Basic Guidelines contain five simplified planning steps. The Intermediate and Advanced Guidelines follow nine planning steps (with some variations in the scope of analysis and level of detail requested): Specify Conservation Planning Goals, Develop Water System Profile, Prepare Demand Forecast, Describe Planned Facilities, Identify Conservation Measures, Analyze Benefits and Costs, Select Measures, Integrate Resources and Modify Forecasts, and Present Implementation and Evaluation Strategy.

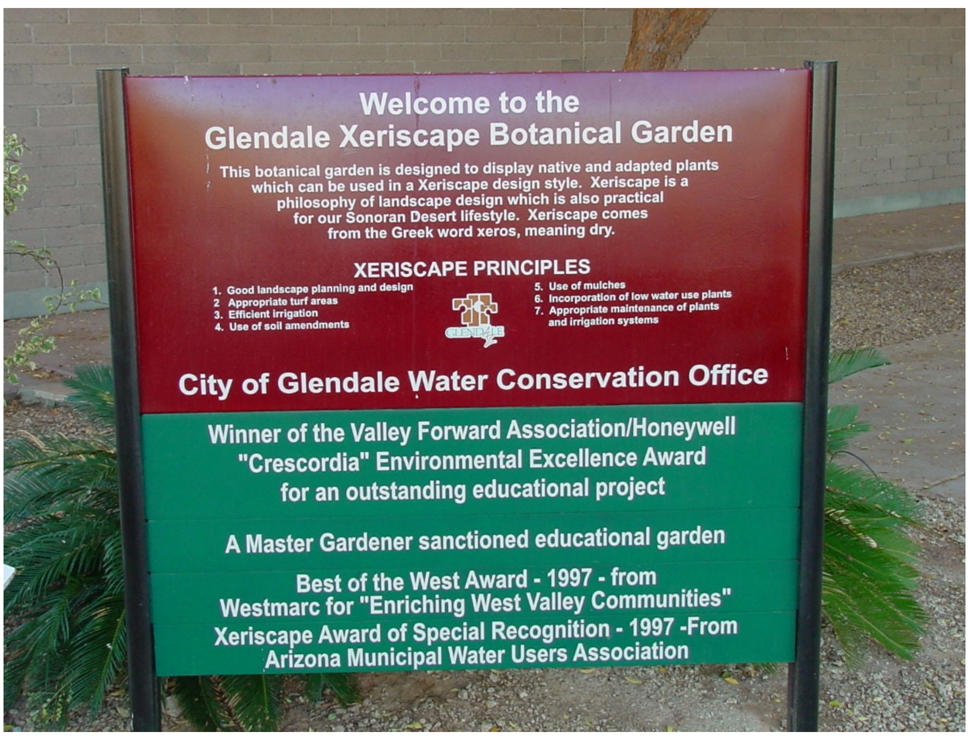
A three-leveled structure is presented for water conservation measures. Level 1 contains four categories of measures that are recommended for consideration, at a minimum, in the Basic Guidelines. Additional measures and categories are added for Levels 2 and 3, and recommended for consideration in the Intermediate and Advanced Guidelines, respectively. Listed below are the three levels and the categories included in each:

**Level 1 Measures**
- ✓ Universal metering
- ✓ Water accounting and loss control
- ✓ Costing and pricing
- ✓ Information and education

**Level 2 Measures**
- ✓ Water-use audits
- ✓ Retrofits
- ✓ Pressure management
- ✓ Landscape efficiency

**Level 3 Measures**
- ✓ Replacements and promotions
- ✓ Reuse and recycling
- ✓ Water-use regulation
- ✓ Integrated resource management

Six appendixes to the Guidelines provide supporting information: detailed descriptions of conservation measures (Appendix A), conservation benchmarks (Appendix B), acronyms and glossary (Appendix C), information resources (Appendix D), funding sources (Appendix E), and state contacts (Appendix F)




**Public Education and Conservation Awareness is a critical component of your Plan.**

## *SHOWERHEAD COST-EFFECTIVENESS EXAMPLE*

| Performance | Base Model | Recommended Level | Best Available (Niagara model) |
|---|---|---|---|
| **Water Use Only** | | | |
| *Gallons Per Minute (gpm)* | 2.5 gpm | 2.2 gpm | 1.5 gpm |
| *Annual Water Use* | 18,250 gallons | 16,060 gallons | 10,950 gallons |
| *Annual Water Cost* | $73 | $64 | $44 |
| *Lifetime Water Cost* | $610 | $540 | $370 |
| **With Electric Water Heating** | | | |
| **Annual Energy Use** | 2,370 kWh | 2,120 kWh | 1,540 kWh |
| *Annual Energy Cost* | $142 | $127 | $92 |
| *Lifetime Energy Cost* | $1,090 | $980 | $710 |
| *Lifetime Energy and Water Cost Savings* | - | $180 | $620 |
| **With Gas Water Heating** | | | |
| *Annual Energy Use* | 131 therms | 120 therms | 94 therms |
| *Annual Energy Cost* | $53 | $48 | $38 |
| *Lifetime Energy Cost* | $450 | $410 | $320 |
| *Lifetime Energy and Water Cost Savings* | - | $110 | $370 |

1. *The flow rate of the Base Model just meets the current federal standards for showerheads.*

## *Cost-Effectiveness Assumptions*

- Lifetime Energy or Water Cost is the sum of the discounted value of annual energy or water costs, based on average usage and an assumed showerhead life of 10 years. Future energy price trends and a discount rate of 3.4%-4.5 % are based on federal guidelines. Future water and wastewater treatment costs are conservatively assumed to increase only at the rate of inflation.
- Usage assumption: duration of 10 minutes per shower, 2 showers per day, and 365 days per year.
- Water temperature: showerhead water temperature is assumed to be 106°F and the inlet water pressure is 80 psi.
- Assumed electricity price: $0.06/kWh, the federal average electricity price in the U.S.
- Assumed gas price: $0.40/therm, the federal average gas price in the U.S.
- Assumed combined water and wastewater price: $4.00/1000 gallons.

## *FAUCET COST-EFFECTIVENESS EXAMPLE*

| Performance | Base Model | Recommended Level | Best Available (Niagara model) |
|---|---|---|---|
| **Water Use Only** | | | |
| *Gallons Per Minute/cycle* | 2.2 gpm | 2.0 gpm | 1.5 gpm |
| *Annual Water Use* | 17,160 gallons | 15,600 gallons | 11,700 gallons |
| *Annual Water Cost* | $69 | $62 | $47 |
| *Lifetime Water Cost* | $570 | $520 | $390 |
| **With Electric Water Heating** | | | |
| **Annual Energy Use** | 970 kWh | 890 kWh | 700 kWh |
| *Annual Energy Cost* | $58 | $54 | $42 |
| *Lifetime Energy Cost* | $450 | $410 | $320 |
| *Lifetime Energy and Water Cost Savings* | - | $90 | $310 |
| **With Gas Water Heating** | | | |
| *Annual Energy Use* | 54 therms | 50 therms | 42 therms |
| *Annual Energy Cost* | $21 | $20 | $17 |
| *Lifetime Energy Cost* | $180 | $170 | $140 |
| *Lifetime Energy and Water Cost Savings* | - | $60 | $220 |

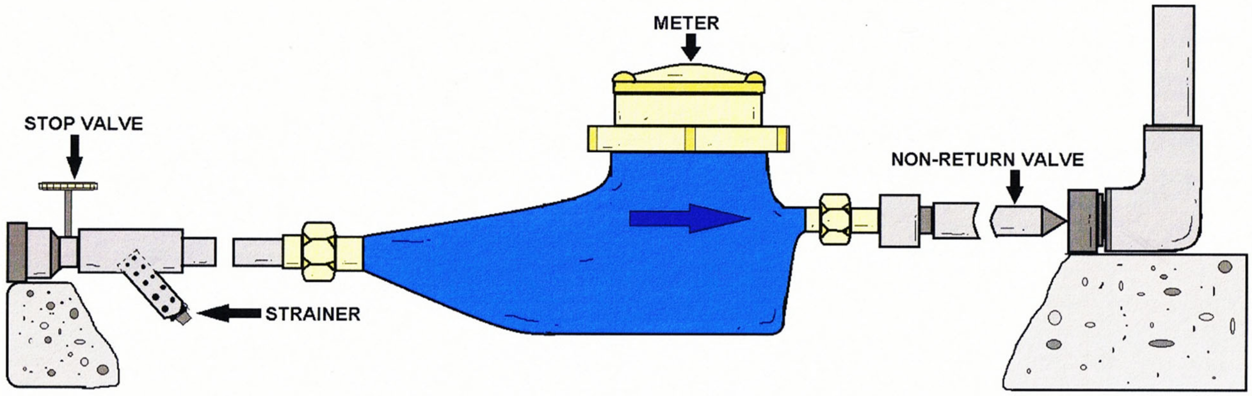
*1. The flow rate of the Base Model just meets the current federal standards for faucets, based on ASME standard test conditions.*
*2. The duration of 1 cycle is based on the American with Disabilities Act (ADA) specification of 10 seconds.*

## *Cost-Effectiveness Assumptions*

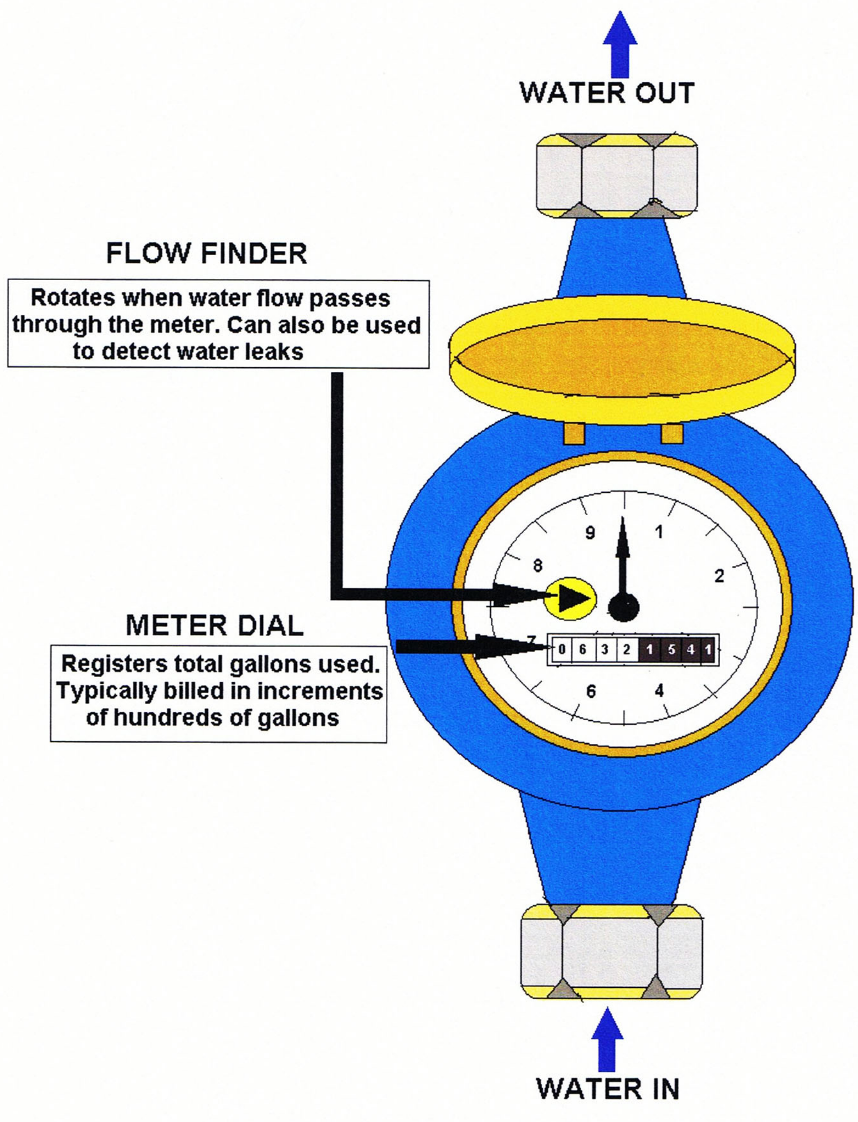
- Lifetime Energy or Water Cost is the sum of the discounted value of annual energy or water costs, based on average usage and an assumed faucet life of 10 years. Future energy price trends and a discount rate of 3.4% - 4.5% are based on federal guidelines. Future water and wastewater treatment costs are conservatively assumed to increase only at the rate of inflation.
- Usage assumption: duration of 1 minute, 30 times per day, and 260 days per year.
- Water temperature: faucet water temperature is assumed to be 80°F and the inlet water pressure is 60 psi.
- Self-closing faucets: each use is assumed to require 2 on-cycles.
- Assumed electricity price: $0.06/kWh, the federal average electricity price in the U.S.
- Assumed gas price: $0.40/therm, the federal average gas price in the U.S.
- Assumed combined water and wastewater price: $4.00/1000 gallons.

## Water Theft (Unaccounted for Water)

**Commonly found methods and devices.  Notice diversion with the Semi-Truck.**



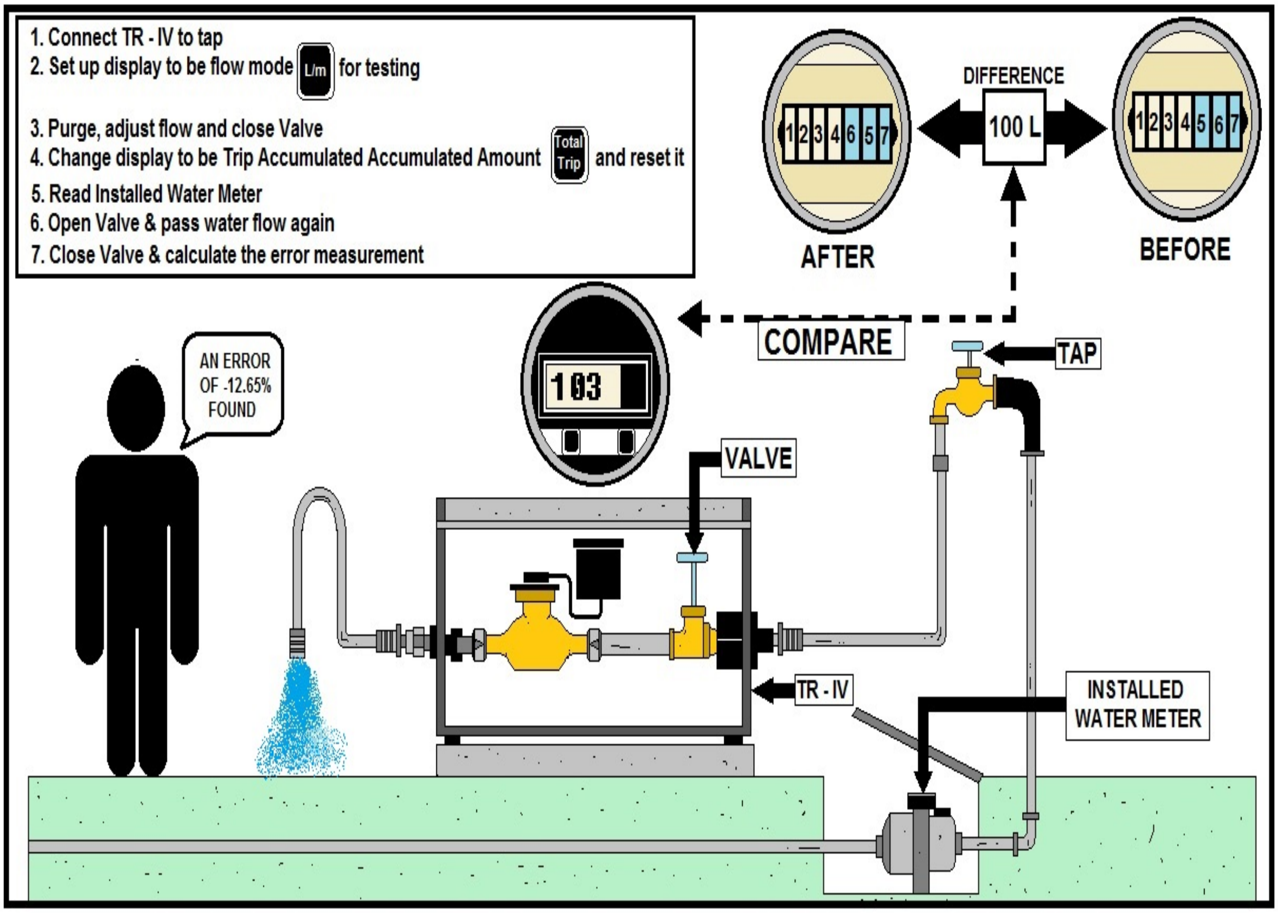

**WATER METER**




**RESIDENTIAL WATER METER (3/4")**

## Meter Shop

Most meters will read lower than normal, never higher. All meters will create "**head loss**" on the water service except for a "**Magnetic Meter**". The large tanks are used to measure the water (in gallons) that is used to calibrate or check the water meter. Most water utilities will charge the customer a fee to check the accuracy of the meter. Below, is equipment used for meter calibration.




TESTING THE ACCURACY OF WATER METERS CAN AID IN THE CONSERVATION OF WATER

# Chapter 2
# OVERVIEW OF THE GUIDELINES

## 1. WATER CONSERVATION GUIDELINES AND THE SDWA

Section 1455 of the Safe Drinking Water Act (**SDWA**) requires the U.S. Environmental Protection Agency to publish these guidelines:

Sec. 1455. (a) Guidelines.—Not later than 2 years after the date of enactment of the Safe Drinking Water Act Amendments of 1996, the Administrator shall publish in the Federal Register guidelines for water conservation plans for public water systems serving fewer than 3,300 persons, public water systems serving between 3,300 and 10,000 persons, and public water systems serving more than 10,000 persons, taking into consideration such factors as water availability and climate.
(b) Loans or Grants.—Within 1 year after publication of the guidelines under subsection (a), a State exercising primary enforcement responsibility for public water systems may require a public water system, as a condition of receiving a loan or grant from a State loan fund under section 1452, to submit with its application for such loan or grant a water conservation plan consistent with such guidelines.

The guidelines are addressed to *water system managers*. Use of the guidelines is *not* required by federal law or regulation; however, water systems can benefit from conservation planning, whether or not it is required by law. It is up to each State to decide whether or not to require water systems to file conservation plans consistent with these or any other guidelines. *It is very important that water system managers understand and comply with their own state, regional, or local regulatory requirements.*

## 2. BENEFITS OF CONSERVATION AND PLANNING

Water conservation consists of *any beneficial reduction in water losses, waste, or use*. In the context of utility planning, the term "beneficial" usually means that the benefits of an activity outweigh the costs.

Conserving water can be beneficial in many ways, but one important reason for conservation is that it can help systems avoid, downsize, or postpone water and wastewater projects. The facilities used to treat and deliver drinking water (and to collect and treat wastewater) are sized to meet demand; if the level of demand is inflated by wasteful use, people pay more than necessary in both capital and operating costs to provide safe and adequate water supply and wastewater services.

Moreover, when the cost of supplying drinking water and processing wastewater is reduced, financial resources can be used to meet other needs.

***Benefits of Water Conservation***

*In order to meet the needs of existing and future populations and ensure that habitats and ecosystems are protected, the nation's water must be sustainable and renewable. Sound water resource management, which emphasizes careful, efficient use of water, is essential in order to achieve these objectives.*

*Efficient water use can have major environmental, public health, and economic benefits by helping to improve water quality, maintain aquatic ecosystems, and protect drinking water resources. As we face increasing risks to ecosystems and their biological integrity, the inextricable link between water quality and water quantity becomes more important.*

*Water efficiency is one way of addressing water quality and quantity goals. The efficient use of water can also prevent pollution by reducing wastewater flows, recycling industrial process water, reclaiming wastewater, and using less energy.*

**Source: EPA Office of Water, *Statement of Principles on Efficient Water Use* (December 1992).**

In connection with infrastructure funding, the value of conservation is appropriately assessed in terms of supply, treatment, and distribution costs that can be *avoided* because of planned reductions in water demand. Conservation becomes more valuable over time because future water supplies and the facilities needed to deliver them are expected to cost more (even when adjusting for inflation). In other words, permanent conservation savings that are realized today will have increasing value into the future.

Planning is a means of anticipating the future and organizing activities in response. Conservation planning can help water system managers take inventory of their existing efforts and identify new opportunities. Planning can help utilities manage competing goals and rising costs, such as those associated with SDWA compliance, infrastructure improvement, and meeting demand growth.

The investment that water system managers make in conservation planning should yield savings that can be measured in terms of water and dollars.

The planning approach suggested by these Guidelines is designed to be accessible and relatively inexpensive. It is very important for utilities to know exactly what planning requirements apply in their states and how other plans already prepared by the system might be used in conjunction with these Guidelines.

### 3. OVERVIEW OF THE PLANNING PROCESS

These Guidelines provide a framework that water managers can use to assess the cost-effectiveness of conservation, as well as the value of conservation in avoiding, lowering, or postponing supply-side capital and operating costs.

**Table 2-1: System Size Categories and Type of Guidelines**

| System Size Category (SDWA) | Applicable Guidelines |
|---|---|
| Serves fewer than 3,300 people | Basic Guidelines<br>or<br>Capacity-Development Approach [a] |
| Serves between 3,300 and 10,000 people | Basic Guidelines<br>Up to 10,000 people served |
| Serves more than 10,000 people | Intermediate Guidelines<br>Up to 100,000 people served |
| | Advanced Guidelines<br>More than 100,000 people served |

[a] States also can promote water conservation planning by small water systems through their capacity-development strategies. Some states may provide assistance to small systems in the planning and implementation of water conservation programs through their capacity-development strategies.

EPA has prepared three sets of Guidelines (as summarized in Table 2-1):

- The Basic Guidelines are designed for use by water systems serving populations of 10,000 or fewer. Some water systems, especially those serving fewer than 3,300 people, may be included in a Capacity-Development Approach, which addresses water conservation through state capacity-development strategies required by the SDWA. (See Section 5 of Part 1.) Systems should check with their state primacy agency for information and guidance about capacity development.

- The Intermediate Guidelines are designed for water systems serving between 10,000 and 100,000 people.
- The Advanced Guidelines are designed for water systems serving more than 100,000 people.

Which Guidelines are appropriate also may depend on various factors and conditions affecting water systems and their need for conservation planning. For example, smaller systems with constrained water supply resources may want to follow the Intermediate Guidelines. *Water system managers should check with their own state's rules, regulations, and recommendations about which Guidelines to follow.*

Each of the Guidelines follows a similar framework for the planning process; however, the Basic, Intermediate, and Advanced Guidelines vary in terms of the scope of the analysis and the amount of detail required when preparing a conservation plan.

The Basic Guidelines provide a very simplified planning approach. The Intermediate and Advanced Guidelines lead to a comprehensive conservation plan, as outlined in Table 2-2. The outline may be adapted to better meet system needs and state requirements.

Many of the worksheets refer to gallons as the unit for measuring water quantity. However, water systems should use the unit of measurement that they typically use for planning, reporting, and other purposes. Water systems also should use available information resources (such as current demand forecasts) whenever feasible in order to expedite preparation of the conservation plan and avoid duplication of other efforts.

The Guidelines also focus on the benefits of conservation for water systems. It may be appropriate for many systems to expand the analysis to include wastewater systems, particularly in the assessment of benefits and costs. Conservation can help communities reduce the cost of wastewater facilities, as well as water facilities, and the Guidelines can provide a framework for making this assessment.

One important distinction among the Guidelines is the number of conservation measures recommended for consideration by managers. The Guidelines reflect a cumulative approach to conservation measures, which are organized into three levels (see Tables 1-3 and 2-3). Each level includes additional categories of measures. For example, the Intermediate Guidelines include more measures than the Basic Guidelines and the Advanced Guidelines include more measures than the Intermediate Guidelines. This framework recognizes the general continuum of conservation measures available to water systems with different needs and capabilities.

This organization of measures should not be interpreted to place a higher value on some measures over others. Water system managers and planners are strongly encouraged to consider the full range of conservation measures, which are described in Appendix A.

**Table 2-2: Contents of a Comprehensive Water Conservation Plan**

1. SPECIFY CONSERVATION PLANNING GOALS
    - List of conservation planning goals and their relationship to supply-side planning.
    - Description of community involvement in the goals-development process.
2. DEVELOP A WATER SYSTEM PROFILE
    - Inventory of existing facilities, production characteristics, and water use.
    - Overview of conditions that might affect the water system and conservation planning.
3. PREPARE A DEMAND FORECAST
    - Forecast of anticipated water demand for future time periods.
    - Adjustments to demand based on known and measurable factors.

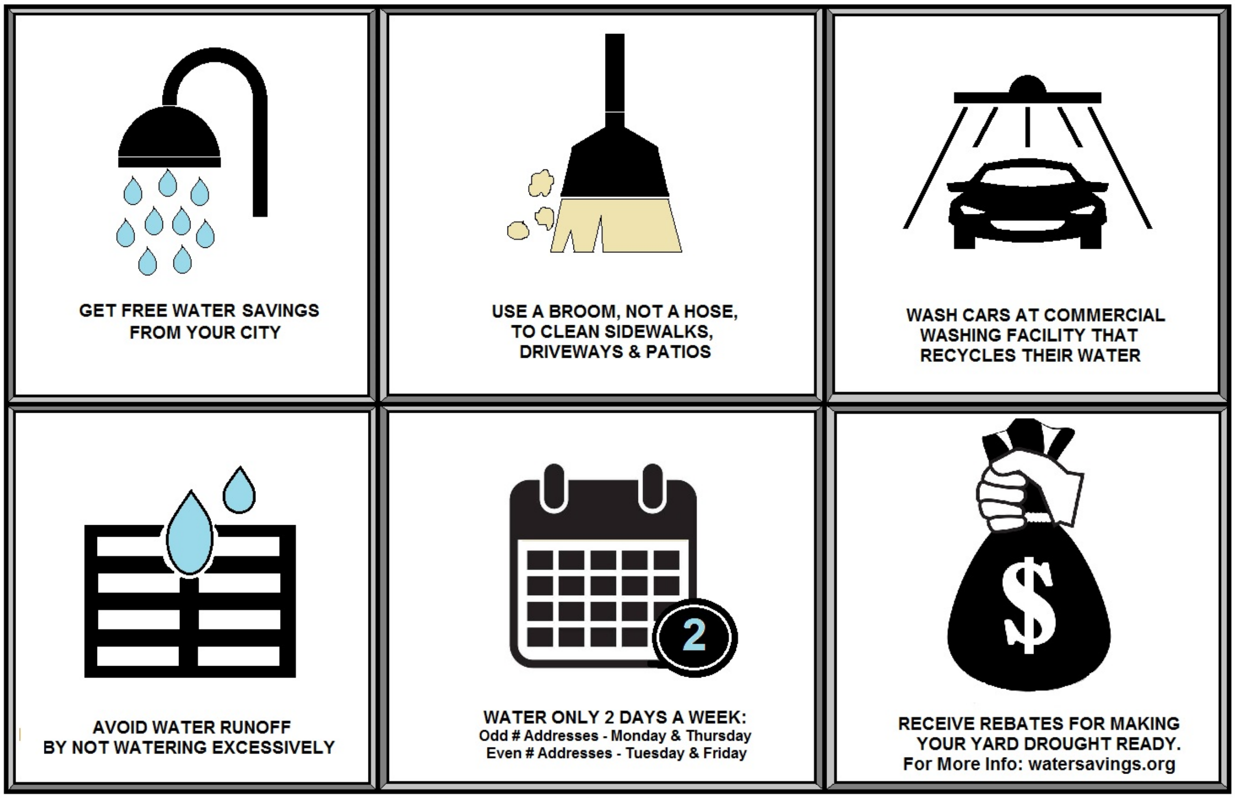
- Discussion of uncertainties and "***what if***" (sensitivity) analysis.

4. DESCRIBE PLANNED FACILITIES
    - Improvements planned for the water system over a reasonable planning horizon.
    - Estimates of the total, annualized, and unit cost (per gallon) of planned supply-side improvements and additions.
    - Preliminary forecast of total installed water capacity over the planning period based on anticipated improvements and additions.
5. IDENTIFY WATER CONSERVATION MEASURES
    - Review of conservation measures that have been implemented or that are planned for implementation.
    - Discussion of legal or other barriers to implementing recommended measures.
    - Identification of measures for further analysis.
6. ANALYZE BENEFITS AND COSTS
    - Estimate of total implementation costs and anticipated water savings.
    - Cost effectiveness assessment for recommended conservation measures.
    - Comparison of implementation costs to avoided supply-side costs.
7. SELECT CONSERVATION MEASURES
    - Selection criteria for choosing conservation measures.
    - Identification of selected measures.
    - Explanation of why recommended measures will not be implemented.
    - Strategy and timetable for implementing conservation measures.
8. INTEGRATE RESOURCES AND MODIFY FORECASTS
    - Modification of water demand and supply capacity forecasts to reflect anticipated effects of conservation.
    - Discussion of the effects of conservation on planned water purchases, improvements, and additions.
    - Discussion of the effects of planned conservation measures on water utility revenues.
9. PRESENT IMPLEMENTATION AND EVALUATION STRATEGY
    - Approaches for implementing and evaluating the conservation plan.
    - Certification of the conservation plan by the system's governing body.

Here is a photograph of a waterless urinal retrofit. Expect the worst, repairing wall and floors. One solution is to use your existing water urinals and shut the water off and utilize the Desert Cube. The above picture is of the WaterLess urinal. It is made out of porcelain and not fiberglass. The traps for this model are relatively inexpensive. There is one more urinal that does not have a replaceable trap and is made in Germany. Some people call it the McDry or Durivent.

**Table 2-3: Guidelines and Associated Conservation Measures [a]**

| Measures | ←Basic Guidelines→ (within ←Intermediate Guidelines→ and ←Advanced Guidelines→) | | |
|---|---|---|---|
| **Measures** | **Basic ←Guidelines→** | **←Intermediate Guidelines →** | **←Advanced Guidelines →** |
| **LEVEL 1 MEASURES** | | | |
| Universal metering [B] | Source-water metering | Fixed-interval meter reading | Test, calibrate, repair, and replace meters |
| | Service-connection metering and reading | Meter-accuracy analysis | |
| | Meter public-use water | | |
| Water accounting and loss control [A] | Account for water | Analyze non-account water | Loss-prevention program |
| | Repair known leaks | Water system audit | |
| | | Leak detection and repair strategy | |
| | | Automated sensors/ telemetry | |
| Costing and pricing [B] | Cost-of-service accounting | Cost analysis | Advanced pricing methods |
| | User charges | Non-promotional rates | |
| | Metered rates | | |
| Information and education [B] | Understandable water bill | Informative water bill | Workshops |
| | Information available | Water-bill inserts | Advisory committee |
| | | School program | |
| | | Public-education program | |

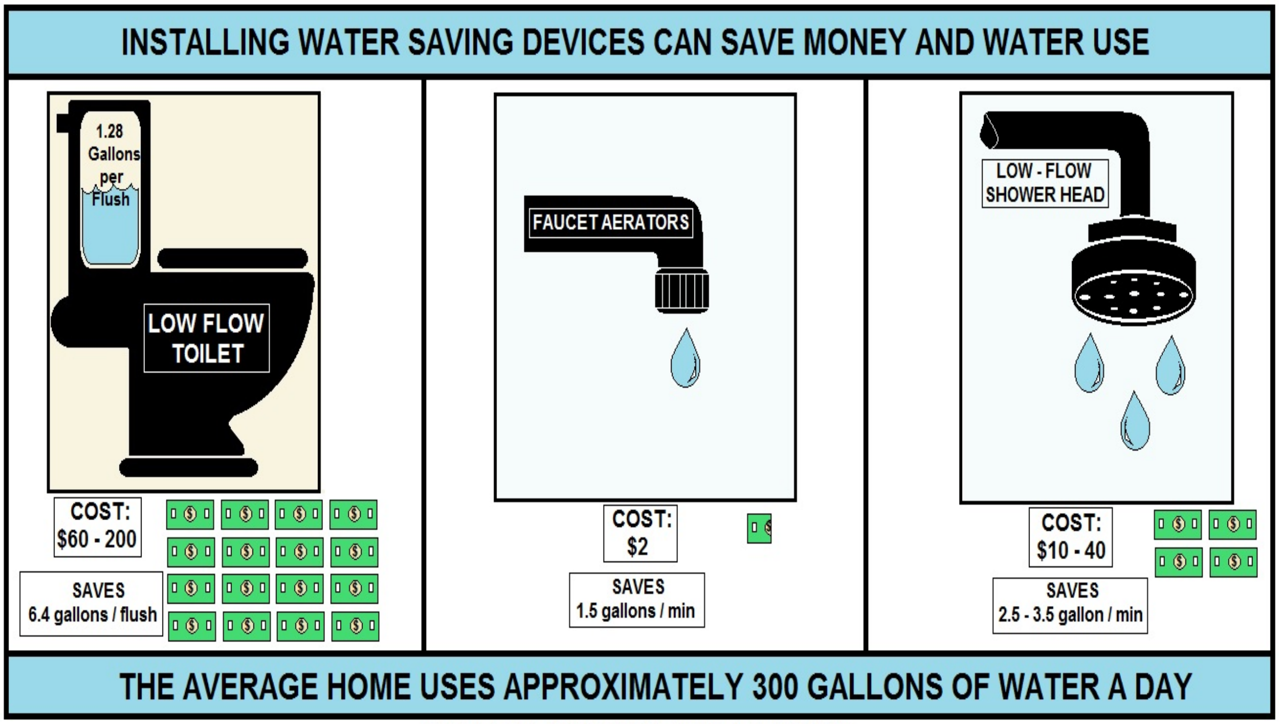



**WATER CONSERVATION MEASURES**

| LEVEL 2 MEASURES | | | |
|---|---|---|---|
| Water-use audits [B] | | Audits of large-volume users | Selective end-use audits |
| | | Large-landscape audits | |
| Retrofits [A] | | Retrofit kits available | Distribution of retrofit kits |
| | | | Targeted programs |
| Pressure management [A] | | Systemwide pressure management | Selective use of pressure-reducing valves |
| Landscape efficiency [P] | | Promotion of landscape efficiency | Landscape planning and renovation |
| | | Selective irrigation submetering | Irrigation management |

| LEVEL 3 MEASURES | | |
|---|---|---|
| Replacements and promotions [B] | | Rebates and incentives (non-residential) |
| | | Rebates and incentives (residential) |
| | | Promotion of new technologies |
| Reuse and recycling [B] | | Industrial applications |
| | | Large-volume irrigation applications |
| | | Selective residential applications |
| Water-use regulation [B] | | Water-use standards and regulations |
| | | Requirements for new developments |
| Integrated resource management [B] | | Supply-side technologies |
| | | Demand-side technologies |

[a] See Appendix A for a description of the measures. Water systems should consider *at least* the measures listed under the guidelines applying to them.
[A] measure affects average-day demand
[P] measure affects maximum-day (peak) demand)
[B] measure affects both average and peak demand




WATER SAVING SOLUTIONS

# Chapter 3
# BASIC GUIDELINES
# FOR PREPARING WATER CONSERVATION PLANS

These Basic Guidelines are designed for use by water systems serving populations of 10,000 or fewer. Some water systems, especially those serving fewer than 3,300 people, may be included in a Capacity-Development Approach, which addresses water conservation through state capacity-development strategies required by the SDWA. (See Section 5 of Part 1.) Systems should check with their state primacy agency for information and guidance about capacity development.

Which Guidelines are appropriate also may depend on various factors and conditions affecting water systems and their need for conservation planning. For example, smaller systems with constrained water supply resources may want to follow the Intermediate Guidelines. ***Water system managers should check with their own state's rules, regulations, and recommendations about which Guidelines to follow.***

## 1. SPECIFY CONSERVATION PLANNING GOALS

### Planning Goals

Planning goals can be developed from different perspectives. These Guidelines emphasize a water supplier perspective. Lowering water demand can help water suppliers avoid, downsize or postpone the construction and operation of supply-side facilities.

***Specify conservation planning goals in terms of expected benefits for the water system and its customers. Involve affected members of the community in the development of conservation planning goals and throughout the implementation process.***

Customers and society at large also benefit from conservation. Conservation benefits society by preserving environmental resources. Conservation can benefit customers by lowering energy and long-term water costs. Water conservation reduces demands on wastewater systems; in fact, the need to reduce wastewater treatment costs can be a strong rationale for water conservation.

The Guidelines and the worksheets can be used to simultaneously address the potential effects of conservation on water and wastewater operations.

Water systems should state their goals in specific terms. Measurable goals are useful for evaluation purposes. For example, many water systems identify a specific water-use reduction goal (as a percentage of current water usage). Water conservation planning goals may include:

- 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 value of water.
- Improving reliability and margins of safe and dependable yields.
- Protecting and preserving environmental resources.

Managers should revisit the goals section before finalizing the conservation plan and periodically thereafter, because goals and the means to achieve them will evolve. As the water system accomplishes certain conservation goals, new objectives may emerge.

**Community Involvement**
The process of developing goals should involve community representation. Modern resource planning emphasizes an open process that gives all affected groups an opportunity to express their interests and concerns. Involving the community in goal development and implementation also serves an important public education function, and can greatly enhance the success of conservation programs. Members of the community who might be interested in water conservation include:

- Residential water consumers
- Commercial water consumers
- Industrial water consumers
- Wholesale customers
- Environmental groups
- Civil rights groups
- Indian tribes
- Labor groups
- Business and commerce groups
- Recreational water users
- Agricultural users
- Educational institutions
- Government agencies

In addition to helping the water system specify planning goals, community participants also may have an ongoing role in a system's conservation program. Ongoing involvement helps maintain and build support for achieving conservation goals and "***getting the word out***" about the conservation effort. Participants can act as a focus group for exploring specific conservation measures (discussed in Section 4), and also can provide valuable linkages to key groups—consumers, businesses, and institutions—involved in implementing certain conservation measures. Participants also can offer input on the level of satisfaction with the system's programs.

Finally, community groups can assist the water system in monitoring results and adjusting program implementation.

For many water systems, involving the community in water system planning will be a new experience. Community involvement does not have to consume excessive time or resources.

Even a few "**town hall**" meetings or "**brainstorming**" sessions can be helpful. Most system managers will find that involving members of the community in developing goals, implementing programs, and evaluating results is a very worthwhile investment. Fortunately, guidance on this approach is available.[1]

1. See *Public Involvement Strategies: A Manager's Handbook* (Denver, CO: American Water Works Association Research Foundation, 1996).

**1. SPECIFY CONSERVATION PLANNING GOALS**

| |
|---|
| These Intermediate Guidelines are designed for water systems serving between 10,000 and 100,000 people. Which Guidelines are appropriate may depend on various factors and conditions affecting water systems and their need for conservation planning. For example, mid-sized systems with constrained water supply resources may want to follow the Advanced Guidelines. ***Water system managers should check with their own state's rules, regulations, and recommendations about which Guidelines to follow.*** |

## Planning Goals

Planning goals can be developed from different perspectives. These planning Guidelines, including the analysis of the benefits and costs of conservation activities, emphasize a water supplier perspective.

***Specify conservation planning goals in terms of anticipated benefits for the water system and its customers. To the extent practical, involve affected members of the community in the development of conservation planning goals and throughout the implementation process.***

The value of conservation is defined primarily in terms of avoided supply-side costs to the water system. Lowering the level of water demand can help water suppliers avoid, downsize, or postpone the construction and operation of costly supply-side facilities.

The benefits of conservation also can be understood from the perspectives of customers, as well as society at large. Conservation benefits society by preserving environmental resources.

Conservation can benefit customers by lowering energy and long-term water costs. Water conservation reduces demands on wastewater systems; in fact, the need to reduce wastewater treatment costs can be a strong rationale for water conservation. The Guidelines and the worksheets can be used to simultaneously address the potential effects of conservation on water and wastewater operations.

Conservation planning goals can take many forms. Water systems should state their goals in specific terms. Measurable goals are useful for evaluation purposes. For example, many water systems identify a specific water-use reduction goal (as a percentage of current water usage).
Water conservation planning goals may include:

- 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 value of water.
- Improving reliability and margins of safe and dependable yields.
- Protecting and preserving environmental resources.

Planners should plan on revisiting the goals section before finalizing the conservation plan and periodically thereafter, because goals and the means to achieving them will evolve. As the water system accomplishes certain conservation goals, new objectives may come into focus.

## Community Involvement

The process of developing goals can involve representatives of various groups in the community (or stakeholders) who may be concerned about a water system and its future. Modern resource planning (such as integrated resource planning) emphasizes an open process that involves all affected groups so that they can have an opportunity to express their interests and concerns. Involving the community in goal development also serves an important public education function. Moreover, it is widely believed that involving the community in developing goals, as well as in the implementation process, can greatly enhance the success of conservation programs.

1. See *Public Involvement Strategies: A Manager's Handbook* (Denver, CO: American Water Works Association Research Foundation, 1996).

## 2. DEVELOP A WATER SYSTEM PROFILE

### System Profile

Taking inventory of existing resources and conditions is an important step in the planning process. A water system profile can help systems assess their present circumstances and design strategies to meet emerging needs.

> ***Summarize the service and operating characteristics of the water system. Provide an overview of conditions and a description of climate, water availability, or other factors that might affect water conservation planning.***

Most water systems should maintain the data and information necessary for building a system profile.

Much information may already have been compiled for a facility plan or for other purposes. Worksheet 4-1 profiles a relatively simple summary table that systems can use to compile and present key system characteristics. The system profile can be expanded to include additional information. For example, systems may want to present data on trends for some characteristics (such as supply and demand measures). Systems should include in their profile additional characteristics or details considered relevant for understanding the nature of the system.

### System Conditions

Worksheet 4-2 provides a very simple overview of planning conditions that might affect the water system and its conservation planning effort. This checklist can be used to make a general review of conditions affecting the supply or the demand for water. For planning purposes, it is important to identify and focus on the conditions that most affect a particular system.

The conditions outlined in the worksheet suggest the need for water conservation planning. While all water systems can benefit from efficiency improvements, water conservation can be especially beneficial for systems experiencing water shortages or rapid increases in demand.

For example, water systems facing one or more of the following conditions are strongly urged to consider the fullest range of conservation measures available to them in accordance with these guidelines:

- Systems in state-designated critical water or stressed areas.
- Systems experiencing frequent droughts, emergencies, or safe yield problems.
- Systems with excessive unaccounted-for water or water losses.
- Systems entering into major construction cycles.
- Systems anticipating rapid growth in water demand.

For some conditions, states might provide benchmark measures that water systems can use for comparison purposes. For example, a state might have specific criteria for defining critical use or stressed areas, for classifying per-capita water use, or for identifying the age of systems. When practical, systems should try to compare significant conditions using generally accepted measures.

In addition to the summary worksheet, planners also should prepare a brief written discussion of the significant conditions affecting their systems. Particular attention can be paid to climate and water availability, but other factors affecting the system can be considered as well. This information can be used to help systems identify problems and opportunities throughout the planning process.

### Current Conservation Efforts

Worksheet 4-3 is provided so that water systems can describe their current water conservation activities and programs. For each conservation measure implemented, planners can indicate the approximate annual water savings achieved, when implementation for the measure began, and whether continued implementation is planned. Any other pertinent information on current efforts and their effectiveness can be provided in the plan as well.

**INTERMEDIATE GUIDELINES FOR PREPARING WATER CONSERVATION PLANS**
**3. PREPARE A DEMAND FORECAST**
**Demand Forecasting**

*Prepare a forecast of anticipated water demand for selected time periods. To the extent practical, the planner should take into account variations in demand based on type of water usage, as well as perform a "what if" (sensitivity) analysis.*

Forecasting water use (or water demand) is a critical part of the planning process. Forecasts can range from simple projections based on anticipated growth in the population to complex models using several variables to explain variations in water use. Forecasts can be made for a water system as a whole; however, forecasts are considered more accurate when they are prepared for separate classifications of water use or sectors.

The Guidelines suggest that planners prepare forecasts for five-year, ten-year, and twenty-year intervals. Additional time points can be used as well. The longer the planning horizon, the greater will be the uncertainty of the forecast. Forecasts should be revisited and updated on a regular basis.

The forecast should recognize the effects of conservation measures already implemented. The forecast also should recognize the demand effects of plumbing efficiency standards established under the 1992 Energy Policy Act (see Appendix B, Tables B-5 and B-6).[2]

New construction and renovations will not contribute as much to total demand as in the past; systems that are not experiencing growth might detect declines in demand due to these effects.

For the purposes of this conservation plan, anticipated demand effects from measures contemplated in the plan should not be included. A revision to the demand forecast based on implementing the planned conservation measures is made in Section 8 (Worksheet 4-12).

*It is not necessary for systems to prepare a separate forecast for the purposes of this plan if a forecast has already been prepared for the system within a reasonable time frame. Planners should include the results of their forecasts in this plan.*

**Forecasting Method**
Systems following the Intermediate Guidelines should use, at a minimum, the forecasting technique provided in Worksheet 4-4. This approach separates (at a minimum) residential and nonresidential customers. The forecast can be made on a per-capita or per-connection basis. However, for the nonresidential sector, planners should use employees, jobs, or another appropriate explanatory variable. The water demand forecast can be refined by considering customer classifications. For example, the nonresidential class can be subdivided into the commercial and industrial classes (as well as wholesale water customers).

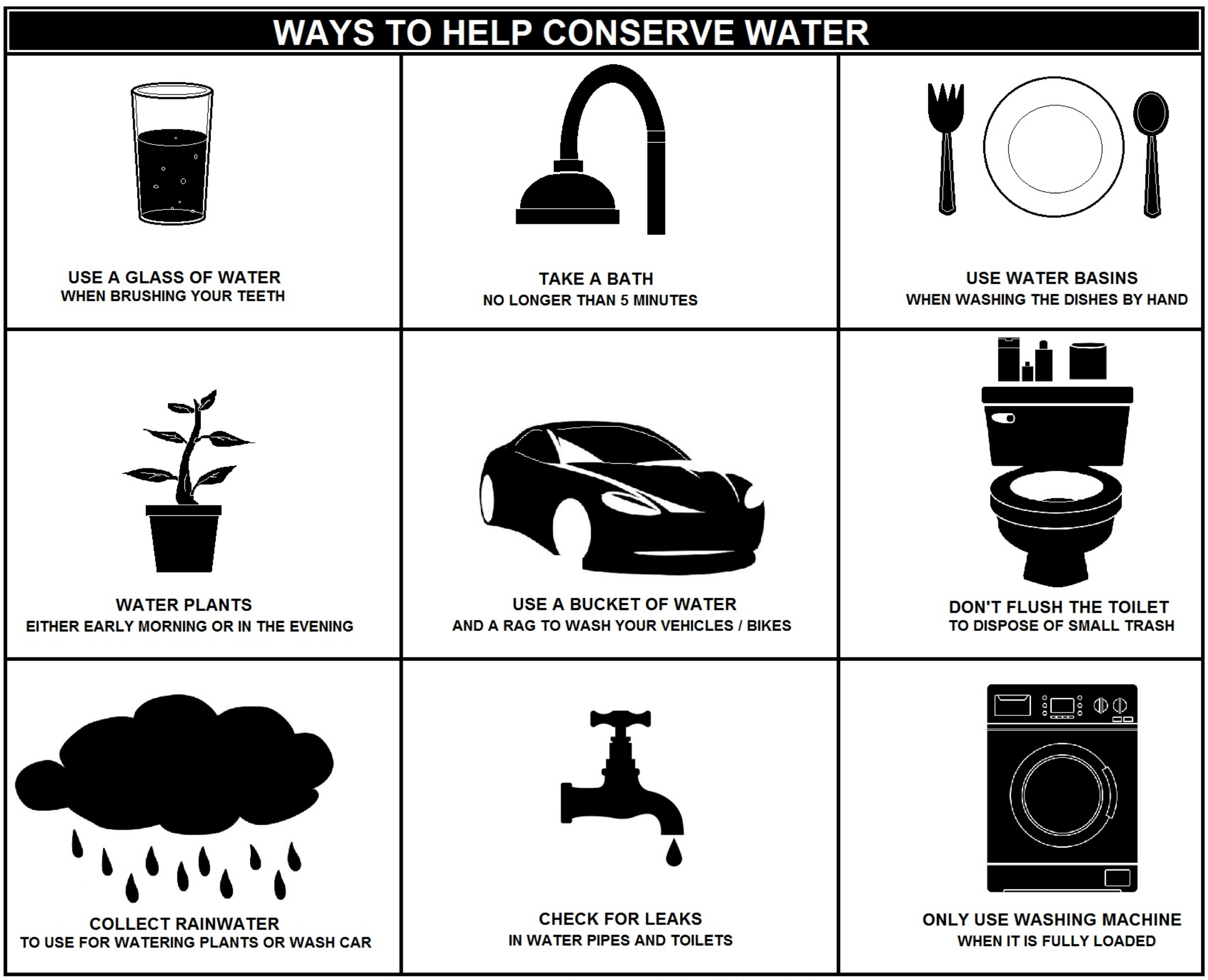
A separate forecast also should be prepared for nonaccount water, or water that does not produce revenues for the system.

Nonaccount water includes authorized uses of water, as well as losses and leaks. (Worksheet A-2 in Appendix A can be helpful in understanding nonaccount water and water losses). Planners also should estimate average-day and maximum-day demand over the planning horizon. As discussed in Section 4, different types of supply-side facilities are designed to meet water demands (peak or average), and various conservation measures target different types of demand.

Each of the forecasts should be subjected to a basic "***what if***" analysis to address potentially important changes in the level or pattern of water demand.

The forecasts should take into account and the plan should explain any known, planned, or measurable changes that will affect demand, *with the exception of the conservation measures contemplated in these guidelines.* Adjustments to the forecast based on expected savings from conservation will be made in Section 8 (Worksheet 4-12).

This method of forecasting also is very simple and limited. While it takes into account variations in water-use by customer class, the method also assumes that unit use (use per person, household, place of business, and so on) does not vary over time.




WAYS TO CONSERVE WATER

# INTERMEDIATE GUIDELINES FOR PREPARING WATER CONSERVATION PLANS
# 4. DESCRIBE PLANNED FACILITIES

**Supply Forecasting**

*Describe improvements planned for the water system over a reasonable planning horizon; identify the types of improvements proposed, and estimate the total, annual, and unit cost of the improvements. Prepare a preliminary forecast of installed capacity.*

In this part of the conservation plan, planners are asked to prepare an estimate of supply costs based on meeting the level of water demand specified in the unadjusted demand forecast (that is, unadjusted for additional conservation). This is a critical part of the analysis because it establishes the anticipated cost of *supply-side* improvements and additions and this cost estimate will be used to represent the value of conservation or *demand-side* activities.

Because the benefits of conservation extend into the future it is important to take a forward-looking approach to supply costs. The concept of marginal or incremental cost captures the idea that the "***true***" value of a supply resource can be measured in terms of the cost of the next increment of supply. If only high-cost supplies are available, the marginal or incremental cost will be high. For many communities, future increments of supply will be very costly. The value of a conserved amount of water at a future point in time will be equivalent to the most costly supply option available at that future time point, because that is the supply option being displaced by conservation.

**Cost Analysis**

A reasonable accounting of anticipated supply costs is needed in order to compare the cost of supply-side measures to the cost of demand-side or conservation measures (on a cost-per-gallon basis). Planners should choose an appropriate time horizon; a twenty-year or other suitable period can be used.

The choice of time frame should be consistent with the demand forecast (Section 3), as well as the other planning considerations. Planners should begin by preparing an estimate of major improvements and additions that will be required over the planning horizon in order to meet anticipated demand (including a safe reserve margin). Detailed cost estimates may be available from facility plans or other planning documents. Worksheet 4-5 can be used to summarize improvements and additions, which are disaggregated into three categories: source of supply, transmission and treatment, and distribution. (Additional categories can be used as needed.)

Planners should consider all capital facility improvements and additions. Improvements include renovations and expansions needed to maintain or enhance safety or reliability within existing facilities.

Additions consist of new facilities. Routine maintenance improvements should not be included. Anticipated water purchases and costs also should be recorded on Worksheet 4-5. For this part of the analysis, the effects of conservation measures currently being implemented should be considered, but the effects of new conservation measures on the need for supply capacity or water purchases should be excluded. (These effects are addressed in Section 8.)

*If no capital improvements and additions are planned, "0" values can be entered and the estimate of supply costs can be based on operating costs (including the cost of energy, chemicals, and purchased water).*

**Estimating Incremental Supply Costs**

Worksheet 4-6 provides a method for placing a value on supply-side improvements and additions. Improvements and additions are separated into categories: source of supply, water treatment facilities, treated water storage, and major transmission lines. Water purchases are separately recorded.

Capital costs over the useful life of the anticipated projects (including financing costs) are annualized and reported on a per-gallon basis. Financing costs can be incorporated into the calculation of *annualized* cost by using the expected interest rate for financing the project(s) or the system's overall cost of capital.

Added to the annualized capital cost forecast is the variable operating cost-per-gallon of production for existing and planned facilities, including costs associated with energy, chemicals, and existing and new water purchases. The resulting estimates of total annual incremental costs by type of facility (peak and average) can be used by planners to arrive at a simple estimate of incremental supply costs, which can later be compared to the unit cost of implementing conservation measures.

Supply-side facilities are designed to meet different types of water demand (as summarized in Table 4-1); similarly, different conservation measures affect different types of water demand. Planners should identify, as reasonably as possible, the extent to which improvements and additions are needed to meet average and/or peak demand.

Capital-cost reductions associated with conservation will depend on the extent to which supply-side facilities can be eliminated, postponed, or downsized. The effect of conservation on the need for facilities will depend on the demand pattern of the individual utility, as well as its construction cycle (that is, the timing of facilities currently under development).

Conservation can be particularly beneficial for systems that have a sufficient planning horizon to integrate conservation with conventional resource options. In some cases, capital costs cannot be avoided but conservation can still yield savings in operating expenditures. A degree of analyst judgment is required in order to evaluate incremental costs and to integrate supply-side and demand-side resources.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## Table 4-1: Relationship of Water Demand to Supply Facilities

| Type of Water Demand | Type of Water Supply Facility |
|---|---|
| Average-day | Source of supply facilities, including raw water storage facilities (such as reservoirs) |
| Maximum-day (peak) | Water treatment plants<br>Major transmission lines |
| Maximum-hour [a] | Treated water storage facilities<br>Distribution mains [b]<br>Pumping stations [b] |

Source: Adapted from Charles W. Howe and F. Pierce Linaweaver, "***The Impact of Price on Residential Water Demand and its Relationship to System Design and Price Structure***," *Water Resources Research 3* (First Quarter 1967): 13-32.

[a] Maximum-day demand plus fire-flow requirements.
[b] These facilities should be considered in the analysis if they could be affected by such conservation measures as leak detection and repair, pressure management, or integrated resource management.

This approach produces a very rough estimate of the value of supply-side options. Costs are not escalated (to account for the increasing value of water-supply resources over time), discounted (to account for the time value of money), or adjusted for inflation. The Advanced Guidelines address these adjustments.

**Preliminary Supply-Capacity Forecast**
Based on the anticipated improvements and additions, planners also can present a preliminary forecast of total supply capacity over the planning period. Worksheet 4-7 is provided for this purpose.

The forecast, which can be presented in a table or graph, can be used to indicate when changes to capacity are expected to occur.

The total supply forecast should reflect both additions to capacity and retirements. Improvements that allow the system to maintain capacity can be indicated with entries under both additions (to reflect the improvement) and retirements (to reflect the facilities taken out of service). A similar analysis can be used for wastewater facilities.

The supply forecast is *preliminary* because it can and will be revised later in the plan to reflect the effect of conservation on water supply needs.

One key to a successful program is a talented speaker. Hire a person with great speaking and entertaining skills to teach children the importance of saving water.

## Worksheet 4-1: Water System Profile

| A | SERVICE CHARACTERISTICS | Number | | |
|---|---|---|---|---|
| 1 | Estimated service population | | | |
| 2 | Estimated service area (square miles) | | | |
| 3 | Miles of mains | | | |
| 4 | Number of treatment plants | | | |
| 5 | Number of separate water systems | | | |
| 6 | Interconnection with other systems | | | |
| **B** | **ANNUAL WATER SUPPLY** | **Annual volume** | **Number of intakes or source points** | **Percent metered** |
| 7 | Groundwater | | | % |
| 8 | Surface water | | | % |
| 9 | Purchases: raw | | | % |
| 10 | Purchases: treated | | | % |
| 11 | Total annual water supply | | | % |
| **C** | **SERVICE CONNECTIONS** | **Connections** | **Water sales** | **Percent metered** |
| 12 | Residential, single-family | | | % |
| 13 | Residential, multi-family | | | % |
| 14 | Commercial | | | % |
| 15 | Industrial | | | % |
| 16 | Public or governmental | | | % |
| 17 | Wholesale | | | % |
| 18 | Other | | | % |
| 19 | Total connections | | | % |
| **D** | **WATER DEMAND** | **Annual volume** | **Percent of total** | **Per connection** |
| 20 | Residential sales | | | |
| 21 | Nonresidential sales | | | |
| 22 | Wholesale sales | | | |
| 23 | Other sales | | | |
| 24 | Nonaccount water: authorized uses | | | |
| 25 | Nonaccount water: unauthorized uses | | | |
| 26 | Total system demand (total use) | | | |

| E | AVERAGE & PEAK DEMAND | Volume | Total supply capacity | Percent of total capacity |
|---|---|---|---|---|
| 27 | Average-day demand | | | % |
| 28 | Maximum-day demand | | | % |
| 29 | Maximum-hour demand | | | % |
| **F** | **PRICING** | **Rate structure** | **Metering frequency** | **Billing frequency** |
| 30 | Residential rate | | | |
| 31 | Nonresidential rate | | | |
| 32 | Other rate | | | |
| **G** | **PLANNING** | **Prepared a plan** ☐ | **Date** | **Filed with state** ☐ |
| 33 | Capital, facility, or supply plan | | | |
| 34 | Drought or emergency plan | | | |
| 35 | Water conservation plan | | | |

## Worksheet 4-2: Overview of System Conditions [a]

| Line | Conditions | Increasing need for conservation→→→ Check applicable description ☐ | | | Don't know ☐ |
|---|---|---|---|---|---|
| **A** | **CLIMATE AND WATER AVAILABILITY** | | | | |
| 1 | Average precipitation | High ☐ | Moderate ☐ | Low ☐ | ☐ |
| 2 | Average temperatures | Low ☐ | Moderate ☐ | High ☐ | ☐ |
| 3 | Critical supply areas | No ☐ | At risk ☐ | Yes ☐ | ☐ |
| 4 | Competing water uses | No ☐ | Possibly ☐ | Yes ☐ | ☐ |
| 5 | Environmental constraints | No ☐ | Possibly ☐ | Yes ☐ | ☐ |
| 6 | Quality/quantity concerns | No ☐ | Possibly ☐ | Yes ☐ | ☐ |
| 7 | Seasonal variations in climate | Low ☐ | Moderate ☐ | High ☐ | ☐ |
| 8 | Instream flow problems | Low ☐ | Moderate ☐ | High ☐ | ☐ |
| 9 | Shortage or emergency frequency | Low ☐ | Moderate ☐ | High ☐ | ☐ |
| **B** | **INFRASTRUCTURE CONDITIONS** | | | | |
| 10 | Age of the system | Newer ☐ | Middle ☐ | Older ☐ | ☐ |
| 11 | General condition of system | Good ☐ | Fair ☐ | Poor ☐ | ☐ |
| 12 | Water losses and leaks | Low ☐ | Moderate ☐ | High ☐ | ☐ |
| 13 | Unaccounted-for water | Low ☐ | Moderate ☐ | High ☐ | ☐ |
| 14 | Safe yield of supply exceeded | No ☐ | At risk ☐ | Yes ☐ | ☐ |
| 15 | Wastewater discharges exceeded | No ☐ | At risk ☐ | Yes ☐ | ☐ |
| 16 | Wastewater capacity exceeded | No ☐ | At risk ☐ | Yes ☐ | ☐ |
| 17 | Potential for recycling and reuse | Low ☐ | Moderate ☐ | High ☐ | ☐ |
| 18 | Improvement plans | Low ☐ | Moderate ☐ | High ☐ | ☐ |
| 19 | Anticipated investment | Low ☐ | Moderate ☐ | High ☐ | ☐ |

| | | | | | |
|---|---|---|---|---|---|
| **C** | **SYSTEM DEMOGRAPHICS** | | | | |
| 20 | Rate of population growth per year | Low ☐ | Moderate ☐ | High ☐ | ☐ |
| 21 | Rate of demand growth per year | Low ☐ | Moderate ☐ | High ☐ | ☐ |
| 22 | Rate of economic growth per year | Low ☐ | Moderate ☐ | High ☐ | ☐ |
| 23 | Per capita water use (by class) | Low ☐ | Moderate ☐ | High ☐ | ☐ |
| 24 | Ratio of peak to average demand | Low ☐ | Moderate ☐ | High ☐ | ☐ |
| 25 | Presence of large-volume users | Low ☐ | Moderate ☐ | High ☐ | ☐ |
| **D** | **OTHER FACTORS** | | | | |
| 26 | | | | | ☐ |
| 27 | | | | | ☐ |
| 28 | | | | | ☐ |

[a] Specific (quantified) benchmarks for these indicators may be provided by the state.

## Worksheet 4-3: Current Water Conservation Activities

**Summarize the system's current water conservation activities/programs:**

| Water conservation measures | *Approximate* annual water savings | Implemented since (date) | Is continued implementation planned? |
|---|---|---|---|
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## Worksheet 4-4: Preliminary Water Demand Forecast [a]

| Line | Item | Current year | 5-year forecast | 10-year forecast | 20-year forecast |
|---|---|---|---|---|---|
| **A** | **RESIDENTIAL DEMAND** | | | | |
| 1 | Current annual water residential sales (total gallons) | | | | |
| 2 | Current population served [b] | | | | |
| 3 | Residential sales per capita (line 1 divided by line 2) [b] | | | | |
| 4 | Projected population [b] | | | | |
| 5 | Projected annual residential water demand (line 3 multiplied by line 4) | | | | |
| **B** | **NONRESIDENTIAL DEMAND [C]** | | | | |
| 6 | Current annual water nonresidential sales (total gallons) | | | | |
| 7 | Current number of employees or jobs [c] | | | | |
| 8 | Water use per employee or job (line 6 divided by line 7) | | | | |
| 9 | Projected number of employees or jobs | | | | |
| 10 | Projected annual nonresidential water demand (line 8 multiplied by line 9) | | | | |
| **C** | **NONACCOUNT WATER (WATER NOT SOLD TO CUSTOMERS)** | | | | |
| 11 | Current and forecast amount [d] | | | | |
| **D** | **WATER SYSTEM TOTAL DEMAND** | | | | |
| 12 | Current total annual water demand (add lines 1, 6, and 11) | | | | |
| 13 | Projected total annual water demand (add lines 5, 10, and 11) | | | | |
| 14 | Adjustments to forecast (+ or -) | | | | |
| 15 | Current (line 12) and adjusted total annual water demand forecast (add lines 13 and 14) [e] | | | | |
| 16 | Current and projected annual supply capacity [f] | | | | |
| 17 | Difference between total use and total supply capacity (+ or -) (subtract line 12 from line 15) | | | | |
| **E** | **AVERAGE-DAY AND MAXIMUM-DAY DEMAND** | | | | |
| 18 | Average-day demand (line 15 divided by 365) | | | | |
| 19 | Current maximum-day demand | | | | |
| 20 | Maximum-day to average-day demand ratio (line 20 divided by line 19) | | | | |
| 21 | Projected maximum-day demand (line 18 multiplied by line 20 for all forecast years) | | | | |
| 22 | Adjustment to maximum-day demand forecast [e] | | | | |
| 23 | Current (line 19) and adjusted maximum-day demand forecast (add lines 21 and 22) | | | | |
| 24 | Daily supply capacity (divide line 16 by 365) | | | | |
| 25 | Ratio of maximum-day demand to daily supply capacity (divide line 23 by line 24) | | | | |

[a] Separate forecasts should be prepared for large-volume users.
[b] Planners can choose to use service connections or households instead of population and per-connection water use instead of per-capita water use.
[c] Explanatory variables other than employees or jobs can be used as appropriate. The forecast should be disaggregated by sector of water use to the greatest extent possible (for example, commercial and industrial water use and nonaccount water) and a qualitative sensitivity analysis ("***what if***") should be performed for each sector's forecast.
[d] Please provide an explanation of the forecast of nonaccount water, including all relevant assumptions.
[e] Please provide an explanation of adjustments to your forecasts, including all relevant assumptions.
[f] Supply capacity should take into account available supplies (permits), treatment capacity, and distribution system capacity and reflect the practical total supply capacity of the system, including purchased water.


**An example of public information water conservation campaign logo**

## Worksheet 4-5: Anticipated Improvements and Additions

**Describe planned improvements and additions:**

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

**Describe time frame for planned improvements and additions (years):**

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

| **Type of Project [a]** | **Improve-ment** | **Addition** | **Start date** | **End date** |
|---|---|---|---|---|
| Source of supply | ☐ | ☐ | ________ | ________ |
| Water treatment facilities | ☐ | ☐ | ________ | ________ |
| Treated water storage | ☐ | ☐ | ________ | ________ |
| Major transmission lines | ☐ | ☐ | ________ | ________ |
| Other ____________________ | ☐ | ☐ | ________ | ________ |
| **Need for Project(s)** (Check all that apply) | | | **Notes** | |
| Enhance compliance with regulations | ☐ | | ________________ | |
| Replace older equipment or facilities | ☐ | | ________________ | |
| Meet average-day demand | ☐ | | ________________ | |
| Meet maximum-day demand | ☐ | | ________________ | |
| Meet future growth needs | ☐ | | ________________ | |
| Other ____________________ | ☐ | | ________________ | |
| **Funding** | | | **Interest rate** | |
| Cost of financing | ☐ | | ____________ | |
| Overall cost of capital [if known] | ☐ | | ____________ | |

**Water purchases**

Anticipated future water purchases ______________ (gallons per year)

Cost of water purchases ______________ (dollars per gallon)

[a] Comprehensive plans can include wastewater facilities.

## Worksheet 4-6: Cost of Supply-Side Facilities

| Line | Item | Facilities for meeting average-day demand | Facilities for meeting maximum-day demand [a] | | | Water purchases needed to meet demand [b] | Estimate of simple incremental supply cost ($/gallon) |
|---|---|---|---|---|---|---|---|
| | | Source of supply | Water treatment facilities | Treated water storage | Major transmission lines | | |
| **A** | **SUPPLY CAPACITY IN ANNUAL GALLONS [c]** | | | | | | |
| 1 | Current installed capacity or water purchases | | | | | | |
| 2 | Planned improvements and additions | | | | | | |
| 3 | Planned retirements | | | | | | |
| 4 | Future installed capacity or purchases (line 1 plus line 2 less line 3) | | | | | | |
| **B** | **COST OF PLANNED IMPROVEMENTS AND ADDITIONS** | | | | | | |
| 5 | Approximate total cost of planned improvements and additions identified in line 2 (including financing costs) | | | | | | |
| 6 | Expected life of new facilities (years) | | | | | | |
| 7 | Estimated annual capital costs (line 5 divided by line 6) | | | | | | |
| 8 | Estimated annual operating costs [d] | | | | | | |
| 9 | Estimated total annual costs (line 7 plus line 8) [e] | | | | | | |
| 10 | Per unit cost of new facilities (line 9 divided by line 2) | | | | | | |
| 11 | Simple incremental supply cost (add all entries from line 10) | | | | | | |

[a] Additional facilities or capital equipment can be included as appropriate.
[b] The plan should indicate whether purchases are needed to meet average-day or maximum-day demand or both.
[c] Planners should select a reasonable planning horizon for supply facilities and use the same time frame for all facilities.
[d] Annual variable operating cost (including energy, chemicals, and water purchases).
[e] This calculation of simplified value does not include a discount rate, an escalation rate, or an adjustment for inflation. This analysis also can be extended to include the incremental cost of wastewater collection and treatment.

## Worksheet 4-7: Preliminary Supply-Capacity Forecast

| Year | Additions (+) | Retirements (-) | Total supply capacity for the system (annual or daily) |
|---|---|---|---|
| 0 | | | |
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |
| 19 | | | |
| 20 | | | |

# Worksheet 4-8: Checklist of Conservation Measures [a]

| Measure [a] | Already imple-mented | Plan to imple-ment | Comments [b] |
|---|---|---|---|
| | ☐ | ☐ | |
| **LEVEL 1 MEASURES** | | | |
| **Universal metering [B]** | | | |
| Source-water metering | ☐ | ☐ | |
| Service-connection metering | ☐ | ☐ | |
| Meter public-use water | ☐ | ☐ | |
| Fixed-interval meter reading | ☐ | ☐ | |
| Meter-accuracy analysis | ☐ | ☐ | |
| *Test, calibrate, repair, and replace meters* | ☐ | ☐ | |
| **Water accounting and loss control [A]** | | | |
| Account for water | ☐ | ☐ | |
| Repair known leaks | ☐ | ☐ | |
| Analysis of nonaccount water | ☐ | ☐ | |
| Water system audit | ☐ | ☐ | |
| Leak detection and repair strategy | ☐ | ☐ | |
| Automated sensors/telemetry | ☐ | ☐ | |
| *Loss-prevention program* | ☐ | ☐ | |
| **Costing and pricing [B]** | | | |
| Cost-of-service accounting | ☐ | ☐ | |
| User charges | ☐ | ☐ | |
| Metered rates | ☐ | ☐ | |
| Cost analysis | ☐ | ☐ | |
| Nonpromotional rates | ☐ | ☐ | |
| *Advanced pricing methods* | ☐ | ☐ | |
| **Information and education [B]** | | | |
| Understandable water bill | ☐ | ☐ | |
| Information available | ☐ | ☐ | |
| Informative water bill | ☐ | ☐ | |
| Water-bill inserts | ☐ | ☐ | |
| School program | ☐ | ☐ | |
| Public-education program | ☐ | ☐ | |
| *Workshops* | ☐ | ☐ | |

| | | | |
|---|---|---|---|
| *Advisory committee* | ☐ | ☐ | ______ |
| **LEVEL 2 MEASURES** | | | |
| **Water-use audits [B]** | | | |
| Audits of large-volume users | ☐ | ☐ | ______ |
| Large-landscape audits | ☐ | ☐ | ______ |
| *Selective end-use audits* | ☐ | ☐ | ______ |
| **Retrofits [B]** | | | |
| Retrofit kits available | ☐ | ☐ | ______ |
| *Distribution of retrofit kits* | ☐ | ☐ | ______ |
| *Targeted programs* | ☐ | ☐ | ______ |
| **Pressure management [A]** | | | |
| Systemwide pressure regulation | ☐ | ☐ | ______ |
| *Selective use of pressure-reducing valves* | ☐ | ☐ | ______ |
| **Landscape efficiency [P]** | | | |
| Promotion of landscape efficiency | ☐ | ☐ | ______ |
| Landscape planning and renovation | ☐ | ☐ | ______ |
| *Selective irrigation submetering* | ☐ | ☐ | ______ |
| *Irrigation management* | ☐ | ☐ | ______ |
| **LEVEL 3 MEASURES** | | | |
| **Replacements and promotions [B]** | | | |
| *Rebates and incentives (nonresidential)* | ☐ | ☐ | ______ |
| *Rebates and incentives (residential)* | ☐ | ☐ | ______ |
| *Promotion of new technologies* | ☐ | ☐ | ______ |
| **Reuse and recycling [B]** | | | |
| *Industrial applications* | ☐ | ☐ | ______ |
| *Large-volume irrigation applications* | ☐ | ☐ | ______ |
| *Selective residential applications* | ☐ | ☐ | ______ |
| **Water-use regulation [B]** | | | |
| *Water-use standards and regulations* | ☐ | ☐ | ______ |
| *Requirements for new developments* | ☐ | ☐ | ______ |
| **Integrated resource management [B]** | | | |
| *Supply-side technologies* | ☐ | ☐ | ______ |
| *Demand-side technologies* | ☐ | ☐ | ______ |

Describe conservation measure: ____________________________________________

Typical water savings from the measure: ______________ per ______________
Number of planned installations: ______________
Anticipated life span for the measure: ______________ years

The measure is designed to reduce:
- [ ] Average-day demand
- [ ] Maximum-day demand
- [ ] Both average-day and maximum-day demand

# Worksheet 4-9: Cost of Conservation Measures

| Line | Item | Amount | Amount |
|---|---|---|---|
| **A** | **COST OF THE CONSERVATION MEASURE [a]** | **Per unit [b]** | **Total cost of the measure** |
| 1 | Materials | $ | $ |
| 2 | Labor | | |
| 3 | Rebates or other payments | | |
| 4 | Marketing and advertising | | |
| 5 | Administration | | |
| 6 | Consulting or contracting | | |
| 7 | Other | | |
| 8 | Total program costs for the life of the measure (add lines 1 through 7) [c] | | $ |
| **B** | **ESTIMATED SAVINGS** | | |
| 9 | Number of units to be installed [d] | | |
| 10 | Estimated annual water savings per unit in gallons [e] | | |
| 11 | Total estimated annual savings for the measure in gallons (multiply line 9 by line 10) | | |
| 12 | Expected life span for the measure in years | | |
| 13 | Total life span estimated savings for the measure in gallons (multiply line 11 by line 12) | | |
| **C** | **ANALYSIS OF COST EFFECTIVENESS** | | **Amount** |
| 14 | Cost of water saved by the measure (line 8 divided by line 13) | | /gallon |
| 15 | Simple incremental cost of water supply [f] | | /gallon |
| 16 | Cost comparison (line 15 less line 14) | | /gallon |
| **D** | **NET BENEFIT OF CONSERVATION** | | **Amount** |
| 17 | Estimated value of water saved by the measure based on incremental supply cost (line 13 multiplied by line 15) | | $ |
| 18 | Net value of water saved by each measure (line 17 less line 8) | | $ |

[a] This analysis is used to aid the comparison and selection of measures. Planners will estimate actual effects of conservation on planned capital facilities in Section 8. A separate analysis should be performed for each conservation measure, but measures can be combined if they jointly produce water savings.
[b] Examples of a unit are a toilet, a retrofit kit, and an audit. A unit estimate may not be appropriate for each measure, in which case total program water savings and costs for the measure can be used.
[c] Include all recurring operation and maintenance costs over the life of the measure.

[d] Units can be individual product units (such as toilets) or groups of products (such as household retrofits), as long as the analysis is consistent. Leave blank if unit values do not apply.
[e] For example, water savings per retrofit. See Appendix B for benchmarks and sample calculations. Leave blank if unit values do not apply.
[f] From Worksheet 4-6, line 11.

## Worksheet 4-10: Comparison of Benefits and Costs of the Conservation Measures

| Line | Conservation measure [a] | Total program cost for the measure [b] | Anticipated annual water savings in gallons [c] | Cost of water saved by the measure ($/gallon) [d] | Net benefit of implementing the measure(s) [e] |
|---|---|---|---|---|---|
| 1 | | $ | | $ | $ |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |
| 10 | | | | | |
| 11 | | | | | |
| 12 | | | | | |
| 13 | | | | | |
| 14 | | | | | |
| 15 | | | | | |
| 16 | | | | | |
| 17 | | | | | |
| 18 | | | | | |
| 19 | | | | | |
| 20… | | | | | |

[a] = Combined measures that produce joint conservation savings should be treated as one measure to avoid duplicate counting.
[b] = From Worksheet 4-9, line 8.
[c] = From Worksheet 4-9, line 11.
[d] = From Worksheet 4-9, line 14.
[e] = From Worksheet 4-9, line 18. This estimate of net benefit does not consider societal benefits and costs.

## Worksheet 4-11: Selection of Conservation Measures and Estimate of Water Savings

| Line | Measure | Selected ☐ | Primary criteria for selecting or rejecting the conservation measure for implementation | Estimated reduction in demand for selected measures (gallons per day) [a] | |
|---|---|---|---|---|---|
| | | | | Average-day demand | Maximum-day demand |
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |
| 10 | | | | | |
| 11 | | | | | |
| 12 | | | | | |
| 13 | | | | | |
| 14 | | | | | |
| 15 | | | | | |
| 16 | | | | | |
| 17 | | | | | |
| 18 | | | | | |
| 19 | | | | | |
| 20… | | | | | |
| Total | | | | | |

[a] Based on Worksheet 4-9, line 11. Planners will need to convert estimates of annual water savings to estimates of reductions in average-day and maximum-day demand for each measure or group of measures.

## Worksheet 4-12: Modified Demand Forecast

| Line | Item | Current year | Year 5 | Year 10 | Year 20 |
|---|---|---|---|---|---|
| 1 | Average-day demand before conservation [a] | | | | |
| 2 | Reduction in average-day demand (line 1 less line 2) [b] | | | | |
| 3 | Average-day demand after conservation | | | | |
| 4 | Maximum-day demand before conservation [a] | | | | |
| 5 | Reduction in maximum-day demand (line 4 less line 5) [b] | | | | |
| 6 | Maximum-day demand after conservation | | | | |
| 7 | Ratio maximum-day to average-day demand before conservation (line 4 divided by line 1) | | | | |
| 8 | Ratio maximum-day to average-day demand after conservation (line 6 divided by line 3) | | | | |

[a] From Worksheet 4-4, line 6.
[b] Based on Worksheet 4-11.

## Worksheet 4-13: Project-Specific Savings

**DESCRIPTION OF PROJECT [a]**

Describe the supply-side project(s): ____________________________________________
______________________________________________________________________

Project was scheduled to begin: ______________________________________

Purpose of the project: ☐ Improvement ☐ Addition

The project is designed to meet: ☐ Average-day demand ☐ Maximum-day demand

Type of project:

☐ Source of supply

☐ Water treatment facilities

☐ Treated water storage

☐ Major transmission lines

☐ Purchased water

☐ Other ______________________________

**CHANGES TO PROJECT [b]**

| Line | Item | Project supply capacity (daily) | Project Costs | |
|---|---|---|---|---|
| | | | Total capital costs ($) | Annual operating costs ($) |
| **A** | **CAPITAL PROJECT IS ELIMINATED** | | | |
| 1 | Original project | | | |
| 2 | Savings from elimination (equals line 1) | | | |
| **B** | **CAPITAL PROJECT IS DOWNSIZED** | | | |
| 3 | Original project | | | |
| 4 | Downsized project | | | |
| 5 | Savings from downsizing (line 3 less line 4) | | | |
| **C** | **CAPITAL PROJECT IS POSTPONED** | | | |
| 6 | Present value of original project | | | |
| 7 | Present value of postponed project | | | |
| 8 | Savings from postponement (line 6 less line 7) | | | |
| **D** | **NEED FOR PURCHASED WATER IS REDUCED [c]** | | | |
| 9 | Original estimate of purchases | | | |
| 10 | Revised estimate of purchases (can be "0") | | | |
| 11 | Savings from reduced purchases (line 9 less line 10) | | | |

[a] Comprehensive plans can include wastewater facilities.
[b] Based on Worksheet 4-12 estimates of reductions in demand.
[c] For purchased water, report only annual operating costs and include costs associated with take-or-pay contract provisions. Transmission facilities needed to transport purchased water should include capital and operating costs associated with such facilities and reported as a capital project.

## Worksheet 4-14: Modified Supply Forecast and Estimated Total Savings

### MODIFIED SUPPLY FORECAST

| Line | Item | Current year | Year 5 | Year 10 | Year 20 |
|---|---|---|---|---|---|
| **A** | **Forecast Supply Capacity (Daily)** | | | | |
| 1 | Supply capacity before conservation program [a] | | | | |
| 2 | Planned reduction in supply capacity [b] | | | | |
| 3 | Supply capacity after conservation (line 1 less line 2) | | | | |
| **B** | **Capacity Reserve** | | | | |
| 4 | Supply capacity less demand (line 3 less line 2 on Worksheet 4-12) | | | | |

### ESTIMATED TOTAL SAVINGS

| Line | Item | Supply capacity (daily) | Project Costs | |
|---|---|---|---|---|
| | | | Total capital costs ($) | Annual operating costs ($) |
| **C** | **Total Estimated Savings from Changes to Supply Projects [c]** | | | |
| 1 | Cost of supply projects before conservation | | | |
| 2 | Cost of supply projects after conservation | | | |
| 3 | Savings (line 1 less line 2) | | | |
| **D** | **Total Estimated Savings from Reduced Operating Costs at Existing Facilities [d]** | | | |
| 4 | Operating costs before conservation | | | |
| 5 | Operating costs after conservation | | | |
| 6 | Savings (line 4 less line 5) | | | |
| **E** | **Conservation Program Costs** | | | Total program costs ($) |
| 7 | Total cost of implementing selected conservation measures [e] | | | |

[a] From Worksheet 4-7.
[b] Based on Worksheet(s) 4-13.
[c] Based on Worksheet(s) 4-13.
[d] Based on annual variable operating cost (including energy, chemicals, and water purchases).
[e] Based on Worksheet 4-10.

## Worksheet 4-15: Implementation Schedule for Measures

| Line | Measure | Required action | Beginning date | Completion date | Notes |
|---|---|---|---|---|---|
| 1 | | | | | |
| | | | | | |
| | | | | | |
| 2 | | | | | |
| | | | | | |
| | | | | | |
| 3 | | | | | |
| | | | | | |
| | | | | | |
| 4 | | | | | |
| | | | | | |
| | | | | | |
| 5 | | | | | |
| | | | | | |
| | | | | | |
| 6 | | | | | |
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| 7 | | | | | |
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| 8 | | | | | |
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| 9 | | | | | |
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| | | | | | |
| 10 | | | | | |
| | | | | | |
| | | | | | |
| 11 | | | | | |
| | | | | | |
| | | | | | |
| 12 | | | | | |
| | | | | | |
| | | | | | |

## Worksheet 4-16: Implementation Strategy

**A. PUBLIC INVOLVEMENT**

Describe plan for public involvement:

**B. MONITORING AND EVALUATION**

Describe plan for monitoring and evaluation:

Describe plan to collect water demand data:

**C. PLAN UPDATES**

Describe plan for updates and revisions:

**D. ADOPTION OF THE PLAN**

Date plan completed: ____________________

Date plan approved: ____________________

Approved by [governing body]: ____________________

Signature: ____________________

Here is a perfect example of a common water conservation problem. Even high tech and metered faucets will often get stuck in the on position.

# INTERMEDIATE GUIDELINES FOR PREPARING WATER CONSERVATION PLANS

## Chapter 5. IDENTIFY CONSERVATION MEASURES

### Levels and Measures

Water systems have a vast array of specific conservation measures at their disposal. These measures include both supply-side and demand-side management techniques for saving water and range from relatively simple educational tools to the promotion of advanced water-efficient technologies. Use of any particular measure depends on whether it meets cost-effectiveness and other planning criteria and whether its use complies with applicable laws and regulations, including state and local plumbing codes.

***Review the list of conservation measures recommended for consideration and identify measures that have been implemented, are planned, or are not planned. Provide an explanation for why any measure is not planned for the water system.***

The conservation measures are organized into three levels: Level 1, Level 2, and Level 3. Each level includes four categories of measures. Specific water conservation measures are identified within each category. Appendix A provides additional information and several worksheets on the conservation measures. Planners are encouraged to explore the full range of potential conservation measures for consideration in their conservation programs.

### Identifying Conservation Measures

Worksheet 4-8 summarizes all measures and highlights the minimum set of measures recommended for consideration in the Intermediate Guidelines. Systems should use the checklist to review and summarize the measures that are currently implemented, planned, or not planned at this time. Planners also can identify additional measures and practices as they develop their conservation plans.

Water systems following the Intermediate Guidelines are expected to implement the very fundamental and widely accepted practices highlighted under Level 1. If Level 1 measures are not in place and not planned for implementation, planners should submit a strong justification, including a cost-effectiveness analysis if it is the basis for not implementing the measure.

Planners can screen the measures in terms of general feasibility. In some cases, it may not be possible for a system to implement a measure because of legal restrictions or for other compelling reasons.

The conservation plan should provide an explanation if a measure cannot be implemented for the period of time covered by the plan. It is not necessary to prepare a cost effectiveness analysis for measures that cannot be implemented.

***For each identified water conservation and other measures of interest, estimate total implementation costs (dollars) and anticipated water savings (volume), assess the cost-effectiveness of the measure, and compare the cost of conservation to benefits (measured in terms of the incremental cost of supply).***

### 6. ANALYZE BENEFITS AND COSTS

### Purpose

In this section, an analysis of benefits and costs is used to aid the comparison and selection of measures. Planners will consider criteria other than efficiency in Section 7 and estimate actual effects of conservation on planned capital facilities in Section 8.

Analyzing benefits and costs is an invaluable part of the planning process. A *cost-effectiveness* analysis can be used to compare alternative conservation measures in terms of dollars per gallon of water saved. For example, one measure might produce savings at a cost of $.25/1,000 gallons while another produces savings at a cost of $.50/1,000 gallons.

Cost-effectiveness analysis also can be used to compare conservation measures to supply options. A simple *net benefit* analysis can be used to determine whether the benefits of implementing a measure outweigh the costs.

**Water Savings**

Worksheet 4-9 should be completed for *each* conservation measure identified in Section 5. In some cases planners may want to combine measures based on the conservation program they envision. *All interrelated measures that are expected to result in an identifiable amount of water savings should be combined and treated as one measure in order to avoid counting the planned water savings more than once in the analysis.*

The worksheet begins with an open-ended description of the measure and an estimate of water savings. The anticipated life span for the measure should be indicated. Planners also should indicate whether the measure is targeted toward reduction in average-day demand, maximum-day demand, or both. Estimates of potential water savings should be as realistic as possible, based on system and regional considerations.

For some measures, particularly those dependent on customer responses (such as information and education programs), the estimation will reflect a high degree of uncertainty. Planners can choose to use a range of estimates under these circumstances.

The plan should indicate typical water savings from the measure, the number of planned installations, and the anticipated life span for the measure, as well as whether the measure is expected to reduce average-day or maximum-day demand (or both).

**Implementation Costs**

Worksheet 4-9 includes a method for summing the total cost of implementing the measure. All costs associated with implementation should be included. Planners should obtain reasonable cost estimates by potential vendors whenever possible. The types of costs that should be analyzed include:

- Materials
- Labor
- Rebates or other payments
- Marketing and advertising
- Administration
- Consulting or contracting
- Other

A realistic implementation schedule should be considered. Any special circumstances affecting the schedule or cost of implementing the proposed measures should be discussed in the plan.

Each worksheet also includes a place to estimate annual unit water savings (that is, savings per measure or "unit"), total annual water savings, and total life span water savings for the measure.

For each measure, the method used to estimate water savings should be provided. This might include, for example, a formula for converting daily per capita savings to annual savings. In some cases (such as a leakage control program), it might not be feasible to estimate savings for each unit, in which case total annual savings for the entire measure are sufficient.

**Cost-Effectiveness**

The analysis of cost-effectiveness for each measure builds on the identification of supply-side costs in Section 4. Using this analysis, the cost of conservation (for example, $.50 per 1,000 gallons saved) can be compared to the simple incremental cost of supply (for example, $2.00 per 1,000 gallons produced).

The difference between the per-gallon cost of conservation and the per-gallon cost of supply is a simple indicator of the potential benefits (or cost savings) from conservation.

*It is not necessary for planners to prepare a cost-effectiveness or net benefit analysis of Level 1 measures if those measures are already implemented or planned for implementation.* An analysis should be presented if cost-effectiveness is the basis for rejecting a Level 1 measure. If the analysis of Level 1 measures leads the planner to conclude that a proposed measure is not cost-effective or that it fails to meet other criteria for implementation, the plan should include an explanation of these findings and conclusions in Worksheet 4-11 (Section 7).

**Net Benefits**

These Guidelines take a somewhat narrow view of benefits and costs, both of which are considered from the perspective of the water supplier. The analysis excludes other potentially important perspectives: water consumers, society, and the environment.

Planners should keep in mind that this approach may somewhat understate certain types of benefits and costs. The value of implementing a conservation measure is estimated by using the simple incremental cost of supply. In other words, the benefits of conservation can be measured in terms of the potential to avoid supply-side costs.

The net benefit from implementing the measure is shown by subtracting total program costs from total program benefits (the dollar value of water saved). When benefits exceed costs (assuming that costs and benefits are adequately specified), a measure is considered reasonably efficient and a good candidate for implementation. However, as discussed in Section 7, the selection of measures can be based on additional considerations.

**Comparison of Measures**

Worksheet 4-10 can be used to compare the individual analyses of conservation measures in Worksheet(s) 4-9. Worksheet 4-10 can be used to screen measures for implementation on the basis of the relative cost-effectiveness and net benefits associated with each measure.

## INTERMEDIATE GUIDELINES FOR PREPARING WATER CONSERVATION PLANS

## 7. SELECT CONSERVATION MEASURES

### Selection Criteria

The first step in the selection process is to identify criteria for evaluating the conservation measures. The cost-effectiveness of the measures (from Section 6) is one criterion, but other factors should be considered as well. Planners are free to consider as many selection criteria as they believe are appropriate, but the relevance of the criteria should be explained in the conservation plan.

***Describe the process by which conservation measures were selected for implementation, including identification of selection criteria. Summarize the selected measures and total anticipated program costs for implementation.***

Criteria that can be used in selecting conservation measures for implementation include:

- Program costs
- Cost-effectiveness
- Ease of implementation
- Budgetary considerations
- Staff resources and capability
- Environmental impacts
- Ratepayer impacts
- Environmental and social justice
- Water rights and permits
- Legal issues or constraints
- Regulatory approvals
- Public acceptance
- Timeliness of savings
- Consistency with other programs

For each selection criterion used, planners should identify whether, how, and why the factor affects the feasibility of implementing one or more conservation measures. Different factors might be assigned different weights. Planners also may want to bear in mind that techniques can be used to mitigate adverse effects and improve acceptance of measures. A cost-effective conservation measure should not be dismissed without careful consideration of how barriers to implementation might be overcome.

**Selecting the Measures**

Worksheet 4-11 provides a simple format for summarizing the selection of measures. For each measure, planners should indicate whether the measure was selected for implementation. Planners also should identify the primary reason or reasons for selecting or rejecting the measure. Special conditions or actions that are required before a selected measure can be implemented (such as an approval from regulators) should be noted.

In some cases, planners may conclude that a measure (or measures) cannot be implemented because of a constraint that exists in the short term.

Conservation measures that might be planned for future implementation, once constraints are resolved, should be discussed in the plan. Planners should briefly discuss their implementation strategies with respect to such measures.

For the conservation measures selected for implementation, planners should estimate the expected reductions in average-day and maximum-day demand. These estimates will be used in the next section of the plan to integrate conservation savings with the system's plans for supply-side facilities.

## 8. INTEGRATE RESOURCES AND MODIFY FORECASTS

**Integrating Options**

In this section, planners can revise the demand and supply-capacity forecasts made in earlier sections of the plan based on anticipated conservation savings. Pay particular attention to the effects of conservation on specific supply-facility projects.

***Modify water demand and supply-capacity forecasts to reflect the anticipated effects of conservation. Indicate whether and how water savings from conservation will allow systems to eliminate, downsize, or postpone supply-side projects or water purchases.***

Planners should be cautious to avoid counting demand-side or supply-side resources more than once in the analysis.

Anticipated savings from conservation should be based on realistic estimates of savings associated with the planned measures. Similarly, supply projects that involve multiple facilities should be considered in terms of the total water supply capacity that is made available through those combined facilities.

Timing is another issue. The plan should address how different supply-side and demand-side projects involve different life spans and implementation schedules.

One twenty-year supply-side project, for example, might be offset by a series of conservation measures that begin and end at different times.

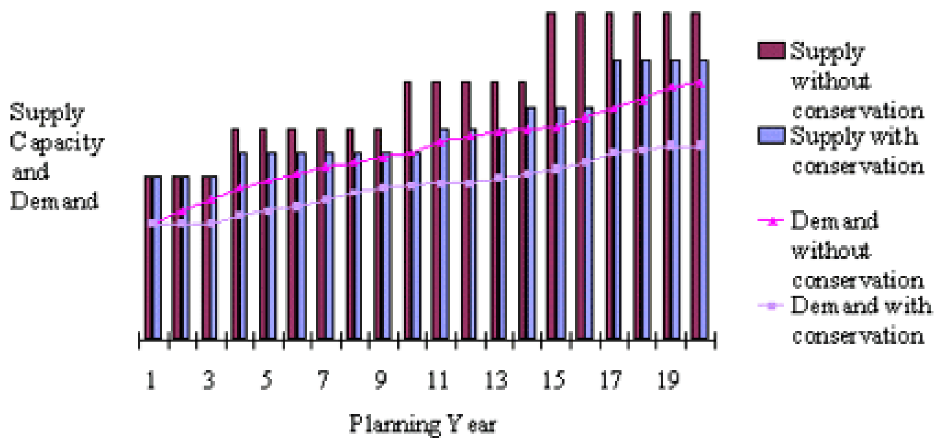
Some conservation plans use a graph to display anticipated annual supply capacity and demand without and with the implementation of conservation measures. Figure 4-1 is an example of this type of graph for a twenty-year planning horizon.

Outdoor water use and abuse is the largest use of water.

Flushometer or commercial type toilet.  If this had the electronic sensor, you may be wasting more water than necessary.  Always adjust the sensor so that the customer can properly use toilet paper and then flush the toilet.  Do not have it flush as soon as the customer stands up.

Xeriscape Garden--try to install a garden for your customers to see.  Believe it or not, you will get a large following of customers that will enjoy your efforts.  Place your garden in front of the Water Department or another large public facility like a Park or Library.  You can get funding for these type of projects from the Bureau of Reclamation or other governmental agencies.

## Figure 4-1 Sample Graph of Modified Supply and Demand Forecasts Based on Implementing Conservation Measures




**Modifying Demand Forecasts**
Planners should use Worksheet 4-12 to collate information from previous worksheets and analyses in order to revise the demand forecasts made in Worksheet 4-4. Revisions should reflect changes based on the introduction of *new* conservation measures. The effects of measures already being implemented should be included in the original demand forecast.

Modifying the demand forecast requires a considerable degree of judgment, particularly in estimating the effects of conservation on average-day and maximum-day demand. The plan should include an explanation of the approach used in revising the demand forecasts.

**Project-Specific Savings**
Planners should identify the anticipated effects of conservation on planned supply-side improvements and additions (as specified in Section 4).

Worksheet 4-13 is provided for this purpose. A worksheet should be completed for separable supply projects as appropriate. Ideally, water conservation strategies that reduce demand will translate into supply-side savings through one or more of the following actions:
- Eliminating a project for the foreseeable future.
- Downsizing a project based on reduced capacity needs.
- Postponing a project into the future.
- Eliminating, reducing, or postponing water purchases.

Adjustments to supply-capacity planning must be realistic, especially in terms of complex and sometimes competing goals.

Supply projects cannot be eliminated, downsized, or postponed if doing so would compromise public health or safety, reduce operational efficiency, or inflate costs beyond a reasonable amount. Some systems (including systems that currently operate with inadequate or unreliable supply reserves) may not be able to translate all demand reductions into supply-capacity reductions.

Planners should identify and describe such circumstances. On the other hand, supply projects that are not needed or are oversized place an unnecessary burden on systems and their customers.

**Modifying Supply Forecasts**
The supply-capacity forecast is revised in Worksheet 4-14. The revision to the supply-capacity forecast should be based on Worksheet(s) 4-13 and consistent with accepted supply-capacity planning practices. The modification of forecasts should reflect reasonable assumptions about anticipated implementation schedules, which are summarized in Section 9. Planners also can indicate the anticipated capacity reserve (the difference between forecast supply capacity and demand).

Worksheet 4-14 also provides a method of summarizing savings in capital and operating costs, based on reductions in supply capacity. Planners also should estimate reductions in operating costs at existing facilities that will occur with demand reductions (apart from operating costs associated with planned facilities). The total program cost of conservation can be compared with the savings in total capital and annual operating costs.

As recognized throughout these Guidelines, water conservation also has non-monetary benefits. Planners should discuss, as appropriate, how implementation of the conservation program will help their system cope with any of the conditions identified in Section 2 (Worksheet 4-2). For example, the planned measures might help a system address problems related to safe yields or drought management.

**Revenue Effects**
The conservation plan should briefly describe how planned conservation measures will affect water utility revenues (based on reduction in sales) and discuss strategies for addressing these revenue effects.

Reductions in water usage will affect the revenues of the water utility. Conservation will help the water utility reduce variable costs (such as energy, chemical, and purchased water costs). In the long term, conservation also will help the utility reduce fixed costs (associated with new capital facilities).

In the short term, reductions and sales can lead to a shortfall in revenues needed to cover fixed costs and sustain the financial viability of the water system.

The planner can estimate the effect of conservation on revenues by multiplying current water rates by the adjusted level of sales (for the variable portion of the water bill). The adjusted level of sales should include the anticipated effects of conservation. Conservation-oriented rate structures have direct revenue effects that should be considered. Worksheet A-4 in Appendix A can be used to evaluate the revenue effects of rate changes.

Conservation planners should work closely with financial planners in order to integrate their analyses, identify potential revenue shortfalls, and devise strategies to ensure that the utility will meet its revenue requirements.

Adjustments to water rates may be needed. For some utilities, a change in rates requires approval from an oversight board or state public utility commission. When rate increases are offset by usage reductions, customer bills and utility revenues can be maintained. Customers and utilities eventually will realize savings from conservation through long-term reductions in costs.

# 9. PRESENT IMPLEMENTATION AND EVALUATION STRATEGY
## Implementation

***Present a strategy and timetable for implementing conservation measures and other elements of the conservation plan. Describe proposed approaches for implementing and evaluating planned conservation measures.***

In this final step in the conservation planning process, the water system specifies its strategy and timetable for implementation.

It can be emphasized, however, that conservation planning will require an *ongoing* effort on the part of water utility managers. Ongoing planning and implementation will go hand in hand. The implementation strategy should include a preliminary schedule for monitoring and evaluating program results and revisiting the plan for updates and modifications.

**Implementation of Measures**
Worksheet 4-15 is a simple template for summarizing the water system's implementation and evaluation schedule for the conservation measures. For each measure, the schedule can identify significant implementation actions, a beginning date, and a completion date. Implementation actions include:

- Securing budgetary resources.
- Hiring of staff.
- Procurement of materials.
- Agreements with suppliers or consultants.
- Acquisition of permits or other approvals from regulatory agencies.
- Legislative actions (for changes in water-use regulations).
- Activity milestones (for example, system audits or distribution of retrofit kits).

Planners should make note of any specific factors or contingencies that might affect or prevent the implementation of specific measures. For example, if a measure cannot be implemented prior to obtaining a special permit or other authority, this fact should be noted along with an explanation of the strategy for obtaining the necessary authority.

Some measures might require implementation actions that take place over several years (in order to sustain conservation savings). The plan should provide sufficient detail to understand the utility's strategy with regard to implementing such measures.

**Implementation and Evaluation**
Worksheet 4-16 provides a very simple summary of the water system's general implementation and evaluation strategy for the conservation plan. Three areas are highlighted:

- Public involvement
- Monitoring and evaluation
- Updates and revisions

A plan for public involvement should discuss whether and when the water system intends to involve members of the community in the implementation of the conservation plan. Some systems may want to schedule regular meetings with community groups to keep them informed of the system's progress in meeting goals.

A plan for monitoring and evaluation should address data collection, modeling, and other issues that will be important in tracking the effects of water conservation on demand over time. The system may want to plan to collect new kinds of data for monitoring purposes as well as for future forecasting needs.

Many systems might find, for example, that more detailed data on demand by customer class are needed, including more detail on contributions to average-day and maximum-day demands. More detailed data might also be needed to assess trends in nonaccount water.

A plan for updates and revisions will help keep the system's conservation plan current over time and account for the system's actual experience with conservation.

Updating forecasts of water demand and supply capacity as new data become available is especially important. In some cases, the system might want to revise or expand its planning goals. Many systems update plans every five years.

However, changing conditions or other concerns might justify more frequent updates. The schedule of updates and revisions might be affected by state or local requirements for conservation planning by the water system.

The conservation planning document also should include a record of the plan's adoption by the water system's governing body (such as a Board of Directors or City Council), as appropriate.


This kiosk is an excellent example of providing materials to the public. You as a water provider should offer free water conservation materials including free audits and toilet retrofit information at several public locations.

# Chapter 5
# ADVANCED GUIDELINES FOR PREPARING WATER CONSERVATION PLANS

**These Advanced Guidelines are designed for water systems serving more than 100,000 people. Which Guidelines are appropriate may depend on various factors and conditions affecting water systems and their need for conservation planning. *Water system managers should check with their own state's rules, regulations, and recommendations about which Guidelines to follow.***

**Much of this information will be similar to Part 4**

### 1. Specify Conservation Planning Goals

### Planning Goals

Planning goals can be developed from different perspectives. These planning guidelines, including the analysis of the benefits and costs of conservation activities, emphasize a water supplier perspective.

***Specify conservation planning goals in terms of anticipated benefits for the water system and its customers. To the extent practical, involve affected members of the community in the development of conservation planning goals and throughout the implementation process.***

The value of conservation is defined primarily in terms of avoided supply-side costs to the water system. Lowering the level of water demand can help water suppliers avoid, downsize, or postpone the construction and operation of costly supply-side facilities.

The benefits of conservation also can be understood from the perspectives of customers, as well as society at large.

Conservation benefits society by preserving environmental resources.
Conservation can benefit customers by lowering energy and long-term water costs. Water conservation reduces demands on wastewater systems; in fact, the need to reduce wastewater treatment costs can be a strong rationale for water conservation. The Guidelines and the worksheets can be used to simultaneously address the potential effects of conservation on water and wastewater operations.

Utilities using the Advanced Guidelines also are encouraged to expand the analysis of benefits and costs to consider the customer and societal perspectives, if only in very general terms.

Conservation planning goals can take many forms. Water systems should state their goals in specific terms. Measurable goals are useful for evaluation purposes. For example, many water systems identify a specific water-use reduction goal (as a percentage of current water usage).

**Water conservation planning goals may include:**

- 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 value of water.
- Improving reliability and margins of safe and dependable yields.
- Protecting and preserving environmental resources.

Planners should plan on revisiting the goals section before finalizing the conservation plan and periodically thereafter, because goals and the means to achieving them will change. As the water system accomplishes certain conservation goals, new objectives may come into focus.

**Community Involvement**

The process of developing goals can involve representatives of various groups in the community (or stakeholders) who may be concerned about a water system and its future. Modern resource planning (such as integrated resource planning) emphasizes an open process that involves all affected groups so that they can have an opportunity to express their interests and concerns.

Involving the community in goal development also serves an important public education function. Moreover, it is widely believed that involving the community in developing goals, as well as in the implementation process, can greatly enhance the success of conservation programs.

***Members of the community who might be interested in water conservation include:***

- Residential water consumers
- Commercial water consumers
- Industrial water consumers
- Wholesale customers
- Environmental groups
- Civil rights groups
- Indian tribes
- Labor groups
- Business and commerce groups
- Recreational water users
- Agricultural users
- Educational institutions
- Government agencies

In addition to helping the water system specify planning goals, community participants also can have an ongoing role in a system's conservation program. Ongoing involvement can help maintain and build support for achieving conservation goals and "***get the word out***" about the conservation effort. Participants can act as a focus group for exploring specific conservation measures (discussed in Section 4).

Participants also can provide valuable linkages to key groups—consumers, businesses, and institutions—who might be involved in implementing certain conservation measures. Participants also can provide input on the level of satisfaction or dissatisfaction with the system's programs. Finally, community groups can assist the water system in monitoring results and adjusting program implementation.

For many water systems, involving the community in water-system planning will be a new experience. However, most system managers will find that involving members of the community in developing goals, implementing programs, and evaluating results is a very worthwhile investment. Fortunately, guidance on this approach is available. [1]

**1. See *Public Involvement Strategies: A Manager's Handbook* (Denver, CO: American Water Works Association Research Foundation, 1996).**

**2. Develop a Water System Profile**

**System Profile**

Taking inventory of existing resources and conditions is an important step in the planning process. A water system profile can help systems in terms of assessing their present circumstances and designing strategies to meet emerging needs.

Most water systems should maintain the data and information necessary for building a system profile. Much information may already have been compiled for a facility plan or for other purposes.

***Summarize the service and operating characteristics of the water system. Provide an overview of conditions and a description of climate, water availability, or other factors that might affect water conservation planning.***

Worksheet 5-1 profiles a relatively simple summary table that systems can use to compile and present key system characteristics. The system profile can be expanded to include additional information.
**Much of this information will appear similar to Part 4**

For example, systems may want to present data on trends for some characteristics (such as supply and demand measures). Systems should include in their profile additional characteristics or details considered relevant for understanding the nature of the system.

**System Conditions**
Worksheet 5-2 provides a very simple overview of planning conditions that might affect the water system and its conservation planning effort. This checklist can be used to make a general review of conditions affecting the supply or the demand for water. For planning purposes, it is important to identify and focus on the conditions that most affect a particular system.

The conditions outlined in the worksheet suggest the need for water conservation planning. While all water systems can benefit from efficiency improvements, water conservation can be especially beneficial for systems experiencing water shortages or rapid increases in demand.

For example, water systems facing one or more of the following conditions are strongly urged to consider the fullest range of conservation measures available to them in accordance with these guidelines:

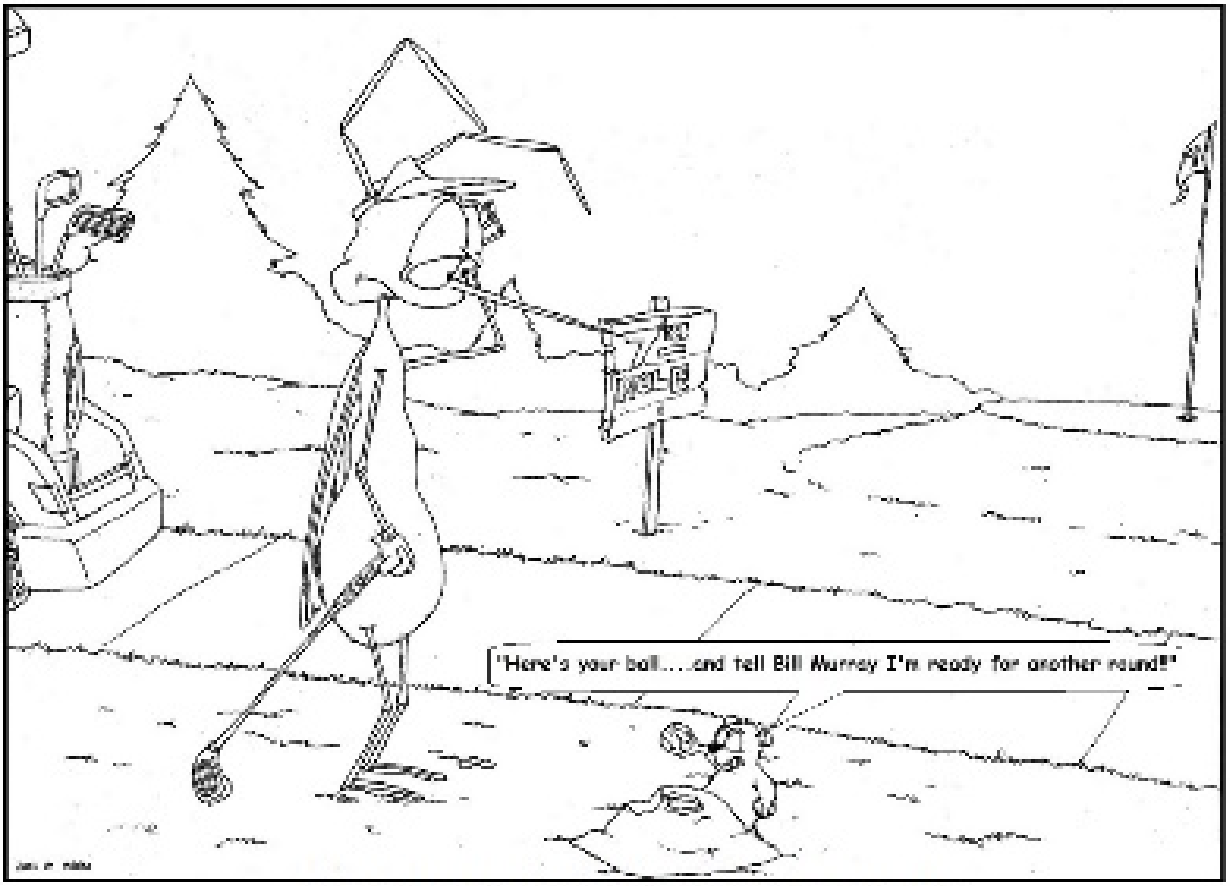
- Systems in state-designated critical water or stressed areas.
- Systems experiencing frequent droughts, emergencies, or safe yield problems.
- Systems with excessive unaccounted-for water or water losses.
- Systems entering into major construction cycles.
- Systems anticipating rapid growth in water demand.

For some conditions, states might provide benchmark measures that water systems can use for comparison purposes. For example, a state might have specific criteria for defining critical use or stressed areas, for classifying per-capita water use, or for identifying the age of systems. When practical, systems should try to compare significant conditions using generally accepted measures.

In addition to the summary worksheet, planners also should prepare a brief written discussion of the significant conditions affecting their systems. Particular attention can be paid to climate and water availability, but other factors affecting the system can be considered as well. This information can be used to help systems identify problems and opportunities throughout the planning process.

**Current Conservation Efforts**
Worksheet 5-3 is provided so that water systems can describe their current water conservation activities and programs.

For each conservation measure implemented, planners can indicate the approximate annual water savings achieved, when implementation for the measure began, and whether continued implementation is planned. Any other pertinent information on current efforts and their effectiveness can be provided in the plan as well.




**SOME GOLF COURSES RECYCLE WATER**

## 3. Prepare a Demand Forecast

### Demand Forecasting

Forecasting water use (or water demand) is a critical part of the planning process. Forecasts can range from simple projections based on anticipated growth in the population to complex models using several variables to explain variations in water use.

***Prepare a forecast of anticipated water demand for selected time periods. To the extent practical, the planner should take into account variations in demand based on type of water usage, as well as perform a "what if" (sensitivity) analysis.***

Forecasts can be made for a water system as a whole; however, forecasts are considered more accurate when they are prepared for separate classifications of water use or sectors.

The Guidelines suggest that planners prepare forecasts for five-year, ten-year, and twenty-year intervals. Additional time points can be used as well. The longer the planning horizon, the greater will be the uncertainty of the forecast. Forecasts should be revisited and updated on a regular basis.

The forecast should recognize the effects of conservation measures already implemented. The forecast also should recognize the demand effects of plumbing efficiency standards established under the 1992 Energy Policy Act (see Appendix B, Tables B-5 and B-6).[2] New construction and renovations will not contribute as much to total demand as in the past; systems that are not experiencing growth might detect declines in demand due to these effects.

For the purposes of this conservation plan, anticipated demand effects from measures contemplated in the plan should not be included. A revision to the demand forecast based on implementing the planned conservation measures is made in Section 8 (Worksheet 5-13).

*It is not necessary for systems to prepare a separate forecast for the purposes of this plan if a forecast has already been prepared for the system within a reasonable time frame. Planners should include the results of their forecasts in this plan.*

### Forecasting Method

Systems following the Advanced Guidelines should prepare a demand forecasting model appropriate to their capabilities and needs. Many systems in this category already employ advanced forecasting techniques.

Current and reasonable forecasts already prepared by the system, including forecasts prepared under other planning or regulatory requirements, will be in accordance with the purpose of these guidelines.

Advanced water demand forecasting generally involves:

- Disaggregated forecasts by customer class or other relevant groups, by average-day and maximum-day demand, and by off-peak and peak season.
- Multivariate models that seek to explain variations in water demand in terms of variations in other factors, such as climate, income, and price.
- Quantified sensitivity ("***what if***") analysis, which allows systems to address uncertainty by varying inputs and assumptions.

Disaggregating forecasts by customer class is important because of the different load factors that groups of customers present. Disaggregating forecasts according to type of demand is relevant for advanced demand management techniques that take into account how different types of demand affect the utility's functional costs. As discussed in Section 4, different types of supply-side facilities are designed to meet average-day or maximum-day water demands, and various conservation measures target different types of demand.

Multivariate models recognize that demand is dynamic and can change with changes in other variables. Sensitivity analysis helps planners deal explicitly with uncertainty that goes along with these dynamics. Addressing uncertainty is a very important part of advanced forecasting. With larger and more diverse service territories, uncertainties are greater; uncertainty also grows with the time horizon of the forecast. Contingency planning can help utilities cope with uncertainty.

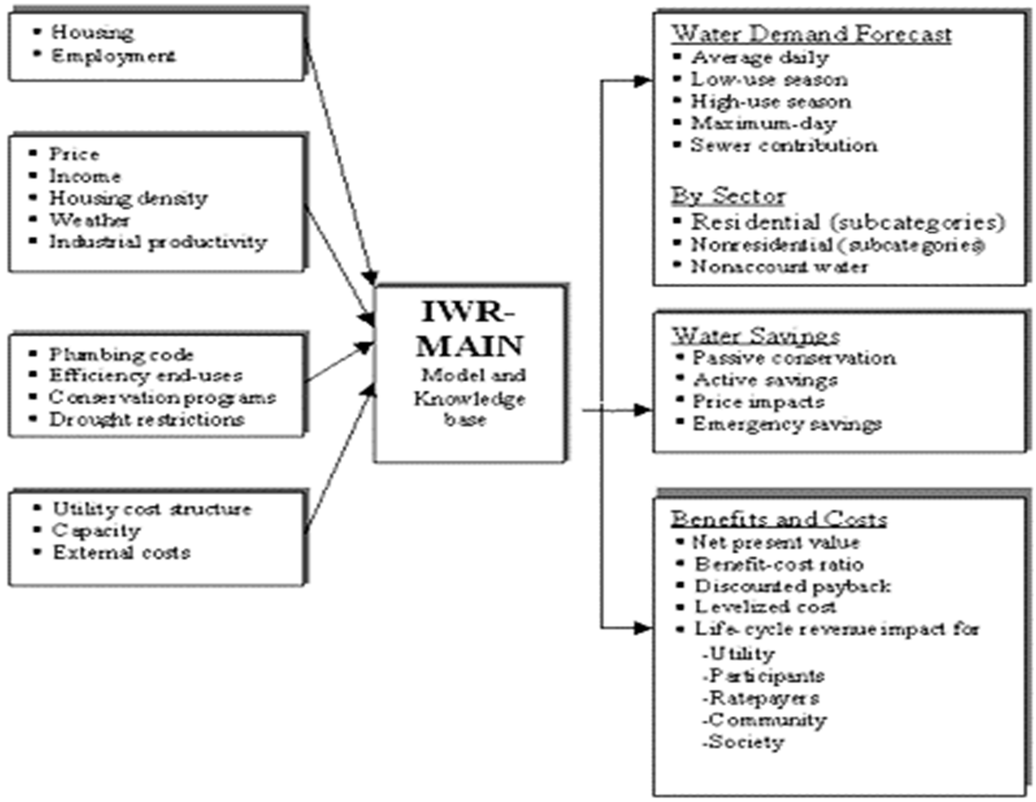
Several computer models are available for advanced forecasting, many of which can be used in accordance with these guidelines. An example of an advanced forecasting tool is the widely-used IWR-MAIN model, which was developed by the U.S. Army Corps of Engineers.[3]

Figure 5-1 is an illustration of the inputs and outputs of the model. The key features of IWR-MAIN are: spatial disaggregation, seasonal disaggregation, sector disaggregation, multiple determinants of water demand, user-added categories, and sensitivity analysis.

The current version of the model also allows planners to incorporate the effects of demand-management into various planning scenarios. Use of empirical models, including but not limited to IWR-MAIN, clearly is consistent with the purpose of these guidelines.

The conservation plan should include a detailed summary of the forecast, results by customer class, and a description of the forecasting methodology used. Any adjustments to the forecasts should be explained in the plan. Worksheet 5-4 provides a template for summarizing the system-wide results of the forecast.

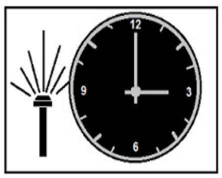
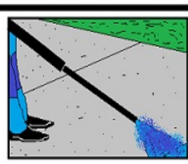
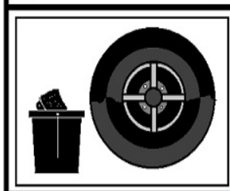
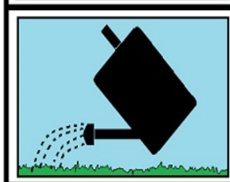
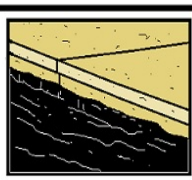
## Figure 5-1. Inputs and Outputs of the IWR-MAIN Forecasting Model




Source: Duane D. Baumann, John J. Boland, and W. Michael Hanemann, Urban Water Demand Management and Planning (New York: McGraw-Hill, 1998): 109.

2. A method for estimating the demand effect of efficient fixtures can be found in Amy Vickers, "The Energy Policy Act: Assessing its Impact on Utilities." *Journal American Water Works Association* (August 1993): 56-62.

3. Duane D. Baumann., John J. Boland, and W. Michael Hanemann. *Urban Water Demand Management and Planning* (New York: McGraw Hill, 1998).

| WATER RESTRICTION STAGE | | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
|  | FREQUENCY | ANY DAY | EVERY OTHER DAY: Even # Houses- Even Days Odd # Houses- Odd Days | VOLUNTARY REDUCTIONS ON TOP OF STAGE 2 | SPRINKLING BAN: Lawn Watering NOT PERMITTED |
|  | WATERING TIMES | BETWEEN 7pm and 7am | BETWEEN 7 - 10am or 7- 10pm for 2 hrs MAX | | |
|  | PRESSURE WASHING WALKWAYS, DRIVEWAYS & SIDING | ANYTIME | ANYTIME | | ONLY PRIOR TO APPLICATION OF PAINT, PRESERVATIVE, STUCCO OR SEALANT |
|  | WASHING VEHICLES, BOATS, HOUSES (Siding) | ANYTIME | ANYTIME | | NOT PERMITTED |
|  | HAND-WATERING, DRIP IRRIGATION, MICRO IRRIGATION | ANYTIME | ANYTIME | | BETWEEN 7 - 10am or 7 - 10pm |
|   | NEW LAWN PERMITS | CAN APPLY FOR A PERMIT | CAN APPLY FOR A PERMIT | | NO PERMITS ISSUED |
|  | FILLING FOUNTAINS, POOLS & HOT TUBS | ANYTIME | ANYTIME | | NOT PERMITTED |

WATER RESTRICTION STAGES

## 4. Describe Planned Facilities

## Supply Forecasting

> ***Describe improvements planned for the water system over a reasonable planning horizon, identify the types of improvements proposed, and estimate the total, annual, and unit cost of the improvements. Prepare a preliminary forecast of installed capacity.***

In this part of the conservation plan, planners are asked to prepare an estimate of supply costs based on meeting the level of water demand specified in the unadjusted demand forecast (that is, unadjusted for additional conservation).

This is a critical part of the analysis because it establishes the anticipated cost of *supply-side* improvements and additions and this cost estimate will be used to represent the value of conservation or *demand-side* activities.

Because the benefits of conservation extend into the future it is important to take a forward-looking approach to supply costs. The concept of marginal or incremental cost captures the idea that the "***true***" value of a supply resource can be measured in terms of the cost of the next increment of supply.

If only high-cost supplies are available, the marginal or incremental cost will be high. For many communities, future increments of supply will be very costly (that is, the marginal cost of developing new water sources will be high). The value of a conserved amount of water at a future point in time will be equivalent to the most costly supply option available at that future time point, because that is the supply option being displaced by conservation.

**Cost Analysis**

A reasonable accounting of anticipated supply-side costs is needed in order to compare the cost of supply-side measures to the cost of demand-side or conservation measures (on a cost-per-gallon basis). Planners should choose an appropriate time horizon; a twenty-year or other suitable period can be used. The choice of time frame should be consistent with the demand forecast (Section 3), as well as the other planning considerations.

Planners should begin by preparing an estimate of major improvements and additions that will be required over the planning horizon in order to meet anticipated demand (including a safe reserve margin). Detailed cost estimates may be available from facility plans or other planning documents. Worksheet 5-5 can be used to summarize improvements and additions, which are disaggregated into three categories: source of supply, transmission and treatment, and distribution. (Additional categories can be used as needed).

Planners should consider all capital facility improvements and additions. Improvements include renovations and expansions needed to maintain or enhance safety or reliability within existing facilities. Additions consist of new facilities.

Routine maintenance improvements should not be included. Anticipated water purchases and costs also should be recorded on Worksheet 5-5. For this part of the analysis, the effects of conservation measures currently being implemented should be considered, but the effects of new conservation measures on the need for supply capacity or water purchases should be excluded. (These effects are addressed in Section 8.)

*If no capital improvements and additions are planned, "0" values can be entered and the estimate of supply costs can be based on operating costs (including the cost of energy, chemicals, and purchased water).*

**Estimating Incremental Supply Costs**
The Advanced Guidelines recommend a method for determining the present value of supply-side costs.

This analysis should be calculated separately for (1) improvements and additions needed to meet *average* demand, and (2) improvements and additions needed to meet peak demand so that the results can be compared to corresponding conservation measures. As illustrated in Worksheet 5-6, this spreadsheet method provides the planner with a year-by-year accounting of costs.

The resulting estimates of total annual incremental costs by type of facility (peak and average) can be used by planners to estimate the incremental cost of supply associated with meeting average or peak demand on a system-specific basis.

Supply-side facilities are designed to meet different types of water demand (as summarized in Table 5-1); similarly, different conservation measures affect different types of water demand.

Planners should identify, as reasonably possible, the extent to which improvements and additions are needed to meet average and/or peak demand.

Two adjustments can be made to costs: one for the annual escalation rate and one for the discount rate. The escalation rate is used to ensure that the benefits of conservation are not undervalued. By using an escalation rate, the analyst assumes that incremental costs of supply measured at a future point in time will be greater than present incremental costs. Many planners, for example, believe that future water supplies will be much more costly to secure and develop, even in real-dollar (inflation adjusted) terms.

In addition to supply costs, other infrastructure costs are expected to escalate with time. In general, the escalation rate will be higher for areas experiencing supply or other constraints that will put pressure on total system costs. Choosing the appropriate escalation rate requires analyst judgment; however, planners may want to investigate past escalation trends relevant to their system.

The second adjustment involves applying a discount rate, which is used to estimate the present value of costs that extend into the future. The discount rate reflects the time value of money (or opportunity costs) and can be based on the system's overall cost of capital.

**Table 5-1: Relationship of Water Demand to Supply Facilities**

| **Type of Water Demand** | **Type of Water Supply Facility** |
|---|---|
| Average-day | Source of supply facilities, including raw water storage facilities (such as reservoirs) |
| Maximum-day (peak) | Water treatment plants<br>Major transmission lines |
| Maximum-hour [a] | Treated water storage facilities<br>Distribution mains [b]<br>Pumping stations [b] |

Source: Adapted from Charles W. Howe and F. Pierce Linaweaver, "The Impact of Price on Residential Water Demand and its Relationship to System Design and Price Structure, *Water Resources Research 3* (First Quarter 1967): 13-32.
[a] Maximum-day demand plus fire-flow requirements.
[b] These facilities should be considered in the analysis if they could be affected by such conservation measures as leak detection and repair, pressure management, or integrated resource management.

Planners should note that discounting is not the same as adjusting for inflation. In order to simplify the presentation, Worksheet 5-6 does not include an adjustment for inflation. It is not necessary to convert nominal to real (inflation-adjusted) dollars for the purpose of assessing benefits and costs. However, if planners choose to represent costs in real dollars, the escalation rate and the discount rate also should be expressed in real dollar terms.

Given the uncertainty associated with the recommended adjustment factors, planners using the Advanced Guidelines also are encouraged to conduct a sensitivity analysis to establish a range of values based on different assumptions for the three adjustments.

**Preliminary Supply-Capacity Forecast**
Based on the anticipated improvements and additions, planners also can present a preliminary forecast of total supply capacity over the planning period. Worksheet 5-7 is provided for this purpose. The forecast, which can be presented in a table or graph, can be used to indicate when changes to capacity are expected to occur.

The total supply forecast should reflect both additions to capacity and retirements. Improvements that allow the system to maintain capacity can be indicated with entries under both additions (to reflect the improvement) and retirements (to reflect the facilities taken out of service). A similar analysis can be used for wastewater facilities.

The supply forecast is *preliminary* because it can and will be revised later in the plan to reflect the effect of conservation on water supply needs.

## ADVANCED GUIDELINES FOR PREPARING WATER CONSERVATION PLANS

### 5. Identify Conservation Measures

### Levels and Measures

Water systems have a vast array of specific conservation measures at their disposal. These measures include both supply-side and demand-side management techniques for saving water and range from relatively simple educational tools to the promotion of advanced water-efficient technologies.

Use of any particular measure depends on whether it meets cost-effectiveness and other planning criteria and whether its use complies with applicable laws and regulations, including state and local plumbing codes.

***Review the list of conservation measures recommended for consideration and identify measures that have been implemented, are planned, or are not planned. Provide an explanation for why any measure is not planned for the water system.***

The conservation measures are organized into three levels: Level 1, Level 2, and Level 3. Each level includes four categories of measures. Specific water conservation measures are identified within each category. Appendix A provides additional information and several worksheets on the conservation measures. Planners are encouraged to explore the full range of potential conservation measures for consideration in their conservation programs.

**Identifying Conservation Measures**
Worksheet 5-8 summarizes the minimum set of measures recommended for consideration in the Advanced Guidelines. Systems should use the checklist to review and summarize the measures that are currently implemented, planned, or not planned at this time. Planners also can identify additional measures and practices as they develop their conservation plans.

Water systems following the Advanced Guidelines are expected to implement the very fundamental and widely accepted practices under Level 1.

If Level 1 measures are not in place and not planned for implementation, planners should submit a strong justification, including a cost-effectiveness analysis if it is the basis for not implementing the measure.

Planners can screen the measures in terms of general feasibility. In some cases, it may not be possible for a system to implement a measure because of legal restrictions or for other compelling reasons.

The conservation plan should provide an explanation if a measure cannot be implemented for the period of time covered by the plan. It is not necessary to prepare a cost effectiveness analysis for measures that cannot be implemented.

# Chapter 6. Analyze Benefits and Costs
## Purpose

In this section, an analysis of benefits and costs is used to aid the comparison and selection of measures. Planners will consider criteria other than efficiency in Section 7 and estimate actual effects of conservation on planned capital facilities in Section 8.

Analyzing benefits and costs is an invaluable part of the planning process. Use a *cost-effectiveness* analysis to compare alternative conservation measures in terms of dollars per gallon of water saved. For example, one measure might produce savings at a cost of $.25/1,000 gallons while another produces savings at a cost of $.50/1,000 gallons.

Cost-effectiveness analysis also can be used to compare conservation measures to supply options. Use a *net benefit* analysis to determine whether the benefits of implementing a measure outweigh the costs.

***For each identified water conservation and other measures of interest, estimate total implementation costs (dollars) and anticipated water savings (volume), assess the cost-effectiveness of the measure, and compare the cost of conservation to benefits (measured in terms of the incremental cost of supply).***

*It is not necessary for planners to prepare a cost-effectiveness or net benefit analysis of Level 1 measures if those measures are already implemented or planned for implementation.* An analysis should be presented if cost-effectiveness is the basis for rejecting a Level 1 measure. If the analysis of Level 1 measures leads the planner to conclude that a proposed measure is not cost-effective or that it fails to meet other criteria for implementation, the plan should include an explanation of these findings and conclusions in Worksheet 5-12 (Section 7).

**Water Savings**

Worksheet 5-9 should be completed for *each* conservation measure identified in Section 5. In some cases planners may want to combine measures based on the conservation program they envision. *All interrelated measures that are expected to result in an identifiable amount of water savings should be combined and treated as one measure in order to avoid counting the planned water savings more than once in the analysis.*

The worksheet begins with an open-ended description of the measure and an estimate of water savings. The anticipated life span for the measure should be indicated. Planners also should indicate whether the measure is targeted toward reduction in average-day demand, maximum-day demand, or both.

Estimates of potential water savings should be as realistic as possible, based on system and regional considerations. For some measures, particularly those dependent on customer responses (such as information and education programs), the estimation will reflect a high degree of uncertainty. Planners can choose to use a range of estimates under these circumstances.

The plan should indicate typical water savings from the measure, the number of planned installations, and the anticipated life span for the measure, as well as whether the measure is expected to reduce average-day or maximum-day demand (or both).

***Much of this information will be similar to Part 4***

**Implementation Costs**

Worksheet 5-9 includes a method for summing the total cost of implementing the measure. All costs associated with implementation should be included. Planners should ascertain reasonable cost estimates by potential vendors whenever possible. The types of costs that should be analyzed include:

- Materials
- Labor
- Rebates or other payments
- Marketing and advertising
- Administration
- Consulting or contracting
- Other

A realistic implementation schedule should be considered. Any special circumstances affecting the schedule or cost of implementing the proposed measures should be discussed in the plan.

Each worksheet also includes a place to estimate annual unit water savings (that is, savings per measure or "***unit***"), total annual water savings, and total life span water savings for the measure.

For each measure, the method used to estimate water savings should be provided. This might include, for example, a formula for converting daily per capita savings to annual savings. In some cases (such as a leakage control program), it might not be feasible to estimate savings for each unit, in which case total annual savings for the entire measure are sufficient.

**Analyzing Benefits and Costs**

Worksheet 5-10 also provides a detailed and relatively precise method for calculating the cost effectiveness and net benefit of each conservation measure. The spreadsheet format allows planners to incorporate year-to-year changes in benefits and costs. The number of years represented in the spreadsheet will vary with the anticipated life span of the measure.

For some water conservation measures, savings will be constant from year-to-year. The same value will appear for each year. However, the spreadsheet also allows the analyst to recognize changes in the effectiveness of the conservation measures over time. The benefits of conservation are displayed in terms of the incremental cost of supply (from Worksheet 5-6). The estimate of benefits should reflect differences in savings from reduction in average-day demand versus reductions in maximum-day demand. This can be accomplished by using the disaggregated estimates of capital in the calculation of benefits.

For example, benefits from measures that reduce only average-day demand can be adjusted to include only the incremental capital cost of source facilities, plus annual operating costs; both are measured on a per gallon basis. The method also allows the planner to incorporate incremental additions and improvements at different years.

The costs are represented in terms of total program costs for the measure. Most conservation program costs take the form of one-year (year 0) expenditures; costs in the subsequent years drop to zero. However, some measures may require recurring expenditures. When this is the case, the same discount rate used in the estimation of supply costs (in Worksheet 5-6) should be applied to the conservation expenditures.

The net present value of conservation is simply the difference between net present benefits and net present costs. The spreadsheet uses nominal dollars to represent net present value. The worksheet reports only nominal dollars. However, planners can adjust their estimates of benefits and costs for anticipated inflation and convert nominal to real (inflation-adjusted) dollars. If real dollars are reported, the escalation rate and discount rate should be expressed in real dollar terms as well.

# ADVANCED GUIDELINES FOR PREPARING WATER CONSERVATION PLANS

## 7. Select Conservation Measures

**Selection Criteria**
The first step in the selection process is to identify criteria for evaluating the conservation measures.

***Describe the process by which conservation measures were selected for implementation, including identification of selection criteria. Summarize the selected measures and total anticipated program costs for implementation.***

The cost-effectiveness of the measures (from Section 6) is one criterion, but other factors should be considered as well.

Planners are free to consider as many selection criteria as they believe are appropriate, but the relevance of the criteria should be explained in the conservation plan.

**Criteria that can be used in selecting conservation measures for implementation include:**

- Program costs
- Cost-effectiveness
- Ease of implementation
- Budgetary considerations
- Staff resources and capability
- Environmental impacts
- Ratepayer impacts
- Environmental and social justice
- Water rights and permits
- Legal issues or constraints
- Regulatory approvals
- Public acceptance
- Timeliness of savings
- Consistency with other programs

For each selection criterion used, planners should identify whether, how, and why the factor affects the feasibility of implementing one or more conservation measures. Different factors might be assigned different weights. Planners also may want to bear in mind that techniques can be used to mitigate adverse effects and improve acceptance of measures. A cost-effective conservation measure should not be dismissed without careful consideration of how barriers to implementation might be overcome.

**Selecting the Measures**
Worksheet 5-12 provides a simple format for summarizing the selection of measures. For each measure, planners should indicate whether the measure was selected for implementation. Planners also should identify the primary reason or reasons for selecting or rejecting the measure. Special conditions or actions that are required before a selected measure can be implemented (such as an approval from regulators) should be noted.

In some cases, planners may conclude that a measure (or measures) cannot be implemented because of a constraint that exists in the short term. Conservation measures that might be planned for future implementation, once constraints are resolved, should be discussed in the plan. Planners should briefly discuss their implementation strategies with respect to such measures.

For the conservation measures selected for implementation, planners should estimate the expected reductions in average-day and maximum-day demand.

These estimates will be used in the next section of the plan to integrate conservation savings with the system's plans for supply-side facilities.

## 8. Integrate Resources and Modify Forecasts
## Integrating Options

***Modify water demand and supply-capacity forecasts to reflect the anticipated effects of conservation. Indicate whether and how water savings from conservation will allow systems to eliminate, downsize, or postpone supply-side projects or water purchases.***

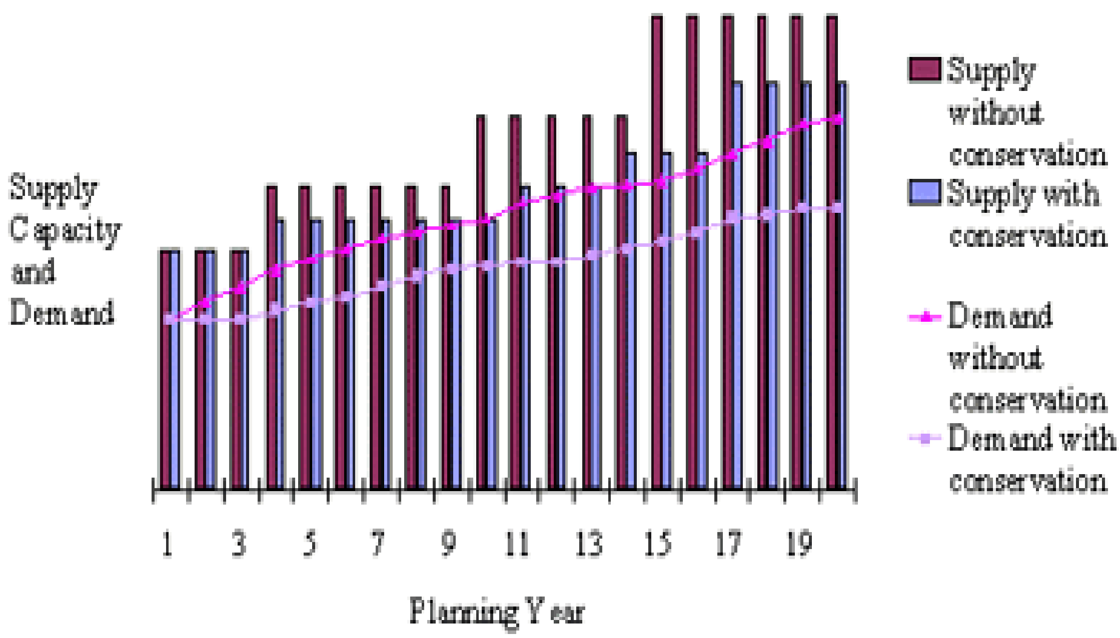
In this section, planners can revise the demand and supply-capacity forecasts made in earlier sections of the plan based on anticipated conservation savings. Pay particular attention to the effects of conservation on specific supply-facility projects.

Planners should be cautious to avoid counting demand-side or supply-side resources more than once in the analysis. Anticipated savings from conservation should be based on realistic estimates of savings associated with the planned measures. Similarly, supply projects that involve multiple facilities should be considered in terms of the total water supply capacity that is made available through those combined facilities. Timing is another issue.

The plan should address how different supply-side and demand-side projects involve different life spans and implementation schedules. One twenty-year supply-side project, for example, might be offset by a series of conservation measures that begin and end at different times.

Some conservation plans use a graph to display anticipated annual supply capacity and demand without and with the implementation of conservation measures. Figure 5-2 is an example of this type of graph for a twenty-year planning horizon.

**Figure 5.2**
**Sample Graph of Modified Supply and Demand Forecasts Based on Implementing Conservation Measures**



**Modifying Demand Forecasts**
Planners should use Worksheet 5-13 to collate information from previous worksheets and analyses in order to revise the demand forecasts made in Worksheet 5-4. Revisions should reflect changes based on the introduction of *new* conservation measures. The effects of measures already being implemented should be included in the original demand forecast.

Modifying the demand forecast requires a considerable degree of judgment, particularly in estimating the effects of conservation on average-day and maximum-day demand. The plan should include an explanation of the approach used in revising the demand forecasts.

**Project-Specific Savings**
Planners should identify the anticipated effects of conservation on planned supply-side improvements and additions (as specified in Section 4). Worksheet 5-14 is provided for this purpose.

A worksheet should be completed for separable supply projects as appropriate. Ideally, water conservation strategies that reduce demand will translate into supply-side savings through one or more of the following actions:

- Eliminating a project for the foreseeable future
- Downsizing a project based on reduced capacity needs
- Postponing a project into the future
- Eliminating, reducing, or postponing water purchases

Adjustments to supply-capacity planning must be realistic, especially in terms of complex and sometimes competing goals. Supply projects cannot be eliminated, downsized, or postponed if doing so would compromise public health or safety, reduce operational efficiency, or inflate costs beyond a reasonable amount.

Some systems (including systems that currently operate with inadequate or unreliable supply reserves) may not be able to translate all demand reductions into supply-capacity reductions. Planners should identify and describe such circumstances. On the other hand, supply projects that are not needed or are oversized place an unnecessary burden on systems and their customers.

**Modifying Supply Forecasts**
The supply-capacity forecast is revised in Worksheet 5-15. The revision to the supply-capacity forecast should be based on Worksheet(s) 5-14 and consistent with accepted supply-capacity planning practices. The modification of forecasts should reflect reasonable assumptions about anticipated implementation schedules, which are summarized in Section 9. Planners also can indicate the anticipated capacity reserve (the difference between forecast supply capacity and demand).

Worksheet 5-15 also provides a method of summarizing savings in capital and operating costs, based on reductions in supply capacity. Planners also should estimate reductions in operating costs at *existing* facilities that will occur with demand reductions (apart from operating costs associated with planned facilities). The total program cost of conservation can be compared with the savings in total capital and annual operating costs.

As recognized throughout these Guidelines, water conservation also has non-monetary benefits. Planners should discuss, as appropriate, how implementation of the conservation program will help their system cope with any of the conditions identified in Section 2 (Worksheet 5-2). For example, the planned measures might help a system address problems related to safe yields or drought management.

***Much of this information will be similar to Part 4***

## Revenue Effects

The conservation plan should briefly describe how planned conservation measures will affect water utility revenues (based on reduction in sales) and discuss strategies for addressing these revenue effects. Reductions in water usage will affect the revenues of the water utility.

Reductions in water usage will affect the revenues of the water utility. Conservation will help the water utility reduce variable costs (such as energy, chemical, and purchased water costs). In the long term, conservation also will help the utility reduce fixed costs (associated with new capital facilities). In the short term, reductions in sales can lead to a shortfall in revenues needed to cover fixed costs and sustain the financial viability of the water system.

The planner can estimate the effect of conservation on revenues by multiplying current water rates by the adjusted level of sales (for the variable portion of the water bill). The adjusted level of sales should include the anticipated effects of conservation. Conservation-oriented rate structures have direct revenue effects that should be considered. Worksheet A-4 in Appendix A can be used to evaluate the revenue effects of rate changes.

Conservation planners should work closely with financial planners in order to integrate their analyses, identify potential revenue shortfalls, and devise strategies to ensure that the utility will meet its revenue requirements.

Adjustments to water rates may be needed. For some utilities, a change in rates requires approval from an oversight board or state public utility commission. When rate increases are offset by usage reductions, customer bills and utility revenues can be maintained. Customers and utilities eventually will realize savings from conservation through long-term reductions in costs.

**9. Present Implementation and Evaluation Strategy**
**Implementation**

In this final step in the conservation planning process, the water system specifies its strategy and timetable for implementation. It can be emphasized, however, that conservation planning will require an *ongoing* effort on the part of water utility managers.

***Present a strategy and timetable for implementing conservation measures and other elements of the conservation plan. Describe proposed approaches for implementing and evaluating planned conservation measures***

Ongoing planning and implementation will go hand in hand. The implementation strategy should include a preliminary schedule for monitoring and evaluating program results and revisiting the plan for updates and modifications.

**Implementation of Measures**

Worksheet 5-16 is a simple template for summarizing the water system's implementation and evaluation schedule for the conservation measures. For each measure, the schedule can identify significant implementation actions, a beginning date, and a completion date. Implementation actions include:

- Securing budgetary resources
- Hiring of staff
- Procurement of materials
- Agreements with suppliers or consultants
- Acquisition of permits or other approvals from regulatory agencies
- Legislative actions (for changes in water-use regulations)
- Activity milestones (for example, system audits or distribution of retrofit kits)

Planners should make note of any specific factors or contingencies that might affect or prevent the implementation of specific measures.

For example, if a measure cannot be implemented prior to obtaining a special permit or other authority, this fact should be noted along with an explanation of the strategy for obtaining the necessary authority.

Some measures might require implementation actions that take place over several years (in order to sustain conservation savings). The plan should provide sufficient detail to understand the utility's strategy with regard to implementing such measures.

**Implementation and Evaluation**
Worksheet 5-17 provides a very simple summary of the water system's general implementation and evaluation strategy for the conservation plan. Three areas are highlighted:
- Public involvement
- Monitoring and evaluation
- Updates and revisions

A plan for public involvement should discuss whether and when the water system intends to involve members of the community in the implementation of the conservation plan. Some systems may want to schedule regular meetings with community groups to keep them informed of the system's progress in meeting goals.

A plan for monitoring and evaluation should address data collection, modeling, and other issues that will be important in tracking the effects of water conservation on demand over time. The system may want to plan to collect new kinds of data for monitoring purposes as well as for future forecasting needs.

Many systems might find, for example, that more detailed data on demand by customer class are needed, including more detail on contributions to average-day and maximum-day demands. More detailed data might also be needed to assess trends in nonaccount water.

A plan for updates and revisions will help keep the system's conservation plan current over time and account for the system's actual experience with conservation. Updating forecasts of water demand and supply capacity as new data become available is especially important. In some cases, the system might want to revise or expand its planning goals.

Many systems update plans every five years. However, changing conditions or other concerns might justify more frequent updates. The schedule of updates and revisions might be affected by state or local requirements for conservation planning by the water system.

The conservation planning document also should include a record of the plan's adoption by the water system's governing body (such as a Board of Directors or City Council), as appropriate.

## Worksheet 5-1: Water System Profile

| A | SERVICE CHARACTERISTICS | Number |
|---|---|---|
| 1 | Estimated service population | |
| 2 | Estimated service area (square miles) | |
| 3 | Miles of mains | |
| 4 | Number of treatment plants | |
| 5 | Number of separate water systems | |
| 6 | Interconnection with other systems | |

| B | ANNUAL WATER SUPPLY | Annual volume | Number of intakes or source points | Percent metered |
|---|---|---|---|---|
| 7 | Groundwater | . | . | .% |
| 8 | Surface water | . | . | .% |
| 9 | Purchases: raw | . | . | .% |
| 10 | Purchases: treated | . | | .% |
| 11 | Total annual water supply | . | . | .% |

| C | SERVICE CONNECTIONS | Connections | Water sales | Percent metered |
|---|---|---|---|---|
| 12 | Residential, single-family | . | | % |
| 13 | Residential, multi-family | | | % |
| 14 | Commercial | | | % |
| 15 | Industrial | | | % |
| 16 | Public or governmental | | | % |
| 17 | Wholesale | | | % |
| 18 | Other | | . | % |
| 19 | Total connections | | | % |

| D | WATER DEMAND | Annual volume | Percent of total | Per connection |
|---|---|---|---|---|
| 20 | Residential sales | | | |
| 21 | Nonresidential sales | | | |
| 22 | Wholesale sales | | | |
| 23 | Other sales | | | |
| 24 | Nonaccount water: authorized uses | | | |
| 25 | Nonaccount water: unauthorized uses | | | |
| 26 | Total system demand (total use) | | | |

| E | AVERAGE & PEAK DEMAND | Volume | Total supply capacity | Percent of total capacity |
|---|---|---|---|---|
| 27 | Average-day demand | ________ | ________ | ________% |
| 28 | Maximum-day demand | ________ | ________ | ________% |
| 29 | Maximum-hour demand | ________ | ________ | ________% |
| **F** | **PRICING** | **Rate structure** | **Metering frequency** | **Billing frequency** |
| 30 | Residential rate | ________ | ________ | ________ |
| 31 | Nonresidential rate | ________ | ________ | ________ |
| 32 | Other rate | ________ | ________ | ________ |
| **G** | **PLANNING** | **Prepared a plan** ☐ | **Date** | **Filed with state** ☐ |
| 33 | Capital, facility, or supply plan | ________ | ________ | ________ |
| 34 | Drought or emergency plan | ________ | ________ | ________ |
| 35 | Water conservation plan | ________ | ________ | ________ |

## Worksheet 5-2: Overview of System Conditions [a]

| Line | Conditions | Increasing need for conservation →→→<br>Check applicable description | | | | | | Don't know |
|---|---|---|---|---|---|---|---|---|
| **A** | **CLIMATE AND WATER AVAILABILITY** | | | | | | | |
| 1 | Average precipitation | High | | Moderate | | Low | | |
| 2 | Average temperatures | Low | | Moderate | | High | | |
| 3 | Critical supply areas | No | | At risk | | Yes | | |
| 4 | Competing water uses | No | | Possibly | | Yes | | |
| 5 | Environmental constraints | No | | Possibly | | Yes | | |
| 6 | Quality/quantity concerns | No | | Possibly | | Yes | | |
| 7 | Seasonal variations in climate | Low | | Moderate | | High | | |
| 8 | Instream flow problems | Low | | Moderate | | High | | |
| 9 | Shortage or emergency frequency | Low | | Moderate | | High | | |
| **B** | **INFRASTRUCTURE CONDITIONS** | | | | | | | |
| 10 | Age of the system | Newer | | Middle | | Older | | |
| 11 | General condition of system | Good | | Fair | | Poor | | |
| 12 | Water losses and leaks | Low | | Moderate | | High | | |
| 13 | Unaccounted-for water | Low | | Moderate | | High | | |
| 14 | Safe yield of supply exceeded | No | | At risk | | Yes | | |
| 15 | Wastewater discharges exceeded | No | | At risk | | Yes | | |
| 16 | Wastewater capacity exceeded | No | | At risk | | Yes | | |
| 17 | Potential for recycling and reuse | Low | | Moderate | | High | | |
| 18 | Improvement plans | Low | | Moderate | | High | | |
| 19 | Anticipated investment | Low | | Moderate | | High | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **C** | **SYSTEM DEMOGRAPHICS** | | | | | | | |
| 20 | Rate of population growth per year | Low | | Moderate | | High | | |
| 21 | Rate of demand growth per year | Low | | Moderate | | High | | |
| 22 | Rate of economic growth per year | Low | | Moderate | | High | | |
| 23 | Per capita water use (by class) | Low | | Moderate | | High | | |
| 24 | Ratio of peak to average demand | Low | | Moderate | | High | | |
| 25 | Presence of large-volume users | Low | | Moderate | | High | | |
| **D** | **OTHER FACTORS** | | | | | | | |
| 26 | | | | | | | | |
| 27 | | | | | | | | |
| 28 | | | | | | | | |

*[a] Specific (quantified) benchmarks for these indicators may be provided by the state.*

## Worksheet 5-3: Current Water Conservation Activities

Summarize the system's current water conservation activities/programs:

| Water conservation measures | *Approximate* annual water savings [if known] | Implemented since (date) | Is continued implementation planned? |
|---|---|---|---|
| | | | |
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## Worksheet 5-4: Summary of Preliminary Water Demand Forecast

**Summary Results of Advanced Forecasting Model [a]**

| Line | Item | Current year | 5-year forecast | 10-year forecast | 20-year forecast |
|---|---|---|---|---|---|
| **A** | **TOTAL ANNUAL WATER DEMAND** | | | | |
| 1 | Current and projected total annual water sales to the residential sector [b] | | | | |
| 2 | Current and projected total annual water sales to the nonresidential sector [b] | | | | |
| 3 | Current and projected total annual water sales to the wholesale buyers [b] | | | | |
| 4 | Current and projected total annual water sales to others [b] | | | | |
| 5 | Current and projected total annual nonaccount water (authorized and unauthorized) [c] | | | | |
| 6 | Current and projected total annual water demand in gallons (add lines 1 through 4) [d] | | | | |
| 7 | Current and projected annual water supply capacity [e] | | | | |
| 8 | Difference between total demand and total supply capacity (+ or -) (line 3 less line 2) | | | | |
| **B** | **AVERAGE-DAY AND MAXIMUM-DAY DEMAND** | | | | |
| 9 | Current and projected average-day demand [f] | | | | |
| 10 | Current and projected maximum-day demand [g] | | | | |
| 11 | Ratio of maximum-day to average-day demand (line 5 divided by line 4) | | | | |
| 12 | Daily supply capacity (divide line 7 by 365) | | | | |
| 13 | Ratio of maximum-day demand to daily supply capacity (divide line 10 by line 12) | | | | |

[a] This Worksheet presumes that the system has prepared a detailed demand forecast using an appropriate model. Include in the conservation plan a description of the forecasting methodology used and a detailed summary of the forecast.
[b] Current year corresponds to Worksheet 5-1, lines 20 through 23.
[c] Current year corresponds to Worksheet 5-1, lines 24 through 25.
[d] Current year corresponds to Worksheet 5-1, line 26.
[e] Supply capacity should take into account available supplies (permits), treatment capacity, and distribution system capacity and reflect the practical total supply capacity of the system, including purchased water.
[f] Current year corresponds to Worksheet 5-1, line 27.
[g] Current year corresponds to Worksheet 5-1, line 28.

## Worksheet 5-5: Anticipated Improvements and Additions

**Describe planned improvements and additions:**

_______________________________________________

_______________________________________________

_______________________________________________

**Describe time frame for planned improvements and additions (years):**

_______________________________________________

_______________________________________________

_______________________________________________

| Type of Project [a] | Improve-ment | Addition | State date | End date |
|---|---|---|---|---|
| Source of supply | ☐ | ☐ | ________ | ________ |
| Water treatment facilities | ☐ | ☐ | ________ | ________ |
| Treated water storage | ☐ | ☐ | ________ | ________ |
| Major transmission lines | ☐ | ☐ | ________ | ________ |
| Other ______________________ | ☐ | ☐ | ________ | ________ |

| **Need for Project(s)** (Check all that apply) | | **Notes** |
|---|---|---|
| Enhance compliance with regulations | ☐ | ________________ |
| Replace older equipment or facilities | ☐ | ________________ |
| Meet average-day demand | ☐ | ________________ |
| Meet maximum-day demand | ☐ | ________________ |
| Meet future growth needs | ☐ | ________________ |
| Other ______________________ | ☐ | ________________ |

| **Funding** | | **Interest rate** |
|---|---|---|
| Cost of financing | ☐ | ____________ |
| Overall cost of capital [if known] | ☐ | ____________ |

**Water purchases**

Anticipated future water purchases ______________ (gallons per year)

Cost of water purchases ______________ (dollars per gallon)

| Year [b] | Annual incremental capacity from improvements/ additions [c] | Annualized incremental capital cost [d] | Annual operating cost [e] | Un-discounted total annualized incremental cost [f] | Escalated value of supply cost in nominal dollars [g] | Present value of supply cost in nominal dollars [h] | Present value of supply cost Per gallon in nominal dollars [i] |
|---|---|---|---|---|---|---|---|
| | Gallons | $ | $ | $ | $ | $ | $/gallon |
| 0 | | | | | | | |
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |
| 5 | | | | | | | |
| 6 | | | | | | | |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | | | | | | | |
| 10… | | | | | | | |
| 20 | | | | | | | |
| Total | | | | | | | |

Source: Adapted from Pekelney, Chesnutt, and Hanemann (1996). See Glossary (Appendix C) for definitions.
[a] = This analysis should be calculated separately for (1) improvements and additions needed to meet **average** demand, and (2) improvements and additions needed to meet **peak** demand so that the results can be compared to corresponding conservation measures. The analysis also can be expanded to include the incremental cost of wastewater collection and treatment.
[b] = The number of years should correspond to the anticipated useful life of the project(s).
[c] = Total gallons of capacity made available through the project(s).
[d] = Annualized incremental capital cost (K):

$K = C \times i \times (1 + i)^n/(1 + i)^n - 1$ where: K = annualized capital costs

C = total expenditures required

n = the useful service life of the capital expenditure (see [b])

i = the appropriate interest or financing rate

[e] = Annual variable operating cost (including energy, chemicals, and water purchases).
[f] = [d] + [e]
[g] = [f] x $(1 + s)^t$ where s is the selected annual escalation rate and t is the year. The escalation rate can be tailored to the nature of capital expenditures.
[h] = [g]/$(1 + r)^t$ where r is the selected annual discount rate and t is the year. The escalation rate can be tailored to the nature of capital expenditures.
[i] = [h]/[c]

## Worksheet 5-7: Preliminary Supply-Capacity Forecast

| Year | Additions (+) | Retirements (-) | Total supply capacity for the system (annual or daily) |
|---|---|---|---|
| 0 | | | |
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |
| 19 | | | |
| 20 | | | |

## Worksheet 5-8: Checklist of Conservation Measures

| Measure [a] | Already implemented ☐ | Plan to implement ☐ | Comments [b] |
|---|---|---|---|
| **LEVEL 1 MEASURES** | | | |
| **Universal metering [B]** | | | |
| Source-water metering | ☐ | ☐ | |
| Service-connection metering | ☐ | ☐ | |
| Meter public-use water | ☐ | ☐ | |
| Fixed-interval meter reading | ☐ | ☐ | |
| Meter-accuracy analysis | ☐ | ☐ | |
| Test, calibrate, repair, and replace meters | ☐ | ☐ | |
| **Water accounting and loss control [A]** | | | |
| Account for water | ☐ | ☐ | |
| Repair known leaks | ☐ | ☐ | |
| Analysis of nonaccount water | ☐ | ☐ | |
| Water system audit | ☐ | ☐ | |
| Leak detection and repair strategy | ☐ | ☐ | |
| Automated sensors/telemetry | ☐ | ☐ | |
| Loss-prevention program | ☐ | ☐ | |
| **Costing and pricing [B]** | | | |
| Cost-of-service accounting | ☐ | ☐ | |
| User charges | ☐ | ☐ | |
| Metered rates | ☐ | ☐ | |
| Cost analysis | ☐ | ☐ | |
| Nonpromotional rates | ☐ | ☐ | |
| Advanced pricing methods | ☐ | ☐ | |

| | | | |
|---|---|---|---|
| **Information and education [B]** | | | |
| Understandable water bill | ☐ | ☐ | |
| Information available | ☐ | ☐ | |
| Informative water bill | ☐ | ☐ | |
| Water-bill inserts | ☐ | ☐ | |
| School program | ☐ | ☐ | |
| Public-education program | ☐ | ☐ | |
| Workshops | ☐ | ☐ | |
| Advisory committee | ☐ | ☐ | |
| **LEVEL 2 MEASURES** | | | |
| **Water-use audits [B]** | | | |
| Audits of large-volume users | ☐ | ☐ | |
| Large-landscape audits | ☐ | ☐ | |
| Selective end-use audits | ☐ | ☐ | |
| **Retrofits [B]** | | | |
| Retrofit kits available | ☐ | ☐ | |
| Distribution of retrofit kits | ☐ | ☐ | |
| Targeted programs | ☐ | ☐ | |
| **Pressure management [A]** | | | |
| Systemwide pressure regulation | ☐ | ☐ | |
| Selective use of pressure-reducing valves | ☐ | ☐ | |
| **Landscape efficiency [P]** | | | |
| Promotion of landscape efficiency | ☐ | ☐ | |
| Landscape planning and renovation | ☐ | ☐ | |
| Selective irrigation submetering | ☐ | ☐ | |
| Irrigation management | ☐ | ☐ | |

| | | | |
|---|---|---|---|
| **LEVEL 3 MEASURES** | | | |
| Replacements and promotions [B] | | | |
| Rebates and incentives (nonresidential) | ☐ | ☐ | |
| Rebates and incentives (residential) | ☐ | ☐ | |
| Promotion of new technologies | ☐ | ☐ | |
| **Reuse and recycling [B]** | | | |
| Industrial applications | ☐ | ☐ | |
| Large-volume irrigation applications | ☐ | ☐ | |
| Selective residential applications | ☐ | ☐ | |
| **Water-use regulation [B]** | | | |
| Water-use standards and regulations | ☐ | ☐ | |
| Requirements for new developments | ☐ | ☐ | |
| **Integrated resource management [B]** | | | |
| Supply-side technologies | ☐ | ☐ | |
| Demand-side technologies | ☐ | ☐ | |

[a] For more information about measures see Appendix A.
[b] Note special issues related to the measure, including legal or other obstacles precluding implementation.
Note: Measures can affect average-day demand [A], maximum-day (peak) demand [P], or both [B], as indicated.

## Worksheet 5-9: Program Costs for Each Conservation Measure or Group of Measures

Describe conservation measure:

____________________________________________________________
____________________________________________________________
____________________________________________________________

Typical water savings from the measure: ________________ per _________________
Number of planned installations: ________________
Anticipated life span for the measure: ________________ years

The measure is designed to reduce:

- ☐ Average-day demand
- ☐ Maximum-day demand
- ☐ Both average-day and maximum-day demand

| Line | Item | Amount | Amount |
|---|---|---|---|
| **A** | **COST OF THE CONSERVATION MEASURE [a]** | **Per unit [b]** | **Total cost of the measure** |
| 1 | Materials | | |
| 2 | Labor | | |
| 3 | Rebates or other payments | | |
| 4 | Marketing and advertising | | |
| 5 | Administration | | |
| 6 | Consulting or contracting | | |
| 7 | Other | | |
| 8 | Total program costs for the life of the measure (add lines 1 through 7) [c] | | |
| **B** | **ESTIMATED SAVINGS** | | |
| 9 | Number of units to be installed [d] | | |
| 10 | Estimated annual water savings per unit in gallons [e] | | |
| 11 | Total estimated annual savings for the measure in gallons (multiply line 9 by line 10) | | |
| 12 | Expected life span for the measure in years | | |
| 13 | Total life span estimated savings for the measure in gallons (multiply line 11 by line 12) | | |

[a] A separate analysis should be performed for each conservation measure, but measures can be combined if they jointly produce water savings.
[b] Examples of a unit are a toilet, a retrofit kit, and an audit. A unit estimate may not be appropriate for each measure, in which case total program water savings and costs for the measure can be used.
[c] Include all recurring operation and maintenance costs over the life of the measure.
[d] Units can be individual product units (such as toilets) or groups of products (such as household retrofits), as long as the analysis is consistent. Leave blank if unit values do not apply.
[e] For example, water savings per retrofit. See Appendix B for benchmarks and sample calculations. Leave blank if unit values do not apply.

Notes on analysis:

## Worksheet 5-10: Analysis of Each Conservation Measure or Group of Measures

| Year [a] | Annual water savings from the conservation measure [b] | Present value of supply cost per gallon in nominal dollars [c] | Undiscounted cost of the conservation measure [d] | Present value cost of conservation in nominal dollars [e] | Net savings from conservation in nominal dollars [f] | Net benefit from implementing the measure [g] |
|---|---|---|---|---|---|---|
| | gallons | $/gallon | $/gallon | $/gallon | $/gallon | $ |
| 0 | 0 | $ | $ | $ | $ | $ |
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | | |
| 11 | | | | | | |
| 12 | | | | | | |
| 13 | | | | | | |
| 14 | | | | | | |
| 15 | | | | | | |
| 16 | | | | | | |
| 17 | | | | | | |
| 18 | | | | | | |
| 19 | | | | | | |
| 20 | | | | | | |
| Totals | | | | | | |
| Average annual savings [h] | | | | | | |

Source: Adapted in part from Pekelney, Chesnutt, and Hanemann (1996).

[a] = The number of years analyzed should cover the expected useful life of the measure.
[b] = Anticipated annual conservation savings. Include attrition or rebound effects if applicable.
[c] = From corresponding column in Worksheet 5-6 (last column).
[d] = Recurring expenditures should be included in the table at the appropriate year.
[e] = $[d]/(1 + r)^t$ where r is the selected discount rate and t is the year. The discount rate should be the same used in Section 4. This column assesses the per-gallon cost of each measure.
[f] = [c] - [e].
[g] = [f] x [b]. This column assesses the total net benefit of the measure.
[h] = Based on the total number of years in the planning horizon.

## Worksheet 5-11: Comparison of Benefits and Costs of the Conservation Measures

| Line | Conservation measure [a] | Total program cost for the measure [b] | Anticipated annual water savings in gallons [c] | Cost of water saved by the measure ($/gallon) [d] | Net benefit of implementing the measure(s) [e] |
|---|---|---|---|---|---|
| 1 | | $ | | $ | $ |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |
| 10 | | | | | |
| 11 | | | | | |
| 12 | | | | | |
| 13 | | | | | |
| 14 | | | | | |
| 15 | | | | | |
| 16 | | | | | |
| 17 | | | | | |
| 18 | | | | | |
| 19 | | | | | |
| 20… | | | | | |

[a] = Combined measures that produce joint conservation savings should be treated as one measure to avoid duplicate counting.
[b] = Based on Worksheet 5-9, line 8.
[c] = Based on Worksheet 5-10, average annual water savings from the conservation measure.
[d] = Based on Worksheet 5-10, present value of supply cost in nominal dollars.
[e] = Based on Worksheet 5-10, net benefit from implementing the measure. This estimate of net benefit does not consider societal benefits and costs.

## Worksheet 5-12: Selection of Conservation Measures and Estimate of Water Savings

| Line | Measure | Selected ☐ | Primary criteria for selecting or rejecting the conservation measure for implementation | Estimated reduction in demand for selected measures (gallons per day) [a] | |
|---|---|---|---|---|---|
| | | | | Average-day demand | Maximum-day demand |
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |
| 10 | | | | | |
| 11 | | | | | |
| 12 | | | | | |
| 13 | | | | | |
| 14 | | | | | |
| 15 | | | | | |
| 16 | | | | | |
| 17 | | | | | |
| 18 | | | | | |
| 19 | | | | | |
| 20… | | | | | |
| Total | | | | | |

[a] Based on Worksheet 5-9, line 11. Planners will need to convert estimates of annual water savings to estimates of reductions in average-day and maximum-day demand for each measure or group of measures.

## Worksheet 5-13: Modified Demand Forecast

| Line | Item | Current year | Year 5 | Year 10 | Year 20 |
|---|---|---|---|---|---|
| 1 | Average-day demand before conservation [a] | | | | |
| 2 | Reduction in average-day demand (line 1 less line 2) [b] | | | | |
| 3 | Average-day demand after conservation | | | | |
| 4 | Maximum-day demand before conservation [a] | | | | |
| 5 | Reduction in maximum-day demand (line 4 less line 5) [b] | | | | |
| 6 | Maximum-day demand after conservation | | | | |
| 7 | Ratio maximum-day to average-day demand before conservation (line 4 divided by line 1) | | | | |
| 8 | Ratio maximum-day to average-day demand after conservation (line 6 divided by line 3) | | | | |

[a] From Worksheet 5-4, line 6.
[b] Based on Worksheet 5-12.

## Worksheet 5-14: Project-Specific Savings

**DESCRIPTION OF PROJECT [a]**

Describe the supply-side project(s):

______________________________________________________________________

______________________________________________________________________

Project was scheduled to begin: ________________________________________

| | | |
|---|---|---|
| Purpose of the project: | ☐ Improvement | ☐ Addition |
| The project is designed to meet: | ☐ Average-day demand | ☐ Maximum-day demand |
| Type of project: | ☐ Source of supply | |
| | ☐ Water treatment facilities | |
| | ☐ Treated water storage | |
| | ☐ Major transmission lines | |
| | ☐ Purchased water | |
| | ☐ Other ______________________ | |

**CHANGES TO PROJECT [b]**

| Line | Item | Project supply capacity (daily) | Project Costs | |
|---|---|---|---|---|
| | | | Total capital costs ($) | Annual operating costs ($) |
| **A** | **CAPITAL PROJECT IS ELIMINATED** | | | |
| 1 | Original project | | | |
| 2 | Savings from elimination (equals line 1) | | | |
| **B** | **CAPITAL PROJECT IS DOWNSIZED** | | | |
| 3 | Original project | | | |
| 4 | Downsized project | | | |
| 5 | Savings from downsizing (line 3 less line 4) | | | |
| **C** | **CAPITAL PROJECT IS POSTPONED** | | | |
| 6 | Present value of original project | | | |
| 7 | Present value of postponed project | | | |
| 8 | Savings from postponement (line 6 less line 7) | | | |

| | | | | |
|---|---|---|---|---|
| **D** | **NEED FOR PURCHASED WATER IS REDUCED [c]** | | | |
| 9 | Original estimate of purchases | | | |
| 10 | Revised estimate of purchases (can be "0") | | | |
| 11 | Savings from reduced purchases (line 9 less line 10) | | | |

[a] Comprehensive plans can include wastewater facilities.
[b] Based on Worksheet 5-13 estimates of reductions in demand.
[c] For purchased water, report only annual operating costs and include costs associated with take-or-pay contract provisions. Transmission facilities needed to transport purchased water should include capital and operating costs associated with such facilities and reported as a capital project.

## Worksheet 5-15: Modified Supply Forecast and Estimated Total Savings

### MODIFIED SUPPLY FORECAST

| Line | Item | Current Year | Year 5 | Year 10 | Year 20 |
|---|---|---|---|---|---|
| **A** | **Forecast Supply Capacity (Daily)** | | | | |
| 1 | Supply capacity before conservation program [a] | | | | |
| 2 | Planned reduction in supply capacity [b] | | | | |
| 3 | Supply capacity after conservation (line 1 less line 2) | | | | |
| **B** | **Capacity Reserve** | | | | |
| 4 | Supply capacity less demand (line 3 less line 2 on Worksheet 5-13) | | | | |

### ESTIMATED TOTAL SAVINGS

| Line | Item | Supply capacity (daily) | Project Costs | |
|---|---|---|---|---|
| | | | Total capital costs ($) | Annual operating costs ($) |
| **C** | **Total Estimated Savings from Changes to Supply Projects [c]** | | | |
| 1 | Cost of supply projects before conservation | | | |
| 2 | Cost of supply projects after conservation | | | |
| 3 | Savings (line 1 less line 2) | | | |
| **D** | **Total Estimated Savings from Reduced Operating Costs at Existing Facilities [d]** | | | |
| 4 | Operating costs before conservation | | | |
| 5 | Operating costs after conservation | | | |
| 6 | Savings (line 4 less line 5) | | | |
| **E** | **Conservation Program Costs** | | | Total program costs ($) |
| 7 | Total cost of implementing selected conservation measures [e] | | | |

[a] From Worksheet 5-7.
[b] Based on Worksheet(s) 5-14.
[c] Based on Worksheet(s) 5-14.
[d] Based on annual variable operating cost (including energy, chemicals, and water purchases).
[e] Based on Worksheet 5-11.

## Worksheet 5-16: Implementation Schedule for Measures

| Line | Measure | Required action | Beginning date | Completion date | Notes |
|---|---|---|---|---|---|
| 1 | | | | | |
| | | | | | |
| | | | | | |
| 2 | | | | | |
| | | | | | |
| | | | | | |
| 3 | | | | | |
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| 4 | | | | | |
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| 8 | | | | | |
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| 9 | | | | | |
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| 10 | | | | | |
| | | | | | |
| | | | | | |
| 11 | | | | | |
| | | | | | |
| | | | | | |
| 12 | | | | | |
| | | | | | |
| | | | | | |

# Worksheet 5-17: Implementation Strategy

## A. PUBLIC INVOLVEMENT

Describe plan for public involvement:

## B. MONITORING AND EVALUATION

Describe plan for monitoring and evaluation:

Describe plan to collect water demand data:

## C. PLAN UPDATES

Describe plan for updates and revisions:

## D. ADOPTION OF THE PLAN

Date plan completed: ____________________

Date plan approved: ____________________

Approved by [governing body]: ____________________

Signature: ____________________

# APPENDIX A
# WATER CONSERVATION MEASURES

This Appendix to the EPA Guidelines for Preparing Water Conservation Plans describes the water conservation measures that water utilities can use in designing water conservation programs. As part of their conservation plans, planners should consider, *at a minimum*, each of the measures specified in the Basic, Intermediate, or Advanced Guidelines, depending on which set of Guidelines apply to the water system.

The measures are organized into three general categories: Level 1, Level 2, and Level 3. Within each level are four subcategories that are used to organize a variety of specific conservation measures:

- **Level 1 Measures**
  - Universal metering
  - Water accounting and loss control
  - Costing and pricing
  - Information and education
- **Level 2 Measures**
  - Water-use audits
  - Retrofits
  - Pressure management
  - Landscape efficiency
- **Level 3 Measures**
  - Replacements and promotions
  - Reuse and recycling
  - Water-use regulation
  - Integrated resource management

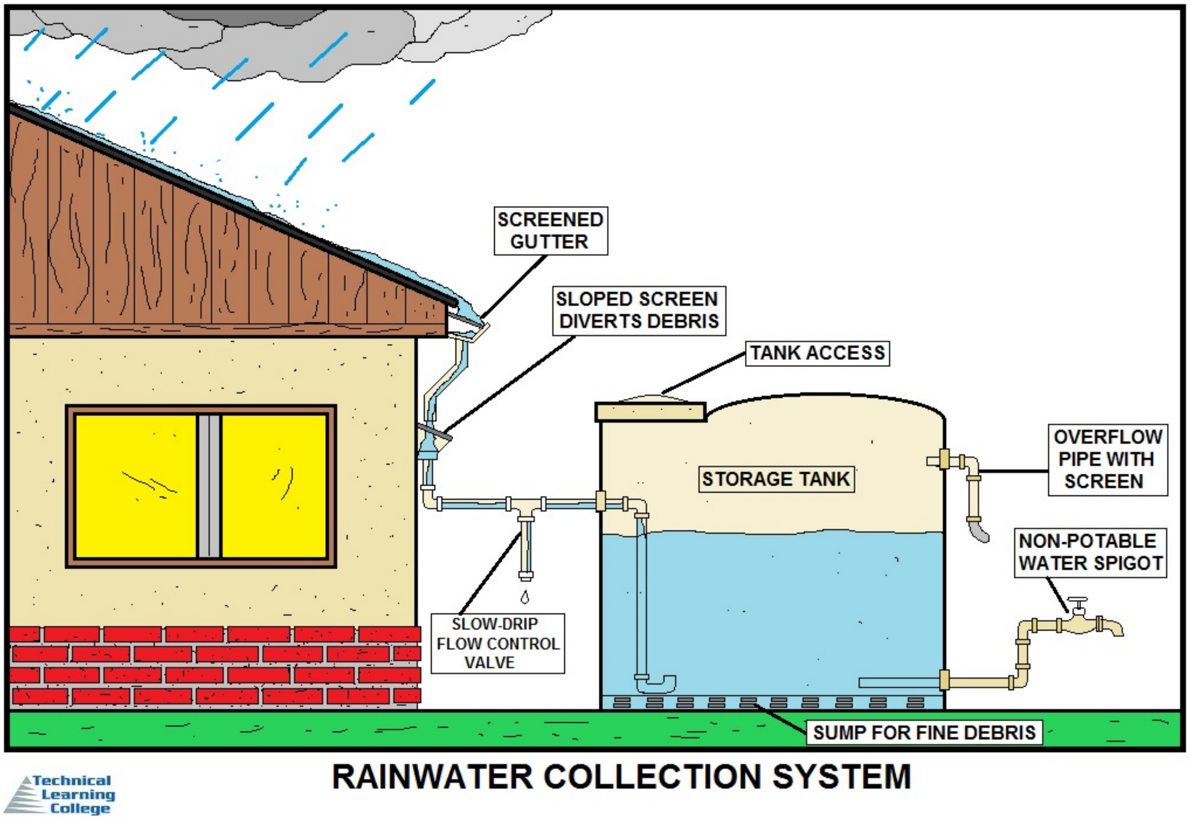
This system of organizing the conservation measures recognizes that the measures considered can vary with the size and capability of the system. *Water systems are strongly encouraged to explore the fullest range of conservation measures practical, including measures beyond the minimum measures suggested in the Guidelines that they are following.*

Many smaller and middle-sized utilities have been very successful in implementing a wide range of beneficial conservation programs.

What follows is a description of each of the twelve subcategories of measures. The Guidelines provide checklists that planners can use in reviewing measures. However, planners are encouraged to consider as many measures as practical, given their capability and the conditions they seek to address. In some cases, planners may choose to consider and implement selected measures beyond those minimally recommended for consideration.

Although this list of conservation measures is relatively current and comprehensive, planners should not limit their analysis only to the measures mentioned here. Planners also should consider new technologies and approaches as they become available.

Letters next to each category indicate whether the measures in that category are considered particularly useful in reducing average-day demand [A], maximum-day or peak demand [P], or both [B]. Worksheets for some of the conservation measures are provided at the end of this Appendix.




RAINWATER COLLECTION SYSTEM

# Level 1 Measures
# Universal Metering [B]

| | Advanced Guidelines | | |
|---|---|---|---|
| | Intermediate Guidelines | | |
| Measures | Basic Guidelines | | |
| Universal metering [B] | Source-water metering | Fixed-interval meter reading | Test, calibrate, repair, and replace meters |
| | Service-connection metering and reading | Meter-accuracy analysis | |
| | Meter public-use water | | |

Metering is a very fundamental tool of water system management and conservation. Worksheet A-1 can be used by systems to assess their metering practices.

***Source-water metering.*** Both the supplier and the customer benefit from metering. Source metering is essential for water accounting purposes.

***Service-connection metering.*** Service-connection metering is needed to inform customers about how much water they are using; suppliers use metering data to more accurately track water usage and bill customers for their usage.

***Public-use water metering.*** All water provided free of charge for public use should be metered and read at regular intervals. This will allow the utility to more accurately account for water. Lack of metering undermines loss control, costing and pricing, and other conservation measures.

***Fixed-interval meter reading.*** A program of fixed-interval meter reading is essential to determine the amount of non-revenue-producing water. Source meters and service connection meters should be read at the same relative time in order to facilitate accurate comparisons and analysis. Readings generally should occur at regular intervals, preferably monthly or bimonthly. Estimated bills should be kept at a minimum, subject to state and local regulations.

***Meter accuracy.*** Water meters can be damaged and deteriorate with age, thus producing inaccurate readings. Inaccurate readings will give misleading information regarding water usage, make leak detection difficult, and result in lost revenue for the system. All meters, especially older meters, should be tested for accuracy on a regular basis. The system also should determine that meters are appropriately sized. Meters that are too large for a customer's level of use will tend to under-register water use.

***Meter testing, calibration, repair, and replacement.*** After determining the accuracy of the metering system, the utility should provide a schedule of activities necessary to correct meter deficiencies. Meters should be recalibrated on a regular basis to ensure accurate water accounting and billing.

## Water Accounting and Loss Control [A]

| Measures | Basic Guidelines | Intermediate Guidelines | Advanced Guidelines |
|---|---|---|---|
| Water accounting and loss control [A] | Account for water | Analyze nonaccount water | Loss-prevention program |
| | Repair known leaks | Water system audit | |
| | | Leak detection and repair strategy | |
| | | Automated sensors/ telemetry | |

In many respects, water conservation begins on the supply side. All water systems will benefit from a water accounting system that helps track water throughout the system and identify areas that may need attention, particularly large volumes of nonaccount water.

Nonaccount water includes water that is *metered but not billed*, as well as *all unmetered* water. Un-metered water may be authorized for such utility purposes (such as operation and maintenance) and for certain public uses (such as fire hydrant maintenance).

Un-metered water also includes unauthorized uses, including losses from accounting errors, malfunctioning distribution system controls, thefts, inaccurate meters, or leaks. Some unauthorized uses may be identifiable. When they are not, these unauthorized uses constitute *unaccounted-for water*.

Implementing a system of water accounting is a necessary first step in developing strategies for loss control. A system of water accounting is provided in Figure A-1. This system for tracking water begins with total water produced and ends with unaccounted-for water. Worksheet A-2 (which follows Figure A-1) and Worksheet A-3 can assist water systems in developing a water accounting and loss control strategy.

***Account for water.*** All water systems, even smaller systems, should implement a basic system of water accounting (as appears in Worksheet A-3). This accounting exercise provides a basis for a strategy to control losses over time.

***Repair known leaks.*** The cost of water leakage can be measured in terms of the operating costs associated with water supply, treatment, and delivery; water lost produces no revenues for the utility. Repairing larger leaks can be costly, but it also can produce substantial savings in water and expenditures over the long run.

Water accounting is less accurate and useful when a system lacks source and connection metering. Although the system should plan to meter sources, unmetered source water can be estimated by multiplying the pumping rate by the time of operation based on electric meter readings.

***Analysis of nonaccount water.*** Nonaccount water use should be analyzed to identify potential revenue-producing opportunities, as well as recoverable losses and leaks. Some utilities might consider charging for water previously given away for public use or stepping up efforts to reduce illegal connections and other forms of theft.

***System audit.*** A system audit can provide information needed to make a more accurate analysis of nonaccount water.

***Leak detection and repair strategy.*** Systems also should institute a comprehensive leak detection and repair strategy. This strategy may include regular on-site testing using computer-assisted leak detection equipment, a sonic leak-detection survey, or another acceptable method for detecting leaks along water distribution mains, valves, services, and meters. Divers can be used to inspect and clean storage tank interiors.

***Automated sensors/telemetry.*** Water systems also consider using remote sensor and telemetry technologies for ongoing monitoring and analysis of source, transmission, and distribution facilities. Remote sensors and monitoring software can alert operators to leaks, fluctuations in pressure, problems with equipment integrity, and other concerns.

***Loss-prevention program.*** This may include pipe inspection, cleaning, lining, and other maintenance efforts to improve the distribution system and prevent leaks and ruptures from occurring. Utilities might also consider methods for minimizing water used in routine water system maintenance procedures in accordance with other applicable standards.

## Costing and Pricing [B]

| Measures | Basic Guidelines | Intermediate Guidelines | Advanced Guidelines |
|---|---|---|---|
| Costing and pricing [B] | Cost-of-service accounting | Cost analysis | Advanced pricing methods |
| | User charges | Non-promotional rates | |
| | Metered rates | | |

Costing and pricing are conservation strategies because they involve understanding the true value of water and conveying information about that value, through prices, to water customers. The use of user charges often is considered a necessary (but not always sufficient) part of a water conservation strategy. Many resources are available on how to account for costs and design water rates.

***Cost-of-service accounting.*** Water systems should use cost-of-service accounting, consistent with generally accepted practices. Many resources are available for this purpose. Understanding and tracking system costs is also a capacity-development strategy for small systems.

***User charges.*** Once costs are established, systems can develop more accurate user charges (or rate structures).

***Metered rates.*** Metered rates should be used so that the customer's water bill corresponds to their water usage.

For many systems, a change in water rates must be approved by regulators or other oversight bodies. It is important for water systems to communicate with regulators about costs and the need for cost-based pricing.

***Cost analysis.*** Systems should conduct a cost analysis to understand what types of usage drive system costs. For example, systems should analyze patterns of usage by season and class of service.

***Nonpromotional rates.*** Systems also should consider whether their current rate structures promote water usage over conservation; non-promotional rates should be implemented whenever possible in order to enhance the conservation signal of rates.

Systems seeking to encourage conservation through their rates should consider various issues: the allocation between fixed and variable charges, usage blocks and breakpoints, minimum bills and whether water is provided in the minimum bill, seasonal pricing options, and pricing by customer class. Systems also should consider the effect of introducing a new rate structure on revenues. Worksheet A-4 is provided for this purpose.

Conservation-oriented pricing requires planners to make certain assumptions (based on the available empirical evidence) about the elasticity of water demand, or the responsiveness of water usage to a change in price.

Elasticity is measured by the ratio of a percentage change in quantity demanded to a percentage change in price. Changes in the rate structure should allow the system to achieve demand reduction goals, recovering water system costs. In allocating costs, the impact of the rate structure on user demand and revenues for specific customer classes should be considered.

***Advanced pricing methods.*** Advanced pricing methods generally allocate costs by customer class and/or type of water use. Advanced pricing might consider seasonal variations or other methods for pricing indoor and outdoor usage based on differing contributions to system peaks.

The conservation orientation of the rate structure can be enhanced by considering the elasticity factors for different classes of water use. Marginal-cost pricing, which considers the value of water relative to the cost of the next increment of supply, can be considered as well.

Systems also can consider special rate-making provisions (such as cost-recovery or lost-revenue mechanisms). Potential revenue instability can be addressed with additional rate structure modifications (such as revenue-adjustment mechanisms).

Obviously, the pricing strategy must be consistent with overall system goals and approved by regulatory or other governing bodies.

## Information and Education [B]

| | Advanced Guidelines | | |
|---|---|---|---|
| | Intermediate Guidelines | | |
| Measures | Basic Guidelines | | |
| Information and education [B] | Understandable water bill | Informative water bill | Workshops |
| | Information available | Water-bill inserts | Advisory committee |
| | | School program | |
| | | Public-education program | |

Information and education are critical to the success of any conservation program. Information and education measures can directly produce water savings, as when customers change their water-use habits. These savings can be difficult to estimate. Also, public education alone may not produce the same amount of sustained water savings as other, more direct approaches (such as leak repairs and retrofits).

But educational measures also can enhance the effectiveness of other conservation measures.

For example, it is widely believed that information plays a role in how water consumers respond to changes in price. More generally, customers that are informed and involved are more likely to support the water system's conservation planning goals. Worksheet A-5 is provided for systems to use in assessing their information and education programs.

***Understandable water bill.*** Customers should be able to read and understand their water bills. An understandable water bill should identify volume of usage, rates and charges, and other relevant information.

***Information available.*** Water systems should be prepared to provide information pamphlets to customers on request. Public information and education are important components of every water conservation plan. Consumers are often willing to participate in sound water management practices if provided with accurate information.

Furthermore, providing information and educating the public may be the key to getting public support for a utility's water conservation efforts. An information and education program should explain to water users all of the costs involved in supplying drinking water and demonstrate how water conservation practices will provide water users with long term savings.

***Informative water bill.*** An informative water bill goes beyond the basic information used to calculate the bill based on usage and rates. Comparisons to previous bills and tips on water conservation can help consumers make informed choices about water use.

***Water bill inserts.*** Systems can include inserts in their customers' water bills that can provide information on water use and costs. Inserts also can be used to disseminate tips for home water conservation.

***School program.*** Systems can provide information on water conservation and encourage the use of water conservation practices through a variety of school programs. Contacts through schools can help socialize young people about the value of water and conservation techniques, as well as help systems communicate with parents.

***Public education program.*** Utilities can use a variety of methods to disseminate information and educate the public on water conservation. Outreach methods include speakers' bureaus, operating booths at public events, printed and video materials, and coordination with civic organizations.

***Workshops.*** Utilities can hold workshops for industries that might be able to contribute to water conservation efforts. These might include, for example, workshops for plumbers, plumbing fixture suppliers, and builders or for landscape and irrigation service providers.

***Advisory committee.*** A water conservation advisory committee can involve the public in the conservation process; potential committee members include elected officials, local business people, interested citizens, agency representatives, and representatives of concerned local groups.

The committee can provide feedback to the utility concerning its conservation plan and develop new material and ideas about public information and support for conservation in the community. Of course, to be meaningful, the utility must be receptive to ideas offered by the committee.

A water distribution crew repairing a hidden leak.

# Level 2 Measures
## Water-Use Audits [B]

| | Advanced Guidelines | | |
|---|---|---|---|
| | Intermediate Guidelines | | |
| Measures | Basic Guidelines | | |
| Water-use audits [B] | | Audits of large-volume users | Selective end-use audits |
| | | Large-landscape audits | |

Water-use or end-use audits can provide water systems and their customers with invaluable information about how water is used and how usage might be reduced through specific conservation strategies.

***Audits of large-volume users.*** Utilities can facilitate water audits for large-volume users, both commercial and industrial. Water audits should begin by identifying the categories of water use for the large-volume user. These may include process, sanitary, domestic, heating, cooling, outdoor, and other water uses. Second, a water audit should identify areas in which overall water use efficiency can be improved through alternative technologies or practices.

***Large-landscape audits.*** Water audits can be used for outdoor usage, as well as for indoor processes. Audits of irrigation practices can provide large-volume commercial, industrial, and public users with information about usage and usage-reduction techniques. These audits can be used in conjunction with irrigation submetering and other landscaping efficiency practices.

***Selective end-use audits.*** Water audits can be widened to include selective end-use audits by customer class, focusing on typical water-use practices within each class. An audit program can be selective in terms of targeting customer groups that have particular needs or for which water conservation could be particularly beneficial.

Audits targeted to older housing, for example, can be particularly beneficial in terms of identifying and fixing plumbing leaks.

End-use audits also can be tailored to the usage practices within user groups. For example, residential water audits may focus on plumbing fixtures, lawn and garden water practices, and customer behavior.

Residential water audits can be used to make immediate repairs and retrofits. Worksheet A-6 summarizes the components of a residential water audit. All water audits should include a written report to the customer that includes specific ideas for conservation. Water audits can be planned and implemented in conjunction with electric power companies or others interested in promoting conservation practices.

## Retrofits [A]

| Measures | Basic Guidelines | Intermediate Guidelines | Advanced Guidelines |
|---|---|---|---|
| Retrofits [A] | | Retrofit kits available | Distribution of retrofit kits |
| | | | Targeted programs |

Water systems can promote conservation through a retrofit program. Retrofitting involves making an improvement to an existing fixture or appliance (versus replacement) in order to increase water-use efficiency. Retrofit programs usually target plumbing fixtures.

***Retrofit kits available.*** A basic retrofit kit may include low-flow faucet aerators, low-flow showerheads, leak detection tablets, and replacement flapper valves. Retrofit kits may be made available free or at cost.

Calculating the savings from a retrofit program requires planners to make a number of assumptions about water use and savings. Some of the assumptions used in retrofitting are:[1]

- Toilets (4-6 flushes per person per day)
- Showerheads (5-15 shower-use minutes per person per day)
- Bathroom Faucets (.5-3 faucet-use minutes per person per day)
- Kitchen Faucets (.5-5 faucet-use minutes per person per day)

Many useful textbooks and manuals are available to help planners estimate typical water use and potential savings from retrofits (See Appendixes B and D.)

***Distribution of retrofit kits.*** Water systems can actively distribute retrofit kits directly or through community organizations. Retrofit kits also can be distributed in conjunction with audit programs.

***Targeted programs.*** Utilities might institute targeted programs for different customer classes (residential, commercial, industrial, public buildings, and so on). Retrofits of industrial premises can include facilities used by the public and employees, as well as facilities used for production purposes.

A program to retrofit low-income housing units may conserve considerable water in older residential housing units with inefficient plumbing fixtures.

Targeted programs also could be designed in cooperation with community organizations. An active retrofit program might be part of a residential water-use audit program. It is important that planners ensure that retrofit programs conform to local plumbing codes and ordinances.

## Pressure Management [A]

| Measures | Advanced Guidelines | | |
|---|---|---|---|
| | Intermediate Guidelines | | |
| | Basic Guidelines | | |
| Pressure management [A] | | Systemwide pressure management | Selective use of pressure-reducing valves |

Reducing excessive pressures in the distribution system can save a significant quantity of water. Reducing water pressure can decrease leakage, amount of flow through open faucets, and stresses on pipes and joints which may result in leaks. Lower water pressure may also decrease system deterioration, reducing the need for repairs and extending the life of existing facilities. Furthermore, lower pressures can help reduce wear on end-use fixtures and appliances.

***System-wide pressure management.*** For residential areas, pressures exceeding 80 psi should be assessed for reduction. Pressure management and reduction strategies must be consistent with state and local regulations and standards, as well as take into account system conditions and needs. Obviously, reductions in pressure should not compromise the integrity of the water system or service quality for customers.

***Pressure-reducing valves.*** A more aggressive plan may include the purchase and installation of pressure-reducing valves in street mains, as well as individual buildings. Utilities might also insert flow restrictors on services at the meter. Restrictors can be sized to allow for service length, system pressure, and site elevation. Utilities can consider providing technical assistance to customers to address their pressure problems and install pressure-reducing valves to lower the customers' water pressure. This may be especially beneficial for large-use customers.


**Customer PRV**

## Landscape Efficiency [P]

| Measures | Basic Guidelines | Intermediate Guidelines | Advanced Guidelines |
|---|---|---|---|
| Landscape efficiency [P] | | Promotion of landscape efficiency | Landscape planning and renovation |
| | | Selective irrigation submetering | Irrigation management |

Outdoor water usage drives maximum-day demand, which in turn drives requirements for transmission and treatment facilities. Reducing outdoor usage can thus be a very effective conservation strategy. Outdoor water use can be reduced through efficiency-oriented landscaping principles.

***Promotion of landscape efficiency.*** Utilities can promote the development of water conserving principles into the planning, development and management of new landscape projects such as public parks, building grounds, and golf courses.

Utilities can also promote low water-use landscaping by residential and nonresidential customers, especially those with large properties. Utilities can cooperate with local nurseries to ensure the availability of water conserving plants.

Water systems may promote Xeriscaping™, an efficiency-oriented approach to landscaping that encompasses seven essential principles:

- Planning and design
- Limited turf areas
- Efficient irrigation
- Soil improvement
- Mulching
- Use of lower water demand plants
- Appropriate maintenance

***Selective irrigation submetering.*** Selective submetering for irrigation water can be used to improve irrigation management, as well as to introduce irrigation pricing.

***Landscape planning and renovation.*** Existing landscapes can be renovated to incorporate water-conserving practices. Public parks, for example, could be managed to incorporate water-efficient landscaping and reduce or eliminate irrigation. Utilities can work with commercial and industrial customers to plan and renovate landscaping in accordance with water conserving practices.

***Irrigation management.*** Irrigation management systems, using metering, timing, and water-sensing devices, also can be promoted by the water utility for large-volume customers.

## Level 3 Measures
## Replacements and Promotions [B]

| Measures | Basic Guidelines | Intermediate Guidelines | Advanced Guidelines |
| --- | --- | --- | --- |
| Replacements and promotions [B] | | | Rebates and incentives [nonresidential] |
| | | | Rebates and incentives [residential] |
| | | | Promotion of new technologies |

***Rebates and incentives.*** In order to accelerate the replacements of older fixtures, utilities can offer rebates and other incentives. Utilities can install water-efficient fixtures by providing fixtures at no cost, giving a rebate for consumer purchased fixtures, or arranging suppliers to provide fixtures at a reduced price.

Utilities can design incentive rebate programs that are targeted to the nonresidential and residential sectors, and to indoor and outdoor uses.

The feasibility and effectiveness of replacements may depend on state and local plumbing codes. A program to accelerate replacements, coupled with high-efficiency standards, can yield substantial water savings.

***Promotion of new technologies.*** Utilities also can get involved with promoting new technologies by manufacturers and distributors of fixtures and appliances. Demonstrations and pilot programs, and even contests, can be used to introduce and promote new products (such as high-efficiency washing machines).

## Reuse and Recycling [B]

| | Advanced Guidelines | | |
|---|---|---|---|
| | Intermediate Guidelines | | |
| Measures | Basic Guidelines | | |
| Reuse and recycling [B] | | | Industrial applications |
| | | | Large-volume irrigation applications |
| | | | Selective residential applications |

***Industrial applications.*** An alternative water source for some systems is "***graywater,"*** or treated wastewater for nonpotable water uses. Water reuse and recycling practices reduce production demands on the water system.

Water utilities should work with their nonresidential customers to identify potential areas for reuse or recycling.

Some industries can substantially reduce water demand through water reuse (or multiple use) in manufacturing processes.

Recycled wastewater can be used for some industrial purposes, agricultural purposes, groundwater recharge, and direct reuse.

***Large-volume irrigation applications.*** Reuse and recycling can be encouraged for large-volume irrigation.

***Selective residential applications.*** In some areas, reuse and recycling can be used in residential applications. Water systems will need to check with local plumbing codes and ordinances for possible conditions and restrictions.

## Water-Use Regulation [B]

| Measures | Advanced Guidelines | | |
|---|---|---|---|
| | Intermediate Guidelines | | |
| | Basic Guidelines | | |
| Water-use regulation [B] | | | Water-use standards and regulations |
| | | | Requirements for new developments |

***Water-use standards and regulations.*** Regulations should be in place to manage water use during droughts or other water-supply emergencies.

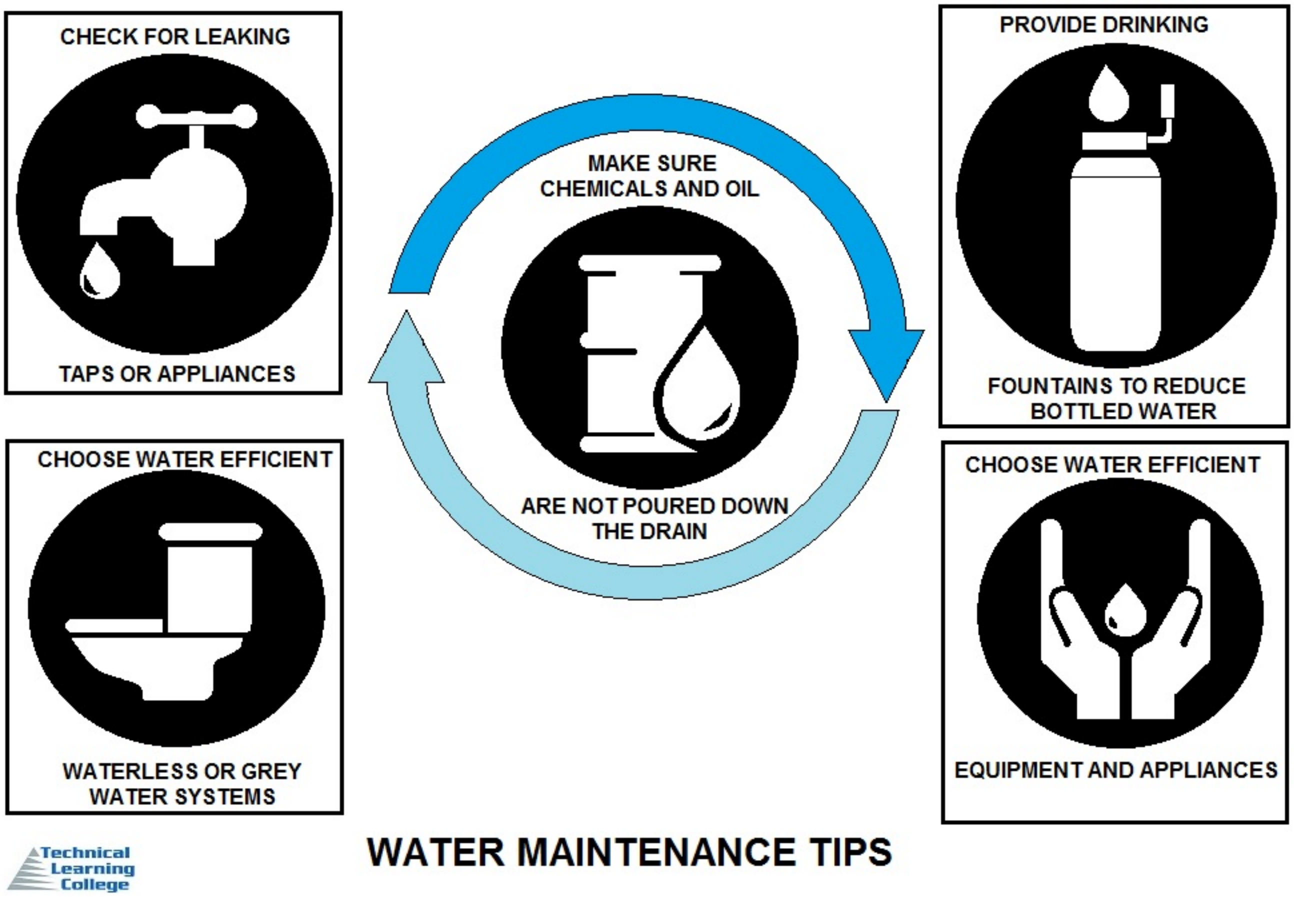
In some cases, utilities may find it desirable to extend water-use regulations to promote conservation during nonemergency situations.

***Examples of water-use regulations are:***

- Restrictions on nonessential uses, such as lawn watering, car washing, filling swimming pools, washing sidewalks, and irrigating golf courses.
- Restrictions on commercial car washes, nurseries, hotels, and restaurants.
- Standards for water-using fixtures and appliances (in addition to the federal efficiency standards, which can be found at the end of this Appendix).
- Bans or restrictions on once-through cooling.
- Bans on non-recirculating car washes, laundries, and decorative fountains.
- Bans on certain types of water use or practice.

***Requirements for new developments.*** Another type of regulation is to impose standards on new developments with regard to landscaping, drainage, and irrigation practices.

Many water systems, including privately owned systems, lack authority to implement this measure. Systems that have such authority must exercise it carefully. In general, restrictions on water use should be justified by the system's circumstances and should not unduly compromise the customer's rights or quality of service.


CHECK FOR LEAKING
TAPS OR APPLIANCES
MAKE SURE
CHEMICALS AND OIL
ARE NOT POURED DOWN
THE DRAIN
PROVIDE DRINKING
FOUNTAINS TO REDUCE
BOTTLED WATER
CHOOSE WATER EFFICIENT
WATERLESS OR GREY
WATER SYSTEMS
CHOOSE WATER EFFICIENT
EQUIPMENT AND APPLIANCES
Technical
Learning
College
WATER MAINTENANCE TIPS

## High Efficiency Toilets

High efficiency toilets, those that use 1.6 gallons or less per flush (1.6 gpf), have been marketed in the United States since the early 1980's. By 1992, seventeen States had established a standard of 1.6 gpf for replacement toilets and those installed in new construction. The Energy Policy Act of 1992 (**EPAct**) established a national manufacturing standard of 1.6 gpf for most toilets, the initial stage of which took effect on January 1, 1994.

### Save Water and Money With Every Flush!

With every flush of your toilet, you can save water and money by having the latest model of Ultra-low-flow (**ULF**) toilet that only uses 1.6 gallons per flush. Toilets account for almost a quarter (25%) of water use in the average home. The Water Department has done research that proves that a family of four can easily flush 50 gallons of water down the drain every day with old high-water-using toilets.

Since 1992, all new homes have been built with ULF toilets, so, if you live in a house built before that date, and it has the original toilets, replacing them with ULF toilets is an excellent way to save a considerable amount of water and money with every flush.

The greatest water savings will accrue to those living in a home built before 1980 when toilets used a full seven gallons per flush. If your home was built between 1980 and 1992, your original toilets typically use 3.5 gallons per flush. Either way, there is a great deal of savings to be had with installation of a new ULF toilet.

There are two types of ULF toilets: gravity and pressure assisted. Gravity-fed models use the water volume and water pressure to force the flush. Pressure-assisted models use air pressure to force the flush. These are becoming more popular. There are numerous models and prices from which to choose, but it’s important to choose a good quality ULF. It is a major purchase with long-term potential savings for you and your family so the Water Department urges you to do your homework before you buy.

To help you choose the model, which best fits your needs and budget, go to www.watercasa.org, then link to get to H2OUSE. Once you arrive at the site, take the tour of the bathroom and click on the toilet for more info on ULF toilets. Also, www.terrylove.com offers an informative report on ULF toilets. Consumer Reports also has several reports (1995, 1998) on ULF toilets. And of course, check with your local plumber for a recommendation.

### New Toilet

The single best thing you can do to improve toilet efficiency is to replace an old inefficient toilet with a new toilet. Toilets made before 1993 use anywhere from 3.5 gallons per flush (gpf) up to 8 gpf, while new high efficiency toilets are mandated to use 1.6 gpf or less. Check to see if your water utility offers any rebates for replacing old inefficient toilets.

If you are unsure of the vintage of your toilet you can often check the date of manufacture by looking at the underside of the tank lid. The date of manufacture is often stamped into the porcelain. If your toilet was made after 1993, it should be an efficient model. Toilets made during the 1980s typically were designed to use 3.5 gallons per flush. Older toilets often use much more water.

If replacing your toilet isn’t an option, at least make sure that your toilet isn’t leaking and replace the flapper if necessary.

During a drought emergency you could be asked to reduce your water use substantially. Toilet use is typically the largest category of indoor water use and there is substantial room for water savings. Here are some tips for maximizing toilet use efficiency:

- Regularly check for and repair toilet leaks.

- Avoid using caustic toilet bowl cleaners such as toilet tank tablets. These products alter the pH of water in your toilet tank and damage plastic and rubber toilet parts, causing severe leaks.
- Flush less frequently. During drought emergencies some families adopt variations of the adage, ***"if it's yellow let it mellow and if it's brown flush it down."***

These high water use toilets were collected and destroyed during a toilet retrofit program. Some of these toilets used as much as 8 gallons per flush.  You will be able to see immediate water saving results with a toilet and waterless urinal retrofit program.

## ULF Toilets *(Good newspaper article material)*

You want to buy a new toilet and you want to make sure it works properly. You may have heard horror stories about new ultra low flush toilets that only use 1.6 gallons of water per flush. But fear not! There are many excellent toilets available that work well and use much less water than the inefficient models of yesteryear.

**Why 1.6 gallons per flush?**
Federal law currently mandates that all toilets manufactured in the U.S. must use an average of 1.6 gallons (6 liters) per flush or less. These 1.6 gallons per flush toilets are often referred to as ultra-low-flush or ULF toilets. This law was put into place in 1992 in an effort to improve water efficiency nationwide and coordinate various state standards. Toilets made from the early 1980s to 1992 used 3.5 gallons per flush or more. Toilets made prior to 1980 used 5.0 to 7.0 or high gallons per flush. The oldest toilets can use more than 8 gallons per flush. Replacing an old toilet with a new ULF model can result in substantial water savings.

**Selecting a Toilet: Gravity vs. Pressure Assist**
There are two basic types of toilets on the market for the residential sector – gravity flush and pressure assist models. Most toilets (old and new) utilize a gravity flush mechanism, but pressure assist models are becoming increasingly popular as manufacturers strive to improve flushing effectiveness while using 1.6 gallons of water or less.

**Gravity**
The most common type of toilets are the gravity-fed models which rely on the weight of the water and head pressure (height of the water in the tank) to promote the flush. If you see freestanding water when peering down into the tank, your toilet is gravity fed. Some old-fashioned toilets had a tank mounted high on the wall above the bowl with a long chain for flushing. These old-time toilets used the height to increase the head pressure and resulting flushing action.

Gravity toilets depend on the volume of water in the tank to flush waste and usually require water pressure of no more than 10 - 15 pounds per square inch (psi) to operate properly. The tank and bowl are usually two separate pieces, although this is not obvious once they are in use. A few one-piece toilets are also available. Gravity tank toilets are relatively inexpensive, with retail prices for two-piece toilets ranging from $75 - $200 and one-piece models costing somewhat more.

**Pressure-Assist**
The pressure-assisted toilet relies on air pressure within a cylindrical tank (metal or plastic-like material) inside your toilet tank. Air inside the cylinder forces a vigorous, rapid, and occasionally noisy flush. The cylinder, along with the "***roaring/whooshing***" sound when you flush it, are sure signs of a pressure-assisted toilet. If you look inside the toilet tank of a pressure-assist model there should be no freestanding water visible. Pressure-assist toilets require a minimum water pressure of 25 psi to operate well. Retail prices for these toilets are generally over $150.

**Purchasing Tips**
**Before you go shopping**

- Determine the type discharge drain line you have.
  ***Floor-Discharge Drain Line***: This toilet is usually bolted to the floor.
  ***Wall-Discharge Drain Line*****:** This toilet is usually attached to the wall, rather than the floor. They can be either gravity or flush valve type toilets.
- Measure the distance from the wall behind the existing toilet to the middle of the toilet drain opening in the floor. Having this "***rough-in***" dimension will ensure that you purchase the correct size toilet.
- Anticipate possible additional work required. While some toilet replacement jobs will proceed

as simple "***drop-in***" replacements, there are a number of small and large additional tasks that could arise. These may include:

Floor tile work
Faulty shut-off valve repair
Repair or modification of water supply lines
Repair or modification of the drain line pitch
Repair or modification of the venting system

- Plan for the legal disposal of old toilets. Talk to your plumber about a plan to dispose of the old toilets. Most internal toilet parts can be removed and sold as recyclable scrap metal. Contact your local solid waste authority for information on their requirements for disposal.

**At the store**

- Shop around for the right toilet. The cheapest toilet may not be the best. You want a toilet that does not clog easily, clears the bowl with a single flush and is largely self-cleaning.
- If the model you choose uses an early closure flapper, make sure that when the flapper wears out, you replace it with another early closure flapper.
- Make sure that the toilet's flapper is made of the new materials that are resistant to tablet type bowl cleaners--better yet, don't use caustic tablets in your toilet.
- Some toilets offer a fully glazed trapway and some do not. A fully glazed trapway, while not a requirement for a good functioning toilet, can improve flushing and bowl cleaning performance. The quality of the pottery is often as important as the flushing mechanism.
- Ask about the diameter of the trap. They range from 1 1/2" to 2 1/2" diameter. Generally, the larger the trap the better the performance, larger than 2 1/4" is preferred.
- The American National Standards Institute (ANSI) designs minimum performance tests and standards for low-consumption toilets. If you have any doubt about a model's performance, ask to see the manufacturer's performance testing data.
- Listen carefully to the noise level of the toilet models you are considering. Some are quieter than others.
- Ask about references. A good performance record is the single most important indicator of quality. Manufacturers have changed their models of low-consumption toilet models considerably since their introduction. Don't be misled by reports of poor performance by old low-consumption toilet models that have been discontinued. Make your decisions based on current models.
- Some manufacturers may offer guarantees that their products will perform well or will not leak for many years. Also, before purchasing, ask about the seller's return policy.

**Water Conservation Tip**

Some manufacturers are now offering dual flush toilets. These innovative products offer two flushing modes – a half-flush for liquid and a full-flush for solids. Dual flush models have been shown to use less water than standard ULF toilets.

## Infrastructure Cost Savings

Use of high-efficiency toilets and other plumbing products due to EPAct will significantly reduce water demand and wastewater generation over time, which, in turn, can reduce or defer the capital investment needed for water supply and wastewater treatment infrastructure.

Accelerated installation of high-efficiency plumbing fixtures, especially 1.6 gpf toilets, through incentive programs has become a very cost-effective way for some municipalities to defer, reduce, or avoid capital costs of needed water supply and wastewater facilities. The magnitude of infrastructure savings achievable through incentive programs for toilet replacement is impressive.

For example, New York City invested $393 million in a 1.6 gpf toilet rebate program that has reduced water demand and wastewater flow by 90.6 mgd, 7% of the city's total water consumption. The rebate program accomplished a net present value savings of $605 million from a twenty-year deferral of water supply and wastewater treatment expansion projects.

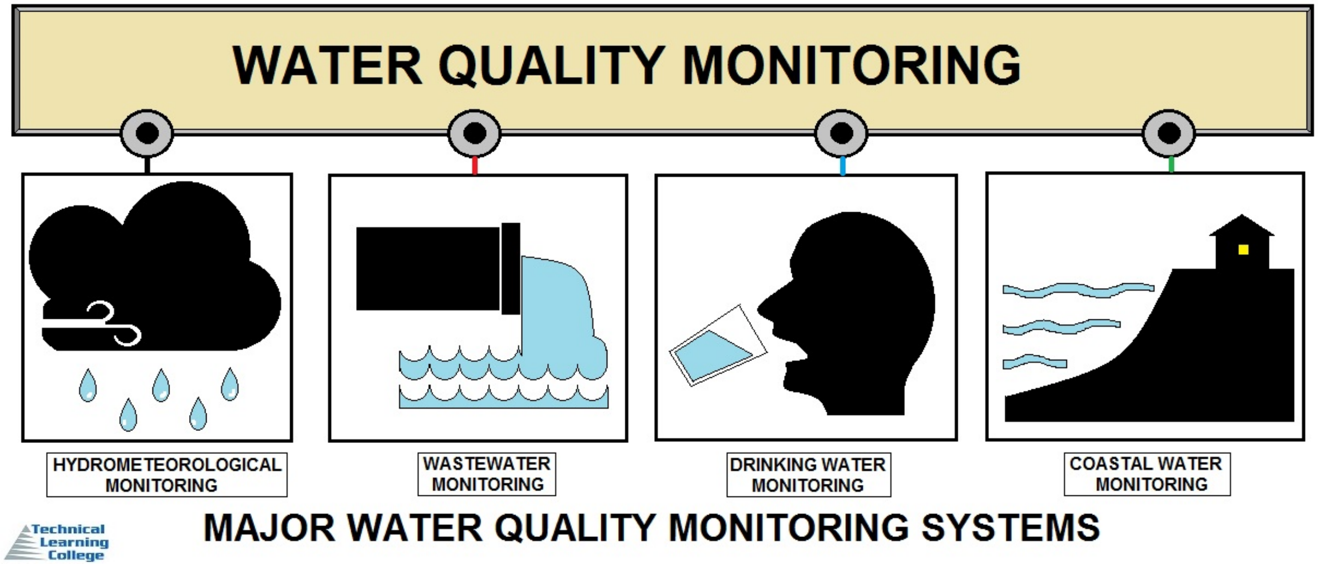
Santa Monica completed a 1.6 gpf toilet replacement program achieving permanent reductions in water usage and wastewater flows of over 1.9 mgd, representing a 15% reduction in average total water demand and a 20% reduction of average total wastewater flow. The cost of the rebate program was $5.4 million. The program will have a net savings of $6 million in the year 2002 due to avoided costs of water imports and wastewater treatment.

**Other Benefits**
High efficiency toilets are a key component of water efficiency programs conducted in cities across the country. These programs achieve a variety of environmental results in addition to reducing costs. Use of water efficient plumbing fixtures and appliances helps to maintain aquatic habitats; restore wetlands and fisheries; protect groundwater from depletion and contamination; and reduce the amount of energy used to pump, heat and treat drinking water and to pump and treat wastewater.

**Conclusions**
Despite the anecdotal reports of poor performance, customer surveys show that satisfaction with 1.6 gpf toilets is high. Analyses of toilet performance indicate that 1.6 gpf toilets require multiple flushes with about the same frequency as higher volume toilets. The plumbing industry has steadily made improvements in toilet technology and market forces should continue to improve overall performance with time.

The water savings from 1.6 gpf toilets is significant. The role of high efficiency toilets as a tool in reducing infrastructure costs is important in light of the 1997 estimate of national needs for drinking water and wastewater facilities totaling 280 billion dollars over 20 years.

High efficiency plumbing products and appliances not only reduce water demand and wastewater flows but have other significant environmental benefits as well.




MAJOR WATER QUALITY MONITORING SYSTEMS

May 20, 2022

Ms. Shanae O'Donnell
Bureau of Reclamation
Phoenix Area Office
P.O. Box 81169
Phoenix, AZ 85069-1169

**SUBJECT: RETROFIT TOILET PROGRAM GRANT ASSISTANCE *Letter Example***

**GENERAL SCOPE:** Water conservation is a critical component of Sunflower's Water Resource Management Plan. Currently, the Town relies solely on groundwater produced from a fractured granite aquifer for its drinking water supply and has no available surface water sources. Normally, the aquifer is recharged by precipitation; however, during the past seven years, drought and population growth has affected our ability to meet peak summer demands for drinking water. Water conservation is extremely critical because studies indicate that the Town of Sunflower water demand will exceed average recharge supplies by the year 2023.

The Water Department would like to implement more water conservation methods to help conserve or lower the daily water demand. Our studies indicate, that the single best thing the Water Department can do to save water inside residential homes is to improve toilet efficiency. The Water Department would like to replace old inefficient toilets with new toilets. Toilets made before 1993 use anywhere from 3.5 gallons per flush (gpf) up to 8 gpf, while new high efficiency toilets are mandated to use 1.6 gpf or less.

Federal law currently mandates that all toilets manufactured in the U.S. must use an average of 1.6 gallons (6 liters) per flush or less. These 1.6 gallons per flush toilets are often referred to as ultra-low-flush or ULF toilets. This law was put into place in 1992 in an effort to improve water efficiency nationwide and coordinate various state standards. Toilets made from the early 1980s to 1992 used 3.5 gallons per flush or more. Toilets made prior to 1980 used 5.0 to 7.0 or high gallons per flush. Replacing an old toilet with a new ULF model will result in substantial water savings.

If a house was built before 1993, and it has the original toilets, replacing them with ULF toilets is an excellent way to save a considerable amount of water and money with every flush.

**PROPOSED PROGRAM:** The Town of Sunflower will begin retrofitting existing residential homes and replace toilets, sink aerators, shower heads in homes older than 1991. The Town will use current staff to find a neighborhood which the homes were built prior to 1980 and attempt to retrofit each home in the section or area. The homes that will require toilet, sink aerator, and/or shower head replacement will all be in the same section or area or within a couple of blocks of each other. This project will include multi-family homes.

The most efficient method for retrofitting group-housing units is to install the low-water fixtures for the owners of apartment complexes and common-metered townhouse and condominium locations. The Water Department began on-site auditing of water use and making recommendations on steps that can be taken to lower total water use of multi-family units back in 1999. This no-cost audit program includes the audit of landscape and non-domestic uses as well as indoor uses, and includes projections of water savings from implementing improvements.

The proposed retrofit program will utilize local plumbing contractors for the toilet replacement and will be in four phases.

**Phase 1**
**The Water Department will:**

- Purchase and store 125 Ultra-low flow toilets.
- Purchase and store 125- 2.5 or fewer gallons per minute showerheads.
- Purchase and store 200- 1.5 gallon per minute sink aerators.
- Purchase and store 25 waterless urinals and 1-year of maintenance supplies.
- Determine sections or areas in Town in which the homes are older than 1993.
- Supply the toilets, sink aerators, showerheads to the Plumbing Contractor.
- Provide homeowner information to the Plumbing Contractor.
- Provide this service without cost to homes and businesses that have fixtures older than 1993.

**The Plumbing Contractor will:**

- Remove the old toilet(s), sink aerators, showerheads.
- Install the new low flow toilet(s), sink aerators, showerheads.
- Repair any damage from the toilet replacement, sink aerators, showerheads.
- Supply any other parts, piping, valves that may be necessary for the toilet replacement.
- Return the older toilet(s) to the Town within 30 days of replacement.
- Replace the toilet(s), sink aerators, showerheads within 10 days of request from Water Department representative.
- Work co-operatively with homeowners, business owners and the Town.

The first phase of this project will start in November 2023 and we are anticipating retrofitting 150 homes with new water saving devices.

**SCHEDULE**: Tentatively, the Water Department will begin retrofitting homes in November of 2017. (Phase 1) We are anticipating a retrofitting minimum of 15 homes per week for the months of November and December of 2018.

| | |
|---|---|
| Phase 1 November, December - 150 Homes | Total cost $60,000.00 |
| Phase 2 January, February - 150 Homes | Total cost $60,000.00 |
| Phase 3 March, April – 100 Homes-25 Businesses | Total cost $60,000.00 |
| Phase 4 May, June – 100 Homes-25 Businesses | Total cost $60,000.00 |

**Total 500 Homes and 50 Businesses $240,000.00**

**COST ESTIMATE OF RETROFIT PHASE 1:** $60,000.00
**TOTAL DOLLAR AMOUNT OF ENTIRE PROGRAM:** $240,000.00
**DOLLAR AMOUNT REQUESTED FROM RECLAMATION**: $30,000.00

**ORGANIZATION'S NAME & ADDRESS:** Town of Sunflower,
303 North Beeline Highway, Sunflower, AZ 85547

**PROJECT MANAGER:** Todd Ploughe, Water Resource Specialist, 303A North Beeline Highway, Sunflower, AZ 85547 (520) 474-5242 Ext. 380.

**TOWN OFFICIAL:** Bill Binder, Public Works Director, 303A North Beeline Highway, Sunflower, AZ 85547 (520) 474-5242 Ext. 289.

**IDENTIFY HOW ACTIVITIES WILL IMPROVE THE EFFICIENCY OF WATER USE:**
The Water Department has predicted that retrofitting will create a public awareness or education of the importance of conserving our water resources. This awareness should create a water conservation attitude that will be reflected by lower water consumption.

This retrofit project is a critical function of the overall water conservation plan and will benefit the public by optimizing and saving the available water.

**PERFORMANCE MEASURES:** The Water Department currently utilizes recognized water use account procedures. Water Department accounting staff will analyze the monthly Gallons Per Capita Per Day (**GPCD**) usage. This information is essential to evaluating overall consumption and determining actual retrofitting project effectiveness. Actual population figure will be determined during the 2004 population census.

Annual water demand in the Town of Sunflower is based at 117 gallons per person per day or 7,500 gallons of water usage per equivalent residential unit per month average over the course of a year. The water demand for the Town of Sunflower has steadily increased over the past 20 years. This increase in demand is directly related to the population growth and related services in the Town of Sunflower.

The Water Department predicts a three-percent per capita water saving in the project area following the Phase 1 retrofitting project. This project should also extend the available resources by reducing the overall water demand of the Town.

**ESTIMATED NUMBER OF PEOPLE TOUCHED:** The Water Department predicts 2.5 people per home x 150 homes will be affected which equals approximately 375 Sunflower residents will be directly influenced by this program. The Water Department predicts that small water conservation promotional gimmicks will reach student's homes and be seen by parents and family members as well.

**BACKGROUND WATER CONSERVATION PROGRAM INFORMATION:**
A review of hydrogeogelogic conditions and existing water use trends indicates that the Town of Sunflower water demand will exceed average recharge supplies by the year 2023. Complicating the water demand / water supply balance is the peak day demands.

Current Town of Sunflower production capacities may not meet projected peak day demands in the near future if anticipated production rates are not realized. Since the peak day demand is a result of increased tourism, commercial use, and outdoor irrigation, a pro-active water conservation program needs to be implemented to help offset the peak day demand. An implemented water conservation program would also extend the available resources by reducing the overall water demand of the Town.

Thank you for your assistance with this project. If you have any questions or need additional information, please contact me at (520) 474-5242, Ext. 380.

Respectfully,

Mike Ploughe
Water Resource Specialist

Ms. Melissa Keidel
Bureau of Reclamation
Phoenix Area Office
P.O. Box 81169
Phoenix, AZ 85069-1169

May 23, 2022

**Follow-up Response Example**

**SUBJECT: RETROFIT PROGRAM PERFORMANCE**

**BACKGROUND:** Water conservation is a critical component of Sunflower's Water Resource Management Plan. Currently, the Town relies solely on groundwater produced from a fractured granite aquifer for its drinking water supply and has no available surface water sources. Normally, the aquifer is recharged by precipitation; however, during the past seven years, drought and population growth has affected our ability to meet peak summer demands for drinking water. Water conservation is extremely critical because studies indicate that the Town of Sunflower water demand will exceed average recharge supplies by the year 2018.

Current Town of Sunflower production capacities may not meet projected peak day demands in the near future if anticipated production rates are not realized. Since the peak day demand is a result of increased tourism, commercial use, and outdoor irrigation, a pro-active water conservation program needs to be implemented to help offset the peak day demand. An implemented water conservation program would also extend the available resources by reducing the overall water demand of the Town.

Our studies indicated that the single best thing the Water Department did to save water inside residential homes was to improve toilet efficiency. The Water Department replaced 500 old inefficient toilets with new toilets. The Town of Sunflower's Water Department had tested several different types and manufacturers of toilets and found the Toto toilet, model #CST7O4, cost to the Town of $72.50 with seat included. The Water Department decided that this toilet was the best choice for performance, customer satisfaction and cost savings.

Toilets made before 1993 use anywhere from 3.5 gallons per flush (gpf) up to 8 gpf, while new high efficiency toilets are mandated to use 1.6 gpf or less. If a house was built before 1993, and it has the original toilets, replacing them with ULF toilets is an excellent way to save a considerable amount of water and money with every flush.

**GENERAL SCOPE:** The Town of Sunflower's Water Department, with financial assistance from the United States Bureau of Reclamation, has implemented conservation methods to help conserve or lower the daily water use demand.

The Water Department predicted that retrofitting would create a public awareness or education of the importance of conserving our water resources. This awareness created a water conservation attitude that will be reflected by lower water consumption.

This retrofit project is a critical function of the overall water conservation plan and will benefit the public by optimizing and saving the available water.

**PERFORMANCE MEASURES:** Toilets are the greatest water user in the house. Residential 1.6 gpf toilets have been shown to reduce toilet water use by 23% to 46% in studies conducted in a number of cities, including Tampa, Phoenix, Austin, and Oakland.

A study published in 1999 by the American Water Works Association Research Foundation that looked in detail at the water use in nearly 100 homes in each of twelve North American cities concluded that high efficiency toilets save an average of 10.5 gallons per person daily.

The Water Department currently utilizes recognized water use account procedures. Water Department accounting staff has analyzed the monthly Gallons Per Capita Per Day (**GPCD**) usage before and after retrofitting. This information is shown below and has been essential to evaluating overall consumption and determining actual retrofitting project effectiveness. On the next page is a snapshot of our retrofit program and performance results.

| LOW-FLOW TOILET REPLACEMENT PROGRAM | | | |
|---|---|---|---|
| | | | |
| SUBMITTED | ACCOUNT | TOILETS | PERFORMANCE |
| | | | |
| 04/08/03 | 00072545 | 2 Toilets | Saved 400 gallons from last April's Use |
| 04/08/03 | 00030040 | 1 Toilet | Saved 450 gallons from last April's Use |
| 01/14/03 | 00030340 | 2 Toilets | Saved 14,800 from last February's Use |
| 02/24/03 | 00061060 | 2 Toilets | Saved 2,400 from last February's Use. |
| 02/21/03 | 00002884 | 4 Toilets | Saved 600 gallons from last February's Use |
| 11/26/02 | 00131732 | 2 Toilets | Saving an average of 1,660 gallons per month |
| 11/26/02 | 00040205 | 2 Toilets | Saving an average of 3,660 gallons per month |
| 12/19/02 | 00000258 | 1 Toilet | An Average of 560 gallons per month |
| 02/21/03 | 00001736 | 2 Toilets | 1,700 gallons in one month of retrofit |
| 02/21/03 | 00131297 | 2 Toilets | An average savings of 900 gallons per month |
| 11/26/02 | 00150760 | 2 Toilets | An Average savings of 7,220 gallons per month |
| 11/26/02 | 00003114 | 2 Toilets | Saved 2,300 gallons in one month |
| 11/26/02 | 00150650 | 2 Toilets | An Average savings of 260 gallons per month |
| 11/26/02 | 00000926 | 2 Toilets | Average savings of 1,420 per month |

*The best performance measurement has been an actual water bill comparison of the water used.*

## Water savings after switching to 1.6 GPF TOTO CST703,CST704,CST744S any TOTO Toilet:

**TOTAL NUMBER OF FIXTURES: 500**

Daily toilets in use: 500 (estimating 2 TOTO 1.6 Units per home)

Approximate flushing
average per toilet a day: 5

Total flushes per day: 2500

Total gallons used a day at 5 gallons per flush: 12,500 Gallons per day

Total gallons used a day at 1.6 gallons per flush: 4,000 Gallons per day

5 gallon per flush yearly total:
125,000 gallons per day x 365 per year = 4,562,500 Gallons per year

1.6 gallon per flush yearly total:
4800 gallons per day x 365 per year= 1,752,000 Gallons per year

**Water savings realized after replacement of existing toilets with 500 - 1.6 GPF Toto Toilets**
**2,900,500 Gallons per year**

***Note: By taking the above annual water savings times our projected resurcharge of the aquifer in 2013, by using any TOTO USA Inc. 1.6 ULT Toilet, the Town of Sunflower will be able to save an estimated average of 2,900,500 Gallons per year or 29,005,000 over the next 10 years in the aquifer.**

Calculating on the basis of five flushes per day per toilet makes the assumption that there is a one to one ratio of toilets to residents. I would suggest that there is likely to be an average of at least two people per toilet. Five flushes per day is a good estimate per person. Those five flushes might not all be the same toilet.

Water use reduction will depend on many demographic variables such as a person's age, medical condition, diet/ethnicity, economic level, and other factors from the Water Department's water conservation educational outreach/ordinance that makes it very difficult to predict for a small sampling.

Therefore, my experience has been that it is best to look at real, metered flow data from existing and especially previously retrofitted buildings of similar types. I have always suggested a prediction of 25% savings when replacing 3.5 gallon toilets with the Toto retrofit toilets, because the least savings I have seen is approximately 26%. This assumes all other fixtures remain the same. Usually this estimate more than justifies the cost of the retrofit.

**NUMBER OF PEOPLE TOUCHED:** The Water Department estimated 2.5 people per home X approximately 300 homes have been affected which equals approximately 750 Sunflower residents will be directly influenced by this program.

Thank you for your assistance with this project. If you have any questions or need additional information, please contact me, Public Works Director, 303A North Beeline Highway, Sunflower, AZ 85547 (520) 474-5247 Ext. 380.

Respectfully,

Bill Binder
Public Works Director

## Integrated Resource Management [B]

<table>
<tr><td rowspan="3">Measures</td><td colspan="3">Advanced Guidelines</td></tr>
<tr><td colspan="2">Intermediate Guidelines</td><td></td></tr>
<tr><td>Basic Guidelines</td><td colspan="2"></td></tr>
<tr><td rowspan="2">Integrated resource management [B</td><td rowspan="2"></td><td rowspan="2"></td><td>Supply-side technologies</td></tr>
<tr><td>Demand-side technologies</td></tr>
</table>

***Supply-side technologies.*** The idea of integrated resource management is that water often is used jointly with other resources. Systems following the Advanced Guidelines might have opportunities to consider and implement measures that can accomplish integrated resource management, where water conservation is jointly accomplished with the conservation of other resources.

On the supply-side, the utility can institute operating practices (including various automation methods, strategic use of storage, and other practices) that achieve energy, chemical, and water savings.

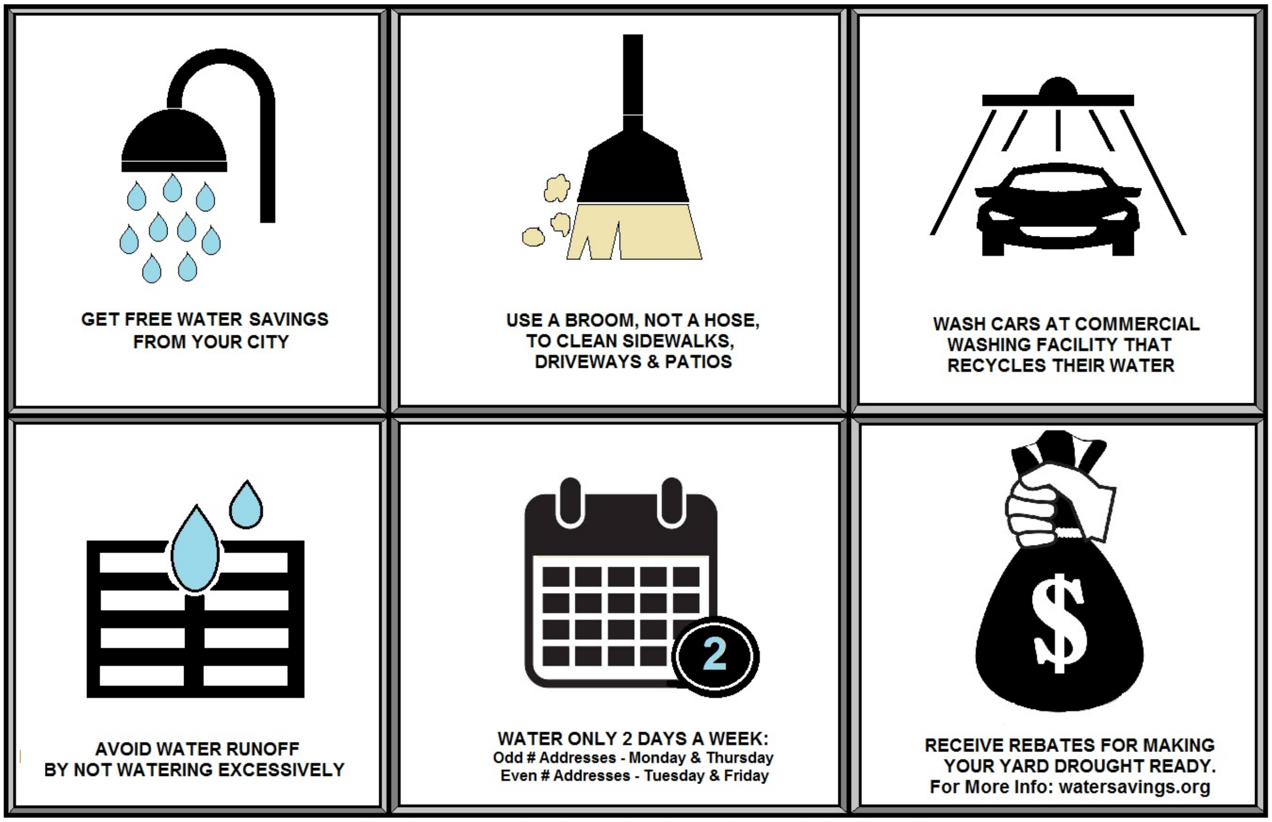
Source-water protection strategies, including land-use management methods, can be used to conserve water resources and avoid costly new supplies. Water and wastewater utilities can jointly plan and implement conservation programs to realize savings and share in the benefits.

***Demand-side technologies.*** Integrative practices also can be accomplished on the demand side. Water and energy utilities can conduct comprehensive end-use audits and jointly promote conservation practices by end-users.

Large-volume users can work with the utility to make adjustments to processes that reduce water and energy usage and wastewater flows, while saving other resources as well.

Utilities that provide wholesale water can work with wholesale customers to design a water conservation program that will be mutually beneficial.

1. Duane D. Baumann, John J. Boland, and W. Michael Hanemann, *Urban Water Demand Management and Planning* ( New York: McGraw Hill, 1998): 254.




**WATER CONSERVATION MEASURES**

# APPENDIX B
# BENCHMARKS USED IN CONSERVATION PLANNING

### Table B-1: Recent Estimates of Indoor Water Use With and Without Conservation

| | Without conservation | | With conservation | | |
|---|---|---|---|---|---|
| **Type of Use** | **Amount (gpcd)** | **Percent of total** | **Amount (gpcd)** | **Percent of total** | **Savings** |
| Toilets | 18.3 | 28.4% | 10.4 | 23.2% | 44% |
| Clothes washers | 14.9 | 23.1% | 10.5 | 23.4% | 30% |
| Showers | 12.2 | 18.8% | 10.0 | 22.4% | 18% |
| Faucets | 10.3 | 16.0% | 10.0 | 22.5% | 2% |
| Leaks | 6.6 | 10.2% | 1.5 | 3.4% | 77% |
| Baths | 1.2 | 1.9% | 1.2 | 2.7% | 0% |
| Dish washers | 1.1 | 1.6% | 1.1 | 2.4% | 0% |
| Total indoor water use | 64.6 | 100% | 44.7 | 100% | 31% |

Source: AWWA WaterWiser, "Household End Use of Water Without and With Conservation," *1997 Residential Water Use Summary - Typical Single Family Home* (http://www.waterwiser.org/wateruse/tables.html).

gpcd = gallons per capita per day

Note: These data are provided for illustrative purposes only and may not be applicable to a given situation. To the extent practical, planners use system-specific assumptions and estimates.

## Table B-2: Benchmarks for Estimating Residential End Uses of Water

| Type of use | Units | Likely range of average values |
|---|---|---|
| **INDOOR USES** | | |
| Average household size | Persons | 2.0-3.0 |
| | | |
| | | |
| | | |
| Frequency of toilet flushing | Flushes/person/day | 4.0-6.0 |
| Flushing volumes | Gallons/flush | 1.6-8.0 |
| Fraction of leaking toilets | Percent | 0-30 |
| | | |
| Showering frequency | Showers/person/day | 0-1.0 |
| Duration of average shower | Minutes | 5-15 |
| Shower flow rates | Gallons/minute | 1.5-5.0 |
| | | |
| | | |
| | | |
| Bathing frequency | Baths/person/day | 0-0.2 |
| Volume of water | Gallons/cycle | 30-50 |
| | | |
| Washing machine use | Loads/person/day | 0.2-0.5 |
| Volume of water | Gallons/cycle | 45-50 |
| | | |
| Dishwasher use | Loads/person/day | 0.1-0.3 |
| Volume of water | Gallons/cycle | 10-15 |
| Kitchen faucet use | Minutes/person/day | 0.5-5.0 |
| Faucet flow rates | Gallons/minute | 2.0-3.0 |
| | | |
| Bathroom faucet use | Minutes/person/day | 0.5-3.0 |
| Faucet flow rates | Gallons/minute | 2.0-3.0 |

| OUTDOOR USES | | |
|---|---|---|
| Average lot size[a] | Square feet | 5000-8000 |
| Average house size[a] | Square feet | 1200-2500 |
| Landscape area[a] | Square feet | 4000-5000 |
| Fraction of lot size in turf[a] | Percent | 30-50 |
| Water application rates[a] | Feet/year | 1-5 |
| | | |
| Percent of homes with pools | Percent | 10-25 |
| Pool evaporation losses | Feet/year | 3-7 |
| Frequency of refilling pools | Times per year | 1-2 |
| | | |
| Frequency of car washing | Times/month | 1-2 |

Source: Duane D. Baumann, John J. Boland, and W. Michael Hanemann, Urban Water Demand Management and Planning (New York: McGraw Hill, 1998), 254.

[a] Reflects single-family averages.

Note: 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.

## Table B-3: Sample Calculation of Water Savings from Showerhead Replacement

The following calculations represent the water savings expected as the result of a showerhead retrofit program. The savings rate represents a difference in average winter water use between homes with low-flow showerheads and homes without low-flow showerheads.

- Non-conserving showerhead flow rate = 3.4 gallons/minute
- Low-flow showerhead flow rate = 1.9 gallons/minute
- Estimated showering time = 4.8 minutes/person/day
- Average winter household water use = 200 gallons per household per day
- Average household size = 2.5 persons
- Water use with non-conserving showerhead = (3.4 gal/min) x (4.8 min/person/day) = 16.3 gpcd
- Water use with low-flow showerhead = (3.4 gal/min) x (4.8 min/person/day) = 9.1 gpcd
- Water savings = 16.3 gpcd - 9.1 gpcd = 7.2 gpcd

At an average household size of 2.5 persons, the savings rate would be 18.0 gallons per household per day (2.5 persons x 7.2 GPCD). The formula for calculating the reduction factors representing the fraction of, for example, single-family winter water use is

**R = (18.0 GPHD)/(200 GPHD during winter) = 0.09 (or 9 percent)**

Source: Duane D. Baumann, John J. Boland, and W. Michael Hanemann, *Urban Water Demand Management and Planning* (New York: McGraw Hill, 1998): 255.

Note: These data are provided for illustrative purposes only and may not be current or applicable. To the extent practical, planners should make regionally appropriate or system-specific assumptions and estimates.

## Table B-4: 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 control | 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 and 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 for new developments | 10 to 20 percent in sector | na |
| | Graywater reuse, residential | 20 to 30 gpcd | na |
| Integrated resource management | Planning and management | Energy, chemical, and wastewater treatment costs | na |

Source: 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

## Table B-5: Water Efficiency Standards Established by The Energy Policy Act of 1992

**Faucets.** The maximum water use allowed by any of the following faucets manufactured after January 1, 1994, when measured at a flowing water pressure of 80 pounds per square inch, is as follows:

| Faucet type | Maximum flow rate (gallons per minute or per cycle) |
|---|---|
| Lavatory faucets | 2.5 gpm |
| Lavatory replacement aerators | 2.5 gpm |
| Kitchen faucets | 2.5 gpm |
| Kitchen replacement aerators | 2.5 gpm |
| Metering faucets | 0.25 gpc |

**Showerheads.** The maximum water use allowed for any showerhead manufactured after January 1, 1994, is 2.5 gallons per minute when measured at a flowing pressure of 80 pounds per square inch.

**Water Closets.** (1) The maximum water use allowed in gallons per flush for any of the following water closets manufactured after January 1, 1994, is as follows:

| Water closet type | Maximum flush rate (gallons per flush) |
|---|---|
| Gravity tank-type toilets | 1.6 gpf |
| Flushometer tank toilets | 1.6 gpf |
| Electromechanical hydraulic toilets | 1.6 gpf |
| Blowout toilets | 3.5 gpf |

(2) The maximum water use allowed for any gravity tank-type white two-piece toilet which bears an adhesive label conspicuous upon installation of the words "Commercial Use Only" manufactured after January 1, 1994 and before January 1, 1997, is 3.5 gallons per flush.

(3) The maximum water use allowed for flushometer valve toilets, other than blowout toilets, manufactured after January 1, 1997, is 1.6 gallons per flush.

**Urinals.** The maximum water use allowed for urinals manufactured after January 1, 1994, is 1.0 gallons per flush.

Note: These standards were developed in 1992. New and emerging technologies can increase the cost effectiveness of conservation measures, affect demand forecasts, and eventually lead to the establishment of new standards.

## Table B-6: Potential Water Savings From Efficient Fixtures

| Fixture [a] | Fixture capacity [b] | Water use (gpd) | | Water savings (gpd) | |
|---|---|---|---|---|---|
| | | Per capita | 2.7-person household | Per capita | 2.7-person household |
| **Toilets [c]** | | | | | |
| Efficient | 1.5 gallons/flush | 6.0 | 16.2 | na | na |
| Low-flow | 3.5 gallons/flush | 14.0 | 37.8 | 8.0 | 21.6 |
| Conventional | 5.5 gallons/flush | 22.0 | 59.4 | 16.0 | 43.2 |
| Conventional | 7.0 gallons/flush | 28.0 | 75.6 | 22.0 | 59.4 |
| **Showerheads [d]** | | | | | |
| Efficient | 2.5 [1.7] gal/min | 8.2 | 22.1 | na | na |
| Low-flow | 3.0 to 5.0 [2.6] gal/min | 12.5 | 33.8 | 4.3 | 11.7 |
| Conventional | 5.0 to 8.0 [3.4] gal/min | 16.3 | 44.0 | 8.1 | 22.0 |
| **Faucets [e]** | | | | | |
| Efficient | 2.5 [1.7] gal/min | 6.8 | 18.4 | na | na |
| Low-flow | 3.0 [2.0] gal/min | 8.0 | 21.6 | 1.2 | 3.2 |
| Conventional | 3.0 to 7.0 [3.3] gal/min | 13.2 | 36.6 | 6.4 | 17.2 |
| **Toilets, Showerheads, and Faucets Combined** | | | | | |
| Efficient | Not applicable | 21.0 | 56.7 | na | na |
| Low-flow | Not applicable | 34.5 | 93.2 | 13.4 | 36.4 |
| Conventional | Not applicable | 54.5 | 147.2 | 33.5 | 90.4 |

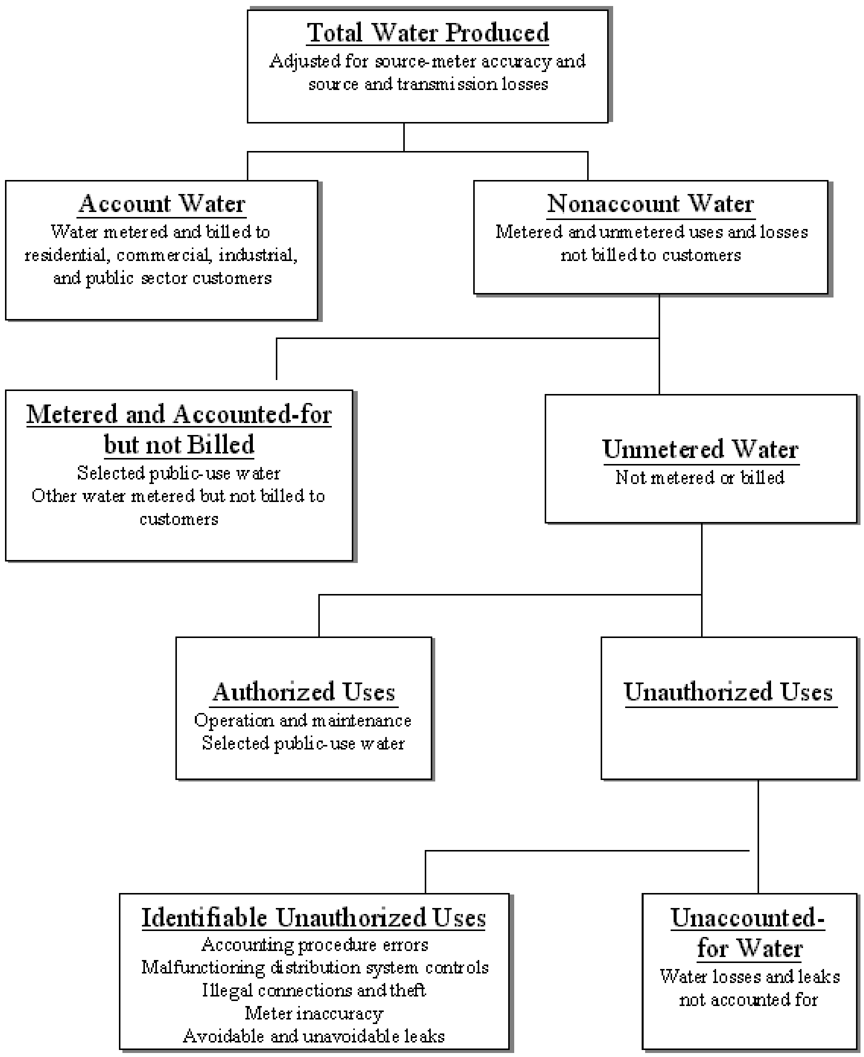
Source: Amy Vickers, "Water Use Efficiency Standards for Plumbing Fixtures: Benefits of National Legislation," *American Water Works Association Journal*. Vol. 82 (May 1990): 53.

See other side for more information

na = not applicable
[a] Efficient = post-1994

Low-flow = post-1980
Conventional = pre-1980
[b] For showerheads and faucets: maximum rated fixture capacity (measured fixture capacity). Measured fixture capacity equals about two-thirds the maximum.
[c] Assumes four flushes per person per day; does not include losses through leakage.
[d] Assumes 4.8 shower-use-minutes per person per day.
[e] Assumes 4.0 faucet-use-minutes per person per day.

## Figure A-1. Water Accounting System



# Worksheet A-1: Metering

### A. BASIC GUIDELINES

**Source metering**

What percentage of source withdrawals is metered?

______________________________________________

**Connection metering**

| Percent of connections metered by customer class: | | Percentage of meters that are outdoors: |
|---|---|---|
| Residential | ________ % | ________ % |
| Industrial | ________ % | ________ % |
| Commercial | ________ % | ________ % |
| Public | ________ % | ________ % |
| Other | ________ % | ________ % |

| Number of meters needed: | | Estimated cost/meter | Estimated total cost |
|---|---|---|---|
| Residential | ________ | ________ | ________ |
| Industrial | ________ | ________ | ________ |
| Commercial | ________ | ________ | ________ |
| Public | ________ | ________ | ________ |
| Other | ________ | | |

**B. INTERMEDIATE GUIDELINES** [Basic Guidelines above plus the following]

| Frequency of meter reading | | Billing frequency | Estimated bills/year |
|---|---|---|---|
| Residential | ________ | ________ | ________ |
| Industrial | ________ | ________ | ________ |
| Commercial | ________ | ________ | ________ |
| Public | ________ | ________ | ________ |
| Other | ________ | ________ | ________ |

Are authorized uses of nonaccount water metered? ______________________________

Schedule for testing source water meters: ______________________________

Schedule for testing connection meters: ______________________________

Are meters correctly sized? ______________________________

**C. ADVANCED GUIDELINES** [Basic and Intermediate Guidelines above plus the following]

Describe the systems' program to test, calibrate, repair, and replace meters (including schedules): ___________
______________________________________________________________________________
______________________________________________________________________________


Example of Xeriscaping

# Worksheet A-2: 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)** | | | % |

# Worksheet A-3: Strategies for Reducing Water Losses

**A. TRANSMISSION LOSSES**
Describe strategy for reducing transmission line losses: ________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________

Estimated annual water savings: ____________________________________________________

**B. NONACCOUNT WATER**
Describe strategy for reducing authorized unmetered uses: ______________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________

Estimated annual water savings: ____________________________________________________

**C. LOSSES AND LEAKS**
Describe strategy for reducing identifiable leaks: _____________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________

Estimated annual water savings: ____________________________________________________

**D. UNACCOUNTED-FOR WATER**
Describe strategy for reducing unaccounted-for water: ___________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________

Estimated annual water savings: ____________________________________________________

# Worksheet A-4: Evaluating Effects of Water Rate Changes

| Line | Item | Value |
|---|---|---|
| 1 | Current price per gallon | $ |
| 2 | Current revenue-producing gallons (or cubic feet) | gallons |
| 3 | Current annual revenues (line 1 multiplied by line 2) | $ |
| 4 | Conservation goal (reduction in water use) | gallons |
| 5 | Conservation goal as percentage of current annual revenue-producing gallons (line 4 divided by line2) | % |
| 6 | Estimate price elasticity of demand (by customer class and/or type of use if applicable) | % |
| 7 | Percentage change in price needed to induce conservation (line 5 divided by line 6) | % |
| 8 | Calculate revised price level (line 1 multiplied by (1.00 plus line 7)) | $ |
| 9 | Revised annual water usage (line 1 less line 4) | gallons |
| 10 | Revised revenues (line 8 multiplied by line 9) | $ |
| 11 | Annualized fixed costs | $ |
| 12 | Annual variable costs for revised water usage | $ |
| 13 | Revised revenue requirements | $ |
| 14 | Net revenue effect (line 10 less line 13) | $ |

Note: Prepare for each customer class to the extent feasible.

## BASIC GUIDELINES ☐

### Understandable water bill

Understandable information about water rates and usage ☐

### Information available

Pamphlet on basic home water conservation practices ☐

Pamphlet on plumbing retrofits and replacements ☐

Pamphlet on summer lawn watering and conservation landscaping ☐

**INTERMEDIATE GUIDELINES** [Basic Guidelines above plus the following] ☐

### Informative water bill

Compare to past usage (previous month, same period previous year) ☐

Flag unusually high recorded uses and notify customers ☐

Information tailored to customer class ☐

### Water-bill inserts

Information on the cost and value of water ☐

Basic water conservation tips ☐

Information on conservation programs ☐

### School program

Visit classrooms ☐

Distribute curriculum materials, such as worksheets and coloring books ☐

Show short information films or slide shows ☐

Field trips to water system facilities ☐

Contests and recognition for posters, ideas, etc. ☐

## Public-education program

| | |
|---|---|
| Press releases, public space advertising, and public service announcements (various media) | ☐ |
| Conservation information centers and mobile information booths | ☐ |
| Speakers bureau, films, and slide shows for community organizations | ☐ |
| Coordination with civic and professional organization resources | ☐ |
| Special events, such as water conservation fairs | ☐ |
| Displays at home shows, garden shows, fairs, libraries, and town halls | ☐ |
| Cooperation with retail plumbing to promote conservation | ☐ |
| Recognize conserving businesses and industries | ☐ |

**ADVANCED GUIDELINES** [Basic and Intermediate Guidelines above plus the following] ☐

## Workshops

| | |
|---|---|
| Workshops for plumbers, plumbing fixture suppliers, and builders | ☐ |
| Workshops for landscape and irrigation service providers | ☐ |

## Advisory committee

| | |
|---|---|
| Creation of a public advisory committee | ☐ |

# Worksheet A-6: Checklist for a Residential Water Audit

## Service Meter ☐

- Calibration/flow test ☐
- Leak test ☐
- Report findings to maintenance personnel ☐

## Kitchen ☐

- Check faucet flow rate ☐
- Offer to install aerator or flow restrictor ☐
- Check for drips and leaks ☐

## Bath ☐

**Shower**

- Check showerhead flow rate ☐
- Offer to install low-flow showerhead or flow restrictor ☐
- Check for drips and leaks ☐

**Sinks**

- Check faucet flow rate ☐
- Offer to install aerator or flow restrictor ☐
- Check for drips and leaks ☐

**Toilets**

- Check for leaks (dye test) ☐
- Clean or replace flapper ☐
- Check the adjustment of the float arm ☐
- Offer to install retrofit devices ☐
- Provide information on available rebates ☐

**Irrigation**

- Measure the flow rate of sprinklers ☐
- Check for leaks in the sprinkler, hose, or sprinkler system ☐

Check the position of sprinklers ☐

Instruct homeowner on efficient water techniques ☐

Recommend a watering schedule based on: ☐

- Any water restrictions imposed by local government ☐
- Best time of day for watering ☐
- Frequency of watering ☐
- Length of time for watering ☐

Provide information about water-efficient landscaping practices ☐

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Source: Adapted from American Water Works Association, Pacific Northwest Section, *Water Conservation Guidebook for Small and Medium-Sized Utilities* (August 1993). Appendix B.

## Water Efficiency Measures for Agricultural Districts

- Provide adequate water measurement and accounting.
- Adopt water pricing structure that encourages efficiency.
- Provide information and education services for water users.
- Designate a water efficiency coordinator.
- Encourage on-farm water management measures such as:
    - ditch lining
    - development of water reuse systems
    - installation of surge valves and gate pipes
    - sprinkler system
    - field leveling
    - soil treatments
- Incentives for on-farm water efficiency measures include in-kind services, educational programs, demonstration projects, and financial incentives, including tax incentives, low-interest loans, equipment purchase subsidies, and water charge discounts or rebates.

For more information, refer to the U.S. Bureau of Reclamation document, Achieving Efficient Water Management.

Public Education should start at an early age. We recommend that you purchase informational coloring books and Tee-Shirts and visit your local public and private schools. Many Teachers will gladly accept your visits to teach their students the benefits of water conservation. There are many programs that can help you develop an outreach or educational program. WET is an excellent resource. We also recommend that you call the Water Conservation Programs for information. All three of these programs offer cutting-edge and dynamic educational programs and the program administrators are wonderful to work with and ascertain valuable information.

## Water Efficiency Measures for Municipalities

**Getting Started:**

- Designate a water efficiency coordinator.
- Develop a water efficiency plan. See the U.S. EPA Water Conservation Guidelines.
- Educate and involve employees and residents in water efficiency efforts.

**System Improvements - Keep a tight system, look at alternative sources:**

- Implement a water-loss management program (e.g. repair leaks). The water industry goal for unaccounted-for-water is 10%.
- Water utilities should strive for universal metering.
- Consider a reclaimed wastewater distribution system for non-potable uses.
- Ensure that fire hydrants are tamper-proof.

**Equipment Changes - Set a good example by using water efficient equipment:**

- Install ultra-low flow toilets and urinals in municipal buildings, or install dams on existing toilets. Retrofit water-saving devices in flushometer valves.
- Install faucet aerators and low-flow shower heads in municipal buildings.
- As municipal appliances or equipment wear out, replace them with water-saving models.
- Minimize the water used in cooling equipment in accordance with manufacturer's recommendations. Shut off cooling units when not needed.
- Eliminate ***"once-through"*** cooling of equipment with municipal water by recycling water flow to cooling tower or replacing with air-cooled equipment.
- Consider installing new water-saving pool filters.

**Policies and Programs to Encourage Efficient Water Use:**

- Ensure the utility rate structure encourages water efficiency, or at least does not encourage water waste.
- Offer incentive programs (rebates/tax credit) to homeowners and businesses to encourage replacement of plumbing fixtures and appliances with water-efficient models.
- Make retrofit kits for residences and businesses available free or at cost. Kits may contain low flow faucet aerators, high efficiency showerheads, leak-detection kits, and replacement valves.
- Promote water-efficient landscape practices to homeowners and businesses, especially those with large, irrigated properties. Practices include use of native plants, landscape innovation to reduce water use, and more efficient irrigation. See link below for more information.

**Other Measures** - For a full list of municipal water efficiency measures see Appendix A of the U.S. EPA Water Conservation Plan Guidelines.

## Water Efficiency Measures for Commercial Businesses

**Please note that these suggested measures are not intended to supersede more stringent state, Tribal, or local health and safety regulations.**

**General:**

- Designate a water efficiency coordinator.
- Develop a mission statement and a plan.
- Educate and involve employees in water efficiency efforts.

**Equipment:**

- Install ultra-low flow toilets, adjust flush valves or install dams on existing toilets.
- Install faucet aerators and high efficiency showerheads.
- Use water-conserving ice makers.
- As appliances and equipment wear out, replace them with water-saving models.
- Eliminate "***once-through***" cooling of equipment with municipal water by recycling water flow to cooling tower or replacing with air-cooled equipment.

**Practices:**

- Detect and repair all leaks.
- Minimize the water used in cooling equipment in accordance with manufacturer's recommendations. Shut off cooling units when not needed.

**Kitchens and Laundries:**

- Turn off dishwashers when not in use. Wash full loads only.
- Scrape, rather than rinse, dishes before washing.
- Use water from steam tables to wash down cooking areas.
- Do not use running water to melt ice or frozen foods.
- Handle waste materials in a dry state whenever possible.
- Wash only full loads of laundry or select the appropriate washing cycle provided on the washing machine. Use a rinse water recycle system. Consider purchasing high efficiency equipment.

**Outside:**

- Wash vehicles less often; use a commercial car wash that recycles water.
- If you have a swimming pool, consider a new water-saving pool filter.
- Lower pool water level to reduce amount of water splashed out.
- Use pool filter backwash for landscape irrigation.
- Use a pool cover to reduce evaporation when pool is not being used.
- Sweep or blow paved areas to clean, rather than hosing off.

## Water Efficiency Measures for Industry

**Please note that these suggested measures are not intended to overrule otherwise applicable federal, state, Tribal or local health and safety regulations.**

**General:**

- Appoint a water efficiency coordinator. Educate and involve employees in water efficiency efforts.

**Equipment:**

- Install high-pressure, low-volume nozzles on spray washers.
- Install in-line strainers on all spray headers; inspect nozzles regularly for clogging.
- Replace high-volume hoses with high-pressure, low-volume cleaning systems.
- As equipment wears out, replace with water-saving models.
- Equip hoses with spring-loaded shutoff nozzles.
- Install ultra-low flow toilets, adjust flush valves or install dams on existing toilets.

**Practices:**

- Detect and repair all leaks.
- Identify discharges that may be re-used and implement re-use practices. Some discharges with potential for re-use are:
    - final rinses from tank cleaning, keg washers, fermenters
    - bottle and can soak and rinse water
    - cooler flush water, filter backwash
    - pasteurizer and sterilizer water
    - final rinses in wash cycles
    - boiler makeup
    - refrigeration equipment defrost
    - equipment cleaning
    - floor and gutter wash
- Use fogging nozzles to cool products.
- Handle waste materials in a dry mode where possible.
- Adjust overflows from recirculation systems by controlling the rate at which make-up water is added: install float-controlled valve on the make-up line, close filling line during operation, provide surge tanks for each system to avoid overflow.
- Turn off all flows during shutdowns. Use solenoid valves to stop the flow of water when production stops.
- Adjust flow in sprays and other lines to meet minimum requirements.
- Wash vehicles less often, or use a commercial car wash that recycles water.
- Discontinue using water to clean sidewalks, driveways, loading docks, and parking lots.

## Water Efficiency Measures for Residences

**Bathrooms:**
- Never use your toilet as a waste basket.
- Do not let the water run while shaving or brushing teeth.
- Take short showers instead of tub baths. Turn off the water flow while soaping or shampooing.
- If you must use a tub, close the drain before turning on the water and fill the tub only half full. Bathe small children together.
- Never pour water down the drain when there may be another use for it - such as watering a plant or garden.

**Kitchen and Laundry:**
- Keep drinking water in the refrigerator instead of letting the faucet run until the water is cool.
- Wash fruits and vegetables in a basin. Use a vegetable brush.
- Do not use water to defrost frozen foods--thaw in the refrigerator overnight.
- Use a dishpan for washing and rinsing dishes.
- Scrape, rather than rinse, dishes before loading into the dishwasher.
- Add food wastes to your compost pile instead of using the garbage disposal.
- Operate the dishwasher only when completely full.
- Use the appropriate water level or load size selection on the washing machine.

**Outside:**
- Sweep driveways, sidewalks and steps rather than hosing off.
- Wash the car with water from a bucket, or consider using a commercial car wash that recycles water.
- When using a hose, control the flow with an automatic shut-off nozzle.
- Avoid purchasing recreational water toys which require a constant stream of water.
- If you have a swimming pool, consider a new water-saving pool filter.
- Lower pool water level to reduce amount of water splashed out.
- Use a pool cover to reduce evaporation when pool is not being used.

**Equipment:**
- **Repair all leaks**. A leaky toilet can waste 200 gallons per day. To detect leaks in the toilet, add food coloring to the tank water. If the colored water appears in the bowl, the toilet is leaking. Toilet repair advice is available at http://www.toiletology.com/index.shtml
- Install ultra-low flow toilets, or place a plastic container filled with water or gravel in the tank of your conventional toilet. Be sure it does not interfere with operation of the toilet's flush mechanisms.
- Install low-flow aerators and showerheads.
- Consider purchasing a high efficiency washing machine which can save over 50% in water and energy use.

## Water Efficiency Measures for Landscaping

*(During drought conditions outdoor watering restrictions may be imposed, and therefore some of the following tips will not apply.)*

**Watering:**

- Detect and repair all leaks in irrigation systems.
- Use properly treated wastewater for irrigation where available.
- Water the lawn or garden during the coolest part of the day (early morning is best). Do not water on windy days.
- Water trees and shrubs, which have deep root systems, longer and less frequently than shallow-rooted plants which require smaller amounts of water more often. Check with the local extension service for advice on the amount and frequency of watering needed in your area.
- Set sprinklers to water the lawn or garden only - not the street or sidewalk.
- Use soaker hoses and trickle irrigation systems.
- Install moisture sensors on sprinkler systems.

**Planting:**

- Have your soil tested for nutrient content and add organic matter if needed. Good soil absorbs and retains water better.
- Minimize turf areas and use native grasses.
- Use native plants in your landscape - they require less care and water than ornamental varieties.

**Maintaining:**

- Use mulch around shrubs and garden plants to reduce evaporation from the soil surface and cut down on weed growth.
- Remove thatch and aerate turf to encourage movement of water to the root zone.
- Raise your lawn mower cutting height - longer grass blades help shade each other, cut down on evaporation, and inhibit weed growth.
- Minimize or eliminate fertilizing which requires additional watering, and promotes new growth which will also need additional watering.

**Ornamental Water Features:**

- Do not install or use ornamental water features unless they recycle the water. Use signs to indicate that water is recycled. Do not operate during a drought.

## Drought Management

Drought can cause great damage in terms of human suffering, economic loss, and environmental impact. Drought can affect every region of the country and every sector of the economy. The total economic impact to agriculture, energy, transportation and recreation/tourism associated with the 1988 drought in the Midwest and parts of the Southeast was estimated at nearly $50 billion.

The nature of drought, and governmental response to it, is aptly summarized in the legislative record of the National Drought Policy Act of 1998:

In many respects, drought presents one of the most challenging dilemmas for policy makers, managers and citizens. It can be both pervasive and covert, moving slowly yet steadily into an entire region.

This "***creeping phenomenon***" also differs from other natural hazards, such as tornadoes or flash floods, in that it lacks any precise or universally accepted definition, seldom results in structural damage, and can linger for lengthy periods of time in affected areas.

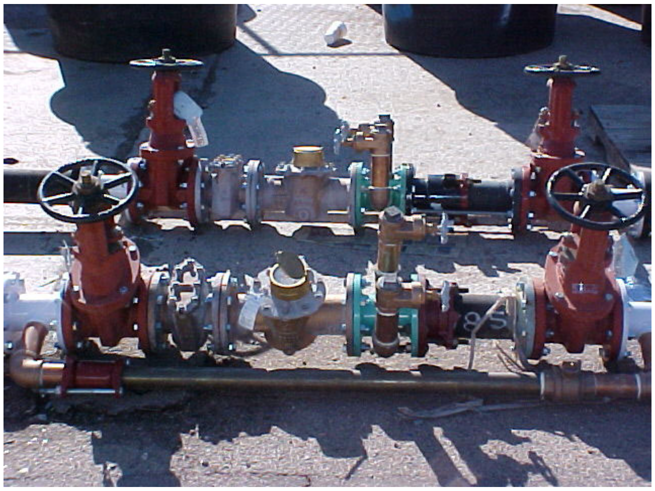
The result is that, compared to other disasters, drought often receives minimal attention in advance or uncoordinated, delayed responses.

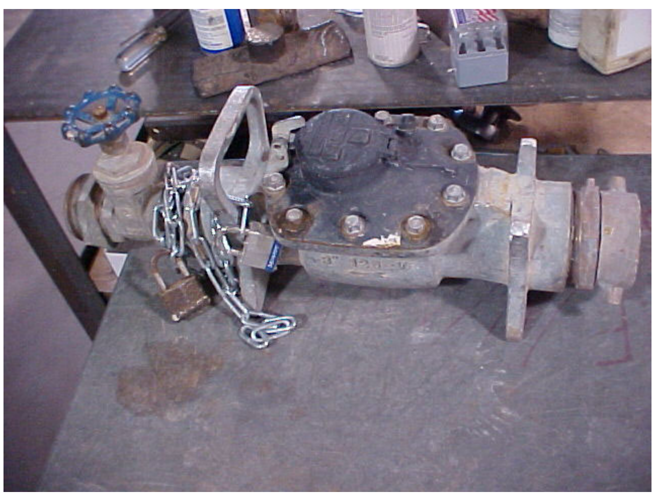
Drought, like other types of disasters, tends to prompt a crisis management, rather than risk management approach.

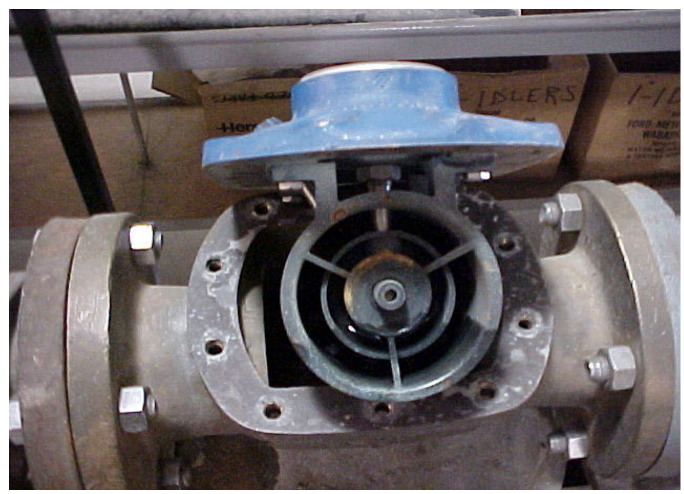
Planning for drought to mitigate its effects allows decision-makers to take actions that reduce the most damage at the least cost. States, Tribes, farmers, ranchers, municipal water suppliers, and water users should develop a contingency plan that includes short and long-term mitigation actions.

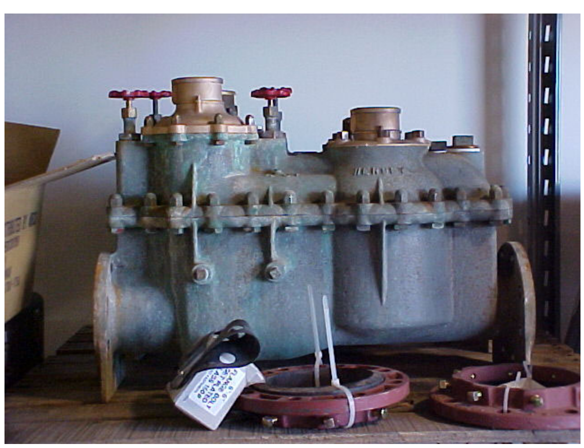
## Water Meters

Meters record the flow of water in a part of the distribution system. Below are pictures of Bypass, Compound, Turbine or Propeller type meters. The top right meter is used to test water meters in the field. Most water meters do not over register flow but will under register flows.









## Water Rates and Pricing

From an environmental economics perspective, pricing can be an extremely valuable public policy tool. Prices can be more than a means of meeting revenue requirements or even turning a profit. Environmental economists have long advocated bringing the price mechanism more fully in line with "***full costs***" so that "users" might respond to "***market signals***" – reflecting the true and full costs of production and consumption.

Since water is basic to life, and certainly to our quality of life, the pricing of water can be a powerful means of signaling this importance and scarcity to water users, most of whom experience very little connection between their water usage and their total bill. In our current era in which water demands are increasing while water supplies are constant or diminishing, it is important to apply economic tools to communicate the true value of fresh water.

**To raise revenue.**
In the Environmental Protection Agency's Office of Water, "***the gap***" is a shorthand expression for discussing the capital needs requirements (projected needs minus projected revenues) of water and wastewater systems over the next several decades. New estimates for wastewater systems alone show sharply rising capital needs requirements in the next century, something on the order of $200 billion (in discounted, present value terms) over the next 20 years. This is much higher than the $120 billion previously estimated in the EPA's 1996 Clean Water Needs Survey (EPA, 1996).

During the early decades of the new millennium, we expect sharply rising capital needs due to:

- ✓ many sewage treatment plants becoming candidates for replacement (with their useful lives expiring);
- ✓ more stringent drinking water and wastewater standards driving up treatment costs;
- ✓ increasing expense and controversy associated with developing new sources of water; and
- ✓ non-point source pollution requiring greater abatement.

To meet the growing financial needs driven by these, more strategic pricing of water and wastewater can play a greater role. Current sewer bills average approximately $200 per household per year. (Raftelis, 1998). A back-of-the envelope calculation on these sewer charges alone shows that if our nation's 83 million sewered households were to experience a doubling of their sewer bills, revenues in excess of $16 billion per year would result, providing annual revenue sufficient to remove the estimated future capital shortfall for infrastructure investment in wastewater.

To summarize, pricing strategies can address "***the gap***" in two ways: to lower demand for water and wastewater services (or slow the growth rate in demand); and to raise revenue. In the water sector, these imperatives are becoming increasingly important.

**II. The Water Sector**
**Heavily Subsidized and Mostly Publicly Owned**
Over the past 200 years, water management in this country has been dominated by large government decisions concerning agriculture, water rights, transportation, hydroelectric power, manufacturing, and drinking needs. The U.S. Bureau of Reclamation and the Army

Corps of Engineers focused on large scale "***development***" of water resources during a time in history when water was believed to be abundant and easily renewed. Dams, canals, aqueducts and reservoirs were built to move water from where it was abundant to where it was needed, or to store it for use during dry seasons. The federal government financed much of that work, and the Department of the Interior's Bureau of Reclamation played a key role. As its name suggests, the goal of that agency was to "***reclaim***" arid lands.

Today, the water allocation problem is more difficult than ever due to a number of forces: increased population, periodic drought, depletion of groundwater, degradation of water quality, land use concerns and competition among water users [agriculture, recreation, urban drinking water and industrial use]. In the arid West where fighting over water rights has a long history, some institutional reform of water policy is under way to better manage the agricultural use of water. Fueling all of these stressors is the historic underpricing of water.

During the 1970s and 1980s, the EPA's Wastewater Treatment Construction Grants Program was a major source of federal funds, providing more than $60 billion for the construction of public wastewater treatment projects. With the 1987 amendments to the Clean Water Act, Congress set 1990 as the last year that grants would be appropriated, phasing out the construction grants program by shifting the method of municipal financial assistance from grants to loans provided by State Revolving Funds.

The twenty-year era of the federal Construction Grants program (1972 - 1992) produced a significant decline in the daily pollutant loads discharged by sewage treatment plants.

Environmental benefits were achieved, but an unintended and unforeseen result was the weakening of a price mechanism that might have served to guide the supply and demand for water more prudently. The true cost of water development and wastewater treatment has taken a back seat to large, institutional decisions concerning economic development, water rights, location of hydropower and other industries, river navigation, and agricultural irrigation.

States generally retain ownership of natural or public water within their boundaries; and state laws and regulations govern the allocation of the rights of private parties and government entities to use such water. State water codes almost always allocate water according to a "***grandfathered***" system of "***first in time, first in right***" (appropriative rights) or according to proximity of land ownership (riparian rights). While water uses must be "***beneficial***", allowable withdrawals are generally unpriced ("***free***").

Large scale water projects conducted by the Bureau of Reclamation and the Corp of Engineers have subsidized water supply for most sectors. All told, the institutional character of the water sector and the influence of governments has greatly subsidized water prices and imbued the water sector with deep political roots and economic norms – not unlike other infrastructure sectors such as roads, airports, energy, etc.

For wastewater treatment, the Construction Grants Program provided more than $60 billion for the construction of public wastewater treatment projects and subsidized 55 - 75% of the capital costs of construction.

Under the Clean Water State Revolving Fund, the average "***subsidy***" is considerably lower: SRF loans are repaid at interest rates approximately 3 percentage points less than market rates.

**Laws and Regulations**

Rate setting can be constrained by the legal and regulatory codes that vary across states and local jurisdictions. Most states will have something of a "***water code***" type law that codifies the rights of public water and wastewater utilities as well as the state's authority over investor-owned utilities.

At the federal level, the Clean Water Act contains language that governs how prices are set for wastewater treatment plants funded under the Construction Grants Program and the State Revolving Fund loan program. User charge regulations under the Act require that wastewater operating, maintenance and replacement (**OM & R**) costs be recovered proportionately from each user or class of user. This places restrictions only on cost recovery for OM & R and then, only in the case of wastewater flows. The EPA user charge regulations do not prohibit conservation rate structures for wastewater capital costs identified separately from OM & R charges, nor do the regulations prohibit conservation rate structures based on metered drinking water (rather than wastewater).

Since most residential water is metered through drinking water intakes (and not wastewater outflows), this regulation does not present a significant impediment to conservation pricing. In general, the EPA user charge regulations [for recipients of Construction Grants for wastewater treatment plants] only restrict how OM & R is charged and does not place restrictions on other types of charges.

**Politics and Public Education**

Publicly owned systems are subject to oversight and competing interests from local county, city or regional governing boards, water authorities or commissions. For publicly owned utilities, elected officials are too often influenced by short-term vote-seeking motivations. In addition to resisting higher prices for fear of retaliation at the ballot box, elected officials are more likely to give short shrift to the need to create depreciation reserves or other financial mechanisms to finance inevitable system replacements.

Politically, elected officials can view askance those rate structures that require pricing above cost recovery.

Elected bodies tend to favor limiting municipal utilities to recovering actual costs plus debt coverage costs to secure the ability to borrow in the capital market. In addition, both citizens and elected officials may wish to keep water and wastewater prices low in order to attract economic development.

In recognition of the competing interests that effect rate structures, the EPA's 1989 publication Building Support for Increased User Fees (EPA, 1989) was introduced to provide guidance on how to conduct an effective public education program that emphasizes the connection between higher fees and the financial and operating integrity of a water or wastewater utility as well as much-needed maintenance and repair of pipes, pumps and manholes.

In a public education program for conservation-oriented rate structures, public acceptance is improved when such rates are tagged to:

- ✓ avoidance or deferral of the price tag associated with capital improvement programs such as expansion and upgrades;
- ✓ avoidance of the need to develop a new water supply source, as for example, in moving from groundwater to surface water;
- ✓ the collateral benefits associated with water conservation:
    - pollution prevention through reduced water withdrawals and wastewater flows, habitat protection and energy conservation;
    - the potential to pay for conservation measures such as metering, improved water accounting, leak detection, water use audits, retrofits, reuse and recycling, and landscape improvements.

Clearly, information plays a role in how water users respond to price. To the extent that the public can be assured of the appropriate use of revenues derived from higher prices, conservation rate structures stand a far better chance of succeeding.

**III. Rate Structures and Practices in the Water Sector**

Current Pricing Practices in the Water Sector

Water's importance to our survival renders it, quite literally, "***priceless***" but this intrinsic value of water is frequently left out under the traditional pricing method -- known as cost-based pricing -- which is an accounting system designed to ensure the financial self-sufficiency of water and wastewater systems.

This pricing method quantifies the costs of capture, treatment and conveyance. As such, this method can often obscure the larger but less quantifiable societal interests in preserving our water resources.

Moreover, given the very high fixed costs associated with water and wastewater facilities, cost-based pricing can predispose rate setting against variable (i.e. commensurate with usage) charges and thus can run counter to conservation goals.

**Cost-based pricing does not need to be in conflict with conservation pricing.**
Supplementing cost-based pricing with incentives for consumers to manage demand is a combination that serves both financial and environmental goals.

Another term that is sometimes used is "***demand management pricing***" to reflect the underlying motivation to lower water demand (or slow the rate of demand growth).

Water and wastewater demand can be manipulated by price to some degree. Water for necessities (sanitation, cleaning and cooking) is far less responsive to price than water for more discretionary uses (lawn watering, car washing, swimming pools).

Water policy analyst Janice Beecher reviewed over 100 studies of the price elasticity of demand – with the following conclusions (Beecher, 1994):

The most likely range for elasticity of residential water demand is -.20 to -.40, meaning a 10% increase in price lowers demand by 2 - 4%.

The most likely range for elasticity of industrial demand is -.50 to -.80, meaning a 10% increase in price lowers demand by 5 - 8%.

Clearly, water is "***inelastic***", meaning that when the price increases, consumption decreases but at a lower rate than the increase in price. Unlike such large factors as the weather, population growth, local geology and hydrology, and the economy; water managers can influence water rates, albeit with an appreciation for the consumers' response.

Moreover, utility managers need to consider that price increases will not likely affect the behavior of many middle and upper income groups. For these groups, stiffer price increases or other conservation strategies might be tried.

Two rate surveys give us some insight as to existing industry practices with regard to conservation pricing. The Raftelis Environmental Consulting Group's 1998 Water and Wastewater Rate Survey depicts 31% of 151 surveyed communities using increasing block rates.

The American Water Works Association's 1998 survey of the residential rate structures of 827 utilities shows approximately 22% employing increasing block rates and 2% employing seasonal rates. For commercial and industrial customers, increasing block rates are slightly less common.

To be precise, it should be noted that both of these results pertain to water rates structures, not wastewater. However, best professional judgment allows us to infer an equivalence between the two. Most residential wastewater is not metered but is instead billed in proportion to water coming into residences (drinking water) or by some other formula.

To the extent that residential wastewater rates derive from water usage and rate structures, some form of price incentive for wastewater conservation exists in a significant portion of sewered communities.

## Example of a Modern Water Customer Service Facility

We wanted to show our students a new and exciting water customer service facility at the cutting edge of our industry. This facility is the beautiful Global Water Building in Maricopa, Arizona. This facility is incredible and this may be your chance to see where we are headed as Global has set the bar for water customer service, water conservation, security and going green all in a building that is primarily made from recycled materials. I have been to most of the water facilities in the nation and this facility can only be compared to a museum. You have an opportunity to see some of TLC's photographs of Global's displays, kiosks and customer service terminals; I guarantee that you will be impressed with this facility. This facility is located in the first subdivision Rancho El Dorado going west from Queen Creek turn off on I-10. The facility is located at the east side of the large loop that runs throughout Rancho El Dorado. Once you are on the far east side of this loop, look for a building just east and north of the large power lines.


Outside view of Global's customer service facility in Maricopa. The majority of this facility is recycled material. The rounded section on the left is a large auditorium.


This is just one of many incredible displays inside Global's facility. The two long windows allow customers to view the SCADA operation center of the water provider while televisions display water conservation information. Below, a customer's bird's eye view of the compliance laboratory. Cutting edge technology that the customers can watch as samples are processed.


Customers can pay bills or access their accounts with these machines or simply walk up to the customer service representative. Notice the public information LED sign above the customer service desk. A modern built and environmental friendly facility. I was told that this facility cost approximately 25 million dollars to design and build.


Museum quality presentations. Here you can see a few of Global's informational kiosks. I was informed that no public money was used to design these displays. There is a working mock-up display of the entire system and various garden plants that either utilize salt water or low-water use in this area as well. I really like the large ceilings and natural stained floors in this customer service reception area.

## Conservation Rate Structures

Prices can be used to modify customer behavior to use less water at the tap, stop and prevent leakage and waste, and send less wastewater for treatment. To achieve the efficiency gains that will enable water system managers to postpone the need for new capital outlays, water utilities and local governments will need to expand their toolkit to include the widest array of conservation-oriented initiatives, using prices as well as measures like universal metering, water accounting and use audits, retrofitting and public education.

The Office of Water's Water Conservation Plan Guidelines provides guidelines for utilities on conservation planning and the conservation measures listed above, of which conservation pricing is listed as one component (EPA, 1998). This paper takes the pricing concept several steps further and discusses particular rate structures.

**The general types of conservation pricing options are:**

- ✓ repeal of volume discounts;
- ✓ increasing block rates;
- ✓ seasonal rates; and
- ✓ excess loading or excess use charges.

Their names suggest the general working/process for most of these rate structures.

Eliminating volume discounts would remove any existing disincentive for conservation. Charging a higher unit price rises as use rises is the most popular form of conservation pricing. Less common are seasonal rates, where prices rise and fall according to water supplies and weather conditions (with higher prices usually occurring between April and October). With all of these options, consumers have an incentive to conserve.

**IV. Key Issues for Utilities, Communities and Water Planners**
In addition to the politics of competing interests that can dominate rate setting, three key issues emerge: the service population's ability to afford higher rates, the effects of conservation rates on a utility's revenues, and their actual effectiveness in reducing water demand. These are discussed below.

**Affordability**
The best rate design involves taking into account the characteristics of particular customer classes. In considering conservation pricing, a utility, water planning body or local government might consider the service area population's ability to pay higher rates. Appropriately designed programs oriented towards customers with limited resources can mitigate the hardship of rate increases on low-income families.

Not only does this have humanitarian benefits, well designed affordability programs can benefit the utilities in avoiding the costs associated with increased arrearages: late payments, disconnection notices and service terminations.

The American Water Works Association Research Foundation (**AWWARF**) issued the most comprehensive report available on rate structures designed to mitigate the costs of water service for low-income customers (AWWARF, 1998).

Entitled “Water Affordability Programs,” this report lays out 5 rate structures that can be considered as model affordability programs. “***Lifeline***” rate structures can mitigate undue hardships for qualifying low-income customers by charging a lower rate for the portion of their monthly water supply which is considered nondiscretionary (the basic amount needed for sanitation, cooking, cleaning, etc.).

Beyond this “***lifeline amount***” (e.g. 8,000 gallons per month), a higher rate will take effect. Alternatively, a discount can be applied to the fixed portion of the bill, e.g. the meter charge, service charge or other such fixed amount. This method also maintains incentives to conserve.

Utilities can also offer budget billing programs, elderly discounts and conservation assistance to assist low-income families.

According to the Raftelis Environmental Consulting Group’s recent water survey, a number of water and wastewater facilities across the nation have instituted water payment assistance programs that provide discounts for low-income or elderly customers. (Raftelis Environmental Consulting Group, 1998).

Section V covers a number of assessment tools and information sources that may be helpful in considering conservation oriented rate structures.

**Revenue stability**

In the small body of literature on water pricing, revenue instability is the most frequently cited problem with various forms of conservation rates (Beecher, 1994). This is because conservation rates can shift cost recovery from fixed charges to variable charges (rates based on use). Utilities also worry that price increases may reduce their sales in an unpredictable manner, leading to less certain revenue streams. If consumers respond with a higher-than-expected reduction in water use, conservation can cause utilities to experience reduced revenues and an unstable cash flow.

One way to mitigate this concern is to gather reliable data on the local service area’s “***elasticity of demand***.” Computer models are available to estimate price elasticities for different customer classes, and hence, the revenue effects of conservation rate structures. To properly design rates as well as to maintain financial stability for the utility, it is necessary to make some demand forecasts.

Existing demand studies can be used to approximate usage responses in a general benchmarking approach, or computer models can be used (in conjunction with detailed customer records) to specify consumer responses to price with greater accuracy. Section V describes some of the tools available for making these estimates.

A second way to mitigate concern about revenue instability is to create a revenue stabilization fund that can be used to even out the collection of revenue, particularly during droughts. In this case, the utility must be able to collect revenues in excess of annual expenditures in some years so that it can draw on the fund during revenue shortfalls that result from lower than expected consumption.

In addition, there must be either legal safeguards or a strong political will to protect these reserves. Surpluses can be used to fund conservation programs or build a reserve for future capacity expansions or upgrades.

**Effectiveness**
Studies of the effectiveness of conservation pricing are few and far between, however, University of Georgia Professor Jeffrey L. Jordan in a 1994 article in the Water Resources Bulletin gave us some insight into a rapidly suburbanizing county in the southeast U.S. In 1991, Spalding County, Georgia (part of the Atlanta SMA), went from a decreasing rate structure to an increasing rate structure. Without any other conservation program being instituted, average yearly water use per customer fell by 5% (Jordan, 1994).

More recently, Jordan has written in the Journal of the American Water Works Association to report on results of a 59 question survey sent to those utilities identified as using some type of conservation rate structure. (Jordan and Albani, 1999). For those 12 systems where the authors had data that could show the effectiveness of a rate change, Jordan and Albani were able to show that yearly average consumption dipped 8 percent and peak-demand-month usage declined 7 percent.

Jeffrey Jordan is also the author of a number of papers providing analysis and information on water issues in the state of Georgia. Entitled the Georgia Water Series, Jordan's papers and other information can be found at http://www.griffin.peachnet.edu/water.

**V. Assessment Tools and Information Sources**
The references section that follows is a complete listing of all source material used for this paper.

Some particularly noteworthy reports and software packages are first highlighted below.

**Helpful reports and software**
To effectively manage demand, a utility must be able to determine future water needs. New water demand forecasting models have enabled water planners to go far beyond the traditional method of estimating future water needs where estimates simply resulted from multiplying per capita use times projected population.

More sophisticated forecasting software now takes into account the socioeconomic characteristics of a service area and the breakdown of water uses into customer classes. Utilities can see how seasonal changes, weather changes and changes in sectoral composition will affect water demand.

Most importantly, for the purposes of conservation pricing, estimates of customer response to changes in user charges can be derived.

IWR-MAIN Water Demand Analysis Software is a software package developed under sponsorship of the Army Corps of Engineers Institute for Water Resources. IWR-MAIN has been updated and continually modified since its first inception in 1982 so that its most recent versions are usable on a personal computer.

The acronym IWR-MAIN stands for Institute for Water Resources – Municipal and Industrial Needs. Version 6.1 was introduced in 1995 and is being used for southern California, Las Vegas, Alabama, Florida and Georgia.

Information on availability and use of the IWR-MAIN Water Use Forecasting Model may be obtained by contacting the Army Corps of Engineers' Institute.

The Environmental Protection Agency's Office of Water has issued two reports aimed specifically at the water and wastewater pricing issue. The first such report, entitled "Building Support for Increasing User Fees," is a helpful guide to the public education needed to price clean water at rates more commensurate with its value (EPA, 1989). This report stresses that rate adjustments are most effective when used in conjunction with a public education program.

This report can be viewed and downloaded electronically from EPA's web site at http://www.epa.gov/clariton/clhtml/pubtitle.html.

A follow-up to this report came in 1993 with "Evaluating Municipal Wastewater User Charge Systems," which serves as a guide to provide information needed to comply with the EPA's construction grant user charge system regulations (EPA, 1993).

This report can be ordered free of charge from the National Service Center for Environmental Publications whose catalog can is found on the EPA's web site at http://www.epa.gov/ncepihom/catalog.html.

Finally, the American Water Works Association has a 1999 version of their manual, "Water Rate Structures and Pricing" (AWWA, 1999).

This is the most comprehensive guide available on all issues associated with water pricing. In 1998, the research arm of AWWA, the American Water Works Research Foundation (AWWARF), produced the most extensive treatment yet on rate design for affordability. It is entitled "Water Affordability Programs."

Browsing the web pages that list publications for both AWWA (http://www.awwa.org) and AWWARF (http://www.awwarf.com) can yield information on the purchase on these and other documents relevant to rate design issues.

## Water Rate *Example*

**Water rates.**

A. The following rates shall apply to all individually metered water services, except residential:

| Meter Size (In Inches) | Monthly Base Charge | |
|---|---|---|
| | Inside City | Outside City |
| 5/8 | $10.86 | $19.55 |
| 3/4 | 16.28 | 29.30 |
| 1 | 23.85 | 42.93 |
| 1 1/2 | 34.69 | 62.44 |
| 2 | 54.21 | 97.58 |
| 3 | 108.47 | 195.25 |
| 4 | 173.52 | 312.34 |
| 6 | 347.02 | 624.64 |
| 10 | 785.99 | 1,414.78 |

B. The following rates shall apply to all individually metered water services for residential units:

| Meter Size (In Inches) | Monthly Base Charge | |
|---|---|---|
| | Inside City | Outside City |
| 5/8 | $10.86 | $19.55 |
| 3/4 | 16.28 | 29.30 |
| 1 | 16.28 | 29.30 |
| 1 1/2 | 34.69 | 62.44 |
| 2 | 54.21 | 97.58 |

C. In addition to the monthly base charge, all metered water shall be charged at the following rate per one thousand (1,000) gallons:

| | Winter Rate | | Summer Rate | |
|---|---|---|---|---|
| | Inside City | Outside City | Inside City | Outside City |
| First 10,000 gallons | $0.96 | $1.73 | $0.96 | $1.73 |
| Next 10,000 gallons | 1.19 | 2.14 | 1.27 | 2.29 |
| Next 80,000 gallons | 1.37 | 2.47 | 1.86 | 3.35 |
| Over 100,000 gallons | 1.19 | 2.14 | 1.86 | 3.35 |

1. Winter rates will be effective with all billings on and after October 1.

2. Summer rates will be effective with all billings on and after May 1.

3. Plus the applicable proportionate part of any taxes or any governmental impositions which are assessed on water sales.

**50-11.1. Reclaimed water service rates.**

The following rates per one thousand (1,000) gallons shall apply to all individually metered reclaimed water services:

| | Winter rate (1) | | Summer rate (2) | |
|---|---|---|---|---|
| | Inside city | Outside city | Inside city | Outside city |
| Reclaimed water | $0.040 | $0.072 | $0.071 | $0.128 |
| Special request recovered water | 0.590 | 1.062 | 0.590 | 1.062 |

(1) Winter rates will be effective with all billings on and after October 1.

(2) Summer rates will be effective with all billings on or after May 1.
(Ord. No. 3164, § 4, 8-24-00)

**50-12. Sewer service rates.**

A. The following sewer service rates shall apply to all dwelling and commercial units where sewer main adjoins the property and the water account is active. In the event the active water account is for the sole purpose of providing fire flow, lawn, landscaping or other irrigation and sprinkling or other use approved by the City Engineer not requiring a sewer connection, the following service rates shall not apply. The effective date shall commence with all billings after October 1, 1997.

| Type of Service | Water Metered | Inside City | Outside City |
|---|---|---|---|
| Single-family dwelling unit | Not applicable | $14.26 | $25.67 |
| Multi-family dwelling unit | Not applicable | 8.47 | 15.25 |
| Commercial | First 20,000 Gallons | 29.69 | 53.44 |
| | Over 20,000 Gallons per 1,000 gallons | 1.48 | 2.66 |
| Commercial Processing & Manufacturing | First 20,000 Gallons per 1,000 gallons | 34.92 | 62.86 |
| | Over 20,000 Gallons | 1.74 | 3.13 |
| Medical Institutions | First 20,000 Gallons per 1,000 gallons | 24.44 | 43.99 |
| | Over 20,000 Gallons | 1.22 | 2.20 |
| Educational Institutions | First 20,000 Gallons per 1,000 gallons | 24.50 | 44.10 |
| | Over 20,000 Gallons | 1.22 | 2.20 |
| Large Volume Industrial | First 20,000 Gallons per 1,000 gallons | 34.92 | 62.86 |
| | Over 20,000 Gallons | 1.74 | 3.13 |

B. In the event of the installation of a separate sewer meter for approved commercial and industrial users, the following sewer service rates shall apply. The effective date shall commence with all billings after October 1, 1997.

| Type of Service | Inside City | Outside City |
|---|---|---|
| Approved commercial-industrial: | | |
| Monthly base charge | $34.92 | $62.86 |
| Per 1,000 gallons | 1.74 | 3.13 |

C. In the event a sewer main adjoins property which is not served by municipal water and the owner/occupant desires to be served by sewer service, the sewer rates set forth in A. shall apply to all single-family and multifamily users. Sewer rates set forth in A. shall apply to all other customers with water provider supplying water billing information to the City. In the event the water provider is the owner/occupant or the water provider information is not available to the City for billing purposes under A., then sewer rates set forth in subsection B. shall apply and installation costs of the sewer meter shall be borne by the customer.

**50-13. Wastewater pretreatment program cost recovery.**
A. In order to provide for recovery of City costs associated with the City of Chandler wastewater pretreatment program, the following fee schedule is established:

Permit application . . . . . $480.00
Monthly metered water charge, per 1,000 gallons . . . . . 0.183
Excess pollutant processing charge:
Per excess lb. BOD* . . . . . 0.207
Per excess lb. SS** . . . . . 0.039
*BOD: Biochemical oxygen demand
**SS: Suspended solids

The above fees shall be separate from all other fees chargeable by the City and apply to nonresidential users of the City Wastewater Collection and Treatment System. These fees relate solely to the pretreatment program requirements and are structured to reimburse the following:

1. Costs of setting up and operating the City's wastewater pretreatment program;
2. Costs of monitoring, inspection and surveillance procedures;
3. Costs of reviewing accidental discharge procedures and construction;
4. Costs associated with processing permit applications and issuing permits;
5. Costs associated with filing appeals;
6. Costs incurred by City for consistent removal of pollutants otherwise subject to Federal pretreatment standards;
7. Other costs deemed necessary to carry out the requirements of the pretreatment program.

Fees shall be reviewed annually each January by the Director of the Municipal Utilities Department to assure they are equitable and sufficient to recover City costs associated with the program as defined above.

B. If any provision, paragraph, word or section of this ordinance is invalidated by any court of competent jurisdiction, the remaining provisions, paragraphs, words or sections shall not be affected and shall continue in full force and effect.
C. All other ordinances and parts of other ordinances inconsistent or conflicting with any part of this ordinance are hereby repealed to the extent of such inconsistency of conflict.

**50-14. Residential refuse removal collection schedule.**
The City shall collect and remove solid waste and recyclables, as defined in Chapter 44 of this Code, from all single-family, duplex and triplex household units within the City no less than once per week for refuse and once per week for recycling, except as provided by Chapter 44 of this Code.
(Ord. No. 3058, § 2, 11-18-99)

**50-15. Residential refuse removal rates.**

A. A monthly charge of eleven dollars ($11.90) on each account billed with the monthly utility bill will be made by the City to cover direct and indirect City expense associated with solid waste refuse and recyclables removal and disposal. It is the City's intent to bill all refuse removal rates for single-family, duplex and triplex household units on the water account serving the user. When the user who requests service does not have an active water account to bill refuse and recyclables removal and disposal service rates, a utility billing account will be established. A security deposit as specified in section 50-3 shall be required from users without the active water account.

B. The refuse/recycling removal and disposal monthly rate shall apply to all single-family, duplex and triplex household units receiving twice-weekly service utilizing either or both ninety-gallon roll-out containers and/or three (3) cubic-yard containers when the water account for the unit is active.

C. Units under construction, not occupied, with the water account in the name of the contractor, will not be charged the monthly rate.

D. When single-family, duplex or triplex household units served share a common water account, the individual household unit rates specified in this section will be charged to the common water account.

E. Special bulk item collections. The following bulk item collection rates shall apply to all single-family, duplex and triplex household units for each special bulk item collection event/unit requested in addition to the established on-call bulk item collections conducted by the City. A bulk item collection unit shall consist of material which equals a maximum area of four (4) feet by four (4) feet by eight (8) feet or landscape material prepared by a commercial landscape contractor, gardener or tree trimmer. Brush must be cut and tied in bundles so as not to exceed forty-eight (48) inches in length and twelve (12) inches in diameter. Tree limbs may not be more than three (3) feet long and five (5) inches in diameter. Bulk item collection shall include the removal of items as discarded furniture, large appliances, household items too large for placement in containers, and brush. Bulk item collection shall not include the collection of construction material resulting from construction, demolition or remodeling of buildings.

| Type of Unit | Rate per Collection Event |
|---|---|
| Single-family, duplex or triplex household unit | $8.50 |

F. Special refuse container collections. The following container collection rates shall apply to all single-family, duplex and triplex household units for each special refuse container collection requested in addition to the established weekly refuse and recycling container collection service:

| Type of Unit | Rate per Collection |
|---|---|
| Single-family, duplex or triplex household unit: | |
| 90 gallon container | $5.00 |
| 3 cubic-yard container | $12.00 |

**50-16. Industrial waste fees.**

A. A three hundred dollar ($300.00) review fee shall be charged to industrial waste generators for each industrial waste application filed as specified in Chapter 44 of this Code.

B. A seventy-five dollar ($75.00) monthly monitoring fee shall be charged to industrial waste generators each month the City landfill is used by the generator for industrial waste disposal.

C. Industrial waste fees shall be reviewed annually each January by the Director of the Municipal Utilities Department to assure they are sufficient to recover City costs associated with the industrial waste program.

# References

**Books and Reports**
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American Water Works Foundation. Water Affordability Programs. Denver, CO: AWWARF, 1998.
Beecher, J.A. et. al. Revenue Effects of Water Conservation and Conservation Pricing: Issues and Practices. National Regulatory Research Institute, Columbus, Ohio (1994).
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Raftelis Environmental Consulting Group, Inc. Raftelis Environmental Consulting Group 1998 Water and Wastewater Rate Survey. Charlotte, NC: Raftelis Environmental Consulting Group, Inc. 1998.

**Web Sites**
American Water Works Association
http://www.awwa.org
American Water Works Research Foundation
http://www.awwarf.com
Georgia Water Series
http://www.griffin.peachnet.edu/water/
Institute for Water Resources, U.S. Army Corps of Engineers
http://www.wrsc. Usace. Army.mil/iwr/
U.S. Environmental Protection Agency
Office of Wastewater Management
http://www.epa.gov/owm
Office of Groundwater and Drinking Water
http://www.epa.gov/ogwdw

## What Is Water Recycling?

**Recycle:** verb 1.a. To recover useful materials from garbage or waste, b. To extract and reuse.

While recycling is a term generally applied to aluminum cans, glass bottles, and newspapers, water can be recycled as well. Water recycling is reusing treated wastewater for beneficial purposes such as agricultural and landscape irrigation, industrial processes, toilet flushing, and replenishing a ground water basin (referred to as ground water recharge). Water is sometimes recycled and reused onsite; for example, when an industrial facility recycles water used for cooling processes. A common type of recycled water is water that has been reclaimed from municipal wastewater, or sewage. The term water recycling is generally used synonymously with water reclamation and water reuse.

Through the natural water cycle, the earth has recycled and reused water for millions of years. Water recycling, though, generally refers to projects that use technology to speed up these natural processes. Water recycling is often characterized as "***unplanned***" or "***planned***." A common example of unplanned water recycling occurs when cities draw their water supplies from rivers, such as the Colorado River and the Mississippi River, that receive wastewater discharges upstream from those cities. Water from these rivers has been reused, treated, and piped into the water supply a number of times before the last downstream user withdraws the water. Planned projects are those that are developed with the goal of beneficially reusing a recycled water supply.

The Palo Verde Nuclear Generating Station, located near Phoenix, Arizona, uses recycled water for cooling purposes.

**How Can Recycled Water Benefit Us?**

Recycled water can satisfy most water demands, as long as it is adequately treated to ensure water quality appropriate for the use. Figure 1 shows types of treatment processes and suggested uses at each level of treatment. In uses where there is a greater chance of human exposure to the water, more treatment is required. As for any water source that is not properly treated, health problems could arise from drinking or being exposed to recycled water if it contains disease-causing organisms or other contaminants.

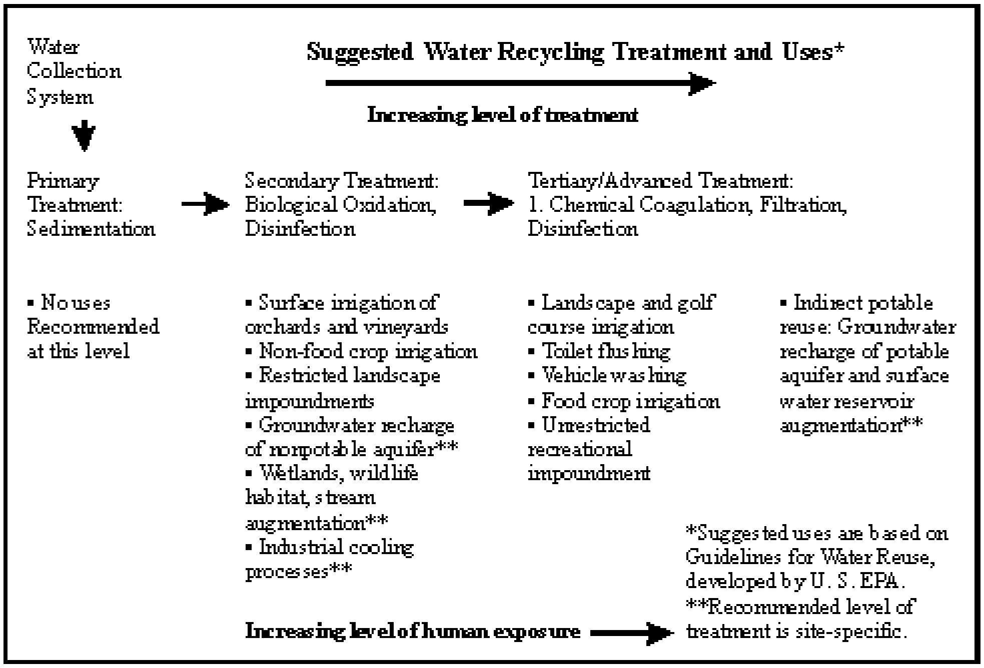


**Figure 1: While there are some exceptions, wastewater in the United States is generally required to be treated to the secondary level. Some uses are recommended at this level, but many common uses of recycled water, such as landscape irrigation generally require further treatment.**

The US Environmental Protection Agency regulates many aspects of wastewater treatment and drinking water quality, and the majority of states in the US have established criteria or guidelines for the beneficial use of recycled water. In addition, in 1992, the EPA developed a technical document entitled "***Guidelines for Water Reuse***," which contains such information as a summary of state requirements, and guidelines for the treatment and uses of recycled water. State and Federal regulatory oversight has successfully provided a framework to ensure the safety of the many water recycling projects that have been developed in the United States.

**The Irvine Ranch Water District provides recycled water for t flushing in high rise buildings in Irvine, California. For buildings over seven stories, the additional cost of providi dual system added only 9% to the cost of plumbing.**

Recycled water is most commonly used for nonpotable (not for drinking) purposes, such as agriculture, landscape, public parks, and golf course irrigation. Other nonpotable applications include cooling water for power plants and oil refineries, industrial process water for such facilities as paper mills and carpet dyers, toilet flushing, dust control, construction activities, concrete mixing, and artificial lakes.

Although most water recycling projects have been developed to meet nonpotable water demands, a number of projects use recycled water indirectly[1] for potable purposes. These projects include recharging ground water aquifers and augmenting surface water reservoirs with recycled water. In ground water recharge projects, recycled water can be spread or injected into ground water aquifers to augment ground water supplies, and to prevent salt water intrusion in coastal areas. For example, since 1976, the Water Factory 21 Direct Injection Project, located in Orange County, California, has been injecting highly treated recycled water into the aquifer to prevent salt water intrusion, while augmenting the potable ground water supply.

[1]*Indirect potable reuse refers to projects that discharge recycled water to a water body before reuse. Direct potable reuse is the use of recycled water for drinking purposes directly after treatment. While direct potable reuse has been safely used in Namibia (Africa), it is not a generally accepted practice in the US.*

While numerous successful ground water recharge projects have been operated for many years, planned augmentation of surface water reservoirs has been less common. However, there are some existing projects and others in the planning stages. For example, since 1978, the upper Occoquan Sewage Authority has been discharging recycled water into a stream above Occoquan Reservoir, a potable water supply source for Fairfax County, Virginia. In San Diego, California, the Water Repurification Project is currently being planned to augment a drinking water reservoir with 20,000 acre-feet per year of advanced treated recycled water.

For over 35 years, in the Montebello Forebay Ground Water Recharge Project, recycled water has been applied to the Rio Hondo spreading grounds to recharge a potable ground water aquifer in south-central Los Angeles County.

## What are the Environmental Benefits of Water Recycling?

In addition to providing a dependable, locally-controlled water supply, water recycling provides tremendous environmental benefits. By providing an additional source of water, water recycling can help us find ways to decrease the diversion of water from sensitive ecosystems. Other benefits include decreasing wastewater discharges and reducing and preventing pollution. Recycled water can also be used to create or enhance wetlands and riparian habitats.

**Water recycling can decrease diversion of freshwater from sensitive ecosystems.**
Plants, wildlife, and fish depend on sufficient water flows to their habitats to live and reproduce. The lack of adequate flow, as a result of diversion for agricultural, urban, and industrial purposes, can cause deterioration of water quality and ecosystem health. Water users can supplement their demands by using recycled water, which can free considerable amounts of water for the environment and increase flows to vital ecosystems.

In California, Mono Lake's water quality and natural resources were progressively declining from lack of stream flow. In 1994, the Los Angeles Department of Water and Power was required to stop diverting one-fifth of the water it historically exported from the basin. The development of water recycling projects in Los Angeles has provided a way to partially offset the loss of Mono Basin water, and to allow the restoration of Mono Lake to move ahead. Copyright 1994, Mono Lake Committee.

**Water recycling decreases discharge to sensitive water bodies.**
In some cases, the impetus for water recycling comes not from a water supply need, but from a need to eliminate or decrease wastewater discharge to the ocean, an estuary, or a stream. For example, high volumes of treated wastewater discharged from the San Jose/Santa Clara Water Pollution Control Plant into the south San Francisco Bay threatened the area's natural salt water marsh. In response, a $140 million recycling project was completed in 1997. The South Bay Water Recycling Program has the capacity to provide 21 million gallons per day of recycled water for use in irrigation and industry. By avoiding the conversion of salt water marsh to brackish marsh, the habitat for two endangered species can be protected.

## Water Recycling Can Reduce and Prevent Pollution

When pollutant discharges to oceans, rivers, and other water bodies are curtailed, the pollutant loadings to these bodies are decreased. Moreover, in some cases, substances that can be pollutants when discharged to a body of water can be beneficially reused for irrigation.

For example, recycled water may contain higher levels of nutrients, such as nitrogen, than potable water. Application of recycled water for agricultural and landscape irrigation can provide an additional source of nutrients and lessen the need to apply synthetic fertilizers.

Recycled water has been used for a number of years to irrigate vineyards at California wineries, and this use is growing. Recently, Gallo Wineries and the City of Santa Rosa completed facilities for the irrigation of 350 acres of vineyards with recycled water from the Santa Rosa Subregional Water Reclamation System.

### What Is the Future Of Water Recycling?

Water recycling has proven to be effective and successful in creating a new and reliable water supply, while not compromising public health. Nonpotable reuse is a widely accepted practice that will continue to grow. However, in many parts of the United States, the uses of recycled water are expanding in order to accommodate the needs of the environment and growing water supply demands. Advances in wastewater treatment technology and health studies of indirect potable reuse have led many to predict that planned indirect potable reuse will soon become more common.

While water recycling is a sustainable approach and can be cost-effective in the long term, the treatment of wastewater for reuse and the installation of distribution systems can be initially expensive compared to such water supply alternatives as imported water or ground water. Institutional barriers, as well as varying agency priorities, can make it difficult to implement water recycling projects.

Finally, early in the planning process, agencies must implement public outreach to address any concerns and to keep the public involved in the planning process.

As water demands and environmental needs grow, water recycling will play a greater role in our overall water supply. By working together to overcome obstacles, water recycling, along with water conservation, can help us to conserve and sustainably manage our vital water resources.

**For more information about water recycling and reuse, contact:**
U.S. Environmental Protection Agency, Region 9
CWA Standards and Permits Office (WTR-5)
75 Hawthorne Street
San Francisco, CA 94105
(415) 972-3527

or

Robert Bastian
U.S. Environmental Protection Agency
Office of Wastewater Management (4204)
Ariel Rios Building
1200 Pennsylvania Ave., NW
Washington, D.C. 20460
Tel: (202) 564-0653
bastian.robert@epa.gov

**EPA Material:**
*Guidelines for Water Reuse.* US EPA Office of Technology Transfer and Regulatory Support. EPA/625/R-92/004. September 1992.
*Municipal Wastewater Reuse: Selected Readings on Water Reuse.* Office of Water (WH-595) EPA 430/09-91-002. September, 1991.

**Other related literature and videos:**
*Layperson's Guide to Water Recycling and Reuse*, published in 1992 by the Water Education Foundation, Sacramento, California.

Video, entitled *Water from Water: Recycling,* produced in 1995 by National Water Research Institute, Fountain Valley, California.

Video, entitled *Water in an Endless Loop,* produced in 1997 by WateReuse Foundation, Sacramento, California.

## WAVE (Water Alliances for Voluntary Efficiency)

**Frequently Asked Questions About U.S. EPA's Voluntary Water-Efficiency Program**
**What is WAVE?**
WAVE (Water Alliances for Voluntary Efficiency) is a non-regulatory water-efficiency partnership created and supported by the U.S. EPA. WAVE's mission is to encourage commercial businesses and institutions to reduce water consumption while increasing efficiency, profitability, and competitiveness.

**Why did EPA create this program?**
WAVE is part of the EPA's long-term effort to prevent pollution and reduce demands on the nation's water and energy resources. As supplies shrink and demands rise, competition among industrial, agricultural, and domestic users for available water is increasing. Through WAVE and other programs, the EPA seeks to ensure that adequate U.S. water resources remain available to support both human and environmental needs.

**Can joining WAVE actually benefit the environment?**
Yes. WAVE helps protect the environment and sustain wildlife habitats by reducing water use, wastewater discharges and energy use. Less wastewater and reduced consumption means less energy is needed to heat, pump, and process water.

This, in turn, helps cut polluting emissions from power plants. The commercial/institutional sectors could potentially save about 1.3 billion gallons of water per day, equivalent to that used by four million homes, by installing water-efficient equipment. Electricity savings resulting from reduced water use would be about 11 million kilowatt-hours per day, enough to meet the needs of 400,000 homes.

**How many types of WAVE memberships are there?**
Two: Partners and Supporters. Partners include lodging establishments, office buildings, and educational institutions. Any water service company, equipment supplier/manufacturer, government agency, or water/wastewater utility may become a Supporter.

**After joining, what then?**
New members sign a Membership Agreement, agreeing to survey water-using equipment, and where profitable, install water-efficient upgrades within a pre-arranged time frame. Members also agree to consider using water-efficient equipment in the design of all new facilities. Program results are reported to the EPA annually.

**What support will I receive?**
The EPA is committed to helping all WAVE members publicize their water efficiency programs. Support includes nationwide public service advertising and press releases. Members also receive free water management software and technical support.

**How much can I expect to save?**
Water-efficiency measures, like those proposed by WAVE, can reduce water and sewer costs up to 30 percent. Significant savings in energy, chemical, and maintenance expenses are also possible. The typical payback period is less than two years.

**Who else has joined WAVE?**
WAVE's participants represent some of the lodging industry's most recognizable names, including Westin, Hyatt, ITT Sheraton, Outrigger, La Quinta Hotels, and Accor Economy Lodging which owns Motel 6, Studio 6 and Red Roof Inns.

Collectively WAVE Lodging Partners control almost 1,900 U.S. hotel properties and more than 342,000 guest rooms. Columbia University in the City of New York and the University of Hawaii at Hilo were among the first to join WAVE as Educational Partners. (WAVE Members)

## Hotel WAVE Information

Water Alliances for Voluntary Efficiency (**WAVE**) is part of the U.S. Environmental Protection Agency's (**EPA's**) long-term effort to prevent pollution and reduce demands on the nation's water and energy resources. WAVE is a voluntary partnership that encourages commercial businesses and institutions to examine water usage and implement water efficiency programs.

As the first sector served by the WAVE program, the lodging industry has an established history of water efficiency success. Since WAVE's inception in 1992, establishments ranging from family-owned bed-and-breakfasts to international hotel corporations have proven that the benefits from water efficiency flow down to the bottom line.

**How Can My Hotel Become More Water Efficient?**
The average hotel in the United States consumes 209 gallons of water each day for each occupied room, meaning even moderate-sized hotels can use tens of thousands of gallons of water each day. By integrating water efficiency practices into everyday operation and installing water-efficient equipment, a 30 percent reduction in water consumption is possible with no loss of comfort to guests. These cost-effective practices conserve energy and valuable natural resources and can considerably reduce your chemical and maintenance costs... and your hotel's bottom line.

In most cases, increasing water efficiency is simple to do and quick to pay off. Choose the water efficiency practices that are economically viable and offer the greatest rewards for your facility.

**How Can I Determine Which Efficiency Measures Are Best for Me?**
WAVE•Saver for Hotels, a windows based software package available from EPA, enables hotel engineers and managers to survey and track water use, and identify specific water saving opportunities. The program includes full-motion video demonstrations, color photos and graphics, and online tutorials.

WAVE•Saver allows you to track water use throughout your hotel, including linen laundering, irrigation, and cooling towers. You can then identify and evaluate a variety of water efficiency measures to save water in those functions.

**WAVE Partners: Hotels and Motels**
*"It has been a pleasure participating in the progressive WAVE program. The WAVE software allowed us to take a deep look at all of the areas of water usage in the hotel. Based on the results of our survey, we have begun to strategically plan for water-efficient replacement fixtures in our 5 year capital plan. Further, water conservation is important to*

*our local community. Therefore, we frequently communicate the conservation efforts that we take through our local marketing efforts.*

*This is great "**feel good**" marketing content that gives us a unique edge over our competition."*

**Brent Reynolds**
Assistant General Manager
Holiday Inn Youngstown–South

Don't just go with the flow, ride the WAVE of water efficiency by joining those WAVE members who have already made the commitment to conserve our vital water resources while saving money.

**Water Efficiency Success Story: Meyer Jabara Hotels**
More than 20 million gallons and nearly $145,000 in water and sewer costs! This is how much Meyer Jabara Hotels, a WAVE Partner since February 1995, estimates its water efficiency program saved in 1997 and 1998. Meyer Jabara Hotels, with headquarters in Danbury, Connecticut, and West Palm Beach, Florida, owns 22 properties with more than 4,000 rooms located in 14 states. Specific water efficiency measures vary among the individual properties; each facility decides which measures are most appropriate and will provide the greatest benefit.

Typical measures include installing water efficient fixtures, repairing equipment leaks, and instituting towel and linen programs, which allow guests to decide whether or not to reuse towels and sheets.

An automated WAVE report feature makes completing and submitting efficiency measure reports as simple as printing!

**WAVE Partners: Office Buildings**
Water Alliances for Voluntary Efficiency (**WAVE**) is part of the U.S. Environmental Protection Agency's (**EPA's**) long-term effort to prevent pollution and reduce demands on the nation's water and energy resources. WAVE is a voluntary partnership that encourages commercial businesses and institutions to examine water usage and implement water efficiency programs. Since its inception in 1992, the WAVE program has helped the lodging industry increase water efficiency. WAVE is now seeking to promote these same principles in office buildings.

**How Can My Office Building Become More Water Efficient?**
Many office buildings are taking a serious look at their water use and are finding significant opportunities to cut costs and improve services through water efficiency. There are many opportunities to reduce water use in office buildings — bathroom fixtures such as toilets, faucets, and showers; landscape irrigation; heating and cooling; and food service areas and cafeterias.

By installing water-efficient equipment and integrating water efficiency practices into everyday operation, a 30 percent reduction in water consumption is possible. These cost-effective practices conserve energy and valuable natural resources and can significantly reduce your building's utility bills and chemical and maintenance costs.

In most cases, increasing water efficiency is simple to do and quick to pay off. Choose the water efficiency practices that are economically viable and offer the greatest rewards for your facilities.

**How Can I Determine Which Efficiency Measures Are Best for Me?**

WAVE•Saver for Office Buildings, a windows-based software package available from the EPA, enables building engineers and managers to survey and track water use and identify specific water-saving opportunities.

The program includes full-motion video demonstrations, color photos and graphics, and online tutorials. WAVE•Saver allows you to track water use throughout your building, including laundry operations, irrigation, and cooling towers. You can then identify and evaluate a variety of water efficiency measures to save water in those functions. WAVE•Saver has budgeting and forecasting features, and also includes an automated WAVE report feature to make completing and submitting efficiency measures reports as simple as printing. Operating instructions are included in the "help" feature on the CDROM, making a paper copy unnecessary.

**Water Efficiency Success Story: The City of San Diego's Ridgehaven Office Building**

In 1994, the City of San Diego purchased the vacant 73,000 square foot Ridgehaven office building for use by its Environmental Services Department (SDESD). Through a myriad of water and energy efficiency retrofits, SDESD transformed this aging structure into a model of water and
energy efficiency.

Currently, Ridgehaven saves 678,800 gallons of water annually — a 58 percent reduction compared to the building's previous water consumption. Through reduced water usage, Ridgehaven also realizes approximately $3,720 in avoided water costs annually. Associated reductions in energy demands and chemical use further contribute to Ridgehaven's savings. Ridgehaven's water efficiency accomplishments include the following:

- ✓ Saved 303,500 gallons of water annually by installing low-flow toilets — a 68 percent reduction.
- ✓ Saved 77,400 gallons of water annually by installing waterless and low-flow urinals — a 60 percent reduction.
- ✓ Saved 45,000 gallons of water annually by installing low-flow shower heads — a 29 percent reduction.
- ✓ Saved 216,000 gallons of water annually by replacing the original inefficient cooling towers with two new closed-loop cooling towers with adjustable conductivity settings allowing increased water reuse — a 45 percent reduction.

***With future plans to install an air separator for its cooling towers, Ridgehaven is not standing still in its water efficiency efforts. The air separator will improve water flow within the system and further reduce water consumption as well as the need for corresponding chemical treatments.***

***Ridgehaven also plans to convert all the building's landscaping to Xeriscape landscaping (e.g., using indigenous plants, minimizing turf areas, instituting efficient irrigation practices, using mulches to minimize evaporation) to further reduce water use.***

**Tom Arnold**
City of San Diego Environmental Services Department.

***"Water efficiency can help office building managers meet their goals to cut costs while still keeping their customers happy. Office building managers should take advantage of all of the water conservation opportunities in their buildings."***

**Tony Gregg**
City of Austin Water Conservation Program

WAVE is now seeking to promote these same principles in educational institutions such as schools, colleges, and universities.

**How Can My School, College, or University Become More Water Efficient?**

Many schools, colleges, and universities are taking a serious look at their water use and are finding significant opportunities to cut costs and improve services through water efficiency. There are many opportunities to reduce water use in educational institutions—laundry facilities; bathroom fixtures such as toilets, showers, and faucets; landscape irrigation; heating and cooling; food service operations and cafeterias; laboratories; and sports facilities.

By installing water-efficient equipment and integrating water efficiency practices into everyday operations, a 30 percent reduction in water consumption is possible.

These cost-effective practices conserve energy and valuable natural resources and can significantly reduce your institution's water, sewer, and energy bills, and chemical and maintenance costs. Schools, colleges, and universities can also use their unique position as educators to help promote water efficiency to the students and the community by example and through educational campaigns.

In most cases, increasing water efficiency is simple to do and quick to pay off. Choose the water efficiency practices that are economically viable and offer the greatest rewards for your facilities.

**Water Conservation Goes to College**

Interested in learning how to save $235,000 each year in water costs? That is how much Columbia University estimates it saves through one of the largest water-efficiency upgrades ever attempted at a university. Even with the cost of hiring an outside firm to design and implement all aspects of the work, Columbia cut its water bill by 25 percent and realized a payback period of only 1.8 years.

Columbia University, located on a 30-acre campus in Manhattan, New York, serves more than 10,000 undergraduate and graduate students. The university's water-efficiency upgrade focused on domestic water use, including replacement of toilets, showerheads, and faucet aerators with high-efficiency models. Columbia also installed a cross-campus water-pumping loop, which allows it to control water pressure and flow to each campus building.

With the loop installed, the University can more closely monitor water consumption and can eliminate all water storage tanks on campus, making annual tank cleaning and flushing unnecessary. Overall, the loop has drastically reduced the number of leaks and the amount of system maintenance required, resulting in further savings.

Using the annual savings from these projects, the University has financed additional energy conservation projects with longer payback periods.

***"Using water efficiently helps to address a number of issues that facility managers face. Water conservation measures helped us reduce maintenance, energy, and water costs by pinpointing high usage areas, replacing bathroom fixtures with low flow models, reducing leaks, and improving metering. At the same time, we helped meet our environmental goals."***

**Tony Trocchia**
Assistant Vice President of Facilities Operations,
Columbia University

**How Can I Join?**

For more information on how WAVE can help you identify water efficiency measures to meet your needs, call 202 564-0623/0624. You also can write to the WAVE Program at U.S. EPA (4204M), Ariel Rios Building, 1200 Pennsylvania Avenue, NW, Washington, DC 20460; or visit our Web site at <www.epa.gov/owm/genwave.htm>. Join WAVE today and make the commitment to take a leading role in conserving our vital water resources while saving money.

## Water-Efficient Landscaping

**What is Water-efficient Landscaping?**
Water, many agree, is our most precious natural resource; without it, life ceases. Yet judging by our water use and consumption practices, many of us in the United States seem to take it for granted.

A typical household uses approximately 260 gallons of water per day. "***Water conscious***" individuals often install high-efficiency showerheads and toilets and wash only full loads of clothes and dishes to reduce consumption. But in the summer, the amount of water used outdoors by a household can exceed the amount used for all other purposes in the entire year. This is especially true in hot, dry climates.

Gardening and lawn care account for the majority of this seasonal increase, but other outdoor activities, such as washing cars and filling swimming pools, also contribute. According to the U.S. Geological Survey, of the 26 billion gallons of water consumed daily in the United States[1], approximately 7.8 billion gallons, or 30 percent[2], is devoted to outdoor uses. The majority of this is used for landscaping.

In fact, it is estimated that the typical suburban lawn consumes 10,000 gallons of water above and beyond rainwater each year (Vickers, p 140). Many mistakenly believe that stunning gardens
and beautiful lawns are only possible through extensive watering, fertilization, and pesticide application. As this booklet will demonstrate, eye-catching gardens and landscapes that save water, prevent pollution, and achieved by employing water-efficient landscaping.

Water-efficient landscaping produces attractive landscapes because it utilizes designs and plants suited to local conditions. This booklet describes the benefits of water efficient landscaping. It includes several examples of successful projects and programs, as well as contacts, references, and a short bibliography.

For specific information about how to best apply water-efficient landscaping principles to your geographical area, consult with your county extension service and local garden and nursery centers. Local governments and water utilities also possess a wealth of information and suggestions for using water more efficiently in all aspects of your life, including landscaping.

Many terms and schools of thought have been used to describe approaches to water-efficient landscaping. Some examples include "***water-wise***," "***water-smart***," "***low-water***," and "***natural landscaping***." While each of these terms varies in philosophy and approach, they are all based on the same principles and are commonly used interchangeably.

One of the first conceptual approaches developed to formalize these principles is known as "***Xeriscape landscaping***." Xeriscape landscaping is defined as ***"quality landscaping that conserves water and protects the environment."*** The word "***Xeriscape***" was coined and copyrighted by Denver Water Department in 1981 to help make water conserving landscaping an easily recognized concept. The word is a combination of the Greek word ***"xeros,"*** which means "***dry***," and "***landscape***."

**The seven principles upon which Xeriscape landscaping is based are:**
• Proper planning and design
• Soil analysis and improvement
• Appropriate plant selection
• Practical turf areas
• Efficient irrigation
• Use of mulches
• Appropriate maintenance

**The eight fundamentals of water-wise landscaping, below, illustrate the similarities in the underlaying concepts and principles of Xeriscape landscaping and other water-efficient approaches.**
• Group plants according to their water needs.
• Use native and low-water-use plants.
• Limit turf areas to those needed for practical uses.
• Use efficient irrigation systems.
• Schedule irrigation wisely.
• Make sure soil is healthy.
• Remember to mulch.
• Provide regular maintenance.

In short, plan and maintain your landscape with these principles of water efficiency in mind and it will continue to conserve water and be attractive.

Denver Water welcomes the use of the term Xeriscape in books, articles, and speeches promoting water conserving landscape.

**Why Use Water-efficient Landscaping?**
Proper landscaping techniques not only create beautiful landscapes, but also benefit the environment and save water. In addition, attractive, water-efficient, low-maintenance landscapes can increase home values.

**Water-efficient landscaping offers many economic and environmental benefits, including:**
• Lower water bills from reduced water use.
• Conservation of natural resources and preservation of habitat for plants and wildlife such as fish and waterfowl.
• Decreased energy use (and air pollution associated with its generation) because less pumping and treatment of water is required.
• Reduced home or office heating and cooling costs through the careful placement of trees and plants.
• Reduced runoff of stormwater and irrigation water that carries topsoils, fertilizers, and pesticides into lakes, rivers, and streams.
• Fewer yard trimmings to be managed or landfilled.
• Reduced landscaping labor and maintenance costs.
• Extended life for water resources infrastructure (e.g., reservoirs, treatment plants, groundwater aquifers), thus reducing taxpayer costs.

**Water-Efficient Landscaping**
Landscaping that conserves water and protects the environment is not limited to arid landscapes with only rocks and cacti.

Through careful planning, landscapes can be designed to be both pleasing to the senses and kind to the environment. One simple approach to achieving this is applying and adopting the basic principles of water efficient landscaping to suit your climatic region. The seven principles of Xeriscape landscaping are used below to describe these basic concepts in greater detail.

**Proper planning and design**
Developing a landscape plan is the first and most important step in creating a water-efficient landscape.

Your plan should take into account the regional and microclimatic conditions of the site, existing vegetation, topography, intended uses of the property, and most importantly, the grouping of plants by their water needs. Also consider the plants' sun or shade requirements and preferred soil conditions.

A well-thought-out landscape plan can serve as your roadmap in creating beautiful, water-efficient landscapes and allow you to continually improve your landscape over time.

**Soil analysis and improvements**
Because soils vary from site to site, test your soil before beginning your landscape improvements.
Your county extension service can analyze the pH levels; nutrient levels (e.g., nitrogen, phosphorus, potassium); and the sand, silt, clay, and organic matter content of your soil. It can also suggest ways to improve your soil's ability to support plants and retain water (e.g., through aeration or the addition of soil amendments or fertilizers).

**Appropriate Plant Selection**
Your landscape design should take into account your local climate as well as soil conditions.

Focus on preserving as many existing trees and shrubs as possible because established plants usually require less water and maintenance. Choose plants native to your region. Native plants, once established, require very little to no additional water beyond normal rainfall. Also, because they are adapted to local soils and climatic conditions, native plants commonly do not require the addition of fertilizers and are more resistant to pests and disease.

When selecting plants, avoid those labeled "***hard to establish***," "***susceptible to disease***," or "***needs frequent attention***," as these types of plants frequently require large amounts of supplemental water, fertilizers, and pesticides. Be careful when selecting non-indigenous species as some of them may become invasive.

An invasive plant might be a water guzzler and will surely choke out native species. Your state or county extension service or local nursery can help you select appropriate plants for your area.

**How is Water-efficient Landscaping Applied?**
**Water-Efficient Landscaping**
The key to successful planting and transplanting is getting the roots to grow into the surrounding soil as quickly as possible. Knowing when and where to plant is crucial to speeding the establishment of new plants. The best time to plant will vary from species to

species. Some plants will thrive when planted while dormant and make sure sufficient moisture is available to support new growth (generally, spring is the best season, but check plant tags or consult with your local nursery for specific species).

**Practical turf areas**
How and where turf is placed in the landscape can significantly reduce the amount of irrigation water needed to support the landscape. Lawns require a large amount of supplemental water and generally greater maintenance than other vegetation. Use turf where it aesthetically highlights the house or buildings and where it has practical function, such as in play or recreation areas. Grouping turf areas can increase watering efficiency and significantly reduce evaporative and runoff losses. Select a type of grass that can withstand drought periods and becomes dormant during hot, dry seasons.

Reducing or eliminating turf areas altogether further reduces water use.

**Efficient irrigation**
Efficient irrigation is a very important part of using water efficiently outdoors, and applies in any landscape—whether Xeriscape or conventional.

**Use of mulches**
Mulches aid in greater retention of water by minimizing evaporation, reducing weed growth, moderating soil temperatures, and preventing erosion. Organic mulches also improve the condition of your soil as they decompose. Mulches are typically composed of wood bark chips, wood grindings, pine straws, nut shells, small gravel, or shredded landscape clippings.

Avoid using rock mulches in sunny areas or around non-arid climate plants, as they radiate large amounts of heat and promote water loss that can lead to scorching. Too much mulch can restrict water flow to plant roots and should be avoided.

**Appropriate maintenance**
Water and fertilize plants only as needed. Too much water promotes weak growth and increases pruning and mowing requirements. Like any landscape, a water-efficient yard will require regular pruning, weeding, fertilization, pest control, and irrigation. As your water-efficient landscape matures, however, it will require less maintenance and less water.

Cutting turf grass only when it reaches two to three inches promotes deeper root growth and a more drought-resistant lawn. As a rule of thumb, mow your turf grass before it requires more than one inch to be removed. The proper cutting height varies, however, with the type of grass, so you should contact your county extension service or local nursery to find out the ideal cutting height for your lawn.

Avoid shearing plants or giving them high nitrogen fertilizers during dry periods because these practices encourage water-demanding new growth.

**Water-Efficient Landscaping**
**Water-efficient Landscape Irrigation Methods**
With common watering practices, a large portion of the water applied to lawns and gardens is not absorbed by the plants. It is lost through evaporation, runoff, or being pushed beyond the root zone because it is applied too quickly or in excess of the plants' needs.

The goal of efficient irrigation is to reduce these losses by applying only as much water as is needed to keep your plants healthy.

This goal is applicable whether you have a Xeriscape or a conventional landscape.

To promote the strong root growth that supports a plant during drought, water deeply and only when the plant needs water. For clay soils, watering less deeply and more often is recommended.

Irrigating with consideration to soil type, the condition of your plants, the season, and weather conditions—rather than on a fixed schedule—significantly increases your watering efficiency.

Grouping plants according to similar water needs also makes watering easier and more efficient.

Irrigating lawns, gardens, and landscapes can be accomplished either manually or with an automatic irrigation system. Manual watering with a hand-held hose tends to be the most water-efficient method. According to the AWWA Research Foundation's outdoor end use study, households that manually water with a hose typically use 33 percent less water outdoors than the average household.

The study also showed that households with in-ground sprinkler systems used 35 percent more water, those with automatic timers used 47 percent more water, and those with drip irrigation systems used 16 percent more water than households without these types of systems. These results show that in-ground sprinkler and drip irrigation systems must be operated properly to be water efficient.

You can use a hand-held hose or a sprinkler for manual irrigation. To reduce water losses from evaporation and wind, avoid sprinklers that produce a fine mist or spray high into the air. Soaker hoses can also be very efficient and effective when used properly. Use a hand-held soil moisture probe to determine when irrigation is needed.

To make automatic irrigation systems more efficient, install system controllers, such as rain sensors, that prevent sprinkler systems from turning on during and immediately after rainfall, or soil moisture sensors that activate sprinklers only when soil moisture levels drop below preprogrammed levels.

You can also use a weather-driven programming system. Drip-type irrigation systems are considered the most efficient of the automated irrigation methods because they deliver water directly to the plants' roots. It is also important to revise your watering schedule as the seasons change. Over-watering is most common during the fall when summer irrigation schedules have not been adjusted to the cooler temperatures.

To further reduce your water consumption, consider using alternative sources of irrigation water, such as gray water, reclaimed water, and collected rainwater. According to the AWWA Research Foundation, homes with access to alternative sources of irrigation reduce their water bills by as much as 25 percent.

## Graywater Section

Graywater is untreated household waste water from bathroom sinks, showers, bathtubs, and clothes washing machines. Graywater systems pipe this used water to a storage tank for later outdoor watering use. State and local graywater laws and policies vary, so you should investigate what qualifies as gray water and if any limitations or restrictions apply. Reclaimed water is waste water that has been treated to levels suitable for nonpotable uses. Check with local water officials to determine if it is available in your area.

Collected rainwater is rainwater collected in cisterns, barrels, or storage tanks. Commercial rooftop collection systems are available, but simply diverting your downspout into a covered barrel is an easy, low-cost approach.

When collecting rainwater, cover all collection vessels to prevent animals and children from entering and to prevent mosquito breeding. Some states might have laws which do not allow collection of rainwater, so be sure to check with your state's water resource agency before implementing a rainwater collection system.

**Water-Efficient Landscaping**
Water-efficient landscaping techniques can be used by individuals, companies, state, tribal, and local governments, and businesses to physically enhance their properties, reduce long-term maintenance costs, and create environmentally conscious landscapes.

The following examples illustrate how water-efficient landscapes can be used in various situations.

**Homeowner–public/private partnership**
• The South Florida Water Management District, the Florida Nurserymen and Growers Association, the Florida Irrigation Society, and local businesses worked together to produce a television video called "***Plant It Smart with Xeriscape.***" The video shows how a typical Florida residential yard can be retrofitted with Xeriscape landscaping to save energy, time, and money. The showcase yard (selected from 70 applicants) had a history of heavy water use—more than 90,000 gallons per month.

After the retrofit, the yard's aesthetic value was enhanced; plus it now uses 75 percent less water and relies on yard trimmings for mulch and compost.

• The Southwest Florida Water Management District (**SWFWMD**), the City of St. Petersburg, and Pinellas County, Florida, produced a video called "***Xeriscape It***!" It shows a landscape being installed using the seven Xeriscape principles. The SWFWMD also funded several Xeriscape demonstration sites and maintains a Xeriscape demonstration garden at its Brooksville, Florida, headquarters. The garden features a variety of native and non-native plants and is available for public viewing, along with a landscape plant identification guide.

• Residents of Glendale, Arizona, can receive a $100 cash rebate for installing or converting more than half of their landscapable area to non-grass vegetation. The Glendale Water Conservation Office conducts an inspection of the converted lawn to ensure compliance with rebate requirements and then issues a rebate check to the homeowner. The purpose of the Landscape Rebate Program is to permanently reduce the amount of water used to irrigate grass throughout Glendale.

**State government**

• Although perceived as a water-rich state, Florida became the first to enact a statewide Xeriscape law. Florida's legislature recognized that its growing population and vulnerable environment necessitated legal safeguards for its water resources.

The Xeriscape law requires Florida's Departments of Management Services and Transportation to use Xeriscape landscaping on all new public properties and to develop a 5-year program to phase in Xeriscape on properties constructed before July 1992. All local governments must also consider requiring the use of Xeriscape and offering incentives to install Xeriscaping.

• Texas also developed legislation requiring Xeriscape landscaping on new construction projects on state property beginning on or after January 1994. Additional legislation, enacted in 1995, requires the Department of Transportation to use Xeriscape practices in the construction and maintenance of roadside parks. All municipalities may consider enacting ordinances requiring Xeriscape to conserve water.

**City government**

In Las Vegas, Nevada, homeowners can receive up to $1,000 for converting their lawn to Xeriscape, while commercial landowners can receive up to a $50,000 credit on their water bill. The city and several other surrounding communities hope these eye-catching figures will help Las Vegas meet its goal of saving 25 percent of the water it would otherwise have used by the year 2010; to date, it has saved 17 percent.

Local officials plan to reach the target with the assistance of incentive programs encouraging Xeriscape, a city ordinance limiting turf to no more than 50 percent of new landscapes, grassroots information programs, and a landscape awards program specifically for Xeriscaped properties.

Preliminary results of a five-year study show that residents who converted a portion of their lawns to Xeriscape reduced total water consumption by an average of 33 percent. The xeric vegetation required less than a quarter of the water typically used and one third the maintenance (both in labor and expenditures) compared to traditional turf.

Developer Howard Hughes Properties (**HHP**), a developer and manager of more than 25,000 acres of residential, commercial, and office development property, has enthusiastically used drought tolerant landscaping on all of its properties since 1990.

Most of the company's properties are located in Las Vegas, one of the country's fastest growing metropolitan areas. To conserve resources, the city and county have implemented regulations requiring developers to employ certain Xeriscape principles in new projects. Specifically, a limited percentage of grass can be used on projects, and it must be kept away from streets. As the area's first large-scale developer to recognize the need and value in incorporating drought tolerant landscaping in parks, streetscapes, and open spaces, HHP uses native and desert-adaptive plants that survive and thrive in the Las Vegas climate with minimal to moderate amounts of water.

**Water-Efficient Landscaping**

Drip system irrigation controllers are linked to weather stations that monitor the evapotranspiration rate.

This allows HHP to determine the correct amount of water to be applied to plants at any given time. HHP tests the irrigation systems regularly and adds appropriate soil amendments to promote healthy plant growth. The maintenance program also includes pest management, the use of mulching mowers, and the use of rock mulch top dressing on all non-turf planting areas. These measures combine to ensure a beautiful, healthy, and responsible landscape.

**Public/private partnerships**
Even the most water-conscious homeowners in Southern California are over-watering by 50 to 70 gallons per day. The excess water washes away fertilizers and pesticides, which pollute natural waterways. The quantity of water wasted (and the dollars that pay for it) are even more substantial for large-scale commercial properties and developments.

An innovative partnership in Orange County links landscape water management, green material management, and non-point source pollution prevention goals into one program—the Landscape Performance Certification Program.

This program emphasizes efficient landscape irrigation and features a "***landscape irrigation budget***" based on a property's landscape area, type, and the daily weather. The Municipal Water District monitors actual water use through a system of 12,000 dedicated water meters installed by participating landscape managers.

Participants, including landscapers, property managers, and homeowner associations, can compare the actual cost of water used on their property with the calculated budget. Those staying within budget are awarded certification, a proven marketing tool. This new voluntary program is implemented by the Municipal Water District with input from the California Landscape Contractors' Association, the Orange County Integrated Management Department, the Metropolitan Water District of Southern California, and local nurseries and has the support of 32 retailing water suppliers.

The program is already credited with increasing the use of arid-climate shrubs and landscaping to accommodate drip irrigation, and has resulted in cost savings to water customers.

**Arizona Municipal Water Users Association**
**(AMWUA)** Web: <www.amwua.org/program-xeriscape.htm>

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Web: <www.montana.edu/wwwwet>

**Rocky Mountain Institute**
1739 Snowmass Creek Road
Snowmass, CO 81654-9199
Phone: 970 927-3851
Web: <www.rmi.org>

**For More Information**
The following list of organizations can provide more information on water-efficient landscaping. This is not meant to be an exhaustive list, rather it is intended to help you locate local information sources and possible technical assistance.

**Water Management Districts or Utilities**
Your local water management district often can provide information on water conservation, including water efficient landscaping practices. Your city, town, or county water management district can be found in the Blue Pages section of your local phone book or through your city, town, or county's Web site if it has one. If you do not know your city, town, or county's Web site, check for a link on your state's Web site. URLs for state Web sites typically follow this format: <www.state.(two letter state abbreviation).us>.

**State/County Extension Services**
Your state or county extension service is also an excellent source of information. Many extension services provide free publications and advice on home landscaping issues, including tips on plant selection and soil improvement. Some also offer a soil analysis service for a nominal fee. Your county extension service can be found in the Blue Pages section of your local phone book under the county government section or through your county's Web site if it has one.

The U.S. Department of Agriculture's Cooperative State Research, Education, and Extension Service (www.reeusda.gov/statepartners/usa.htm) provides an online directory of land-grant universities which can help you locate your state extension service.

Government Guide (www.governmentguide.com) is yet another online resource that might prove helpful in locating state or local agencies.

**Organizations**
The following is a partial list of organizations located across the United States that provide helpful information on water-efficient landscaping.

For even more information, particularly on plants suited to your locale, consult your local library, county extension service, nursery, garden clubs, or water utility.

Ball, Ken and American Water Works Association Water Conservation Committee. *Xeriscape Programs for Water Utilities.* Denver: American Water Works Association, 1990.
Bennett, Jennifer. *Dry-Land Gardening: A Xeriscaping Guide for Dry-Summer, Cold-Winter Climates.* Buffalo: Firefly, 1998.
Bennett, Richard E. and Michael S. Hazinski. *Water-Efficient Landscape Guidelines.* Denver: American Water Works Association, 1993.
Brenzel, Kathleen N., ed. *Western Garden Book,* 2001Edition. Menlo Park: Sunset Publishing Corporation, 2001.
City of Aurora, Colorado Utilities Department. *Landscaping for Water Conservation: Xeriscape!* Aurora: Colorado Utilities Department, 1989.
Johnson, Eric and Scott Millard. *The Low-Water Flower Gardener: 270 Unthirsty Plants for Color, Including Perennials, Ground Covers, Grasses & Shrubs.* Tucson: Ironwood Press, 1993.
Knopf, James M. *The Xeriscape Flower Gardener.* Boulder: Johnson Books, 1991.
Knopf, James M., ed. *Waterwise Landscaping with Trees, Shrubs, and Vines: A Xeriscape Guide for the Rocky Mountain Region, California, and the Desert Southwest.* Boulder: Chamisa Books, 1999.
Knox, Kim, ed. *Landscaping for Water Conservation: Xeriscape.* Denver: City of Aurora and Denver Water, 1989.
Nellis, David W. *Seashore Plants of South Florida and the Caribbean: A Guide to Identification and Propagation of Xeriscape Plants.* Sarasota: Pineapple Press, Inc., 1994.
Perry, Bob. *Landscape Plants for Western Regions: An Illustrated Guide to Plants for Water Conservation.* Claremont: Land Design Publishing, 1992.
Phillips, Judith. *Natural by Design: Beauty and Balance in Southwest Gardens.* Santa Fe: Museum of New Mexico Press, 1995.

**Water-Efficient Landscaping**
**Southern Nevada Water Authority**
1001 S. Valley View Boulevard, Mailstop #440
Las Vegas, NV 89153
Phone: 702 258-3930
Web: <www.snwa.com>

**Southwest Florida Water Management District**
2379 Broad Street
Brooksville, FL 34604-6899
Phone: 352 796-7211 or 800 423-1476 (Florida only)
Web: <www.swfwmd.state.fl.us/watercon/
xeris/swfxeris.html>

**Sustainable Sources Green Building Program: Sustainable Building Source Book**
E-mail: info@greenbuilder.com
Web: <www.greenbuilder.com/sourcebook/
xeriscape.html>

**Water Conservation Garden – San Diego County**
12122 Cuyamaca College Drive West
El Cajon, CA 92019
Phone: 619 660-0614
Fax: 619 660-1687
E-mail: info@thegarden.org
Web: <www.thegarden.org/garden/xeriscape/
index.html> and <www.sdcwa.org/manage/conservation-xeriscape.phtml>\

**WaterWiser: The Water Efficiency Clearing House**
(Operated by AWWA in cooperation with the U.S. Bureau of Reclamation)
6666 West Quincy Avenue
Denver, CO 80235
Phone: 800 559-9855
Fax: 303 794-6303
E-mail: bewiser@waterwiser.org
Web: <www.waterwiser.org>

**Xeriscape Colorado!, Inc.**
P.O. Box 40202
Denver, CO 80204-0202
Web: <www.xeriscape.org>

## Resources

**Water-Efficient Landscaping**
Phillips, Judith. *Plants for Natural Gardens: Southwestern Native & Adaptive Trees, Shrubs, Wildflowers & Grasses.* Santa Fe: Museum of New Mexico Press,1995.
Robinette, Gary O. *Water Conservation in Landscape Design and Maintenance.* New York: Nostrand Reinhold, 1984.
Rumary, Mark. *The Dry Garden.* New York: Sterling Publishing Co., Inc., 1995.
Springer, Lauren. *The Undaunted Garden: Planting for Weather-Resilient Beauty.* Golden: Fulcrum Publishing, 1994.
Springer, Lauren. *Waterwise Gardening.* New York: Prentice Hall Gardening, 1994.
Stephens, Tom, Doug Welsh, and Connie Ellefson. *Xeriscape Gardening, Water Conservation for the American Landscape.* New York: Macmillan Publishing,1992.
Sunset Books, eds. *Waterwise Gardening: Beautiful Gardens with Less Water.* Menlo Park: Lane Publishing Company, 1989.
Vickers, Amy. *Handbook of Water Use and Conservation.* Amherst, MA: WaterPlow Press, 2001.
Weinstein, Gayle. *Xeriscape Handbook: A How-To Guide to Natural, Resource-Wise Gardening*. Golden: Fulcrum Publishing, 1998.
Williams, Sara. *Creating the Prairie Xeriscape.* Saskatchewan: University Extension Press, 1997.
Winger, David, ed. *Xeriscape Plant Guide: 100 Water-WisePlants for Gardens and Landscapes.* Golden: Fulcrum Publishing, 1998.
Winger, David, ed. *Xeriscape Color Guide.* Golden: Fulcrum Publishing, 1998.
Winger, David, ed. *Evidence of Care: The Xeriscape Maintenance Journal, 2002, Vol. 1*, Colorado WaterWise Council, 2001.
Technical advice provided by Alice Darilek, Elizabeth Gardener, and David Winger.

**For more information regarding water efficiency, please contact:**
Water Efficiency Program (4204M)
U.S. Environmental Protection Agency
Ariel Rios Building, 1200 Pennsylvania Avenue, NW.
Washington, DC 20460
<www.epa.gov/OWM/water-efficiency/index.htm>

# Water Conservation Ordinance Examples Section

***Educational Uses Only.***

## Water Conservation Ordinance Example #1

- Town of Sunflower Ordinance No. 506, Water Conservation and Requirements and Restrictions to Manage Water During Periods of Water Shortage, and Declaring an Emergency was adopted by Town Council in 1997.

- The Town of Sunflower has historically experienced conditions of drought and during times of drought, the Town has experienced situations in which water demand has exceeded production capability in the Town water system

- The Town of Sunflower is surrounded by natural forest lands which are especially subject to forest fire during the summer months at the same time that other demands upon the Sunflower water system are at their highest and in the interest of the general welfare of the citizens of the Town of Sunflower to maintain water levels sufficient to assist in the fighting of fires year-round, but especially so during summer drought periods while providing its citizens with sufficient water.

- The Town of Sunflower has determined that it is appropriate and prudent to ameliorate demand stresses on its water system through conservation measures and prohibitions against unnecessary or unwise water usage during such periods of time.

Section 1. There is hereby established the following policies, rules, regulations, penalties and plans for the Town of Sunflower to be implemented during water conservation periods.

Section 3. **Water Conservation Compliance.** It shall be unlawful for any customer of the Town of Sunflower Water Department to and no customer of the Town of Sunflower Water Department shall knowingly make, cause, use or permit the use of water from the Town for residential, commercial, industrial, agricultural or any other purpose in a manner contrary to any provisions of this Ordinance, or in an amount in excess of that use is permitted under any water conservation level declared in accordance with this Ordinance.

Section 4. **Restrictions During Water Shortages.**

A. The Town Manager, upon the recommendation of the Public Works Director, is hereby authorized to declare Water Conservation Levels in conformity with and based upon the Resource Status Levels set forth herein below which assess the relationship between water demand and municipal safe production capability.

Safe production capability is ninety percent (90%) of the total available water resources, based upon distribution components, storage reserves, weather conditions and historic data.

B. The following Resource Status Levels are hereby prescribed:

1. Resource Status I: When water demand is equal to or less than safe production capability.
2. Resource Status II: When demand is greater than safe production capability for three (3) consecutive days.
3. Resource Status III: When demand is greater than safe production capability for two (2) consecutive weeks.
4. Resource Status IV: When water demands exceeds total production capability.

C. The following Water Conservation Levels shall govern the use of water by customers of the Sunflower Water Department, as prescribed below:

***Water Conservation Level I: Water Awareness***. Water users are specifically encouraged to minimize waste in water used for irrigation, vehicle and pavement washing, construction and other water consuming activities.

1. ***Water Conservation Level II: Water Restriction.*** The Following water users are restricted or prohibited. No person shall:
   a. Irrigate, wash vehicles, fill or refill pools, spas or wading pools except as vided herein and subject to additional restriction as contained herein. Even-numbered street addresses are restricted to said uses on Monday, Wednesday, Friday and Sunday; odd-numbered street addresses and all other addresses are restricted to Tuesday, Thursday, and Sunday.
   b. Wash vehicles on the allowed days unless a bucket and hose with a positive cutoff nozzle is used. No restrictions apply to vehicles that must be washed for public health, safety or welfare purposes, or to commercial car washes.
   c. Wash paved areas such as drives, sidewalks, or tennis courts, except for health or safety.
   d. Irrigate golf courses except before noon and after 7:00 p.m. No restrictions if treated effluent is used.
   e. Use ornamental fountains except if equipped with a recycling pump.
   f. Use water from a fire hydrant expect for emergencies or upon the written approval of the Public Works Director and the Fire Chief; and except for such use associated with firefighting activities, public health, safety or welfare.

2. ***Water Conservation Level III: Water Emergency.*** In addition to the restrictions set forth in Section 4.C.2.a through 4.C.2.f above, the following water uses are further restricted or prohibited. No person shall:
   a. Fill or refill swimming pools, spas or wading pools.
   b. Irrigate golf courses. No restrictions apply if treated effluent is used.
   c. Wash vehicles, paved areas, or use fire hydrants on a non-emergency basis without written approval of the Public Works Director and the Fire Chief. No restrictions apply to vehicles that must be washed for public health, safety or welfare, or to commercial car washes.
   d. Irrigate outdoors other than between the hours of 6:00 p.m. to 10:00 p.m. and 4:00 a.m. to 8:00 a.m. on Monday and Thursday for even-numbered street addresses and on Tuesday and Friday for odd-numbered street addresses and all others. No restrictions if treated effluent is used.

4. ***Water Conservation Level IV: Water Crisis.*** The following water uses are restricted or prohibited. No person shall:

   a. Do any of the acts prescribed in Sections 4.C.2.a through 4.C.2.f. and 4.C.3.a through 4.C.3.d above.
   b. Use any potable water for irrigation.
   c. Use fire hydrants, wash pavements, fill or refill pools or spas or fountain unless for public health, safety or welfare.
   d. Use potable water for dust control on public or private streets or capital improvement projects.
   e. Use potable water in violation of any other restriction deemed necessary by the Town Council for the purpose of protecting the welfare of the citizens of the Town of Sunflower.

## PROGRAM DESCRIPTIONS *Examples*

The following program area descriptions and specific program elements are the focus of the 2000 Water Conservation Plan. These elements are the result of what the customers of Sunflower said they want from the conservation program: education and public awareness; technical assistance; regulations; planning and research; and, interagency coordination. Some program elements continue activities initiated during implementation of the 2000 plan. Some are adaptations of elements necessitated by changing circumstances and new technology. Others describe programs that will be created and collateral materials which will be developed and produced to implement new program initiatives in response to customer desires.

***PROGRAM 1: EDUCATION AND PUBLIC AWARENESS***

**School Education**

Education (K-12): Research conducted by the Water Department prior to development of this plan indicated a strong customer interest in water education for children. Community leaders and residents placed almost identical emphasis on water conservation awareness education. Community leaders responded in this fashion, to meet this customer mandate. The Water Department developed these recommendations into what has become the town's water conservation education program.

This program has integrated water conservation into a broad water education program; and has involved the issues of where domestic drinking water comes from and how to protect our water supplies from pollution. Among the first recommendations were the following:

***Project WET*:** (Water Education for Teachers) An interdisciplinary, supplementary water education program, the goal of Project WET is to facilitate and promote the awareness, appreciation, and knowledge of water resources education. The instructional activities span grades from kindergarten through high school, allowing the teacher to choose activities that best suit the needs of the classroom curriculum. There are pages, which may be copied for class use, and the majority of the activities include hands-on learning and enrichment opportunities.

This workshop introduces the teacher to the materials and ensures that the teacher will use the materials correctly. Components of the Project WET workshop focus on Arizona-Specific water issues and pollution prevention activities. This was developed by the University of Arizona Water Resources Research Center specifically for local supplement to the national workshop.

***School Curriculum Materials:*** In addition to Project WET materials, the Town distributes teachers' guides, student books and materials, and the Arizona water maps to facilitate lessons for students in grades K-12.

***Forest Park Lake Project;*** The constructed wetlands habitat component of Walker County Sanitary District Wastewater Treatment Plant provides a living laboratory to learn about water treatment and the environment, including the interaction of fish and wildlife.

-  ***Mini Grants****:* Small development grants from the Town to schools will create additional teaching tools for water education.

-  ***School Garden Program****:* In conjunction with the Master Gardener Program at the Cooperative Extension Service, school site-based demonstration gardens for native low-water use plants will be developed.

**Residential**

Homeowner irrigation classes will teach fundamentals of efficient drip and sprinkler irrigation, use of lawn water guides and simple irrigation auditing techniques. Four types of workshops will be offered in the spring and fall at libraries and community centers. Currently, the Town is proposing using local experts to assist in this endeavor.

| Class Name | Schedule | # Taught per Year |
|---|---|---|
| Introduction to Sprinkler Systems | 1 Night, 2.5 Hours | 2 |
| Introduction to Drip Irrigation Systems | 1 Night, 2.5 Hours | 2 |
| Sprinkler System Design | 1 Nights, 2.5 Hours | 1 |
| Drip Irrigation System Design | 1 Nights, 2.5 Hours | 1 |

Classes generally will be advertised through in the local Sunflower newspapers. Some workshops may be sponsored and advertised through the Parks and Recreation Department. Staff is exploring expanding the menu to include classes on rainwater harvesting. A workshop on irrigating with grey water has been developed.

- Homeowner landscape workshops introduce the aesthetics and water conservation potential of Xeriscape for residential landscapes will be offered. Residents will learn the basics of Xeriscape design, irrigation and plant materials selection.

- Homeowner landscape design workshops assist residents in the design of residential Xersicapes. Residents will learn more advanced Xeriscape design concepts and leave with a basic design for their residence. Some of these events will be included in the Water-Wise Garden and Landscape Festivals.

- Public Events. Community fairs and events, and home and garden shows are held on an annual basis in the Sunflower area. Public events are a mechanism for taking water conservation messages directly to customers. Water conservation staff participates in a minimum of two major community events per year.

- Town of Sunflower's Computer Home Page Web Site. This Internet computer information tool will help assist customers in many different ways. The Water Department offers several different and entertaining programs, water conservation to pollution prevention web sites.

- KMIG Radio Campaign. The Water Department has a radio announcement campaign that runs during the spring and summer seasons. These fifteen or thirty second announcements are just one of many techniques that the Water Department uses to help our community conserve our most precious natural resource.

- Channel 9 Television Campaign. The Water Department has a television commercial announcement campaign that runs during the entire year. These forty-five second commercials are just one of many techniques that the Water Department uses to help our community conserve water and have been received with great public support.

- Local Newspaper Sponsorship. Sunflower's Public Awareness Campaign includes the bi-weekly sponsorship of the local meteorological report. Each issue, the Town publishes a water conservation hint along with the evaporation/transpiration rate, a daily guide for watering grass.

- Conservation Literature Distribution. Literature on a variety of conservation topics and techniques is available and provided on demand through telephone inquiries, at specials events, through customer services locations, and via distribution by Water staff who make contact with customers in the normal pursuit of field activities or presentation responsibilities.

- Water Conservation/Pollution Prevention Banner. The Town of Sunflower has water conservation public awareness banners on all Town vehicles and a billboard size as well for business shows and presentations. This is part of Sunflower's Public Awareness Campaign.

- Promotion of 6-liter toilets could be done through press and distribution of literature. In a drought situation, depending on severity, a financial incentive program to encourage replacement of 3.5 to 5-gallon toilets with 1.6 gallon models will be considered.

- Efficient appliances promotion. Promotional materials to focus on the water and energy saving benefits of horizontal axis washing machines will be developed. The Water Department may participate in an U. S. Department of Energy financial incentive or quantity purchase program to promote this technology.

- Evaporative Cooler technology and efficiency information will be offered through new publications and promotional programs to assist customers to improve evaporative cooler efficiency and to optimize their cooling expenditures.

**Non-Residential**

Workshops. Workshops will be offered at least once annually to facility managers, including Town of Sunflower facilities managers, on a wide range of topics from general water conservation planning to cooling tower treatment and maintenance, and irrigation control on a local or regional level.

In-Town Employee/Facility Management training. This training consists of: Introducing the concept of water conservation to new employees via their orientation class;

- Providing technical assistance materials to Town facility personnel;
- Providing training to water conservation/pollution prevention (P2) training to Town inspectors so they can be aware of conservation opportunities and can be able to assist customers. Current Plumbing Codes and water conservation techniques will be utilized.

All Parks Department gardeners receive annual training on efficient watering practices. Park's management also receives instruction on how to use computers to develop efficient watering schedules.

- Forest Park Lake utilization. The town will encourage the use of Forest Park and possible future Xeriscape garden has a teaching field trip site for education programs, including some teacher training sessions. This is also the primary site for the town's Water-Wise Garden and Landscape Festival.

- Artificial turf utilization. The Town encourages the use of artificial grass. This water conservation program started with a soccer field replacement and will continue with residential use.

## Turf Resolution Example

1. All plant material used for landscaping shall be from the Low Water Use Plant Lists in development Bulletin 15-1. Development projects will be required to use mulch, rocks, art and other non-plant materials that do not use water and/or help to prevent evaporation.

2. Turf Areas or lawn areas are only permitted when reclaimed water is used for irrigation or within an Oasis area.

3. Irrigation systems shall be of the "drip irrigation" type. Irrigation systems must be limited to operation between the hours of 7:00 PM and 7:00 AM. Spray, sprinkler bubbler, and soaker hose irrigation systems are prohibited, except to irrigate turf or lawn areas within an Oasis Area. Flood irrigation methods are absolutely prohibited.

4. All water features such as fountains, ponds, falls, etc. must use recirculated water and must not have a water capacity larger than 50 gallons.

5. Live native trees of greater than six-inch diameter at the 4 foot level must be preserved whenever possible.

6. An Oasis Area may be used for turf or lawns, flower or vegetable gardens, but shall be limited to 1,000 sq. ft. or 3% of the entire development site or parcel, whichever is less.

7. Minimum landscaping requirements for street right-of-way areas or the first 10 feet of the yard setback areas. Minimum landscaping requirements for areas where residential and non-residential areas abut one another

   - Buffering and Right-Of-Way Requirements. As part of the Town municipal water conservation requirements, all plants in rights-of-way and served by Town of Sunflower water shall be from the Sunflower Low-Water Using Plant List. This requirement is reviewed by Water Department staff and will continue. A copy is available in the Appendix.

**PROGRAM AREA 3: REGULATION**

***Complete copies can be found in the Appendix*.**

**Ordinance No. 537 Equivalent Residential Unit (ERU) Ordinance**

- Town of Sunflower Ordinance No. 537, Equivalent Residential Unit Requirements adopted by Town Council in 1999 provides that an equivalent residential unit is the amount of water necessary to serve a residential unit with 7,500 gallons of potable water.

- Water development fees currently projected and established as a multiple of equivalent peak residential units.

- Desire to allow for adjustment in the initial projected number of units, based upon actual historical water use.

**Ordinance Example Water Development Fees Ordinance**

- Town of Sunflower Ordinance No. 528, Water Development Fees adopted by Town Council in 1998 mandates that the water development fee established by Ordinance No. 480 was insufficient to fully provide for the acquisition of new water supplies and new water delivery systems to provide for the demands of new development while providing for the continuation of a reasonable water supply to existing residents of the community.

- The Town of Sunflower has determined that, to the extent that new development and new residents place demands upon the public water facilities of the Town, those demands should be satisfied by shifting the responsibility for financing the provision of such facilities which provide benefits to new development from the public at large to the development creating those demands.

- Equivalent Peak Residential Unit: An Equivalent Peak Residential Unit shall be the amount of water necessary to serve a residential unit with seven thousand five hundred (7,500) gallons of potable water. The Water Development Fee for proposed uses in excess of such amount shall be established on the basis of projected monthly water use as a multiple of the Equivalent Peak Residential Unit.

**Ordinance Example, Water Conservation Ordinance**

- Town of Sunflower Ordinance No. 506, Water Conservation and Requirements and Restrictions to Manage Water During Periods of Water Shortage, and Declaring an Emergency was adopted by Town Council in 1997.

- The Town of Sunflower has historically experienced conditions of drought and during times of drought, the Town has experienced situations in which water demand has exceeded production capability in the Town water system

- The Town of Sunflower is surrounded by natural forest lands which are especially subject to forest fire during the summer months at the same time that other demands upon the Sunflower water system are at their highest and in the interest of the general welfare of the citizens of the Town of Sunflower to maintain water levels sufficient to assist in the fighting of fires year-round, but especially so during summer drought periods while providing its citizens with sufficient water.

- The Town of Sunflower has determined that it is appropriate and prudent to ameliorate demand stresses on its water system through conservation measures and prohibitions against unnecessary or unwise water usage during such periods of time.

Section 1. There is hereby established the following policies, rules, regulations, penalties and plans for the Town of Sunflower to be implemented during water conservation periods.

Section 2. **Declaration of Policy:** Because of the conditions prevailing in the Town of Sunflower, the general welfare requires that the water resources available to the Town be put to the maximum beneficial use to the extent to which they are capable, and that waste, unreasonable use, or unreasonable method of use of water be prevented, and that conservation of water be provided for in the interests of the Town of Sunflower and for the public welfare.

Section 3. **Water Conservation Compliance.** It shall be unlawful for any customer of the Town of Sunflower Water Department to and no customer of the Town of Sunflower Water Department shall knowingly make, cause, use or permit the use of water from the Town for residential, commercial, industrial, agricultural or any other purpose in a manner contrary to any provisions of this Ordinance, or in an amount in excess of that use is permitted under any water conservation level declared in accordance with this Ordinance.

Section 4. **Restrictions During Water Shortages.**

A. The Town Manager, upon the recommendation of the Public Works Director, is hereby authorized to declare Water Conservation Levels in conformity with and based upon the Resource Status Levels set forth herein below which assess the relationship between water demand and municipal safe production capability. Safe production capability is ninety percent (90%) of the total available water resources, based upon distribution components, storage reserves, weather conditions and historic data.

B. The following Resource Status Levels are hereby prescribed:

a. Resource Status I: When water demand is equal to or less than safe production capability.
b. Resource Status II: When demand is greater than safe production capability for three (3) consecutive days.
c. Resource Status III: When demand is greater than safe production capability for two (2) consecutive weeks.
d. Resource Status IV: When water demands exceeds total production capability.

C. The following Water Conservation Levels shall govern the use of water by customers of the Sunflower Water Department, as prescribed below:

i. ***Water Conservation Level I: Water Awareness***. Water users are specifically encouraged to minimize waste in water used for irrigation, vehicle and pavement washing, construction and other water consuming activities.

ii. ***Water Conservation Level II: Water Restriction.*** The Following water users are restricted or prohibited. No person shall:

g. Irrigate, wash vehicles, fill or refill pools, spas or wading pools except as vided herein and subject to additional restriction as contained herein. Even-numbered street addresses are restricted to said uses on Monday, Wednesday, Friday and Sunday; odd-numbered street addresses and all other addresses are restricted to Tuesday, Thursday, and Sunday.
h. Wash vehicles on the allowed days unless a bucket and hose with a positive cutoff nozzle is used. No restrictions apply to vehicles that must be washed for public health, safety or welfare purposes, or to commercial car washes.
i. Wash paved areas such as drives, sidewalks, or tennis courts, except for health or safety.
j. Irrigate golf courses except before noon and after 7:00 p.m. No restrictions if treated effluent is used.
k. Use ornamental fountains except if equipped with a recycling pump.
l. Use water from a fire hydrant expect for emergencies or upon the written approval of the Public Works Director and the Fire Chief; and except for such use associated with firefighting activities, public health, safety or welfare.

iii. ***Water Conservation Level III: Water Emergency.*** In addition to the restrictions set forth in Section 4.C.2.a through 4.C.2.f above, the following water uses are further restricted or prohibited. No person shall:

e. Fill or refill swimming pools, spas or wading pools.

f. Irrigate golf courses. No restrictions apply if treated effluent is used.

g. Wash vehicles, paved areas, or use fire hydrants on a non-emergency basis without written approval of the Public Works Director and the Fire Chief. No restrictions apply to vehicles that must be washed for public health, safety or welfare, or to commercial car washes.

h. Irrigate outdoors other than between the hours of 6:00 p.m. to 10:00 p.m. and 4:00 a.m. to 8:00 a.m. on Monday and Thursday for even-numbered street addresses and on Tuesday and Friday for odd-numbered street addresses and all others. No restrictions if treated effluent is used.

4. ***Water Conservation Level IV: Water Crisis.*** The following water uses are restricted or prohibited. No person shall:

f. Do any of the acts prescribed in Sections 4.C.2.a through 4.C.2.f. and 4.C.3.a through 4.C.3.d above.

g. Use any potable water for irrigation.

h. Use fire hydrants, wash pavements, fill or refill pools or spas or fountain unless for public health, safety or welfare.

i. Use potable water for dust control on public or private streets or capital improvement projects.

j. Use potable water in violation of any other restriction deemed necessary by the Town Council for the purpose of protecting the welfare of the citizens of the **Town of Sunflower**

Section 5. Termination Of Water Service For Violation. In addition to any other legal or equitable remedy to enforce the provisions of this Ordinance Number 506, the Town of Sunflower may terminate or suspend water service to property owned or controlled by any party in violation of any provision in this Ordinance. The Town manager or the Public Works Director may cause a notice of water termination to be served upon the violating party stating that service will be discontinued in five (5) calendar days from the day of service unless a hearing is requested. A hearing may be requested by delivery of a request in writing to the Town Manager, which shall be received by the Town Manager, on or before the expiration of said five (5) calendar day period. If a hearing is requested, the Town Manager shall convene a hearing within three (3) days of the written request. The requesting party may appear before the Town Manager and may present such evidence and reasons such party may have for not effectuating a termination or suspension of water service and may bring to the hearing such other persons or evidence as such party may desire. After hearing, and upon finding that such a violation has occurred, the Town Manager may order that water service be terminated or suspended pending compliance with the provisions in this Ordinance.

Section 6. Penalties. Any violation of any provision in this Ordinance shall be a civil violation and shall be subject to a civil sanction not less than Fifty Dollars ($50.00) and not to exceed Two Thousand Five Hundred Dollars ($2,500.00) for each day that the violation continues. The imposition of a civil sanction shall not be suspended.

Section 7. If any section, subsection, sentence, clause, phrase or portion of this Ordinance Number 506 is for any reason held to be invalid or unconstitutional by the decision of any court of competent jurisdiction, such decision shall not affect the validity of the remaining portions thereof.

Section 8. All ordinances and parts of ordinances in conflict with the provisions of this Ordinance are hereby repealed to the extent of such conflict.

## Water Supply & Storage Requirements Ordinance Example

- Town of Sunflower Ordinance No. 481, Water Supply & Storage Requirements was adopted by Town Council in 1996 amends Ordinance No. 275 which was adopted in 1986. This Ordinance sets water storage requirements for new residential, commercial or industrial sites.

**Water Development Fees Ordinance Example**

- Town of Sunflower Ordinance No. 480, Water Development Fees Ordinance was adopted by Town Council in 1996 bears a reasonable relationship to the water supply and delivery burdens imposed upon the Town by new development.

- Mandates the necessity for acquiring new water supplies and new water delivery systems to provide for the continuation of a reasonable water supply to existing residents of the community.

- The fee established in this ordinance bears a reasonable relationship to the burden imposed upon the Town of Sunflower by new development, new residents and continued growth. Water Features: The use of water features are permitted with the following restrictions:

**Native & Low Water Use Landscaping Example**

- Town of Sunflower Resolution No. 1303, Native and Low-Water Use Landscaping-Buffer Requirements adopted by Town Council in 1998 mandates conservation at turf-related facilities by requiring the use of reclaimed water only. Turf areas or lawn areas are only permitted when reclaimed water is used for irrigation or within an Oasis Area.

- Water Features: The use of water features are permitted with the following restrictions:

1. All water features such as fountains, ponds falls, etc. must use recirculated water.
2. Water capacity for water features shall not exceed fifty (50) gallons.

- Use of Low Water Use Heating Devices: "Point-of-use" water heaters or properly designed "closed loop" hot water recirculation systems shall be utilized in all structures to avoid wasting water while waiting for it to get hot.

**Water Conservation Plumbing Requirements Example**

- The Sunflower Construction Code specifies maximum flow rates for domestic plumbing in buildings. Flow rates and consumption maximums are consistent with state law and with federal appliance water use restrictions. These standards are enforced on all new construction or permitted reconstruction. Standards are enforced by the Community Development Department.

**New Water Rates for Summer Conservation Example**

- Town of Sunflower Resolution No. 1322, New Water Rates for Summer Conservation was adopted by Town Council in 1998 justifying a water increase for water consumption higher than 10,000 gallons per month from May through September each year to provide economic incentive for water conservation.

## WATER CONSERVATION City of Sierra Vista *Ordinance Example*

151.16.001 Purpose
151.16.002 Water- Saving Plumbing Fixtures
151.16.003 Water Conservation Guidelines
151.16.004 Water Use Regulations – All Property

**Section 151.16.001 Purpose**

Being that the City of Sierra Vista is committed to conserving water, the following goals are established:

A. To reduce the rate of depletion of groundwater resources in order to ensure the availability of water for future use.
B. To assist in reducing overall per capita water use.
C. To reduce yard irrigation and irrigation-related waste.
D. To reduce irrigation water usage without sacrificing landscape quality by using lower water use plants, improved design and planting practices, different watering practices, and better irrigation system design and maintenance.
E. To encourage voluntary water conservation for existing single family residences while requiring conservation on all other properties.
F. To establish rebate programs which would provide incentives in the form of rebates for conversion to water saving devices.

Section 151.16.002 Water – Saving Plumbing Fixtures

A. New Construction: Interior Plumbing. All interior plumbing in new buildings, including all residential uses, shall meet the following requirements:

1. Toilets shall not use more than 1.6 gallons per flush, including toilets with flush valves.
2. Shower heads shall be designed to use no more than three gallons per minute at a pressure of 80 psi.
3. Kitchen and lavatory faucets and replacement aerators shall be designed to deliver no more than an average of three gallons of water per minute at a pressure of 80 psi or shall be equipped with permanent flow control devices that allow delivery of no more than an average of three gallons of water per minute at a pressure of 80-psi.
4. Evaporative cooling systems and decorative fountains shall be equipped with water recycling or reuse systems.
5. All new hot water pipes shall be insulated during construction, as per the Uniform Plumbing Code.
6. All new residential construction shall include hot water recirculating systems.

B. Commercial; Industrial and Public Development

1. Lavatory faucets shall be equipped with a mechanism that causes the faucets to close automatically after delivering no more than an average of one quart of water.
2. Waterless urinals shall be installed in all new public, commercial, multi-family residential common-use, and industrial buildings where urinals are utilized. All applicable plumbing codes shall apply.
3. Existing public, commercial, multi-family residential common-use, and industrial building restroom remodels or retrofits shall convert existing urinals to waterless urinals.
4. All new commercial car wash facilities shall utilize water recycling systems which recycle a minimum of 75 percent of the water utilized.
5. No automatic toilet flushing fixtures (without sensors) shall be allowed in a new or retrofit construction.

C. Existing Buildings. In existing buildings or premises in which plumbing installations are to be replaced, such replacement shall comply with all code requirements for water-saving devices.

**Water Conservation Guidelines**

1. To the extent feasible, spray irrigation on city owned property during the months of April through October must occur between the hours of 4:00 a.m. and 9:00 a.m. This restriction serves as a guideline for landscape watering on non-city owned property. This restriction shall not apply to drip irrigation and low precipitation bubblers, hand watering, or watering of containerized plants and plant stock.
2. To the extent feasible, all spray irrigation on city owned property during the months of November through March must occur between the hours of 10:00 a.m. and 3:00 p.m. This restriction serves as a guideline for landscape watering on non-city owned property. This restriction shall not apply to drip irrigation and low precipitation bubblers, hand watering, or watering containerized plants and plant stock. This restriction shall not apply to golf courses or parks that are in regular use or in use for a special event during these hours.
3. To the extent feasible, all city owned properties other than parks and golf courses shall water no more than every other day.
4. Restrictions in division (1), (2) and (3) above do not apply to the following:
   a. Outdoor irrigation necessary for the establishment of newly sodded lawns and landscaping within the first 30 days of planting, or watering of newly seeded turf within the first year of planting, or after top dressing and fertilizing, or after cutting turf.
   b. Irrigation necessary for one day only where treatment with an application of chemicals requires immediate watering to preserve and existing landscape or to establish a new landscape;
   c. Water used to control dust or compact soil;
   d. Visually supervised operation of watering systems for short periods of time to check system condition and effectiveness.
5. Automatic shutoff nozzles are recommended for use on any hoses used for hand watering, car washing or other outdoor uses.

6. To the extent possible, outdoor swimming pools should be covered when not use is for a period greater than 5 days.
7. Charity car washes are encouraged to utilize commercial car washing facilities which either recycle their water or which discharge all water into the city's sanitary sewer system.
8. To the extent feasible, hot water heaters shall be located in proximity to the most frequently utilized plumbing fixture outlets.
9. The potential for using harvested water should be evaluated and, when practical, incorporated into landscape design. Such design shall be consistent with the requirements of the development code and the Surface Water Plan as currently adopted or subsequently amended.
10. All public, commercial, multi-family residential common use area, and industrial facilities utilizing washing machines, including but not limited to commercial laundry facilities, schools, health clubs, motels and fire and Police Chiefs, are encouraged to utilize washing machines which incorporate the most current water-saving design features available.

SECTION 151.16.004 Water Use Regulations – All Property

A. Water for Parks and Golf Courses.

   1. All parks shall use medium and low water use plants as per the requirements in section 151.15.007 or as allowed by the Director of Community Development. High water use turf or other restricted plants shall be allowed only in those areas with heavy usage, such as athletic fields and playgrounds.
   2. All golf courses shall use medium and low water use plants as per the requirements in the section 151.15.117 or as allowed by the Director of Community Development.
   3. The water source utilized for irrigation shall consist of reclaimed wastewater, harvested rainwater or an alternative water supply other than groundwater, to the extent feasible.
   4. All new golf course development shall limit turf areas to the extent feasible consistent with state of the art "target-type" golf course design standards. Turf area shall be limited to 5 acres per hole.
   5. New ponds, lakes, artificial watercourses and other types of water hazard areas shall be prohibited except as described in section 151.16.004 (b)(7) below and except for holding ponds utilized for treated effluent being used for permitted irrigation purposes.
   6. All parks and golf courses shall be approved as conditional uses.

B. Design Regulations. The following regulations apply to all new development, and to expansions or major renovations at existing city owned parks, city and non-city owned golf courses, and city owned athletic fields.

   1. With the exception of temporary irrigation systems needed to establish low water use plants, spray irritation shall not be used on slopes greater than four feet of horizontal distance per one foot vertical change (4:1).
   2. All existing disturbed slopes and all man-made slopes shall receive erosion control from plantings and/or terracing. Concrete, asphalt, or

any other water and air impervious paving/cover will be allowed only where it is the most appropriate methodology and where no other practical alternative exists.

3. Plants that require spray irrigation or a mowing frequency of more than three times per year shall not be used in street medians, except that spray irrigation may be used in street medians for up to 36 months where the primary objective is to reclaim disturbed areas with low water use plants.
4. Spray irrigation shall not be used to apply water to any area within eight feet of a street curb or storm sewer inlet. These areas may be irrigated by drip, bubble, soaker, or subsurface irrigation systems.
5. Sprinkler heads shall be installed at least eight inches away from impermeable surfaces.
6. No spray irrigation shall be used in areas less than ten feet in any dimension except within residential properties, or where such an area is contiguous with adjacent property so that the dimensions totals ten feet minimum. Within parking lots no spray irrigation shall be used on any area less than 15 feet in any dimension. These areas may be irrigated by drip, bubbler, soaker, or sub-surface irrigation systems.
7. Ponds, fountains, wetlands, marches, water features for wildlife habitat, functional holding ponds or other reservoirs that are supplied in whole or in part by any water supply shall not exceed 500 square feet of surface area unless approved by the Director of Community Development. Multiple water features on the same property will be considered together to determine surface area. Flowing water used in fountains, waterfalls and similar features shall be re-circulated.

C. Irrigation Systems Standards.

The following standards apply to all expansions or major renovations at existing parks, golf courses and athletic fields, and to all new development except single family residential. The standards serve as voluntary guidelines for single-family residential development. In general, irrigation systems shall be designed to be site-specific, reflecting plant type, soil type, infiltration rates, slopes, and prevailing wind direction.

1. Irrigation systems shall be designed to be in conformance with all provisions of this article. Temporary irrigation systems (allowed for no longer than 1 year) shall not be required to meet these standards.
2. Application equipment for which the manufacturer specifies flow rates in gallons per minute (gpm) shall not share a control valve with equipment for which the manufacturer specifies flow rates gallons per hour (gph).
3. Irrigation systems shall be controlled by an automatic controller equipped with the following features:
   a. Two or more independent programming schedules.
   b. Capable of programming run times in one minute increments and displaying the run time as a numeric display.
   c. Total program memory retention.
   d. Ability to be fitted with and the use of an external rain switch interrupter and soil moisture sensor.

4. No intentional over spray is allowed where it may obstruct pedestrian traffic on a city required pedestrian walkway.
5. Irrigation systems shall be designed such that water pressure at the sprinkler or emitter is not more than 20% in excess of the manufacturer's maximum recommended pressure range for that device. Pressure may be regulated by design or by installation of a pressure regulating device or devices.
6. Irrigation systems shall be designed to minimize low head line drainage.

D. Use of Misters The use of misters is prohibited in commercial and industrial developments.

# CITY OF SANTA FE, NEW MEXICO Example
## WATER CONSERVATION, FUGITIVE WATER, and WATER WASTE ORDINANCES
### ADOPTED: NOVEMBER 14, 2001

**BE IT ORDAINED BY THE GOVERNING BODY OF THE CITY OF SANTA FE:**

**25-1.1 Definitions**

*Effluent* for purposes of this chapter means treated wastewater whether publicly or privately owned.

*Fugitive water* means the pumping, flow, release, escape, or leakage of any water from any pipe, valve, faucet, irrigation system or facility onto any hard surface such that water accumulates as to either create individual puddles in excess of ten square feet in size or cause flow along or off of the hard surface or onto adjacent property or the public right-of-way, arroyo, or other water course, natural or manmade. Fugitive water also means, during the irrigation of landscaping, the escape or flow of water away from the landscaping plants being irrigated even if such flow is not onto a hard surface. Excluded from this definition is incidental runoff caused by vehicle washing (provided that a shut-off nozzle is used), the periodic draining of swimming pools and spas, and the intentional washing of hard surfaces for an explicit public health, safety, or sanitation purpose.

*Grey Water* means household wastewater other than from water closets and kitchen sinks.

*Waste* means any non-beneficial use of water within the city limits including that caused by the pumping of wells.

Waste includes but is not limited to the following:

A. Leaks to indoor and outdoor plumbing system (faucets, hose bibs, showerheads,

toilets, etc.) in excess of 0.25 gallons per minute. Residential water users, both single family and multi-family are exempt from the indoor plumbing aspect of this definition.

*Wastewater* for purposes of this chapter means the liquid and water carried waste or sewage from residential dwellings, commercial buildings, industrial and manufacturing facilities and institutions whether treated or untreated.

**25-1.2 Enforcement**.

A. Enforcement. There shall be three modes of enforcement: payment of administrative fees; discontinuance of water service; and prosecution of petty misdemeanors through the municipal court.

(1) Administrative Fees. The following administrative fees shall be assessed for violations of the provisions in chapter 25 by customers of the municipal water system, whether inside or outside the city limits. Fees shall be assessed on the customer's water bill. All violations on a single date at a single customer address shall constitute a single offense for purposes of enforcement of this chapter. The fees within a calendar year shall be: twenty dollars ($20.00) for the first violation at a given customer's address; fifty dollars ($50.00) for the second violation at the same customer address; one hundred dollars ($100.00) for the third violation at the same customer address, and two hundred dollars ($200.00) for the fourth and each additional violation.

(2) When a violation of this chapter occurs, and the water division director or his

or her designee determines that the specific circumstances of the violation are of such a serious nature as to require immediate measures and abatement, the director or designee may take steps to temporarily shutoff the water source or discontinue the water service pursuant to its duly adopted procedures as a means of compelling compliance with this chapter. The city may effect such measures by entry upon private premises if the water service or city water meter is located on private premises. Any violation which depletes the water system during water emergency management stage 2 or greater shall be deemed to deplete water essential to maintain fire flows and shall be cause for immediate discontinuance of water service.

(3) For water users within the city limits but not a municipal water system customer, violations shall be a petty misdemeanor subject to prosecution in the municipal court.

**25-2.3 Scope.** There is established a city of Santa Fe comprehensive water conservation requirements ordinance that shall apply to all water whether potable or effluent, and all citizens, businesses, and governmental entities within the corporate limits of the city and all customers of the city water or wastewater utility wherever situated. Furthermore, all provisions of this chapter related to water surcharges, shall apply to all persons, customers, and property served by the city water utility wherever situated.

**25-2.5 Conservation Signage and Literature Distribution.**

A. Public, semi-public, and governmental restroom and shower facilities shall post not less than one (1) water conservation sign in each restroom and shower facility, the size of which shall not be less than eight and one-half (8.5) inches by eleven (11) inches. Such entities may use a city-provided sign or develop their own sign using city-provided text, the text of which shall cite this section. A "public facility" shall not include those facilities solely used by the entity's employees. A "semi-public facility" shall include all private clubs and fraternal organizations.

B. Hotels, motels, and other lodging facilities shall provide a water conservation informational card or brochure in a visible location in each guest room. Such facilities may use city-provided literature or develop their own using city-provided text. Lodging facilities shall not provide daily linen and towel changing for those guests staying multiple nights unless the guests specifically requests each day that the linen and towels be changed.

C. Retail plant nurseries shall provide their "end-use customers" with city-provided low water use landscape literature and water efficient irrigation guidelines at the time of sale of any outdoor perennial plants. An "end-use customer" is the person or persons who will ultimately own the plant material. A landscape contractor or architect is not an end-use customer. In order to facilitate the purchasing of low water use plants, nurseries are strongly encouraged to tag or sign their low water use plants that require little to no supplemental watering once established. For the sale of all turf or grass seed or sod, the customer shall be given city-provided literature indicating the restrictions to planting water consumptive turf, per Chapter 14.

D. Landscape contractors, maintenance companies and architect shall provide their prospective clients with city-provided low water use landscape literature and water efficient irrigation guidelines at the time of presenting a service contract to the prospective client. Landscape professionals are strongly encouraged to educate their customers regarding the operation of their timed irrigation systems.

E. Title companies and others closing real estate transactions shall provide the entity purchasing a home, business, or property with city-provided indoor and outdoor conservation literature at the time of closing.

F. City Departments shall provide indoor and outdoor conservation literature to:

(1) All persons applying for a building permit from the permit and development review division.

(2) All customers initiating new water service from the city water Division.

**25-2.6 Indoor Conservation.**

A. Water system leaks from private water lines shall be repaired by the owner or property manager within fifteen (15) days of initial notification by the water utility. Proof of repair shall be provided to the water utility upon completion of the repair.

B. For all new and remodeling construction and all replacements of existing plumbing fixtures, the water conservation plumbing standards set out below shall be met. In addition, with the exception of item (4), all existing water users shall retrofit their facilities such that the plumbing fixtures noted below are in place by. Single and multi-family residential water users are exempt from this retrofit requirement.

(1) Water Closets. Water closets, either flush tank, flushometer tank, of flushometer valve operated, shall have an average consumption of not more than 1.6 gallons (6.1 liters) of water per flush. Water closets that use a "quick closing" flapper to limit the flush to 1.6 gallons per flush shall not be used to satisfy this requirement.

(2) Urinals. Urinals shall have an average water consumption of not more than 1.0 gallon (3.8 liters) of water per flush, with the exception that, if approved by the Inspection and Enforcement Division, blowout urinals may be installed for public use in stadiums, race courses, fairgrounds, and other structures used for outdoor assembly and for similar uses

(3) Non-Metered Faucets. Lavatory and kitchen faucets shall be equipped with aerators and shall be designed and manufactured so that they will not exceed a water flow rate of 2.5 gallons (9.5 liters) per minute.

(4) Metered Faucets. Self-closing or self-closing metering faucets shall be installed on lavatories intended to serve the transient public, such as those in but not limited to, service stations, train stations, airports, restaurants, and convention halls. Metered faucets shall deliver not more than 0.25 gallons (1.0 liters) of water per use.

(5) Shower Heads. Showerheads shall be designed and manufactured so that they will not exceed a water supply flow rate of 2.5 gallons (9.5 liters) per minute. Emergency safety showers are exempted from this provision.

(6) Installation. Water-conserving fixtures shall be installed in strict accordance with the manufacturers' instructions to maintain their rated performance.

(7) Certificate of Compliance. For all new and remodeling construction, all the requirements regarding water conserving devices mentioned in subsections 25-2.6B(1) through 25-2.6B(6) SFCC 1987 shall be certified by a certificate of compliance by a licensed mechanical contractor or plumbing permittee before or at the time of the final plumbing inspection.

(8) Authority to Permit Exceptions. The city building inspector and the city engineer have the authority to permit exceptions to subsections 25-2.6B(1) through 25-2.6B(7) SFCC 1987 in any

case necessary to maintain adequate health and sanitation standards.

C. Eating Establishments. All public and private eating establishments shall provide water or other beverages only upon request. Eating establishments serving beverages in single-serving containers shall only serve an accompanying glass if specifically requested by the customer. These provisions shall be clearly communicated to the customer in at least one of the following manners: on the menu, by use of a “table tent” or similar signage on the table, or posting in a location clearly visible to all customers. All catering and banquet shall comply with the provisions of this subsection.

**25-2.7 Outdoor Conservation.**

A. Outdoor irrigating periods. The following requirements for outdoor irrigation of landscaping shall be in effect from May 1 through October 31 of each and every year. Outdoor irrigation is prohibited between 10:00 am and 6:00 pm. In addition, if water supply and demand conditions indicate a need to manage demands more aggressively in a given year, the water division director may institute "odd-even" irrigation restrictions. Odd-numbered addresses may irrigate only on Tuesdays, Thursdays, and Saturdays. Even-numbered addresses may irrigate only on Wednesdays, Fridays, and Sundays. It is emphasized that most landscaping can remain healthy and attractive with much less frequent irrigating than the three (3) day per week allowance. For a location lacking an identifiable odd or even-numbered address, the owner or managing agent shall select an odd-even schedule to which it chooses to adhere provided the city water utility is so notified. A large irrigation user may designate a portion of its landscape area as "odd" and a portion as "even" if active use of the landscaping and/or water pressure limitations constrains the owner's ability to irrigate the entire landscaped area in either an odd or even day, provided the city water utility is so notified.

B. Exemptions.

(1) Water Sources and Irrigation Methods. The following sources of water and types of irrigation methods and applications are exempt from the three (3) day per week outdoor irrigating restriction in paragraph A should the division director institute such restrictions. These sources and irrigation methods are not exempt from the time of day irrigation restriction.

(a) Treated effluent applied by truck or other vehicle;

(b) Water harvested from precipitation;

(c) Grey water. Grey water is defined as household waste water other than from water closets and kitchen sinks;

(d) The irrigation of outdoor plants which are in movable containers.

(2) Newly installed turf sod and seed. If the water division director institutes the odd-even irrigation restrictions, newly installed turf sod and seed shall be exempt from three day per week irrigation restriction in paragraph A, above, for a sixty (60) day period after its purchase or installation. New turf shall not be exempt from the time-of-day irrigation restriction in subsection A. Plant nurseries and landscape contractors shall attach a city-provided notification of the sixty (60) day exemption and subsequent requirement to comply with paragraph A to the bill of sale. Citizens shall retain the notification and bill of sale during the sixty (60) day exemption period as proof of the exemption. The exemption is for the newly installed turf sod or seed only and not for other new or existing landscaping.

(3) Nursery Stock. Plants being irrigated for retail or wholesale sales are exempt from paragraph A, above.

(4) Landscape Maintenance and Contracting Companies. All manual watering by landscape maintenance and contracting companies are exempt from paragraph A, above. Landscape companies setting timed irrigation systems shall ensure that the systems comply with paragraph A.

(5) Street Medians. Hand watering of landscaped medians is exempted from subsection A. The Parks Division shall make every effort to utilize treated effluent for median watering west of St. Francis Drive.

C. Authority to permit exceptions. The city water director has the authority to permit exceptions to this subsection provided the water conservation objection is not compromised.

D. Potable Water Use for Certain Construction and Landscaping Purposes. For those construction and landscaping purposes permitted by the New Mexico Environment_Department to use treated wastewater, potable water use from a fire hydrant is prohibited. Treated wastewater from the city's effluent fill station or other facility shall be used for such purposes.

**WATER WASTE.**

**25-3.1 Water Waste Prohibited.** No person, firm, corporation, county, state, federal, or municipal facility or operation shall cause or permit to occur any water waste, whether served by the city water utility or by a private well. In general, the occurrence of an unforeseeable or unpreventable failure or malfunction of plumbing and irrigation system hardware shall not be deemed sufficient grounds for issuance of a citation or other enforcement proceedings unless and until the city issues a formal warning notice.

For unforeseeable or unpreventable outdoor violations, the city shall generally issue a formal warning notice prior to taking enforcement action. Prior to taking formal enforcement action the city may instruct the water user to not operate the faulty system until it is appropriately repaired. If operating the system is integral to the operation of the facility the city may in its discretion provide a period of time in which to remedy the violation prior to commencing formal enforcement action. Once a warning notice or an initial citation has been issued for an outdoor occurrence, subsequent water waste events shall be subject to strict enforcement. Strict enforcement may include the issuance of citations and such other actions, as the city deems necessary to bring the water user into compliance. For indoor water waste events and for those water waste events outdoors caused by a faulty system which is integral to the operation of the facility, the waste must be abated within 15 calendar days of the issuance of a warning notice or initiation of enforcement action. Enforcement action shall be commenced if the waste continues to occur beyond the 15 day period.

**25-3.2 Fugitive Water Flow Prohibited.** No person, firm corporation, county, state, federal, or municipal or other government facility or operation shall cause or permit the occurrence of fugitive water.

**25-3.3 Exemptions.**

A. "Water Waste" shall not include:

(1) Flow resulting from firefighting or routine inspection of fire hydrants or
from training activities.

(2) Water applied to abate spills of flammable or otherwise hazardous materials.

(3) Water applied to prevent or abate health, safety, or accident hazards when alternate methods are not available.

(1) Water which reaches or flows onto adjacent property or public or private
right-of-way when caused by vandalism, wind, emergencies or acts of god.

(2) Flow resulting from a routine inspection or maintenance of the city water
utility system.

(3) Water used by the city of Santa Fe in the installation, maintenance, repair
or replacement of public facilities and structures including but not limited to traffic control devices, storm and sanitary sewer structures and road or street improvements.

(4) Water used by contractors or utilities including but not limited to saw cutting or pavement, compaction, or other use required under terms of their contract.

B. "Fugitive water" shall not include:

(1) Storm run-off, including snowmelt run-off, allowed under provisions of
Article VIII SFCC 1987 14-90.4.

(2) Flow resulting from temporary city water utility system failures or malfunctions.

(3) Water applied, such as in the cleaning of hard surfaces, to prevent or abate_public health, safety, or accident hazards when alternate methods are not available. The washing of outdoor eating areas and sidewalks is not included in this exemption.

(4) Flow resulting from vandalism, high winds, emergencies, and acts of god.

(5) The occurrence of an unforeseeable or unpreventable failure or malfunction of plumbing or irrigation system hardware, prior to the issuance of a formal warning notice issued to the water user. Once a formal warning notice has been issued, the water user is instructed to not operate the faulty system until it is appropriately repaired, unless operating the system is integral to the operation of the facility. Once a warning notice has been issued, subsequent fugitive water events at the same location will be subject to issuance of citations.

**25-3.5 Scope.** The preceding provisions on water waste and fugitive water shall apply to all water whether potable or effluent, and all citizens, businesses, and governmental entities within the corporate limits of the city and all customers of the city water or wastewater utility wherever situated.

Water Conservation starts with excellent customer service. This will include regular water conservation training. Your Water Department's first line of defense is an educated staff that can help customers by telling them of water conservation methods and handling most conservation calls.

## RESOLUTION *Another Water Conservation Ordinance Example*

### *Adopting a long-term water resource sustainability strategy for the City of Flagstaff, Arizona and the customers served by the city water utility.*

**WHEREAS,** water is a basic and essential need of every living creature;

**WHEREAS,** water resources are recognized as a limited and precious natural resource in Northern Arizona;

**WHEREAS,** declining groundwater levels and unreliable surface water supplies have been observed;

**WHEREAS,** the health, comfort, and standard of living of the citizens of Flagstaff depend on an adequate supply of potable water;

**WHEREAS,** efficient use and development of existing water resources will assure a sustainable supply of potable water for future generations;

**WHEREAS,** the enforcement of water conservation strategies cause increased expenses to the city water Utility:

**NOW, THEREFORE, BE IT RESOLVED BY COUNCIL, THE GOVERNING BODY OF THE CITY OF FLAGSTAFF, ARIZONA,** that the City's long-term water resource sustainability strategy, as described in the following resolution sections, is hereby adopted this_____day of_________, 202_.

**Section 1. Planning and development**

A. Promote regional awareness and planning that preserves surface and groundwater resources in Northern Arizona to include:
   1) Long term water resource planning that incorporates sustainable growth principles along with a water conservation lifestyle
   2) Partner with other regional governing agencies and water users in the planning process
   3) Addressing water quality and quantity issues as well as water conservation
   4) Develop water conservation and water use efficiency programs concurrently with potable water resource development

**Section 2. Surface water supplies**

A. Achieve less dependence surface watersheds; sources that rely on annual precipitation levels for supply:
   1) Make efficient use of these important resources in years when adequate precipitation is received
   2) Research methodology to increase existing watershed yield

B. Storm water recapture
   1) Promote the beneficial use of individual property storm water run-off for landscape irrigation per allowable regulations

2) Research the potential benefits of storm water reuse in the city flood control master plan. Potential benefits may include:
    a. Public lands irrigation
    b. Wetlands/wildlife habitat
    c. Groundwater recharge

C. Foreign water importation
1) Explore the option of obtaining surface water rights to augment existing supplies

**Section 3 Ground water supplies**

A. Maintain ground water withdrawals in existing well fields by:
1) Avoid pumping of existing well fields beyond long term recharge capability
2) Explore and develop new groundwater sources meeting the safe sustainable yield criteria
3) Regional cooperation in safe sustainable groundwater withdrawal
4) Consideration of use of non-potable water resources to recharge aquifers

**Section 4 Reclaimed Water**

A. Develop a reclaimed water use policy for beneficial non-potable reuse of the city wastewater flow and prioritize reclaimed water use over potable water use where regulations permit:
1) Improve the city wastewater treatment capability to meet present and future reclaimed water demands
2) Expand the city reclaimed water distribution system to provide for cost-effective delivery of reclaimed water.
3) Aggressively develop and market the use of reclaimed water instead of potable water where regulations permit
4) Support and encourage the installation of gray water reuse irrigation systems for existing and future development
    a. Adopt gray water use standards

**Section 5 Water Conservation & Efficiency**

A. Maintain a comprehensive water use ordinance which reduces peak seasonal water demands and encourages the reduction of per capita/per day consumption of potable water through:
1) Educational programs
2) Incentives/rebates
3) Rate structures
4) Planning and development
5) Yearlong water conservation measures

B. Support of funding for water conservation measures to include:
1) Adequate funding for education, incentives, and rebates through
    a. Budget appropriations
    b. Grants
    c. Conservation surcharges and/or fines
2) Provision of staff necessary to administer the water conservation program which may include the following:
    a. Full-time conservation program manager
    b. Temporary seasonal positions for ordinance enforcement

# Water Conservation Product Section

## Town Installs Waterless Urinals

We haven't had much rain lately and need to think of ways to conserve water. Because of the current drought and social responsibility of saving our natural resources, the Town of Sunflower's Water Department is excited to announce the Waterless Urinal Retro-fit Pilot Program has begun. The Water Department has implemented this along with several other new water conservation methods and technologies to help reduce our daily water demand.

The Town has installed 17 of these completely waterless urinals in public facilities throughout the Town. These urinals are expected to save 750,000 gallons per year. This type of urinal replacement program is successful in 30 cities throughout Arizona.

Waterless urinals work completely without water. Waterless urinals can be easily installed to all restroom applications. This fixture saves up to 45,000 gallons of water and more per year per fixture. It greatly reduces typical urinal maintenance and improves restroom sanitation.

Waterless urinals eliminate and/or minimize these common problems:

| | |
|---|---|
| Urinal Odors | Vandalism |
| Flush Valve Repairs | Line Encrustations |
| Low Water Pressure | Leaking Flush Valves |
| Costly Flush Sensors | Water & Sewer Costs |
| Stoppages and Overflows | Rest Room Shut Downs |
| High Demand On Septic Tanks | Mitigation for Water Usage |

The Water Department will closely analyze and test these and other water conservation devices and hopefully install more devices in throughout public facilities. Water saving devices, along with water conservation awareness are major components of the Town's Water Conservation Program.

**HOW THEY WORK:**
No-Flush urinals resemble conventional fixtures, and easily replace them. They install to the regular waste lines, but eliminate the flush water supply lines. Flush valves are eliminated as well; there are no handles to touch, no sensors, no moving parts! The urinal bowl surfaces are urine repellent; urine is 99% liquid and its drainage is effected without flush water. Daily cleaning procedures are the same as for flushed urinals.

Bill Fields, Water Resource Specialist, "***After a balanced consideration the Waterless urinal seems to be a water conservation fixture who's time has come. It clearly reduces maintenance costs, and may do so dramatically and immediately for some installations. The best part is an automatic saving 1 - 3 gallons of water per usage, depending on the model of flush urinal you're replacing." "In any new construction, or whenever you plan to replace a flush urinal, Waterless urinals should be given serious consideration and possibly required in the near future***."

**Editor's note**: After years of testing, all three of the major brands or types of waterless urinals do save a significant amount of water. You must be prepared for three major issues. These issues are the cost of the retrofit, the cleaning of the urinals, including the cost of the trap replacements and/or trap fluid and third, your sincere belief that you need to save water and understand that saving water will reduce your monthly revenues to the Water Department.

We suggest that you first increase the basic service water billing charge before implementing a serious water conservation program. We have seen several facilities that have installed the waterless urinals to only replace the model with a conventional water urinal. (There is a huge maintenance requirement to prevent the traps from filling with salts).

Another waterless urinal style, but the trap will need to be replaced. There is one more model that does not have a replaceable trap. It is difficult to find and comes from Germany. It is known as the McDry or Durivent. It is more expensive at first, but again, no trap to replace. Two problems with the McDry or Durivent--the interior smoothness of the inside of the permanent trap is a little rough and cleaning the trap is difficult. We at TLC utilize a hand-held pressure sprayer and have modified the end to flush out the trap. The Durivent company may have improved the interior surface of the inside of the trap by the time of printing this manual.

**Why do Urinals Smell?**

**Biofilm -** the key problem is biofilm, a translucent film 0.1 mm thick derived from body fluids. It forms on the ceramic bowl and all pipe-work, but is particularly difficult to clean where it collects on the internal surface of the urinal waste outlet and trap above the water level. The biofilm takes several weeks to form - that's why waterless urinals, or new urinals, often operate without odor problems for several months. The naturally occurring bacteria which thrive on this biofilm are what cause the smell. Even bleach is not successful at killing them. Reduction in water, for example using watermisers, usually leads to an increase in buildup.

**Leaking, staining and splashing** - washers in urinal traps perish very quickly, causing leakage and staining outside of the trap - leading to bad smells. Odor also comes from urine that splashes on the walls and floor. When urine is left to dry it acts as a breeding ground for 'bad' bacteria that cause unpleasant odors.

## Hot Water Recirculation Systems

The Metlund® Hot Water D'MAND® System consists of an electronically controlled pump and valve assembly that allows for the rapid delivery of hot water to plumbing fixtures without the loss of cold water down the drain.

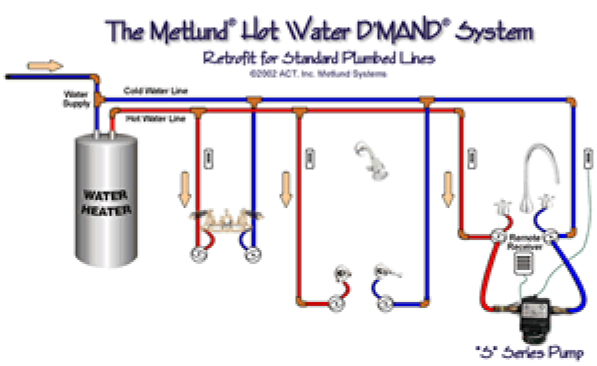
The D'MAND System is activated when someone creates a demand for hot water by activating the pump with any one of a number of methods. At that time, the Hot Water D'MAND System pumps the hot water to the plumbing fixtures. Once hot water reaches the pump, the System detects a 3° to 4° temperature rise and completely shuts off so there is no loss of energy or water!

The Metlund D'MAND System is the only UL Listed and Uniform Plumbing Code Listed hot water distribution system that is recognized by the US Department of Energy to *save **both** water **and** energy*.

Its features include:


- Automatic "fail-safe"
- 3-year (S-50) or 5-year (S-69 and S-02) warranty
- Life expectancy 15 to 20 years
- Less than $1.00 a year to operate
- Delivers hot water within seconds to more than one fixture
- Delivers hot water without wasting cold water down the drain
- System only operates when there is a demand for hot water
- Simple installation for new and existing homes
- Works with all standard water heaters (gas, electric, tankless, or propane)
- Title 24 Compliance (CA only)
- "No Sweat" easy installation package available with optional remote control button
- IAPMO "Uniform Plumbing Code" approved
- UL Listed

### How Does it Work?




At the push of a button, the Metlund® Hot Water D'MAND® System circulates the ambient temperature water in the hot water pipes (water that is normally lost down the drain) back to the water heater. This occurs up to 80% faster than just letting the water run down the drain—the usual scenario. Depending on the plumbing layout, the route and time can vary. The Metlund D'MAND

System moves the water so rapidly, that hot water arrives at the fixtures before the heat is lost through the pipe.

As the ambient temperature water in the cold water line travels towards the hot water heater, the D'MAND System fills the hot water line with hot water. When the hot water reaches the D'MAND System, a thermal sensor (thermistor) senses a temperature rise and quickly closes the zone valve while it shuts the pump off. The sophisticated electronic circuitry that does this is attached to the high-performance pump housing.

This results in getting hot water to the fixtures four to five times quicker (on average), greater convenience in not having to wait, a savings in water and energy, and a reduction in sewage costs. As a by-product of these savings, a cumulative result is the improvement of air quality.

The Metlund D'MAND System can utilize the cold water line as a return line or use a dedicated return line. By using the existing cold water line, it is easy to retrofit existing homes or businesses. Special plumbing is not needed, and since the System will not allow for hot water to cross over to the cold water line, all the cold water fixtures still have cold water.

## Pre-Rinse Sprayer Program

**Serving Up Energy Savings**
Restaurants typically have the highest energy use per square foot of any business. To help manage and lower your energy costs it is a great idea to replace pre-rinse sprayers in restaurants and food service establishments.  Most water providers have developed programs to distribute pre-rinse sprayers.

The high-performance dishwashing pre-rinse sprayers will:
- Clean dishes faster and better.
- Lower water and energy use.
- Save money on electric, natural gas, water and sewer bills.

The efficient, high performance sprayers are engineered to produce a high velocity, fan-spray pattern. The knife-like spray pattern cleans dishes faster and improves cleaning performance, increasing efficiency and productivity at your facility. You use less water to rinse dishes, saving energy on water heating and saving money on your water, sewer and electric or natural gas bills.

Replace your old pre-rinse sprayer with a high-performance model that uses only 1.6 GPM. Most water providers will come to the establishment, at the customer's convenience, and install the high-performance, pre-rinse sprayer at no cost to the customer. All installations should be performed by licensed journeyman plumbers. Most pre-rinse sprayers also come with a 5 year manufacturer's warranty.

**Free Program Eligibility Information Example**
Most restaurant or food service establishments with a dishwashing pre-rinse sprayer in several water conservation areas are eligible to receive a free, replacement high-performance sprayer.

Do you manage or own a restaurant or kitchen and use a kitchen sprayer to pre-rinse dirty dishes? Do you want to reduce your water costs? The SmartRinse program can help you save money, and it's FREE!

The amount of energy and water used by pre-rinse kitchen sprayers is significant. We are offering a solution to help your restaurant SAVE ON HOT WATER COSTS by replacing your pre-rinse kitchen sprayer with a new, high-efficiency, high-velocity spray valve.

By replacing old, high volume sprayers with this FREE high-velocity model, a typical restaurant can SAVE up to $1,000 a year in energy, water and wastewater costs.

Your new replacement sprayer has a knife-action spray pattern, meaning more efficient rinsing than older, inefficient models.

## ENERGY SAVINGS ESTIMATES/per nozzle

| Usage per day | Water savings per day | Waste water savings per day | Cost savings Therms per day | ANNUAL DOLLAR SAVINGS |
|---|---|---|---|---|
| Small Facility | | | | |
| 2 hours | 100 gallons | 100 gallons | .07 therms | $300–$400 |
| Medium Facility | | | | |
| 4 hours | 200 gallons | 200 gallons | 1.3 therms | $700–$900 |
| Large Facility | | | | |
| 6 hours | 300 gallons | 300 gallons | 2.0 therms | $1,000–$1,300 |

*Stated savings are estimates based on tests developed by Fisher-Nickel, Inc., within the scope of the Food Service Technology Center program and are based on average pre-rinse valve use and average California gas, water and waste water costs. Real savings may differ.*

## Town of Sunflower WashSmart Rebate Program *Example*

***<u>Water efficient clothes washers save water and reduce energy costs.</u>***

If you are purchasing a new water efficient clothes washing machine, the Town of Sunflower has a way for you to reduce water and energy consumption and save money. The Sunflower Water Department is offering homeowners and small businesses a $200.00 rebate to install a new high-efficiency clothes washing machine to replace an existing non-efficient washing machine. By using less water, you can save money on water bills and water heating costs throughout the year. High efficiency clothes washers use 40% – 67% less water, 33% less detergent and can help save 50% – 65% on energy costs for drying.

***<u>To Qualify</u>***

The WashSmart Program begins March 6, 2016 and ends June 1, 2017 or when the Sunflower Water Department (SWD) has approved fifty rebates. Only SWD customer's purchase of qualifying washing machines purchased after March 1, 2016 are eligible for the rebate. See the list of machines that qualify for this program. **Rebates are not retroactive.**

The rebate applies to replacements of existing washing machines in residences and small businesses receiving water supply from the Town of Sunflower. You must be a full time resident of Sunflower and in good standing with the SWD, have a minimum of four people living in your household or operate a business that uses an existing high water use washing machine on the business premises. Commercial laundromats and properties on private wells are not eligible.

Old washing machines replaced under this program must be recycled at the Sunflower Water Department at 8111 N. Beeline Highway. **A signed washing machine recycling receipt must be obtained** from personnel in the SWD Customer Service building as proof of drop off. There is no charge for the drop off.

**Documentation**

To obtain the rebate, the following documentation must be provided.

1. A pre-approved rebate program form (available at the Sunflower Water Department, 8111 N. Beeline Highway).
2. A signed recycling receipt from the Sunflower Water Department.
3. Receipt for proof of appliance purchase to include brand & model.

**(Visit the Water Department for list of qualifying washing machines)**

## List of WashSmart Qualifying Clothes Washing Machines

| Brand | Model | Type |
|---|---|---|
| Frigidaire | GLTF2940E | Front Loader |
| Frigidaire | FTF2140E | Front Loader |
| Kenmore | 4405 | Front Loader |
| Kenmore | 4508 | Front Loader |
| Kenmore | 4586 | Front Loader |
| Kenmore | 4587 | Front Loader |
| Kenmore | 4596 | Front Loader |
| Kenmore | 4597 | Front Loader |
| Kenmore | 4598 | Front Loader |
| Kenmore | 4599 | Front Loader |
| Kenmore | C450840 | Front Loader |
| Kenmore | C450940 | Front Loader |
| Kenmore | 4646 | Front Loader |
| Kenmore | 4647 | Front Loader |
| LG | WM1814C | Front Loader |
| LG | WM1832C | Front Loader |
| LG | WM2032H | Front Loader |
| LG | WM2077C | Front Loader |
| LG | WM2277H | Front Loader |
| LG | WM2432H | Front Loader |
| Maytag | MAH2400 | Front Loader |
| Maytag | MAH6700 | Front Loader |
| Maytag | MAH8700 | Front Loader |
| Maytag | MAH9700 | Front Loader |
| Miele | W1119 | Front Loader |
| Miele | W1203 | Front Loader |
| Miele | W1213 | Front Loader |
| Miele | W1215 | Front Loader |
| Siemens | WFXD5200UC | Front Loader |
| Siemens | WFXD8400UC | Front Loader |
| Whirlpool | GHW9150P | Front Loader |
| Whirlpool | GHW9160P | Front Loader |
| Whirlpool | GHW9300P | Front Loader |
| Whirlpool | GHW9400P | Front Loader |
| Whirlpool | GHW9460P | Front Loader |

# APPENDIX C
# ACRONYMS AND GLOSSARY

## Acronyms

| | |
|---|---|
| AWWA | American Water Works Association |
| BAT | Best available technology |
| BMP | Best management practice |
| BuRec | United States Bureau of Reclamation |
| DOI | United States Department of the Interior |
| DSM | Demand-side management |
| EPA | United States Environmental Protection Agency |
| gpcd | Gallons per capita per day |
| gpf | Gallons per flush |
| gpm | Gallons per minute |
| IRP | Integrated resource plan (or planning) |
| mgd | Million gallons per day |
| MOU | Memorandum of understanding |
| NAWC | National Association of Water Companies |
| SRF | State Revolving Fund |
| SDWA | Safe Drinking Water Act |
| ULFT | Ultra-low-flush toilet |

# Glossary

**appropriation.** The right to withdraw water from its source.
**audit (end-use).** A systematic accounting of water uses by end users (residential, commercial, or industrial), often used to identify potential areas for water reduction, conservation, or efficiency improvement.
**audit (system).** A systematic accounting of water throughout the production, transmission, and distribution facilities of the system.
**available supply.** The maximum amount of reliable water supply, including surface water, groundwater, and purchases under secure contracts.
**average-day demand.** A water system's average daily use based on total annual water production (total annual gallons or cubic feet divided by 365); multiple years can be used to account for yearly variations.
**avoided cost.** The savings associated with undertaking a given activity (such as demand management) instead of an alternative means of achieving the same results (such as adding supply); can be used to establish the least-cost means of achieving a specified goal. Can be measured in terms of incremental cost.
**baseline.** An established value or trend used for comparison when conditions are altered, as in the introduction of water conservation measures.
**beneficial use.** A use of water resources that benefits people or nature. State law may define beneficial use.
**benefit-cost analysis.** A comparison of total benefits to total costs, usually expressed in monetary terms, used to measure efficiency and evaluate alternatives. See also cost-effectiveness and avoided-cost.
**best management practice.** A measure or activity that is beneficial, empirically proven, cost-effective, and widely accepted in the professional community.
**block.** A quantity of water for which a price per unit of water (or billing rate) is established.
**budget (water-use).** An accounting of total water use or projected water use for a given location or activity.
**capital facilities.** Physical facilities used in the production, transmission, and distribution of water.
**commodity charge.** See variable charge.
**community water system.** According to the SDWA, a drinking water conveyance system serving at least 15 service connections used by year-round residents of the area served by the system or regularly serving at least 25 year-round residents.
**conservation (water).** Any beneficial reduction in water losses, waste, or use.
**conservation pricing.** Water rate structures that help achieve beneficial reductions in water usage. See nonpromotional rates.
**consumptive use.** Use that permanently withdraws water from its source.
**cost-effectiveness.** A comparison of costs required for achieving the same benefit by different means. Costs are usually expressed in dollars, but benefits can be expressed in another unit (such as a quantity of water). See net benefits.
**customer class.** A group of customers (residential, commercial, industrial, wholesale, and so on) defined by similar costs of service or patterns of water usage.
**decreasing-block (or declining-block) rate.** A pricing structure for which the dollar amount charged per unit of water (such as dollars per gallon) decreases with the amount water usage.
**demand forecast.** A projection of future demand that can be made on a system-wide or customer-class basis.
**demand management.** Measures, practices, or incentives deployed by water utilities to permanently reduce the level or change the pattern of demand for a utility service.
**demographic.** Having to do with population or socioeconomic conditions.
**discount rate.** A percentage that is used to adjust a forecast of expenditures to account for the time value of money or opportunity costs; it can be based on the utility's cost of capital.
**distribution facilities.** Pipes, treatment, storage and other facilities used to distribute drinking water to end users.

**drought.** A sustained period of inadequate or subnormal precipitation that can lead to water supply shortages, as well as increased water usage.
**end use.** Fixtures, appliances, and activities that use water.
**end user.** Residential, commercial, industrial, governmental, or institutional water consumer.
**escalation rate.** A percentage that is used to adjust a forecast of expenditures to account for the increasing value of a good or service over time (apart from the discount rate and inflationary effects).
**evapotranspiration.** Water losses from the surface of soils and plants.
**fixed charge.** The portion of a water bill that does not vary with water usage.
**fixed costs.** Costs associated with water service that do not vary with the amount of water produced or sold.
**graywater.** Treated or untreated and stored wastewater used for nonpotable purposes, such as irrigation.
**increasing-block (or inclining-block) rate.** A pricing structure for which the dollar amount charged per unit of water (such as dollars per gallon) increases with the amount water usage.
**incremental cost.** The additional cost associated with adding an increment of capacity.
**instream flow.** River and stream waters that maintain stream quality, aquatic life, and recreational opportunities.
**integrated resource planning.** An open and participatory planning process emphasizing least-cost principles and a balanced consideration of supply and demand management options for meeting water needs.
**investor-owned utility.** A private utility owned by investors and typically regulated by a state public utility commission.
**irrigation scheduling.** An automated method for optimizing outdoor water use by matching the watering schedule to plant needs.
**large-volume user.** A water customer, usually industrial or wholesale, whose usage is substantial relative to other users; large-volume users may present unique peaking or other demand characteristics.
**leak detection.** Methods for identifying water leakage in pipes and fittings.
**life span.** The expected useful life of a supply-side or demand-side project, measure, or practice. (The life span may not be identical to useful life for tax purposes.)
**load management.** Methods for managing levels and patterns of usage in order to optimize system resources and facilities.
**losses (water).** Metered source water less revenue-producing water and authorized unmetered water uses.
**low water-use landscaping.** Use of plant materials that are appropriate to an area's climate and growing conditions (usually native and adaptive plants). See Xeriscape™.
**market penetration.** The extent to which an activity or measure is actually implemented compared to all potential uses or markets.
**marginal-cost pricing.** A method of rate design where prices reflect the costs associated with producing the next increment of supply.
**master metering.** A large meter at a point of distribution to multiple uses or users that could be further submetered. Includes metered wholesale sales.
**maximum-day demand.** Total production for the water system on its highest day of production during a year.
**meter.** An instrument for measuring and recording water volume.
**mixed-use meter.** A meter measuring water use for more than one type of end use (such as indoor and outdoor use).
**needle peaks.** Persistent levels of peak demand that drive the capacity needs of a water system despite reductions in average demand.
**net benefits.** The numerical difference between total benefits and total costs, both of which must be expressed in the same unit (usually dollars). See cost-effectiveness.
**net present value.** The present value of benefits less the present value of costs.
**nominal dollars.** Forecast dollars that are not adjusted for inflation.
**nonaccount water.** Metered source water less metered water sales.
**nonconsumptive use.** Water withdrawn and returned to the source.

**nonpromotional rates.** Rates that do not encourage additional consumption by water users.
**nonresidential customer.** A commercial or industrial utility customer.
**normalization.** Adjustment of a variable to a "normal" level based on averaging over an accepted period of time; used in forecasting.
**opportunity cost.** The value of a foregone opportunity that cannot be pursued because resources are taken up by a chosen activity.
**peak demand.** The highest point of total water usage experienced by a system, measured on an hourly and on a daily basis.
**per-capita use.** Total use divided by the total population served.
**per-capita residential use.** Residential use divided by the total population served.
**precipitation rate (sprinkling).** The surface application rate for landscape watering, usually expressed in inches per hour.
**present value.** Future expenditures expressed in current dollars by adjusting for a discount rate that accounts for financing costs.
**pressure regulator.** A post-meter device used to limit water pressure.
**price elasticity of demand.** A measure of the responsiveness of water usage to changes in price; measured by the percentage change in usage divided by the percentage change in price.
**rationing.** Mandatory water-use restrictions sometimes used under drought or other emergency conditions.
**raw water.** Untreated water.
**real dollars.** Forecast dollars that are adjusted for inflation.
**retrofit.** Replacement of parts in an existing plumbing fixture or water-using appliance in order to improve its operational efficiency.
**revenue-producing water.** Water metered and sold.
**reuse (water).** Beneficial use of treated wastewater.
**Safe Drinking Water Act (SDWA).** Federal drinking water quality legislation administered by the U.S. Environmental Protection Agency (EPA) through state primacy agencies; amended in 1996.
**safe yield.** The maximum reliable amount that can be withdrawn from a source without compromising quality or quantity, as defined by hydrological studies; can be based on acceptable withdrawals during a critical supply period or drought with a specific probability of occurrence.
**seasonal rate.** A pricing structure for which the dollar amount charged per unit of water (such as dollars per gallon) varies by season of use; higher rates usually are charged in the season of peak demand.
**sensitivity analysis.** An analysis of alternative results based on variations in assumptions; a "what if" analysis.
**service territory.** The geographic area served by a water utility.
**source-of-supply.** Facilities used to extract and/or store raw water prior to transmission and distribution.
**source meter.** A meter used to record water withdrawn from a surface water or groundwater source, or purchased from a wholesale supplier.
**State Revolving Fund (SRF).** State loan funds for water utilities established under the Safe Drinking Water Act.
**supply management.** Measures deployed by the utility that improve the efficiency of production, transmission, and distribution facilities.
**submetering.** Metering for units comprising a larger service connection, such as apartments in a multifamily building.
**surcharge.** A special charge on a water bill used to send customers a specific pricing signal and recover costs associated with a particular activity.
**system (water).** A series of interconnected conveyance facilities owned and operated by a drinking water supplier; some utilities operate multiple water systems.
**take-or-pay.** A contract provision obligating a purchaser to pay for a commodity whether or not delivery is taken.
**tariff.** The schedule of a utility's rates and charges.
**toilet tank displacement device.** A plastic bag or dam installed in a toilet tank to reduce flush volume. Considered effective only for fixtures using more than 3.5 gallons per flush.
**toilet flapper.** Valve in the toilet tank that controls flushing.

**transfers (water).** Exchange of water among willing buyers and sellers.
**transmission facilities.** Pipes used to transport raw or treated water to distribution facilities.
**treated water.** Water treated to meet drinking water standards.
**ultra-low-flush toilet.** A toilet that uses not more than 1.6 gallons per flush.
**unaccounted-for water.** The amount of nonaccount water less known or estimated losses and leaks.
**uniform rate.** A pricing structure for which the dollar amount charged per unit of water (such as dollars per gallon) does not vary with the amount of water usage.
**universal metering.** Metering of all water-service connections.
**unmetered water.** Water delivered but not measured for accounting and billing purposes.
**user class.** See customer class.
**variable charge.** The portion of a water bill that varies with water usage; also known as a commodity charge.
**variable cost.** Costs associated with water service that vary with the amount of water produced or sold.
**water right.** A property right or legal claim to withdraw a specified amount of water in a specified time frame for a beneficial use.
**watershed.** A regional land area, defined by topography, soil, and drainage characteristics, within which raw waters collect and replenish supplies.
**weather-adjusted.** Water demand, revenues, or other variables adjusted to a "normal" weather year; also known as weather normalization.
**wholesale water.** Water purchased or sold for resale purposes.
**Xeriscape™.** Landscaping that involves seven principles: proper planning and design; soil analysis and improvement; practical turf areas; appropriate plant selection; efficient irrigation; mulching; and appropriate maintenance.

# Appendix D
# Information Resources

*Note: Inclusion on this resource list does not constitute an endorsement by Technical Learning College or the U.S. Environmental Protection Agency.*

## Guides and Handbooks

American Water Works Association. *Before the Well Runs Dry. Volume I. A Handbook for Designing a Local Water Conservation Plan*. Denver, CO: American Water Works Association, 1984.

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 http://www.awwa.org/
American Water Works Association WaterWiser: The Water Efficiency Clearinghouse:
 http://www.waterwiser.org/
American Water Works Research Foundation:
 http://www.awwarf.com/
American Water Resources Association:
 http://www.uwin.siu.edu/orgs/awra.html
American Society of Plumbing Engineers:
 http://www.aspe.org
Association of Metropolitan Water Agencies:
 http://www.amwa-water.org/water
Bureau of Reclamation, U.S. Department of the Interior:
 http://www.usbr.gov/tcg/written/wc.html
Green Seal:
 http://www.greenseal.org
Institute for Water Resources, U.S. Army Corps of Engineers:
 http://www.iwr.usace.army.mil/
National Drinking Water Clearinghouse:
 http://www.estd.wvu.edu/ndwc/
National Drought Mitigation Center:
 http://enso.unl.edu/ndmc
National Ground Water Association:
 http://www.h2o-ngwa.org/
National Watershed Network:
 http://www.ctic.purdue.edu/watershed/
US_watersheds_8digit.html
Natural Resource Conservation Service, U.S Department of Agriculture:
 http://www.nrcs.usda.gov/
Rural Community Assistance Program:
 http://www.rcap.org/
Rural Water Association:
 http://www.ruralwater.org
Universities Council on Water Resources:
 http://www.uwin.siu.edu/
U.S. Environmental Protection Agency:
 http://www.epa.gov/owm/genwave.htm
U.S. Geological Survey:
 http://www.usgs.gov
U.S. Water News:
 http://www.uswaternews.com
Water Education Foundation:
 http://www.water-ed.org
Water Environment Federation:
 http://www.wef.org
Water Online:
 http://www.wateronline.com/
Water Quality Association:
 http://wqa.org/
Water Share, U.S. Department of the Interior, Bureau of Reclamation:
 http://www.watershare.usbr.gov

# APPENDIX E
# FEDERAL FUNDING SOURCES FOR WATER CONSERVATION

| Agency | Elements | Information |
|---|---|---|
| U.S. Environmental Protection Agency | Program | Drinking Water State Revolving Fund (**DWSRF**) Program |
| | National contact | Jamie Bourne, (202) 260-5557 |
| | Regional contacts | Each state has an agency that administers the program. See Appendix F. Contact information can be found at www.epa.gov/ogwdw/dwsrf.html |
| | Type of assistance | Primarily loans. |
| | Eligibility | Drinking water systems including public and private community water systems and non-profit non-community water systems. |
| | Eligible activities | Construction of facilities which will facilitate compliance with national primary drinking water regulations or further the health protection objectives of the Safe Drinking Water Act. |
| | Eligible measures | Residential water meters are eligible for DWSRF funding if part of an eligible project. |
| U.S. Environmental Protection Agency | Program | Clean Water State Revolving Fund (**CWSRF**) Program |
| | National contact | Richard Kuhlman, (202) 260-7366. Also see CWSRF website at www.epa.gov/OWM/finan.htm |
| | Regional contacts | Each state has an agency that administers the program. For state contact call (202) 260-7359. |
| | Type of assistance | EPA capitalizes state revolving loan funds. States issue or refinance loans, purchase or guarantee local debt, or purchase bond insurance. |
| | Eligibility | Eligibility varies according to each state's program and priorities. Eligible recipients generally include communities, individuals, citizen's groups, non-profits, Indian Tribes, and others. |
| | Eligible activities | Eligible projects may include a wide range of water-quality projects, such as:<br>• municipal wastewater treatment facilities<br>• agricultural, rural, and urban runoff control<br>• estuary improvement projects<br>• wet weather flow control<br>• groundwater protection projects |

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| | Eligible measures | At a state's option, the following publicly-owned water conservation measures may be eligible for loan funding:<br>**Structural Measures**<br>• Meters<br>• Plumbing fixture retrofits or replacements<br>• Efficient landscape irrigation equipment<br>• Gray water recycling<br>• Wastewater reuse<br>**Nonstructural Measures**<br>• Incentive wastewater service charges<br>• Water use ordinances or regulations<br>• Public education programs |
| Bureau of Reclamation, U.S. Department of the Interior | Program | Water Conservation Field Services Program/Efficiency Incentives Program |
| | National contact | Cindy Dyballa (202) 208-7589. Also, see the Bureau's Watershare website at www.watershare.usbr.gov |
| | Regional contacts | Reclamation has five regional offices and 21 area offices located in the 17 western states. For contact information visit the Bureau's Watershare website (see above). |
| | Type of assistance | Grants are awarded but each program office may administer the program differently. |
| | Eligibility | Eligible recipients generally include water systems that contract for water supplies through the Bureau of Reclamation. |
| | Eligible activities | Eligible projects may include a wide range of water conservation projects, including planning, education, demonstration of innovative technologies, and implementation of measures. |

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| | Eligible water conservation measures | The following water conservation measures may be grant eligible:<br>**Structural Measures**<br>• Meters<br>• Leak detection and control equipment<br>• Plumbing fixture retrofits or replacements<br>• Water efficient appliances (e.g. clothes washers)<br>• Efficient landscape irrigation equipment<br>• Gray water recycling<br>• Commercial/institutional conservation equipment<br>• Industrial reuse or recycling<br>• Wastewater reuse<br>**Nonstructural Measures**<br>• Conservation or non-promotional rate structure<br>• Water use ordinances or regulation<br>• Public education programs |
| Rural Utilities Service, U.S. Department of Agriculture | Program | Rural Utilities Service, Water and Wastewater Loan/Grant Program |
| | National contact | Richard Mansfield (202) 690-2670 |
| | Regional contacts | USDA has an office in each state; contact information can be found on the RUS website www.usda.gov/rus/water |
| | Type of assistance | Grants and loans (loans are more common). |
| | Eligibility | Cities and towns with populations less than 10,000 that cannot find private funding. |
| | Eligible activities | The program primarily funds the construction of drinking water and wastewater infrastructure (approximately 60% of assistance is allocated to drinking water improvements). |
| | Eligible water conservation measures | **Structural Measures**<br>• Meters<br>• Leak detection and control equipment<br>• Gray water recycling<br>• Wastewater reclamation and reuse |
| Rural Business-Cooperative Service, U.S. Department of Agriculture | Program | Rural Economic Development Loans and Grants |
| | National contact | Director, Specialty Lenders Division (202) 720-1400 |
| | Regional contacts | Consult phone directory for the number of the local Office of Rural Development |
| | Type of assistance | Direct loans (most often) and project grants |

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| | Eligibility | Electric and phone utilities that have current loans with the Rural Utilities Service (RUS) or Rural Telephone Bank loans can apply for zero interest loans or grants, and can in turn offer loans to local businesses, nonprofit organizations, etc. |
| | Eligible activities | Establishment or expansion of rural businesses or community development projects with job creation, including water and sewer industrial development parks and other infrastructure. |
| | Eligible water conservation measures | **Structural Measures**<br>• Meters<br>• Leak detection and control equipment<br>• Plumbing fixture retrofits or replacements<br>• Water-efficient appliances<br>• Commercial/institutional conservation measures<br>• Industrial reuse or recycling<br>• Wastewater reclamation and reuse |
| National Resources Conservation Service, U.S. Department of Agriculture | Program | Resource Conservation and Development |
| | National contact | Terry D'Addio, National Program Manager, 202-720-2241 |
| | Regional contacts | Each state has a Natural Resources Conservation Service Office. |
| | Type of assistance | Advisory service and counseling, project loans and grants possible when funding levels allow. The program can offer technical support in the form of a coordinator for adopted projects (including activities pertaining to water management). While funds are not awarded, the agency can help projects find additional funding elsewhere. |
| | Eligibility | Applicants must be state or local governments and nonprofit organizations with the authority to plan or carry out activities relating to resource use and development in multi-jurisdictional areas (including Puerto Rico, Virgin Islands, Guam, and Northern Marina Islands). Beneficiaries must be located in a designated resource conservation and development area. |
| | Eligible activities | Resource conservation and development |
| | Eligible water conservation measures | Indirect support for both structural and nonstructural measures may be obtained. |
| Economic Development Administration, U.S. | Program | Economic Development Administration's Public Works and Development Facilities Grants Program |
| | National contact | David McIlwain (202) 482-5265 |

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| Department of Commerce | Regional contacts | Each state has a representative; contact information can be found on the Commerce Department website www.doc.gov/eda |
| | Type of assistance | Grants only. |
| | Eligibility | Activities to assist in the economic development of economically distressed areas (high unemployment or low income). Most grants are made to rural communities, but urban communities are eligible as well. |
| | Eligible activities | The program funds public works infrastructure and development facilities, including improvements to drinking water systems and wastewater systems (especially industrial wastewater). Projects that provide immediate assistance will receive special emphasis. Funds may not be used for residential systems. |

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| | Eligible water conservation measures | **Structural Measures**<br>• Meters<br>• Leak detection and control equipment<br>• Plumbing fixture retrofits or replacements<br>• Gray water recycling<br>• Commercial/institutional conservation measures<br>• Industrial reuse or recycling<br>• Wastewater reclamation and reuse |
| Appalachian Regional Commission | Program | Appalachian Regional Commission Grant Program |
| | National contact | Harry Roesch (202) 884-7774 |
| | Regional contacts | Each state has a representative; contact information can be found on the Appalachian Regional Commission website (www.arc.gov). |
| | Type of assistance | Grants only. |
| | Eligibility | Activities that expand infrastructure to encourage economic development and meet state environmental statutes in economically distressed areas in Appalachian states from Northeast to Mississippi. Program needs federal agencies (for example RUS, HUD, and Tennessee Valley Authority) to administer funds and requires at least a partial match from either federal, state, or local sources. States make final decisions on whether projects are eligible for funding. |
| | Eligible activities | The program funds public works infrastructure only, including improvements to drinking water systems and wastewater systems. The water conservation measures can be funded only if they are part of a larger economic-development package. |

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| | Eligible water conservation measures | **Structural Measures**<br>• Meters Leak detection and control equipment<br>• Gray water recycling<br>• Commercial/institutional conservation measures<br>• Industrial reuse or recycling<br>• Wastewater reclamation and reuse |
| U.S. Department of Housing and Urban Development | Program | Community Development Block Grants |
| | National contact | Yvette Aidara (202) 708-1322 ext. 4378 |
| | Regional contacts | Each state has a HUD office; contact information can be found on the HUD website www.hud.gov |
| | Type of assistance | Grants and loans (loans are more common). |
| | Eligibility | Intended to primarily assist low to moderate income communities. Approximately 70% of the total money goes directly to urban areas, mostly low to moderate income; the remaining 30% is allocated to state programs that target non-entitled low to moderate income areas (population less than 50,000/county population less than 200,000). |
| | Eligible activities | All kinds of activities are eligible, including planning and management efforts, as long as they are a part of a community economic development project. State programs may choose to prioritize infrastructure funding. |
| | Eligible water conservation measures | **Structural Measures**<br>• Meters<br>• Leak detection and control equipment<br>• Plumbing fixture retrofits or replacements<br>• Water-efficient appliances<br>• Water-efficient landscaping or irrigation equipment<br>• Gray water recycling<br>• Commercial/institutional conservation measures<br>• Industrial reuse or recycling<br>• Wastewater reclamation and reuse<br>**Nonstructural Measures**<br>• Development of nonpromotional water rate structures<br>• Developing water use regulations or wastewater ordinances |
| Community Planning and Development, U.S. Department of Housing and Urban Development | Program | Empowerment Zones Program (Urban) |
| | National contact | National Office of Community Planning and Development (202) 708-6339, 1-800-998-9999 |
| | Regional contacts | Directors of Community Planning and Development at regional HUD |

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| | Type of assistance | Grants related to revitalization planning. |
| | Eligibility | An applicant must be nominated by a local government or state where the area is located. Applicants on behalf of nominated beneficiaries may also include, but are not limited to, state and local governments, regional planning agencies, non-profit organizations, community-based organizations, or partnerships of community members and other entities. The beneficiary (urban area) is eligible if it (1) meets certain population requirements; (2) is an area of pervasive poverty, unemployment, and general distress; (3) does not exceed 20 square miles, and (4) meets other locative requirements. While Round I Zones have been selected, Congress has authorized the selection of 15 additional urban Empowerment Zones |
| | Eligible activities | Potential Empowerment Zones submit creative plans for revitalization and, if chosen, receive grants to help execute these plans. |
| | Eligible water conservation measures | **Structural Measures**<br>• Meters<br>• Leak detection and control equipment<br>• Plumbing fixture retrofits or replacements<br>• Water-efficient appliance<br>• Water-efficient landscaping or irrigation equipment<br>• Gray water recycling<br>• Commercial/institutional conservation measures<br>• Industrial reuse or recycling<br>• Wastewater reclamation and reuse |
| U.S. Department of Health and Human Services | Program | Empowerment Zones Program (Rural) |
| | National contact | Victor Vasquez (202) 619-7980 |
| | Regional contacts | Jim Gatz (202) 260-0397 can help identify appropriate state agencies. |
| | Type of assistance | Project grants |

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| | Eligibility | A rural applicant must be nominated by a local government or state where the rural area is located. Applicants on behalf of nominated beneficiaries may also include, but are not limited to, state and local governments, regional planning agencies, non-profit organizations, community-based organizations, or partnerships of community members and other entities. An area is eligible if it (1) has a maximum population of 30,000; (2) is an area of pervasive poverty, unemployment, and general distress; (3) is smaller than 1,000 square miles; and (4) meets other locative requirements. Round I zones have been selected, 5 additional zones have been authorized by Congress. |
| | Eligible activities | Potential Empowerment Zones submit creative plans for revitalization and, if chosen, receive grants to help execute these plans. |
| | Eligible water conservation measures | **Structural Measures**<br>• Meters<br>• Leak detection and control equipment<br>• Plumbing fixture retrofits or replacements<br>• Water-efficient appliance<br>• Water-efficient landscaping or irrigation equipment<br>• Gray water recycling<br>• Commercial/institutional conservation measures<br>• Industrial reuse or recycling<br>• Wastewater reclamation and reuse |

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| Pacific Northwest Laboratory, U.S. Department of Energy | Program | Pacific Northwest National Laboratory |
| | National contact | Michael Baechler (503) 417-7553.<br>www.pnl.gov/energystar |
| | Regional contacts | Not applicable |
| | Type of assistance | Market transformation. |
| | Eligibility | Bulk purchase of water-efficient clothes washers by high volume purchasers, including multifamily residential units, builders, utilities, energy commissions, and developers, but not retailers. |
| | Eligible activities | The program provides access to a specific model of high performance water-conserving clothes washers selected in a national competition. |
| | Eligible water conservation measures | **Structural Measures**<br>• Water-efficient appliances |

# APPENDIX F
# STATE CONTACT LIST

| State | Primacy Agency | Drinking Water SRF Agency | Water Resource Agency |
|---|---|---|---|
| Alabama | Water Division<br>Department of Environmental Management<br>P.O. Box 301463<br>Montgomery, AL 36130-1463<br>334-271-7774 or 334-271-7823 | Department of Environmental Management<br>1751 Cong. WM Dickinson Drive<br>P.O. Box 301463<br>Montgomery, AL 36130-1463<br>334-271-7773 | Office of Water Resources<br>Department of Economic and Community Affairs<br>Montgomery, AL 36130<br>334-242-5499 |
| Alaska | Drinking Water Program<br>Division of Environmental Health<br>Department of Environmental Conservation<br>555 Cordova Street<br>Anchorage, AK 99501-2617<br>907-269-7647 | Facility Construction and Operations Division<br>Department of Environmental Conservation<br>410 Willoughby Avenue, #105<br>Juneau, AK 99801-1795<br>907-465-5136 | Water Resources Section<br>Division of Mining and Water<br>Department of Natural Resources<br>3601 C Street, Suite 200<br>Anchorage, AK 99503-5929<br>907-269-8400 |
| Arizona | Department of Environmental Quality<br>1110 W. Washington St<br>Phoenix, AZ 85007<br>602-207-2300 | Drinking Water Section<br>Department of Environmental Quality<br>1110 W. Washington St<br>Phoenix, AZ 85007<br>602-207-4617 | Department of Water Resources<br>500 N. Third Street<br>Phoenix, AZ 85004<br>602-417-2408 |
| Arkansas | Department of Health<br>4815 W. Marham<br>Little Rock, AR 72205<br>501-661-2623 | Department of Health<br>4815 W. Marham<br>Little Rock, AR 72205<br>501-661-2623 | Soil and Water Conservation Commission<br>101 East Capitol Street<br>Little Rock, AR 72201 |
| California | Division of Drinking Water and Environmental Management<br>Department of Health Services<br>601 North 7th Street, MS 92,<br>Sacramento, CA 95814<br>Mail: P.O. Box 942732,<br>Sacramento, CA 94234-7320<br>916-323-6111 | Division of Drinking Water and Environmental Management<br>Department of Health Services<br>P.O. Box 942732<br>Sacramento, CA 94234-7320<br>916-323-4344 | Department of Water Resources<br>1020 9th Street, 3rd Floor<br>Sacramento, CA 95814<br>916-327-1655 |

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| Colorado | Water Quality Control Div., Department of Public Health and Environment<br>4300 Cherry Creek Drive S.<br>Denver, CO 80222-1530<br>303-692-3500 | Water Quality Control Division<br>Department of Public Health & Environment<br>4300 Cherry Creek Drive<br>Denver, CO 80222-1530<br>303-692-3554 | Division of Water Resources, Dept. of Natural Resources<br>1313 Sherman St., Rm. 818<br>Denver, CO 80203<br>303-866-3586 |
| Connecticut | Div. of Environmental Health, Bureau of Regulatory Services, Dept. of Public Health<br>410 Capitol Avenue, P.O. Box 340308<br>Hartford, CT 06134-0308<br>860-509-8000 | Water Supplies Section<br>Department of Public Health<br>P.O. Box 340308<br>450 Capitol Avenue (MS# 51 WAT)<br>Hartford, CT 06134-0308<br>860-509-7333 | Bureau of Water Management, Department of Environmental Protection<br>79 Elm Street<br>Hartford, CT 06106-5127<br>860-424-3704 |
| Delaware | Health Systems Protection<br>Division of Public Health<br>Health and Social Services<br>P.O. Box 637<br>Dover, DE 19903<br>302-577-4501 | Division of Public Health<br>Department of Health & Social Services<br>P.O. Box 637<br>Dover, DE 19903<br>302-739-5410 | Division of Water Resources, Department of Natural Resources and Environmental Control<br>302-739-4860 |
| Florida | Division of Water Facilities<br>Dept. of Environmental Protection<br>Twin Towers Building,<br>2600 Blair Stone Road, Mail Station #70<br>Tallahassee, FL 32399<br>904-488-2996 | Bureau of Local Government Wastewater Financial Assistance, Dept. of Environmental Protection<br>Twin Towers Building 2600 Blair Stone Road<br>Tallahassee, FL 32399<br>850-488-8163 | Office of Water Policy<br>Dept. of Environmental Protection<br>Twin Towers Building<br>2600 Blair Stone Road<br>Tallahassee, FL 32399<br>850-488-1554 |
| Georgia | Water Resources Branch<br>Environmental Protection Division, Dept. of Natural Resources<br>1152 East Tower<br>205 Butler Street, SE<br>Atlanta, GA 30334<br>404-656-4807 | Environmental Protection Division<br>Drinking Water Permitting & Engineering Program<br>Department of Natural Resources<br>Floyd Towers East, Suite 1362<br>205 Butler Street, SE<br>Atlanta, GA 30334<br>404-656-0719 | Water Resources Branch, Environmental Protection Division<br>Department of Natural Resources<br>1152 East Tower<br>205 Butler Street, SE<br>Atlanta, GA 30334<br>404-656-4807 |

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| Hawaii | Safe Drinking Water Branch, Environmental Management Division, Environmental Health Administration, Department of Health<br>919 Ala Moana Blvd.<br>Honolulu, HI 96814<br>808-586-4258 | Safe Drinking Water Branch, Environmental Management Division, Environmental Health Administration, Department of Health<br>919 Ala Moana Blvd. (308)<br>Honolulu, HI 96814<br>808-586-4258 | Division of Water Resource Management<br>Land and Natural Resources Department<br>1151 Punchbowl Street<br>Honolulu, HI 96813<br>808-587-0214 |
| Idaho | Division of Environmental Quality<br>Department of Health and Welfare<br>1410 North Hilton<br>Boise, ID 83706-1255<br>208-373-0502 | Bureau of Drinking Water and Wastewater<br>Division of Environmental Quality<br>Department of Health and Welfare<br>1410 North Hilton<br>Boise, ID 83706-1255<br>208-373-0291 | Department of Water Resources<br>1301 N. Orchard Street<br>Boise, ID 83706<br>208-327-7910 |
| Illinois | Bureau of Water Environmental Protection Agency<br>2200 Churchill Road,<br>Springfield, IL 62794-9276<br>217-782-1654 | Division of Public Water Supplies<br>Environmental Protection Agency<br>P.O. Box 19276<br>Springfield, IL 62794-9276<br>217-785-8653 | Office of Water Resources, Department of Natural Resources<br>310 South Michigan Avenue, Room 1606<br>Chicago, IL 60604<br>312-793-3129 |
| Indiana | Office of Water Management<br>Department of Environmental Management<br>100 N. Senate<br>P.O. Box 6015<br>Indianapolis, IN 46206-6015<br>317-232-8476 | Drinking Water Branch<br>Department of Environmental Management<br>100 North Senate Avenue<br>P.O. Box 6015<br>Indianapolis, IN 46206-6015<br>317-308-3281 | Division of Water Department of Natural Resources<br>402 West Washington Street,<br>Indianapolis, IN 46204.<br>317-232-4161 |
| Iowa | Water Supply Section<br>Water Quality Bureau<br>Environmental Protection Division, Dept. of Natural Resources<br>Wallace State Office Bldg.<br>Des Moines, IA 50319 | Water Quality Bureau<br>Department of Natural Resources<br>Wallace Office Building<br>900 East Grand Street<br>Des Moines, IA 50319<br>515-281-8869 | Water Resources Section<br>Water Quality Bureau<br>Environmental Protection Division, Department of Natural Resources<br>Wallace State Office Bldg.<br>Des Moines, IA 50319 |
| Kansas | Bureau of Water<br>Department of Health and Environment<br>Forbes Field, Building 283<br>Topeka, KS 66620<br>785-296-5500 | Public Water Supply<br>Bureau of Water<br>Forbes Field, Building 283<br>Topeka, KS 66620<br>785-296-5503 | Kansas Water Office<br>109 S.W. Ninth Street<br>Suite 300<br>Topeka, KS 66612-1249<br>785-296-3185 |

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| Kentucky | Drinking Water Branch Natural Resources and Environmental Protection Cabinet<br>14 Reilly Road<br>Frankfort, KY 40601<br>502-564-3410 | Division of Water<br>Drinking Water Branch<br>Department of Natural Resources & Environmental Protection Cabinet<br>14 Reilly Road<br>Frankfort, KY 40601<br>502-564-3410 | Division of Water, Water Resources Branch<br>Natural Resources and Environmental Protection Cabinet<br>14 Reilly Road<br>Frankfort, KY 40601<br>502-564-3410 |
| Louisiana | Office of Public Health<br>Department of Health and Hospitals<br>1201 Capitol Access Road, P.O. Box 629<br>Baton Rouge, LA 70821-0629<br>504-342-9500 | Municipal Facilities Division<br>Department of Environmental Quality<br>P.O. Box 82215<br>Baton Rouge, LA 70884-2215<br>504-765-0810 | Office of Water Resources, Department of Environmental Quality<br>P.O. Box 82215<br>Baton Rouge, LA 70884 |
| Maine | Department of Human Services<br>221 State Street<br>Augusta, ME 04333<br>207-287-3707 | Department of Human Services<br>10 State House Station<br>157 Capitol Street<br>Augusta, ME 04333-0010<br>207-287-5685 | Water Resource Regulation Division<br>Bureau of Land and Water Quality<br>Department of Environmental Protection<br>17 State House Station<br>Augusta, ME 04333-0017<br>207-287-7789 |
| Maryland | Water Management Administration<br>Department of the Environment<br>2500 Broening Highway<br>Baltimore, MD 21224<br>410-631-3567 | Public Drinking Water Program<br>Department of the Environment<br>2500 Broening Highway<br>Baltimore, MD 21224<br>410-631-3702 | Water Management Administration<br>Department of the Environment<br>2500 Broening Highway<br>Baltimore, MD 21224<br>410-631-3567 |
| Massachusetts | Water Resources Commission<br>Department of Environmental Protection<br>1 Winter Street<br>Boston, MA 02108<br>617-292-5948 | Department of Environmental Protection<br>1 Winter Street<br>Boston, MA 02108<br>617-292-5529 | Water Resources Commission<br>Department of Environmental Protection<br>1 Winter Street<br>Boston, MA 02108<br>617-292-5948 |
| Michigan | Drinking Water and Radiological Protection<br>Department of Environmental Quality<br>P.O. Box 30630<br>Lansing, MI 48909<br>517-335-9218 | Drinking Water and Radiological Protection<br>Department of Environmental Quality<br>P.O. Box 30630<br>Lansing, MI 48909<br>517-335-8326 | Department of Environmental Quality<br>P.O. Box 30630<br>Lansing, MI 48909<br>517-373-7917 |

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| Minnesota | Department of Health<br>121 East Seventh Place<br>St. Paul, MN 55101<br>612-215-0700. | Drinking Water<br>Protection Section<br>Department of Health<br>121 7th Place East<br>Suite 220<br>St. Paul, MN 55164-0975<br>612-215-0746 | Division of Waters Department of Natural Resources<br>500 Lafayette Road<br>Saint Paul, MN 55155<br>612-297-2835 |
| Mississippi | Office of Health Regulation<br>State Department of Health<br>2423 North State Street<br>P. O. Box 1700<br>Jackson, MS 39215-1700<br>601-960-7518 | Division of Water Supply<br>State Department of Health<br>P.O. Box 1700<br>Jackson, MS 39215-1700<br>601-960-7518 | Office of Land and Water Resources<br>Department of Environmental Quality<br>P.O. Box 10631<br>Jackson, MS 39289 |
| Missouri | Public Drinking Water Program<br>Division of Environmental Quality<br>Department of Natural Resources<br>P.O. Box 176<br>Jefferson City, MO 65102<br>573-751-5331 | Public Drinking Water Program<br>Department of Natural Resources<br>P.O. Box 176<br>Jefferson City, MO 64102<br>573-751-5331 | Department of Natural Resources<br>P. O. Box 176,<br>Jefferson City, MO 65102<br>1-800-334-6946 |
| Montana | Department of Environmental Quality<br>P.O. Box 200901<br>Helena, MT 59620-0901<br>406-444-2544 | Technical and Financial Assistance Bureau<br>Department of Environmental Quality<br>P.O. Box 200901<br>Helena, MT 59620-0901<br>406-444-6776 | Water Resources Division Department of Natural Resources and Conservation<br>48 N. Last Chance Gulch<br>Helena, MT 59620-2301<br>406-444-6601 |
| Nebraska | Division of Environmental Health<br>Department of Health and Human Services<br>301 Centennial Mall South<br>P.O. Box 95007<br>Lincoln, NE 69509<br>402-471-2541 | Department of Health & Human Services<br>301 Centennial Mall South, 3rd Floor<br>P.O. Box 95007<br>Lincoln, NE 68509-5007<br>402-471-2541 | The Nebraska Natural Resources Commission<br>301 Centennial Mall South<br>Lincoln, NE 68509<br>402-471-2081 |

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| Nevada | State Health Division<br>Department of Human Resources<br>505 East King Street, Room 203<br>Carson City, NV 89706-7921<br>702-687-3600 | Bureau of Health Protection Service<br>Department of Human Resources<br>1179 Fairview Drive<br>Carson City, NV 89701-5405<br>702-687-6615 | Planning, Department of Conservation and Natural Resources<br>1550 E. College Parkway, Suite 142<br>Carson City, NV 89706-7921<br>702-687-3600 |
| New Hampshire | Division of Water Resources<br>Department of Environmental Services<br>64 No. Main Street<br>Concord, NH 03301-4913<br>603-271-3406 | Water Supply Engineering Bureau<br>Department of Environmental Services<br>6 Hazen Drive<br>P.O. Box 95<br>Concord, NH 03302-0095<br>603-271-3503 | Division of Water Resources<br>Department of Environmental Services<br>64 No. Main Street<br>Concord, NH 03301-4913<br>603-271-3406 |
| New Jersey | Office of Water Policy Analysis<br>Department of Environmental Protection<br>CN-426<br>Trenton, NJ 08625<br>609-292-7219 | Water Supply Element<br>Department of Environmental Protection<br>CN 426<br>401 E. State Street, 3rd Floor<br>Trenton, NJ 08625<br>609-292-7219 | Bureau of Water Allocation, Department of Environmental Protection<br>CN-426<br>401 E. State Street, 3rd Floor<br>Trenton, NJ 08625<br>609-292-2885 |
| New Mexico | Drinking Water Compliance Section, Field Operations Division, Drinking Water and Community Services Bureau<br>Environment Department<br>525 Camino de los Marquez, Suite 4<br>Santa Fe, NM 87502<br>505-827-7536 | Drinking Water Bureau<br>Environment Department<br>525 Camino De Los Marquez<br>Suite 4, P.O. Box 26110<br>Santa Fe, NM 87502<br>505-827-7536 | Office of the State Engineer<br>Interstate Stream Commission<br>P.O. Box 25102<br>Santa Fe, NM 87504-5102<br>505-827-6175 |
| New York | Bureau of Public Water Supply Protection, Div. of Environmental Protection<br>Department. of Health<br>50 Wolf Rd., Room 302<br>Albany, NY 12233-3505<br>518-458-6423 | Bureau of Public Water Supply Protection<br>Department of Health<br>2 University Place, Room 410<br>Albany, NY 12203-3313<br>518-458-6731 | Division of Water<br>Department of Environmental Conservation<br>50 Wolf Rd., Room 302<br>Albany, NY 12233-3505<br>518-457-2470 |
| North Carolina | Public Water Supply Section Div. of Environmental Health<br>Department of Environment, Health and Natural Resources<br>P.O. Box 29536<br>Raleigh, NC 27626 | Public Water Supply Section Department of Environment, Health & Natural Resources<br>P.O. Box 29536<br>Raleigh, NC 27626 | Division of Water Resources, Department of Environment, Health and Natural Resources<br>512 N. Salisbury Street<br>Raleigh, NC 27604 |

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| | 919-733-2321 | 919-733-2321 | 919-715-3047 |
| North Dakota | Div. of Municipal Facilities<br>Environmental Health Section<br>1200 Missouri Ave.<br>P.O. Box 5520<br>Bismarck, ND 58506-5520<br>701-328-5150 | Division of Municipal Facilities<br>Department of Health<br>1200 Missouri Avenue<br>Bismarck, ND 58506<br>phone: (701) 328-5211 | North Dakota State Water Commission<br>900 E. Boulevard Avenue<br>Bismarck, ND 58505<br>701-328-4989 |
| Ohio | Division of Drinking and Ground Waters Environmental Protection Agency<br>1800 Watermark Drive<br>P.O. Box 1049<br>Columbus, OH 43216-1049<br>614-644-2752 | Division of Drinking Water/ Groundwater Environmental Protection Agency<br>P.O. Box 1049<br>1800 Watermark Drive<br>Columbus, OH 43216-1049<br>614-644-2752 | Department of Natural Resources<br>Building E-2<br>1939 Fountain Square Court<br>Columbus, OH 43224<br>614-265-6610 |
| Oklahoma | Water Quality Division<br>Department of Environmental Quality<br>1000 Northeast 10th Street<br>Oklahoma City, OK 73117-1212<br>405-271-5205 | Water Quality Division<br>Department of Environmental Quality<br>1000 Northeast Tenth Street<br>Oklahoma City, OK 73117-1212<br>405-271-5205 | Water Resources Board<br>3800 North Classen Blvd.<br>Oklahoma City, OK 73118<br>405-530-8845 |
| Oregon | Drinking Water Program Health Division<br>Department of Human Resources<br>500 Summer Street, NE<br>Salem, OR 97310-1012<br>503-731-4010 | Health Division<br>Department of Human Resources<br>800 NE Oregon Street<br>P.O. Box 14360<br>Portland, OR 97293-0460<br>503-731-4010 | Water Resources Department<br>Commerce Building<br>158 12th Street<br>Salem, OR 97310<br>503-378-3739 |
| Pennsylvania | Bureau of Water Supply Management<br>Office of Water Management<br>Department of Environmental Protection<br>P.O. Box 8467<br>Harrisburg, PA 17105<br>717-787-5017 | Municipal Financial Assistance Division<br>Department of Environmental Protection<br>P.O. Box 8467<br>Harrisburg, PA 17105-8467<br>717-772-4054 | Bureau of Watershed Conservation<br>Office of Water Management<br>Department of Environmental Protection<br>P.O. Box 8467<br>Harrisburg, PA 17105<br>717-787-5267 |
| Rhode Island | Division of Drinking Water Quality<br>Department of Health<br>Three Capitol Hill, Providence, | Drinking Water Quality Division<br>Department of Health<br>3 Capitol Hill | Water Supply Management Division<br>Department of Environmental |

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| | RI 02908-5097<br>401-277-2231 | 209 Cannon Building<br>Providence, RI 02908<br>401-277-6867 | Management<br>235 Promenade Street<br>Providence, RI 02908<br>401-277-4700 |

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| South Carolina | Bureau of Water<br>Department of Health and Environmental Control<br>26 Bull Street<br>Columbia, SC 29201<br>803-734-5342 | Water Pollution Control<br>Department of Health and Environmental Control<br>2600 Bull Street<br>Columbia, SC 29201<br>803-734-5283 | Water Resources Division, Department of Natural Resources<br>1201 Main Street, Suite 1100<br>Columbia, SC 29201<br>803-737-0800 |
| South Dakota | Drinking Water Division<br>Department of Environment and Natural Resources<br>523 E. Capitol Avenue<br>Pierre, SD 57501-3181<br>605-773-3754 | Water and Waste Funding Assistance<br>Department of Environment & Natural Resources<br>Joe Foss Building<br>523 East Capitol<br>Pierre, SD 57501-3181<br>605-773-4216 | Drinking Water Division<br>Department of Environment and Natural Resources<br>523 E. Capitol Avenue<br>Pierre, SD 57501-3181<br>605-773-3754 |
| Tennessee | Division of Water Supply<br>Department of Environment and Conservation<br>L and C Tower, 6th Floor<br>401 Church Street<br>Nashville, TN 37243<br>615-532-0191 | Division of Water Supply<br>Department of Environment & Conservation<br>401 Church Street, 6th Floor<br>L&C Tower<br>Nashville, TN 37243-1549<br>615-532-0155 | Division of Water Supply<br>Department of Environment and Conservation<br>L and C Tower, 6th Floor<br>401 Church Street<br>Nashville, TN 37243<br>615-532-0191 |
| Texas | Public Drinking Water Section of the Water Utilities Division<br>Natural Resource Conservation Commission<br>P.O. Box 13087<br>Austin, TX 78711-3087<br>512- 239-1000 | Natural Resources Conservation Commission<br>P.O. Box 13087<br>Austin, TX 78711-3087<br>512-239-6020 | Water Development Board<br>P.O. Box 13231, Capitol Station<br>Austin, TX 78711<br>512-463-8061 |
| Utah | Division of Drinking Water, Department of Environmental Quality<br>P.O. Box 144830<br>Salt Lake City, UT 84114-4830<br>801-536-4188 | Division of Drinking Water,<br>Department of Environmental Quality<br>P.O. Box 144830<br>Salt Lake City, UT 84114-4830<br>801-536-4197 | Board of Water Resources<br>P.O. Box 146201<br>Salt Lake City, UT 84114-6201<br>801-538-7299 |
| Vermont | Water Supply Division<br>Department of Environmental | Water Supply Division<br>Department of | Water Resources Board, Environmental Board |

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| | Conservation<br>Agency of Natural Resources<br>103 South Main Street<br>Waterbury, VT 05671-0403<br>802-241-3600 | Environmental Conservation<br>Old Pantry Building<br>103 South Main Street<br>Waterbury, VT 05671-0403<br>802-241-3400 | National Life Records Center Building, Drawer 20<br>Montpelier, VT 05602<br>802-828-3309 |
| Virginia | Division of Water Supply Engineering<br>Office of Water Programs<br>Room 109<br>1500 East Main Street,<br>Richmond, VA 23219<br>804-371-2885 | Division of Water Supply Engineering<br>Department of Health<br>1500 East Main Street,<br>Room 109-31<br>Richmond, VA 23219<br>804-786-1768 | Department of Environmental Quality<br>629 East Main Street<br>Richmond, VA 23240<br>804-698-4471 |
| Washington | Division of Drinking Water<br>Department of Health<br>Airdustrial Way, Building 3<br>P.O. Box 47822<br>Olympia, WA 98504-7822<br>360-586-5207 | Division of Drinking Water<br>Department of Health<br>Airdustrial Way, Building 3<br>P.O. Box 47822<br>Olympia, WA 98504-7822<br>360-236-3093 | Department of Ecology<br>Water Resources Program<br>PO Box 47600<br>Olympia, WA 98504-7600<br>360-407-6602 |
| West Virginia | Bureau for Public Health<br>Environmental Engineering Division<br>Office Of Environmental Health Services<br>304-558-2981 | Bureau for Public Health<br>Office of Environmental Health Services<br>815 Quarrier Street #418<br>Charleston, WV 25301-2616<br>304-558-2981 | Office of Water Resources<br>Division of Environmental Protection<br>1201 Greenbriar Street<br>Charleston, WV 25311<br>304-558-2108 |
| Wisconsin | Bureau of Drinking Water/ Groundwater<br>Department of Natural Resources<br>P.O. Box 7921<br>Madison, WI 53707<br>608-266-0821 | Bureau of Drinking Water/ Groundwater<br>Department of Natural Resources<br>P.O. Box 7921<br>Madison, WI 53707-7921<br>608-267-7651 | Water Management<br>Department of Natural Resources<br>101South Webster Street, WT-2<br>Madison, WI 53707<br>608-267-2375 |
| Wyoming | Water Quality Division<br>Department of Environmental Quality<br>Herschler Building<br>122 West 25th Street<br>Cheyenne, WY 82002-0600<br>307-777-7075 | Water Quality Division<br>Department of Environmental Quality<br>Herschler Building<br>122 West 25th Street<br>Cheyenne, WY 82002-0600<br>307-777-7075 | State Engineer Office<br>Herschler Building, 4 East<br>Cheyenne, WY 82002<br>307-777-5927<br><br>Water Development Comm.<br>4 West Herschler Building<br>Cheyenne, WY 82002<br>307-777-7626 |

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