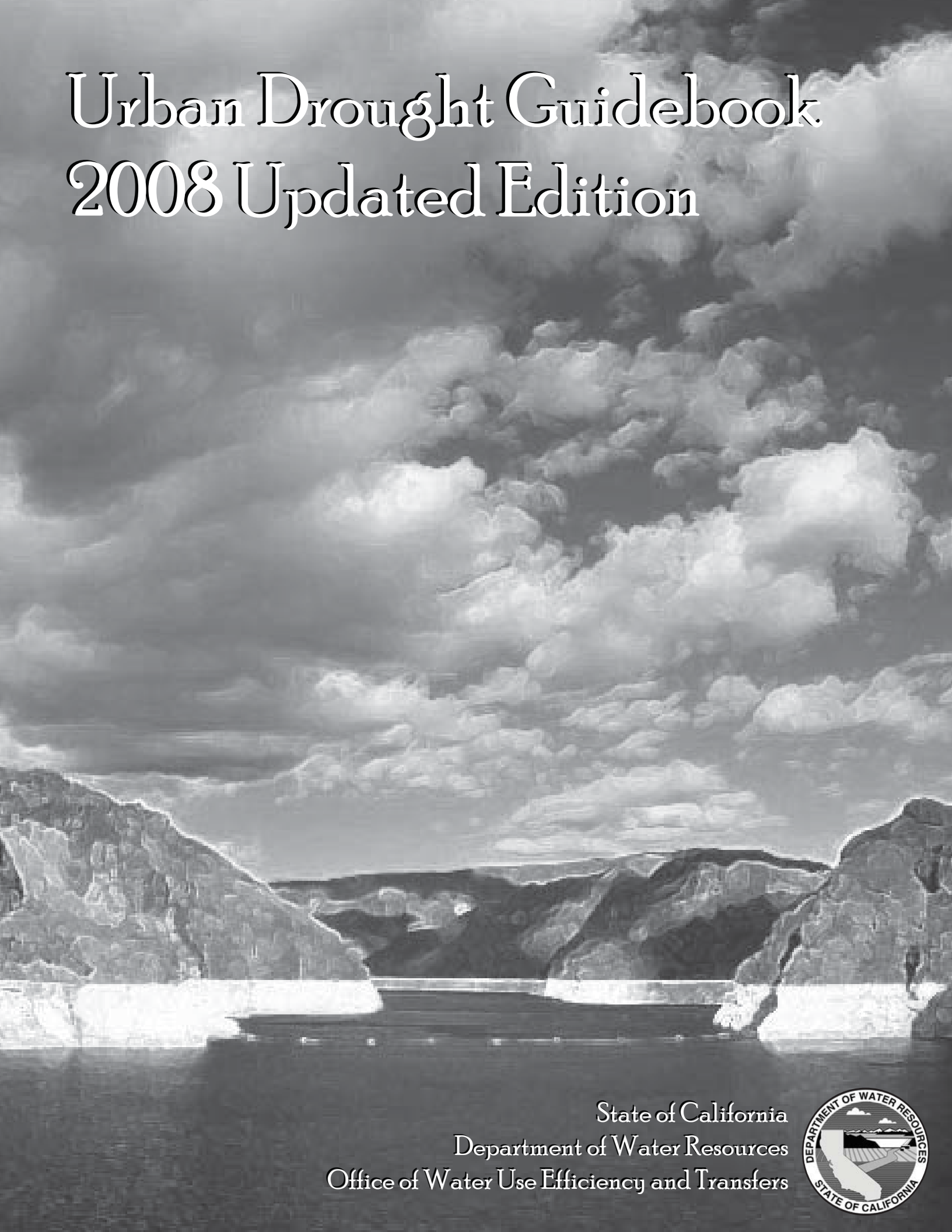
Urban Drought Guidebook 2008 Updated Edition



State of California
Department of Water Resources
Office of Water Use Efficiency and Transfers

Cover Photo

Lake Mead, storing Colorado River water that supplies irrigation and domestic water to much of Southern California at 50 percent capacity, winter 2007.

Photo by Andy Pernick , U.S. Bureau of Reclamation photographer.

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Foreword

To help local agencies and communities prepare for the possibility of another dry year and possible water supply interruptions, the Department of Water Resources is pleased to publish this updated version of the Urban Drought Guidebook. Drought, climate change, natural disasters, and environmental protections can all affect water supplies. Good planning and preparation can help agencies maintain reliable supplies and reduce the impacts of supply interruptions. We, the U. S. Bureau of Reclamation, and the California Urban Water Conservation Council worked together on the guidebook to provide technical assistance to local water suppliers.

As water suppliers review and update their Water Shortage Contingency Plans, we hope the new information and examples of exceptional efforts by water suppliers throughout California and the United States will be useful. The wide array of approaches presented in the guidebook reflects the variable water supply and demand scenarios from one end of the state to the other. Accordingly, water suppliers will be able to use this guidebook to design programs that reflect local and regional conditions.

Sincerely,

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Acronyms and Abbreviations

AF	Acre Feet
AFY	Acre Feet Per Year
AWE	Alliance for Water Efficiency
AWWA	American Water Works Association
BMPs	Best Management Practices
CCWD	Contra Costa Water District
CEQA	California Environmental Quality Act
CII	Commercial, Industrial, Institutional
CLCA	California Landscape Contractors Association
CPUC	California Public Utilities Commission
Council	California Urban Water Conservation Council (CUWCC)
CVPIA	Central Valley Project Improvement Act
CVP	Central Valley Project
DEP	Department of Environmental Protection
DHS	Department of Health Services (California)
DWR	Department of Water Resources
EBMUD	East Bay Municipal Utility District
ET	Evapotranspiration
GIS	Geographic Information System
GPCD	Gallons per Capita per Day
GPD	Gallons per Day
GPDD	Gallons per Day per Dwelling Unit
GPDC	Gallons per Day per Connection
GPDA	Gallons per Day per Irrigated Acre
GPDE	Gallons per Day per Employee
GPF	Gallons per Flush
GPM	Gallons per Minute
HET	High Efficiency Toilets
HCF	Hundred Cubic Feet
IA	Irrigation Association
ICI	Industrial, Commercial, Institutional
IWU	Indoor Water Use
LADWP	Los Angeles Department of Water and Power

Acronyms and Abbreviations (continued)

MGD	Million Gallons Per Day
MMWD	Marin Municipal Water District
MWDSC	Metropolitan Water District of Southern California
MWDOC	Municipal Water District of Orange County
NDMC	National Drought Mitigation Center (University of Nebraska)
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
OES	Office of Emergency Services (California)
PUC	Public Utilities Commission (California)
Reclamation	U.S. Bureau of Reclamation
RO	Residential Occupancy
SCWA	Sonoma County Water Agency
SDCWA	San Diego County Water Authority
SFPUC	San Francisco Public Utilities Commission
SPU	Seattle Public Utilities
SWP	State Water Project
SWRCB	State Water Resources Control Board
TWDB	Texas Water Development Board
UAW	Unaccounted for Water
ULF	Ultra Low Flush
USGS	United States Geological Survey
UWMPA	Urban Water Management Planning Agency
WARN	Water/Wastewater Agency Response Network
WC	Water Code
WCI	Water Conservation Initiative
WCM	Water Conservation Manager
WSCP	Water Shortage Contingency Plan

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Quick Drought Information References

Additional drought information can be found at these Web sites:

http://www.owue.water.ca.gov

http://watersupplyconditions.water.ca.gov/

http://www.usbr.gov/drought/

http://www.usbr.gov/lc/region/scao

http:// www.usbr.gov/mp/watershare

http://www.cuwcc.org

Introduction

Much has changed in the realm of California water since DWR first published the Urban Drought Guidebook in 1988. Some of the situations and challenges facing water managers today include:

- On average, Californians use less water per person today, but the state's population has grown from nearly 30 million in 1990 to more than 37 million in 2007.
- 2006 was the hottest year on record in most of California and the United States.
- 2006-2007 was the driest water year on record in many California counties.
- Water is delivered through an increasingly complex and aging network of distribution systems.
- Water treatment processes have become more sophisticated and costly.
- Energy-related expenses, from transportation to treatment, have increased significantly.
- The environment is taxed to a critical point in some key waterways of the state, including the Delta.
- The reliability of water deliveries has diminished as uncertainty and variability increases, as related to climate change, regulatory actions, system security and other factors.

There are also new opportunities for addressing water shortages since the 1990s. Widespread use of the Internet allows for information sharing and communication to a level unimagined in previous decades. New technology allows for more efficient use of water, from commercial cooling towers to smart irrigation controllers. Regional alliances have been established, often on a formal basis, to coordinate water supply and demand management efforts.

This guide will help water managers facing water shortages by showing them how to use tried and true methods of the past as well as making use of new tools and methods.

Managing water shortages involves using programs to temporarily reduce demand and find alternate water to temporarily increase supply. The guidebook discusses water shortage management programs that belong in water shortage contingency plans. It was first written in 1988, and then updated in 1991 and 2008 to help water suppliers cope with potentially severe drought and other water shortages. The focus of the guide is to provide a step-by-step process to anticipate and respond to water shortages. The guidebook emphasizes two areas: First, it uses examples of well-conceived and executed plans in California and other parts of the country to illustrate recommendations

whenever possible. Second, it stresses that successful programs are commonly the result of a cooperative effort between water suppliers and their customers. Activities that foster this spirit of cooperation are highlighted.

Definition of a Drought

In the most general sense, drought is a deficiency of precipitation over an extended period of time, resulting in a water shortage for some activity, group, or environmental sector. Whatever the definition, it is clear that drought cannot be viewed solely as a physical phenomenon. A water shortage occurs when supply is reduced to a level that cannot support existing demands. Natural forces, system component failure or interruption, or regulatory actions may cause these water shortages. Such conditions could last two to three months or extend over many years.

Water Shortage Contingency Planning

A reliable water supply is essential. Its importance highlights the need to prepare for a drought or other water shortage. Contingency planning before a shortage allows selection of appropriate responses consistent with the varying severity of shortages. While the actions taken should be adequate to deal with the circumstances and no more, it is essential that water suppliers start demand-reduction programs before a severe shortage. Water suppliers that delay demand-reduction programs may exhaust reserve supplies early in an extended shortage and could cause unnecessary social and economic harm to the communities. A Water Shortage Contingency Plan (WSCP) should enable water suppliers to provide water for public health and safety and minimize impacts on economic activity, environmental resources and the region's lifestyle.

Here are sample priorities for use of available water:

1. Health and Safety – interior residential and fire fighting
2. Commercial, Industrial, and Institutional – maintain economic base, protect jobs
3. Permanent Crops – takes five to 10 years to replace
4. Annual Crops – protect jobs
5. Landscaping – direct water to trees and shrubs
6. New Demand – generally, two years of construction projects are already approved

Drought-Related Regulations and Planning Requirements

Declaration of Water Shortage Emergencies—California Water Code Sections 350-359 and Government Code Sections 8550-8551

For California water suppliers, the requirements of these two acts need to be incorporated into any water shortage plans. The key elements of these acts are

summarized in Table 1. The complete text of the relevant code sections is contained in Appendix A. These provisions provide the authority for water suppliers to declare a water shortage emergency. Then the local water supplier is provided with broad powers to enforce regulations and restrictions for managing the water shortage. Water needed for domestic purposes is given priority and discrimination within a class of customers is not allowed. Investor-owned water suppliers will find drought related information from the California Public Utilities Commission in Appendix B.

Table 1 Outline of California Water Code, Chapter 3

Section Reference	Summary of Key Points
350	Governing body of water supply distributor has authority to declare water shortage emergency condition. Defines water shortage emergency condition as when there would be "insufficient water for human consumption, sanitation, and fire protection."
351	A public hearing is required prior to a water shortage emergency condition declaration.
352	Advertisement of the public hearing must follow certain notification and distribution procedures.
353	Governing body of water supply distributor must adopt regulations and restrictions to "conserve the water supply for the greatest public benefit." Priority uses are domestic, sanitation, and fire protection.
354	Option given to governing body of water supply distributor to establish additional water allocation, distribution, and delivery priorities. Method of allocation cannot discriminate "between customers using water for the same purpose or purposes."
355	Regulations and restrictions are in effect until the emergency is over and the water supply has been replenished or augmented.
356	Regulations and restrictions allow prohibiting new or additional service connections. Enforcement of regulations and restrictions may include discontinuing service to customers willfully violating them.
357	Regulations and restrictions must prevail over allocation provisions of laws pertaining to water rights of individual customers. Water distributors subject to regulation by the State Public Utilities Commission (PUC) need prior approval by the PUC before adopting regulations and restrictions of this type.
358	Review of an emergency declaration or adopted regulations and restrictions adopted by a court is not prohibited.
359	Requirements for applying for federal drought relief program.

Proposition 218

Proposition 218, which was approved by the voters in 1996, added Article XIII C (taxes) and D (fees and assessments) to the California Constitution. Proposition 218 may apply to how a water supplier sets assessments and fees. Water suppliers should consult their attorney for modification of fees, assessments or charges. For the full text of Proposition 218 go to http://vote96.sos.ca.gov/bp/218.htm.

Urban Water Management Planning Act

Since 1983, the state requires every urban water supplier that provides water to 3,000 or more customers, or that provides more than 3,000 acre-feet of water annually to develop and implement an Urban Water Management Plan (UWMP) (California Water Code Sections 10610-10657). The California Department of Water Resources (DWR) provides a guidebook, conducts workshops, and serves as a repository for the plans. The law requires suppliers to report on the reliability of its water service and whether it is sufficient to meet the needs of its customers during normal, dry, and multiple dry years. Water suppliers update their UWMPs every five years.

The Urban Water Management Planning Act describes the contents of UWMPs as well as how urban water suppliers should adopt and implement the plans. An important requirement is that each water supplier must prepare an urban water contingency analysis (California Water Code Section 10632). The analysis includes six components:

1. A description of the stages of action an agency will take in response to water shortages
2. An estimate of supply for three consecutive dry years
3. A plan for dealing with a catastrophic supply interruption
4. A list of the prohibitions, penalties and consumption reduction methods to be used
5. An analysis of expected revenue effects of reduced sales during shortages and proposed measures to overcome those effects
6. How it will monitor and document water cutbacks

The full text of Section 10632 is included in Appendix A. Final versions of the 2005 UWMPs of more than 100 water suppliers, including their WSCPs, are at: http://www.owue.water.ca.gov/urbanplan/index.cfm.

Integrated Regional Management Plans

Integrated Regional Management Plans are being developed and implemented throughout the state, partly in response to Proposition 50 (November 2002) and Proposition 84 (November 2006), statewide bonds that provides funding to encourage a regional approach to water management. Regions have distinct identities and hydrologic

and ecologic connections. Water supply reliability is a primary water management objective to be considered in these integrated plans. Meeting dry year demands is an important component of water supply reliability. UWMPs and the associated WSCPs prepared by local water suppliers provide an important foundation for Integrated Water Management Plans.

"One Water, One Watershed" Integrates Drought Actions in Region

A noteworthy regional water management effort is the "One Water, One Watershed" project of the Santa Ana Watershed. It brings together three California counties, 69 cities, and 98 water suppliers, covering 2,800 square miles, to develop regional partnerships to address the water supply and quality challenges. It identifies the major challenges threatening water supply reliability as climate change, continued drought in the Colorado River basin, Bay Delta vulnerabilities, and population growth and explosive development. The goal of "One Water, One Watershed" is to create a sustainable Santa Ana Watershed that will be drought-proof, salt-balanced, and will support economic and environmental health through 2030. For more information about this innovative project, go to http://www.sawpa.org/html/OneWater.htm.

In addition to the importance of Urban Water Management Plans to regional water management plans, the UWMPs are also important for land use planning. The approvals of large new developments in California must be linked to assurances that there is an adequate water supply (Senate Bills 610 and 221, 2001 - http://www.owue.water.ca.gov). If the proposed project was not accounted for in the most recently adopted UWMP, it requires project sponsors to discuss whether the water supplier's total projected water supplies available during normal, single dry, and multiple dry water years during a 20-year projection will meet the projected water demand of the project. Without assurances that there is a reliable source of water, even in dry years, large development projects cannot proceed.

Involve the Public

Public involvement is clearly required for smooth implementation of all phases of a demand reduction program. Community participation at the program development stage is also important. Public involvement will, to a large extent, determine the effectiveness and equity of the water supplier's water shortage management program.

7-Step Planning and Implementation Process

The chapters of this guidebook describe step-by-step planning designed to guide water suppliers before and during a water shortage. Water Shortage Contingency Plans have specific mandatory requirements and penalties that become effective when certain shortage conditions or triggers occur.

Water shortage planning is dynamic. It evolves as conditions change and new information becomes available.

Step 1 calls for the formation of a water shortage response team with a leader to spearhead the effort and involve the various units in the organization.

Step 2 calls for water suppliers to collect supply and demand data. These data are needed as a basis for planning and estimating how much water of acceptable quality will be available under various shortage conditions, including multiyear shortages. Pumping and pipeline capacity also are considered. Calculating projected demand, including increases because of growth and less precipitation, will be balanced against projected supply. **The best time to initiate this process is before a shortage occurs.**

Step 3 examines not only the quantity of water available from various supply augmentation and demand reduction options, but any problems or constraints resulting from the use of such sources.

Step 4 identifies trigger mechanisms to react to shortage severity.

(Steps 3 and 4 involve assessing shortage mitigation options and setting drought-stage triggers. These can be parallel efforts that support the final selection of WSCP elements in Step 5.)

Step 5 represents the synthesis of information from previous steps. Groups of water saving measures are associated with progressive levels of supply shortage. The key element of this step is involvement of customers in order to create a program that the community understands, contributes to, and supports.

Step 6 develops a budget and presents the draft plan to the public for review and revision. Formally establishing the ordinances and interagency agreements that underlay the plan happens before the plan is adopted.

Step 7 considers the nuts and bolts of how to implement the plan. Procedural issues, staffing needs, and budget and funding considerations must be resolved. **The preparation and implementation of a plan requires many complicated actions and we recommend that the supplier begin planning at least six months before rationing might start.**

The following Water Shortage Contingency Planning Checklist is provided to give the reader an overview of the entire planning cycle and to help keep track of the tasks. Some of the tasks can be done simultaneously and are not necessarily in the order that a particular water supplier will follow. The checklist, combined with the information provided in the 7 Steps, can help form the foundation of a water supplier's water shortage contingency plans and actions.

Water Shortage Contingency Planning Checklist

FIRST STEPS

Designate Water Shortage Response Team Leader	
Designate team member from each department or division	
Set priorities	
Identify potential supplemental supply sources	
Identify potential interconnections	
Identify regional suppliers for potential cooperative actions	
Establish a community advisory committee	

SUPPLY

Quantify worst-case supply (minimum) for next five or more years	
Local surface	
Wholesale	
Groundwater	
Recycled	
Other	

WATER QUALITY

Project water quality changes by source	
Identify water treatment devices necessary to use on degraded quality sources	
Identify low-quality water sources and develop plan for blending	

DEMAND

Quantify worst-case demand (maximum) by season for next five or more years	
Single Family	
Multifamily	
Commercial	
Industrial	
Institutional	
Landscape	
Recycled	
Agricultural	
Wholesale	
New connections	

SUPPLY AND DEMAND BALANCE

Quantify yearly shortage for next five or more years	
2008	
2009	
2010	
2011	
2012	
2013	

INCREASE SUPPLY

Project possible supplemental supplies and carryover	
Schedule well driller for new or rehabilitated wells	
Plan to increase supplier efficiency	
Meters	
System losses	
System pressure	
System flushing	
Supplier landscaping	

DECREASE DEMAND

Determine health & safety minimum supply	
Plan Stage 1 – public relations campaign and recommend customer actions	
Adopt and publicize water-waste ordinance and time of day irrigation restrictions	
Make available non-potable water stations for non-potable uses	
Review pricing structure and rates by stage	
Select water allocation method by customer class and stage	
Adopt restriction enforcement rules and penalties	
Selected stage and customer class demand reduction programs to help customers	
Plan for catastrophes with cascading failures – 50 percent supply shortage or more	

COMPLETE DRAFT WATER SHORTAGE CONTINGENCY PLAN

Establish stage triggers based on priorities and quantifiable supply availability by source	
Include carefully crafted flexibility to triggers	
Identify lag-time and seasonal issues related to each reduction program	
Establish structure and impacts of limited-number-of -days irrigation programs	
Develop revenue plan to balance budget by stage	
Develop customer appeal procedure	
Establish monitoring program to track water production and use	

COMMUNITY INVOLVEMENT

Complete DRAFT Plan	
Provide DRAFT Plan to community	
Contact significantly impacted customers (agriculture, green industry, tourist industry, etc.) and request input	
Contact local suppliers and government agencies and request input	
Hold at least three public meetings to receive comments on DRAFT Plan	
Incorporate useful community suggestions into the DRAFT Plan	
Adopt the final Water Shortage Contingency Plan	

SUPPLIER CAPABILITIES AND RESOURCES

Establish required computer capabilities for billing, data tracking and customer support	
Identify required changes to existing computer systems	
Make required computer system changes and test thoroughly	
Prepare customer information brochures	
Meter reading	
Leak detection	
Plumbing hardware recommendations and rebate programs	
Customer assistance programs offered by supplier staff	
Identify needed new full-time and part-time contract staff	
Procure space for additional staff and increased customer visits	
Develop media contacts	
Identify and purchase water conservation devices for distribution to customers	
Develop training program for staff	
Develop training programs for affected businesses	
Establish water-waste and information hotline	

STEP 1: Establish a Water Shortage Response Team

Selecting the Water Shortage Response Team

Effective water shortage planning and implementation requires a water supplier to:

- Designate a water shortage response team leader to lead the team.
- Establish a water shortage response team of senior staff representing all departments.
- Provide the water shortage response team with funding and staff.

Selecting a water shortage response team leader is the critical first step. The water shortage response team leader is someone who the water supplier's board of directors and general manager trust to speak for the supplier on the nightly news, lead meetings at which hundreds of customers attend, and organize and manage a multiyear shortage response program. This person is someone who is able to work with and motivate all agency staff and communicate the importance of working together to agency staff and the community. The person should be able to handle several complex situations at one time, deal with the public calmly and consistently, and gain the support of local businesses and groups.

In selecting team members keep in mind that developing a specific, detailed Water Shortage Contingency Plan (WSCP) requires collecting and analyzing water supply, demand and use information and understanding the agency's budget, costs and sources of income. Most suppliers have a general WSCP but when drought conditions signal that the WSCP may need to be implemented it is time to revise the plan to be specific to the current drought. Every department of the water supplier will be involved in developing the specific water shortage response plan and in implementing it. The types of information needing review include:

- Supply reliability: may change from year to year.
- Demand: may increase due to growth or decease due to efficiency programs.
- Revenue: may have changed due to new rates and the shortage contingency fund may be depleted.
- Infrastructure status: areas in need of repair or subject to pipe breaks may aggravate shortage.
- Emergency supplies: usually may not be available until needed.

Every department of the water supplier will be involved in developing the specific water shortage response plan and in implementing the plan.

For instance, the billing department will have to change the billing format so that customers can compare their monthly water use with the targeted reduction. And meter readers may have to read meters monthly instead of bi-monthly and computer programmers will have to develop new account databases to track customer's penalty charges and rebate program participation. Human resources may need to hire temporary staff; and engineering may be deepening wells, installing new water treatment devices and designing system interconnections. Operations may need to accelerate capital improvements or add leakage repair crews as drying soils create more stress on pipes. The water conservation staff will be essential in many of these actions. The implementation of a water shortage response program will probably affect every staff member's job responsibilities.

Smaller water suppliers may have only one or two people to do all the work. In medium to large organizations, the water shortage team members will probably include:

- General Manager – Overall direction on the response.
- Water Shortage Response Team Leader– coordination, information gathering and dissemination, key support staff assignments, role clarification, and communication with broad array of interested parties
- Water Treatment Manager – Overall guidance on drinking water quality and operations, issues related to potential alternative supplies, and opportunities for use of non-potable water
- Finance Manager – Cost estimates for supply alternatives and demand reduction programs, customer data base improvements and bill format changes, expected lost revenue estimates, recommend rate changes, use of the revenue stabilization fund
- Conservation Manager - water use reduction measures management, cost estimates to achieve demand reductions, and liaison with green industry and large water users (residential and commercial, industrial and institutional (CII) customers)
- Planning / Engineering Manager – new connection water use projections, new and expanded supply infrastructure, interconnection planning, water quality treatment improvements
- Operations Manager – meter reading frequency, meter accuracy, system water loss audit and repair
- Customer Service – customer contact starts here, current information about the states of program is necessary
- Administrative Staff – hiring staff, purchasing equipment, negotiating union contract adjustments
- Legal staff – review legality of program, rate changes, interagency agreements and contracts

- Communications Director (wholesale and large retail agencies) – Messaging, customer relations, media relations, press releases, and coordination with wholesale customers
- Environmental Review (wholesale and large retail agencies) – Review supplemental supply projects and prepare environmental documentation

Setting Agency Priorities

The water supplier's primary demand reduction program focuses on providing customers with programs and knowledge that help them to reduce their use while still allowing them flexibility and choice in how water is used. Public support and cooperation is likely to be higher if actions are equitable, that is, all water users are experiencing a similar service level and degree of hardship.

Given clear, timely and specific information on supply conditions and the necessary actions to forestall increase reductions, customers prefer the opportunity to meet targeted demand reduction levels through voluntary compliance measures. The decision to move to mandatory restrictions is more acceptable if the voluntary approach has been tried first but has not resulted in enough demand reduction to ensure public health, safety, and environmental protection through the projected duration of the shortage.

Maintaining Momentum

Implementing a water shortage response program will require three to six months. For instance, if rationing is planned to take effect on May 1, the water shortage response team would need to begin work no later than November 1 of the previous year. Step 7 contains a detailed implementation schedule. Use this schedule as a target and set completion dates for each plan element.

Coordinate, Cooperate and Communicate

The development of a good plan is contingent upon coordination, cooperation and communication with the community, within the agency, among local agencies, and regionally. Here are some items for the team to consider in terms of coordination:

- Establish a community advisory committee.
- If the water supplier is a city or county, include departments such as parks, fire, and the office of emergency services.
- Organize meetings with sanitary districts, local cities, counties tribes, and water suppliers, regional heath and water quality boards, etc.
- Establish a regional public communication program.
- If others use the same sources, coordinate withdrawals and pumping - quantity and timing.

Denver Water Adopts Drought Principles

In 2002, the Board of Water Commissioners adopted a policy stating that Denver Water's goal for drought response is to preserve the quality of public life and economic activity to the extent possible in the face of water shortage. The Drought Response Plan outlines specific measures designed to maximize available water supplies and minimize water use. Because every drought is different, the Board can adjust and refine drought response measures based on actual conditions.

Denver Water's prime response to drought is to budget water use so supplies will be available for the most essential uses. The water use restrictions imposed during the 2002–2003 drought indicated that no single "silver bullet" was effective at encouraging all customers to reduce water use. Instead, a "basket of programs"—restrictions, surcharges, enforcement, incentives, and monitoring and evaluation—is recommended to create an overall atmosphere that encourages water savings.

The Board adopted a set of principles to guide the development of drought restrictions:

- Avoid irretrievable loss of natural resources.
- Restrict less essential uses before essential uses.
- Affect individuals or small groups before affecting large groups or the public as a whole, allowing as much public activity as possible to be unaffected.
- Minimize adverse financial effects on the community.
- Eliminate water waste.

STEP 2: Forecast Supply in Relation to Demand

Water shortage contingency planning includes a process of defining possible responses to an array of defining to a whole array of "what-if?" scenarios. And good planning backed by accurate data allows wise decisions when faced with specific situations.

However, what used to be considered good predictions based on historical data now has a new level of uncertainty. The new reality is the increased variability of precipitation. Water suppliers will want to build in increased uncertainty when implementing the following procedure. Be sure to not limit planning to the drought of record. Consider the possibility of back-to-back drought periods that do not allow time to replenish regular and emergency supplies.

Both historical information and information on current conditions are necessary. Historical data can be used to generate a reasonably precise definition of "normal" versus "drought" characteristics. Review of the present supply is used to estimate how much water of acceptable quality will probably be available. Historical and current data are used to create water shortage scenarios. These scenarios should account for shortage periods exceeding the drought of record by one or more years. This chapter reviews the data needed to assess possible water shortage scenarios and calculations necessary for interpreting the data.

And today, more suppliers consider the potential effect of climate change when determining the reliability of their water supply.

I. Data Collection

Data concerning the water supply, treatment flexibility, distribution system, and customer characteristics are compiled and used for building a shortage-planning database. General categories of information include:

Supply Data

- Facilities data – maximum sustained pumping rates, pipeline capacities, etc.
- Local supply status, (also provide to water wholesalers)
- Supply allocation and forecast from water wholesalers
- Stream flow
- Reservoir levels
- Groundwater table elevations and quality by elevation
- Precipitation records and forecasts (rainfall and snowpack)
- Water quality by source and reservoir level
- Production records (minimum of five years) and forecasts

The National Drought Mitigation Center (NDMC) at the University of Nebraska, Lincoln, in collaboration with other federal agencies, hosts the U.S. Drought Monitor, a map of the U.S. with a graphic display of the intensity of drought in various regions and a summary of drought conditions. The NDMC also provides useful information about drought planning and climate change. Its Web site address is http://www.drought.unl.edu/. The Desert Research Institute and Western Regional Climate Center is another good climatology resource with their California Climate Tracker; it can be found at http://www.wrcc.dri.edu/monitor/cal-mon/index.html.

Two of the most comprehensive sources of historical information for California are California Climatological Data available at the U.S. Department of Commerce National Oceanic and Atmospheric Administration National Weather Service Web site at: http://www.weather.gov/view/states.php?state=CA and Water Resources Data – California which is in Water Resources Data for the United States, Water Year 2006, that is available at the U.S. Geological Survey (USGS) Web site at: http://ca.water.usgs.gov/. The Water Supply Outlook DWR California Data Exchange Center at http://cdec.water.ca.gov/ complements the USGS publication in that it presents DWR data.

Water Conditions in California provides current information and runoff forecasts for the water year and is available at http://watersupplyconditions.water.ca.gov/. Another DWR publication, California Water Supply Outlook provides current information on hydrologic conditions such as snowpack, runoff, and reservoir storage and is published twice each month. Appendix F summarizes State and federal agency Web sites that may be useful in supplying data during water shortage emergencies.

The body of historical information summarized in the various DWR publications previously discussed is continually updated and available at: http://www.publicaffairs.water.ca.gov/information/pubs.cfm.

Demand Data

- Water use records (minimum of five years) and forecasts
- Service area population and growth projections
- Customer class characteristics

Water use data is needed by month (or as often as is available) for each customer for at least the last five years. This data is used to determine, for individual customer and customer class, the average use by month, by season and by year. Collect the following data:

- The average number of residents per single-family residence and per multifamily unit.
- The number of units per multifamily connection.
- The number of businesses served by each commercial meter and the number of employees at each business. Identify industrial customers with the North

American Industry Classification System (http://www.census.gov/epcd/www/naics.html) - the business licensing entity may have this information available.

- The number of acres irrigated by each landscape irrigation meter and each agricultural meter. The county agricultural commissioner, university extension, and resource conservation district may have this information or help you find it.
- The annual quantity of unaccounted-for water by subtracting sales + flushing + measured fire/leaks/breaks from production.
- If there is time, the accuracy of the various sizes and ages of meters. Calibrate all 4-inch and larger meters.

II. Data Analysis

Much of the information discussed previously is routinely collected and analyzed as part of periodic planning for water master plans, wastewater master plans, UWMPs, and general plan updates. Coordinate the development of a drought-planning database with ongoing data collection and analysis programs. If not previously determined in other studies, analysis of the raw data may be required to illuminate certain drought period trends, such as the relation of landscape irrigation to precipitation.

Supply Data Analysis (projected dry-year supply without augmentation)

First, determine the reliable yield for each source for the next five or more years. Assume a repeat of the worst historical drought and include an adjustment for increased uncertainty and variability – longer, dryer periods or back-to-back droughts with short wet intervals. For purchased water sources, do not use the contracted allocation but ask the water wholesaler to provide estimates of how much water is likely to be available during each of the next five or more years. Work with the wholesaler to develop the allocation method for short supplies.

Water Quality Data Analysis

Establish treated water quality by source for constituents regulated by the Safe Drinking Water Act (PL 93 523) and Title 22 of the California Administrative Code. Comparison of this information with raw water data gives insights into the seasonal variability of the supply and the ability of the treatment system to respond to changes in raw water quality. Develop data on how the water quality of each source may vary with the 2008-2012 use projections. The ability to treat water of degraded quality adequately during drought will be critical if the agency plans to use all possible supplies. Identify process or chemical changes needed to respond to reduced raw water quality and new supply sources.

Suppliers that blend water from various sources will have to examine the ability of the treatment system to meet water quality standards when lesser quality water is delivered from one or more sources. Also, certain commercial or industrial customers may need advanced notification if the water quality characteristics will be significantly different during drought periods.

To stay informed of drought-induced water quality issues, a water supplier may decide to temporarily expand its routine water quality-monitoring program. This information may also be useful in alleviating customer concerns if aesthetic differences in water quality, such as chlorides, hardness, and odor occur during a drought. Increased testing will also provide data on possible impacts of varying water quality on the agency and customer distribution systems.

Water Demand Data Analysis (projected dry-year demand without demand reduction programs)

The more information that is known about how customers use water, the better the demand projections and selection of appropriate demand reduction measures will be. At a minimum, identify customer type and their seasonal demands. Standard water supplier customer types include: single family residential, multifamily residential, commercial, industrial, institutional, landscape, recycled, agricultural and wholesale.

From a review of water use records, specific water use factors can be determined for each user type on an average monthly, seasonal and annual basis. Knowledge of user characteristics will be helpful when assessing the demand reduction impacts of restrictions and rationing allocation methods and estimating revenue generation from pricing changes and water shortage surcharges. Common units of water use measurement, in order of usefulness, are:

- Gallons per capita per day (gpcd)
- Gallons per day per dwelling unit (gpdd)
- Gallons per day per connection (gpdc)
- Gallons per day per irrigated acre (gpda) by crop, irrigation and soil type
- Gallons per day per employee (gpde)

Further analysis of a given category, such as determining individual subarea factors or correlating customer classes with land use designations, may be useful. This is especially important if a large proportion of the overall demand is generated by one or two customer-class types.

Analyze water use records on a seasonal basis. Again, conducting this analysis by customer type is essential. Winter residential use compared with summer residential use gives a good indication of indoor versus outdoor usage. The same analysis of seasonal water use among industrial customers may be indicative of process changes or landscape irrigation. Overall indoor-use may be best determined by the local sanitary

district based on inflows, with winter data based on non-precipitation periods (to avoid storm water inflow impacts).

Demand for water usually increases in a dry year over normal demand. This is because more water is needed for landscape irrigation because of less than normal precipitation during the spring and fall. Drought year demand will increase the most in areas such as inland valleys and desert areas that ordinarily use a high percentage of water for landscape irrigation. Some agencies have reported unexpected demand from previously un-served people requesting water service because of failing private wells.

Shortages will vary by year, but will tend to increase over time as supplemental supplies are exhausted, as demonstrated in the table below from a water supplier with an annual water delivery of 10,000 acre-feet (AF) per year:

Year	Shortage	
2008	15%	1,500 AF
2009	25%	2,500 AF
2010	20%	2,000 AF
2011	40%	4,000 AF
2012	45%	4,500 AF

To forecast drought year demand, it may be helpful to plot normal year consumption in the service area. That is, the average of 2002-2006 demand might approximate normal rainfall year demand, and overlay this with data on demand in previous drought years; for example, 1999 or 2007 may have been a low rainfall year. Comparing average demand with dry-year demand may provide a multiplier (i.e., 107 percent) to use for predicting the dry-year demand of increased future demand due to growth or other factors. Agencies may be able to plot full supply periods against data from the drought period 1987-1990, California's last major statewide drought. At a regional level, parts of Southern California experienced a series of consecutive dry years in the late 1990s/early 2000s. Other significant droughts occurred during 1928-34 and 1976-77. However, if the water supplier implemented demand reduction programs or the media publicized the need to reduce use, the dry year demand information will not reflect unmitigated demand. Keep in mind that demand will have increased due to growth in the service area. Project the dry year increase for each customer type.

III. Is there a Predicted Shortage?

A supplier's projected supply for the next five or more years, when compared with projected demand for the next five or more years, provides data on the yearly (or monthly) supply/demand balance. In some cases these projections may show that the supplies will be adequate. It is more likely that during significant dry periods suppliers will find the supply deficit will vary year to year but gradually increase as reserve supplies dwindle. The predicted unmitigated annual supply deficit is then met with

supplemental supplies and demand reduction programs. A combination of supplemental supplies and reduced demand is used to balance supply and demand.

A “mitigated supply” is the normal dry year supplies plus emergency supplies. “Mitigated customer demand” is the projected dry year demand minus reductions resulting from demand reduction programs. The combination of emergency supplies and reduced demand is planned to balance supply and demand.

A closely coordinated effort between water wholesalers and retailers is essential. Where they exist, water wholesalers may take the lead and ask their retail customers to share in developing regional and supplier specific water shortage response plans. However, since most retail agencies have multiple sources of supply (wholesale, groundwater, and local surface) they can prepare for water shortage without waiting for their wholesaler to take the lead. This section discusses how various water suppliers utilize supply and demand data to guide their response to a supply shortage. In the case where water suppliers have control over their supply systems, they assume the role of both water wholesaler and water retailer.

Cooperate with other Agencies

Suppliers are entering into regional, county and local agreements to improve water supply management, share the cost of emergency supplies, and improve demand reduction media messages and program cost.

Bay Area Water Suppliers Partner to Create New Drought Media Campaign

In July of 2007, Bay Area water suppliers unveiled a regional public education campaign aimed at reminding residents and businesses to curb water use. The new “Water Saving Hero” campaign features ordinary people adopting simple water conservation practices in their everyday lives. The messages appear on billboards, transit stations, buses, trains, newspapers and are on the radio. A new Web site, www.WaterSavingHero.com, links Bay Area residents to their local water supplier’s conservation tips and cash rebate information. The million dollar campaign is a partnership among Bay Area water suppliers and organizations including the San Francisco Public Utilities Commission, Bay Area Water Supply and Conservation Agency, Santa Clara Valley Water District, Contra Costa Water District, Zone 7 Water District, Bay Area Clean Water Agencies.

El Dorado County Agencies Collaborate in Drought Planning Process

In 2004 El Dorado County Water Agency, the El Dorado Irrigation District, Grizzly Flats Community Service District, and Georgetown Divide Public Utility District initiated a collaborative drought planning process that identifies actions that can be pursued individually or jointly. They are exploring the use of a model to anticipate real-world drought impacts through drought simulations.

The El Dorado Irrigation District is now extending its drought preparedness analysis to include a regional climate scenario, incorporating precipitation, temperature, and hydrology factors derived from 12 internationally recognized climate change models.

Actions by Water Wholesalers

In California, wholesalers manage source supplies or supplies from primary water suppliers such as the State Water Project, the Central Valley Project, and the Colorado River system.

Water wholesalers can offer the following types of leadership before and during a water shortage:

- Develop an allocation process with retailers.
- Provide retail agencies with regular updates to wholesale water supply availability.
- Coordinate a consistent regional message and/or media-market basis.
- Coordinate supplemental supply purchases and agency interconnections.
- Coordinate regional demand reduction strategies.
- Coordinate financing for joint supplemental supply and demand reduction projects.
- Coordinate regional or area wide demand reduction projects.

Actions by Retail Water Suppliers

Each water retailer will make its own determination that the possibility of a water shortage exists and adopt a current and specific WSCP. Managing supply and demand in a drought is difficult and the following procedure is recommended.

Consider Carryover Storage

The water supplier also decides how much of the current year supply can be carried over as insurance against a possible subsequent drought year. At a minimum, the carryover

amount will be enough to meet essential health, safety, and firefighting needs if the subsequent winters are as dry as the driest years on record. By reducing demand more than is necessary in the first year of a shortage, (i.e., 15 percent instead of 5 percent) suppliers have been able to carry over enough supply to avoid increasing reduction targets in subsequent years.

Climate Change

The potential impact of climate change on California's water resources is another consideration that some water suppliers are exploring. It is expected that one of the impacts of the more variable weather patterns associated with climate change will be longer, drier droughts. More information can be found at this DWR Web site: http://www.climatechange.water.ca.gov/.

Bay Area Agencies Address Climate Change in Water Plans

The San Francisco Public Utility Commission (SFPUC) has embarked on a project to incorporate global warming concerns into their forecasting and planning activities. The SFPUC has evaluated the effect of a 1.5 degree Celsius temperature rise between 2000 and 2025 on the Hetch Hetchy watershed at various elevations. It expects that with this rise in temperature, there will be less or no snowpack below 6,500 feet and faster melting snowpack above 6,500 feet. As such, SFPUC estimates that about 7 percent of the runoff draining into Hetch Hetchy Reservoir will shift from spring and summer seasons to the fall and winter seasons in the Hetch Hetchy Basin. This shift is manageable within SFPUC's planning models, but other water suppliers with storage at lower elevations could be harder hit, especially during longer, dryer drought periods.

Similarly, the Santa Clara Valley Water District, the agency that supplies water to much of Silicon Valley, has begun incorporating the possible effects of climate change into its water management plans, much as it already does for earthquakes and flooding. It is partnering with Sustainable Silicon Valley's CO_2 Initiative, a key strategy to respond to climate change by changing the way energy is consumed. The focus is on both energy and water efficiency.

IV. Catastrophic Supply Interruptions

California water suppliers are required to develop plans to cope with catastrophic supply interruptions. Plans are required to be adopted for shortages up of to 50 percent.

Earthquakes	Power Outages	Floods
System Failures	Fires	Water Contamination

The "cascading effect" is often experienced when a catastrophe occurs. For example, in the previous table, if an earthquake strikes, power outages often follow with water supply interruptions and subsequent water quality problems occurring soon thereafter. During the Southern California wildfires of 2008, several communities were stricken with such a problem. In the city of Ramona, a fire-related power failure shut down the local pumping station. When the pumping station stopped sending water to the community, there was no backup generator to take over (voters rejected a proposal to buy one in 1989, so Ramona borrowed three from the San Diego County Water Authority). It took several days for Ramona's drained water supply to be refilled, re-pressurized and de-contaminated. Meanwhile, the Ramona Municipal Water District did not have enough employees to shut off all the meters or to restart them. After some delay, three dozen employees from neighboring water agencies helped shut off each of the districts 10,000 meters. It took about 100 workers to reopen the meters one by one to avoid straining the system and rupturing pipes.

Preparing for Uncertainty

System interconnections with suppliers in the region and participation in comprehensive regional disaster plans can help lessen the effects of catastrophic supply interruptions. In addition to predictable catastrophes such as floods, earthquakes, power outages and contamination, the physical destruction of facilities as a result of terrorism has taken a higher profile in recent years.

Orange County Alerts Drivers of Water Emergency

In 2007, Orange County experienced an interruption in service because of a weeklong shutdown of a local water treatment plant coupled with a pronounced spike in water usage. This crisis led county water officials to request that the transportation department activate 35 message boards along five major freeways reading, "ORANGE COUNTY WATER EMERGENCY: CONSERVE WATER." The signs seem to have done the trick. In addition to the freeway signs, which Caltrans officials said had never been used for such a purpose, a county water official attributed the success of the conservation effort to cities and water districts that used temporary pumps to help push water to areas where it was needed.

WARN, the Water/Wastewater Agency Response Network, supports and promotes statewide emergency preparedness, disaster response, and mutual assistance matters for public and private water and wastewater utilities. California is divided into six regions that coincide with the California Office of Emergency Services regions. Their Web site can be found at www.calwarn.org.

Some agencies have the capacity to generate "reverse 911 calls" to alert residents of evacuation notices or other directives, such as boil-water notices. Others have agreements with local school districts to use their auto-dial system to parents to provide emergency information.

STEP 3: Balance Supply and Demand: Assess Mitigation Options

The ability to temporarily augment supply or reduce water demand is specific to each water supplier. This chapter presents a discussion of these two general types of water shortage mitigation options to be reviewed for applicability. Appendixes D and J provide more complete descriptions of many of the measures.

Some water suppliers already have experience with some of these programs and principles and may offer valuable insights as to effectiveness and customer reaction. Appendix E is a listing of published information pertinent to water shortage management and water conservation. A Water Shortage Contingency Plan that has a track record establishes a foundation for effective water shortage management.

Even though the emphasis is on water shortages of finite duration, some of the water shortage mitigation measures presented in this guidebook are also appropriate to be used as part of a long term water conservation strategy. Cost effective long term water conservation measures are valuable to a community in that a given amount of supply can support more users or be available for reserves. However, care must be taken when instituting a WSCP concurrently with a long term water conservation plan. All water suppliers should maintain a multi-year drought water supply buffer whenever possible. Water suppliers where growth impacts supply reliability or whose customers are already highly efficient will want to do additional planning.

Supply Augmentation Methods

Methods of supply augmentation can be classified into three groups: (1) increase existing supplies, draw from reserve supplies or develop new supplies, (2) increase supplier water use efficiency, and (3) cooperate with other agencies. Table 2 lists several examples of these methods. Appendix D contains a discussion of supply augmentation measures. Implementation of supply augmentation is often difficult because few of these actions can be undertaken quickly. Also, many of these methods involve balancing environmental and jurisdictional considerations. Finally, if reserves are used, these supplies must eventually be replenished.

Consider whether or not the proposed action constitutes a “project” pursuant to the California Environmental Quality Act (CEQA) California Public Resources Code Sections 2100 et seq and the CEQA Guidelines in the California Code of Regulators, Title 14, Chapter 3. Section 15378 of the Guidelines provides a definition of a project and Sections 15260-15285 describe actions that are exempt from specified environmental review requirements in §15269 with three specific emergency exemptions:

1. Emergency repairs to public service facilities necessary to maintain service.
2. Projects carried out by a public agency to maintain, repair, restore, demolish,

or replace property damaged or destroyed in a disaster in which a state of emergency has been proclaimed by the Governor.

3. Specific actions necessary to prevent or mitigate an emergency.

Appendix C contains pertinent language from the CEQA Guidelines, including potential exemptions. Certain drought response actions may not be exempt from CEQA and it is important to review the pertinent sections of the CEQA Guidelines for additional information regarding what constitutes an emergency before proceeding.

Despite the inherent difficulties with using supply augmentation options, even minimal supply augmentation programs have been helpful in water shortage situations. Developing extra supply increases utility credibility with customers by demonstrating that the water supplier is maximizing its efforts to deal with the water shortage. Also, supply augmentation can provide a water shortage buffer in case of multi year shortages or can be used to minimize the amount of demand reduction needed to meet temporary supply deficits.

Increase existing supplies, draw from reserves and develop new supplies

Suppliers with surface water supplies may be able to use the amount of reservoir dead storage down to the legal minimum pool. Lake Cachuma, a U.S. Bureau of Reclamation reservoir in Santa Barbara County, was supplied with a floating pump and pipeline to move dead storage water almost a mile back to the reservoir outflow.

Groundwater wells can often be deepened and the pump-rate increased for limited time periods. Lower quality groundwater can be blended or special treatment devices installed. In adjudicated basins it is sometimes possible during emergencies to temporarily increase the annual amount pumped. Well drillers often have waiting lists for their services during water shortages, so planning ahead and reserving time in their schedule can help insure increased groundwater production when it is needed.

It may be possible to attract new recycled water customers during a drought. Because of Department of Health Services regulations on recycled water use, landscape irrigation with recycled water is probably already more efficient that potable water irrigation use. If recycled water use customers are only reduced by the amount they exceed the landscape demand then they will not be penalized for their efficiency and will benefit from their recycled water system investments.

The best possible solution is to have emergency supplies held in reserve. These are often held in local groundwater basins but can also be located in distant water banks.

During extreme shortages expensive new water supplies may be the only solution to meeting demands. Desalination, brackish water nano-filtration, temporary pipelines, and even water importation by train or truck become affordable. Nano-filtration can also be used to improve the quality of recycled water, expanding the number of possible customers. Water transfers from willing sellers using available pipeline capacity has become a significant source of supplemental water during shortages.

Increase Supplier Water Use Efficiency

To win the public's cooperation, water suppliers and municipal agencies can demonstrate a visible commitment to efficient water use. Actions to make a utility's operating system more efficient save water and set a good example for the public. A utility company can take actions itself to conserve water before asking customers to do the same, demonstrating a leadership role. One example is to reduce or stop turf irrigation and install low volume irrigation systems for shrubs and trees at all agency facilities.

System water audits can identify major water losses. Once a supplier quantifies their system losses, it is time to conduct a leak detection and repair program and possibly a meter replacement program. Detailed information on these procedures can be found at the California Urban Water Conservation Council Web site at: http://www.cuwcc.org/m_bmp3.lasso

Information about publications at:

http://www.cuwcc.com/publications/action.lasso?-Database=cuwcc_store&-Layout=CDML&-Response=welcome2.lasso&-AnyError=error.html&Business_Serial_ID=10185&-Search.

When appropriate, implement water theft prevention programs, generally targeting street cleaners, water trucks, and construction sites. These programs save water and have high visibility. Thus, they complement the public education programs.

"Water pirating" becomes more common when local private wells go dry and people in rural, coastal and foothill regions especially become more desperate. More often, they show up at the water supplier's doorstep, asking for a hook-up.

A supplier can reduce water main flushing to the extent permissible by health and fire standards, recycle water used to backwash filters, and flush existing wells to develop the maximum flow possible. Limit landscape irrigation at water supplier facilities to appropriate plants and be efficient and runoff free.

Water suppliers can reduce system pressure to the extent permissible by fire fighting standards. Comparison of water use records of two similar Denver neighborhoods indicated that homes with lower water pressure utilize an average of 6 percent less water than those with higher pressure. They can also coordinate fire department pressure checks with main flushing to accomplish both tasks with the same water.

The South Florida Water Management District Water Shortage Plan requires system pressure reductions when there is even a moderate water shortage. Water authorities are asked to reduce pressure to 45 psi at the point of use (i.e., the meter). The utility then notifies local fire departments to make arrangements to restore pressure quickly in case of fire.

Avoid using pressure reduction as a conservation measure during Stage I or Stage II programs because reduced pressure may cause irrigation systems to function poorly.

Table 2 Supply Augmentation Methods

Supply Augmentation Method	Examples
Increase existing supplies, draw from reserve supplies or develop new supplies	1. Increase groundwater pumping 2. Increase use of recycled water 3. Require use of nonpotable water for nonpotable uses 4. Build emergency dams 5. Reactivate abandoned dams 6. Employ desalination – land or ship based 7. Import water by truck 8. Rehabilitate operating wells 9. Deepen wells 10. Add wells 11. Reactivate abandoned wells 12. Renegotiate contractually controlled supplies 13. Use reservoir dead storage
Increase supplier water use efficiency	1. Conduct distribution system water audit 2. Conduct distribution system leak detection and repair 3. Reduce distribution system pressure 4. Replace inaccurate meters 5. Minimize reservoir spills 6. Suppress reservoir evaporation 7. Recirculate wash water 8. Blend primary supply with water of lesser quality 9. Transfer surplus water to areas of deficit 10. Change pattern of water storage and release operations 11. Stop turf irrigation at supplier facilities
Cooperate with other agencies	1. Negotiate purchases or 'options' 2. Arrange for exchanges 3. Establish transfers or interconnections 4. Employ mutual aid agreements

Demand Reduction

Demand reduction is the most straightforward way to address water shortages. Curtailment of water demand is directed at supplier and customer uses that are inefficient, wasteful, or able to be temporarily reduced or suspended. Since the supplier may mandate certain demand reduction actions, enforcement mechanisms are needed for maximum effectiveness of those actions.

Demand reduction programs vary by Stage (severity of shortage). Stage 1 is usually voluntary and relies on a public information campaign and enforcement of water waste ordinances. Stage 2 can often be managed with a more intensive public information campaign and mandatory restrictions. Stage 3 and Stage 4 most often require customer allocations and/or severe landscape irrigation restrictions. Demand reduction measures to assist customers reduce demand are offered in all stages but increase in scope with the severity of the shortage.

Plumbing hardware changes can also yield considerable savings. For example, one private college dormitory near Santa Barbara installed 350 ultra-low flush toilets for 1,400 students and had immediate water savings of 30 percent. Providing home water audits, free hose nozzles and buckets, rebates for efficient plumbing fixtures and appliances, and gray water information can reduce residential use by up to 50 gallons per capita per day without significant lifestyle changes.

Florida Prioritizes Demand Reduction Actions

Florida has established a process to prioritize demand reduction actions. On April 17, 2007, Florida released the Florida Drought Action Plan. Each of the five water management districts in Florida approves plans and rules for addressing water shortages. Concern in Florida has risen, as November 2005 to March 2007 ranks as the third driest period in the state's recorded history. The goal of Florida is to monitor and assess data from the five water management districts, coordinate drought management activities, communicate with decision makers and others and take actions to reduce adverse effects. An interesting and useful component of the Florida Drought Action Plan is the Recommended Water Conservation Alternatives table (http://www.dep.state.fl.us/drought/news/2007/files/ florida_drought_action_plan.pdf). It presents the various agricultural and urban water conservation alternatives and ascribes a priority rating based upon the potential amount of water to be saved, the cost effectiveness of the measure, and the ease of implementation. Conservation rate structures, incentives, statewide irrigation design and installation standards, and metering of reclaimed water services are some of the high priority measures.

Public Information Campaign

A public information campaign is the most common way to combat a water shortage. Benefits of public information campaigns include rapid implementation with no direct cost to the customer and raising public awareness of the severity of the water shortage. Water savings from this measure alone ranged from 5 to 20 percent, depending on the time, money, and effort spent.

Examination of water reductions in Goleta during the 1987-92 drought shows that when the public perceives the drought to be severe, they changed behaviors (such as flushing the toilet less often).

Voluntary measures are normally effective only when the public is convinced that a critical water shortage or drought exists. This can be accomplished by letting the public know how many days of supply remain, or showing them pictures of near-empty reservoirs. These types of photographs were successfully employed in Santa Barbara County during 1990 to urge the public to reduce water use. Commonly encouraged conservation actions for various customer types are summarized in this section.

Two programs initiated in California in 2007 are the Water Saving Hero campaign in the San Francisco Bay Area (http://www.watersavinghero.com/) and the 20-Gallon Challenge (http://www.sdcwa.org/manage/20GallonChallenge.phtml) sponsored by the San Diego County Water Authority. The Water Saving Hero campaign featured a series of ordinary people saving water in catchy ads splashed across billboards throughout the region. A Web site directs people to their local water districts for more information about incentives that are available to help them save water. The 20-Gallon Challenge

provides people specific ways they can reduce their water use by 20 gallons per day, from clothes washing to lawn watering. Since few people realize how much water they use, this can be informative and motivational.

Landscape Irrigation

Tip	Estimated Savings
Water only before 6 a.m. and after 8 p.m. to reduce evaporation and interference from wind.	20-25 gallons per day
Don't overwater! 1. Reduce each irrigation cycle by 1-3 minutes, or eliminate one irrigation cycle per week. Use the landscape calculator and watering index. Also check out www.sandiego.gov/water/conservational to learn how much to water. 2. Water only after the top inch of soil is dry. 3. Reset irrigation controllers and replace batteries in the spring and fall.	15-25 gallons for each minute; up to 250 gallons per cycle
Adjust sprinklers to prevent overspray and run-off	15-25 gallons per day
Repair leaks and broken sprinkler heads.	20 gallons per day per leak
Add 2" to 3" of mulch around trees and plants to reduce evaporation.	20-30 gallons per day per 1,000 sq. ft.
Install water-efficient drip irrigation system for trees, shrubs, and flowers to get water to the plant's roots more efficiently.	20-25 gallons per day
Upgrade to a "smart irrigation controlloer" that automatically adjusts watering times for hotter weather, and shuts down the system when it rains.	40 gallons per day
Replace a portion of lawn with beautiful native and California-friendly plants. **Note: These plants do best when planted after winter rains begin.** For great examples, check out: landscapecontenst.com.	33-60 gallons per day per 1,000 sq. ft. depending on climate

Restrictions

Ordinances banning specific uses of water are forms of mandatory measures. Examples of types of demand reduction ordinances are listed on the next page.

Water Waste Ordinances

Ordinances making water waste illegal vary but often read:

Waste of Water Prohibited. No water shall be wasted. All water shall be put to reasonable beneficial use. Prohibited water uses include, but are not limited to, the following:

- Use of any ornamental fountain using potable or makeup water for operation.
- Car washing except at commercial car washes that recycle water.
- Use of potable water from hydrants for non-potable uses.
- Washing of sidewalks, streets, decks or driveways (except for public health and safety).
- Pressure washing of buildings (possible exemption for building rehabilitation projects- painting).
- Untended hoses without shutoff nozzles.
- Gutter flooding.
- Sprinkler irrigation whose spray pattern hits paved areas.

Landscape Irrigation Ordinances

1. Watering only between certain hours or on specific days: In 1988, the city of San Luis Obispo limited landscape irrigation to every other day and water use increased. Odd-even or thrice weekly watering limitations often result in increased water use because they encourage customers to irrigate when they otherwise might not. If irrigation is allowed less frequently, water use has been shown to decrease. Restricting irrigation to twice weekly is recommended during the initial stages of drought. During advanced stages sprinkler irrigation can be restricted to once weekly, or eventually banned. Micro irrigation of shrubs and trees can be encouraged as this will be a permanent efficient change. The Water Shortage Plan for the city of Santa Barbara demonstrates how outdoor residential watering restrictions can be made more severe as a drought progresses. During Phase 1 and 2 (minimum water shortage), existing residential landscaping could only be irrigated before 8 a.m. and after 5 p.m. During Phase III (severe water shortage) the city banned the use of sprinklers and regulations allowed only drip irrigation.
2. Watering only with hand held hose or container: In March 1990, the city of Santa Barbara banned sprinklers and residential customers could only use drip irrigation. Sprinkler bans can create considerable public resentment because of the great inconveniences they cause. Fixed allocations, allowing customers to responsibly use the water they are allocated as they see fit, allow the water purveyor to avoid unpopular water use bans until Phase 4. For example, the

North Marin County Water District exceeded its rationing goal of 30 percent with its sprinkler ban. It subsequently changed the plan to a voluntary percentage reduction program. A rationing level of 30 percent was achieved through that change, eliminating most of the turf damage that would have occurred if the sprinkler ban had been continued.

3. Watering only with recycled water: Lawn watering was prohibited in Corpus Christi, Texas, on Aug. 25, 1984, during a serious drought. The city implemented a program to use reclaimed water for landscape irrigation and construction uses. Licensed, private tank truck companies delivered reclaimed water to business and residential customers. Before implementing this program, the public health aspects were addressed by the local public health agency. Regulations set a minimum 1 part per million chlorine residual be maintained to all applied reclaimed water. This reclamation program was very successful both for reducing landscape losses and for maintaining jobs and income of severely affected nursery and landscape businesses. This program provided an estimated 7 million gallons of reclaimed water for residential and business landscaping throughout the city from August through October 1984.

4. Watering only with graywater: In 1989, Santa Barbara County amended its Building Code Ordinance to allow the use of graywater and in 1990 San Luis Obispo County adopted similar regulations. Most single-family residences produce 20 to 40 gallons of gray water per person each day. The per capita graywater produced at a residence is enough to provide all the water needs of four mature fruit trees or a dozen shrubs. The gray water is distributed through irrigation hose to subsurface irrigation points.

Each supplier will estimate the monthly amount of irrigation use by customer class as a check on the possible amount of demand reduction of limiting irrigation. Some suppliers have found that multiple-residential accounts use 15 percent or less of their total yearly demand for irrigation. The nature of the restrictions used will depend on the severity and timing of the situation. Possible water restrictions are noted below.

- Prohibit irrigation during the warmest hours of the day, for example between 10 a.m. and 7 p.m. Consider allowing irrigation only during early morning and evening when customers can observe the efficiency of the irrigation system. Allowing irrigation between 9 p.m. and 5 a.m. often results in sprinklers running all night or systems with leaks operating for days or weeks before being noticed and repaired.
- Limit all sprinkler irrigation to a specific number of days per week. The number of days will depend on target consumption goals, the time of year and the extent to which irrigation is occurring, and how much demand has already decreased. For example, if demand has already been reduced by 15 percent through other measures, limiting sprinkler irrigation during July and August to two days a week could further reduce average daily demand by as much as 5 percent. Limiting lawn or turf watering to one day a week could reduce average daily demand by as much 10 percent.

Denver Prioritizes Landscape Drought Measures

The Denver, Colorado, Drought Response Plan has a thoughtful approach to the use and timing of water use restrictions. Denver Water's goal for drought response is to preserve the quality of public life and economic activity to the extent possible in the face of water shortage. In 2002, Denver Board of Water Commissioners adopted policy guidelines for developing a drought restriction program. Denver Water will follow these principles in restricting landscape water use during a drought.

- Avoid irretrievable loss of natural resources.
- Allow watering of irreplaceable trees.
- Avoid killing perennial landscaping if possible.
- Tailor water restrictions as much as possible to known landscape needs.
- Restrict less essential uses before essential uses.
- Restrict water use for misters, fountains and other aesthetic water features first.
- Avoid using water as a substitute for something else (for example, cleaning impervious surfaces or washing personal vehicles).
- Curtail outdoor water use (except for watering trees and shrubs), along with restrictions on commercial use, before restricting domestic indoor use.
- Affect individuals or small groups before affecting large groups or the public as a whole, allowing as much public activity as possible to be unaffected.
- Preserve community pools rather than residential pools.
- Restrict golf courses before public parks.
- Restrict water use on less heavily used areas of parks where grass can go dormant before restricting use on formal and informal playing fields, where recreational activity would either kill the grass or have to be prohibited.

Minimize adverse financial effects.

- Try not to put people out of business, although businesses that depend on purely discretionary water use will be affected.
- Restrict seasonal commercial use, which is likely to be outdoors.
- Restrict nonessential uses of water in businesses before affecting fundamental business functions.
- Work with large-volume water users to reduce use in the least disruptive manner.
- Engage in ongoing dialogue with the green industry to obtain input and allow these businesses to plan for future months.

Eliminate waste.

- Enforce restrictions and permit limitations in an effective manner.
- Adopt restrictive criteria for exemptions from restrictions.
- Discourage or prohibit irrigation of medians.
- Prohibit installation of new landscaping if its survival next season is in doubt.
- Develop incentive programs to promote savings.
- Perform audits to identify water waste and recommend solutions.
- Adopt extensive public information and media relations programs.
- Inform customers about the problems caused by drought and what they can do to help.
- Hold and attend public meetings as necessary to receive input.

The basic response to a Stage 1 Drought is voluntary measures; to a Stage 2 Drought, mandatory restrictions; to a Stage 3 Drought, a general prohibition on lawn watering; and to a Stage 4 Drought, rationing of water supplies for essential uses. Because Stage 2, Stage 3 and Stage 4 Drought restrictions are mandatory, they must be incorporated into Denver Water's Operating Rules, where they become enforceable pursuant to the Denver Charter, the Denver Revised Municipal Code and provisions in Denver Water's water service agreements and water leases.

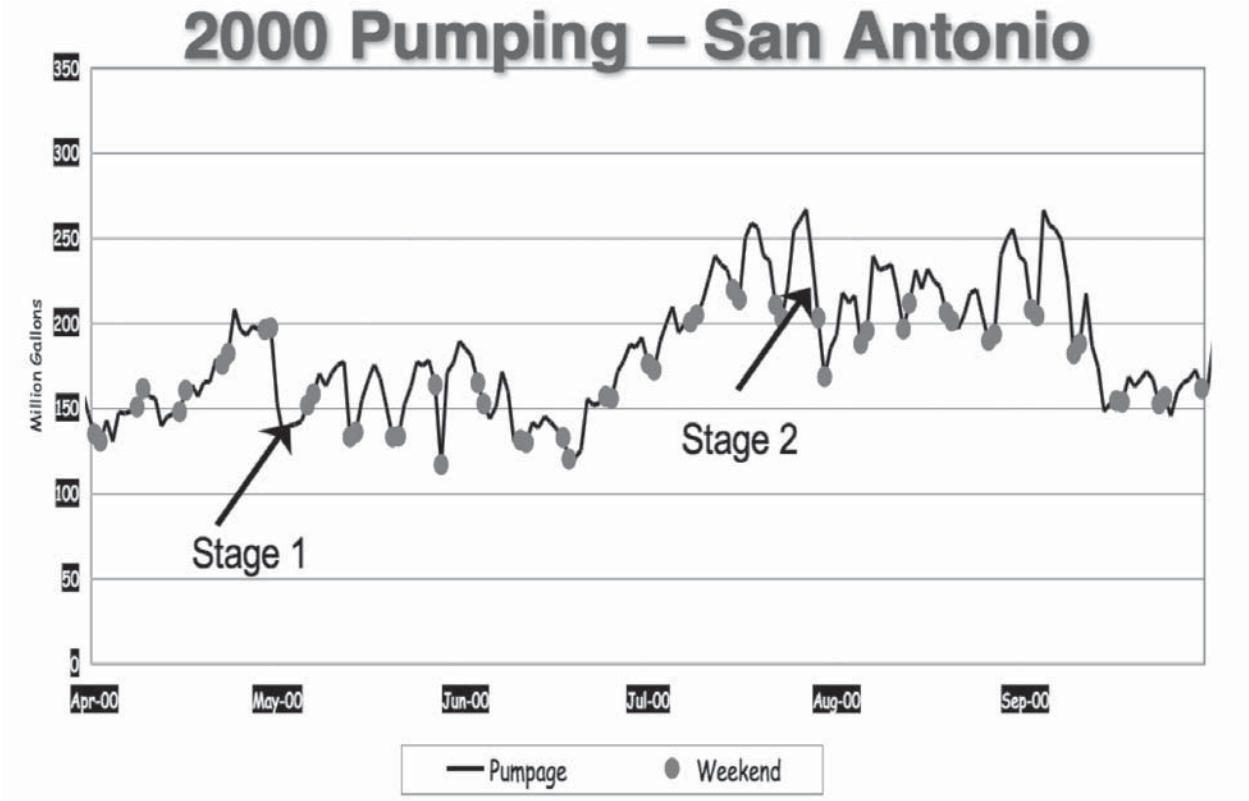
Sample schedules:

- Twice weekly (avoid allowing irrigation on weekend days to maximize reduction)
  - For residential addresses ending in odd numbers: Monday and Thursday;
  - For residential addresses ending in even numbers: Tuesday and Friday;
  - For commercial accounts: Monday and Friday;
  - Wednesday, Saturday and Sunday: no outdoor irrigation with sprinklers.
- Once Weekly by address, addresses ending with:
  - 0 or 1: Monday;
  - 2 or 3: Tuesday;
  - 4 or 5: Wednesday;
  - 6 or 7: Thursday;
  - 8 or 9: Friday;
  - Saturday and Sunday: No irrigation with sprinklers.
- Ban sprinkler irrigation, with low-volume irrigation prohibited during the warmest hours of the day, for example, between 10 a.m. and 6 p.m.

Savings from Mandatory Measures Far Exceed Voluntary Water Restrictions in Colorado

An analysis of the different approaches used by eight water suppliers in Colorado during a 2002 drought demonstrated that mandatory restrictions were an effective tool in their communities (Use and Effectiveness of Municipal Water Restrictions During Drought in Colorado, Douglas S. Kenney and others, 2004). The researchers found that during periods of mandatory restrictions, savings measured in expected use-per-capita ranged from 18 to 56 percent, compared to just 4 to 12 percent savings during periods of voluntary restrictions. The key provisions of each program were the rules restricting lawn watering. Four water suppliers that restricted watering to every third day resulted in 22 percent reductions in water use; three water suppliers that limited watering to twice weekly had 33 percent reductions; and the one city that restricted watering to once a week saved 56 percent.

As demonstrated below, restricted days, with NO weekend days, reduced weekend peaks.



Possible Exemptions from Water Use Restrictions

- Categories of possible exemptions include: new landscapes with low-volume irrigation, sports fields and golf course greens.
- The efficient use of non-potable water for street cleaning, dust control at construction sites and other non-potable uses are unlikely to be restricted.

Pricing

California law requires that water suppliers provide an analysis of the expected revenue effects of reduced sales during shortages. Well-designed rate structures can reduce the potential financial effects of water shortages.

Water suppliers can implement new water pricing structures during water shortages. In metered areas raising rates on the quantity used will result in water use reductions. A water supplier can expect rapid and significant water use reductions to result from

large per billing unit price increases. Combining a large billing unit price increase with significant excess use charges can guarantee that the targeted reduction is achieved. Devise water rates to enable the supplier to recover its purchase, treatment, and delivery costs as well as the additional costs related to the water shortage response program and replenishing the drought emergency fund.

Make pricing changes a part of a water shortage contingency plan and adopt them as part of the plan. This can reduce the rate change approval from months to weeks.

Proposition 218, approved by the voters in 1996, added Article XIII C (taxes) and D (fees and assessments) to the California Constitution. Proposition 218 may apply to how a water supplier sets rates. Water suppliers should consult with their attorney for its agency's situation for rate modification actions. For the full text of Proposition 218 go to http://vote96.sos.ca.gov/bp/218.htm.

These sections limit the authority of local government to impose, extend or increase taxes and property-related assessments, fees and charges. Among other requirements, assessments are limited to the special benefit conferred, and fees and charges are limited to the cost of providing the property-related service. Voter approval is required for taxes and certain fees or charges.

Proposition 218 changed procedures used by local government agencies for increasing fees, charges, and benefit assessments. Assessments, fees, and charges imposed as an "incident of property ownership" are now subject to a majority public vote. Water-related charges potentially affected by Proposition 218 include some meter charges, acreage-based irrigation charges, and standby charges. Not all post-Proposition 218 proposed assessments to fund water agency charges have succeeded in receiving voter approval. Most water agencies use a combination of fees for water service and other charges or property assessments to cover operating costs. Depending on an individual agency's fee structure, it could experience financial problems during a drought, when water sales revenues are down and the need for voter approval would limit ability to increase assessments.

Inclining Block Rate

The billing rate increases as water use increases under an inclining block rate structure. This encourages customers to save water and frugal water users will benefit from lowered rates.

During water shortages make the steps between blocks very steep to strongly discourage excess use. In 1987, the Goleta Water District replaced its two-tier block rate structure with a four-tier inclining block rate structure. Tier four was $2.25 per hundred cubic feet (HCF). During rationing this rate structure was accompanied by an excess use charge of four times the highest tier ($9 per HCF) for customers who exceeded their allotment (see the section on excess use charges below).

Include a lifeline rate in the pricing system that is as low as possible for basic health and safety uses.

Seasonal Rates

For seasonal rates, low water charges cover the water production costs in winter; in summer, or other peak periods, the rates increase to meet the capital costs associated with the expanded facilities necessary to produce peak demand capacity. These increased summer rates influence customers to reduce water use to lower their costly summer water bills. The Los Angeles Department of Water and Power has a seasonal rate structure.

Uniform Rate

The same rate is charged for each billing unit consumed. While this method provides some incentive to reduce consumption it represents a passive rate structure that is not likely to reduce water sufficiently during a drought.

Drought Surcharge

During extreme water shortages, water utilities often institute surcharges to alleviate falling revenues because of decreased water sales. Make it clear that these surcharges are separate from normal billing, and will be eliminated when the declared shortage ends.

Excess Use Charge

This water fee is assessed during rationing periods to those customers exceeding their allotments. During a serious 1984 Texas drought, Corpus Christi officials implemented stiff excess use charges: $3 for the first 1,000 gallons over the allotment; $5 for the next 1,000 gallons; $10 for the next 1,000 gallons; and, finally, $25 for each additional 1,000 gallons.

Some water suppliers have programs to audit specific water uses. Recommendations are made on how much water is needed for the uses after reasonable conservation measures are implemented. The use of landscape water budgets, where a certain amount of water is allowed per square foot of landscape, is a good example. When rationing is required, these conservation-based amounts can provide volume of water for the first tier. Water used beyond that can be priced more expensively to encourage conservation.

Whenever price structure changes are contemplated for use as part of a water shortage management plan, a realistic assessment of how long it will take to get it approved. Often, the utility rate setting takes several months. However, declaring a water shortage emergency allows agencies to make immediate rate adjustments.

Also, it may be unrealistic to expect the conservation benefits of price changes to make an immediate impact, especially if billing cycles are staggered or are bimonthly.

Denver Establishes Drought Pricing Principles

There is a relationship between price and demand. In theory, customers respond to an increase in price by reducing demand. The question is at what price level will the customer respond? The answer varies based on a number of factors.

Surcharges will be incorporated into an overall program to increase customer awareness of the drought's severity and the importance of saving water. Customers respond to the "basket of programs" concept, which includes surcharges. Drought pricing plays a role in creating an environment in which customers recognize the importance of reducing water use.

Surcharges may apply to current water demands, new taps, or other demands on the water supply. There is concern about issuing new taps when existing customers are subject to surcharges. Applying various forms of surcharges to different types of demands on the water supply provides an equitable method allowing all customers to share the burden of the reduced supply.

Surcharges are less effective by themselves. Industry studies and Denver Water's own customer surveys indicate that surcharges are more effective at reducing water use when combined with other restrictions to create an atmosphere that promotes water savings. Customer response to price signals varies depending on several factors such as affluence, billing frequency, and the normal cost of water. Empirical data show that customers respond to temporary water pricing strategies as part of a water savings environment.

Surcharges are separate from rates. Rates are based on cost. They are established to recover particular kinds of costs specified by the Denver City Charter. The purpose of drought surcharges, on the other hand, is to raise awareness of the value of water, to reduce water use, and to penalize those who don't comply with drought restrictions. These goals are better accomplished when surcharges are implemented as a temporary measure outside the cost-of-service rate structure.

Surcharges should match the severity of the drought. Because every drought is different, each one may require a different set of responses. Surcharges must be structured to help create an atmosphere of appropriate water savings.

Surcharges must be feasible for computer systems to handle. Denver Water must be able to respond to drought conditions quickly and efficiently. Any change in water use charges must be manageable with only moderate modifications to existing computer systems. Substantial changes increase response times and contribute to errors. Because internal coordination is critical, staff members from Customer Care, Information Technology, Accounting, and other relevant sections will be included in discussions of surcharge options.

Surcharges should be tailored for different customer groups and monitored for effect. A one-size surcharge does not fit all. Commercial and industrial customers use water differently from residential customers. Large-volume public use customers may need some accommodation. The surcharge structure must be flexible enough to promote water savings while still addressing diverse customer needs.

Surcharges should reflect overall drought response philosophies. Because all surcharge structures divide customers into groups, no surcharge structure is 100 percent "fair." Some customers may pay a surcharge even if they comply with the other restrictions. In addition to raising awareness of the value of water and encouraging temporary reductions in use, surcharges can supplement revenues if necessary.

Surcharges may need to be seasonally adjusted. In Colorado's semi-arid climate, water use is greater in summer than in winter. Outdoor use is more discretionary than indoor use, and surcharges should be adjusted to assist in maintaining a water savings environment. Because restrictions to reduce indoor use are difficult to design, adjusting surcharge thresholds can be more effective at monitoring and reducing indoor water demand in winter.

Public input and information are key to customer understanding of surcharges. When surcharges are designed and implemented, the public must have adequate opportunities for input, the surcharge must help create an atmosphere of water savings, and the public must receive adequate information to fully understand the surcharge program.

Surcharges are temporary measures. The criteria that determine when surcharges will be lifted should be specified before the surcharges are imposed. This will reinforce the temporary nature of the surcharge in the minds of customers.

Equity issues related to removing the surcharge should be addressed in advance. The specified conditions leading to termination of surcharges do not always occur at the end of a billing period. Criteria for lifting the surcharge once the specified conditions occur should be considered ahead of time.

However, significant excess use charges, even where billing cycles were staggered or on a bimonthly basis, had an immediate and significant impact on demand during 1990 in San Luis Obispo, Santa Barbara and Ventura counties.

It is standard practice for water suppliers to maintain a dry-year contingency reserve fund to protect revenue through two or more consecutive years of supply reductions below normal demand levels. Rate hikes, surcharges, or borrowing strategies are expected in agencies without an established reserve or when the reserve has become depleted.

EBMUD Maintains Revenue Recovery Plan for Dry Times

The East Bay Municipal Utility District (EBMUD) assesses its water availability and integrates the data into its financial planning and annual rate review for budget purposes. In the past, when mandatory use reductions were implemented based on this assessment, an inclining block rate structure was adopted as part of the water shortage management program, designed to encourage consumers to conserve water and to fully mitigate the revenue and expenditure impacts. In addition to offsetting the decrease in water sales, revenue recovery covers the extraordinary expenses of the water shortage management program. During the drought year of 1988, EBMUD budgeted $1.8 million for this program.

Unmetered Suppliers and Pricing

Unmetered areas face special challenges implementing drought conservation programs because they cannot impose per customer reductions or per capita allotments. Conservation programs consist of informational programs, restrictions, voluntary measures using rebates and incentives, technical assistance. Appendix K presents suggested programs for agencies with unmetered residential accounts.

Rationing Allocations

Rationing programs often reflect two general approaches – supplier-oriented or customer-oriented.

- Supplier-oriented approaches require little or no additional staff or computer programming to develop customer based data. It also may result in a program that may be perceived as inequitable and the demand reduction may be small and not sustained.
- Customer-oriented approaches require additional staff and computer programming to develop individualized allocations and more customer service. These programs usually produce significant and sustained demand reductions.

Consumer response to rationing allocation programs is more predictable than to other approaches, and these are generally the most effective programs to achieve significant demand reduction. As an example, Table 3 shows the broad range of conservation policies adopted by selected California water suppliers during the 1976 1977 drought and their results. In nearly every instance where mandatory rationing was implemented, consumers responded by reducing water use more than was requested.

A strict rationing program combined with a prohibition of landscape sprinkler irrigation can bring per capita water use down to low levels. The Marin Municipal Water District achieved a per capita use rate of 35 gallons per day in 1977.

In California, the California Public Utilities Commission regulates private water suppliers, also known as Investor Owned Utilities. They have established rules and procedures for regulated agencies regarding rationing and service connection moratorium. Its Instructions for Water Conservation, Rationing, and Service Connection Moratoria can be found in Appendix B.

Table 3 Programs Adopted by Retail Water Suppliers during California Drought 1976-77

Supplier	Residential Rationing Program	Achievement Percent
Marin Municipal Water District	Mandatory 57 percent per capita	65
East Bay Municipal Utility District	Mandatory 35 percent per household	40
Contra Costa County Water District	Mandatory 30 percent	25
San Francisco Water Department	Mandatory 25 percent	30
Los Angeles DWP	Mandatory 10 percent	16
Sunnyvale Water Department	Voluntary 25 percent	26
Santa Clara Valley Water District	Voluntary 25 percent	30
City of Pleasanton	No program	19

One of the inherent problems with a rationing system is in accurately designing the program to achieve the desired demand reduction level without greatly exceeding this amount. Although midcourse corrections can be made to lessen the impact of a program proving to be too severe, such adjustments are risky and most managers are reluctant to make them. Water officials feel that changing programs too often sends a message to customers that the supplier's planning was faulty. Therefore, it is necessary that rationing program corrections be presented carefully to customers.

Key elements of a successful rationing program are that the available water is shared as equitably as possible, and that customers are kept informed about the status of the shortage. The California Water Code, Section 354 of Chapter 3, Appendix A, provides for the establishment of priorities and allocations for purposes beyond basic domestic, sanitation, and fire protection uses. Allocation disagreements, however, are to be expected and procedures to handle exceptions and variances need to be part of a rationing program.

A good public information program helps in administering and enforcing a rationing plan. Publish information regarding water use and supply at least weekly to keep customers committed. Also, providing fixture replacement rebates, customer water on-site assistance and useful information to help customers reduce water consumption stimulates relatively painless short-term and long-term water demand reductions.

Rationing programs are generally patterned after one of five basic allocation schemes: (1) Percent Reduction, (2) Financial Rationing, (3) Per Connection Allotment, (4) Per Capita Allotment, (5) Hybrid Per Capita - Percentage. Percent reductions and financial rationing can be applied to all customers. The other schemes are only for residential customers.

Percent Reduction Allotment: *all account types*	
+	useful for non-residential vary based on efficiency
+	easy to determine and administer
+	establish minimum/maximum amounts to limit extremes
–	penalizes conservers
–	rewards "above average" users
–	promotes water use during non-shortage periods

A percentage reduction assigns each customer a consumption reduction goal as a percentage of the consumption level used in a previous year or a five-year average. Required percent reductions can be constant, stepped, or variable. Fixed percentage reductions were used widely during the 1977 California drought. The cities of Concord, Palo Alto, San Mateo, Napa, and Vallejo all used allotment programs that depended on a customer's previous year water use. In Southern California, people were given a baseline allotment of 90 percent of their previous year's consumption with excess use charges for water consumption above that level. The fixed percentage system was easy to coordinate because water allocations were quickly determined from the previous year's water bills. The percentage reduction method, however, was widely perceived as inequitable because it had the effect of penalizing former water conservers while rewarding those who had previously used large water quantities. Neighbors living in identical houses could therefore receive vastly different water allotments. Also, this plan does not distinguish between indoor and outdoor water use.

During severe shortages a rationing plan based on percentage reductions may cause huge disparities in allotments among similar customers. This will create serious management problems for the water supplier because many requests for exemptions will be filed and many people will perceive the system to be unfair. In 1991, the city of San Francisco called for reductions of 90 and 33 percent in exterior and interior water use respectively. Inequity was minimized by limiting deliveries to 300 gallons per single family home per day, and 150 gallons per multifamily dwelling per day.

The percentage seasonal allotment is similar to percentage reduction except that the consumption reduction goal varies depending on the time of year. Both of these methods inadvertently reward past wasteful behavior and penalize past conservation by using previous demand levels in the computation of rationed allotments.

Financial Rationing: *all account types*	
+	market determines water uses, avoids allotments
–	relates water use to income
–	residential tiers are based on average number of occupants
–	large number of appeal
–	difficult to set non-residential tiers

Financial rationing sets tiers based on past use for non-residential customers and the number of residents for residential customers. The advantage of this system is that the market determines how water is used and, because it avoids per-customer allotments, it is easy for the supplier to implement. The community is unlikely to support this scheme because it relates water use to income and there is no sense of equity. Since non-residential tiers are based on historical use it rewards high-water users and penalizes efficient customers. The supplier sets residential tiers based on the average number of occupants, resulting in a large number of appeals. Generally, the negatives outweigh the positives.

Per Connection Allotment: *residential*	
+	easy to establish allotments
–	no relationship between customer characteristics and water use
–	not equitable
–	doesn't recognize historical use

Per Connection allotment (residential only) establishes a customer's water consumption goal on a unit basis (such as the number of bedrooms per single family home or multi-family unit) calculated from an estimate of essential uses. A per connection basis is easier to determine than a per capita basis, but may introduce unfair allocations because there is no relationship between historical use, customer characteristics, or how many people live at the residence.

Per Capita Allotment: *residential*	
+	suitable for extreme shortages
+	equitable base allotment, sewer charges on number of residents
–	must determine and update per account occupancy
–	water for essential inside use only
–	doesn't recognize historical use

Per Capita allotment (residential only) provides a fixed amount of water per person. San Francisco area residents in an attitude survey conducted after the 1976-77 drought preferred this rationing method. Marin County's plan with per capita allotments was considered fairest, however it banned irrigation completely. This program achieved a 63.1 percent reduction compared to 1975 (pre-drought) consumption. Apartment dwellers cut their water use by an average 45 percent and single family homes reduced water use 75

percent. This method results in significant work for agency staff, both in determining the number of residents per home and in changing allotments as the number of residents per home changes. It is difficult to equitably provide allocations for other than essential inside use.

Hybrid Per Capita / Percentage: *residential*	
+	equitable recognizes variety of uses
+	flexibility suitable to all stages
+	provides customers greatest control
+	recognizes factors like lot size, historic use and economics
–	additional staff / computer work to determine allotments
–	requires more public education

Hybrid per capita / percentage allotment programs have allowed limited outside irrigation, distinguished between single family and multifamily dwellings with different water use requirements and still produced 35 to 45 percent reductions. Customers prefer a fixed allocation within which they can determine their own water use priorities. The hybrid provides water for inside use and a percentage of the five-year average outside use. GISs (geographic information system) now allow the outside use portion of the hybrid system to be based on the landscaped area served by each meter. A maximum per customer allocation is necessary, however, in order to limit the amount of water allocated to large parcels. Otherwise the community may not see the allocation method as equitable.

The type of rationing selected depends on three factors: (1) the amount of water available for health, safety and sanitary purposes, commercial-industrial uses, agriculture and landscape irrigation; (2) the seasonal variation in water consumption (usually a function of irrigation demand): and (3) the degree of homogeneity among consumer types. Where water is in extremely short supply and no water is available for irrigation, the fixed allotment approach usually works best. Where some water is available for landscape irrigation, a plan that permits the customer more water in the dry season, a hybrid per capita basis is preferable.

The information below is summarized from the Tampa (Florida) Water Department Residential Water Conservation Study: The Impacts of High Efficiency Plumbing Fixture Retrofits in Single-Family Homes, January 8, 2004.

Note that no leakage is included in this summary. While a small percentage of residences do have significant water leaks (especially in toilets) suppliers generally do not allocate water for wasteful water uses. Customers unable to meet the health and safety targets should receive information or a home water audit that helps them to find and repair leaks.

Health & Safety Inside Residential Use (gallons per capita per day)				
	Non-conserving fixtures		Conserving fixtures	
Toilets	5 flushes x 3.6 gpf =	18.0	5 flushes x 1.6 gpf =	8.0
Shower / bath	12.7 shower/ 2.6 bath	15.3	9.2 shower & 2.6 bath	11.8
Clothes washer	1/3 load	14.7	1/3 load	7.8
Kitchen / bathroom	Faucets & dishwasher	10.0	Faucets & dishwasher	6.7
Inside Total (gallons per capita per day)		58.0		34.3

Health & Safety Inside Residential Use with Habit Changes (gpcd)				
	Non-conserving fixtures		Conserving fixtures	
Toilets	4 flushes x 3.6 gpf =	14.4	4 flushes x 1.6 gpf =	6.4
Shower / bath	9.2 shower/ 2.4 bath	11.6	9.2 shower/ 2.4 bath	11.6
Clothes washer	1/4 load	11.0	1/4 load	6.0
Kitchen / bathroom	Faucets & dishwasher	8.0	Faucets & dishwasher	6.0
Inside TOTAL (gallons per capita per day)		45.0		30.0

Goleta Combines Hybrid Per Capita and Percentage Reduction Approaches

The Goleta Water District's rationing plan established a hybrid per capita and percentage reduction for residential accounts. Each residential account received a health and safety allocation (11 HCF/month single family [68 gallons per capita per day (gpcd), four people], 7 HCF/month multi-residential unit [58 gpcd, three people]) and a percentage of its average use. Reductions ranged from 0 percent for the most conservative users (28 percent of residential customers) to 45 percent for the largest users. If the water shortage increases, the percentage add on can be reduced or eliminated.

Residential allocations were increased for additional residents at the service, for health related problems and fruit trees, but only if the account had efficient toilets and showerheads and drip irrigation. Commercial accounts were reduced by a percentage from their five-year average. Agricultural accounts were provided enough water to keep permanent crops (orchards) alive but not enough to produce full yields.

This program was implemented in May 1989 with a goal of 15 percent conservation and achieved a 30 percent reduction. When the drought intensified during the winter of 1990, even with allocations staying the same, residential accounts reduced use by 50 percent with a district reduction of 36 percent below the 1984-88 average.

In general, restrictions prohibiting specific consumer actions (such as a total ban on sprinkler usage or car washing) are less popular and harder to enforce than those providing customers with an allocated amount. Reserve absolute restrictions for cases of extreme shortage.

When rationing is in effect water suppliers may want to make special efforts to help customers save trees in their landscapes. Mature trees take longer to establish than smaller landscape plants, and their value is greater. Trees also provide shading, cooling, and help to keep the air cleaner. If the water supplier permits some landscape irrigation, it may advise customers to irrigate trees because they are the most valuable component of the landscape. Even if no landscape irrigation is permitted, customers might be advised to use graywater to keep trees alive.

Enforcement

During significant shortages, a call for voluntary conservation may not bring sufficient reduction of water use, especially when water consumption is to be reduced by 15 percent or more. In such cases it may be necessary to use mandatory conservation measures (such as restrictions or rationing), enforceable under the authority of special ordinances or revised rate schedules. Table 4 summarizes penalties that can be used to enforce such programs. The most severe violations may call for shutting off service. Less extreme infractions may be handled with a rate schedule that imposes financial penalties for excess use.

Table 4 Examples of Drought/Emergency Conservation Plan Penalties

Violation Occurrence	Penalty	
	Prohibited use	Excess use
First	Written warning by regular mail.	Written warning by regular mail.
Second	Written warning delivered by utility representative who will offer conservation tips and approved retrofit devices.	Surcharge if allotment is exceeded.
Third	Flow restrictor (1 gallon per minute) installed for 48 hours, installation and removal charges assessed.	Surcharge if allotment is exceeded.
Additional	Shutoff, plus reconnection charge of $25.	Surcharge if allotment is exceeded.

Education, Citations and Fines

Many water suppliers have noted that the availability of enforcement mechanisms is the most important feature, and that application of enforcement procedures is rare. Nevertheless, it is important that customers know that those who choose not to cooperate will be dealt with firmly. This way, the consumer is assured that the program

is uniformly applied and fair to all. Communicate the supplier's resolve to enforce the regulations at the start of the program.

A common enforcement program is to use water waste patrols, frequently referred to as "water cops" or "waste busters." They usually issue warnings for the first violation. Subsequent violations are subject to fines and, if still uncorrected, installation of a water flow restrictor at the customer service connection. Water cops enforce the water shortage restrictions and water waste rules. The goal of water cops is to use education to help customers save water, not merely to penalize violators.

Restrictions on the days when landscape irrigation are allowed have not always been successful. Some residents water on the designated days regardless of whether the landscape needs it. Others over irrigate their landscapes in the hope the irrigation will last longer. This overuse cannot be controlled by patrols.

Landscape irrigation runoff is easily detected by the water patrols when it occurs on front lawns and public and business landscapes. The value of these patrols is to help customers understand and operate their irrigation systems. The patrols are also a visible reminder to the community of the seriousness of the situation.

Patrols are particularly necessary when there are restrictions on the time-of-day when landscape irrigation is allowed. Schedule the patrols to do most of their patrolling in the evenings and early mornings. Restrictions on middle-of-the-day watering mean that many residents with automatic sprinklers will schedule watering for when they are asleep and sprinkler malfunctions may go unnoticed. Photos or video made during evening or early morning patrols have been a useful tool to demonstrate to property managers and non-residential property owners that their irrigation systems need repair or adjustment.

Monitoring customers for compliance with mandatory measures that are not strictly consumption related is complex. Most water suppliers rely heavily on peer pressure and observations by the public and by water supplier field employees during their regular work schedule. Also, city or county employees, whose daily routine work requires them to be moving about the community, can be empowered to issue citations, although these employees are often reluctant to fulfill this role. These types of employees include supervisors of street and wastewater departments and inspectors for building, plumbing, electrical, construction and health services. This is an effective method of covering the service area at minimum expense and with little interruption of the employee's regular duties. Police are not widely used unless there is a problem with a specific customer.

Most jurisdictions provide an appeal process for customers. And some offer alternatives to fines, including water conservation classes, interior and exterior water use efficiency retrofits, the application of fees to a professional landscape evaluation and water audit.

Customer hotlines have also been useful in identifying repeat violators. These hotline reports can be Web-based as well. And they can be integrated with the agency's work

order system to send a monitoring official to visit the reported address to issue a warning, or citation as necessary. Hotlines greatly assist the agency's credibility in enforcement, if reported violations are quickly followed up by enforcement. One drawback reported is that some neighborly feuds cause repeated calls to hotlines. The agency staff will have to identify such patterns, and eliminate responding to calls where no violations are observed. Despite this perceived drawback, the reduced time to address violations because of public reporting helps enforcement.

Texas Cities Enforce Drought Ordinances

Citations issued by the city of Corpus Christi, Texas, (www.cctexas.com/?fuseaction=main.view&page=612) for violations of the water conservation ordinance represent a misdemeanor charge, punishable by a fine not to exceed $200. The San Antonio, Texas (www.saws.org/conservation/), water conservation plan provides for a special team of civilian field investigators to enforce the drought response ordinance when the highest-level drought stage is reached. These field investigators will be drawn from the fire, building, health, wastewater, public works, and planning departments. Investigators will be empowered to issue both warning and regular citations to violators. Enforcement powers needed by a water supplier should be clearly described in drought ordinances.

Flow Restrictors

Some customers will continue to exceed their allotment regardless of the amount of their water bill. Even one customer that refuses to support the community's efforts to reduce water use can undermine the essential community belief in equity. At some point the media will contact water suppliers with a request for information on customers with the greatest water use or largest bills. Suppliers have the legal authority to enforce drought regulations by terminating service. Most suppliers have instead chosen to install flow restrictors on non-cooperative customers. Flow restrictors can be manufactured by the supplier to provide, for instance, a one gallon-per-minute flow—allowing only enough water for health and safety needs. Flow restrictors may not be allowed in jurisdictions where required fire suppression sprinklers are on the same supply line as the rest of the home or business.

Feedback to Customers

In order for customers to know how they are doing in meeting their conservation requirements, provide customers with simple instructions on how to read their meters and to convert billing units to gallons.

Print a comparison of actual water use with allocation on the bills. Also, print the customer's allocation for the next billing period on the bill. If the customer has a yearly allocation, provide information on the year-to-date use on the bill.

STEP 4: Establish Triggering Levels

Identify the specific supply shortage that will "trigger" each of the water shortage plan stages. Then, in Step 5, with deficit reduction targets quantified, the appropriate water saving measures can be selected for the demand reduction program. Triggers can include such indicators as water quality changes, supply interruptions, environmental changes and regional agreements.

Trigger Mechanisms

Define Trigger Mechanisms

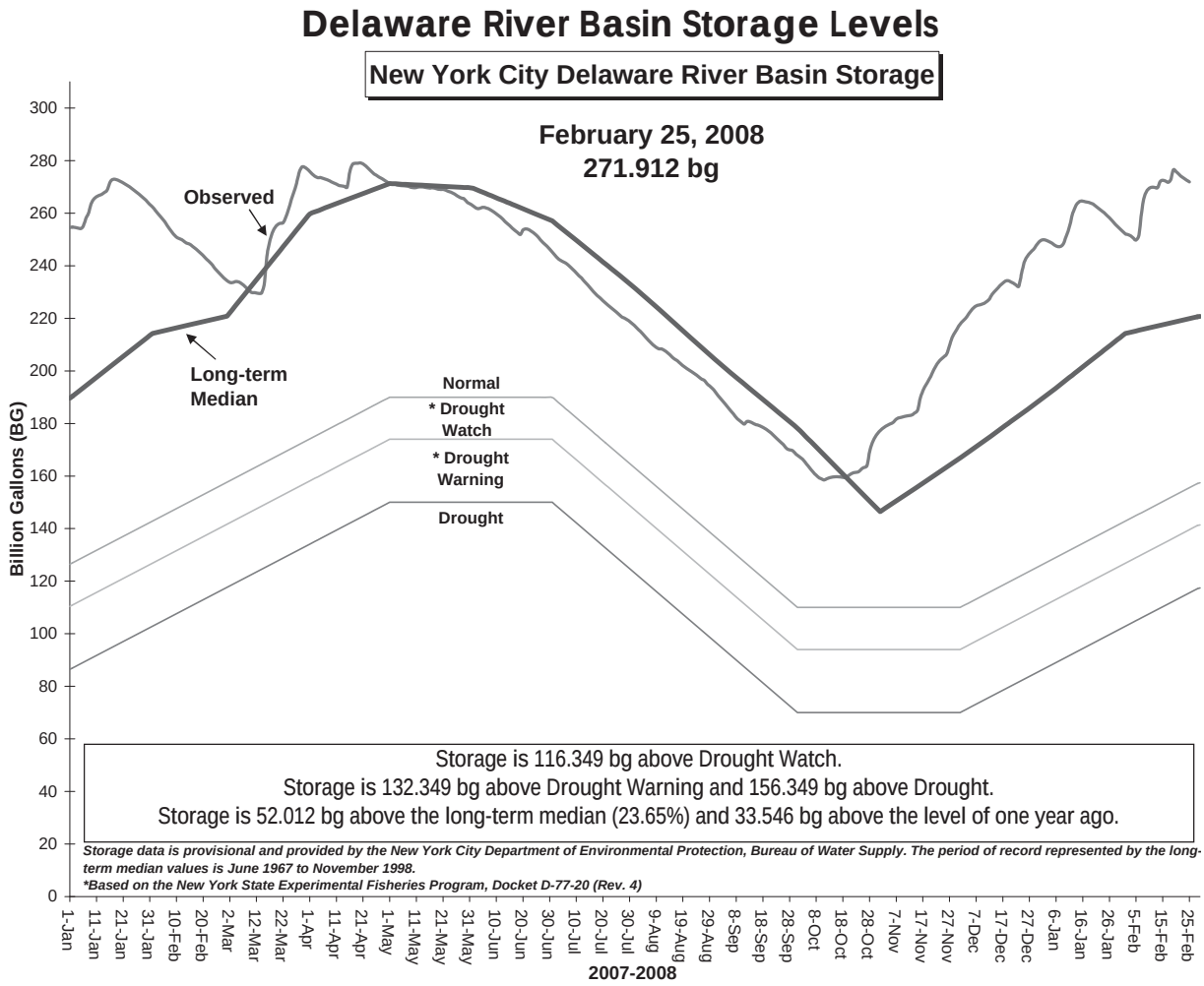
Comparison of forecast supply and demand provides the basis for implementing or intensifying a water shortage emergency. The number of supply sources and the degree of uncertainty affecting the reliability of each source determines the complexity of the water shortage triggers. A relatively simple scheme, which the city of Denver has adopted, is illustrated in Table 6. In this case, measurement of the water level of the reservoirs (expressed as a percent of normal seasonal capacity) gives sufficient indication of drought status in a community primarily dependent on surface water.

Table 5 City of Denver, May 2004 Drought Response Plan - Stage Criteria

Reservoir Storage Less Than	Drought Stage	Water Use Reduction Goal
80%	Stage 1	10-15%
65%	Stage 2	15-25%
40%	Stage 3	25-40%
25%	Stage 4	40%+

The threshold for declaring a drought - reservoir storage at 80 percent - was chosen for two reasons. First, 80 percent is the amount of water that, with increasingly cautious use, is projected to see Denver Water's existing customers through a drought more severe than they experienced in the 1950s. Second, is to avoid inconveniencing customers more often than necessary. As growth occurs or firm yield estimates change, this threshold may need to be changed.

A sliding scale for trigger values is often represented graphically. In the drought contingency plan for the Delaware River Basin, several stages of diversions, reservoir releases, emergency reservoir operations, and conservation measures are keyed to four drought stage conditions. These conditions are determined from a set of operation curves based on the total remaining available storage in three reservoirs.



Causes of Delaying Implementation of a Stage

There will be enormous pressure to NOT declare a water shortage. It is important that triggers be clearly defined and documented as part of the adopted water shortage plan. Imposing restrictions, significant water rate increases or rationing on a community results in upset customers that foresee damage to their businesses, homes and lifestyles. Political leaders need clearly defined triggers to make decisions when there is a water supply problem. 1n 1992, Seville, Spain, hosted a world exposition. That same year the city had a drought. The community used all of its reserve water supplies to avoid announcing a water shortage. When the exposition ended, the community had so little water left that it risked severe damage to the city's future.

Table 6 Example of Impact of Declaring Stage 1 (15% voluntary) in 2008 or 2010

Source	2008	2009	2010	2011	2012	2013	2013	
Local Reservoir	8,399	7,466	6,532	5,599	3,266	2,333	2,333	
(% of normal)	90%	80%	70%	60%	35%	25%	25%	
Wholesale supply	1,490	2,980	1,863	1,490	2,235	2,980	2,235	
(% of normal)	20%	40%	25%	20%	30%	40%	30%	Groundwater Use
Groundwater	2,350	1,000	2,350	2,350	2,350	2,350	2,350	15,100
Banked Groundwater	1,500		350	1,650	2,000	3,250	3,250	12,000
Recycled Water	1,200	1,200	1,500	1,500	1,500	1,500	1,500	27,100
Reservoir Carryover	900	3,239	3,284	3,279	3,269	2,020	1,833	
DWR Dry Year Program	0	0	0	0	0	0	0	
TOTAL	15,839	15,884	15,879	15,869	14,620	14,433	13,501	
Dry year demand (+7%)	15,519	15,519	15,519	15,519	15,519	15,519	15,519	
% shortage	2%	2%	2%	2%	-6%	-8%	-15%	
Stage 1 Demand	12,600	12,600	12,600	12,600	12,600	12,600	12,600	
Carryover	3,239	3,284	3,279	3,269	2,020	1,833	901	
Source	2008	2009	2010	2011	2012	2013	2013	
Local Reservoir	8,399	7,466	6,532	5,599	3,266	2,333	2,333	
(% of normal)	90%	80%	70%	60%	35%	25%	25%	
Wholesale supply	1,490	2,980	1,863	1,490	2,235	2,980	2,235	
(% of normal)	20%	40%	25%	20%	30%	40%	30%	Groundwater Use
Groundwater (entitlement)	2,350	2,350	2,350	2,350	2,350	2,350	2,350	16,450
Banked Groundwater	3,250	2,500	600	1,600	2,300	3,250	3,250	16,750
Recycled Water	1,200	1,200	1,200	1,500	1,500	1,500	1,500	33,200
Reservoir Carryover	900	2,070	3,046	2,991	2,931	1,982	1,795	
DWR Dry Year Program								
TOTAL	17,589	18,565	15,591	15,531	14,582	14,395	13,463	
Dry year demand (+7%)	15,519	15,519	15,519	15,519	15,519	15,519	15,519	
% shortage	12%	16%	0%	0%	-6%	-8%	-15%	
Normal/Stage 1 Demand	15,519	15,519	12,600	12,600	12,600	12,600	12,600	
Carryover	2,070	3,046	2,991	2,931	1,982	1,795	863	

Note: available at www.cuwcc.org as an Excel workbook

In Table 7, note that by asking the community to voluntary reduce water use during 2008 (assuming customers respond with a 15 percent reduction from average demand) the suppliers ends up with an extra 5,100 acre-feet of banked groundwater – extending the banked supply by 19 months. In this example, is it better for the community to voluntarily reduce water use starting in 2008 or 2010? There is no right answer. The

actions of other local suppliers may make it beneficial to join a regional program in either 2008 or 2010. The availability of other emergency supplies, such as the DWR Dry Year Program, may allow the supplier to delay implementing Stage 1 until 2010 without increasing the risk to the community.

Whatever parameters are used for trigger mechanisms, they should be ones that can be assessed frequently. Make the analysis of such information readily available to decision makers in a timely manner. Using such a quantified system, advancing through drought stages can be almost automatic. When complex trigger mechanisms are used, however, some uncertainty may arise as to whether to initiate a given drought stage. For example, reservoir levels are low but a water transfer is being negotiated. Assign the resolution of such 'gray area' decisions to a specific individual or group that is clearly responsible for making these difficult decisions. Let early demand reduction program implementation be the guiding rule, not "hoping for rain."

Denver Weighs Advantages of Early Versus Delayed Drought Action Implementation

The Denver Water Department's Drought Response Plan addresses the tradeoffs associated with early versus delayed action in case of possible drought. Declaring a drought is similar to announcing a candidacy for political office: triggering the event requires considerable preparation and good timing. Based upon the existing triggering system, Denver estimates that its customers would have water use restrictions about 10 percent of the time. The Denver plan also discusses the impact of drought in terms of the effects on water supplies as well as society. Less tangible than the effects of drought on the water supply are the societal, economic, environmental, and political impacts, including relations with surrounding communities. These issues, Denver contends, are important factors to consider (www.denverwater.org).

Denver Water staff spent a great deal of time analyzing and debating the advantages and disadvantages of taking early action in response to a possible drought versus delaying action until drought conditions are more clear. Tradeoffs are shown in Table 7.

Table 7 City of Denver, May 2004 Drought Response Plan – Early Versus Delayed Implementation

Early Action	Delayed Action
Customers are frequently asked or required to reduce water use.	Customers are infrequently asked or required to reduce water use.
Reservoirs stay relatively full.	Reservoirs are less full.
A severe drought can be withstood before storage water runs out.	A less severe drought can be withstood before storage water runs out.

A primary focus in the debate over early action versus delayed action is the potential hardship caused by reducing water use versus drawing down reservoir storage. Reducing water use could affect businesses and damage water-thirsty landscapes. Low reservoirs reduce or prevent recreation, stress the environment, create aesthetic problems and put the community at risk. Denver Water staff proposed storage levels and drought responses on the basis of three questions:

- How severe a drought could Denver Water withstand with a range of potential storage levels?
- With these storage levels, how often and how much would customers be asked to reduce water use?
- How low would storage levels get?

Alternatively, a weighted indicator may be derived from the combination of all relevant factors. The latter method is used in the drought contingency plan for the Delaware River Basin which relies on five drought indicators: precipitation, groundwater levels, reservoir storage stream flow, and the Palmer Drought Severity Index, a standard meteorological classification of moisture conditions, from extremely wet (4.00) to extreme drought (-0.400). Ranges of values for each of these parameters are assigned to one of four drought stages (normal, drought watch, drought warning, and drought emergency). In order for a given drought stage to start, three of the five drought parameters must indicate a given stage. During winter months, if the Palmer Index and stream flow indicators are judged unreliable, then any two of the three remaining drought indicators will trigger a given drought stage.

Include Flexibility

Correlate the number of successive levels of drought stages with a series of realistic deficit reduction goals. Most communities have used between three and five stages. Fewer than three stages require dramatic changes between the first and second stages. Greater than five stages may incur frequent transitions that could reduce the effectiveness of deficit reduction measures as they are introduced. Recent experience indicates, however, that water suppliers often delay imposing more restrictive stages and thus stage five is often implemented within a few weeks or months of stage three – indicating a failure to achieve earlier staged demand reductions.

Deficit reduction objectives for each drought stage are commonly expressed as a percentage of average demand levels or as a quantity of water saved. Tables 8 show goals established for Manchester, Connecticut.

Table 8 Manchester, Connecticut, Drought Contingency Plan

Drought Phase	Water Supply Available	Action
Alert	80 percent of reservoir capacity	Closely monitor reservoir capacities and implement resource management plan. The water capacity is brought to the attention of the citizens through press releases.
Advisory	70 percent of reservoir capacity	Follow the water resource management plan and requests voluntary conservation measures on the part of the citizens (usually outdoor water use).
Emergency Phase 1	60 percent of reservoir capacity	Mandatory use restrictions (typically a ban on outdoor water use - a 10 percent reduction).
Emergency Phase 2	40 percent of reservoir capacity	Mandatory 10 percent reduction in indoor water use. All outdoor water use is banned. A public relations campaign is initiated to identify methods to accomplish the required reductions (total use reduction 20 percent). Enforcement actions will be taken.
Emergency Phase 3	30 percent of reservoir capacity	Mandatory 20 percent reduction in indoor water use. Outdoor use banned. Overall minimum 30 percent use reduction is required. Additional mandatory reductions in indoor water use may be required based upon continued reductions in reservoir levels. Enforcement actions will be taken.

The setting of realistic goals includes correct timing of demand reduction efforts in light of the drought at hand. While curtailment of water use results in economic impacts on the water supplier and the customer, failure to curtail water use when necessary may result in much greater economic impacts later. Establishing appropriate levels of deficit reduction is important in terms of sustaining customer support of voluntary and mandatory measures.

Criteria for Curtailment during a Water Shortage

The Seattle Plan establishes the following criteria for curtailments during a water shortage. There are several criteria for deciding which curtailment measures are appropriate to reduce demand during a water shortage:

- Timing: Can the measures or actions produce results in the necessary timeframe?
- Magnitude of savings: Will the measures or actions result in enough water savings to make a meaningful difference. That is, will it reduce demand to the level the impaired water system can handle?
- Season: Are the actions or measures relevant to the time of year? That is, banning lawn watering during the summer irrigation season versus during non-irrigation season.

- Costs: How severe are the cost implications of the measure to the customer, including local business and industry, relative to the need for action? Note: While there could be costs to certain customers, particular actions still may be necessary for public health and safety.

Seattle Establishes Exit Strategy for Water Shortage Contingency Plan Stages

As soon as actual and forecast supply conditions substantially improve, Seattle Public Utilities will either inform the public of the return to normal use of water, or inform them that the utility is moving from one stage to a lesser stage of this plan. This latter process would occur until there was a return to normal operations. Stages could be skipped in this process as conditions and forecasts warrant.

STEP 5: Develop a Staged Demand Reduction Program

Identify the demand management actions that will be used in each stage to produce the necessary water savings. Supply augmentation is not considered in this step. Supply was considered in Step 4 when the water shortage stage triggers were developed. In this step, demand management actions are correlated with customer water-use characteristics and the projected savings are quantified. Program design is evaluated for effectiveness, timeliness, and cost.

Establish Stages

The best approach to managing water demand during a water shortage is to use a staged approach, with increasing levels of savings in each successive stage. A typical staged reduction is shown in the Table 9:

Table 9 Example Stages with Demand Reduction Goals

Stage	Water Shortage	Demand reduction goal - %
1	Minimum	10 to 15
2	Moderate	15 to 25
3	Severe	25 to 40
4	Critical	40+

Prepare a description of the specific measures in each stage as is shown in Table 9. This list is a general guide. The actual plan developed by a water supplier may differ depending on local circumstances.

Stage 1 relies primarily on voluntary action by customers. These actions are taken in anticipation of the drought continuing and the community benefiting from increased carryover. Subsequent stages are in response to increasing supply shortages. Stage 2 uses some mandatory measures and Stages 3 and 4 involve water rationing. Stage 4 includes extensive restrictions on water use and would be initiated only in extreme circumstances. Efforts made during the first three stages to avert reaching Stage 4 will save the customers and the water suppliers from the potential hardships of extreme shortages.

The estimated percent water use reduction in the model plan for each drought stage was derived from savings achieved in previous drought situations by comparable water shortage management plans. The typical demand reduction goals for staged plans normally range from 5 to 10 percent in the first stage to as much as 50 percent in the last stage. Stage 4 in the model program could achieve more than 50 percent savings by further reducing the per capita water allotment contained in the model plan. Community hardship, however, increases above 35 percent. For example, most communities facing a 50 percent cutback could save, by using graywater, valuable

Contra Costa Water District Water Shortage Contingency Plan Sets Reduction Goals

Sample customer class reduction goals under the various supply shortage stages are shown in Table 10. These allotments are provided as an example of how to achieve the overall desired reduction goal while acknowledging the constraints various customer classes may have in effecting short-term demand reduction. Alternative allocations may be considered at the time a given stage is implemented. The Board of Directors has recognized in the past that industrial customers cannot sustain the same percentage cutback as municipal customers without severe economic hardship. Therefore, it is proposed to keep reductions to industrial customers to less than 10 percent, and in most cases to have a goal of no more than 5 percent. It was also recognized that multifamily residential water users have primarily indoor water use and cannot reduce their water use as much as the single-family residences, which typically use nearly half of their water outdoors. The use of increments of five in choosing the reduction goals helps Contra Costa Water District in communicating its reduction goals to its customers.

trees and shrubs, but most turf would go dormant and some may die. Lawns are less expensive and easier to replace than mature trees and shrubs.

Review of customer-use data from the Goleta Water District reveal that deciding on reduction targets for each customer class must be determined by analyzing actual use records. Single-family accounts are estimated to use about 31 percent of the annual total for outside use (comparing January-March with June-August consumption). Multifamily accounts are estimated to use about 12 percent of the annual total for outside use (comparing January-March with June-August consumption). Reducing single-family to a health and safety allocation of 35 gallons per capita per day (gpcd) would result in a maximum reduction from the five-year average of 60 percent. Reducing multifamily to a health and safety allocation of 35 gpcd would result in a maximum reduction from the five-year average of 44 percent. Thus it is not possible for this supplier to target multifamily for a 50 percent reduction.

Select Demand Management Measures

Consider the short-term versus long-term water-use reduction impacts of the measures you select. Short-term measures may be cheaper and faster to implement, but long-term measures may provide permanent increased water-supply reliability. For instance, providing toilet displacement bags (short-term) versus replacing inefficient toilets with efficient ones (long-term).

Demand reduction measures seek to reduce water use through plumbing fixture replacement, fixture leak detection and repair, water audits to reveal alternative ways of using water, improved landscape irrigation practices, and use restrictions specific to

Table 10 Example Customer Reduction Goals Excerpt from "Contra Costa Water District Water Shortage Contingency Plan Sets Reduction Goals" (previous page)

Water Use Sectors	2004 Sales (AF)	% of Total Sales	Stage I 0-10%(a)		Stage II 10-20%(a)		Stage III(b) 20-35%(a)		Stage IV(b) 35-50%(a)		Maximum(b) 50%	
			Goal (%)	Sales (AF)	Goal (%)	Sales (AF)	Goal (%)	Sales (AF)	Goal (%)	Sales (AF)	Goal (%)	Sales (AF)
Raw Water Service Area												
Municipal	47,434	39%	5%	45,062	15%	40,319	25%	35,576	40%	28,460	50%	23,717
Industrial	33,255	27%	0%	33,255	5%	31,592	5%	31,592	10%	29,930	40%	19,953
Irrigation	1,612	1%	10%	1,451	30%	1,128	75%	403	90%	161,110	100%	0
Agriculture	184	0%	5%	175	15%	156	25%	138	40%	58,661	50%	92
Subtotal	82,485	68%		79,943		73,195		67,709				43,762
Treated Water Service Area												
SF Residential	22,054	18%	5%	20,951	20%	17,643	30%	15,438	45%	12,130	50%	11,027
MF Residential	6,325	5%	5%	6,009	15%	5,376	25%	4,744	40%	3,795	50%	3,163
Irrigation	4,443	4%	10%	3,999	30%	3,110	75%	1,111	90%	444	100%	0
Commercial	4,287	4%	5%	4,073	10%	3,858	20%	3,430	30%	3,001	50%	2,144
Industrial	247	0.2%	0%	247	5%	235	5%	235	10%	222	40%	148
Public Authority	985	1%	5%	936	10%	887	20%	788	30%	690	50%	493
Private Fire Protection	137	0.1%	0%	137	0%	137	0%	137	0%	137	0%	137
Temporary Service	76	0.1%	0%	76	0%	76	100%	0	100%	0	100%	0
Municipal	62	0.1%	5%	59	15%	53	25%	47	40%	37	50%	31
Subtotal	38,616	32%		36,487		31,375		25,930		20,456		17,143
Total	121,101	100%	4%	116,430	14%	104,570	23%	93,639	35%	79,117	50%	60,905

(a) Range in overall reduction goal to be achieved for a given supply reduction stage. A stage's overall reduction goal equals the water supply shortage remaining after supplemental supplies are obtained.

(b) The Urban Water Management Planning Act requires the Plan to consider the reductions necessary to achieve a maximum reduction of 50percent. Stages III and IV are not expected to be experienced as a result of drought, but rather in response to an emergency situation and exceeds CCWD's estimate of the minimum public health and safety requirement.

the customer class. There are many sources of information regarding water conservation measures. The California Urban Water Council's Web site (www.cuwcc.org) is a key source of information about urban water management practices. State and federal agencies listed in Appendix F are also good sources of water conservation information.

Establish or expand existing toilet and clothes washer rebate programs. While replacement is normally part of a long term conservation program, it can be implemented quickly if enough financial and human resources are allocated.

Homes without efficient devices have an average of 24 gallons per capita per day (gpcd) indoor use more than water-efficient homes, that is, 58 gpcd vs. 34 gpcd, respectively. A replacement campaign reduces consumption in these less efficient homes by providing efficient showerheads, dye tablets to identify leaky toilets and offering toilet, clothes washer, low-volume irrigation equipment and other rebates.

Some water suppliers offer incentives to replace turf as part of their ongoing conservation programs. This can be expanded and focused on the installation of appropriate landscaping or artificial turf when the shortage ends.

During moderate supply shortages, demand reduction methods can be incorporated as part of the requirements for new connections to the water system. Alternatively, new customers can be actively encouraged to voluntarily adopt demand reduction measures with a connection fee discount. During severe and critical supply shortages, deferment of new development or at least deferment of landscape installations in new development is justifiable and important to ensure customer support for the program.

A ban on new connections during critical shortages is something water suppliers will be asked to consider by its existing customers. Because already permitted construction projects will continue for many months, the short-term economic impacts on the construction trades could be minimal. If the shortage persists, the additional demand resulting from new connections approved during the shortage could result in severe economic harm to existing customers.

If a supplier does not stop issuing new meters during rationing, a way to reduce the impact of new connections is to enact a demand-offset program. Under this program, developers wanting approval for new construction are required to demonstrate that they will conserve, in the community, two to three times the quantity of water the new project will use.

Developers have the option to carry out the conservation themselves or they can contribute a specified amount into the water supplier's conservation fund. These funds can then be used to finance conservation improvements in public facilities, low-income housing or expand customer rebate programs. This has the double benefit of conserving water and providing assistance to low-income residents or the whole community.

A one-to-one offset puts the existing community at a disadvantage. Although the developer has offset the new demand, this has been accomplished by using up some of the slack in the community's existing water use practices. When the next drought comes there is less slack and the new development, which is already water efficient, will result in increased demand.

This hardening of demand is compensated for by having a greater than one-to-one offset. The developer would fund conservation of more water than the amount the new project would use. This would mean that the new project would make the community better able to resist a water shortage. Santa Monica has required a two-to-one offset.

Mandatory compliance measures are more severe than voluntary measures and produce greater water savings. The principal drawback to mandatory measures is customer resentment if the measures are not seen as equitable. Therefore, design the mandatory measures well and accompany them with a good public relations campaign. Demonstrate to customers that their sacrifices are warranted. Show them that the water supplier is achieving a balance between demand and available supply.

Three methods of demand reduction exist which are generally imposed to affect all customer classes – Restrictions on water-use practices, price restructuring, and rationing (limits on customer water-use).

Table 11 Demand Reduction Measures

Customer Category	Examples
Existing Residential	1. Interior a. Public Information b. Residential water audit c. Fixture leak detection and repair d. Plumbing fixture replacement e. Appliance replacement
	2. Exterior a. Public Information b. Landscape water audit c. Turf irrigation guidelines / Irrigation timer settings d. Pool covers & refill restrictions, hose nozzles e. Landscape irrigation improvements & repair f. Use restrictions (day or time of use) g. Graywater use guidelines
Existing Commercial and Institutional	1. Employee information programs 2. Interior water use audits 3. Landscape irrigation audits 4. Plumbing fixture repair and replacement 5. Irrigation system repair and improvement 6. Specific use restrictions
Existing Industrial	1. Employee information programs 2. Interior water use audits 3. Landscape irrigation audits 4. Plumbing fixture repair and replacement 5. Irrigation system repair and improvement 6, Process water audits 7. Process system repair and improvement 8. Specific use restrictions
New Connections	1. Information program 2. Plumbing code changes 3. Restrictions on new landscaping 4. Pool filling restrictions 5. No new landscaping 6. Connection moratorium

Summary of Recommendations By Work Group Area

The six Work Groups provided extremely valuable input. The ranking and scoring below was based largely on the informed professional judgment of the Work Group participants, rather than on empirical data, which was often unavailable. DEP staff adjusted some of the Work Group rankings and scores to provide greater consistency among the groups, and to incorporate input received during public review of the draft report. The body of this report describes each of the recommendations. Readers are also encouraged to review the Work Group reports which are available on the Department's website.

The reader will note that there is some overlap among the recommendations in this report. For example, several Work Groups endorsed similar alternatives involving public education, outreach, or technical assistance. Other related recommendations address topics like improved measurement of water use, implementation of conservation rate structures, and reuse of reclaimed water. In most cases the Department combined similar alternatives into a single recommendation and simply noted that another Work Group had a comparable recommendation.

Recommended Water Conservation Alternatives[1]

Water Conservation Alternative	Priority	Total Score	Amount of Water Saved (1 to 5)[2]	Cost-Effectiveness (1 to 3)[3]	Ease of Implementing (1 to 3)[4]
Agricultural Irrigation					
AI-1: Cost share and other incentives	High	10	💧💧💧💧💧	$$$	○̆○̆
AI-2: More mobile irrigation labs to achieve water conservation BMPs	High	10	💧💧💧💧💧	$$$	○̆○̆
AI-3: Increase rainfall harvesting and recycling of irrigation water	High	9	💧💧💧💧💧	$$$	○̆
AI-4: Increase the reuse of reclaimed water	High	9	💧💧💧💧💧	$$$	○̆
AI-5: Improve methods for measuring water use and estimating agricultural water needs	Medium	8	💧💧💧💧	$$	○̆○̆
AI-6: Conduct additional research to improve agricultural water use efficiency	Medium	8	💧💧💧💧	$$	○̆○̆
AI-7: Increase education and information dissemination	Medium	8	💧💧💧	$$	○̆○̆○̆
AI-8: Amend WMD rules to create incentives for water conservation	Medium	8	💧💧💧💧	$$	○̆○̆

[1] The "scores" assigned to each alternative have been made by the Department of Environmental Protection, with the benefit of the recommendations of participants in the Water Conservation Initiative.

[2] A score of 1 indicates the least water saved, 5 the most.

[3] A score of 1 indicates the least cost-effective, 3 the most cost-effective.

[4] A score of 1 indicates relatively difficult to implement, 3 relatively easy.

Water Conservation Alternative	Priority	Total Score	Amount of Water Saved (1 to 5)[2]	Cost-Effectiveness (1 to 3)[3]	Ease of Implementing (1 to 3)[4]
Landscape Irrigation					
LI-1: Develop and adopt state irrigation design & installation standards and require inspection.	High	10	💧💧💧💧💧	$$$	☼☼
LI-2: Expand and coordinate educational/outreach programs on water-efficient landscaping.	High	9	💧💧💧💧	$$$	☼☼
LI-3: Establish a statewide training and certification program for irrigation design and installation professionals.	High	9	💧💧💧💧	$$$	☼☼
LI-4: Develop environmentally sound guidelines for the review of site plans	Medium	8	💧💧💧💧	$$$	☼
LI-5: Conduct applied research to improve turf and landscape water conservation	Medium	8	💧💧💧💧	$$	☼☼
LI-6: Establish a training and certification program for landscape maintenance workers.	Medium	7	💧💧💧💧	$$	☼
LI-7: Evaluate the use of water budgeting as an effective water conservation practice	Low	6	💧💧💧💧	$	☼
LI-8: Evaluate the need to establish consistent statewide watering restrictions for landscape irrigation	Low	6	💧💧💧	$$	☼
Water Pricing					
WP-1: Phase in conservation rate structures	High	10	💧💧💧💧💧	$$$	☼☼
WP-2: Require drought rates as part of utility conservation rate structures	Medium	8	💧💧💧	$$$	☼☼
WP-3: Consider using market principles in the allocation of water, while still protecting the fundamental principles of Florida water law	Medium	7	💧💧💧	$$$	☼
WP-4: Improve cost-effectiveness in the next cycle of regional water supply plans	Medium	7	💧💧	$$$	☼☼
WP-5: Phase in informative billing	Medium	7	💧💧	$$$	☼☼
WP-6: Require more measurement of water use, including metering and sub-metering					
a) Sub-metering of new multi-family residences	Medium	7	💧💧💧	$$	☼☼
b) Sub-metering retrofit of existing multi-family residences	Low	6	💧💧💧💧	$	☼
WP-7: Adopt additional state guidance on water supply development subsidies	Low	6	💧💧	$$	☼☼

Water Conservation Alternative	Priority	Total Score	Amount of Water Saved (1 to 5)[2]	Cost-Effectiveness (1 to 3)[3]	Ease of Implementing (1 to 3)[4]
Industrial/Commercial/Institutional					
ICI-1: Consider establishing a "Conservation Certification" program	High	10	♦ ♦ ♦ ♦	$ $ $	♁ ♁ ♁
ICI-2: Consider a range of financial incentives and alternative water supply credits	High	10	♦ ♦ ♦ ♦	$ $ $	♁ ♁ ♁
ICI-3: Consider cooperative funding for the use of alternative technologies to conserve water	High	9	♦ ♦ ♦ ♦	$ $ $	♁ ♁
ICI-4: Implement additional water auditing programs	Medium	8	♦ ♦ ♦ ♦	$ $	♁ ♁
ICI-5: Promote utilization of reclaimed water	Medium	8	♦ ♦ ♦ ♦	$ $	♁ ♁
ICI-6: Investigate methods of assuring that large users from public suppliers have the same conservation requirements as users with individual permits	Low	6	♦ ♦ ♦	$ $	♁
Indoor Water Use					
IWU-1: Expand programs to replace inefficient toilets	High	10	♦ ♦ ♦ ♦ ♦	$ $ $	♁ ♁
IWU-2: Require that inefficient plumbing fixtures be retrofitted at time of home sale	High	9	♦ ♦ ♦ ♦	$ $ $	♁ ♁
IWU-3: Provide incentives to retrofit inefficient home plumbing fixtures	High	9	♦ ♦ ♦ ♦	$ $ $	♁ ♁
IWU-4: Support national dishwasher and clothes washer standards; offer incentives for purchasing efficient washers	High	9	♦ ♦ ♦ ♦	$ $ $	♁ ♁
IWU-5: Create a water auditor inspection program for the sale of new and existing homes, supported by a refundable utility service fee	Medium	8	♦ ♦ ♦ ♦	$ $ $	♁
IWU-6: Coordinate and expand the statewide water conservation campaigns	Medium	8	♦ ♦ ♦ ♦	$ $	♁ ♁
IWU-7: Evaluate the potential for gray water use	Low	5	♦ ♦ ♦	$	♁
IWU-8: Investigate the potential for cisterns	Low	4	♦ ♦	$	♁

Water Conservation Alternative	Priority	Total Score	Amount of Water Saved (1 to 5)[2]	Cost-Effec-tiveness (1 to 3)[3]	Ease of Imple-menting (1 to 3)[4]
RW-1: Encourage metering and volume-based rate structures for reclaimed water service	High	10	♦ ♦ ♦ ♦ ♦	$ $ $	☼ ☼
RW-2: Education and Outreach	High	9	♦ ♦ ♦ ♦	$ $	☼ ☼ ☼
RW-3: Facilitate seasonal reclaimed water storage (including ASR)	High	9	♦ ♦ ♦ ♦	$ $ $	☼ ☼
RW-4: Link reuse to regional water supply planning	High	9	♦ ♦ ♦ ♦	$ $ $	☼ ☼
RW-5: Implement viable funding programs	High	9	♦ ♦ ♦ ♦ ♦	$ $	☼ ☼
RW-6: Promote agency support of groundwater recharge and indirect potable reuse	High	9	♦ ♦ ♦ ♦ ♦	$ $	☼ ☼
RW-7: Encourage reuse in Southeast Florida	High	9	♦ ♦ ♦ ♦ ♦	$ $	☼ ☼
RW-8: CUP incentives for utilities that implement reuse programs	Medium	8	♦ ♦ ♦ ♦	$ $	☼ ☼
RW-9: Encourage use of supple-mental water supplies	Medium	7	♦ ♦ ♦	$ $	☼ ☼
RW-10: Assist in ensuring economic feasibility for reuse utilities and end users	Medium	7	♦ ♦ ♦	$ $	☼ ☼
RW-11: Encourage reuse system interconnects	Medium	7	♦ ♦ ♦	$ $	☼ ☼
RW-12: Enable redirection of existing reuse systems to more desirable reuse options	Low	6	♦ ♦ ♦	$ $	☼
RW-13: Facilitate permitting of backup discharges	Low	6	♦ ♦	$ $	☼ ☼

Evaluate Demand Reduction Measures

Once water shortage demand reduction measures are identified, generate certain information to provide decision makers with a basis to review and select measures that will be used in the plan. Basic considerations include:

- Water savings
- Lead time required to activate measure
- Direct and indirect costs
- Legal or procedural requirements for implementation

The Florida Drought Action Plan, April 2007, used a matrix to evaluate demand reduction programs according to several important factors. Alternative practices are rated by amount of water saved, cost effectiveness, ease of implementation, and then prioritized by total score. This graphic representation is easy to understand and represents the consensus of the stakeholders in terms of establishing what actions should be taken first.

Step 5 is finalized by eliminating measures that are infeasible and arranging the remaining feasible measures in logical groups. Identify the specific application of a water shortage management measure, such as mandatory versus voluntary, residential versus nonresidential, etc.

Evaluate Water Saved by Staged Reductions

The water saved by one of the four stages listed in Table 10 will vary by month. Many measures included in the various stages emphasize reducing outside water use. Therefore, their effectiveness will be higher in the warmer months. The percentage savings during 1989 and 1990 in San Luis Obispo and Goleta, however, were as high during the winter as the summer. The public seems to respond with greater efforts to reduce use when winter rains fail to materialize. Some water suppliers find that a rationing plan expected to save 25 percent of the total demand on an annual average basis actually saves as much as 35 percent in the summer; a correspondingly lower rate of savings, perhaps 15 percent, during the winter. Other water suppliers may achieve a more uniform savings throughout the year.

Exactly how much water savings can be achieved in any given month is difficult to predict. A service area where most of the water use is residential with a large proportion used for landscape irrigation may have high summer savings relative to the annual average. Whereas, a service area with low summer irrigation demands may experience much less variation from the predicted annual average savings.

One way to account for the variation in percent savings is to assume that the savings can be scaled to the normal year demand curve. The predicted percent savings for a given stage in the month of interest is based on the ratio of monthly water use to annual

average water use. For example, in Table 12, the percent savings from Stage 1, expected to average 10 percent, may vary from 7.7 percent in December to 13.3 percent in July. In eight out of 12 months the savings may be below the target but the water savings in June, July, and August may result in achieving the annual reduction target. While people over-irrigate more in the spring and fall, their overall water use is higher in the summer, thus the opportunity for greater water savings. Seasonal differences are not as marked in coastal areas as they are inland. This example can be used as a general guideline but will not be accurate in every service area. Implementation of demand reduction programs in unmetered service areas presents special problems and some implementation ideas are provided in Appendix K.

An important way to reduce landscape water use is to limit the time of irrigation to early morning and evening. Twice weekly irrigation of lawns is generally adequate but only the customer can determine when and how much their landscape needs. Having all irrigation occur, for instance, on weekdays will make enforcement easier. If irrigation is limited to odd-even days of the week or every other day the water supplier may actually experience an increase in landscape water use. One way to temper the potential impact on peak water demand is to assign watering days based on odd-even numbered addresses. Customers with odd-numbered addresses water on Mondays and Thursdays, even-numbered addresses water on Tuesdays and Fridays. Customers with multiple addresses on the same property, such as commercial properties, are assigned watering days. This is similar to the city of Fresno summer watering schedule that includes restricted watering hours and has also reduced energy use for groundwater pumping.

Table 12 Sample Demand Reduction Stages

Stage	Water Supplier Actions	Consumer Actions	Penalties
1. Minimal 10 to 15 percent shortage	**Water Suppliers** Initiate public information campaign. Explain drought situation to the public and governmen¬tal bodies. Explain other stages and forecast future actions. Request voluntary water conser¬vation. Audit own facilities and repair or replace outdated or equipment, devices, etc. Advertise toilet, appliance, and equipment rebate programs. Adopt ordinances banning water waste: e.g., • No hosing of paved surfaces • No irrigation between 10 a.m. and 5 p.m. • No water running into street • Leaks repaired within 48 hours • Recirculating water only in fountains Prepare and disseminate educational brochures, bill inserts, etc. Disseminate technical information to specific customer types on ways to save water. Set up public information booths urging water conservation and showing the public ways they can save water. Offer residential water surveys and landscape water audits. Coordinate media outreach program. Issue regular news releases to the media. Begin advertising campaign to remind consumers of the need to save water. Recruit and train employee volunteers for speakers' bureau.	**Residential Customers** Implement voluntary water use reductions Adhere to water waste ordinance Participate in rebate programs **Commercial Customers** Research reuse options Improve cooling tower efficiency Establish employee 'resource efficiency teams' to identify additional water and energy saving measures **Agricultural Customers** Delay plantings of new permanent crops	**Water Waste Penalties** 1. Educational letter or visit 2. Educational visit and warning 3. Citation 4. Installation of flow restrictor and possible fine 5. Shutoff and reconnection fee

Table 12 Sample Demand Reduction Stages

Stage	Water Supplier Actions	Consumer Actions	Penalties
2. Moderate 15 to 25 percent shortage	**Water Suppliers** Continue vigorous public information campaign. Explain drought conditions. Disseminate technical information. Ask consumers for 15 to 25 percent mandatory or voluntary water use reductions, depending on available supplies for future years. Ask all restaurants to serve water only on request – increases public awareness. Institute rate changes to cause conservation. Explain new rate schedules to customers. Explain further reductions planned in suc¬ceeding rationing stages. Lobby for passage of drought ordinances by appropriate governmental agencies. Make showerheads available to public at special depots. Advertise availability of toilet and other device rebates. Increase efficiency of system water supplies e.g.: • Enforce hydrant opening regulations • Increase meter reading efficiency and meter maintenance • Intensify leak detection and repair program Municipal Agencies (parks, school district, etc.) Reduce water use for street cleaning, main flushing and landscaping.	**Residential Customers** Adhere to water waste ordinance Car washed only with bucket and hose with self closing nozzle Commercial/ Industrial Users Commercial car washes to increase water recycling Water served to restaurant customers only on request **All Customers** Voluntarily set minimum air conditioner temperatures to 75 degrees F unless equipment recirculates water. Three times per week watering **Agricultural Customers** Increase orchard maintenance, use of mulching and drip irrigation.	**Water Waste Penalties** 1. Educational letter or visit 2. Education visit and warning 3. Citation 4. Installation of flow restrictor and possi¬ble fine 5. Shutoff and reconnection fee **Mandatory Programs** 1. Excess use charges 2. Flow restrictors 3. Fines

Table 12 Sample Demand Reduction Stages

Stage	Water Supplier Actions	Consumer Actions	Penalties
3. Severe 25 to 40 percent shortage	Water Suppliers Institute rationing programs through fixed allotments or percentage cutbacks. Require all homes and businesses to have low- flow showerheads and ultra low-flow (ULF) toilets before granting an increased allotment. Prohibit outdoor evaporative mist coolers. Provide incentives for the replacement of water using residential air conditioners. Provide incentives for the installation of no flush urinals. Require installation of evapotranspiration (ET) Irrigation Controllers in all new multifamily, and commercial, industrial and institutional (CII) construction. Provide incentives for the retrofit of ET irrigation controllers at existing multifamily, and CII customers. Provide incentives for the retrofit of ultra low flush-dual flush toilets in existing single, multi-family, and CII accounts. Prohibit multiple showerheads that exceed a combined flow rate of 2.5 gpm. Provide incentives for the retrofit of pre-rinse spray valves for food service. Prohibit hosing of paved surfaces. Prohibit the use of hoses without a shutoff valve. Implement rate changes to penalize use over allotment. **Municipal Agencies (parks, school districts, etc.)** Pool covers required for all municipal pools. Main flushing allowed only for emergency purposes.	**Residential Customers** Cars washed only with buckets or hoses equipped with shutoff valves and only during specified irrigation hours. **All Customers** Manage water consumption to stay within water allotments. Suggest weekly water meter reading by customers. The filling of ponds, pools permitted only with water provided by tank truck services Twice weekly watering	**Mandatory** Excess use charges Flow restrictors Fines

Table 12 Sample Demand Reduction Stages

Stage	Water Supplier Actions	Consumer Actions	Penalties
4. Critical 40+ percent shortage Mandatory reductions	**Water Agencies** All of the previous Stage steps intensified. Monitor production weekly for compliance with necessary reductions. Per capita water use allocations for residential customers No potable water used by landscape meters Adopt plumbing codes that require the separation of toilet and kitchen sink drainage in new residential construction from the remainder of the wastewater system to enable future reuse. **Municipal Agencies (parks schools districts)** All public water uses not required for health or safety prohibited unless using tank truck water supplies or recycled water. Irrigation of public parks, cemeteries, etc. permitted only with recycled water.	**All Customers** Manage water consumption to stay within water allotments. Suggest daily/ weekly water meter reading. Landscaping irrigation restrictions including one or more of the following: • Sprinkler ban • Limited irrigation with drip system • Irrigation only with graywater or reclaimed water Once per week watering. The topping off or filling of ponds, pools permitted only with water provided by tank truck services.	**Mandatory** Excess use charges Flow Restrictors Fines

Table 13 Variation in Staged Reduction Savings

Month	Projected drought year demand, acre feet	Ratio of monthly demand to average monthly demand	Savings by stage, percent		
			1	2	4
January	11,570	0.88	8.83	22.06	44.13
February	11,980	0.91	9.14	22.85	45.69
March	12,680	0.97	9.67	24.18	48.36
April	12,930	0.99	9.86	24.66	49.31
May	13,420	1.02	10.24	25.59	51.18
June	16,310	1.24	12.44	31.10	62.20
July	17,370	1.32	13.25	33.12	66.25
August	15,950	1.22	12.17	30.42	60.83
September	12,120	0.92	9.24	23.11	46.22
October	11,980	0.91	9.14	22.85	45.69
November	10,920	0.83	8.33	20.82	41.65
December	10,090	0.77	7.70	19.24	38.48
Annual savings goal			**10.00**	**25.00**	**50.00**

Lag Time Issues

Water suppliers may assume that they will immediately achieve the reduced levels of water use requested. In areas that have not experienced rationing before, this is unlikely. This is because other local water suppliers in the region may have differing messages that may make it difficult to achieve significant water use reductions. For this reason cooperation with other local and regional water suppliers in the development of a consistent drought related message can be very beneficial. Customer response can also be delayed because many customers find out their water use only in their bills. With the unseasonably dry hot weather usually associated with droughts, water use can be higher.

By the time water suppliers find out that response is lagging, less water is available for the rest of the year. The likely result of this lag time effect is that water suppliers will have to leapfrog over more moderate rationing levels all the way to severe levels in the spring and summer. Instead of progressing from a Stage 1 rationing level to a Stage 2 level, they will have to immediately go from Stage 1 to Stage 3. This was the experience of many San Francisco area suppliers in 1977 and the experience of even more suppliers in the first years of the 1986-1991 drought.

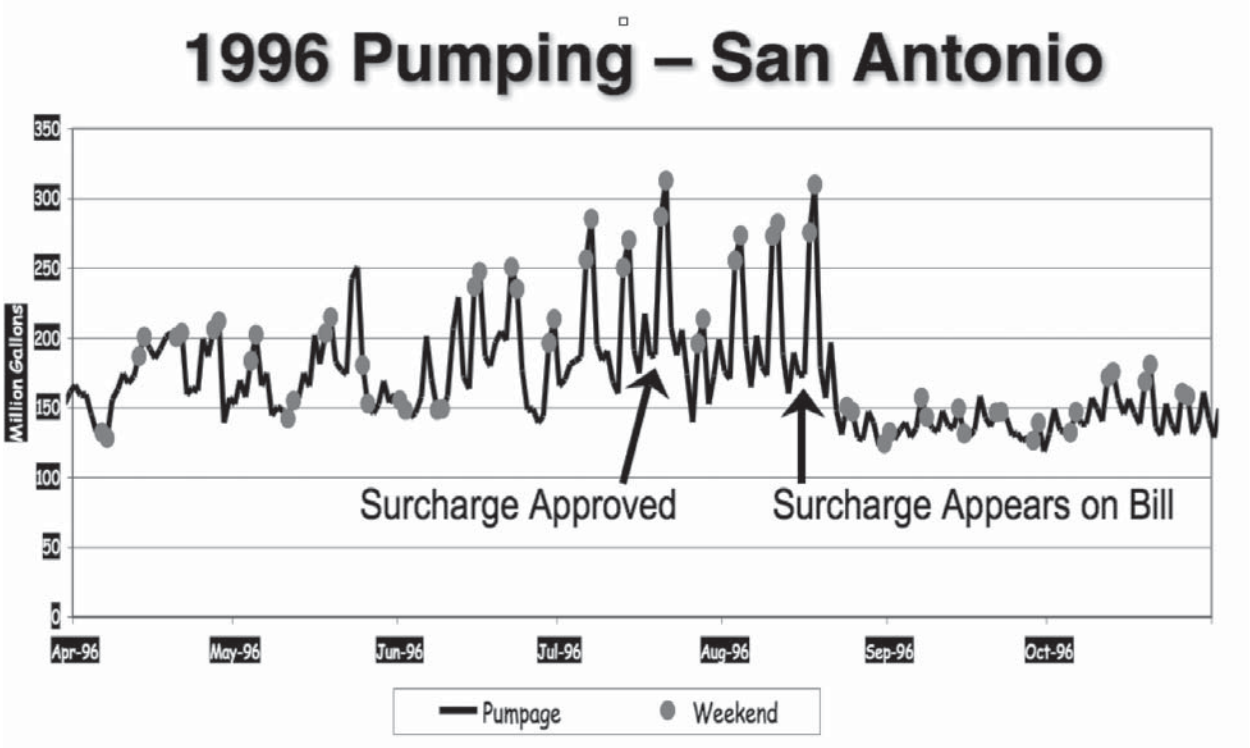
Another effect of the lag time is that water suppliers may have to draw down emergency storage and overdraft groundwater to make it through later months of the year. That reduces the supply of water targeted to help meet the next year's needs.

This lag time effect is likely to lead to unnecessary economic losses unless it is accounted for by the early setting of significant rationing levels. It is better to have communities

ration early at levels that are uncomfortable but manageable than to wait and later have to live with extreme rationing.

It is important that the customers hear consistent messages from water suppliers in the region, particularly when they are in the same media markets. There are frequently significant differences in the supplies available to adjacent water suppliers. If customers served by one water supplier are asked to reduce their water use as much as

30 percent while their neighbors served by another water supplier are only asked to conserve 10 or 15 percent, they will question the equity of the program. This can lead some of them to not meet the reduction needs. In the following example, the Sonoma County Water Agency in 2007 demonstrates the challenges faced by water suppliers in such a situation.



Sonoma County Water Agency Reports Achievement of Water Restriction Goals, Citizen Response from April 2007- October 2007

The Sonoma County Water Agency (SCWA) serves 750,000 users in Sonoma, Marin and Mendocino counties, including the cities of Santa Rosa, Windsor, Rohnert Park, Cotati, Petaluma, Valley of the Moon, North Marin and Marin Municipal water districts.

The State told the water agency in mid-June to cut its diversions by 15 percent from July 1 to October 28 from the same period in 2004, saving the water in Lake Mendocino for the Russian River's fall salmon run. If water had been drawn out at the normal rate, Lake Mendocino would have been virtually dry in October when water would be needed to support the fall run of Chinook salmon, which are listed as threatened on the federal Endangered Species Act list. While the other major reservoir in the system, Lake Sonoma, was nearly full, getting more of that water into the Russian River was a problem. The National Marine Fisheries Service limited the amount the Water Agency could discharge from Lake Sonoma's Warm Springs Dam into Dry Creek. Too much water could damage the fishery.

Thus, the Sonoma County Water Agency embarked on an aggressive water conservation campaign to rein in water use. Each of the contracting municipalities and retail water suppliers implemented their own programs to meet the cuts established by SCWA, the water wholesaler. SCWA provided information and daily updates on their Web site at www.scwa.ca.gov and worked closely with its local newspaper to keep the public informed. Following are excerpts from the Santa Rosa Press Democrat between April 2007 and October 2007, illustrating how quickly conditions can change, affecting the triggering mechanisms of a water shortage contingency plan, as well as some typical responses from the public.

April 13, 2007: Water conservation urged; Reservoir could drop to record-low level. County officials are asking everyone to make a (voluntary) effort to conserve between 10 and 15 percent beginning immediately.

April 25, 2007: County seeks river flow cut; Plan could affect farmers, recreation along Russian River during summer.

May 7, 2007: Water woes return; A combination of low spring rainfall levels and new regulations could cause drought conditions in Sonoma, Mendocino and Marin counties by fall.

June 27, 2007: City (Rohnert Park) water savings exceed State order.

July 1, 2007: Mandatory 15 percent water conservation ordered.

July 6, 2007: WATER SAVINGS FALLING SHORT; hot spell blamed for high use, but Water Agency indicates it may take tougher steps. The Sonoma County Water Agency said its customers used 853 acre feet of water between July 1 and July 4 -- 61 acre-feet more than the target of 792 acre-feet.

July 12, 2007: State takes tough line on water savings; Official says while unlikely, county supply could be cut off if conservation falls short.

July 16, 2007: Asking a few questions about conservation. (Columnist asks for a 15 percent reduction in building permits to go with 15 percent cuts in water use.)

July 17, 2007: County steps up water efforts; Next: Officials want State to help limit usage, feds to free more water from Lake Sonoma.

July 17, 2007: 'Water cops' tag homes, threatening $500 fines. After the first 15 days, the Water Agency is well behind its goal. Use has dropped just 9.9 percent below the 2004 level. If the Santa Rosa doesn't meet its goal or if the Water Agency calls for an even higher conservation level, the city has an emergency program prepared. The program has several levels that include rationing, no water for irrigation, pools and fountains and rules that water for new construction must be offset by savings elsewhere.

July 18, 2007: SCWA TOUGHENS RULES ON WATER USE: Officials next week to reveal allocation figures for each city, water district. Similarly, the Water Resources Control Board warned last week it would consider prohibiting Sonoma County from drawing any water from the river if the conservation order isn't fulfilled. On Monday, the agency plans to tell each contractor what its allocation will be. The allocations will be based on a 15 percent reduction in the 2004 level and will take into account population and per capita water use, so cities will not be penalized for already having strong conservation programs, Water Agency officials said.

July 18, 2007: Petaluma may link escrow, water use; proposed ordinance would require efficiency inspections before property sales. Future homes sales in Petaluma could hinge on water efficiency inspections to determine if plumbing and appliances meet conservation standards. An ordinance being drafted by the city would require the inspections before transfer of ownership of residential or commercial property. The point-of-sale provision is the first of its kind in Sonoma County.

July 18, 2007: Water wasters EDITORIAL; Tougher measures are needed to meet state-mandated goals. Santa Rosa, the largest consumer of water, has already started down this path by sending out "water cops" to look for water wasters. Neighbors may also report water waste by calling a hot line. If problems aren't corrected within 30 days, residents will face fines of $500 a day. Windsor is also stepping up efforts. At 6 p.m. today a public hearing will be held in the Town Council Chambers on an emergency water ordinance that includes mandatory rationing and a moratorium on new development. It's likely that other cities will need to adopt tough measures -- or expect State regulators to do the dirty work for them by ordering the water agency to turn off its pumps in order to meet the 15 percent cutback requirement.

July 19, 2007: Tipsters key in cutting water waste; as part of conservation effort, cities, districts follow up on anonymous reports of overuse. "It is one of our top 10 conservation tips, to report water waste," Brad Sherwood, a Water Agency spokesman, said Wednesday. The Water Agency, the cities and water districts have set up hot lines for anonymous tips, and the Water Agency also is planning to put a tip form on its Web site, Sherwood said.

July 23, 2007: Water uncertainty; Consumers, region's water districts scramble

to find ways to meet requirement to cut usage of flow from Russian River by 15 percent. The cities and water districts also have provisions to fine or even disconnect their customers who waste water. Those penalties kick in when water conservation measures are made mandatory.

July 23, 2007: Water conservation improves dramatically; Sonoma County Water Agency's latest reading shows 13.1 percent reduction in use, close to 15 percent required by state.

July 24, 2007: Voluntary water conservation urged; Officials see situation as 'generally manageable' as long as everyone is pitching in.... the Water Agency said the cumulative savings since the order took effect July 1 is now 14.2 percent. That's a significant increase from the first four days of July when an 8.5 percent conservation rate was attributed to a hot spell.

The Water Agency wanted to set allocations for its major contractors. The allocations formula put forth by the Water Agency would take into account water conservation programs already in place and are not 15 percent across-the-board decreases.

July 26, 2007: WATER MANDATE LEVEL REACHED; 15 percent reduction achieved in Sonoma, Marin counties; still a 'long way to go' toward conservation, authorities warn. Water officials say it is important to keep up conservation efforts now, because it becomes harder to cut back by 15 percent in September and October. "Now is the highest demand period of the year. It's easier to get conservation," said Chris Murray, principal engineer for the Water Agency. "When you get into the fall . . . it's more difficult to get conservation." But officials were still relieved to have reached their target for now.

August 1, 2007: Efforts to save water paying off; County reports 16.6 percent reduction in diversions from Russian River, urges continued conservation.

August 14, 2007: Wells fill gap in conservation. The 19 percent reduction in Russian River water use has been achieved by cities' and the county's increasing reliance on their own well water as much as by homeowners getting stingy with their tap water. Water officials in Santa Rosa, Rohnert Park, Petaluma and North Marin reported their total water usage dropped about 10 or 11 percent.

August 28, 2007: Water usage down 18.4% , beating state mandate. Nearing the midway point in a mandatory conservation program, Sonoma County continues to run ahead of the state target for water savings from the Russian River, officials said Monday.

September 24, 2007: Sonoma on track to meet water conservation target. The Sonoma County Water Agency has drawn about 20 percent less water from the river since July 1 than it did in the same period in years past, state water officials said.

October 28, 2007: Sonoma County Water Agency reports that its total water diversion from the Russian River was 21.6 percent, meeting the 15 percent reduction from July 1 to October 28 that was required by the State Water Resources Control Board.

STEP 6: Adopt the Water Shortage Contingency Plan

Update the Water Shortage Contingency Plan (WSCP) developed for the last Urban Water Management Plan for the current water shortage situation. Each drought or other shortage situation has enough unique characteristics that a general plan cannot define all the scenarios and specific supply and demand management actions. The usefulness of a WSCP lies in planning the range of supply and demand management actions in advance of the situation and in defining the communication mechanisms by which decisions will be made during the event.

Move quickly to formally adopt the updated WSCP once it is completed – catastrophes can happen at any time. With public input and noticing requirements, adopting a plan can take one to two months. The implementation process, running concurrently with the adoption process, can usually be completed within five months. If drought conditions are imminent, the water supplier will need to treat the situation as an emergency, mobilizing the necessary people to develop and implement the procedures to carry out the needed drought phase.

Involve the Community

When the draft is completed, present it at several community forums. If the plan is available for download from the supplier's Web site it will increase the quality of the public suggestions. The community will be more likely to reduce water use if the draft plan incorporates ideas presented at the public forums. Include the sectors of the community that could be most affected, such as tourism, agriculture, the landscape industry, hospitals and nursing homes, and disadvantaged communities in the service area.

Prepare a Revenue Program

A reduction in water use will mean a revenue shortfall for most water suppliers. This is especially true with the additional costs of purchasing emergency supply and implementing demand reduction programs. There are two common ways of balancing the costs and revenues: (1) raising water rates and (2) imposing a water shortage surcharge. If a Stage 3 or Stage 4 program is initiated, rates may have to be doubled to cover fixed costs and extraordinary rationing and supplemental supply expenses. Two additional funding sources that may be available are the financial reserves in the general or water revenue fund and a designated water shortage emergency account.

Raising water rates can include an excess charge for each unit of water over the customer's allotment when rationing is in effect. This helps to reinforce adherence to the allotted amounts. Forecasting the amount of revenue that will be generated, however, is more complicated when using this method. Some water suppliers have refunded excess use charges if the customer was able to repay the excess water during the rationing year. While the refunds are added work for the supplier they build community support and trust.

Table 14 Example Excess Use Charges

Units in Excess of Allotment	Excess Use Charge per Unit
First bill, excess units	Four times normal rate
Second bill, excess units	Four times normal rate
Third consecutive bill, excess units	Ten times normal rate

Table 13 shows an example budget worksheet projecting the financial effects of the four stages of a WSCP. As water demand is reduced from normal to half of normal, it requires rate increases of 6 to 57 percent to keep the budget balanced. The cost of supply is dropping but the cost of treatment increases as lower-quality sources are used. Capital projects are suspended, but the cost of the conservation program (customer assistance and rebates) and other operating expenses steadily increase.

Table 15 WSCP Budget Worksheet

Sales	**Normal**	**Stage 1**	**Stage 2**	**Stage 3**	**Stage 4**
		85% normal	**75% normal**	**65% normal**	**50% normal**
		6% rate increase	12% rate increase	26% rate increase	57% rate increase
Fixed charge	$7,409,676	$7,409,676	$7,409,676	$7,409,676	$7,409,676
Quantity charge	$10,401,091	$10,643,938	$10,129,399	$9,923,566	$9,825,051
Total Income	$17,810,767	$18,053,614	$17,539,075	$17,333,242	$17,234,727
Operating Expenses	**Normal**	**Stage 1**	**Stage 2**	**Stage 3**	**Stage 4**
overhead expense	$525,500	$550,000	$575,000	$600,000	$600,000
source of supply	$3,903,000	$3,505,170	$3,099,800	$2,647,800	$2,695,750
product. & purification	$2,000,000	$2,556,136	$2,249,840	$1,858,240	$1,716,600
trans. & distribution	$2,500,000	$2,500,000	$2,500,000	$2,500,000	$2,500,000
customer accounts	$850,000	$900,000	$950,000	$1,000,000	$1,000,000
general & admin.	$3,000,000	$3,300,000	$3,600,000	$3,900,000	$3,900,000
Conservation	$175,000	$300,000	$900,000	$1,200,000	$1,200,000
depreciation	$3,600,000	$3,600,000	$3,600,000	$3,600,000	$3,600,000
capital projects	$1,000,000	$750,000	$0	$0	$0
Total Operating expense	$17,553,500	$17,961,306	$17,474,640	$17,306,040	$17,212,350
Budget Balance	$257,267	$92,308	$64,435	$27,202	$22,377

Note: available at www.cuwcc.org as an Excel workbook

If the water supplier simply wants to recover all of its extraordinary water shortage related expenses and lost revenues necessary to meet fixed costs, a water shortage surcharge can be applied for the duration of the crisis. The water shortage surcharge method is easier to administer and may enable a more accurate prediction of the

additional revenue that will be generated. This method is also easier for the customers to understand as a water shortage related charge and not a disguise for a rate increase that may not end when the water shortage is over. As part of the water shortage surcharge ordinance, describe the termination of the surcharge once the crisis is past.

Consider the financial feasibility of funding part of the revenue shortfall from emergency reserves. It may be practical to cover as much as 50 percent of the first year extraordinary expenses and lost revenue from such funds if they are available.

Regardless of the method selected, include the following actions as part of the revenue program:

1. Estimate the amount of water use reduction that will be achieved and the associated lost revenue.
2. Estimate revenue needs include funds for expensive new water supplies, increased water quality monitoring and an extended multiyear rationing program.
3. Design a rate adjustment or water shortage surcharge that will cover the expected revenue deficit.
4. Monitor actual revenue and compare with forecast revenue; adjust water shortage surcharges as needed, but not too often.

State and federal agencies offer some financial assistance to communities affected by drought. Programs available in 2007 are summarized in Appendix G. Use of such external sources of financial assistance may reduce a water supplier's revenue shortfall. However, most of these are programs of last resort, so be prepared to go it alone.

Formalize Cooperation with Local Agencies

Draft ordinances and interagency agreements that will be available for adoption for different levels of water shortage. They may contain various levels of mandatory restrictions and provisions that will go into effect when a state of emergency is declared by the governing body.

Regional or cooperative water supplier water shortage contingency planning can provide a common approach to drought management among adjacent water suppliers, identification of emergency supplies, and possibly provide for emergency interconnections or other joint activities. Interagency agreements confirmed in advance will speed response to an emergency and help avoid hurried decisions on matters such as price and equity. Here are some examples of interagency agreements.

East Bay Municipal Utility District (EBMUD) and Sacramento County Water Agency Agreement

Looking long-term, EBMUD and Sacramento County Water Agency ended a 35-year legal and political negotiation in 2007, reaching agreement on the Freeport Regional

Water Project. When finished in 2010, it will provide 85 million gallons of water a day to Sacramento County Water Agency. During drought years, 100 million gallons a day will be delivered to EBMUD. Sacramento County Water Agency will benefit with the additional protection of the Lower American River and the promotion of water conservation and recycling the project will provide.

Potomac River Agreement

The Potomac River Low Flow Allocation Agreement provides that in cases of drought, each of the participating agencies would adjust withdrawals to maintain a specific amount of flow in the lower reaches of the Potomac River near Washington, D.C.

California Exchange Agreement

During the 1976 1977 California drought, The Metropolitan Water District of Southern California (MWDSC), in cooperation with the California Department of Water Resources, made water available to Marin Municipal Water District (MMWD) through EBMUD. This State/regional/local water exchange agreement resulted in the construction of an emergency pipeline connecting Richmond and San Rafael. This pipeline enabled EBMUD to wheel water from MWDSC through its distribution system to MMWD. The additional water was obtained by EBMUD from a pumping station in the Delta that pumped water that would otherwise be pumped south to MWDSC. MWDSC obtained replacement water from its Colorado River Supply that was not experiencing a drought.

Longview, Washington, Agreement

The emergency resulting from the Mount Saint Helens eruption rendered the city of Longview's water supply untreatable and resulted in an agreement among Longview, the city of Kelso, Washington state, the Weyerhaeuser Paper Co., and the International Paper Co. to supply water to Longview. As this situation illustrates, not all emergencies can be anticipated.

Review and Finalize Plan

Subject the WSCP to a formal public review process. This will help minimize future objections when mandatory provisions are needed. Describe the WSCP elements and the need for them in clear, concise presentations by staff to the board of directors, the public and the media.

Hold several public hearings on the plan following sufficient notice by the news media. Expect opposition and allow for and welcome ideas for beneficial changes to the plan. The green industry, i.e., landscape contractors, nurseries, etc., can mitigate economic harm during a water shortage if they are involved and are informed of potential availability of efficient irrigation systems, graywater distribution systems and other efficient technologies.

Contacting industry representatives ahead of time and discussing with them the opportunities and difficulties that rationing will entail may help them understand the reasons for plan requirements and gain their support. There is a good chance that they may have innovative ideas that can be incorporated into the program. The California Landscape Contractors Association and the Irrigation Association, for example, train and certify their members as certified water managers. They can provide a list of qualified professionals that the water supplier can refer customers to when they need to improve the efficiency of their landscape water use. This is good for business for the landscape industry and good for the water supplier in terms of having confidence in the services being provided.

STEP 7: Implement the Water Shortage Contingency Plan

Essential Elements of Implementing a Water Shortage Contingency Plan (WSCP)

Implementation of a WSCP requires:

1. Adequate staff levels
2. Staff training and support
3. Office space
4. Equipment
5. Budget
6. Connecting the silos: intra-office communication
7. Coordination with other agencies
8. Computer and billing format capabilities
9. Customer assistance
10. Customer appeals
11. Special need customers
12. Dealing with the media
13. Monitoring of actual use

Considerations

Examples of specific drought implementation program needs:

1. Staff levels – first year (community of 75,000 people)
    a. Two full-time staff (can use reassignments), three six-month contracts, four interns.
    b. A tremendous amount of customer contact will occur when rationing or restrictions are announced, when customers receive large penalty bills and when appeals are filed. Educate district employees about the rationing program so that they are informed. The workload begins to drop off after six months.
2. Training and support
    a. Integrate new staff into agency.
    b. Provide training and recognize good performance.

c. Interns from local universities can be trained to perform water audits for those customers who exceed their allocations or ask for help. The water audit is free, and the auditors carry showerheads, faucet aerators, washers, plumbing tape and other materials that allow them to teach customers how to make simple repairs. Water auditors also do landscape water audits, show customers how to set irrigation clocks and demonstrate the use of soil probes.

d. Train customer service personnel about drought restrictions, so they may easily respond to customer questions.

Seattle Trains Water Cops

A drought monitor's (water cop's) only responsibility is to enforce the drought response measures. Temporary employees are recruited for this function, and those hired must be able to interact with the public and communicate the drought restrictions. Thorough background checks are required.

Training. Drought monitors undergo an intensive training program to prepare them to patrol the service area. Dispatchers and data entry staff participate in the training program, which will address:

- Dealing with irate customers.
- Reading meters.
- Understanding the drought restrictions.
- Operating irrigation systems.
- Passing driving tests.
- Knowing the boundaries of their patrol area.
- Understanding the data entry equipment.

Documentation. Water cops use hand-held data entry devices that allow them to issue tickets in the field. This system keeps track of the number of violations for each customer and enables the drought monitor to ascertain the appropriate-level violation. Drought monitors will also keep track of stops that did not result in a ticket or written warning but were merely educational in nature.

3. Office Space

a. Expanded office space is essential for new staff. Consider space adequate for high-volume customer traffic - a portable building, store front, etc. Separate it from normal functions.

4. Equipment
    a. Telephones - multiple lines, cell phones, new hot line number.
    b. Computers - one per person, staff will need current information to provide correct answers to customers' questions.
    c. Cars - for appeals, inspections, audits, and water waste patrols
    d. Audit kits, educational materials, water waste report forms
5. Budget (75,000 people - $150,000 + money for rebates)
    a. The cost of staff, cars, phones and computers
    b. The cost of publicity, rebates, and free showerheads, nozzles, soil probes, buckets, etc.
6. Connecting the silos
    a. Keeping everyone informed with regular e-mail updates
    b. Create a Shortage Management Team involving billing, programming, customer service, public relations, operations/engineers, water conservation, and senior management, etc.
    c. Schedule team meetings at least monthly before declaring Stage 1, and weekly afterward.
    d. Present board or policy reports summarizing each department's activities regularly during a drought.
    e. Consider tying enforcement and compliance calls directly into utility work-order system to track and process complaints more rapidly.
7. Coordination with other agencies
    a. Monthly meetings with other suppliers, city and county building and health, emergency services, county agricultural commissioner, etc.
    b. Develop phone and e-mail group contacts for emergencies

    8. Computer and billing formal capabilities (See Appendix K)

    a. Establish flexible billing and water use history database capabilities.
    b. Adopt a flexible and informative billing format.
9. Customer Assistance
    a. Establish evening and weekend hours, hot-line and Web site information.
    b. Provide house calls, efficient landscape irrigation training and meter reading brochure.
10. Customer Appeals
    a. Rationing manager and appeals committee make decisions.

b. Staff can either be used for processing appeals or helping customers make permanent efficiency changes. Design appeal process to ask for water efficiency changes from customers.

11. Special needs customers – hospitals, coin laundries, etc.

    a. Recognize special needs but require efficiency upgrades.

    b. Audits are always necessary.

12. Dealing with the media - publicity, customer privacy, consistency

    a. Free news coverage - the most effective tool

    b. Keep the message consistent.

Activate a Public Information/Media Program

Getting the public involved will require an expansion of an existing water conservation public information program. A vigorous public education program during a water shortage emergency is crucial for achieving substantial water use reductions. The water supplier assumes a central role in publicizing the extent of the water shortage problem as well as in helping consumers conserve. Even voluntary programs have achieved significant reductions in water use where the public was well informed and understood the need to conserve.

Aim a public education program at five basic groups:

1. **Provide information to local decision-makers** regarding why certain actions are needed, why special arrangements for communication and coordination will be called for, and the possible need for both emergency funds and emergency powers.

2. **Encourage governmental bodies (park and fire departments, universities, recreational facilities and other water-dependent agencies) to provide leadership** by taking timely actions to reduce demand and provide examples to the public. Government actions can go beyond the efforts being asked of the public and occur quickly and at the initiation of the agencies themselves. The water supplier takes the lead and works with local elected officials and the media to promote cooperation and commitment from governments in its service area. Governments are willing to respond, especially if given technical guidance.

3. **Provide detailed information to industry, schools, retailing, and other groups** that are asked to comply with specific use restrictions. Also, call upon these groups to suggest alternatives to the proposed rationing program that might achieve an equivalent level of demand reduction with potentially less economic harm. Innovative ideas have been generated by the private sector in past droughts. As a minimum, this approach will help ensure willing participation by demonstrating a genuine interest in their perspective.

4. **Provide frequent briefings to the news media** to ensure timely and accurate communication. Be especially watchful for human-interest stories. Telling the media of specific instances of an individual or group making sacrifices for the common good is a way the water supplier can show appreciation for conservation efforts.
5. **Provide information to the public on a regular basis** about the water supply situation, what actions are being proposed or being taken, how those actions will mitigate supply shortages, and how well customers are meeting program goals.

When appealing to customers for water use reductions, act equitably, credibly and consistently. Demonstrate to the public that the water supplier is doing everything possible to minimize the shortage. Pursue supply options vigorously; if new supplies are too costly or not achievable in a short time, communicate that fact. Publicity about changes in water supplier operation and maintenance practices that conserve water is helpful. Also, provide accurate information concerning supply status (reservoir and ground water levels), water use reductions, and other pertinent information to all company personnel, especially those briefing the media or involved with public education, as well as meter readers and billing department employees.

Developing the public information campaign takes time. The Denver Drought Plan includes the following media implementation plan.

In dealing with the media, have one person speak for the water supplier preferably the water shortage response team leader. Make immediate response to media inquiries to maintain communication links and to avoid media representatives seeking alternative information sources that are probably less informed. Good communication provides opportunities for a water supplier to tell its story and ensures that knowledgeable people will be called upon to speak on the issues.

Before developing water shortage related public information strategies, there are several important issues to keep in mind about program focus and content. First, emphasize that the water supply situation is unpredictable and may change from month to month. No one can be certain when the situation will improve. Even if precipitation increases, the effect on the water supply may not be immediate. The water supplier needs to proceed cautiously by starting demand reduction programs early and avoid relaxing any measures too soon. Also, customers need to realize that the drought impact is not uniform across a state or region and that the problem will be more severe in some areas and less severe in others.

Some classes of customers may carry the burden of coping with the water shortage more than others. Some groups with high potential for reduction may be asked to reduce water use more than others, but avoid discrimination within a class of customers. Landscape irrigation may have to be curtailed. Conversely, it may be decided to minimize water reductions to commercial-industrial

Communications Plan Key in Denver Drought Plan

Once the Board has identified a specific drought stage, Denver Water's Community Relations staff will develop an appropriate communications plan based on the elements specified in the Outline for a Drought Communication Plan.

February

- Select advertising agency to assist staff with mass media advertising campaign.
- Announce "Spring Watch" (voluntary ban on lawn watering), subject to Board decision.
- Promote relevant news story topics to media and respond to media inquiries.

March

- Begin developing message-of-the-week program.
- Reinforce voluntary ban on lawn watering.
- Board contracts with ad agency.
- Community Relations staff and agency begin work on campaign.
- Hold public meeting about surcharges.
- Promote relevant news story topics to media and respond to media inquiries.

April

- Begin disseminating message of the week.
- Reinforce voluntary ban on lawn watering.
- Promote relevant news story topics to media and respond to media inquiries.
- Board determines drought stage and corresponding drought response measures.
- Post drought stage and response measures on Web site.
- Intensify media relations.
- Community Relations staff prepares and mails notices to all customers.
- Board approves ad campaign.

May

- Disseminate message of the week.
- Ad campaign begins.
- Mail notices of drought response measures to all customers.
- Promote relevant news story topics to media and respond to media inquiries.

customers in order to preserve as many jobs as possible. Carefully communicate the reasoning behind these or any mandatory curtailment of supplies.

Make the public aware of the impact of the water shortage on water system costs as early as possible. Reduced water sales will obviously reduce revenue. Most water suppliers have fixed costs on the order of 75 to 80 percent of their total budget and the public needs to know this. There may be significant additional costs incurred for purchasing water, conservation programs, emergency pumps, pipes, other equipment, increased water quality testing, and other water shortage related activities. These costs will be borne by the system users.

Finally, avoid being placed in an adversarial position. Focus on the emergency at hand without blame implied toward the water supplier's management or a customer class.

It is important to tailor the public information program to the type of community served. For large decentralized areas, methods that allow the water supplier to reach many customers relatively inexpensively such as Web sites, e-mail, direct mail, bill inserts and media advertisements are appropriate. Smaller, close knit communities with central business districts may also be well served by a central information center.

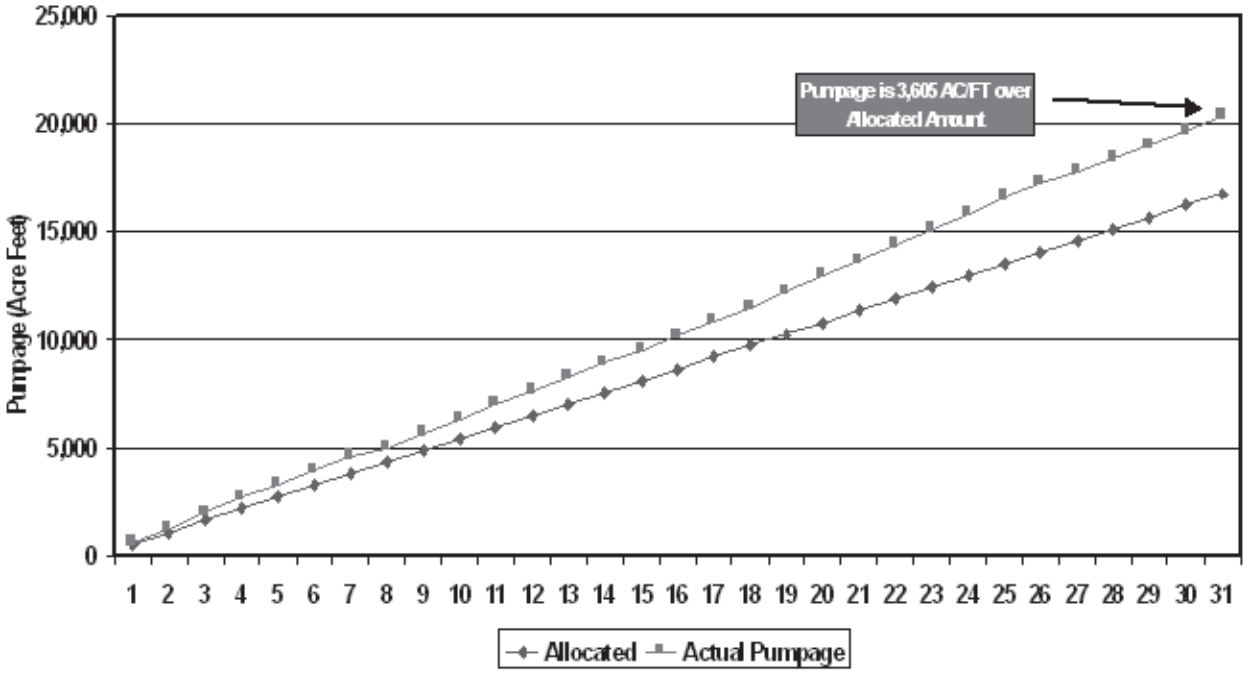
Public information programs provide long term benefits by increasing the customers' understanding of their water use and of the water supplier's operations. Such an understanding will be useful in generating public support for future efforts regarding rate increases or new efficiency and supply projects.

When undertaking any public information effort, it is crucial that the information be accurate and consistent and that requested use reductions be commensurate with the seriousness of the situation. In other words, the customer must understand what the trigger conditions are, what the consequences of the different stages of drought are, and how the emergency measures will help relieve or minimize the problem.

13. Monitoring of actual use

    a. Chart actual water supply and demand on a graph. A seven day average can be used to smooth out daily fluctuations. Update this graph weekly.

    b. Compare actual demand and supply with projected demand and supply to determine if stage adjustments may be needed. Before altering the demand reduction stage, consider program adjustments such as raising the level of expenditure on public information, increasing enforcement efforts, or both. If this does not achieve the required stabilization, adjust the stage.



Monitoring Targeted versus Actual Water Production

Continually monitor the effectiveness of the individual conservation measures, supply availability, and actual water use. Here's how Seattle handled it:

Seattle Incorporates Seasonal Differences into Drought Plan

The Seattle plan recognizes that the impacts of drought during different seasons have different effects. It found that it is essential to closely monitor water quality during droughts and particularly during warm weather. This applies to water quality in rivers as well as to the drinking water provided to customers. Water quality issues must be considered for drinking water and instream uses when supply management decisions are made. The Seattle water distribution system is designed to carry a large capacity of water during summer peak months. If demand is significantly lowered, water will not move through the system at the "design" rate. The slower moving water, coupled with higher summer temperatures will increase the likelihood that drinking water quality problems will arise.

Example Planning Timeline

26 Nov	Staff member begins to research and draft an updated plan.
10 Dec	Draft plan is ready for staff review. GM and team review plan and suggest changes. The plan is modified and expanded to include implementation procedures.
17 Dec	Essential staff review the draft plan and comment on how it affects their functions, ensure that it is 'workable.'
3 Jan	Board subcommittee reviews the draft plan, suggests changes, and sends the plan to the Board for review and action.
January	Full Board reviews the draft plan and schedules public hearings.
mid-Feb	Public hearings announced. Plan released for public review.
Feb-Mar	Public hearings result in public pressure to revise specific elements of the plan
31 Mar	The Board declares a Water Shortage Warning, requests 10 percent reduction (rainy season is almost over) and adopts Plan
April	Customers are notified by direct mail that mandatory rationing has been adopted and how the plan will affect them
mid-Apr	Customers receive individual letter with their allotment, description of rationing plan and appeal procedure, general rationing/information brochure, and conservation information on how to reduce use (efficient toilets, showerheads, landscaping, meter reading, leak repair, etc.)
1 May	Board declares a Water Shortage Emergency, Stage 1 (rainy season is over)

Modify your general drought plan to meet the specific conditions of the drought possible in the next year or two. Begin six months before you know for sure that you will have to implement rationing. Most water suppliers are able to forecast the likelihood of drought-related supply shortages a year before they occur. Six to eight months is a reasonable time to develop an effective, equitable rationing plan that your staff can implement smoothly.

Why does good water shortage contingency planning take at least six months and significantly longer if regional plans are being developed and implemented? Let's assume that the restrictions will take effect on May 1 - that means planning would begin on November 1.

- On Nov. 1, ask a staff member to research and draft an updated rationing plan. This individual will become very familiar with the plan and perhaps will be the rationing manager.
- Two weeks later the draft plan is ready for staff review. The general manager and department heads review the plan and the underlying assumptions and suggest changes. The plan is changed and expanded to include implementation procedures.
- A week later, affected staff are asked to review the effect of the plan on their functions - customer service, billing, computer programming, budget, operations, etc. - to ensure that the plan as written is workable.

- It is now mid-December and a subcommittee of the elected board reviews the plan, suggests changes, and sends the plan to the board for review and action.
- During early January the Board reviews the final draft of rationing plan and schedules public hearings
- Staff finds a large meeting room, prepares presentation materials, designs the news releases and advertisements and by mid-February sends out the public hearing announcements (direct mail, paid ads, news stories). This information includes rationing plan specifics and invites public input at a series of hearings.
- The first public hearing, late February, with hundreds of customers attending, results in public pressure to revise specific elements of the plan.
- At the second public hearing, in early March, usually with only half as many customers attending, suggested changes to the plan are reviewed and public input continues. The board declares a Water Shortage Emergency (the rainy season is almost over).
- At the last public hearing, in mid-March, with hundreds of customers still in attendance, the staff reviews public suggestions, presents a variety of rationing plans for board consideration, and the board selects a plan.
- By the end of March all customers are notified by direct mail that mandatory rationing has been adopted and how the plan will affect them.
- By mid-April customers receive an individual letter with an allotment for that account, description of rationing plan and appeal procedure, general rationing/information brochure, and conservation information on how to reduce use with such things as efficient toilets, showerheads, landscaping, meter reading, leak repair, etc.
- On May 1 rationing begins.

This is a tight time line and requires that one staff member be responsible for keeping the momentum going. As each winter storm arrives, the motivation to maintain the rapid pace will decrease. It is important that someone be responsible for this process and, in most cases, the water conservation Manager becomes the rationing manger. This makes sense in that the conservation staff is aware of how customers can reduce use, has public education and assistance experience, and conservation programs will become essential to the success of the rationing plan.

While the rationing manager is orchestrating the rationing plan approval process, the agency can also start preparing for implementation. Support from the general manager is essential, since the rationing manager will need to hire staff, spend money, act as media spokesperson, call staff meetings, etc.

APPENDIX A

Declaring a Water Shortage Emergency and Water Shortage Contingency Planning

Water Code Section 350-359

350. The governing body of a distributor of a public water supply, whether publicly or privately owned and including a mutual water company, may declare a water shortage emergency condition to prevail within the area served by such distributor whenever it finds and determines that the ordinary demands and requirements of water consumers cannot be satisfied without depleting the water supply of the distributor to the extent that there would be insufficient water for human consumption, sanitation, and fire protection.

351. Excepting in event of a breakage or failure of a dam, pump, pipe line or conduit causing an immediate emergency, the declaration shall be made only after a public hearing at which consumers of such water supply shall have an opportunity to be heard to protest against the declaration and to present their respective needs to said governing board.

352. Notice of the time and place of hearing shall be published pursuant to Section 6061 of the Government Code at least seven days prior to the date of hearing in a newspaper printed, published, and circulated within the area in which the water supply is distributed, or if there is no such newspaper, in any newspaper printed, published, and circulated in the county in which the area is located.

353. When the governing body has so determined and declared the existence of an emergency condition of water shortage within its service area, it shall thereupon adopt such regulations and restrictions on the delivery of water and the consumption within said area of water supplied for public use as will in the sound discretion of such governing body conserve the water supply for the greatest public benefit with particular regard to domestic use, sanitation, and fire protection.

354. After allocating and setting aside the amount of water which in the opinion of the governing body will be necessary to supply water needed for domestic use, sanitation, and fire protection, the regulations may establish priorities in the use of water for other purposes and provide for the allocation, distribution, and delivery of water for such other purposes, without discrimination between consumers using water for the same purpose or purposes.

355. The regulations and restrictions shall thereafter be and remain in full force and effect during the period of the emergency and until the supply of water available for distribution within such area has been replenished or augmented.

356. The regulations and restrictions may include the right to deny applications for new or additional service connections, and provision for their enforcement by discontinuing service to consumers willfully violating the regulations and restrictions.

357. If the regulations and restrictions on delivery and consumption of water adopted pursuant to this chapter conflict with any law establishing the rights of individual consumers to receive either specific or proportionate amounts of the water supply available for distribution within such service area, the regulations and restrictions adopted pursuant to this chapter shall prevail over the provisions of such laws relating to water rights for the duration of the period of emergency; provided, however, that any distributor of water which is subject to regulation by the State Public Utilities Commission shall before making such regulations and restrictions effective secure the approval thereof by the Public Utilities Commission.

358. Nothing in this chapter shall be construed to prohibit or prevent review by any court of competent jurisdiction of any finding or determination by a governing board of the existence of an emergency or of regulations or restrictions adopted by such board, pursuant to this chapter, on the ground that any such action is fraudulent, arbitrary, or capricious.

359.

(a) Notwithstanding any other provision of law that requires an election for the purpose of authorizing a contract with the United States, or for incurring the obligation to repay loans from the United States, and except as otherwise limited or prohibited by the California Constitution, a public water agency, as an alternative procedure to submitting the proposal to an election, upon affirmative vote of four-fifths of the members of the governing body thereof, may apply for, accept, provide for the repayment together with interest thereon, and use funds made available by the federal government pursuant to Public Law 95-18, pursuant to any other federal act subsequently enacted during 1977 that specifically provides emergency drought relief financing, or pursuant to existing federal relief programs receiving budget augmentations in 1977 for drought assistance, and may enter into contracts that are required to obtain those federal funds pursuant to the provisions of those federal acts if the following conditions exist:

(1) The project is undertaken by a state, regional, or local governmental agency.

(2) As a result of the severe drought now existing in many parts of the state, the agency has insufficient water supply needed to meet necessary agricultural, domestic, industrial, recreational, and fish and wildlife needs within the service area or area of jurisdiction of the agency.

(3) The project will develop or conserve water before October 31, 1978, and will assist in mitigating the impacts of the drought.

(4) The agency affirms that it will comply, if applicable, with Sections 1602, 1603, and 1605 of the Fish and Game Code.

(5) The project will be completed on or before the completion date, if any, required under the federal act providing the funding, but not later than March 1, 1978.

(b) Any obligation to repay loans shall be expressly limited to revenues of the system improved by the proceeds of the contract.

(c) No application for federal funds pursuant to this section shall be made on or after March 1, 1978.

(d) Notwithstanding the provisions of this section, a public agency shall not be exempt from any provision of law that requires the submission of a proposal to an election if a petition requesting such an election signed by 10 percent of the registered voters within the public agency is presented to the governing board within 30 days following the submission of an application for federal funds.

(e) Notwithstanding the provisions of this section, a public water agency that applied for federal funds for a project before January 1, 1978, may make application to the Director of the Drought Emergency Task Force for extension of the required completion date specified in paragraph (5) of subdivision (b). Following receipt of an application for extension, the Director of the Drought Emergency Task Force may extend the required completion date specified in paragraph (5) of subdivision (b) to a date not later than September 30, 1978, if the director finds that the project has been delayed by factors not controllable by the public water agency. If the Drought Emergency Task Force is dissolved, the Director of Water Resources shall exercise the authority vested in the Director of the Drought Emergency Task Force pursuant to this section.

(f) For the purposes of this section, "public water agency" means a city, district, agency, authority, or any other political subdivision of the state, except the state, that distributes water to the inhabitants thereof, is otherwise authorized by law to enter into contracts or agreements with the federal government for a water supply or for financing facilities for a water supply, and is otherwise required by law to submit those agreements or contracts or any other project involving long-term debt to an election within that public water agency.

Water Code Section 10632

10632.The plan shall provide an urban water shortage contingency analysis which includes each of the following elements which are within the authority of the urban water supplier:

(a) Stages of action to be undertaken by the urban water supplier in response to water supply shortages, including up to a 50 percent reduction in water supply, and an outline of specific water supply conditions which are applicable to each stage.

(b) An estimate of the minimum water supply available during each of the next three water years based on the driest three-year historic sequence for the agency's water supply.

(c) Actions to be undertaken by the urban water supplier to prepare for, and implement during, a catastrophic interruption of water supplies including, but not limited to, a regional power outage, an earthquake, or other disaster.

(d) Additional, mandatory prohibitions against specific water use practices during water shortages, including, but not limited to, prohibiting the use of potable water for street cleaning.

(e) Consumption reduction methods in the most restrictive stages. Each urban water supplier may use any type of consumption reduction methods in its water shortage contingency analysis that would reduce water use, are appropriate for its area, and have the ability to achieve a water use reduction consistent with up to a 50 percent reduction in water supply.

(f) Penalties or charges for excessive use, where applicable.

(g) An analysis of the impacts of each of the actions and conditions described in subdivisions (a) to (f), inclusive, on the revenues and expenditures of the urban water supplier, and proposed measures to overcome those impacts, such as the development of reserves and rate adjustments.

(h) A draft water shortage contingency resolution or ordinance.

(i) A mechanism for determining actual reductions in water use pursuant to the urban water Shortage Contingency Analysis.

Government Code Section 8550-8551

8550. The state has long recognized its responsibility to mitigate the effects of natural, manmade, or war-caused emergencies which result in conditions of disaster or in extreme peril to life, property, and the resources of the state, and generally to protect the health and safety and preserve the lives and property of the people of the state. To insure that preparations within the state will be adequate to deal with such emergencies, it is hereby found and declared to be necessary:

(a) To confer upon the Governor and upon the chief executives and governing bodies of political subdivisions of this state the emergency powers provided herein; and to provide for state assistance in the organization and maintenance of the emergency programs of such political subdivisions;

(b) To provide for a state agency to be known and referred to as the Office of Emergency Services, within the Governor's office; and to prescribe the powers and duties of the director of that office;

(c) To provide for the assignment of functions to state agencies to be performed during an emergency and for the coordination and direction of the emergency actions of such agencies;

(d) To provide for the rendering of mutual aid by the state government and all its departments and agencies and by the political subdivisions of this state in carrying out the purposes of this chapter;

(e) To authorize the establishment of such organizations and the taking of such actions as are necessary and proper to carry out the provisions of this chapter.

It is further declared to be the purpose of this chapter and the policy of this state that all emergency services functions of this state be coordinated as far as possible with the comparable functions of its political subdivisions, of the federal government including its various departments and agencies, of other states, and of private agencies of every type, to the end that the most effective use may be made of all manpower, resources, and facilities for dealing with any emergency that may occur.

8551. This chapter may be cited as the “California Emergency Services Act.”

APPENDIX B

PUC Water Rationing Moratoria

CALIFORNIA PUBLIC UTILITIES COMMISSION

Water Division

INSTRUCTIONS FOR WATER CONSERVATION,

RATIONING AND SERVICE CONNECTION MORATORIA

Standard Practice U-40-W

SAN FRANCISCO, CALIFORNIA

July 2004

INSTRUCTIONS FOR WATER CONSERVATION,

RATIONING AND SERVICE CONNECTION MORATORIA

A-PURPOSE AND SCOPE

1. The purpose of this standard practice is to provide guidance to Water Division staff, to the public and to utilities as to steps to be taken when the utility suffers from a water shortage. The three levels of action are voluntary rationing, mandatory rationing and a service connection moratorium.

B-BACKGROUND

2. General Order 103, Chart 1, and Standard Practice U-22-W, Determination of Water Supply Requirements of Water Systems, address water supply requirements, but supply can be affected temporarily due to drought or decreased production of a utility's wells. When this happens, utilities may have to resort to mandatory conservation or may have to institute a service connection moratorium.
3. Parties may also protest service area extensions (see Standard Practice U-14-W) over concern that the available supplies may be inadequate to serve the new customers, which would be the equivalent of a service connection moratorium (see Section F)1.
4. The position of the Commission in overall water supply planning was set forth in Decision 99-04-061, April 22, 1999 (see Appendix A to this Standard Practice).

C-DEVELOPMENT OF CONSERVATION AND RATIONING

5. In mid-1976, due to a drought, the Commission opened an Order Instituting Investigation (OII, Case No. 10114, June 8, 1976) to determine what actions to take. In early 1977, the Commission issued an emergency decision that allowed water utilities to distribute water conservation kits and to implement cost effective water conservation programs.

6. The Commission was once again faced with drought conditions in mid-1988. The Commission opened OII 89-03-005 that allowed all classes of water utilities to file a water conservation and rationing plan consisting of two distinct parts: Rule 14.1 (a "voluntary conservation" program which allowed mandatory rationing to be triggered) and Schedule 14.1 (the mandatory rationing and penalty part). This plan was based primarily upon the Department of Water Resources and Metropolitan Water District's model plans, but also incorporated aspects of the North Marin Water District, East Bay Municipal Utility District, and California Water Service Company's existing conservation and rationing plans. The main objective of Rule 14.1 and Schedule 14.1 was to have a plan readily available for any utility that needed conservation and/or rationing methods. This plan allowed regulated utilities to achieve conservation of 17.5% to 26%.

7. The drought was officially declared over in February 1993 and the OII was closed. Because history shows that drought occurs in California about once every ten years, Rule 14.1 has remained in place. When conditions become severe, the utility may file an advice letter to institute Schedule 14.1. The Commission must approve implementation of this schedule by resolution.

D-VOLUNTARY RATIONING

8. Voluntary rationing consists of the step described in Rule 14.1 (Appendix B). This Tariff Rule should be in the tariff book of every utility that might suffer from a water shortage.

E-MANDATORY RATIONING

9. Mandatory rationing consists of the steps described in Schedule 14.1. The utility adds schedule 14.1 to its tariff book by filing an advice letter with full justification. Staff will prepare a resolution for consideration by the Commission. The Commission must approve the imposition of mandatory conservation.

10. Schedule 14.1 may be modified to fit the needs of the utility and its particular water shortage situation. The following provisions are examples of what might be included in a typical Schedule 14.1:

    A. Prohibit nonessential and unauthorized water use, including:

        i. use for more than minimal landscaping in connection with new construction;

        ii. use through any meter when the company has notified the customer in

writing to repair a broken or defective plumbing, sprinkler, watering or irrigation system and the customer has failed to effect such repairs within five days;

iii. use of water which results in flooding or runoff in gutters or streets;

iv. use of water through a hose for washing cars, buses, boats, trailers or other vehicles without a positive automatic shut-off valve on the outlet end of the hose;

v. use of water through a hose for washing buildings, structures, sidewalks, walkways, driveways, patios, parking lots, tennis courts, or other hard-surfaced areas;

vi. use of water to clean, fill or maintain levels in decorative fountains;

vii. use of water for construction purposes unless no other source of water or other method can be used;

viii. service of water by any restaurant except upon the request of a patron; and

ix. use of water to flush hydrants, except where required for public health or safety.

B. Establish customer water allocations at a percentage of historical usage with the corresponding billing periods of a non-drought year being the base.

C. Establish an allocation of a percentage of historical usage with the corresponding billing periods of a non-drought year being the base for consumption for users of process water (water used to manufacture, alter, convert, clean, grow, heat or cool a product, including water used in laundries and car wash facilities that recycle the water used).

D. Establish a minimum allocation of a number of Ccf per month (one Ccf is one hundred cubic feet) for any customer regardless of historical usage.

E. Establish an exceptions procedure for customers with no prior billing period record or where unusual circumstances dictate a change in allocation.

F. Establish a penalty ("conservation fee") of $2.00 per Ccf for usage over allocated amounts, provided, however, that banking of under usage from month to month is allowed.

G. Provide that penalty funds are not to be accounted for as income, but are to be kept in a separate reserve account for disposition as directed by the Commission.

H. Provide that, after written warning for nonessential or unauthorized water use, for subsequent violations the utility may install a flow restrictor to be left in a minimum of three days. The second time a flow restrictor is installed it may be left in until rationing ends.

I. Establish charges of $25, $50, or actual cost depending on meter size

for removing restrictors, and provide that continuing nonessential or unauthorized use may result in disconnection.

J. Establish an appeal procedure first through the utility, then to the Commission staff through the Executive Director, then to the Commission via a formal complaint.

F-SERVICE CONNECTION MORATORIUM

11. A service connection moratorium is sometimes imposed by the California Department of Health Services. The California Water Code, Section 350 et seq., provides that any public water supplier may, after public notice and hearing, declare a water shortage emergency within its service area whenever it determines that the ordinary demands and requirements of its consumers cannot be satisfied without depleting the water supply to the extent that there would be insufficient water for human consumption, sanitation, and fire protection. After it has declared a water shortage emergency, it must adopt such regulations and restrictions on water delivery and consumption as it finds will conserve its water supply for the greatest public benefit. Section 357 requires that suppliers which are subject to regulation by the CPUC shall secure its approval before making such regulations and restrictions effective.

12. Section 2708 of the Public Utilities Code states:

2708. Whenever the commission, after a hearing had upon its own motion or upon complaint, finds that any water company which is a public utility operating within this State has reached the limit of its capacity to supply water and that no further consumers of water can be supplied from the system of such utility without injuriously withdrawing the supply wholly or in part from those who have theretofore been supplied by the corporation, the commission may order and require that no such corporation shall furnish water to any new or additional consumers until the order is vacated or modified by the commission. The commission, after hearing upon its own motion or upon complaint, may also require any such water company to allow additional consumers to be served when it appears that service to additional consumers will not injuriously withdraw the supply wholly or in part from those who theretofore had been supplied by such public utility.

13. To establish a service connection moratorium the utility must:

a. Hold a public meeting under Section 350 and 351 of the Water Code

b. Add the following language to each service schedule:

Moratorium

No service shall be provided to any premises not previously served within the _____ _____ Service Area as defined on the Service Area Map filed as a part of these tariffs."

G-Exemptions

14. Some decisions to impose a moratorium contain exceptions. For example in Citizen's Utilities (CUCC) Montara District:

    "The moratorium shall not apply to owners of real property who are customers of CUCC on or before the date of this order, or their successors in interest, if any change in the use of their property will not increase their demand upon the system." (D.86-05-078, Ordering Paragraph 3.)

15. D.86-05-078 also provided that prospective customers could seek an exemption from the moratorium by filing an application with the Commission showing that extraordinary circumstances required an exemption.

16. In D.00-06-020, June 8, 2000 the Commission granted an application and authorized Citizens Utilities to install a water service connection to applicant's property at APN 037-278-090 following cessation of service at applicant's property at 888 Ocean Boulevard in Montara. Costs were to be borne by applicant. The order made it clear that water service could not be reinstated at 888 Ocean Boulevard absent a lifting or easing of the moratorium. Such determinations were also delegated to staff2.

The Commission's Role in Water Planning

The two state agencies primarily responsible for overseeing water planning are the California Department of Water Resources, which manages the State Water Project and produces the California Water Plan, and the State Water Quality Control Board and Regional Water Quality Control Boards that have authority over water allocation and water quality protection.

In addition to the state agencies that have broad planning and management powers, local government also has a part in water use decisions. For example, county boards of supervisors, county water agencies, land use planning agencies, city governments, municipal water districts and many special districts all have a role in the use of water in California.

In this context, the Commission has recognized the futility of one party taking unilateral action to protect a groundwater basin:

Rehabilitation of the Santa Maria Groundwater Basin is not the responsibility of, and is beyond the physical and financial resources of any single individual, company, or agency. Even if [Southern California Water Company] were to stop drawing from the basin entirely and injected into the basin the entire 7,900 AFY it desires to obtain from the [Central Coast Water Authority], the basin's fundamental problems of declining quantity and water quality would not be solved. Most simply put, the basin's salvation as a water resource requires the immediate, undivided, sincere and selfless attention of all its users.

(Re Southern California Water Company, 48 CPUC2d 511, 519 (D.93-03-066) (emphasis in original).)

The Commission's role is limited to ensuring that each jurisdictional water utility provides its customers with "just and reasonable service . . . and facilities as are necessary to promote the safety, health, comfort and convenience of its patrons, employees, and the public." (§ 451.) The Commission has further delineated the service standard in its General Order 103 where it proscribes Standards of Service including water quality, water supply, and water pressure, as well as many other details of service.

The Commission has not, however, dictated to investor-owned utilities what method of obtaining water must be used to meet its present and future responsibility of providing safe and adequate supply of water at reasonable rates. (Southern California Water, 48 CPUC2d at 517.)

Which is not to suggest that the Commission ignores issues of water availability in its regulation of water utilities. The Commission requires that all water utilities prepare, file, and update a water management plan, which includes identification of water sources as well as consumption projections over 15 years. These plans are updated by the utility as part of its general rate case.

Rule N0. 14.1 Water Conservation and Rationing Plan

General Information

If water supplies are projected to be insufficient to meet normal customer demand, and are beyond the control of the utility, the utility may elect to implement voluntary conservation using the portion of this plan set forth in Section A of this rule after notifying the Commission's Water Division of its intent. If, in the opinion of the utility, more stringent water measures are required, the utility shall request Commission authorization to implement the mandatory conservation and rationing measures set forth in Section B.

The Commission shall authorize mandatory conservation and rationing by approving Schedule No. 14.1, Mandatory Water Conservation and Rationing. When Schedule No. 14.1 has expired, or is not in effect, mandatory conservation and rationing measures will not be in force. Schedule No. 14.1 will set forth water use violation fines, charges for removal of flow restrictors, and the period during which mandatory conservation and rationing measures will be in effect.

When Schedule No. 14.1 is in effect and the utility determines that water supplies are again sufficient to meet normal demands, and mandatory conservation and rationing measures are no longer necessary, the utility shall seek Commission approval to rescind Schedule No. 14.1 to discontinue rationing.

In the event of a water supply shortage requiring a voluntary or mandatory program, the utility shall make available to its customers water conservation kits as required by Rule 20. The utility shall notify all customers of the availability of conservation kits.

APPENDIX C

Guidelines for Implementing the California Environmental Quality Act

Excerpts from:

http://ceres.ca.gov/topic/env_law/ceqa/guidelines/art18.html Page 1 of 15

Title 14. *California Code of Regulations*

Chapter 3. Guidelines for Implementation of the California Environmental Quality Act

Article 18. Statutory Exemptions

Sections 15260 to 15285

15260. General

This article describes the exemptions from CEQA granted by the Legislature. The exemptions take several forms. Some exemptions are complete exemptions from CEQA. Other exemptions apply to only part of the requirements of CEQA, and still other exemptions apply only to the timing of CEQA compliance.

Note: Authority cited: Section 21083, Public Resources Code; Reference: Section 21080(b), Public Resources Code.

Discussion: This section serves as an introduction to this article on statutory exemptions. The section notes that the exemptions take basically three forms, being either complete exemptions, partial exemptions, or special timing requirements. The court in Western Municipal Water District of Riverside County v. Superior Court of San Bernardino County (1986) 187 Cal. App. 3d 1104, pointed out that "the self-evident purpose of a [statutory] exemption is to provide an escape from the EIR requirement despite a project's clear, significant impact." This is in contrast to categorical exemptions which are disallowed if the project would otherwise have an environmental impact.

By way of example, the Supreme Court held in Napa Valley Wine Train, Inc. v. Public Utilities

Commission (1990) 50 Cal 3d 370, that CEQA is a legislative act subject to legislative limitations and legislative amendment. Through that premise, the court held that statutory exemptions were enacted to avoid the environmental review process for an entire class of projects. In the specific case, an excursion train proposed for operation within an existing railroad right-of-way fell within the exemption language in Public Resources Code Section 21080(b)(11), even though the use might have potential environmental consequences. Subsequent legislation enacted Public Resources Code Section 21080.04 making the wine train project subject to CEQA.

15261. Ongoing Project

(a) If a project being carried out by a public agency was approved prior to November 23, 1970, the project shall be exempt from CEQA unless either of the following conditions exist:

(1) A substantial portion of public funds allocated for the project have not been spent, and it is still feasible to modify the project to mitigate potentially adverse environmental effects, or to choose feasible alternatives to the project, including the alternative of "no project" or halting the project; provided that a project subject to the National Environmental Policy Act (NEPA) shall be exempt from CEQA as an ongoing project if, under regulations promulgated under NEPA, the project would be too far advanced as of January 1, 1970, to require preparation of an EIS.

(2) A public agency proposes to modify the project in such a way that the project might have a new significant effect on the environment.

(b) A private project shall be exempt from CEQA if the project received approval of a lease, license, certificate, permit, or other entitlement for use from a public agency prior to April 5, 1973, subject to the following provisions:

(1) CEQA does not prohibit a public agency from considering environmental factors in connection with the approval or disapproval of a project, or from imposing reasonable fees on the appropriate private person or entity for preparing an environmental report under authority other than CEQA. Local agencies may require environmental reports for projects covered by this paragraph pursuant to local ordinances during this interim period.

(2) Where a project was approved prior to December 5, 1972, and prior to that date the project was legally challenged for noncompliance with CEQA, the project shall be bound by special rules set forth in Section 21170 of CEQA.

(3) Where a private project has been granted a discretionary governmental approval for part of the project before April 5, 1973, and another or additional discretionary governmental approvals after April 5, 1973, the project shall be subject to CEQA only if the approval or approvals after April 5, 1973, involve a greater degree of responsibility or control over the project as a whole than did the approval or approvals prior to that date.

Note: Authority cited: Section 21083, Public Resources Code; Reference: Sections 21169, 21170, and 21171, Public Resources Code; County of Inyo v. Yorty, 32 Cal. App. 3d 795.

Discussion: While not specifically mentioned among the statutory exemptions contained in CEQA, the ongoing project exemption is a result of the prospective application of statutes when they are enacted. Accordingly, CEQA clearly applies to governmental projects approved after November 23, 1970, the effective date of CEQA. This section seeks to codify case law interpreting the application of CEQA to projects which were in process at the time of CEQA's effective date but not yet finally approved or still capable

of being changed to avoid environmental damage. This section is also complicated by the special rules that apply to private projects approved after the Friends of Mammoth decision in 1972 and before April 5, 1973, the end of the statutory moratorium on the application of CEQA to private projects. The special rules are included here with some administrative interpretation in the interest of completeness of the ongoing project exception.

15262. Feasibility and Planning Studies

A project involving only feasibility or planning studies for possible future actions which the agency, board, or commission has not approved, adopted, or funded does not require the preparation of an EIR or Negative Declaration but does require consideration of environmental factors. This section does not apply to the adoption of a plan that will have a legally binding effect on later activities.

Note: Authority cited: Section 21083, Public Resources Code; Reference: Sections 21102 and 21150, Public Resources Code.

Discussion: This section provides an interpretation of the exception in CEQA for feasibility and planning studies. This section provides an interpretation holding clearly that feasibility and planning studies are exempt from the requirements to prepare EIRs or Negative Declarations. These studies must still include consideration of environmental factors. This interpretation is consistent with the intent of the Legislature as reflected in Sections 21102 and 21150. The section also adds a necessary limitation on this exemption to show that if the adoption of a plan will have a legally binding effect on later activities, the adoption will be subject to CEQA. This clarification is necessary to avoid a conflict with Section 15378(a)(1) that the adoption of a local general plan is a project subject to CEQA.

15268. Ministerial Projects

(a) Ministerial projects are exempt from the requirements of CEQA. The determination of what is “ministerial” can most appropriately be made by the particular public agency involved based upon its analysis of its own laws, and each public agency should make such determination either as a part of its implementing regulations or on a case-by-case basis.

(b) In the absence of any discretionary provision contained in the local ordinance or other law establishing the requirements for the permit, license, or other entitlement for use, the following actions establishing the requirements for the permit, license, or other entitlement for use, the following actions shall be presumed to be ministerial:

(1) Issuance of building permits.

(2) Issuance of business licenses.

(3) Approval of final subdivision maps.

(4) Approval of individual utility service connections and disconnections.

(c) Each public agency should, in its implementing regulations or ordinances, provide an identification or itemization of its projects and actions which are deemed ministerial under the applicable laws and ordinances.

(d) Where a project involves an approval that contains elements of both a ministerial action and a discretionary action, the project will be deemed to be discretionary and will be subject to the requirements of CEQA.

Note: Authority cited: Section 21083, Public Resources Code; Reference: Section 21080(b)(1), Public Resources Code; Day v. City of Glendale, 51 Cal. App. 3d 817.

Discussion: This section provides an interpretation of the exemption for ministerial projects. The term "ministerial" is defined in Section 15369. This section provides additional explanation. The key point is that the determination of whether a particular project is ministerial must be based on an examination of the law or ordinance authorizing the particular permit. The problem is that ordinances vary. Ordinances in adjacent counties requiring permits for the same kind of activity may provide different kinds of controls over the activity. In one county, the ordinance may be ministerial, and in the other the permit may be discretionary and therefore subject to CEQA. The section identifies four types of permits or licenses which are normally ministerial in most jurisdictions. The section creates a presumption that these activities are ministerial unless evidence is presented showing that there are discretionary provisions in the relevant local ordinance. The section encourages public agencies to identify their ministerial permits in their implementing procedures. This approach will simplify the administration of the process in the individual agency. This section also codifies the ruling in Day v. City of Glendale cited in the note and other court decisions which have held that where a project approval involves elements of both ministerial action and discretionary action, the project will be deemed to be discretionary and therefore subject to CEQA. The court in Friends of Westwood, Inc. v. Los Angeles (1986) 191 Cal. App. 3d 259, provided guidance, and held that the legislative history of CEQA indicates that the term 'Ministerial' is limited to those approvals which can be legally compelled without substantial modification or change. "It is enough that the [agency] possesses discretion to require changes which would mitigate in whole or part one or more of the [significant or potentially significant] environmental consequences an EIR might conceivably uncover."

15269. Emergency Projects

The following emergency projects are exempt from the requirements of CEQA.

(a) Projects to maintain, repair, restore, demolish, or replace property or facilities damaged or destroyed as a result of a disaster in a disaster stricken area in which a state of emergency has been proclaimed by the Governor pursuant to the California Emergency Services Act, commencing with Section 8550 of the Government Code. This includes projects that will remove, destroy, or

significantly alter an historical resource when that resource represents an imminent threat to the public of bodily harm or of damage to adjacent property or when the project has received a determination by the State Office of Historic adjacent property or when the project has received a determination by the State Office of Historic Preservation pursuant to Section 5028(b) of Public Resources Code.

(b) Emergency repairs to publicly or privately owned service facilities necessary to maintain service essential to the public health, safety or welfare.

(c) Specific actions necessary to prevent or mitigate an emergency. This does not include long-term projects undertaken for the purpose of preventing or mitigating a situation that has a low probability of occurrence in the short-term.

(d) Projects undertaken, carried out, or approved by a public agency to maintain, repair, or restore an existing highway damaged by fire, flood, storm, earthquake, land subsidence, gradual earth movement, or landslide, provided that the project is within the existing right of way of that highway and is initiated within one year of the damage occurring. This exemption does not apply to highways designated as official state scenic highways, nor any project undertaken, carried out, or approved by a public agency to expand or widen a highway damaged by fire, flood, storm, earthquake, land subsidence, gradual earth movement, or landslide.

(e) Seismic work on highways and bridges pursuant to Section 180.2 of the Streets and Highways Code, Section 180 et seq.

Note: Authority: Section 21083, Public Resources Code. Reference: Sections 21080(b)(2), (3), and (4), 21080.33 and 21172, Public Resources Code; Castaic Lake Water Agency v. City of Santa Clarita (1995) 41 Cal.App.4th 1257; and Western Municipal Water District of Riverside County v. Superior Court of San Bernardino County (1987) 187 Cal.App.3d 1104.

Discussion: This section identifies the emergency exemptions from CEQA. The exemptions for emergency repairs to existing highways and for emergency projects involving historical resources that are an imminent threat to the public reflect statutory provisions. Highway repairs are limited to those which do not expand or widen the highway.

In Western Municipal Water District of Riverside County v. Superior Court of San Bernardino County (1987) 187 Cal. App. 3d 1104, the court held that an emergency is an occurrence, not a condition, and that the occurrence must involve a clear and imminent danger, demanding immediate attention. In this case, the water district proposed to dewater areas that could potentially be subject to liquefaction in the event of an earthquake. The excess water was to be pumped out to reduce the hazard as an emergency project. The court, however, ruled that this was not the proper use of this exemption. The imminence of an earthquake is not a condition but a potential event and no real change had yet occurred or could be incontestably foreseen as being mitigated by the proposed actions. The standard of review is there must be substantial evidence in

the record to support the agency findings of an emergency, in this case, the Court found inadequate evidence of imminent danger and the subsequent need for immediate action. This holding is now codified in subsection (c).

15273. Rates, Tolls, Fares, and Charges

(a) CEQA does not apply to the establishment, modification, structuring, restructuring, or approval of rates, tolls, fares, or other charges by public agencies which the public agency finds are for the purpose of:

(1) Meeting operating expenses, including employee wage rates and fringe benefits,

(2) Purchasing or leasing supplies, equipment, or materials,

(3) Meeting financial reserve needs and requirements,

(4) Obtaining funds for capital projects, necessary to maintain service within existing service areas, or

(5) Obtaining funds necessary to maintain such intra-city transfers as are authorized by city charter.

(b) Rate increases to fund capital projects for the expansion of a system remain subject to CEQA. The agency granting the rate increase shall act either as the Lead Agency if no other agency has prepared environmental documents for the capital project or as a Responsible Agency if another agency has already complied with CEQA as the Lead Agency.

(c) The public agency shall incorporate written findings in the record of any proceeding in which an exemption under this section is claimed setting forth with specificity the basis for the claim of exemption.

Note: Authority cited: Section 21083, Public Resources Code; Reference: Section 21080(b)(8), Public Resources Code.

Discussion: This section identifies and interprets the exemption that applies to the adoption of rates, tolls, fares, and other charges. The section spells out the provisions of the statutory exemption for these charges and in summary form provides an interpretation of the kinds of rate increases that still remain subject to CEQA. The section also identifies the requirement to make written findings to support the claim that the rate change falls within the specific exemptions provided in this section. These findings are an unusual requirement with an exemption and need to be highlighted. Granted by the Legislature, they were also subject to constraints enacted by the Legislature.

15282. Other Statutory Exemptions

The following is a list of existing statutory exemptions. Each subdivision summarizes statutory exemptions found in the California Code. Lead agencies are not to rely on the language contained in the summaries below but must rely on the actual statutory

language that creates the exemption. This list is intended to assist lead agencies in finding them, but not as a substitute for them. This section is merely a reference tool.

15284. Pipelines.

(a) CEQA does not apply to any project consisting of the inspection, maintenance, repair, restoration, reconditioning, relocation, replacement, or removal of an existing hazardous or volatile liquid pipeline or any valve, flange, meter, or other piece of equipment that is directly attached to the pipeline.

(b) To qualify for this exemption, the diameter of the affected pipeline must not be increased and the project must be located outside the boundaries of an oil refinery. The project must also meet all of the following criteria:

(1) The affected section of pipeline is less than eight miles in length and actual construction and excavation activities are not undertaken over a length of more than one-half mile at a time.

(2) The affected section of pipeline is not less than eight miles distance from any section of pipeline that had been subject to this exemption in the previous 12 months.

(3) The project is not solely for the purpose of excavating soil that is contaminated by hazardous materials.

(4) To the extent not otherwise required by law, the person undertaking the project has, in advance of undertaking the project, prepared a plan that will result in notification of the appropriate agencies so that they may take action, if necessary, to provide for the emergency evacuation of members of the public who may be located in close proximity to the project, and those agencies, including but not limited to the local fire department, police, sheriff, and California Highway Patrol as appropriate, have reviewed and agreed to that plan.

(5) Project activities take place within an existing right-of-way and that right-of-way will be restored to its pre-project condition upon completion of the project.

(6) The project applicant will comply with all conditions otherwise authorized by law, imposed by the city or county as part of any local agency permit process, and to comply with the Keene-Nejedly California Wetlands Preservation Act (Public Resources Code Section 5810, et seq.), the California Endangered Species Act (Fish and Game Code Section 2050, et seq.), other applicable state laws, and all applicable federal laws.

(c) When the lead agency determines that a project meets all of the criteria of subdivisions (a) and (b),the party undertaking the project shall do all of the following:

(1) Notify in writing all responsible and trustee agencies, as well as any public agency with environmental, public health protection, or emergency response

authority, of the lead agency's invocation of this exemption.

(2) Mail notice of the project to the last known name and address of all organizations and individuals who have previously requested such notice and notify the public in the affected area by at least one of the following procedures:

(A) Publication at least one time in a newspaper of general circulation in the area affected by the proposed project. If more than one area is affected, the notice shall be published in the newspaper of largest circulation from among the newspapers of general circulation in those areas.

(B) Posting of notice on and off site in the area where the project is to be located.

(C) Direct mailing to the owners and occupants of contiguous property shown on the latest equalized assessment roll.

The notice shall include a brief description of the proposed project and its location, and the date, time, and place of any public meetings or hearings on the proposed project. This notice may be combined with the public notice required under other law, as applicable, but shall meet the preceding minimum requirements.

(3) In the case of private rights-of-way over private property, receive from the underlying property owner permission for access to the property.

(4) Immediately inform the lead agency if any soil contaminated with hazardous materials is discovered.

(5) Comply with all conditions otherwise authorized by law, imposed by the city or county as part of any local agency permit process, and to comply with the Keene-Nejedly California Wetlands Preservation Act (Public Resources Code Section 5810, et seq.), the California Endangered Species Act (Fish and Game Code Section 2050, et seq.), other applicable state laws, and all applicable federal laws.

(d) For purposes of this section, "pipeline" is used as defined in subdivision (a) of Government Code Section 51010.5. This definition includes every intrastate pipeline used for the transportation of hazardous liquid substances or highly volatile liquid substances, including a common carrier pipeline, and all piping containing those substances located within a refined products bulk loading facility which is owned by a common carrier and is served by a pipeline of that common carrier, and the common carrier owns and serves by pipeline at least five such facilities in California.

Note: Authority cited: Section 21083, Public Resources Code. Reference: Section 21080.23, Public Resources Code.

Discussion: This section describes the statutory exemption for the inspection, maintenance, repair, restoration, reconditioning, relocation, replacement, or removal

of existing hazardous or volatile liquid pipelines. The Legislature's purpose in creating this exemption was to encourage the upkeep of existing pipelines by limiting the review required of particular activities.

Subsection (b) establishes the criteria under which a pipeline project qualifies for this exemption. These include a prohibition on increasing the diameter of the existing pipeline, limitations on the length of pipeline which may be worked on at any one time, provision of an emergency notification plan to local safety agencies and the California Highway Patrol for their review and agreement, site restoration, and compliance with local, state, and federal environmental laws. Subsection (c) clarifies that the lead agency is responsible for determining that the criteria described in subsection (b) have been met. This exemption is to be invoked by the lead agency, not the project applicant. The project applicant is responsible for providing public notice, obtaining property owner's permission where the pipeline crosses private property, and complying with all regulatory requirements.

APPENDIX D

Supplemental Information on Supply Augmentation Measures

A brief overview of supply augmentation techniques is provided to explain how such measures fit into the overall picture of required water shortage response actions. After a basic understanding of the supply situation is agreed upon, selection of appropriate supply augmentation methods can be made.

Reliable Supply

When a water year (or years) turns out to be very dry, a water supplier needs to make decisions on how much of the available supply to use and how much to carry over into the next year as insurance against possible subsequent dry years. Water demand is often greater during dry years because of the lack of rainfall, higher temperatures, and consequent increased irrigation use.

Urban water suppliers generally can achieve 35 percent reductions with only moderate economic impact and may base carryover levels on the ability to provide 65 percent of normal demand for several years. At a minimum, urban systems should always keep enough reserves to handle residential health and safety needs and potential fire suppression requirements.

In assessing reliable supplies, a water supplier starts with current usable water storage and adds the amount of additional supply expected in the worst year(s) of record (for some watersheds this was 1977 but in much of Southern California is it now 2006-07). This provides a total supply with 95 percent reliability. The amount to be carried over into the next year(s) would then be deducted from the total to yield the reliable supply for the current year. Allowance for evaporation and other losses should be deducted. This quantity would then be the amount available without special action. Because the risk of the next year being the driest on record is small (at least until the season is well underway), most water suppliers choose to define a reliable yield as that which can be obtained in about 90 percent of the years. However, it is useful to be able to make a simple assessment of the water supply situation periodically throughout the rainy season. A so-called “rule curve” is a good tool for this purpose.

A simple graph that a water manager can use to estimate system water delivery capability as a function of runoff (or, in some cases, accumulated reservoir storage levels). There are many potential kinds of such graphs but the simplest relates water year runoff (or projected remaining water year runoff) with project deliveries.

A simple single stream-single reservoir graph would be constructed by adding expected storable and divertible inflow to current starting storage, then subtracting the storage reserve needed at the end of the water year to yield the total amount deliverable.

The storable inflow for more complicated systems may need to be determined from operation studies that simulate monthly operation over a long period of historical record. The resulting annual supply available is plotted on a chart with runoff. Runoff forecasts are updated as the season progresses and the manager has an immediate estimate of water supply from the graph.

More sophisticated forecasting models are now including the potential effect of global climate change in their calculations and estimates.

For large complicated systems, the initial estimate may need refinement or confirmation by more detailed water system operation studies. But larger agencies with more complex supply systems generally have the technical staff to update estimates periodically.

One of the virtues of a graph is that it can show water customers at a glance where their supply system stands as a function of runoff. Water users can readily see how their supply of water relates to the wetness or dryness of the year and it drives home the point that water availability depends on the weather or other often uncontrollable factors, and it is not an assured quantity.

If it is necessary to augment available supplies, many possibilities can be considered. Several supply augmentation measures are described below.

Prepare to Switch to Groundwater Where Possible

Groundwater represents a reserve supply source. Water suppliers can increase groundwater extraction by:

1. Withdrawing previously banked groundwater
2. Drilling new wells
3. Reactivating abandoned wells
4. Deepening existing wells
5. Leasing private wells

For example, by the end of the severe 1984 Texas drought, the city of Corpus Christi developed an additional 25 million gallons per day (MGD) from groundwater wells. Three new city wells produced 2.7 MGD. Another 18.4 MGD came from reactivated wells that had been drilled for a drought during the 1950s. They also made provisions to lease private wells.

The first step is to gather all the data available on groundwater resources in one's district. Review of local experience during the last several drought years can be revealing. Are water tables higher or lower than those periods? How much did they fall in comparison to the amount pumped and natural recharge? To what extent did groundwater substitute for surface supply deficiencies? How much new demand has been added? Has any groundwater overdraft or contamination occurred? Are there

unused wells of marginal water quality that can be used temporarily or by blending with better quality supplies? What kind of problems, if any, developed in previous droughts and what was done to alleviate the problems? For example, added extractions from deeper wells may cause some shallower wells to go dry.

The second step is to ensure that all potentially usable wells are in good working order. Where it can be determined from the data review that groundwater levels will decline so that the well would run dry, consider deepening prior to the months of high demand.

For wells that have not been in use, inspect and prepare them for use. Such preparation might include surging and cleaning the wells as well as pumping to ensure the well is capable of producing water. Rehabilitation of large capacity wells may cost $25,000 each, so purveyors may wish to check what is needed and where services can be obtained but hold back until the water supply is needed. However, be aware that during droughts the demand for new wells and rebuilding old wells exceeds the capacity of well drillers.

The third step is to arrange for power hookups. If many abandoned wells are put back into service, the number of pumps, pump motors, and electrical transformers available for use might be insufficient. In 1977, the lack of transformers was a limiting factor. This may limit the amount of groundwater available for use. An early assessment of the need for groundwater pumping equipment improves the chance of adequate water supply. Also, consider the power needs of the pump motor, including the time needed to provide power hookups. Power could be limited because of reduced hydroelectric power generation. In some cases, diesel or natural gas power may be used to power the pumps.

Another early action that may be available is the relaxation of limits on groundwater pumping in adjudicated basins. There are inherent problems to such action as adjudicated basins are the result of judicial decisions. The procedure for modifying such a decision has to be worked out by the court and the involved parties. Relaxation of controls requiring court approval may not be practicable during dry years. Some decrees, however, include useful mechanisms for responding to dry years. Examples include use of temporary surplus water and the transfer of right to use decreed water.

Water masters usually manage adjudicated basins. The manager of the basin will determine what options are available for responding to dry year conditions. Finally, the accelerated use of imported water stored in an adjudicated basin may be possible. The use of such water will probably be subject to regulation by a water district.

Decrees determine the relative rights to the use of the “safe yield” of an adjudicated basin. Some basins add “temporary surplus” to the amount that may be pumped. “Safe yield” means the average amount of water that may be taken from a basin without damaging that basin.

In most areas of the state, additional groundwater use during a drought is only a temporary source of water supply. Eventually the underground supply must be replenished or the basin may be damaged. Water levels in some basins will recover as

surface supplies replace pumping, but others will require recharge programs to restore water levels.

Interconnections and Transfers

The California Water Code governs the transfer of water from one water user to another. Below are listed the most significant sections of the Water Code a potential water transfer participant should know.

1. Conditional Temporary Urgency Changes (WC 1435)
2. Conventional "Changes in Place of Use" (WC 1700)
3. Notice of Temporary Change (WC 1725)
4. Trial Transfers of Water (WC 1735)
5. Long Term Transfer of Water (WC 1737)
6. Use of State Facilities (WC 1810)

A water transfer, in this context, is an agreement between a supplier that has excess water and makes water available to a water short entity (a willing seller and willing buyer). Normally the infrastructure to move water directly from the seller to the buyer is not available. Usually the infrastructure of the State Water Project (SWP) or the Central Valley Project (CVP) is needed to wheel or move the water. Various circumstances can exist that require an intermediary to be involved in the water transfer. In this case the seller's water is delivered to the intermediary and the intermediary provides water to the buyer. This situation usually exists when the water sold is moving to an area that does not have a "place of use" permit, from the State Water Resources Control Board, or both SWP and CVP facilities are required to move the water.

Specific requirements of any water transfer are dependent on the water rights the water is under. Approvals may be required from the State Water Resources Control Board (SWRCB), California Department of Water Resources (DWR), and United States Bureau of Reclamation; or all of the above agencies. In addition to requirements in the Water Code CVP contractors are subject to provisions of the Central Valley Improvement Act.

Agencies or individuals interested in water transfer should check the following for additional information:

Department of Water Resources: www.watertransfers.water.ca.gov

Dean Reynolds, Water Transfer DWR, 916-651-7055

State Water Resources Control Board: www.waterrights.ca.gov/watertransfer/default.htm

United States Bureau of Reclamation: www.usbr.gov/mp/cvpia/3405a/index.html

Interested parties are encouraged to contact the above agencies for more information. Although the water transfer concept is simple, the details can become quite complex.

Fallow Croplands Temporarily for Added Water Supply

In some areas, farmers are willing to sell water normally used for crops. This would only provide transferable supply in surface water delivery areas where the reduction in use would add to surface water supply. Generally, the amount made available would be the evapotranspiration of the crop (the difference between diversion and return flow and deep percolation).

In 1977, under the Federal Emergency Drought Act, the U.S. Bureau of Reclamation purchased 46,440 acre-feet (AF) of water at prices ranging from $15 to $87 per AF. The average was about $53 per AF. Some 3,900 AF was deducted as an allowance for lost reuse of return flow and wheeling losses. Thus about 42,500 AF was sold to 26 different contractors at an average price of $61 per AF. About 25,500 AF was used to maintain high-value perennial crops and the remaining 21,000 AF was used to support foundation dairy and beef cattle herds, breeding stock and other approved uses.

Most of the supply for the federal programs was from Sacramento Valley irrigators who left rice acreage unplanted; although about 8,000 AF came from the State Water Project out of the water relinquished by SWP Southern California Contractors as part of State system exchanges. Most of the water sold was for use on the west side of the San Joaquin Valley by federal contractors.

The program was entirely voluntary. The U.S. Bureau of Reclamation, as a water broker, bought water from growers and districts that did not need it and sold it to other consumers who faced severe economic losses due to the drought. Little adverse public reaction was noted. The act allowed the Bureau of Reclamation to negotiate water prices but required that there be no undue benefit or profit to the seller. In addition to paying a price sufficient to compensate growers for not growing a crop, (or reducing acreage), an additional sum was paid to compensate other landowners in the service area for added costs incurred because their customary supply from return flow was cut off.

Financial assistance was available for purchase of water through interest-free loans with up to five years to repay. Eighteen of the 26 California Central Valley Project contractors who purchased water under the program opted for the interest-free emergency loans. The loans totaled approximately $2 million out of $2.6 million total sales.

In 1991, the Department of Water Resources established a water bank to provide water to meet critical needs, such as health and safety, fire fighting, maintaining baseline populations of fish, or carry over storage for next year. Water was purchased from willing sellers.

Reduce Nonessential Uses

Using water in ways it is most needed represents an effective form of supply augmentation. The following lists possible sources of diverted water.

Reduce Power Generation

During the 1987 dry year, the San Francisco Water Department maximized reservoir levels by cutting back on hydroelectric power production. Although it cost $30 million in lost power revenues, this action saved the department 360,000 acre-feet of water (at $83.33 per acre-foot).

Limit Aquifer Recharge Programs

During dry periods, aquifer recharge programs (or "groundwater banking") should be suspended and previously "banked" groundwater withdrawn to augment the system's supplies.

Eliminate Recreational Boating

Reservoirs used for recreational boating can be emptied to water levels below boat ramps. Boating should be curtailed until the reservoir refills to an adequate level.

Exploit Unused Surface Water Supplies

These supplies are generally used only in more extreme drought stages because of aesthetic or economic criteria. Sources to consider include large recreational and golf course ponds. Also, dead reservoir storage (water below the out-take) level can be used. This water can be obtained by installing alternate piping and pumping facilities.

Increase Use of Recycled Water

Recycled water is used to irrigate farms, golf courses and other large turf areas; to recharge groundwater; for industrial cooling and processing, toilet flushing, and a variety of environmental purposes. With the uncertainties of drought, examination of opportunities for new recycled water projects and the extension of existing projects is an appropriate part of drought contingency planning.

In order to facilitate future use of recycled water, agencies may consider requiring new construction to be double plumbed to use recycled water.

For more information about recycled water, go to these Web sites: Department of Health Services' Regulations and Guidance for Recycled http://www.dhs.ca.gov/ps/ddwem/waterrecycling/default.htm

http://www.owue.water.ca.gov/

Use of Graywater

In a severe water shortage graywater use allows residential customers to save millions of dollars worth of mature trees and shrubs. The California Department of Water Resources has a Graywater Guidebook available on-line at www.owue.water.ca.gov.

During 1989 Santa Barbara County amended the Building Code Ordinance to allow the use of graywater and the Uniform Plumbing Code has allowed graywater use since 1992. For graywater systems that require modifications to the drain pipe a Building Permit is required.

Graywater can be used for landscape irrigation and includes drainwater from residential showers, bathtubs, bathroom sinks and clothes washers. Plumbed graywater systems use a small surge tank and piping to provide subsurface irrigation water to trees and shrubs. There are no restrictions on the use of graywater for irrigation if it is carried in a bucket. Graywater does not include water that has come in contact with toilet waste, water from kitchen sinks and dishwashers, and laundry water from soiled diapers.

Investigate Blending Poor Quality Water with Good Quality to Stretch Supplies

In some cases blending in marginal quality groundwater can stretch municipal supply.

Weather Modification

Weather modification is widely practiced in California's mountain watersheds, especially in the southern Sierra. Many of the best prospects are in the Sacramento River basin, in watersheds that are not seeded now. The Lahontan regions are already well covered by cloud seeding projects, except for the Susan River. With the exception of the upper Trinity River watershed, and perhaps the Russian River, there is little new potential in the North Coast region because not much extra rainfall could be captured due to limited storage capacity. There is also potential to increase water production by more effective seeding operations in existing projects. Precipitation enhancement should not be viewed as a remedy for drought. Cloud seeding opportunities are generally fewer in dry years. It works better in combination with surface or groundwater storage to increase average supplies. In the very wet years, when sponsors already have enough water, cloud seeding operations are usually suspended.

Some benefits could be achieved from a crash program of cloud seeding in unseeded watersheds. However, amounts would likely be considerably less than from a well designed program of aerial and ground seeding. Water managers who have storage facilities on mountain watersheds probably should seriously consider weather modification and carry out some advance planning for future years. Where potential cloud seeding projects have had considerable past study or have operated in the past, a properly directed aerial cloud seeding program may be able to quickly augment precipitation and runoff to some extent. However, the number of commercial cloud

seeding firms is small and the resources might not be available if there are high demands for new projects in a drought year.

Desalination

Seawater desalting creates a new water supply by tapping the significant supply from the Pacific Ocean. There is additional new water supply possible from desalting oil field production water in the San Joaquin and Salinas valleys and brackish agricultural drainage water in the San Joaquin and Imperial valleys. Desalting wastewater increases the range of beneficial uses for which recycled municipal wastewater can be used. Desalting groundwater allows groundwater of impaired quality to be adequately treated for potable use.

For more information about recycled water, go to this Web site:

www.owue.water.ca.gov

Emergency Supplies

For those communities that are very short of water, emergency supplies may be needed. Although inconvenient, hauling water is a simple expedient for individual residences or small communities. Hauling costs are nominal if distances are short, but can be high if long distances and large quantities of water are involved. It can be hauled with small containers in the family car or to large tank trucks or railroad tank cars. Public health considerations require care in selecting hauling vessels. Tank trucks or containers that have been used for toxic materials must not be used, since it is almost impossible to remove all traces of these materials from containers.

It is interesting to note that, during 1977, several communities with severe water rationing were able to get by with 35 to 50 gallons per capita per day of average residential supply. Goleta's 1989-90 water use averaged 67 gpcd at single family accounts and 49 gpcd at multi-family accounts.

Larger communities may find temporary pipelines practical. Even irrigation sprinkler pipe may work if a suitable source can be found. The State Office of Emergency Services (OES) can provide some assistance. Go to their Web site at http://www.oes.ca.gov for information about their services and regional offices.

APPENDIX E

Drought Reference Materials

This is a list of drought-related publications that provide background information as well as helpful drought management strategies and regulatory requirements related to water shortage contingency programs and water rationing. The publications are listed with the most recently published documents first.

Resource	Author/ Publisher	Publication Year	Description
Water Resources Planning, Manual of Water Supply Practices, M50	American Water Works Association	2007	A brief section titled Drought Management and Water Resources Planning provides a definition of drought and information about interagency coordination, plan development and implementation.
Urban Drought Guidebook	California Department of Water Resources	2008	This guidebook, updated from the 1991 edition, provides a step-by-step approach to developing and implementing drought plans.
Drought and Water Crises: Science Technology and Management Issues	Edited by Donald A. Wilhite	2005	A look at innovative strategies for managing droughts in an international context. Articles in this volume look at case studies from the U.S., Spain, Canada, and China, and draws lessons for future drought management policy.
Water 2025: Preventing Crises and Conflict in the West	U.S. Bureau of Reclamation, www.doi.gov/initiatives/water2025.html	2005	Water 2025 focuses on stretching existing water supplies through collaboration, technology and innovative, market-based solutions. It is designed to produce results and demonstrate investments that can help in preventing crises and conflict in the West.
Emergency Management in California	Governor's Office of Emergency Services, www.oes.ca.gov/Operational/OESHome.nsf/PDF/EMGuide/$file/EMGuide.pdf	2003	This guide describes California's emergency management system and outlines the roles of the public and private entities that contribute to the State's ongoing preparedness, response, recover, and mitigation efforts.

Resource	Author/ Publisher	Publication Year	Description
Drought Indicators and Triggers: A Stochastic Approach to Evaluation	Anne Steinemann, Journal of the American Water Resources Association	2003	A scholarly article presenting a modeling approach for developing and evaluating drought triggers.
Economic Impacts of the Florida Environmental Horticulture Industry, Apr. 2000	Institute of Food and Agricultural Sciences, University of Florida	2002	This article reports the findings of an economic impact study of Florida's environmental horticulture industry in 2000. Included in the study is an evaluation of how drought and water restrictions affected the industry.
Paving Our Way to Water Shortages: How Sprawl Aggravates the Effects of Drought	American Rivers, Natural Resources Defense Council, Smart Growth America; by Betsy Otto, Katherine Ransel, Jason Todd, Deron Lovaas, Hannah Stutzman, and John Bailey.	2002	This study investigates what happens to water supplies when natural areas are replaced with roads, parking lots, and buildings.
Drought Management Handbook	American Water Works Association	2002	This handbook provides water utility managers with a practical guide on how to formulate and implement drought management plans. It describes proven tools, programs, and activities that utilities can use to deal with drought.
Working Toward an Active National Drought Policy, Mar. 2001	Ane D. Deister	2001	This article from the Journal of the AWWA chronicles the creation and later actions of the National Drought Policy Commission.
California Emergency Services Act, 2001	Department of Water Resources	2001	CA Government Code Sections 8550 and CA Water Sections 350 covering Emergency Services and Water Shortage Emergencies in case of natural, manmade, or war-caused emergencies. Covers disaster conditions and insures that preparations within the state will be adequate to deal with such emergencies.

Resource	Author/ Publisher	Publication Year	Description
California Landscaping - Nov/Dec 2001 "Trophy Awards 2001: A Celebration of Excellence in Landscaping"	California Landscape Contractors Association	2001	Article in this issue:- "Are You Ready for the Coming Drought?" Is California teetering on the edge of profound water shortfall that could rival that year's power shortages for economic and social disruption?
Preparing for California's Next Drought: Changes Since 1987-92	California Department of Water Resources	2000	This report reviews items that DWR should consider in near-term drought planning. The report gives an overview of California hydrology and water supply, describes conditions encountered in the 1987-92 drought, summarizes changed conditions since that drought, and recommends actions that the department could take to respond to future drought conditions.
Critical Water Shortage Contingency Plan	Governor's Advisory Drought Planning Panel. Department of Water Resources	2000	This contingency plan was prepared in response to the commitment in the CALFED Bay-Delta Program's Record of Decision that the Governor would convene a panel to develop a "contingency plan to reduce the impacts of critical water shortages primarily for agricultural and urban water users." The report provides background on water supply conditions in California, discusses changes in water management conditions since the 1987-1992 drought, outlines water shortage management challenges, and gives recommendations for action.
Drought Management Planning in Water Supply Systems: Proceedings from UIMP International Course held in Valencia	Enrique Cabrera and Jorge Garcia-Serra, eds. Kluwer Academic Publishers	1999	This book is aimed at water supply engineers, working in utilities and consultancies. The topics include Water Supply Systems Modernization, Drought Management in an Urban Context, and Practical Cases (Israel, USA, Italy, Spain).
Drought Management Policies and Economic Effects in Urban Areas of California, 1987-1992	Lloyd S. Dixon, Nancy Y. Moore, Ellen M. Pint. RAND	1996	This report provides the definition and measurement of the effects of the 1987-1992 drought in urban areas, an analysis of data collected from 85 urban water agencies on drought management strategies and customer responses during the drought, and an analysis of household water demand and consumer surplus losses due to the drought in Alameda County Water District.

Resource	Author/ Publisher	Publication Year	Description
The Value of Water Supply Reliability, Aug. 1994	Barakat and Chamberlin, Inc. -- California Urban Water Agencies	1994	This report summarizes the results of a survey conducted to study residential water shortage economic losses. The report discusses what California residents are willing to pay per household on their water bills to avoid water shortages of varying magnitude and frequency.
Long-Term Water Conservation and Shortage Management Practices: Planning that Includes Demand Hardening	Tabers, Caramanis & Associates for California Urban Water Agencies	1994	"Demand Hardening" reflects the concept that it is harder to obtain demand reductions during water shortages from customers who have already conserved. This publication develops a definition of Demand Hardening and identifies the impacts of Demand Hardening and the other interactions of Long-Term Conservation and Shortage Demand Management measures.
The Impact of Customer Attitude and Physical Variable on Water Use Before, During and After a Drought	Santa Barbara County Water Agency	1993	A research proposal for a residential water demand forecasting research project.
Bay-Delta Hearings - The Economic Cost of Drought-Induced Urban Greenery Losses	Sycamore Associates and Spectrum Economics	1992	This report from CALFED Bay-Delta hearings discusses the one economic impact Santa Barbara's local water authorities could not avoid during the 1980s drought: the effect of the water shortages on Santa Barbara County landscapes.
Drought Management Planning	American Water Works Association	1992	This publication provides water utility managers with a practical guide to the formulation and implementation of drought management plans. The emphasis of this book is on demand-side responses to drought-related water supply emergencies.

Resource	Author/ Publisher	Publication Year	Description
Journal - American Water Works Association - "Conservation," Oct. 1992, Vol. 84, No. 10	American Water Works Association	1992	Articles include:-"Urban Drought Response in Southern California 1990-91"-"Creating Economic Incentives for Conservation"-"Developing a Long-Term Drought Plan for Phoenix"-"Water Demand Monitoring in Austin, Texas"-"Water Audit Encourages Residents to Reduce Consumption"-"Nonresidential Water Conservation: A Good Investment"-"Potential Impact of Water-Efficient Plumbing Fixtures on Office Water Consumption."
The Costs of Water Shortages: Case Study of Santa Barbara	Spectrum Economics and Sycamore Associates. Metropolitan Water District of Southern California	1992	This report outlines some of the ways in which the customers and staff of two water utilities in Santa Barbara County dealt with the immediate problems arising from the 1990 drought. The report also discusses solutions that were found to reduce the water shortage impacts.
Bay Delta Hearings - Economic Impacts of Urban Water Shortages: Summary of Recent Studies	State Water Contractors	1992	This exhibit from Phase II of the Bay-Delta Hearings provides an update regarding the possible economic consequences of decisions by the State Board that would reduce available water supplies to the urban economy of California.
California's Continuing Drought 1987-1991	CA Dept. of Water Resources	1991	This report summarizes the status of the continuing drought as of December 1, 1991 and gives an accounting of actions taken to date. Fish and wildlife were cited as most damaged. After four years of consecutive drought, the State Water Project made no deliveries to agricultural contractors and only 30 percent to urban customers. Federal agricultural contractors received 25 percent and urban contractors 75 percent of deliveries.
Cost of Industrial Water Shortages	William Wade, Julie Hewitt, and Matthew Nussbaum. Spectrum Economics, Inc.	1991	This report discusses the issue of economic impacts of water shortages on the industrial sector. This analysis is based on a survey of industrial plants in California to determine industrial water use patterns, the extent of adopted conservation and the potential for plant production losses and employment reductions associated with reductions in water supplies.

Resource	Author/ Publisher	Publication Year	Description
Industrial/ Commercial Drought Guidebook for Water Utilities	California Department of Water Resources	1991	This guide will assist water utility conservation coordinators help their industrial and commercial customers initiate immediate responses to a drought. The guide outlines effective programs to improve water use efficiency by large nonresidential water users.
Journal - American Water Works Association - 1990 May Conservation," Vol. 82, No. 5	American Water Works Association	1990	Articles include:-"Reducing Water Demand During Drought Years" and -"Operating the Seattle Water System During the 1987 Drought."
Managing Limited Urban Water Supplies: Conference for California Water Agencies	California Dept. of Water Resources	1989	Booklet to accompany the 1989 Conference for California Water Agencies. Topics covered include: Landscape Water Audits, Residentail Water Surveys, Public Information & Water Education, Commercial & Industrial Conservation, Water Rates & Pricing and Preparing for Drought.
Consumer Response to the Drought Media Campaign in Southern California	Planning and Management Consultants, Ltd.	1989	This report describes the results of two telephone surveys of residential water users in Southern California that were designed to measure the impact of Metropolitan Water District's 1988 drought media campaign. The results of a pre-campaign survey can be found in the report "Drought Media Campaign: Analysis of the Pre-Campaign Survey" (PMCL 1988).
Compendium on Water Supply, Drought, and Conservation	Janice A. Beecher, Ann P. Laubach. The National Regulatory Research Institute	1989	A comprehensive and interdisciplinary approach to the consideration of water resource issues and policies.
Consumer Response to Drought	Planning and Management Consultants, Ltd. Metropolitan Water District of Southern California	1988	This report summarizes the findings of a study of factors which govern the consumer adoption of water conservation during drought. The report identifies practical approaches to encourage conservation behavior, evaluates written materials used by water agencies in promoting conservation, reviews drought response plans of U.S. water agencies and recommends specific Drought Plan actions.

Resource	Author/ Publisher	Publication Year	Description
Drought Media Campaign: Analysis of the Pre-Campaign Survey	Planning and Management Consultants, Ltd.	1988	This report describes the results of a survey of residential water users that was conducted prior to the implementation of Metropolitan Water District's 1988 drought media campaign. The results of this survey are used as "baseline" conditions against which the post-campaign survey results are gauged against. These post-campaign survey results can be found in the report "Consumer Response to the Drought Media Campaign in Southern California" (PMCL 1989).
Economic Value of Reliable Water Supplies for Residential Water Users in the State Water Project Service Area, Jun. 9, 1987	Richard Carson and Robert Mitchell. Metropolitan Water District of Southern California	1987	This paper reports economic values for changes in the reliability of water supply. From the perspective of the residential water user, these values reflect the cost of damages expected from a period of water shortage.
Before the Well Runs Dry Volume II: A Handbook on Drought Management	American Water Works Association	1984	This handbook describes a five-step process designed to provide water suppliers and local government officials from small- and medium-sized communities with guidelines on how to develop a contingency plan for coping with drought.
The 1976-1977 California Drought: A Review	CA Dept. of Water Resources	1978	This fifth and final report on the 1976-1977 California drought. Urges Californians not to let up on water conservation efforts, even though the rains have returned.
The Continuing California Drought	CA Dept. of Water Resources	1977	This is the third in a series of reports on the worst California drought in history.

APPENDIX F

Drought-related Web Sites

This is a list of drought-related Web sites that provide a wealth of information from current water supply outlooks to fire conditions and information regarding planning, monitoring, and implementing water shortage programs. Web sites addresses change periodically, so please note the date of this list and look for updates as appropriate.

Web site	Source	Description
U.S. Government Web sites		
http://www.drought.unl.edu/dm/monitor.html	US Drought Monitor, National Drought Mitigation Center, University of Nebraska, Lincoln	Updated weekly, the US Drought Monitor provides a map of the US with a graphic display of the intensity of drought in various regions as well as a summary of conditions throughout the country.
http://drought.unl.edu/	National Drought Mitigation Center, University of Nebraska, Lincoln	NDMC helps people and institutions develop and implement measures to reduce societal vulnerability to drought. The Web site provides a wealth of information, including a definition of drought and climate change, how to plan for drought, monitor it, assess risks and impacts, and mitigate it. Also provides links to state drought plans (http://drought.unl.edu/plan/stateplans.htm).
http://www.drought.noaa.gov/	US Dept. of Commerce, National Oceanic and Atmospheric Administration	NOAA's Drought Information Center provides a wealth of information about drought and climate conditions as well as links to other sites, including state and regional climate centers. Their Drought Calculator shows the amount of rainfall needed to end droughts around the country. The US and Global Climate Perspective section provides up-to-date information.
http://www.weather.gov/oh/hic/current/drought/	National Weather Service Hydrological Information Center	NWS, a unit of NOAA, provides drought statements issued by NEW Forecast Offices and links to state, local, and regional weather and hydrologic sources of information.
http://www.weather.gov/view/states.php?state=CA	National Weather Service: California Data	NWS provides forecasts, weather summaries, climate and hydrological data, warnings and advisories, and fire weather.

Web site	Source	Description
http://www.wrcc.dri.edu/	Western Regional Climate Center (NOAA & Desert Research Institute)	Provides climate and weather information for western US, including climate extremes and major storms on a state-by-state basis.
http://water.usgs.gov/waterwatch/?m=dryw&w=map&r=us	US Geological Survey	Provides US and state maps showing normal seven-day average streamflow compared to historic streamflow for the current day of the year.
http://ca.water.usgs.gov/	US Geological Survey, California Science Center	Provides information on California's rivers and streams. You'll also find information about ground water, water quality, and many other topics.
http://www.usbr.gov/drought/	US Bureau of Reclamation's Drought Program	Provides information about the assistance and planning based upon the Drought Relief Act of 1991 and U.S. Bureau of Reclamation drought program contacts.
www.usbr.gov/lc/region/scao	US Bureau of Reclamation's Southern California Area Office	The U.S. Bureau of Reclamation encourages and facilitates water use efficiency and assists agencies in meeting the demand for limited water resources.
www.usbr.gov/mp/watershare	US Bureau of Reclamation's Mid-Pacific Region	Reclamation's Mid-Pacific Region's Web site includes information on federal reservoir conditions, water releases, recreational area conditions.
http://www.epa.gov/owm/water-efficiency/index.htm	US Environmental Protection Agency	The mission of EPA's WaterSense program is to protect the future of the country's water supply by promoting and enhancing the market for water-efficient products and services.
http://www.usace.army.mil/	US Army Corps of Engineers	This Web site stores technical information on the role of the Corps during declared drought emergencies and disasters.
http://fire.boi.noaa.gov/	US Forest Service	USFS provides fire weather reports and water conditions in national forests.
State of California Web sites		
http://watersupplyconditions.water.ca.gov/	CA Dept. of Water Resources, Drought Preparedness page	DWR's Web page provides links to the state's hydrologic and water supply conditions, information for private well owners, links to local water shortage contingency plans and other drought sites.
http://cdec.water.ca.gov	CA Dept. of Water Resources, California Data Exchange Center	DWR's operational hydrologic data including current river conditions, snowpack status, river stages/flows, reservoir data/reports, satellite images, precipitation/snow, river/tide forecasts, water supply, weather forecast, and statewide water conditions.

Web site	Source	Description
www.owue.ca.gov/urbanplan/index.cfm	CA Dept. of Water Resources	DWR provides access to copies of final Urban Water Management Plans, including local agencies' Water Shortage Contingency Plans.
http://listhost1.water.ca.gov/mailman/listinfo/water_news	CA Dept. of Water Resources	DWR provides a daily compilation of news clips through California Water News, including drought and water supply conditions.
www.watertransfers.water.ca.gov	CA Dept. of Water Resources	This web site provides access to information related to water transfers in the CALFED solution area in which the CALFED agencies are involved.
http://www.climatechange.water.ca.gov/	CA Dept. of Water Resources	DWR provides information about the potential and actual impacts of climate change on California's water resources and links to related Web sites pertaining to the issue.
www.owue.water.ca.gov	CA Dept. of Water Resources' Office of Water Use Efficiency	OWUE offers technical and financial assistance to agencies and the general public.
http://www.oes.ca.gov	CA Office of Emergency Services	OES coordinates the response efforts of state and local agencies in emergencies and disasters. Additionally, OES coordinates the integration of federal resources into state and local response and recovery operations. Its Web site provides information about OES regions and divisions and describes the Standardized Emergency Management System.
http://www.fire.ca.gov	CA Dept. of Forestry and Fire Protection	Provides information about fire conditions, including current major incidents.
http://www.cdph.ca.gov/certlic/drinkingwater/Pages/default.aspx	CA Dept. of Public Health	Regulates drinking water quality safety.
http://www.cpuc.ca.gov/PUBLISHED/REPORT/40495.htm	CA Public Utilities Commission	Provides information about water rationing for PUC regulated investor owned utilities.
http://www.waterrights.ca.gov/watertransfer/default.htm	CA State Water Resources Control Board	Rules for obtaining emergency water appropriations.

Web site	Source	Description
Other Web sites		
www.calwarn.org	Water/Wastewater Agency Response Network (WARN)	Supports and promotes statewide emergency preparedness, disaster response, and mutual assistance matters for public and private water and wastewater utilities. The core of the WARN Web site is its emergency equipment database that matches utility resources to a member's needs during an emergency. A member can locate emergency equipment, such as pumps, generators, chlorinators, and evacuators. and trained personnel (e.g. treatment plant operators) that they may need in an emergency.
www.cuwcc.org	California Urban Water Conservation Council	The Council offers a wide array of information and services including product news, publications, and technical resources to foster implementation of water management practices.
http://www.smartcommunities.ncat.org/management/drought.shtml	Smart Communities Network	This page offers a portal to current news items and events relevant to how communities deal with drought.
http://www.awwa.org/waterwiser/	American Water Works Association/ Alliance for Water Efficiency (AWE)	A shared, Web-based clearinghouse of information regarding drought and water efficiency throughout the US.
http://www.cadroughtprep.net/	California Drought Preparedness	CA Rural Water Association's Web site offers water shortage information specific to small water systems, including links to potential funding sources.
http://www.WaterSavingHero.com	Bay Area water suppliers	This Web site links Bay Area residents to their local water agency's conservation tips and cash rebate information. The campaign is a partnership among Bay Area water suppliers and organizations including the San Francisco Public Utilities Commission, Bay Area Water Supply and Conservation Agency, Santa Clara Valley Water District, Contra Costa Water District, Zone 7 Water District, Bay Area Clean Water Agencies and others.
http://www.sdcwa.org/manage/20GallonChallenge.phtml	San Diego County Water Authority	SDCWA's 20-Gallon Challenge offers a list of conservation tips, from "no cost- easy to do" to "low cost- more effort required" and "higher cost- most effort required.," and provide an estimate of how much water each action can save.

Web site	Source	Description
http://www.scwa.ca.gov/water_conservation/tips.php	Sonoma County Water Agency	In cooperation with Marin and Mendocino county water suppliers, Sonoma County Water Agency offers customers the "Top 10 Water Conservation Tips."
http://www.wmwd.com/enough	Corona Dept. of Water & Power, Eastern Municipal Water District, Elsinore Valley Municipal Water District, Rancho California Water District, Riverside Public Utilities and Western Municipal Water District	This program is similar to the city of Denver's "Use Only What You Need" friendly pledge and "FRE Bs" program that offers their customers free "stuff", like a rubber duckie, t-shirt, shower head, and even a skate board to promote the program: http://useonlywhatyouneed.org/

APPENDIX G

Emergency Drought Funding

This is a list of potential sources of financial assistance for drought programs from State and federal agencies. Funding sources and amounts vary significantly based on water supply conditions and agency budget processes. Generally, the U. S. Bureau of Reclamation and the California Department of Water Resources are the main sources of federal and State drought funding for local water suppliers.

This list (next page) provides a starting point for the exploration of those major funding sources as well as some other possible drought funding sources for local water suppliers. Some funding programs that focus on water use efficiency may be redirected during times of drought. The forms of financial assistance vary by program and include loans, loan guarantees, grants, cost sharing, seed money for projects, subsidized purchases, and direct construction.

Grant Program	Funding Entity	Web site Address	Contact Person	E-mail	Telephone	Eligible Entities	Eligible Projects	Funding-Total	Funding-per project	Cost share
FEDERAL										
Reclamation's States Drought Emergency Act	Reclamation	www.usbr.gov/drought/	Reclamation staff at Regional and Area Offices	listed on Reclamation Web site: www.usbr.gov/main/regions.html	listed on Reclamation's Web site	Water suppliers in states where the governor or Tribal Governing Body has requested drought assistance.	financial and technical assistance to drought plagued areas of the west	$12 million for Fiscal Year 2007	varies	varies
Water 2025 Challenge Grant Program	Reclamation	www.grants.gov	Miguel Rocha	Water2025RFP@do.usbr.gov	303.445.2841	irrigation and/or water districts, State agencies with water management authority, other water deliverers in western US	physical improvement projects that will conserve water and improve water management	Varies by year based upon annual appropriation approved by Congress	$300,000	50%
Water 2025 System Optimization Review Program	Reclamation	www.grants.gov	Miguel Rocha	Water2025RFP@do.usbr.gov	303.445.2481	irrigation and/or water districts, State agencies with water management authority, other water deliverers in western US	reviews of water delivery systems, districts, or basins resulting in a plan of action to improve efficiency and operations	Varies by year based upon annual appropriation approved by Congress	$300,000	50%
Water Conservation Field Services Program	Reclamation Area Offices	www.grants.gov	Area Office staff	listed on Reclamation Web site: www.usbr.gov/main/regions.html	listed on Reclamation Web site	water purveyors that receive water from Reclamation, tribes, universities, states, local governments and non-profit organizations	water management, conservation planning, implement., demonstration of innovative technologies, public education, research	Varies by year based upon annual appropriation approved by Congress	$100K	50%
CALIFORNIA STATE PROGRAMS										
Special California State Drought Funding	DWR	www.owue.water.ca.gov/finance/index.cfm	Manucher Alemi	malemi@water.ca.gov	916.651.9662	yet to be determined: if special drought funding becomes available, it will be posted on this DWR Web site	yet to be determined	yet to be determined	yet to be determined	TBD

Grant Program	Funding Entity	Web site Address	Contact Person	E-mail	Telephone	Eligible Entities	Eligible Projects	Funding-Total	Funding-per project	Cost share
Proposition 50, Chapter 7g: Water Use Efficiency Program	DWR	www.owue.water.ca.gov/finance/index.cfm	Manucher Alemi	malemi@water.ca.gov	916.651.9662	public water districts, local agencies, tribes, non-profit organizations, universities, State & Federal agencies	water use efficiency projects that will provide benefits to the Bay-Delta	$15 million urban, $20 million agric.	varies	varies
Consolidated Grants: multiple state funding programs	SWRCB/ DWR	faast.swrcb.ca.gov/index.html	Erin Ragazzi	enragazzi@waterboards.ca.gov	916.341.5733	varies, public agencies and non-profit organizations eligible for most programs	non-point source pollution control, urban stormwater, integrated watershed management projects, clean beaches initiative	varies	varies	20-25%
Proposition 50, Chapter 8: Integrated Regional Water Management Program	DWR/ SWRCB	www.swrcb.ca.gov/funding/irwmgp/index.html	Tracie Billington	tracieb@water.ca.gov	916.651.9226	public agencies, non-profit organizations	projects to protect communities from drought, protect & improve water quality, reduce dependence on imported water	$380 million	$50k planning, $25 million implement	25% plan, 10% implement
Proposition 50, So. Cal. Projs. to reduce demand on the Colorado River	DHS	dhs.ca.gov/ps/ddwem/Prop50/default.htm					Projects to meet drinking water standards, reduce Colorado River water use	$260 million	$50k - $20 million	
Proposition 84	DWR, SWRCB, DHS	www.waterboards.ca.gov/funding/index.html	pending		pending	pending	sustainable communities, statewide planning, IRWM, etc.	$5.4 billion	pending	pending

APPENDIX H

Water Efficient Landscape Web Sites

This is a list of landscape-related Web sites that provide information for improving landscape water use efficiency and reducing demand. Web site addresses change periodically, so please note the date of this list and look for updates as appropriate.

Web site	Description
www.amwua.org	Arizona Municipal Water Users Association's Water Conservation page includes information about Smartscape, a training program for landscape professionals and other landscape info including plant selection lists, installation tips, demo gardens, watering schedules, and drip irrigation guidelines.
www.anla.org	American Nursery & Landscape Association represents members who grow, distribute and retail plants, providing education, research and public relations services.
www.bewaterwise.com	Sponsored by the Family of Southern California Water Agencies, provides a Southern California Heritage Gardening Guide, a Native Knowledge Hotline, Garden Profiles, Watering Index information, and incentive programs for businesses.
www.cabq.gov/ waterconservation/	City of Albuquerque's Water Conservation page offers xeriscape rebates, services, and information about restrictions and enforcement in their community. Six free xeric design templates produced by local landscape professionals are free to homeowners and businesses. It provides blueprints in creating spectacular landscapes with color, logic, beauty and purpose.
www.californiaoaks.org	California Oak Foundation is a non-profit educational organization committed to preserving the state's oak forest ecosystem and its rural landscapes.
www.cangc.org	California Association of Nurseries and Garden Centers is a professional organization dedicated to the promotion and advancement of the nursery industry.
www.cbia.org	California Building Industry Association, an association of more than 6,000 companies in the homebuilding industry, is working to build a wide variety of new homes up and down the state to house our growing population.
www.ciwmb.ca.gov	California Integrated Waste Management Board offers information about composting, mulch, organic materials and grass cycling.
www.clca.org	California Landscape Contractors Association provides a list of licensed landscape contractors, training and certification programs, and water management information. Includes resource links for installing and caring for California-friendly plants.

Web site	Description
www.cnps.org	California Native Plant Society's mission is to increase understanding and appreciation of California's native plants and to conserve them and their natural habitats. Includes an on-line Manual of California Vegetation, local chapters and plant sales, and lists of botanic gardens and native plant nurseries.
www.cufr.ucdavis.edu	Center for Urban Forest Research, a research station of the USDA Forest Service and The UC Department of Environmental Horticulture demonstrates ways that trees add value to communities, converting results into financial terms to stimulate more investment in trees.
www.cuwa.org/	California Urban Water Agencies offers a set of publications focusing on water conservation and demand management, focusing on the potential and costs of urban water management practices.
www.cuwcc.org	California Urban Water Conservation Council offers a wide array of information and services including a Virtual Home Tour of the Water Saver Home, product news, publications, and technical resources.
www.ebmud.com/conserving_&_recycling/	East Bay Municipal Utilities District offers customers a WaterSmart Residential Landscape Rebate of up to $1,000 for those who convert high-water-using gardens into water conserving landscapes. It also offers landscape irrigation audits and rebates for irrigation equipment upgrades.
www.epa.gov/owm/water-efficiency/index.htm	An overview of U.S. Environmental Protection Agency's Water Efficiency Program, including 'Water-Efficient Landscaping: Preventing Pollution & Using Resources Wisely.'
www.epa.gov/win	U.S Environmental Protection Agency's Watershed Information Network: a roadmap to information services for protecting and restoring water resources.
www.greengardener.org	Santa Barbara's Green Gardener Certification Program educates and certifies local gardeners in resource efficient and pollution prevention landscape management practices. It provides training classes and a list of certified green gardeners.
www.irrigation.org/	Irrigation Association supports the irrigation industry in their efforts to pursue water conservation through efficient irrigation. It provides training and certification to irrigation professionals and foster a communication network among irrigation manufacturers, designers, distributors, contractors, educators, and technicians.
www.irwd.com	Irvine Ranch Water District provides landscape customers with support to stay within their water allocations, based upon current weather data. It offers free irrigation water management software to compare weekly water usage to allocations.
www.isa-arbor.com	International Society of Arboriculture fosters a greater appreciation for trees and promotes research, technology and the practice of arboriculture, including certification credentials.

Web site	Description
www.itrc.org	Irrigation Training and Research Center at California Polytechnic State University- San Luis Obispo provides irrigation training and research services. It offers Landscape Irrigation Auditor and Landscape Water Budget classes.
www.snwa.com	The Southern Nevada Water Authority, with its seven member agencies including the Las Vegas Valley Water District now offers two programs: Water Smart Landscapes and Water Smart Homes, with the Southern Nevada Home Builders Association as a sponsor. Water Smart Homes includes water-efficient landscaping and irrigation systems as well as hot water recirculation systems and water efficient appliances. During the past five years, the Water Smart Landscapes Program has replaced more than 32 million square-feet of turf with xeriscape.
www.marinwater.org/ waterconservation.html	Marin Municipal Water District offers their customers weekly watering schedules, landscape irrigation site surveys, and a list of water efficient landscapers.
www.mwdh2o.com	Metropolitan Water District of Southern California provides conservation tips and information, rebates and incentives including the Protector del Agua training program, a watering calculator, the Southern California Heritage Landscape program, a synthetic turf program and home gardeners water conservation workshops.
www.mwdoc.com	Municipal Water District of Orange County's Web site offers residential landscape seminars, professional landscape training and certification programs, and a Smart Timer weather based irrigation controller rebate program.
www.nctlc.com/	Northern California Turf and Landscape Council and Green Industry Council's Web site.
www.owue.water.ca.gov	California Department of Water Resources' Office of Water Use Efficiency offers financial and technical assistance to agencies involved in water conservation. It hosts CIMIS, the California Irrigation Management Information System, a network of 120 automated weather stations to provide evapotranspiration information to help irrigation scheduling. Information about water recycling and desalination is also available through the office.
www.pacinst.org/	Pacific Institute is an independent think-tank studying issues of development, environment and security. It has produced numerous studies related to water use efficiency potential.
www.sdcwa.org	San Diego County Water Authority provides a landscape calculator, information about xeriscape principles, a water conservation garden and a Smart Landscape (weather based controllers) program to their customers.
www.stopwaste.org/	Alameda County Waste Management Authority provides information about waste and water efficient landscaping practices through two publications, Bay Friendly Landscaping and Bay Friendly Gardening, and local seminars.

Web site	Description
www.swfwmd.state.fl.us/	Southwest Florida Water Management District's extensive source of info on conserving water. Includes on-line library of water conservation research and program model for estimating savings and costs of various water conservation programs.
www.treepeople.org/	Tree People helps restore watersheds and fragile habitats, heals inner-city communities, brings neighbors together, cools and greens campuses and addresses water and energy conservation in the Los Angeles region.
www.turfcouncil.org	Southern California Turfgrass Council promotes education and research for the turfgrass and landscape industries.
www.usbr.gov/lc/region/scao/	U.S. Bureau of Reclamation Lower Colorado Regional Office encourages and facilitates water conservation and assists agencies in meeting demand for limited water resources.
www.usbr.gov/mp/watershare/	U.S. Bureau of Reclamation Mid-Pacific Region's Water Share Web site features Water Wise Gardens of California, information about demonstration gardens throughout the state.
www.water.denver.co.gov/conservation/conservframe.html	Denver Water offers a wide variety of information and assistance for landscape water conservation including tips on tree care in dry climates, residential outdoor self audit of sprinkler systems, and before and after photos of xeriscape conversions.
www.water-ed.org/	Water Education Foundation provides information, publications, tours and briefings about California water including landscape water use.
www.watereuse.org/	WateReuse Association advocates for the beneficial and efficient use of water resources through education, science and technology using recycling, reuse and desalination for the benefit of the public and the environment.
www.waterplan.water.ca.gov	California Department of Water Resources Statewide Water Planning projects future statewide water supply and demand, including landscape water use.
www.wateright.org	Center for Irrigation Technology at California State University, Fresno developed Wateright as a multi-functional, educational resource for irrigation water management. The homeowners and commercial turf growers sections provide tutorials and irrigation scheduling programs.
www.waterwiser.org	American Water Works Association clearinghouse for water conservation research, calendar of conservation events, links to other water conservation info, product info, etc.

APPENDIX I

Water Conservation Programs for Water Suppliers with Unmetered Residential Accounts

Landscape Programs

For Stage 2, restrict landscape irrigation to three times per week; Stage 3, twice per week; Stage 4, once per week or a total ban on sprinkler irrigation, depending on need. Specify which days of the week watering is permitted. Limit irrigation to morning and evening (not between 10 am and 5 pm). Drought patrols should be active during these times to detect broken irrigation equipment, runoff, and other signs of waste. A customer call-in number to report illegal irrigation should be advertised.

- Offer landscape water audits programs.
- Conduct water audits and offer climate appropriate scheduling information.
- Work with local nurseries, landscape architects and contractors, etc. to educate them and the public.
- Establish appropriate landscape requirements for new development, including residential, commercial and industrial hookups.
- Review and change existing requirements or practices, such as banning turf on front yard mounds, turf in median strips, turf required on berms, etc.). DWR has a “Model Water Efficient Landscape Ordinance” available.
- Establish appropriate Landscape Guidelines for Existing Landscapes, including residential, commercial and industrial hookups.
- Establish incentives to convert sprinkler irrigation to low volume irrigation when appropriate.
- Promote graywater use.
- Sponsor seminars on plant selection, that is which to convert to drip, which to save, which to let die.
- Restrict time or days of irrigation. Check agency peak water-energy demand data.
- Prohibit non-recirculating fountains.
- Restrict pool, fountain, and spa water use.
- Require permits for the draining and refilling of swimming pools.
- Provide information on replacing existing landscapes with low water using plants and appropriate irrigation systems. During water shortage is not the best time to re-landscape.

System Measures

- Reduce system pressures.
- Calibrate all production, commercial, industrial, and zone meters.
- Conduct a water audit and leak detection program. This is possible to do without accurate customer usage records by using zone measurements.
- Install meters at key distribution points. This allows subarea flow measurements to be made, and aids in isolating areas of overuse and probable leakage.
- Reduce agency water use. Establish agency policy on water conservation. Demonstrate landscape conservation with water efficient gardens. Reduce employee water use by installing efficient toilets and showerheads, self-closing faucets, on-demand water heaters, etc.
- Loan or install acoustical meters to help customers understand how they use water.

Commercial/Industrial

- Establish percent reduction goals for all commercial and industrial accounts.
- Restrict landscape water use.
- Provide technical assistance for conversion of cooling towers and other industrial water using processes.
- Establish an industrial and commercial audit program.

Information and Public Relations Programs

- Conduct active public information campaigns - 10 to 20 percent reductions can be achieved due to consistent and continuous public information campaigns.
- Conduct active school education programs.
- Conduct active employee water conservation campaign. Ask for suggestions, and offer at-home incentives.
- Conduct high visibility toilet replacement programs, such as board members' homes, schools, visitor and other public toilet facilities.

Interior Residential Programs

- Install flow restrictors on water wasting homes.
- Establish an active toilet replacement program.
- Establish a showerhead replacement program. Coordinate activities with local energy utility and/or wastewater treatment plant.

- Provide information on average water use and establish guidelines to reduce water use.
- Conduct a residential water survey program. Include interior leak detection using acoustical devices, showerhead replacement, leak detection dye tablets and exterior water audit.

Review Building Code Requirements

- Require efficient toilets, low flow showerheads, faucet aerators on house resale or remodeling.
- Design homes for water as well as energy efficiency.
- Consider requiring all new construction to be pre-plumbed for future hook-ups to solar water heating or gray water.
- Require new construction to be double plumbed. Use recycled water wherever it is available or where it will be available.
- Establish recycled and graywater guidelines.

Economics and Rates

- Review agency operational costs, and economic value of new water supply. Also evaluate secondary costs and impacts of energy and sewer.
- Evaluate current rate structure, and change rate structure to higher rates for water shortage response. This may also be an appropriate method to encourage water use reductions if initial agency efforts do not succeed.
- Allow customers to change to metered rate for actual usage.
- Base water rates on lot size.
- Charge extra for pools, spas, or fountains.

APPENDIX J

Sample Emergency Water Shortage Ordinance

ORDINANCE NO. XXX

AN ORDINANCE ENACTED AS AN EMERGENCY MEASURE ESTABLISHING RULES AND REGULATIONS FOR RATIONING WATER DURING A WATER SHORTAGE EMERGENCY AND ESTABLISHING PENALTIES FOR VIOLATIONS THEREOF

THE CITY COUNCIL OF THE CITY OF HAYWARD DOES ORDAIN AS FOLLOWS:

SECTION 1. FINDINGS AND DETERMINATIONS

(a) A water shortage emergency condition prevails within the area served by the Hayward Water System.

(b) The San Francisco Water Department, at the direction of the San Francisco Public Utilities Commission, has requested that all resale customers, including the Hayward Water System, immediately institute a water conservation program designed to effect a [TBD] percent reduction in water usage.

(c) The rules, regulations and restrictions set forth in this ordinance are intended to conserve the water supply of the Hayward Water System for the greatest public benefit with particular regard to domestic use, sanitation and fire protection.

(d) The specific uses prohibited or restricted by this ordinance are nonessential, if allowed, would constitute wastage of Hayward Water System water, and should be prohibited pursuant to the City of Hayward's general authority under its charter as well as the authority granted by State Water Code Section 350 et seq. and the common law.

(e) The actions taken hereinafter are exempt from the provisions of Sections 21000 et seq. of the Public Resources Code as a project undertaken as immediate action necessary to prevent or mitigate an emergency pursuant to Title 14, California Code of Regulations Section 15269 (State CEQA Guidelines).

(f) The following measures are therefore found to be necessary as an emergency measure for preserving the public peace, health or safety.

SECTION 2. DEFINITIONS

(a) The "Hayward Water System" is the Hayward Municipal Water System operated under Divisions of the City of Hayward Public Works Department.

(b) "Director" is Director of Public Works of the City of Hayward.

(c) "Person" means any person, firm, partnership association, corporation, company, organization or governmental entity.

(d) "Customer" means any person, whether within or without the geographic boundaries of the City of Hayward, who uses water supplied by the Hayward Water System.

(e) "Process Water" means water used to manufacture, alter, convert, clean, heat or cool a product, including water used in laundries and recycled car wash facilities.

(f) "Unit of Water" is 100 cubic feet of water.

(g) "Water" is water from the Hayward Water System.

SECTION 3. PROHIBITION OF NONESSENTIAL WATER USE

It shall be unlawful for any person to use water obtained from the Hayward Water System for nonessential uses as hereinafter defined.

SECTION 4. NONESSENTIAL USES DEFINED

The following uses of water are hereby determined to be nonessential, except as further provided herein:

(a) Use of water in excess of those certain allotments set forth in Schedule A entitled "Allotment System For Water Use During Water Shortage Emergency" attached hereto and hereby made a part hereof. Allotments as established herein shall be based on [Year TBD] use with adjustments for unusual conditions. New services or services without [Year TBD] history shall be allotted on comparable customer usage. The City Council is hereby authorized from time to time to establish by resolution allotments different from the allotments set forth in said Schedule A due to changes in circumstances.

(b) Use of water through any meter when the customer has been given 10 days written notice to repair broken or defective plumbing, sprinkler, watering or irrigation systems and has failed to effect such repairs.

(c) Use of water that results in flooding or runoff in gutters or streets.

(d) Use of water through a hand-held hose for washing cars, buses, boats, trailers or other vehicles, unless the hose is equipped with a positive shutoff nozzle.

(e) Use of water through a hand-held hose for washing buildings, structures, sidewalks, walkways, driveways, patios, parking lots, tennis courts, or other hard-surfaced areas.

(f) Use of water for filling any existing or new swimming pool or hot tub.

(g) Use of water to clean, fill or maintain levels in decorative fountains.

(h) Use of water for construction purposes such as consolidation of backfill unless no other source of water or other method can be used.

(i) Service of water by restaurants except upon the request of a customer.

SECTION 5. EXCEPTIONS

Written application for an exception or adjustment may be made to:

Hayward Water System
777 B Street
Hayward, California 94541-5007

The Director may

(a) Grant permits for the uses of water otherwise prohibited or

(b) Adjust the established allotments if it is found that:

(1) To fail to do so would cause an emergency condition adversely affecting the health, sanitation, fire protection, or safety of the customer or the public, or adverse impacts such as loss of production or jobs; or

(2) The customer has demonstrated to the Director's satisfaction that circumstances have changed warranting a change in the customer's allotment.

No permit shall be granted or allotment adjusted unless the customer has adopted all practicable water conservation measures and has demonstrated to the Director's satisfaction that there are no alternatives to the use of water from the Hayward Water System and that Hayward's water will be used efficiently and without waste. The Director's denial of application for an exception or adjustments is final.

SECTION 6. EXCESS WATER USE CHARGE

(a) In addition to regular metered service charges under Section 11-2.38 of the Hayward Municipal Code, every consumer shall pay for each billing period an excess use charge for water delivered in excess of established allotments. This excess use charge shall be based upon a rate schedule as specified from time to time by resolution of the City Council.

(b) The excess use charge shall not apply to any residential customer whose consumption is 1000 cubic feet or less per bi-monthly billing period.

SECTION 7. ENFORCEMENT

(a) Installation of Flow-Restricting Devices: In lieu of or in addition to the penalties provided for in Section 356 of the Water Code, the Hayward Water System may, after one written warning, install a flow-restricting device on the service line of any customer violating any of the provisions of this ordinance, including use of water in excess of the established allotments.

(b) Charges for Installation and Removal of Flow-Restricting Devices: Charges for installation and removal of flow-restricting devices shall be based upon a rate schedule as specified from time to time by resolution of the City Council.

(c) Discontinuance of Water Service: Continued water consumption in violation of the provisions of this ordinance may result in the discontinuance of water service by the Hayward Water System. A charge shall be paid prior to reactivating a service that has been discontinued as provided herein. The charge shall be specified from time to time by resolution of the City Council.

SECTION 8. EFFECTIVE DATE

The findings and determinations set forth in Section 1. hereof constitute the statement of reasons for adopting this ordinance as an emergency measure in the manner provided by Section 617 of the Charger. This ordinance shall be effective immediately.

SECTION 9. OPERATIVE DATE

The requirements of this ordinance shall be operative as of [Date TBD].

INTRODUCED at a regular meeting of the City Council of the City of Hayward, held the [Date TBD], by Councilmember

Sample Escalated Water Rationing Ordinance

ORDINANCE NO. XXX

AN ORDINANCE ENACTED TO ESTABLISH RULES AND REGULATIONS FOR INCREASED WATER RATIONING DURING A WATER SHORTAGE EMERGENCY AND ESTABLISHING PENALTIES FOR VIOLATIONS THEREOF

THE CITY COUNCIL OF THE CITY OF HAYWARD DOES ORDAIN AS FOLLOWS:

SECTION 1. FINDINGS AND DETERMINATIONS

(a) A water shortage emergency condition prevails within the area served by the Hayward Water System.

(b) On [Date TBD), the San Francisco Water Department, at the direction of the San Francisco Public Utilities Commission, requested that all resale customers, including the Hayward Water System, immediately institute a water conservation program designed to effect a [TBD] percent reduction in water usage.

(c) Such action was taken by the City of Hayward's adoption of Ordinance No. [TBD]

(d) On [Date TBD], the San Francisco Water Department, at the direction of the San Francisco Public Utilities Commission, recommended that all resale customers, including the Hayward Water System adopt additional water use restrictions to enhance their water conservation programs.

(e) The rules, regulations and restrictions set forth in this ordinance are intended to conserve the water supply of the Hayward Water System for the greatest public benefit with particular regard to domestic use, sanitation, and fire protection.

(f) The specific uses prohibited or restricted by this ordinance are nonessential, if allowed, would constitute wastage of Hayward Water System water, and should be prohibited pursuant to the City of Hayward's general authority under its Charter as well as the authority granted by State Water Code sections 350 et seq. and the common law.

(g) The actions taken hereinafter are exempt from the provisions of sections 21000 et seq. of the Public Resources Code as a project undertaken as immediate action necessary to prevent or mitigate an emergency pursuant to Title 14, California Administrative Code section 15071 (State of California Environmental Impact Report Guidelines).

(h) The following measures are therefore found to be necessary as an emergency measure for preserving the public peace, health, and safety.

SECTION 1.5 AMENDED PROGRAM

This ordinance supersedes Ordinance No. [TBD]

SECTION 2. DEFINITIONS

(a) The "Hayward Water System" as operated under divisions of the City of Hayward Public Works Department.

(b) "Director" is Director of Public Works of the City of Hayward.

(c) "Person" means any person, firm, partnership, association, corporation, company, organization, or governmental entity.

(d) "Customer" means any person, whether within or without the geographic boundaries of the City of Hayward, who uses water supplied by the Hayward Water System.

(e) "Process Water" means water used to manufacture, alter, convert, clean, heat, or cool a product, including water used in laundries and recycled car wash facilities.

(f) "Unit of water" is 100 cubic feet of water.

(g) "Water" is water from the Hayward Water System.

SECTION 3. PROHIBITION OF NONESSENTIAL WATER USE

It shall be unlawful for any person to use water obtained from the Hayward Water System for nonessential uses as hereinafter defined.

SECTION 4. NONESSENTIAL USES DEFINED

The following uses of water are hereby determined to be nonessential, except as further provided herein:

(a) Use of water in excess of those certain allotments set forth in Schedule A entitled "Allotment System For Water Use During Water Shortage Emergency" attached hereto and hereby made a part hereof. Allotments as established herein shall be based on [Year TBD] use with adjustments for unusual conditions. New services or services without [Year TBD] history shall be allotted on comparable customer usage. The City Council is hereby authorized from time to time to establish by resolution allotments different from the allotments set forth in said Schedule A due to changes in circumstances.

(b) Use of water through any meter when the person billed for the water service has been given 10 days written notice to repair broken or defective plumbing, sprinkler, watering, or irrigation systems and has failed to affect such repairs.

(c) Use of water that results in flooding or runoff in gutter or streets.

(d) Use of water through a hand-held hose for washing buildings, structures, mobile homes, sidewalks, walkways, driveways, patios, parking lots, tennis courts, or other hard-surfaced areas.

(e) Use of water for filling or refilling after draining of any existing or new swimming pool, spa, or hot tub; topping off will be allowed to the extent the designated

allocation is not exceeded. Because it is necessary to fill a swimming pool as part of its construction process, building permits for new pools will not be issued during the current water shortage emergency.

(f) Use of water to clean, fill, or maintain levels in decorative fountains.

(g) Use of water for construction purposes such as consolidation of backfill unless no other source of water or other method can be used.

(h) Service of water by restaurants except upon the request of a customer.

(i) The washing of all vehicles, including but not limited to automobiles, motorcycles, RV's, trucks, transit vehicles, trailers, boats, trains, and airplanes, is prohibited outside of a commercial washing facility. Use of water through a hand-held hose in connection with the exceptions to this use restriction is prohibited unless the hose is equipped with a positive shut-off nozzle.

(j) Verified water waste as determined by the Director will serve as prima facie evidence that the allocation assigned to the water account is excessive; therefore the allocation will be subject to review and possible reduction, including termination of service.

(k) The use of recycled water and for all commercial car washes is strongly recommended.

(l) The use of groundwater and/or reclaimed water for the irrigation of golf courses and similar turf areas is encouraged when approved by the Department of Public Health.

(m) The enforcement of any contractual provision that requires the installation of landscaping requiring irrigation. Nothing in this Section 4 restricts the use of groundwater and/or reclaimed water when otherwise lawful.

SECTION 5. EXCEPTIONS

(a) Written application for an exception or adjustment may be made to:

Hayward Water System
777 B Street
Hayward, California 94541-5007

(b) After written application, the Director may grant permits for the uses of water otherwise prohibited or adjust the established allotments if the Director finds that:

(1) The person billed for the water service has demonstrated that to do otherwise would cause an emergency condition adversely affecting the health, sanitation, fire protection, or safety of the person served or the public, or would result in loss of production or jobs; or

(2) The person billed for the water service has demonstrated to the Director's satisfaction that circumstances have changed, warranting a change in the

allotment. No permit shall be granted or allotment adjusted unless the person billed for the service has adopted all practicable water conservation measures and has demonstrated to the Director's satisfaction that there are no alternatives to the use of water from the Hayward Water System and that Hayward's water will be used efficiently and without waste.

(c) Upon the filing of a written request for an exception, the owner of a multiple residential development or a single-family household shall include a certification that the following water conservation efforts, at a minimum, have been implemented in every toilet and shower in the multiple residential development or single-family household:

(1) All toilet tanks have been tested for leaks with leak detection dye tablets;

(2) A two-quart plastic bag filled with water has been installed in all toilet tanks; and

(3) An approved flow restrictor has been installed in every shower head.

In multiple residential unit developments served by a master meter where the owner does not own the units within the development, the owner shall provide certification under penalty of perjury that a kit containing the equipment for the above described water conservation efforts was delivered to every unit and each unit owner or occupant was urged to install the kits.

(d) The Director's denial of an application for an exception or adjustments is final.

(e) The following service charges or other charges approved from time to time by City Council resolution shall be applied to allotment changes:

(1) Temporary residents – a fee of [Fee TBD] for changing existing allotments;

(2) Adjustments to prior billings – a minimum fee of [Fee TBD] to adjust prior billings.

SECTION 6. EXCESS WATER USE CHARGE

(a) In addition to regular metered service charges under Section 11-2.38 of the Hayward Municipal Code, every person billed for water service shall pay for each billing period an excess use charge for water delivered in excess of established allotments. This excess use charge shall be based upon a rate schedule as specified from time to time by resolution of the City Council.

(b) The excess use charge shall not apply to any residential customer whose consumption is 1000 cubic feet or less per bi-monthly billing period.

(c) In addition to the exception set forth in subsection

(d) and notwithstanding any other provision of law, the Director of Public Works is authorized to adopt rules and regulations providing for waiver of excess use or other charges where their imposition would give rise to a civil right of action against the City by the person billed or would constitute a manifest and gross miscarriage of fairness and equity.

SECTION 7. BANKING OF WATER ALLOCATION

An unused portion of a customer's water allocation during a given billing period may be used in the next billing period to offset excess water usage in that period as provided in rules and regulations promulgated by the Director of Public Works in compliance with direction from the City Council.

SECTION 8. ENFORCEMENT AND PENALTIES

(a) Installation of Flow-Restricting Devices: In lieu of or in addition to the penalties provided for in Section 356 of the Water Code, the Hayward Water System may, after one written warning, install a flow-restricting device on the service line of any customer violating any of the provisions of this ordinance, including use of water in excess of the established allotments.

(b) Charges for Installation and Removal of Flow-Restricting Devices: Charges for installation and removal of flow-restricting devices shall be based upon a rate schedule as specified from time to time by resolution of the City Council.

(c) Reduction or Discontinuance of Water Service: Verified water waste consisting of continued water consumption in violation of the provisions of this ordinance will serve as prima facie evidence that the allotment to the water account is excessive and may result in the reduction or discontinuance of water service by the Hayward Water System. A charge shall be paid prior to reactivating a service which has been discontinued as provided herein. The charge shall be specified from time to time by resolution of the City Council.

(d) Any person or customer violating or failing to comply with the provisions of this ordinance or any code or regulation adopted by reference shall constitute an infraction. Upon conviction of an infraction, a violator shall be subject to payment of a fine, not to exceed the limits set forth in California Government Code section 36900. After a third conviction for a violation of the same provision, subsequent violations within a twelvemonth period may be charges as a misdemeanor. Upon conviction of a misdemeanor, a violator shall be subject to payment of a fine or imprisonment, or both, not to exceed the limits set forth in California Government Code section 36901.

(e) Each violator shall be guilty of a separate offense for each and every day during any portion of which any violation of any provision of this ordinance or of any code or regulation adopted by reference is committed, continued, or permitted by such person, and such person shall be punished accordingly.

(f) Whenever this ordinance or any code or regulation adopted by reference makes any act or omission unlawful, it shall include causing, permitted, aiding, abetting, suffering, or concealing the fact of such act or omission.

(g) Any violation of this ordinance or of any code or regulation adopted by reference shall constitute a public nuisance. In addition to any other remedies provided in this ordinance, the City may summarily abate such nuisance and may bring a civil suit to enjoin or abate the violation.

(h) The remedies provided for herein shall be cumulative and not exclusive.

(i) In addition to the punishment provided by law, a violator convicted of a misdemeanor or an infraction shall be liable for such costs, expenses, or disbursements paid or incurred by the City or any of its contractors in connection with the abatement or prosecution of the violation.

SECTION 9. SEVERABILITY

If any provision of this ordinance is held by any court or by any federal, state, or local agency of competent jurisdiction to be invalid, then said provision shall be considered a separate, distinct, and independent part of this ordinance, and such holding shall not affect the validity and enforceability of all other provisions hereof.

SECTION 10. OPERATIVE DATE

The requirements of this ordinance shall be operative as of xxx, 2005.

INTRODUCED at a regular meeting of the City Council of the City of Hayward, held the [Date TBD], by Councilmember

Sample 50 Percent Water Rationing Ordinance

ORDINANCE NO. XXX

AN ORDINANCE ENACTED AS AN EMERGENCY MEASURE TO ESTABLISH RULES AND REGULATIONS FOR INCREASED WATER RATIONING DURING A WATER SHORTAGE EMERGENCY AND ESTABLISHING PENALTIES FOR VIOLATIONS THEREOF

THE CITY COUNCIL OF THE CITY OF HAYWARD DOES ORDAIN AS FOLLOWS:

SECTION 1. FINDINGS AND DETERMINATIONS

(a) A water shortage emergency condition prevails within the area served by the Hayward Water System.

(b) On [Date TBD], the San Francisco Water Department, at the direction of the San Francisco Public Utilities Commission, requested that all resale customers, including the Hayward Water System, immediately institute a water conservation program designed to effect a [TBD] percent reduction in water usage.

(c) Such action was taken by the City of Hayward's adoption of Ordinance No. [TBD]

(d) The severity of the water shortage has prompted the Governor of the State of California to call upon all communities to adopt water rationing plans to effect a 50 percent reduction in water usage.

(e) On [Date TBD], the San Francisco Water Department, at the direction of the San Francisco Public Utilities Commission, requested that all resale customers, including the Hayward Water System, immediately increase water conservation programs to effect a 50 percent reduction in water usage.

(f) The rules, regulations and restrictions set forth in this ordinance are intended to conserve the water supply of the Hayward Water System for the greatest public benefit with particular regard to domestic use, sanitation, and fire protection.

(g) The specific uses prohibited or restricted by this ordinance are nonessential, if allowed, would constitute wastage of Hayward Water system water, and should be prohibited pursuant to the City of Hayward's general authority under its Charter as well as the authority granted by State Water Code sections 350 et seq. and the common law.

(h) The actions taken hereinafter are exempt from the provisions of sections 21000 et seq. of the Public Resources Code as a project undertaken as immediate action necessary to prevent or mitigate an emergency pursuant to Title 14, California Administrative Code section 15071 (State of California Environmental Impact Report Guidelines).

(i) The following measures are therefore found to be necessary as an emergency measure for preserving the public peace, health, and safety.

SECTION 1.5 AMENDED PROGRAM

This ordinance supersedes Ordinance No. [TBD]

SECTION 2. DEFINITIONS.

(a) The "Hayward Water System" as operated under divisions of the City of Hayward Public Works Department.

(b) "Director" is Director of Public Works of the City of Hayward.

(c) "Person" means any person, firm, partnership, association, corporation, company, organization, or governmental entity.

(d) "Customer" means any person, whether within or without the geographic boundaries of the City of Hayward, who uses water supplied by the Hayward Water System.

(e) "Process Water" means water used to manufacture, alter, convert, clean, heat, or cool a product, including water used in laundries and recycled car wash facilities.

(f) "Unit of Water" is 100 cubic feet of water.

(g) "Water" is water from the Hayward Water System.

SECTION 3. PROHIBITION OF NONESSENTIAL WATER USE

It shall be unlawful for any person to use water obtained from the Hayward Water System for nonessential uses as hereinafter defined.

SECTION 4. NONESSENTIAL USES DEFINED

The following uses of water are hereby determined to be nonessential, except as further provided herein:

(a) Use of water in excess of those certain allotments set forth in Schedule A entitled "Allotment System for Water Use During Water Shortage Emergency" attached hereto and hereby made a part hereof. 3 Allotments as established herein shall be based on [Year TBD] use with adjustments for unusual conditions. New services or services without [Year TBD] history shall be allotted on comparable customer usage. The City Council is hereby authorized from time to time to establish by resolution allotments different from the allotments set forth in said Schedule A due to changes in circumstances.

(b) Use of water through any meter when the person billed for the water service has been given 10 days written notice to repair broken or defective plumbing, sprinkler, watering, or irrigation systems and has failed to affect such repairs.

(c) Use of water that results in flooding or runoff in gutters or streets.

(d) Use of water through a hand-held hose for washing buildings, structures,

sidewalks, walkways, driveways, patios, parking lots, tennis courts, or other hard-surfaced areas.

(e) Use of water for filling or refilling after draining or any existing or new swimming pool, spa, or hot tub; topping off will be allowed to the extent the designated allocation is not exceeded. Because it is necessary to fill a swimming pool as part of its construction process, building permits for new pools will not be issued during the current water shortage emergency.

(f) Use of water to clean, fill, or maintain levels in decorative fountains.

(g) Use of water for construction purposes such as consolidation of backfill unless no other source of water or other method can be used.

(h) Service of water by restaurants except upon the request of a customer.

(i) The washing of all vehicles, including but not limited to automobiles, motorcycles, RV's, trucks, transit vehicles, trailers, boats, trains, and airplanes, is prohibited outside of a commercial washing facility. Notwithstanding the foregoing, the following exceptions apply to this use restriction: washing windows on all vehicles and the use of water to clean commercial or safety vehicles requiring cleaning for health or safety reasons (e.g. garbage trucks, food delivery vehicles, ambulances, etc.). Use of water through a hand-held hose in connection with the exceptions to this use restriction is prohibited unless the hose is equipped with a positive shut-off nozzle.

(j) Water used for all cooling purposes and for commercial car washes unless it is recycled.

(k) The use of potable water on golf courses except for the irrigation of putting greens.

(l) The use of potable water for street sweepers/washers is prohibited.

(m) Notwithstanding contractual or statutory language to the contrary, the use of potable water to irrigate any landscaped areas in developments approved after the effective date of this ordinance. Water meters serving landscaped areas requiring irrigation will not be installed during the current water shortage.

(n) The enforcement of any contractual or statutory provision that requires the installation of landscaping requiring irrigation. Nothing in this Section 4 restricts the use of groundwater and/or reclaimed water when otherwise lawful.

SECTION 5. EXCEPTIONS

Written application for an exception or adjustment may be made to:

Hayward Water System
777 B Street
Hayward, California 94541-5007

After written application, the Director may grant permits for the uses of water otherwise

prohibited or adjust the established allotments if the Director finds that:

(a) The person billed for the water service has demonstrated that to do otherwise would cause an emergency condition adversely affecting the health, sanitation, fire protection or safety of the person served or the public, or would result in loss of production or jobs; or

(b) The person billed for the water service has demonstrated to the Director's satisfaction that circumstances have changed, warranting a change in the allotment; or

(c) The person billed for the water service has demonstrated to the Director's satisfaction that an adjustment in the allotment based upon 60 gallons per day per person in a single-family household or 150 gallons per day in a multifamily living unit is warranted. No permit shall be granted or allotment adjusted unless the person billed for the service has adopted all practicable water conservation measures and has demonstrated to the Director's satisfaction that there are no alternatives to the use of water from the Hayward Water System and that Hayward's water will be used efficiently and without waste.

Upon the filing of a written request for an exception, the owner of a multiple residential development or a single-family household shall include a certification that the following water conservation efforts, at a minimum, have been implemented in every toilet and shower in the multiple residential development or single-family household:

1) All toilet tanks have been tested for leaks with leak detection dye tablets;

2) A two-quart plastic bag filled with water has been installed in all toilet tanks; and

3) An approved flow restrictor has been installed in every showerhead.

In multiple residential unit developments served by a master meter where the owner does not own the units within the development, the owner shall provide certification under penalty of perjury that a kit containing the equipment for the above described water conservation efforts was delivered to every unit and each unit owner or occupant was urged to install the kits. The Director's denial of an application for an exception or adjustments is final. The following service charges or other charges approved from time to time by City Council resolution shall be applied to allotment changes:

1) Temporary residents – a fee of [Fee TBD] for changing existing allotments;

2) Adjustments to prior billings – a minimum fee of [Fee TBD] to adjust prior billings.

SECTION 6. EXCESS WATER USE CHARGE

(a) In addition to regular metered service charges under Section 11-2.38 of the

Hayward Municipal Code, every person billed for water service shall pay for each billing period an excess use charge for water delivered in excess of established allotments. This excess use charge shall be based upon a rate schedule as specified from time to time by resolution of the City Council.

(b) The excess use charge shall not apply to any residential customer whose consumption is 1000 cubic feet or less per bi-monthly billing period.

SECTION 7. ENFORCEMENT

(a) Installation of Flow-Restricting Devices: In lieu of or in addition to the penalties provided for in Section 356 of the Water Code, the Hayward Water System may, after one written warning, install a flow-restricting device on the service line of any customer violating any of the provisions of this ordinance, including use of water in excess of the established allotments.

(b) Charges for Installation and Removal of Flow-Restricting Devices: Charges for installation and removal of flow-restricting devices shall be based upon a rate schedule as specified from time to time by resolution of the City Council.

(c) Reduction or Discontinuance of Water Service: Verified water waste consisting of continued water consumption in violation of the provisions of this ordinance will serve as prima facie evidence that the allotment to the water account is excessive and may result in the reduction or discontinuance of water service by the Hayward Water System. A charge shall be paid prior to reactivating a service that has been discontinued as provided herein. The charge shall be specified from time to time by resolution of the City Council.

SECTION 8. EFFECTIVE DATE

The findings and determinations set forth in Section 1 hereof constitute the statement of reasons for adopting this ordinance as an emergency measure in the manner provided by section 617 of the Charter. This ordinance shall be effective immediately.

SECTION 9. OPERATIVE DATE

The requirements of this ordinance shall be operative as of [Date TBD].

INTRODUCED at a regular meeting of the City Council of the City of Hayward, held the [Date TBD], by Councilmember

Sample Excess Water Use Charges Resolution

HAYWARD CITY COUNCIL

RESOLUTION NO. _____

Introduced by Councilmember

RESOLUTION ESTABLISHING EXCESS WATER USE CHARGES AND ENFORCEMENT CHARGES FOR RATIONING WATER DURING A WATER SHORTAGE EMERGENCY

WHEREAS, by Ordinance No. [TBD] the City Council adopted an emergency ordinance establishing rules and regulations operative [Date TBD], for water rationing during the current water emergency; and

WHEREAS, excess water use charges and enforcement charges shall be based upon rate schedules specified from time to time by resolution of the City Council.

NOW, THEREFORE, be it resolved by the City Council of the City of Hayward that said Council does hereby adopt the following charges:

SECTION 1

In addition to regular meter service charges, charges based upon the amount of water supplied and surcharges under Section 11-2.38 of the Hayward Municipal Code, the following amounts will be charged for water delivered in excess of established allotments.

Excess Use Charges In Addition to All Other Water Charges for All Hayward Water Customers

Excess Use Range	Percent of Water Used In Excess of Allotment	Excess Use Charge per 100 Cubic Feet for all Water Used in Excess of Allotment
A	0% to 10% over allotment	Charges TBD
B	10.01% to 20% over allotment	Charges TBD
C	Over 20.01% over allotment	Charges TBD

SECTION 2.

In accordance with Section 7 of Ordinance No. [TBD] the following charges shall be established for enforcement purposes:

(a) Charges for installation and removal of flow-restricting devices shall be as follows:

Meter Size	Installation Charge	Removal Charge
5/8” to 1”	Charges TBD	
1-1/2” and 2”	Charges TBD	

(b) A charge of [Charge TBD] shall be paid prior to reactivating a service which has been discontinued as provided in Ordinance No. [TBD]

IN COUNCIL HAYWARD, CALIF. ,

ADOPTED BY THE FOLLOWING VOTE:

SCHEDULE A

ALLOTMENT SYSTEM FOR WATER USE DURING
WATER SHORTAGE EMERGENCY

SINGLE FAMILY RESIDENTIAL UNITS:

Allotments to provide for a minimum overall decrease of 50% of [Year TBD] use

(Table 1.)

BI-MONTHLY BILLING-in HCF	% REDUCTION
0 to 10	None
11 to 40	Sliding scale from 5% to 50%
All use over 40	90% all over 40

MULTIPLE RESIDENTIAL UNITS:

DESCRIPTION	REDUCTION
Domestic with irrigation water	50%
Domestic without irrigation water	20%
Irrigation Only Services	90%

COMMERCIAL AND INDUSTRIAL:

Process Water	20%
Domestic Water	50%
Irrigation Only Services	90%

GOVERNMENTAL:

Domestic Water	50%
Irrigation Services	90%

CONSTRUCTION SERVICES:

Allowed by permit only	---

Water from other sources will be used where available

TABLE 1

WATER RATIONING ORDINANCE
RESIDENTIAL SLIDING SCALE

Use in Base Year			Allotment			
Billing (cubic ft)	Gallons	GPD (60 days)	Billing (cubic ft)	Gallons	GPD (60 days)	% reduction
100	748	12	100	748	12	0%
200	1496	25	200	1496	25	0%
300	2244	37	300	2244	37	0%
400	2992	50	400	2992	50	0%
500	3740	62	500	3740	62	0%
600	4488	75	600	4488	75	0%
700	5236	87	700	5236	87	0%
800	5984	100	800	5984	100	0%
900	6732	112	900	6732	112	0%
1000	7480	125	1000	7480	125	0%
1100	8228	137	1033	7727	129	6%
1200	8976	150	1066	7974	133	11%
1300	9724	162	1099	8221	137	15%
1400	10472	175	1132	8467	141	19%
1500	11220	187	1165	8714	145	22%
1600	11968	199	1198	8961	149	25%
1700	12716	212	1231	9208	153	28%
1800	13464	224	1264	9455	158	30%
1900	14212	237	1297	9702	162	32%
2000	14960	249	1330	9948	166	34%
2100	15708	262	1363	10195	170	5%
2200	16456	274	1396	10442	174	37%
2300	17204	287	1429	10689	178	38%
2400	17952	299	1462	10936	182	39%
2500	18700	312	1495	11183	186	40%
2600	19448	324	1528	11429	190	41%
2700	20196	337	1561	11676	195	42%
2800	20944	349	1594	11923	199	43%
2900	21692	362	1627	12170	203	44%
3000	22440	374	1660	12417	207	45%
3100	23188	386	1693	12664	211	45%
3200	23936	399	1726	12910	215	46%
3300	24684	411	1759	13157	219	47%
3400	25432	424	1792	13404	223	47%

Use in Base Year			Allotment			
Billing (cubic ft)	Gallons	GPD (60 days)	Billing (cubic ft)	Gallons	GPD (60 days)	% reduction
3500	26180	436	1825	13651	228	48%
3600	26928	449	1858	13898	232	48%
3700	27676	461	1891	14145	236	49%
3800	28424	474	1924	14392	240	49%
3900	29172	486	1957	14638	244	50%
4000	29920	499	1990	14885	248	50%

All water use over 40 units will be reduced by 90 percent

1 cubic foot + 7.48 gallons

100 cubic foot (HCF) = 748 gallons

APPENDIX K

Example Forms and Calculations

This appendix provides a collection of example forms and calculations that a water supplier can use as ideas when developing their own drought program. Each supplier has a distinct set of conditions to consider when facing dry conditions. These forms and calculations are intended only as examples that can be tailored to the particular needs of the water supplier. Any numbers or quantities contained in these forms reflect only sample data.

Appendix K includes:

1. Software Capabilities for Billing, Rates and Rationing
2. Sample Supply Projections
3. Essential Health and Safety Calculations
4. Sample Reductions by Customer Type and Priority
5. Water Rationing Stages and Triggering Mechanisms
6. Allotment Methods
7. Example - Calculating Hybrid Allotment for Stage 2
8. Example - Calculating Hybrid Allotment for Stage 3
9. Example – Calculating Hybrid Allotment for Stage 4
10. Hybrid Allotment Calculation Method
11. Calculations for Determining Seasonal Adjustments
12. Effects of hybrid allotments on conserving and non-conserving households
13. Effects of hybrid allotments on households with varying number of residents
14. Effects of seasonal distribution of allotments on conserving and non-conserving households
15. Effects of seasonal distribution of allotments on households with varying numbers of residents
16. Sample Bill Calculations – uniform rates and tiered rates
17. Sample Customer Assistance Computer Screen - Commercial
18. Sample Customer Assistance Computer Screen – Residential
19. Residential Water Use Efficiency Audit
20. Residential Water Use Efficiency Audit Recommendations
21. Appeal Process

Software Capabilities for Billing, Rates and Rationing

Many water suppliers do not have utility billing system software that provides the necessary capabilities to store and manipulate data and revise rates structures and bill formats. Many utility billing systems do not the capability to provide the customer with information about their current or past water use, or to print messages on the bill.

A supplier's ability to manage a water shortage depends upon good historic and current data and an ability to communicate rate changes, allocations and excess use charges with customers. If a supplier's billing and data management software does not provide the following capabilities the software may need to be replaced as soon as possible.

On the next page is a list of minimum software capabilities necessary for professional water management.

Capability	Quickly/Easily Modified	Supplier Controlled
Can the software manage a tiered billing system?		
Can rate tiers be modified?		
Can tiers be added or removed?		
Can the system estimate revenue changes due to rate changes?		
Can the tiered rate structure integrate meter size? (i.e., different tiered rate block sizes by meter size)		
Can the system integrate conservation elements and estimated revenue impacts? The system can be set to give discounts to customers who use less and also add a surcharge to customers who over use. To find out the effects of this change could be done the same as question 4		
Can the customer classifications be modified?		
Can the supplier define prior period usage to generate specified date ranges (i.e., prior quarter, previous year, previous 5-year average) and show on bill?		
Can the supplier define future period targeted use or allocations to generate specified date ranges (i.e., next month, next quarter, next year) and show on bill? This would be used for landscape water budgets, water shortages, etc.		
Can the system generate excess-use charges during rationing		
Can the system integrate customer details:		
Parcel size? (i.e., acreage, acres irrigated, etc.) Can the supplier establish fields that can be tied to the parcel, use, soil type, customer, etc.		
Landscape size, plant type, irrigation type, etc.		
Participation in conservation program(s)		
Participation in one or more rebate programs		
Irrigation water budget by month and year		
Rationing allocation by month and year		
Maintain minimum 5-year water use history		
Special need/ rate/ or class customer		
Can the software link multiple dwelling units per meter? This could be used to link individually metered multi-family units with common-area landscape meters, etc		
Can the system link costs of water to different water sources?		
Can costs be coded as variable or fixed?		
Can meters be identified as indoor, outdoor, restricted, etc.?		
Can the system provide the customer with information about their current or past water use, or to print messages on the bill?		

Sample Supply Projections

PROJECTED SUPPLY INFORMATION - without supplemental water (AF)					
Source	**Normal**	**2008**	**2009**	**2010**	**2011**
Local Surface	10,000	8,000	6,000	4,000	2,000
Groundwater	2,200	2,600	2,600	2,200	2,000
Imported	2,100	630	420	420	420
Recycled Water			500	1,000	1,500
Total	14,300	11,230	9,520	7,620	5,920
% shortage		21%	33%	47%	59%
Average Demand	14,000				
Needed Additional Supply			1,500	3,000	4,000
New Total			11,020	10,620	9,920
% Supply Shortage			23%	26%	31%

PROJECTED SUPPLY INFORMATION - with supplemental water (AF)					
Source	**Normal**	**2008**	**2009**	**2010**	**2011**
Local Surface	10,000	8,000	6,000	4,000	2,000
Groundwater	2,200	2,600	2,600	2,200	2,000
Imported	2,100	630	420	420	420
Recycled Water			500	1,000	1,500
Water Transfer			1900	3800	5500
Total	14300	11230	11420	11420	11420
% Shortage		21%	20%	20%	20%

Essential Health and Safety Calculations with Graywater Contribution to Landscape Irrigation Water Availability

Allocated water use is 50 gallons per capita per day				
	Non-conserving fixtures		Conserving fixtures	
Toilets	4 flushes x 3.5 gpf=	14.0	5 flushes x 1.6 gpf =	8.0
Shower/bath	5 min x 3.0 gpm =	15.0	5 min x 2.5 gpm =	12.5
Clothes washer	1/3 load	11.0	1/3 load	6.0
Kitchen/dishwasher	5 gpcd	5.0	4 gpcd	4.0
bathroon sinks	4 gpcd	4.0	4 gpcd	4.0
Inside TOTAL (gpcd)		49.0		34.5
Landscape use		1.0		15.5
Total purchased (gpcd)		50.0		50.0
Available graywater (bath, clothes washer, sinks)		30.0		22.5
Total landscape water from each resident (gpcd)		31.0		38.0
Total landscape water from four residents (gpd)		124		152

Allocated water use is 40 gallons per capita per day				
	Non-conserving fixtures		Conserving fixtures	
Toilets	3 flushes x 3.5 gpf =	10.5	5 flushes x 1.6 gpf =	8.0
Shower / bath	5 min x 2.5 gpm =	12.5	5 min x 2.5 gpm =	12.5
Clothes washer	1/4 load	8.0	1/3 load	6.0
Kitchen / dishwasher	5 gpcd	5.0	4 gpcd	4.0
bathroon sinks	4 gpcd	4.0	4 gpcd	4.0
Inside Total (gpcd)		40.0		34.5
Landscape use		-		5.5
Total purchased (gpcd)		40.0		40.0
Available graywater (bath, clothes washer, sinks)		24.5		22.5
Total landscape water from each resident (gpcd)		24.5		
Total landscape water from four residents (gpd)		98		112

Sample Reductions by Customer Type and Priority

Customer type - AF							
Priority	**Residential**	**Comm/ Indust**	**Ag - Perm**	**Recreation**	**Ag - Annuals**	**Total**	
"Average use"	9,000	1,800	2,600	600	600	14,600	
Health & Safety (50 gpcd)	5,600	100	0	0	0	5,700	
Commercial	0	1,250	0	0	0	1,250	
Ag - Perm	0	0	2,100	0	0	2,100	
Landscape/Ag	900	100	0	400	400	1,800	STAGE II
New Connections	0	0	0	0	0	0	Available Supply
TOTAL (AF)	6,500	1,450	2,100	400	400	10,850	10,950
% reduction	28%	19%	19%	33%	33%	26%	25% reduction

Priority	**Residential**	**Comm/ Indust**	**Ag - Perm**	**Recreation**	**Ag - Annuals**	**Total**	
"Average use"	9,000	1,800	2,600	600	600	14,600	
Health & Safety (50 gpcd)	5,600	100	0	0	0	5,700	
Commercial	0	1,220	0	0	0	1,220	
Agric - Perm	0	0	1,900	0	0	1,900	
Landscape/Ag	200	0	0	200	200	600	STAGE III
New Connections	0	0	0	0	0	0	Available Supply
TOTAL (AF)	5,800	1,320	1,900	200	200	9,420	9,490
% reduction	36%	27%	27%	67%	67%	35%	35% reduction

Priority	**Residential**	**Comm/ Indust**	**Ag - Perm**	**Recreation**	**Ag - Annuals**	**Total**	
"Average use"	9,000	1,800	2,600	600	600	14,600	
Health & Safety (40 gpcd)	4,500	80	0	0	0	4,580	
Commercial	0	1,180	0	0	0	1,180	
Agric - Perm	0	0	1,810	0	0	1,810	
Landscape/Ag	0	0	0	0	0	0	STAGE IV
New Connections	0	0	0	0	0	0	Available Supply
TOTAL (AF)	4,200	1,260	1,810	0	0	7,270	7,300
% reduction	53%	30%	30%	100%	100%	50%	50% reduction

Sample Water Rationing Stages and Triggering Mechanisms Including Surface, Groundwater and Imported Supplies

Supply Shortage	Demand Reduction Goal	Triggering Mechanisms
10%	Stage I - 10% reduction Can be achieved through a voluntary program	• Dry year (based on local, regional or state standard) • Supply is 90-99% of "normal" • Ground water overdraft exists
10% - 20%	Stage II – 10% - 20% reduction Usually achieved through a mandatory program	• Dry or critically dry year • Supply is 80-90% of "normal" • 1 year change in ground water storage exceeds 5 year average annual decline by more than 20% • Contamination of 10% of ground water supply (exceeds primary drinking water standards)
20% - 35%	Stage III - 20% - 35% reduction Always a mandatory program	• Second dry or critically dry year • Supply is 65-80% of "normal" • 1 year change in ground water storage exceeds 5 year average annual decline by more than 40% • Contamination of 20% of ground water supply (exceeds primary drinking water standards) • Disaster loss of 20-35% of supply

Allotment Methods
(all can be seasonal)

1. **Percent Reduction Allotment (all account types)**
   - Positives
     - Useful for non-residential - vary reductions based on efficiency
     - Easy to determine allotment and administer program
     - Good to establish minimum/maximum amounts to limit extremes
   - Negatives
     - Penalizes conservers
     - Rewards "above average" users
     - Promotes water use during non-shortage periods
2. **Financial Rationing (all account types)**
   - Positives
     - Market determines water uses, avoids allotments
   - Negatives
     - Relates water use to income
     - Residential tiers are based on average number of occupants
     - Large number of appeals
     - Difficult to set non-residential tiers
3. **Per Connection Allotment (residential only)**
   - Positives
     - Easy to establish allotments
   - Negatives
     - No relationship between customer characteristics and water use
     - Not equitable
     - Doesn't recognize historic use
4. **Per Capita Allotment (residential only)**
   - Positives
     - Suitable for extreme shortages
     - Equitable, can base allotment and sewer charges on number of residents
   - Negatives
     - Doesn't recognize historic use
     - Must determine and update per account occupancy
     - Water for essential inside use only
5. **Hybrid Per Capita/Percentage Allotment (residential only)**
   - Positives
     - Equitable - recognizes variety of uses
     - Flexibility - suitable to all stages
     - Provides customers greatest control
     - Recognizes water use factors like climate, lot size and economics
   - Negatives
     - Additional staff / computer work to determine allotments
     - Requires more public education
6. **Specific Use Restrictions - unmetered areas (Guidebook - Appendix I)**

EXAMPLE
Calculating Hybrid Allotment for Stage 2

Sample Priority Allotment for Residential – Stage 2

The water supplier has 80% of average supply available and is in a Stage 2 shortage.

Average year residential account water demand = 8,400 AF

Water available for residential accounts in Stage II = 7,100 AF

1. Residential accounts "health & safety" allotment

   (68 gpcd)*(75,000 people)*(365 days)=(1,861,500,000 gallons/325,851 gallons)≈ 5,700 AFY

   Health & safety" allotment per single family account (assumes four residents)

   (68 gpcd)*(4 people)=(272 gpd)*(365 days)=(99,280/748)≈ 132 HCF per year

   Health & safety" allotment per multi-family account (assumes three residents)

   (68 gpcd)*(3 people)=(204 gpd)*(365 days)=(74,460/748)≈ 102 HCF per year

2. Additional water available for residential add-on

   Available res. water – "health & safety" res. allotment = non-essential add-on

   7,100 AF – 5,700 AF = 1400 AF

   Normal use – "health & safety" = normal non-essential water use

   8,400 AF – 5,700 AF = 2,700 AF

   (Residential add-on/normal non-essential use)= percentage non-essential add-on

   (1,400 AF/2,700 AF)≈ 50% of normal non-essential use available

EXAMPLE
Calculating Hybrid Allotment for Stage 4

Sample Priority Allotment for Residential – STAGE 4

The water supplier has 50% of average supply available and is in a Stage 4 shortage.

Average year residential account water demand = 8,400 AF

Water available for residential accounts in Stage IV = 4,500 AF

1. Residential accounts "health & safety" allotment

   (50 gpcd*75,000 people)*(365 days)=(1,368,750,000 gallons/325,851 gallons) ≈ 4,200 AFY

   "Health & safety" allotment per single family account (assumes four residents)

   (50 gpcd)*(4 people)=(200 gpd)*(365 days)=(73,000/748) ≈ 98 HCF per year

   "Health & safety" allotment per multi-family account (assumes three residents)

   (50 gpcd)*(3 people)=(150 gpd)*(365 days)=(54750/748) ≈ 72 HCF per year

2. Additional water available for residential add-on

   Available res. water – "health & safety" res. allotment = non-essential add-on

   4,200 AF – 4,200 AF = 0 AF

   Normal use – "health & safety" = normal non-essential water use

   8,400 AF – 4,200 AF = 4,200 AF

   Residential add-onnormal non-essential water use = percentage non-essential add-on

   (0 AF/4,200 AF) = 0% of normal non-essential use available

Calculations for Determining Seasonal Admustments

Conserving household - Single family with 4 residents

2006-07 average yearly water use = 182 HCF

	State 2	Stage 3	Stage 4	(50%)
Basic Single Family allot. (68 gpcd)	132	132	108	(54 gpcd)
Available Add-on	+25 (50%)	+10 (20%)	+0	
Yearly Allotment	157 HCF	142	108	
Reduction	14%	22%	40%	

Specific Example – conserving household

Bill Every Two Months	2003	2004	2005	2006	2007	Average
Nov-Dec	22	25	26	24	23	24
Jan-Feb	19	20	22	21	18	20
Mar-Apr	22	28	32	30	23	27
May-Jun	34	36	40	36	34	36
Jul-Aug	36	40	42	38	34	38
Sep-Oct	34	37	40	38	36	37
Annual use	167	186	202	187	168	182 HCF

1. Winter billing period average use

Nov-Dec	Jan-Feb	Mar-Apr	Winter Avg	Winter Avg	Min. Allot	Difference
24	+20	+27=(71/3)	≈ 24 HCF	24	-22 =	2 HCF

2. Summer billing period average use

May-Jun	Jul-Aug	Sep-Oct	Summer Avg	Summer Avg	Minimum Allotment	Difference
36	+38	+37=(111/3)	= 37 HCF	37	-22	= 15HCF

3. Seasonal Adjustment factor

(Winter difference/Summer difference) = percentage of winter use versus summer use

(2/15) ≈ 11% Summer = 90% Winter = 10%

Non-essential add-on is divided 90% to summer billing periods and 10% to winter periods.

Effect of Hybrid Allotments on Conserving and Non-conserving Households

NON-CONSERVING HOUSEHOLD - Single family with 4 residents

2006-07 average yearly water use = 332 HCF

	Stage 2	Stage 3	Stage 4 (50%)
Basic Single Family allot. (68 gpcd)	132	132	108 (54 gpcd)
Available Add-on	100 (50%)	40 (20%)	0
Yearly Allotment (HCF)	232	172	108
Reduction	30%	48%	67%

MEDIUM-CONSERVING HOUSEHOLD - Single Family with 4 residents

2006-07 average yearly water use = 232 HCF

	Stage 2	Stage 3	Stage 4 (50%)
Basic Single Family allot. (68 gpcd)	132	132	108 (54 gpcd)
Available Add-on	50 (50%)	20 (20%)	0
Yearly Allotment (HCF)	182	152	108
Reduction	22%	34%	53%

CONSERVING HOUSEHOLD - Single Family with 4 residents

2006-07 average yearly water use = 182 HCF

	Stage 2	Stage 3	Stage 4 (50%)
Basic Single Family allot. (68 gpcd)	132	132	108 (54 gpcd)
Available Add-on	25 (50%)	10 (20%)	0
Yearly Allotment (HCF)	157	142	108
Reduction	14%	22%	40%

Effect of Hybrid Allotments on Conserving and Non-conserving Households

NON-CONSERVING HOUSEHOLD - Single family with 4 residents

2006-07 average yearly water use = 332 HCF

	Stage 2	Stage 3	Stage 4 (50%)
Basic Single Family allot. (68 gpcd)	132	132	108 (54 gpcd)
Available Add-on	100 (50%)	40 (20%)	0
Yearly Allotment (HCF)	232	172	108
Reduction	30%	48%	67%

MEDIUM-CONSERVING HOUSEHOLD - Single Family with 4 residents

2006-07 average yearly water use = 232 HCF

	Stage 2	Stage 3	Stage 4 (50%)
Basic Single Family allot. (68 gpcd)	132	132	108 (54 gpcd)
Available Add-on	50 (50%)	20 (20%)	0
Yearly Allotment (HCF)	182	152	108
Reduction	22%	34%	53%

CONSERVING HOUSEHOLD - Single Family with 4 residents

2006-07 average yearly water use = 182 HCF

	Stage 2	Stage 3	Stage 4 (50%)
Basic Single Family allot. (68 gpcd)	132	132	108 (54 gpcd)
Available Add-on	25 (50%)	10 (20%)	0
Yearly Allotment (HCF)	157	142	108
Reduction	14%	22%	40%

Effect of Hybrid Allotments on Households with Varying Number of Residents

Single family with 4 residents

	Stage 2 (50% Available)		Stage 3 (20% available)		Stage 4 (no additional)	
2006-07 average use	Allot.	% reduced	Allot.	% reduced	Allot.	% reduced
182 HCF	157 HCF	14%	142 HCF	22%	108 HCF	40%
232 HCF	182 HCF	22%	152 HCF	34%	108 HCF	53%
332 HCF	232 HCF	30%	172 HCF	48%	108 HCF	67%

Single family with 8 residents

	Stage 2		Stage 3		Stage 4	
2006-07 average use	Allot.	% reduced	Allot.	% reduced	Allot.	% reduced
182 HCF	228 HCF	0%	228 HCF	0%	204 HCF	0%
232 HCF	230 HCF	1%	229 HCF	1%	204 HCF	12%
332 HCF	280 HCF	16%	249 HCF	25%	204 HCF	39%

Multiple residential - 10 units assuming 3 residents in each unit (master meter)

	Stage 2		Stage 3		Stage 4	
2006-07 average use	Allot.	% reduced	Allot.	% reduced	Allot.	% reduced
820 HCF	840 HCF	0%	840 HCF	0%	720 HCF	12%
1020 HCF	930 HCF	9%	876 HCF	14%	720 HCF	29%
1220 HCF	1030 HCF	16%	916 HCF	25%	720 HCF	41%

Effects of Seasonal Distribution of Allotments on Conserving and Non-conserving Households

NON-CONSERVING HOUSEHOLD - Single family with 4 residents

2006-07 average yearly water use = 332 HCF

	Stage 2	Stage 3	Stage 4 (50%)
Yearly Allotment	232 HCF	172	108
Adjusted Summer Months	25	17	9
Adjusted Winter Months	14	12	9
Monthly Minimum (HCF)	11	11	9

MEDIUM-CONSERVING HOUSEHOLD - Single family with 4 residents

2006-07 average yearly water use = 232 HCF

	Stage 2	Stage 3	Stage 4 (50%)
Yearly Allotment	182 HCF	152	108
Adjusted Summer Months	18	14	9
Adjusted Winter Months	12	11	9
Monthly Minimum (HCF)	11	11	9

CONSERVING HOUSEHOLD - Single family with 4 residents

2006-07 average yearly water use = 182 HCF

	Stage 2	Stage 3	Stage 4 (50%)
Yearly Allotment	157 HCF	142	108
Adjusted Summer Months	15	13	9
Adjusted Winter Months	11	11	9
Monthly Minimum (HCF)	11	11	9

Effects of Seasonal Distribution of Allotments on Households with Varying Numbers of Residents

Single family with 4 residents

	Stage 2		Stage 3		Stage 4	
2006-07 average use	Sum	Winter	Sum	Winter	Sum	Winter
182 HCF	15	11	13	11	9	9
232 HCF	18	12	14	11	9	9
332 HCF	25	14	17	12	9	9

Single family with 8 residents

	Stage 2		Stage 3		Stage 4	
2006-07 average use	Sum	Winter	Sum	Winter	Sum	Winter
182 HCF	19	19	19	19	17	17
232 HCF	19	19	19	19	17	17
332 HCF	28	19	22	19	17	17

Multiple Residential - Ten units assuming 3 residents in each unit

	Stage 2		Stage 3		Stage 4	
2006-07 average use	Sum	Winter	Sum	Winter	Sum	Winter
820 HCF	70	70	70	70	60	60
1020 HCF	100	70	82	70	60	60
1220 HCF	133	70	95	70	60	60

Sample Bill Calculations
Showing Excess Water Use Charges

Agency with a uniform rate structure

Customer's allotment is 22 HCF for this bi-monthly billing period

Tier	Rate	HCF	Amount Billed
Normal	$1.39	22	$30.58
Excess 1	$8.00	2	$16.00
Excess 2	$20.00	0	$0.00
	Water use	24	$48.58

Excess Tier 1 (101-140%) applies to water use from 23 to 31 HCF

Excess Tier 2 (141% +) applies to all water use from 32 HCF on up

Excess Tiers 1 and 2 apply to excess use during rationing periods.

Agency with a four tier rate structure

Customer's allotment is 22 HCF for this bi-monthly billing period

Tier	Rate	HCF	Amount Billed
Essential	$0.90	9	$8.10
Tier 2	$1.35	9	$12.15
Tier 3	$1.80	4	$7.20
Tier 4	$2.25	0	$0.00
Excess 1	$9.00	2	$18.00
Excess 2	$22.50	0	0
	Water use	24	$45.45

Essential tier applies only to residential accounts

Single family account receives nine HCF per tier per bi-monthly bill

Multi-residential unit receives seven HCF per tier per bi-monthly bill

Excess 1 tier applies to excess use during rationing.

Excess 2 tier applies to third consecutive excess use during rationing

Providing Customer Allotment and Billing Information
Sample Commercial Computer Screen

Rationing Inquiry

Active

172-058-0 **Commercial**

(office building) **5000 Rhoads Ave.**

Periods	HCF used	ALLOT	5-Year Average	Amount Billed	Amount Normal
Apr-May	43	40	49	$96.75	$76.50
Jun-Jul	40	48	58	$69.75	$69.75
Aug-Sep	37	48	57	$63.00	$63.00
Oct-Nov	39	48	54	$67.50	$67.50
Dec-Jan	28	40	48	$42.75	$42.75
Feb-Mar	26	40	45	$38.70	$38.70
Totals	213	264	311	$378.45	$358.20

Inspection Date

Potential Flow Restrictor? NO

Exceeded Allotment 1 Time(s) Command 3 = 2006-2007

Calculations for April/May Bill as shown above

Agency has a four tier rate structure

Essential tier applies only to residential accounts

Excess 1 tier applies to excess use during rationing periods.

Excess 2 tier applies to third consecutive excess use period during rationing.

	Rate	HCF	Amount Billed	Amount Normal	
Essential	$0.90	-			
Tier 2	$1.35	18	$24.30	18	$24.30
Tier 3	$1.80	9	$16.20	9	$16.20
Tier 4	$2.25	13	$29.25	16	$36.00
Excess 1	$9.00	3	$27.00	0	$0.00
Excess 2	$22.50	0	----	0	----
		43	$96.75	43	$76.50

Providing Customer Allotment and Billing Information
Sample Residential Computer Screen

Rationing Inquiry

Active

172-712-6 **Single Family**

Susan Smith **264 Puente Ave.**

Periods	HCF used	ALLOT	5-Year Average	Amount Billed	Amount Normal
Apr-May	24	22	23	$45.45	$31.05
Jun-Jul	32	30	36	$61.20	$47.70
Aug-Sep	34	30	38	$133.20	$52.50
Oct-Nov	24	30	35	$31.05	$31.05
Dec-Jan	20	22	27	$23.85	$23.85
Feb-Mar	18	22	21	$20.25	$20.25
TOTALS	152	156	180	$315.00	$206.40

Inspection Date

Potential Flow Restrictor? Yes

Exceeded Allotment 3 Time(s) Command 3 = 1989-90

Actual yearly use was less than yearly allotment so excess charges were refunded.

Agency sent customer refund check for $108.60 at the end of rationing year.

Calculations for April/May Bill as shown above

Agency has a four tier rate structure

Essential tier applies only to residential accounts

Excess 1 tier applies to excess use during rationing periods.

Excess 2 tier applies to third consecutive excess use period during rationing.

Sample
Residential Water Use Efficiency Audit

Date _____ Account # _____ Meter # _____

Name _____ Address _____ Zip Code _____

Daytime Phone # _____ Evening Phone # _____

BILLING INFORMATION

Bill Date	HCF	Reasonable Use
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

	HCF		
Current Meter Reading	_____	Date	_____
Last Meter Reading	_____	Date	_____
Amount Used	_____	Days	_____
Average Daily Use	_____		

ESSENTIAL DOMESTIC WATER USE INFORMATION

Inside Water Pressure _____ psi Outside Water Pressure _____ psi

Number of full-time residents _____ Fruit Trees _____ Horses _____

		Number					Leaks Detected
Toilets	1.6 gpf	_____	3.5 gpf	_____	5-7 gpf	_____	
Showerheads	2.5 gpm	_____	> 2.5 gpm	_____			
Faucets	Aerated	_____	Non-aerated	_____			

NON-ESSENTIAL DOMESTIC WATER USE INFORMATION

Water Softener o Yes o No o Exchange

Cycles per week _____ Brand _____ Model No. _____

RO Unit o Yes o No Automatic shut-off o Yes o No o Not working

Pool/Spa o Yes o No Pool Cover o Yes o No o Not used

How often is water added to the pool? _____

Irrigation Water Use Information

Automatic	No. of Stations	_____	Cycles per week	_____	Length of cycle	_____
Manual	Times per week	_____	Length of Cycle	_____	Shut-off reminder	_____
Turf	Area	_____ ft^2	Condition	_____	Soil Moisture	_____

Comments & Recommendations _____

_____

_____

_____

Minimal changes are required to convert this form to Commercial and Institutional

Sample
Providing Customer Allotment and Billing Information
Sample Commercial Computer Screen

Residential Water Use Efficiency Audit Recommendations

For questions or help, call **(hotline)**

INDOOR WATER USE INFORMATION

Install:	o Efficient Toilets	o Efficient Showerheads	o Faucet Aerators
Repair Leaks:	o Toilets	o Showerheads	o Faucets
Change:	o R.O. Unit Call Dealer to install automatic shut-off valve		o Water Softener Call Dealer to reset timer

OUTDOOR WATER USE INFORMATION

Irrigation:	o Repair system	o Reset timer	o Allow lawn to brown
Fruit Trees:	o Mulch	o Install drip irrigation	o Contact Farm Advisor
Pool/Spa:	o Cover pool	o Repair	

Comments _____

_____

Inspector _____ Date _____

Water Meter Information

Read water meter(s) at the same time each day. Numbers to the right of the decimal point on the dial of the water meter(s) are in Hundred Cubic Feet (HCF). 1 HCF = 748 gallons.

Determine Water use Goal: (reasonable use may be a rationing allotment or individual goal)

Current Water Meter Reading		1075.23	HCF
Reasonable Use for 61 days	+	24.00	HCF
Target Water Meter Reading	=	1099.23	HCF

$$\text{Water Use per Day} = \left(\frac{24\text{ HCF}}{61\text{ days}}\right) = .39\text{ HCF}\left(\frac{748\text{ gallons}}{1\text{ HCF}}\right) = 292\text{ gallons per day (gpd)}$$

Determination of Actual Use: (make these calculations as often as necessary)

Your Present Water Meter Reading		1075.23	HCF	Date	7/13/07
Your Last Water Meter Reading	–	1058.59	HCF	Date	6/11/07
Amount of Water Used	=	16.64	HCF	Days	32 days

Current Water Use per Day: $\left(\frac{16.64\text{ HCF}}{32\text{ days}}\right) = .52\text{ HCF}\left(\frac{748\text{ gallons}}{1\text{ HCF}}\right) = 387\text{ gpd}$

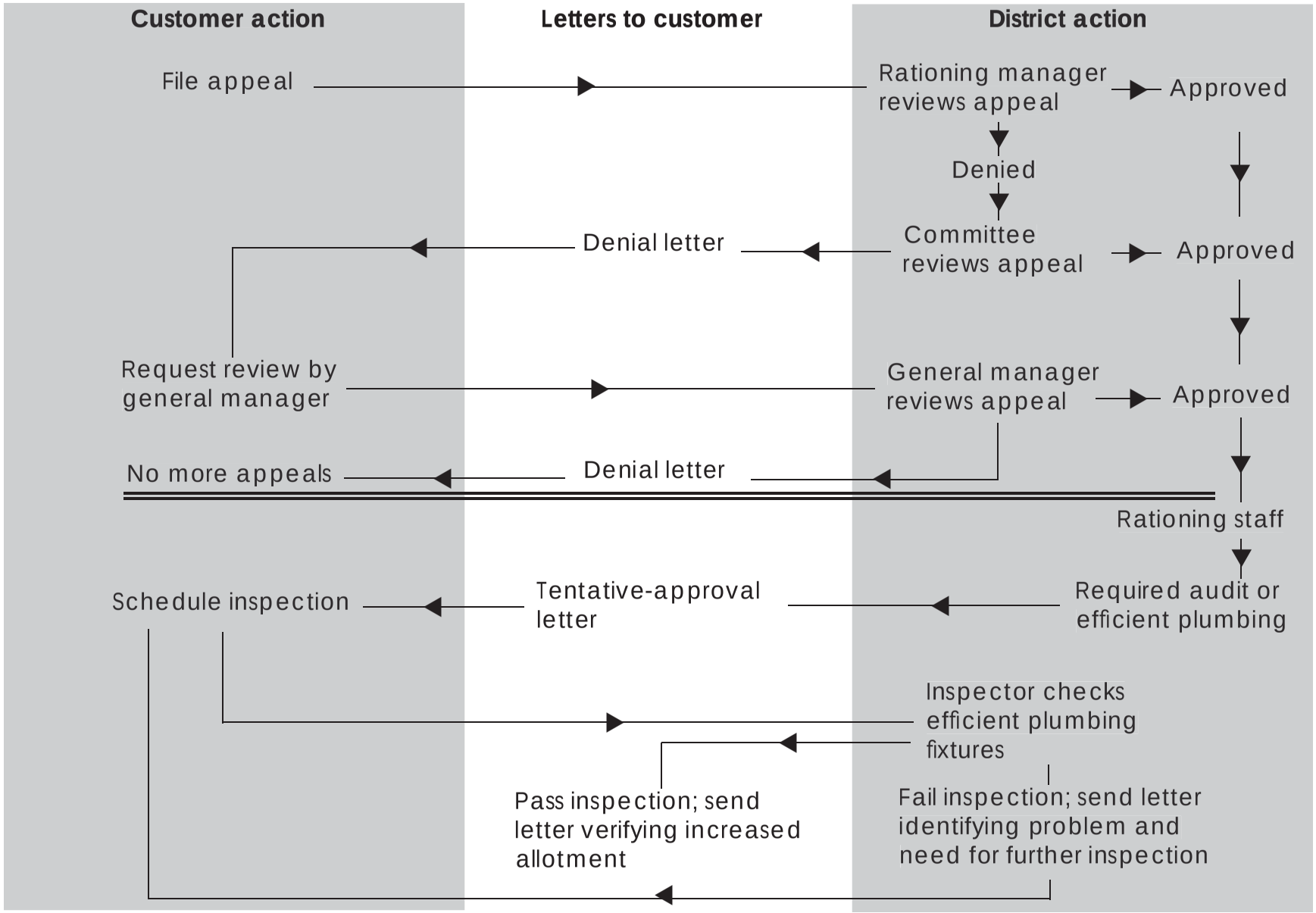
Current Water Use per Week: 7 days X 387 gpd = 2,709 gallon per week

Projected Water Use in 61 days at Present Rate: 31.72 HCF

Excessive Water use Per Day 387 gpd (actual use) – 292 gpd (target use) = 95 gpd

Minimal changes are required to convert this form to Commercial and Institutional

Appeal Process



U. S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

California
Urban Water
Conservation
Council

DEPARTMENT OF WATER RESOURCES
STATE OF CALIFORNIA