SANTA BARBARA COUNTY WATER PURVEYORS

Bradbury Dam

WATER SHORTAGE CONTINGENCY / DROUGHT PLANNING HANDBOOK

Final, subject to revision
September 2007

Guidelines and Tables for Preparing a Water Shortage Contingency / Drought Plan

United States Bureau of Reclamation Water Shortage Contingency/Drought Planning Handbook

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ACKNOWLEDGEMENTS

This handbook contains a compilation of resources from a variety of sources. Portions of the text were excerpted from the Urban Drought Guidebook published by the California Department of Water Resources and updated in 1991. The majority of tables found in this handbook were derived from forms developed by the Department of Water Resources for preparation of Urban Water Management Plans (UWMP) and Water Shortage Contingency Plans Year 2000 (Please note that the 2005 version of the UWMP guidebook was changed significantly and the table numbers will no longer correspond to those listed in this handbook). The American Water Works Association's Drought Management Handbook was also used to help develop this handbook.

The Concept of Drought*

Drought is a normal, recurrent feature of climate, although many erroneously consider it a rare and random event. It occurs in virtually all climatic zones, but its characteristics vary significantly from one region to another. Drought is a temporary aberration; it differs from aridity, which is restricted to low rainfall regions and is a permanent feature of climate.

Drought is an insidious hazard of nature. Although it has scores of definitions, it originates from a deficiency of precipitation over an extended period of time, usually a season or more. This deficiency results in a water shortage for some activity, group, or environmental sector. Drought should be considered relative to some long-term average condition of balance between precipitation and evapotranspiration (i.e., evaporation + transpiration) in a particular area, a condition often perceived as "normal". It is also related to the timing (i.e., principal season of occurrence, delays in the start of the rainy season, occurrence of rains in relation to principal crop growth stages) and the effectiveness (i.e., rainfall intensity, number of rainfall events) of the rains. Other climatic factors such as high temperature, high wind, and low relative humidity are often associated with it in many regions of the world and can significantly aggravate its severity.

Drought should not be viewed as merely a physical phenomenon or natural event. Its impacts on society result from the interplay between a natural event (less precipitation than expected resulting from natural climatic variability) and the demand people place on water supply. Recent droughts in both developing and developed countries and the resulting economic and environmental impacts and personal hardships have underscored the vulnerability of all societies to this "natural" hazard.

***Excerpted from** the National Drought Mitigation Center, University of Nebraska, Lincoln.*

Overview

This handbook has been prepared to assist local urban water districts with the preparation of a drought or water shortage contingency plan. It is a planning and implementation guide that will help districts define the conditions under which a water shortage exists. This handbook will also help guide districts in developing a list of specified actions that will be taken in response to a shortage. The forms, sample materials, references, resources, and background information used in this handbook are compiled from a variety of sources including water resource planning assistance documents prepared by the California Department of Water Resources, the Army Corps of Engineers, and the Western Drought Coordination Council, as well as the County Water Agency. This handbook provides a template for preparation of a water shortage contingency plan.

Districts can take advantage of the information provided in this handbook to prepare for a water shortage condition, but can also use the template to guide them through a water shortage condition already underway. Any district already experiencing a drought condition should select the most recent average year for use as the "Average Year" in the worksheets and then use the information for the current year under "Current Year" in the worksheets for planning purposes.

*Note: Throughout this handbook the word "district" is typically used to refer to water suppliers. Other terms, such as purveyor and agency, are also used. They all refer to "a supplier of water to urban customers".

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*Many of the tables and Tables contained in this document were adapted from the forms used to complete an Urban Water Management Plan.

I

INTRODUCTION

In this handbook you will examine ways to prepare your district for water shortages, and identify specific actions your district can take to prevent shortages or to respond to them when they occur. The most effective water shortage response effort begins long before a water shortage occurs. In order to respond most effectively, water districts need to consider all options in preparing for and responding to water shortages.

A. Background

Past Droughts

Historical records show that local drought periods of several years or more are cyclical, recurring about every forty years. Tree ring studies covering time periods of several centuries reveal apparent droughts lasting as long as 16 years or more. Current records show droughts in Santa Barbara County have lasted an average of five years.

In a general sense, the impacts of drought result from the interplay between a natural event (less precipitation than expected resulting from natural climatic variability) and the demand people place on water supply. The impacts of drought are intensified in areas that are entirely dependent on one water supply, particularly if that supply is surface water. Additional sources of supply allow water purveyors to coordinate the management of the different supplies to increase the total overall yield of an individual supply. For example, wet year water held in a surface reservoir can be stored by injection or surface recharge in the groundwater basin to increase dry year supplies.

Drought of 1986-91

The most recent drought occurred from 1986 until 1991 and included some of the driest years on record. The drought had serious impacts on water users and the environment. Statewide, farmers lost or could not plant crops, forests were damaged and many trees died, urban water users were forced to conserve unprecedented amounts of water, and fisheries suffered from greatly reduced flows in rivers and lowered reservoir levels. The Central Coast region of California (Monterey, San Luis Obispo and Santa Barbara counties) was particularly hard hit by the drought.

The impact of the drought on the Central Coast was intensified by the fact that water purveyors in San Luis Obispo and Santa Barbara counties were entirely dependent on local water supplies at the time the drought occurred. Hardest hit were areas relying on local surface reservoirs, as some groundwater users were able to make up the supply deficit by increased pumping. By late 1989, the City of Santa Barbara's Gibraltar Reservoir was completely empty. Lake Cachuma, the primary regional water supply reservoir which serves several communities in the Santa Barbara area, was drawn down to only 14% of capacity by February 1991, its lowest level since the lake first filled in 1957.

In response to this critical water supply situation, several water purveyors on the South Coast of Santa Barbara County (Goleta Water District, City of Santa Barbara, Montecito Water District) adopted drought emergency measures, and water use restrictions were implemented. Together, these three entities served approximately 180,000 people and some agricultural users. Each of these purveyors developed distinct and yet similarly effective water conservation programs. They also cooperated on innovative public education programs to reduce water demand.

As the drought progressed, rationing, penalty rates, and prohibition of certain water uses caused water demand to drop dramatically. Local residents faced and met the challenge of saving water with impressive results; water demand in both the Goleta and Santa Barbara service areas was approximately 40% below normal in 1990 and 1991.

In addition to efficiency, some communities sought relief with expensive, and in some cases short-term, water supplies. The City of Santa Barbara, in a joint effort with several other local purveyors, commissioned construction of a temporary desalination facility, which has since been converted to a permanent part of the City's water supply. A number of water purveyors on the South Coast also cooperated in constructing an emergency water supply pipeline to "wheel" water from the State Water Project (SWP) into southern Santa Barbara County, via Los Angeles and Ventura Counties. This project utilized local entitlements to water from the SWP, which had not been exercised up to that point in the absence of a delivery system.

Demand reduction, however, was the most significant local response to the drought. Per capita water demand fell in some months to 55% below normal. The amount of water conserved by customers was more than double the amount provided by alternative water supplies. This dramatic reduction also had a downside: a substantial reduction in anticipated revenue to the water purveyors. One challenge facing water purveyors after the drought was how to determine the long-term effects of the drought on demand (demand hardening), and to adopt appropriate water rate structures, which would balance water demands with operational costs. Water rates after the drought included the cost of new water supplies developed to provide a buffer against future droughts, such as the State Water Project and desalination. As a result of the difficulties experienced in the 1986-91 drought, local water purveyors teamed with the County to evaluate which responses worked, and which didn't. Resources Section 6 summarizes the lessons learned in that extended drought.

Overview of Water Shortage/Drought Planning in California

Much of California enjoys a Mediterranean-like climate with cool, wet winters and warm, dry summers. On average, 75 percent of the State's average annual precipitation of 23 inches falls between November and March, with half of it occurring between December and February. Floods and droughts occur often, sometimes in the same year. Therefore, planning for water shortages is essential.

The U.S. Bureau of Reclamation, the State of California Department of Water Resources and the CALFED Governor's Advisory Drought Planning Panel's Critical Water Shortage Contingency Plan require water purveyors in California to prepare plans for addressing water shortages for state and federal planning purposes and to be eligible to participate in various water shortage relief programs.

The Reclamation States Emergency Drought Relief Act of 1991 Title II: Drought Contingency Planning Section 202 authorizes the Secretary of the Interior, acting pursuant to Federal Reclamation

law, utilizing the resources of the Department of the Interior, and in consultation with other appropriate Federal and State officials, Indian tribes, public, private, and local entities, to prepare or participate in the preparation of cooperative water shortage contingency plans for the prevention or mitigation of adverse effects of drought conditions. Section 203 states that elements of the contingency plans prepared pursuant to section 202 may include, but are not limited to, any or all of the following:

1. Water banks.
2. Appropriate water conservation actions.
3. Water transfers to serve users inside or outside authorized Federal Reclamation project service areas in order to mitigate the effects of water shortage.
4. Use of Federal Reclamation project facilities to store and convey non-project water for agricultural, municipal and industrial, fish and wildlife, or other uses both inside and outside an authorized Federal Reclamation project service area.
5. Use of water from dead or inactive reservoir storage or increased use of ground water resources for temporary water supplies.
6. Water supplies for fish and wildlife resources.
7. Minor structural actions.

The State of California's Urban Water Management Planning Act was enacted in 1985 and requires urban water suppliers serving 3,000 acre-feet of municipal/industrial water per year or 3,000 urban customers, to prepare a comprehensive urban water management plan (UWMP) addressing their current and projected water sources/supplies, water uses, supply reliability, comparison of supply and demand, water demand management (conservation) programs, wastewater recycling and water shortage contingency planning.

In addition, the CALFED Drought Contingency Plan (December 2000) prepared by the Governor's Drought Advisory Panel, outlines a Critical Water Shortage Reduction Marketing Plan, which would provide a water market for agencies experiencing critical water shortages. Criteria for participation in the water marketing program include demonstrating that the purchasing agency has taken appropriate steps to prepare for critical water shortages.

These legal requirements, along with the benefits of avoiding impacts associated with water shortage provide ample incentive for local agencies to prepare a water shortage contingency plan. In an effort to provide specific guidelines for completing a plan, the United States Bureau of Reclamation, South Central California Area Office in Fresno, and the Santa Barbara County Water Agency have developed the following handbook. Water districts can develop a water shortage contingency plan for their agency by completing each of the tables provided.

B. Using This Handbook

This handbook is organized as a series of steps that will assist a water purveyor in completing a water shortage plan. The steps include:

1. Outlining water supply and demand
2. Using information from Step 1 to project water supply shortages
3. Planning for Shortages and Mitigating Impacts
4. Developing a Public Outreach Campaign to ensure customers are aware of supply issues

5. Reviewing how shortages could affect revenue and expenditures
6. Finalizing and adopting your water shortage plan.

To facilitate the completion of each step, tables are provided to organize information for water shortage planning. In addition, a number of references and resources for further information are included to guide water purveyors and other entities that may be able to assist in the development of a water shortage plan.

C. Adopting Your Plan

Once you have completed all of the tables, you will have all of the materials and information necessary for a complete water shortage plan for your district. The next step is to compile the plan in a manner that will be the most useful for you district. Then your district should officially adopt the plan so that it can be implemented as soon as it becomes apparent that a water shortage is imminent. The steps listed below provide a guide for adopting your plan.

1. Announce through local media that draft copies of your water shortage plan are available for review.
2. Set Public Meeting dates to provide the public with a forum for providing comments.
3. Incorporate comments into the draft Water Shortage/Drought Plan to create your Final Plan.
4. Adopt the Water Shortage/Drought Plan through an ordinance.
5. Send official copies of your plan to the Bureau of Reclamation, the California Department of Water Resources, and neighboring water districts.
6. Implement your plan through an aggressive public information campaign.
7. Develop administrative procedures to ensure enforcement of the restrictions outlined in your plan.

II

WATER SUPPLY AND WATER DEMAND INFORMATION
(Getting Started)

In this section you will compile information about your district's current and future water supplies and customer demand. You will determine an average year, and then, beginning with the current year, prepare projections for future years in five year increments. You may set these increments so that they correspond to the dates used in your Urban Water Management Plan, which is updated every five years (2005, 2010, etc).

To develop future water supply and demand projections you will need to: know how many service connections you have, know the amount and source of water available to your district in the future (you can incorporate information from your district's long range water supply plan), understand past water use trends, and obtain information regarding future population growth in your service area.

You will also need to be sure to include all regulatory and legal requirements that affect your supplies including minimum flow rates for streams, species habitat requirements, and reservoir conservation requirements. The data included in these tables will be used in later sections to develop a worst-case water shortage scenario and to understand the financial impacts of reduced water sales on the district.

(Note: These tables were adapted from *City of New Albion, California 2000 Urban Water Management Plan,* which is the sample plan for preparing an Urban Water Management Plans developed by the State of California, The Resources Agency, Department of Water Resources. If you have already prepared an Urban Water Management Plan, you can use that plan as a reference as you complete your drought plan. Many of the tables reference in the footnotes the tables from the Urban Water Management Plan from which you can transfer the applicable information into the tables in this document.)

Water Supply Information

Table 1 - Complete the following table by inserting information regarding all supplies available to your agency. For projections, using five year increments, be sure to include anticipated reductions due to factors such as seawater intrusion, contamination, land subsidence, and siltation.

Table 1

Available Water Supplies* (Shown in Calendar Years)					
SOURCE*	**Current Year** (specify)	**Average Year** (specify)	**Five Years Later** (specify)	**Ten Years Later** (specify)	**Fifteen Years Later** (specify)
Surface Water					
1.					
2.					
3.					
Groundwater					
Recycled Wastewater					
Imported Water					
State Water Project					
Sales to Other Agencies					
Totals					
*Units of Measure: Acre-feet/Year					

**See Glossary for further explanation of categories*
SOURCE: Table 3 of Urban Water Management Plan 2000

Information on Service Connections

Table 2 - Complete the following table by filling in the number of service connections by customer class served by your agency. For projections please use the number of additional dwelling units that will be added in the next 5 or 10 years based on local community or land use plans. If your district uses designations for customer classes than those listed, please substitute the customer class types that your district currently uses.

Table 2

Number of Service Connections By Customer Type* **(Shown in Calendar Years)**				
Customer Sector	**Current Year** (specify)	**Five Years Later** (specify)	**Ten Years Later** (specify)	**Fifteen Years Later** (specify)
Single Family				
Multi-Family				
Commercial				
Industrial				
Institutional/Public				
Recreation				
Landscape				
Agriculture				
Total				

**See Glossary for further explanation of categories*
SOURCE: Table 6 of Urban Water Management Plan 2000 Including Historical Information

Water Demand Information

Table 3 - Complete the following table by filling in the total amount of water sold by customer class for each year listed. For projections, use estimates of new developments from community plans as described for Table 2, and population figures as outlined in Table 4 below. If your district uses designations for customer classes other than those listed, please substitute the customer class types that your district currently uses. Also, if your district has an existing water efficiency program, please refer to Section IV, Part B for information on Demand Hardening due to existing water efficiency programs before you calculate demand for future years. For more information on water savings for water efficiency programs visit **www.cuwcc.org**.

Table 3

Past, Current and Projected Water Demand (Deliveries)* (Shown in acre-feet per Calendar Year)						
Customer Sector	**Drought Year** (specify)	**Average Year** (specify)	**Current Year** (specify)	**Five Years Later** (specify)	**Ten Years Later** (specify)	**Fifteen Years Later** (specify)
Single Family						
Multi-Family						
Commercial						
Institutional/Public						
Industrial						
Recreation						
Agriculture						
Landscape						
Unaccounted Loss						
Other						
Total						

SOURCE: Table 5 of Urban Water Management Plan 2000

Population and Per-Capita Demand Information

Table 4 - Complete the following table by entering current and projected population levels. Utilize one of the methods below to project population changes. To determine per-capita demand for each year, determine total water sales to urban customers (in gallons) - adding together residential, institutional, industrial, commercial, and recreational deliveries as listed in Table 3 - and divide this figure by the total population within your service area for each year (See text below for information on population figures for future years). Then divide that amount by 365 (days in a year) to determine gallons per person per day - or per-capita demand.

Table 4

Population and Per-Capita Demand				
	Current Year	**Five Years Later**	**Ten Years Later**	**Fifteen Years Later**
Population*				
Per-Capita Demand (gallons per person per day)				

*SOURCE: Table 2 of Urban Water Management Plan 2000

Methods for Determining and Projecting Population

It can be difficult to determine a precise number of people living in your service area. There are a number of ways to estimate population within the boundaries of a water district and several sources of information (local planning agency or association of governments, local county assessor's office, California Department of Finance, your district's records of metered accounts) to guide you in developing this information. You will need to determine the best method to use depending on the availability of information in your community and whether or not your district serves a city or an unincorporated area within the local county. The guidelines below provide a method for unincorporated areas and a method for cities.

Method 1 - Unincorporated Areas:

a. Contact your County Assessor's Office to determine the total number of registered voters within the boundaries of your service area. Multiply this number by the ratio of total county population divided by the total number of registered voters within the county. The answer is an estimate of the total population in your service area. If this information is not available, contact the local land-use or demographic planning agency to obtain population figures for your service area. If this information is not available, obtain the data for the number of persons per household, a factor that is available in most areas, and multiply that number by the number of residential meters in your service area to determine an estimated population.

b. If you have used voter registration information to create a base population, then obtain the community's recent historical annual growth rate (a % increase or decrease each year), project the increase in five year increments and add that to the base population derived in the previous step. If your community has an approved land use plan for your area, this may also contain population projections. If not, you can use your historical rate of new connections per year and multiply that by the persons per household figure referenced in the previous step.

Method 2 - Incorporated Cities:

a. Visit the California Department of Finance website at www.dof.ca.gov. Choose the link for demographic information, and then follow the link for their Catalog of Publications. The link for Report E-1 outlines population estimates for City and County populations with annual percent change. Use the population estimates provided for your city for the current year***. (See***

Resource Section 1, Part A for a copy of the 1999 population figures for each city in California from Report E-1).

b. To project future population, check the city planning agency to see if they have projections. If not, see step "b" in the previous method.

Comparing Supply and Demand Projections

Table 5 – Use the following table to compare supply (Table 1) and demand (Table 3) totals to determine if anticipated supplies will meet projected demands for the next 15 years.

Table 5

Projected Supply and Demand Comparison (Acre-feet/Year)				
	Current Year (specify)	**Five Years Later** (specify)	**Ten Years Later** (specify)	**Fifteen Years Later** (specify)
Supply totals*				
Demand totals**				
Difference				

*See information completed for Table 1
**Table 3

III

PROJECTING AND DEFINING WATER SUPPLY SHORTAGES THAT TRIGGER MITIGATION ACTIONS
(Understand the Risks)

Options to Address Shortages in Worst Case Supply Scenario

Before you can develop a strategy for addressing water shortages, you will need to consider possible shortage scenarios and how they might impact your district. Developing possible water shortage scenarios will help you understand the possible risks a water shortage would pose to your district and will allow you to develop an effective plan for addressing possible shortages. In this section you will develop a hypothetical worst-case supply scenario using consecutive, increasingly dry, water years. Once you have created the worst-case scenario, you will consider alternative ways to address the resulting shortages. The three types of alternatives included in this section are: 1) supply augmentation; 2) demand reduction; and 3) a combination of supply augmentation and demand reduction.

How to Use Tables 6, 7, 8, 9 and 10

Tables 6 and 7 will help you determine how a multi-year water shortage would affect your district. Tables 8, 9 and 10 are provided to demonstrate alternative approaches to addressing the hypothetical shortfalls outlined in Tables 6 and 7.

Table 8 will help you demonstrate how supply augmentation or enhancement would offset water shortages during multiple dry years. Alternative supply augmentation methods are described in detail in Resource Section 1. Some steps to augment water supplies may need to be taken *before* a water shortage, such as importing water for local storage to be available during a water shortage. Other steps, such as conjunctive use of groundwater and surface water supplies, can be taken during the water shortage.

Table 9 will help you illustrate how demand reduction can reduce supply shortfalls. Some demand management strategies (water use efficiency) should be implemented at all the times, regardless of water shortages. The California Urban Water Conservation Council's (CUWCC) statewide Urban Water Conservation Memorandum of Understanding contains examples of long-term efficiency measures, called best management practices (BMPs) (For further information check the CUWCC website at www.cuwcc.org or call (916) 552-5885). Short-term demand reduction during water shortage periods can be accomplished using water conservation strategies such as those listed in Table 12.

Table 10 will help you illustrate how both demand reduction and supply augmentation methods can be used together to minimize shortages during multiple dry years.

Table 6 – Use the following table to project the hypothetical shortages that would be experienced by your district if a multi-year water shortage were to occur. For total supply sources use the information on Table 1 (Total). For total demand use the information developed in Table 3. You may use progressive shortage reductions (i.e. 10%, 20%, 30%, etc) or use fewer than five years to more closely match your district's unique situation. However, this scenario is hypothetical and meant to provide an extreme worst- case example to help you plan.

Table 6

Hypothetical Worst-Case Planning Scenario Statewide and Local Drought Supply						
Source of Supply*	**Average Year Water Supply Available (Acre-feet)**	**Multiple Dry Water Years** (Acre-feet)				
		Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Surface Water						
1.						
2.						
3.						
Groundwater						
Recycled Wastewater						
Imported Water						
State Water Project						
Sales to Other Agencies						
Total						

Assume worst historical drought condition and show corresponding decline in each supply

* See information prepared for Table 1 – sources of supply should correspond to those listed and may include: groundwater, surface water, State or other imported water and other surface water.

Table 7 – Use this table to project your district's water supply balance during a worst-case planning scenario assuming average demand. This will illustrate clearly the potential impact a prolonged water supply shortfall would have on your customers if demand is not reduced, and/or supply is not increased. If you have a surplus in every year, you may skip Tables 8 – 10. If you have a shortfall in any year, complete Tables 8 – 10 for the years where the shortfall occurs. For example, if the shortfall does not appear until Year 3, you may skip filling in the columns for Year 1 and 2.

Table 7

Water Supply Balance with Average Demand Levels

Hypothetical Worst-Case Planning Scenario **Statewide and Local Drought**						
	Average Year Water Supply Available (Acre-feet)	**Multiple Dry Water Years** (Acre-feet)				
		Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Total Supply *						
Total Demand (assume average year demand levels)**						
Supply Balance						

*Table 6
**Table 3

Table 8 *Supply Augmentation Option;* Table 9 *Demand Reduction Option;* and Table 10 *Simultaneous Supply Augmentation and Demand Reduction Option*, will help you illustrate three alternative approaches to addressing the water supply shortages resulting from the hypothetical scenario contained in Tables 6 and 7.

Table 8 - Use this table to project how **supply augmentation** methods could be implemented in your district to minimize or eliminate projected shortages. New supplies might include: reservoir carryover, drought water bank, new groundwater, desalinated seawater, recycled wastewater, or other sources including other imported water sources.

Table 8

Hypothetical Worst-Case Planning Scenario Statewide and Local Drought Supply Augmentation Only Option – Assumes No Demand Reduction						
	Average Year Water Supply Available (Acre-feet)	**Multiple Dry Water Years** (Acre-feet)				
		Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Supply Balance *(Shortfall or Surplus)						
New Supplies (Augmentation)** **1.**						
2.						
3.						
4.						
Subtotal New Supplies						
Supply Balance with New Supplies						

*Table 7

**New supplies might include: reservoir carryover, drought water bank, new groundwater, desalinated seawater, recycled wastewater, or other sources including other imported water sources.

Table 9 – Use this table to project the level of **demand reduction** needed in the absence of new supplies. If the supply balance is negative (shortfall) then divide the absolute value of the supply balance figure by the total supply (second line) to derive the percentage reduction needed.

Table 9

Hypothetical Worst-Case Planning Scenario Statewide and Local Drought Demand Reduction Only Option – No New Supplies Available						
	Average Year Water Supply Available (Acre-feet)	**Multiple Dry Water Years** (Acre-feet)				
		Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Supply Balance* (shortfall or surplus) (Acre-feet)						
Total Supply* (Acre-feet)						
Percent Demand Reduction Needed**						

*****See Table 7.

** If the supply balance (first line) is positive, then no demand reduction is needed. If the supply balance is negative (shortfall) then divide the absolute value of the supply balance figure by the total supply (second line) to derive the percentage reduction required.

Table 10 - Use this table to project how a **combination of water supply augmentation and demand reduction** methods could be implemented in your district to minimize or eliminate projected shortages. Indicate the total percentage demand reduction that would be needed in conjunction with new supplies. To calculate the net supply balance, add the values for supply balance and total new supply rows for each year. The absolute value of this sum is the number of acre-feet that demand will have to be reduced. To determine percent demand reduction take this absolute value and divide by total supply available for that year (from Table 7).

Table 10

Hypothetical Worst-Case Planning Scenario Statewide and Local Drought Simultaneous Supply Augmentation *and* Demand Reduction Option						
	Average Year Water Supply Available (Acre-feet)	**Multiple Dry Water Years** (Acre-feet)				
		Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Supply Balance (Shortfall or surplus)* (Acre-feet)						
Total of New Supplies (Augmentation)** (Acre-feet)						
Net Supply Balance (Required demand reduction) (Acre-feet)						
Percent Demand Reduction Needed**						

*Table 7
**Table 8
** New supplies might include: reservoir carryover, drought water bank, new groundwater, desalinated seawater, recycled wastewater, or other sources including other imported water sources.

IV

PREPARING FOR, MINIMIZING, AND RESPONDING TO WATER SHORTAGES
(Develop a Strategy)

A. Introduction

In this section you will examine ways to prepare your district for water shortages, and identify specific actions your district can take to prevent shortages or to respond to them when they occur. The most effective water shortage response effort begins long before a water shortage occurs. In order to respond most effectively, water districts need to consider all options for preparing for and responding to water shortages. There are generally four types of actions to consider: demand reductions, supply alternatives, operational changes and environmental/water quality changes. The following list includes these categories and the associated specific alternatives for districts to evaluate.

List of potential actions to address water shortages

	Demand Reductions
	Voluntary and mandatory use restrictions
	Pricing changes
	Public awareness
	Changes in plumbing codes
	Conservation credits
	Changes in irrigation methods
	Industrial conservation techniques
	Alternatives to water consuming activities
	Supply Alternatives
	New storage
	Reallocation of supplies
	New system interconnections
	Desalination, importation by barge, reuse
	Operational Changes
	Conjunctive use management
	Water banking
	Long-term changes in reservoir release rules
	Conditional reservoir operation and in-stream flows
	Water marketing
	Institutional changes
	Legal changes
	Operational coordination between systems
	Environmental and Water Quality Changes
	Reductions in required low flows
	Alternative means of achieving water quality

Source: U.S. Army Corps of Engineers, *Managing Water for Drought*, September 1994.

In this section you will develop a strategy for responding to water shortages. The tables in this section will focus on **demand reduction strategies** and **supply alternatives** in the development of a water shortage strategy. The tables will allow you to match specific supply augmentation and demand reduction options with water shortage triggering stages to meet the reduced availability of water supplies during a water shortage in your district.

You may want to investigate options for operational changes or environmental and water quality changes. However, due to the variability in the feasibility of these options from water district to water district, these subjects are not addressed here.

B. Preparing for a Water Shortage

In the previous sections you have analyzed your district's water supply and demand figures and have developed hypothetical worst-case water shortage projections for planning purposes. In this section you will use these hypothetical situations to establish triggers for your water shortage response plan and the actions you will take before and during a water shortage. You will need to consider a number of factors when developing your action plan and choosing water shortage mitigation measures. These considerations include:

- Potential water savings
- Timing required to implement measures
- Direct and indirect costs
- Quality of supplies
- Environmental impacts
- Legal or procedural requirements for implementation
- Community support
- Adequacy of treatment facilities to use supplemental sources
- Staffing requirements

When planning for a water shortage, it is essential to balance supply and demand. The impacts of water shortage hit hardest when agencies place unrealistic expectations on the amount of water supply available and do not include a realistic estimate of the potential for reductions in demand.

Important note about water demand: State and federal legislation has been enacted to improve long term efficiency of water use and local water purveyors have implemented a variety of long term efficiency programs. In general, water demand per capita has remained below the levels prior to the last drought. This decrease in per-capita use is also referred to as "demand hardening". This means that water districts will see a lower % decrease in water use the next time they promote drought conservation measures. See Appendix 1 for 2003 water demand and population figures for local water purveyors. Per capita demand figures are shown for 1980 (per-drought), 1990 (during the drought) and 2003 (dry year). Depending on the age, number and effectiveness of water efficiency programs in your area, you may want to consider adjusting per capita demand to allow for demand hardening expected in five, ten, and fifteen year projections.

A few challenges you will face in preparing for a water shortage include:

- Water shortages are unpredictable events. The duration and severity of water shortages vary and no two water shortage events will have the same impact on a water district. Water districts must be flexible and prepared in order to minimize the effects of a water shortage on customers.

- Water shortages can impact even adjacent districts very differently depending on the source of water supplies used by the districts, the amount of water in held in reserve (water shortage buffer), the type of customers and the types of water efficiency measures practiced in typical, non-drought years.

- It is difficult to invest the time to plan for a water shortage when water supplies are plentiful. We automatically swing into action when crisis strikes, freely funneling time and money into alleviating suffering and property damage. This is crisis management. But once the crisis is over, it seems like too much trouble to invest the time and resources in planning that could ease the effects of the next water shortage.

- The responsibility for responding to water shortages is divided among many governmental jurisdictions including planning departments, water purveyors, public health departments, etc. These entities must coordinate efforts in order to effectively respond to a water shortage event.

There are good reasons to plan for water shortage -- that is, to practice risk management rather than crisis management:

- Droughts are low-profile natural disasters, but analysis shows that they can be as expensive as floods and hurricanes.

- Planning ahead gives decision-makers the opportunity to implement the most cost effective and equitable programs during a water shortage.

C. Develop a Water Shortage Strategy with Stages

In this section, you will develop a specific plan for augmenting supplies during a shortage and reducing demand to a level that can be sustained by the water supply available during a shortage. The types of customers served and the statutory authority of the utility are some of the considerations that need to be taken into account. A good public information program is extremely important for a successful water shortage strategy. Communicating to customers those measures which are necessary at a given level of shortage will determine how well the public accepts the program.

Step 1: **Developing Water Shortage Strategy Stages:**

The best approach to managing water during a water shortage is to use a staged approach, with increasing levels of supply augmentation and demand reduction in each successive stage. A typical water shortage contingency program will have four stages.

Table 11 provides a guideline for how to determine the water supply shortage levels that would trigger each stage of the District's water shortage plan. The percentages used here were taken from the *Example Urban Water Management Plan, 2000* (Drought Contingency Plan Chapter) prepared by the California Department of Water Resources. These may be adjusted to more appropriately reflect the

percentage reductions that would create threats to human health and the environment in your district. You should review how a shortage in supply of each percentage level (15% to 50%) could affect your district. If average year supplies are well above current use, then the listed percentages may be fine for your district. If average year supplies are only slightly more than current demand, you may want to enact the stages of your water shortage plan at smaller percentage levels than those indicated in Table 11.

The stages are designed to be somewhat flexible and it is not intended that an agency would move through each stage in every circumstance. It is more likely that a voluntary program (Stage 1) would be tried at the first sign of a water shortage and then, if conditions worsened, Stage 2 or 3 would be implemented. In the event of an earthquake or other sudden event that severely reduces supply availability, an agency may need to begin Stage 4 actions immediately. The triggers selected by your district for Table 11 will help determine which stage is in effect at any time during a water shortage.

Table 11

Triggers for Implementing Drought Actions	
Stage 1 – Minimal	**Up to 5%** Total Supply Reduction
Stage 2 – Moderate	**15-25%** Total Supply Reduction
Stage 3 – Severe	**25-35%** Total Supply Reduction
Stage 4 – Critical	**35-50%** Total Supply Reduction

SOURCE: Table 9 of Urban Water Management Plan 2000

Step 2 – How to Select Appropriate Drought Mitigation Measures:
(Excerpted from the Drought Management Handbook, American Water Works Association, 2002)

Now that you have defined the Water Shortage Strategy stages, you will need to select the actions that will be taken during each stage. A valuable tool for assessing potential actions for water shortage mitigation is a decision matrix. Water shortage mitigation actions can be aligned along one axis with assessment criteria along the other. You should use the actions listed in Table 12 and the criteria listed below to create this matrix. A point system or a simple plus/minus system can be established to aid in selecting measures. Such a matrix could prove valuable in gaining consensus from water users or other water districts. As the district gains experience implementing various measures, the assessment criteria should be updated or re-evaluated.

The following criteria should be used when preparing a drought mitigation strategy.

Anticipated water savings: The size of the target use group and anticipated savings are key factors for assessing measures.

Consumer acceptance: Any measures must meet with some level of consumer acceptance. Without proper public education and involvement, no measure will meet with a high level of public acceptance. The message must be clear and concise when the drought program is implemented.

Equity: The measures selected must be perceived as equitable to all customer classes. This will enhance the acceptance of the measures selected. If there is a real or perceived inequity between various consumer groups, then the measures may not achieve the desired results. However, since some water uses are assigned a higher priority than others, by law, parity must sometimes be sacrificed.

Sustainability: Another element of assessment is the calculation of a particular measure's sustainability over time. In other words, will the measure provide only a short-term reduction or is it also a viable long-term measure? Each has its place depending on the particular drought event, its anticipated duration, and the long-term water supply situation.

Cost: Careful consideration needs to be given to the cost of implementing mitigation measures. These costs include the cash outlay to promote, coordinate, and enforce a given measure, as well as the costs in lost revenues (See Section VII for more information about rates and revenue stabilization during a drought). In recent droughts some water districts have discovered that their drought measures were so effective in reducing demand, that revenues declined dramatically causing a cash flow crisis for the district. Therefore, both the cost of implementing a measure and the resultant impact on revenue flow must be taken into account so that the intensity of the measures taken can coincide with the severity of the crisis.

Legal and contractual issues: Districts must assess measures from a legal and contractual standpoint. Some existing codes, regulations, ordinances and contracts may need to be revised in order to implement specific drought measures. In particular, the need to make these revisions may affect the timing of when a measure can be implemented.

Policy compatibility: Drought measures should be, to the extent possible, compatible with existing long-term policy objectives such as conservation programs.

Reliability history: The measures presented in this handbook have been proven effective and reliable in many areas and under a variety of circumstances. Each district is unique, and must consider its own past experiences or those of similar agencies when assessing the potential of each measure.

Ease of implementation: Some measures may offer substantial mitigation but will prove very difficult to actually implement. The means of implementing each measure should be carefully analyzed to determine if it warrants further consideration.

Step 3: Matching Water Shortage Mitigation Actions to Strategy Stages

A description of the specific supply augmentation and demand reduction measures in each stage should be prepared as shown in Table 12. This list serves as a general guide which you can use to assess each potential action and select from the actions ranked the highest in your decision matrix to determine which actions you will take during each stage. The actual plan developed by your agency should be based on local circumstances so it may not include each action listed.

Supply Augmentation Methods

One way to minimize shortages to customers is to increase supplies **before the** water shortage and/or provide a "water shortage buffer" to serve as a reserve when rainfall is low or other conditions cause reductions in the level of typical supplies available to the district. Methods of supply augmentation can be classified into 5 groups: 1) methods to increase existing supplies or develop new supplies; 2) drawing from reserve supplies; 3) methods to increase efficiency (demand reductions); 4) modifications to operations; and 5) cooperative efforts with other agencies. Table 12 contains several examples of these methods. Resource Section 1, Part B includes information on specific 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 resources must eventually be replenished. 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 utility is maximizing its efforts to deal with the water shortage, even before it begins. 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.

Demand Reduction Methods

Demand reduction is the most straightforward way to address drought-induced water supply deficits. Efforts to help customers reduce demand should first be directed at those customer uses which are inefficient, wasteful or able to be temporarily reduced or suspended without significant hardship. Since certain conservation actions on the part of the customer may be mandated, enforcement mechanisms are needed for maximum implementation of demand reduction.

The typical demand reduction goals for staged plans normally range from 5-10 percent in the first stage, to as much as 50% in the last stage. Stage 1 relies primarily on voluntary demand reduction actions taken by the water customers. These actions are taken in anticipation of a future water shortage creating a modest water shortage. Subsequent stages are in response to increasingly severe water shortage conditions. Stage 2 utilizes 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 very extreme circumstances. Each stage incorporates and builds on the actions taken in the previous stages.

There are many ways that water districts can request and encourage water conservation from their customers. The success of these efforts depends largely on how well the district communicates with customers and with the media. The level of savings achieved will depend, in part, on how efficiently customers use water before the water shortage begins. On the one hand, if customers use water efficiently before a water shortage begins, the impact of the water shortage is minimized because shortages are less likely to occur (unless the district has not set aside a buffer for shortages). On the other hand, if customers are already efficient in their water use, there is less excess water use to be cut during a water shortage. District managers need to consider current levels of water use when preparing

a water shortage action plan in order to understand what level of conservation may be possible during a water shortage.

This section addresses both pre-drought and drought actions. Pre-drought demand reduction measures include implementation of the fourteen best management practices (BMPs) identified in the statewide Memorandum of Understanding (MOU) for Urban Water Conservation in California. These measures are listed in Table 12. These measures are long-term, cost-effective programs that are appropriate for implementation by all urban water districts. Implementation of these measures results in more efficient water use in urban communities. (For more information about these BMPs or a copy of the statewide MOU, visit the California Urban Water Conservation Council's web site at: www.cuwcc.org or call (916) 552-5885.)

Resources Section 1 C contains a key with estimates and ranges of potential demand reduction, timing to realize water savings, and costs to water districts that are based on previous results of similar programs implemented in Santa Barbara County during the 1986-1991 drought.

Table 12 – This table includes a checklist of potential actions for your water shortage strategy – highlight or circle the options your district will use to augment supplies and reduce demand during the next water shortage. You will need to determine the relative costs of, and quantities available from, the potential supplemental supplies for your district. This should be included as part of your district's long-term water supply planning process. You will also need to determine which demand reduction measures will meet your district's needs for potential demand reduction, timing to realize water savings, and cost. Please check the appropriate column to identify in which stage you would implement each action. There is also a line for "other" in each category. Add as many rows as needed to address additional actions not listed in this table.

Table 12

ACTIONS FOR YOUR DROUGHT STRATEGY	STAGE					
	1	2	3	4	NA	Use Regional Program*
Methods to Increase Existing Supplies						
Increase use of recycled wastewater						
Increase use of nonpotable water for nonpotable uses						
Construct emergency dams						
Re-activate abandoned dams						
Other (specify)						
Drawing From Reserve Supplies						
Use reservoir dead storage						
Add wells						
Deepen wells						
Re-activate abandoned wells						
Rehabilitate operating wells						
Renegotiate contractually controlled supplies						
Other (specify)						

ACTIONS FOR YOUR DROUGHT STRATEGY	STAGE					
	1	2	3	4	NA	Use Regional Program*
Methods to Increase Efficiency						
Suppress reservoir evaporation						
Reduce dam leakage						
Minimize reservoir spills						
Reduce distribution system pressure						
Conduct distribution system water audit						
Conduct distribution system leak detection and repair						
Surge and clean wells						
Other (specify)						
Modifications to Operations						
Re-circulate wash water						
Blend primary supply with water of lesser quality						
Transfer surplus water to areas of deficit						
Change pattern of water storage and release operations						
Other (specify)						
Cooperative Efforts with Other Agencies						
Exchanges						
Transfers or interconnections						
Mutual aid agreements						
Drought Water Bank						
Other (specify)						
Demand Reduction Actions* **						
Residential Water Use Surveys – BMP 1						
Plumbing Fixture Retrofit – BMP 2						
System Water Audits, Leak Detection And Repair – BMP 3						
Metering with Commodity Rates for All New Connections and Retrofit of Existing Connections – BMP 4						
Large Landscape Conservation Programs And Incentives (applies only to non-residential accounts with large landscaped areas) – BMP 5						
High-Efficiency Washing Machine Rebate Programs – BMP 6						
Public Information Programs** - BMP 7						
School Education Programs – BMP 8						
Conservation Programs For Commercial, Industrial, And Institutional (CII) Accounts – BMP 9						
Wholesale Agency Assistance Programs – BMP 10						

ACTIONS FOR YOUR DROUGHT STRATEGY	STAGE					
	1	2	3	4	NA	Use Regional Program*
Conservation Pricing – BMP 11						
Water Conservation Coordinator – BMP 12						
Water Waste Prohibition – BMP 13						
Residential Ultra Low Flow Toilet Replacement Programs – BMP 14						
Implement all applicable pre-stage 1 measures						
Provide technical assistance to customers						
Begin public information campaign– drought message**						
Ask customers for voluntary reductions in use						
Provide incentives to customers to reduce water consumption (rebates, free devices)						
Limit number of building permits issued						
Implement water shortage rate structure (Change the water rate structure from a uniform rate to an inclining block rate)						
Request increased reduction by customers						
Require that eating establishments serve water only when specifically requested by customers						
Prohibit use of running water for cleaning hard surfaces such as sidewalks, driveways, and parking						
Require hotels/motels to post notice of drought condition with tips in each guest room						
Provide weekly updates on supply conditions to media and public						
Prohibit some uses of water – i.e., lawn watering using sprinklers						
Institute rationing programs through fixed allotments or percentage cutbacks						
Reduce pressure in water lines						
Prohibit use of ornamental fountains and ponds, except when water is re-circulated (include a sign adjacent to the fountain stating that the water in the fountain is being re-circulated)						
Prohibit filling swimming pools and spas unless the pool or spa is equipped with a pool cover						

ACTIONS FOR YOUR DROUGHT STRATEGY	STAGE					
	1	2	3	4	NA	Use Regional Program*
Prohibit the use of potable water for cleaning, irrigation and construction purposes, including but not limited to dust control, settling of backfill, flushing of plumbing lines, and washing of equipment, buildings and vehicles.						
Vehicles and boats can only be washed at a car wash that recycles water or uses 10 gallons or less of water per cycle or with a bucket and hose equipped with a automatic shut-off nozzle						
Intensify implementation of all measures in previous stages						
Implement mandatory water rationing including per-capita water use allocations for residential customers						
Restrict water use only to priority uses (no lawn watering, car washing)						
Other (specify)						

* Rely on a regional program for this action, if available. For example, in Santa Barbara County, the County Water Agency provides a water efficiency program that provides benefits for the water purveyors within the County. The California Urban Water Conservation Council (CUWCC) may also provide such benefits for your area.

**If your water district is in a region with several districts that would utilize the same radio and television stations for advertising, it is advisable to coordinate your public information efforts so that customers are not confused by conflicting messages or different rules imposed by different water districts in the same area.

***Definitions for Demand Reduction Actions (best management practices - BMPs) can be found in the Glossary and on the CUWCC website at: http://www.cuwcc.org/m_bmp.lasso

How to Use Your Strategy When a Shortage is Imminent

Once you have completed Table 12, you have developed an important element of your strategy for addressing a water shortage. The following information describes how to implement this section of your water shortage plan when a shortage is imminent.

Step 1: Evaluate Water Saved by Staged Reductions:

The water savings realized by the demand reduction methods in any stage will vary from month to month. Many methods included in Table 12 emphasize outside water use reduction. Therefore, their effectiveness will be higher in the warmer months. Not only will the percentage of total demand reduction be higher, but the total quantity of water saved will also be greater because of the higher water demand during those months. For example, if a Stage 3 water rationing plan is expected to save 25 percent of the total demand on an annual average basis, savings may be as much as 35 percent in the summer months. There would be a correspondingly lower rate of savings, perhaps 15 percent, during the winter.

It is difficult to predict exactly how much water will be saved in any given month. If most of the water use in your service area is residential with a large proportion used for landscape irrigation, you can expect high summer savings relative to the annual average; whereas if you have low summer irrigation demands you would experience much less variation from the predicted annual average savings. One way to account for this variation is to assume that the savings can be scaled to the average year demand curve.

Step 2: Select Stage

The estimated water savings from the four-stage plan can be used to decide which stage to select to reduce demand to match available supply at any time before or during a water shortage. The following procedure is recommended.

1. Graph projected water supply. Include the analysis of supplemental sources in determining the available water supply for the coming year.

2. Estimate dry year water demand. Apply the percent savings anticipated for each stage to the projected dry year demand curve. Graph the results as a series of three adjusted demand curves together with the projected dry year demand.

3. Compare supply and demand curves to determine which water shortage stage will reduce demand to match the available supply. Select the appropriate stage and publicize which stage of the water shortage strategy you must enter to sustain use through the shortage. (See Section VI for information on Public Outreach Methods).

Lag Time Problem:

Water agencies frequently assume that they will immediately achieve the levels of water use reduction they are expecting or asking from their customers. This is not always the case. One reason may be that adjacent water suppliers in the region might have different messages regarding the severity of the drought or may have different programs in place, which can confuse residents. This is compounded by the fact that customers on a bi-monthly billing cycle do not know how much water they are using until they receive their water bill as long as two months from the start of the program. Also, with the unseasonably mild winter weather usually associated with droughts, water use can actually be higher.

By the time water suppliers realize that they are not achieving the savings they were expecting, or that the 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 may have to leapfrog over Stages 2 and 3 reduction levels all the way to severe levels in order to have sufficient water supplies available to meet demand.

Another effect of the lag time is that suppliers draw down terminal reservoirs and emergency storage, and overdraft groundwater to make it through later months of the year. That can reduce the supply of water for emergencies and water to meet the next year's needs.

To avoid some of these lag time effects, it is better to begin water conservation efforts earlier at levels that are uncomfortable but manageable rather than to wait and later have to implement much more extreme measures, such as rationing.

V

MONITORING PROCEDURES
(Watch Closely)

Implementation of a water shortage plan includes ongoing monitoring of the effectiveness of the individual conservation measures, monitoring supply availability and monitoring actual water use.

A. Water Production and Use Monitoring

Normal Monitoring Procedure

In normal or average water supply conditions, production figures are recorded daily. Totals are reported weekly to the Water Treatment Facility Supervisor. Totals are reported monthly to the Water Department Manager and incorporated into the water supply report.

Stage 1 and 2 Water Shortages

During a Stage 1 or 2 water shortage, daily production figures are reported to the Supervisor. The Supervisor compares the weekly production to the target weekly production to verify that the reduction goal is being met. Weekly reports are forwarded to the Water Department Manager and the Water Shortage Response Team. Monthly reports are sent to the City Council or Board of Directors. If reduction goals are not met, the Manager will notify the governing board so that corrective action can be taken.

Stage 3 and 4 Water Shortages

During a Stage 3 or 4 water shortage, the procedure listed above will be followed, with the addition of a daily production report to the Manager.

Disaster Shortage

During a disaster shortage, production figures will be reported to the Supervisor hourly, and to the Manager and the Water Shortage Response Team daily. Reports will also be provided to the governing board and the local Office of Emergency Services.

B. Supply and Demand Comparison Tracking

It is critical to track available supply and actual use on a regular basis and assure that demand levels do not substantially exceed targets set in Section IV. Compare actual demand and supply with projected demand and supply to determine if stage adjustments are needed. Prior to altering the demand reduction stage, consider any program adjustments such as raising the level of expenditure on public outreach or increasing enforcement efforts. If these actions do not achieve the required stabilization, then adjust the stage. It is best to avoid going up and down in stages because this can hurt public confidence and acceptance. Try to avoid going down until the water shortage is over or the shortage

emergency has passed. Using these techniques, you can stay on top of the situation and make informed decisions throughout the duration of the water shortage.

VI

PUBLIC OUTREACH
(Keeping Your Customers Informed)

This section outlines the methods that a water district can use to provide information to the public and the media during a water shortage. It includes a menu of options for informing the public about the water shortage and actions they can take to reduce their water use, and a checklist for keeping the media involved. There is also a table for identifying media contacts. Sample public information materials such as press releases, bill inserts, advertisements, and workshop topics, along with guidelines for writing a press release are included in the Resources Section 4.

A note about ongoing water use efficiency versus drought-driven conservation measures

Since the early 1990's, following the last prolonged drought in Santa Barbara County (1986-91), state and local water districts have increased their efforts to promote long-term water use efficiency. The California Urban Water Conservation Memorandum of Understanding has been adopted and implemented by a number of local districts. This plan contains best management practices which are ongoing efforts to use water more efficiently. As a result of implementation of long-term efficiency programs, per-capita water demand is now lower than before the last drought. This is referred to as "demand hardening" and means that water districts will not likely see the high levels of conservation savings that were reached in the last drought.

General Public Outreach

The public will be affected by water shortages, and should be involved in water shortage preparedness efforts. During a water shortage, the effectiveness of water shortage responses is often a function of the trust, knowledge, and commitment of the public. Many water managers believe they practice good "public involvement" because they conduct regular meetings at which agency policies are explained and questions from the public answered. But this approach may not be effective in developing trust, knowledge and commitment to agency decisions, nor in inducing changes in water users behavior that can reduce water shortage impacts. The agency needs to develop a comprehensive outreach program that reaches all customers with messages regarding the water situation and specific steps they can take to use water efficiently.

Public participation may help to increase administrative accountability; to supply pertinent information; to evaluate methodological approaches and use priorities; to raise broad but related value questions; to call planners' attentions to immediate problems; and to make plans more politically acceptable. Generally, effective public involvement has the following characteristics: two-way communication; involvement early and through the entire process; deliberation involving informal and personal processes; and representation of all interests.

There are many methods you can use to inform your customers about the water shortage, and inform them of the steps you would like them to take to conserve. Table 13 presents a list of options for you to use in your outreach efforts.

Table 13 - Place a checkmark by the options that you will consider including in your public awareness campaign during a water shortage.

Table 13

Menu of Options for Public Outreach

Public Awareness Program	Options to be Implemented
Bill Inserts for water bills	
Public service advertising – run for free by local media	
Paid Advertising – Newspaper	
Paid Advertising – Radio	
Paid Advertising – Television	
Paid Advertising – Movie Slides for local movie theaters	
Paid Advertising – Chamber of Commerce Newsletter	
District newsletter	
Classroom Presentations	
Drought Pamphlet – mass distribution to all customers	
Drought Website	
Public Workshops – Drought Survival – Water conservation	
Drought Information Center	
Public Advisory Committee	
Displays in District Office	
Low flow fixture rebates	
Low flow fixture distribution	
Promote use of Greywater	
Drought Tolerant Plant Tagging Program at local nurseries	
Promoting CIMIS information	
Drought Hotline	
Water Surveys (audits)	
Displays in Public Libraries, at local schools, shopping malls, etc.	
Bus ads	
Billboards	
Promotional Items with a conservation message (mugs, rulers, stickers, pens)	

Involving the Media

The local media (newspapers, radio and television stations) in any community is an essential partner in helping a water district increase public awareness regarding a water shortage situation. The media can reach most, if not all, of your customers with information and tips that will help keep water use levels down to the targeted levels. On the other hand, the media can hurt your efforts by distorting the effects that rationing and conservation were having on the community, overly dramatizing situations that are not representative of the community as a whole, or simply presenting a much bleaker picture of the situation

than actually exists. For instance, news reporter might only interview customers whose landscapes had died or those who had retrofitted their toilets and were dissatisfied, rather than featuring those who were able to comply with reductions with a minimum of hardship. During water shortages, the majority of the residents are able to successfully cope with water shortage restrictions, at least in the short-run. This fact may not be considered as newsworthy as the stories about people who were unhappy or experiencing hardship.

Some sensationalizing media tactics, such as printing photos of dry, cracked mud from the bottom of a local reservoir, may also have a positive affect. After seeing such photos in the newspaper, local residents will better understand the magnitude of the problem and may be more inspired to conserve. However, when these same pictures are viewed by residents in communities in other parts of the state or country, it may have the negative affect of decreasing tourism if travelers avoid visiting places they perceive as a disaster area.

One recommendation for successfully working with the local media, to use them as allies, is to encourage them to present the positive, everyday efforts of residents as well covering the sensational stories. It is difficult to achieve a 100% accurate representation, but keeping the media informed through press releases or press conferences will help to mitigate the negative affects of dramatized or one-sided reporting.

It is important that the public hear consistent messages from water suppliers in the area, particularly when they are in the same media market. There can be significant differences in the supplies available to adjacent water districts. However, if customers in one district are asked to reduce their water use as much as 30% while their neighbors served by another district are only asked to conserve 10 or 15%, they will question the equity of the program, or become confused. This can lead some of them not to meet their reduction goals.

Analysts drew three conclusions about the media from the 1986-1992 California drought.

1. **The role of the media is not well understood by water managers**.
   The media are governed by their own rules of objective reporting, newsworthiness, and perceptions of what the public wants to know. They cannot be managed by water agencies. If they were, they would not be able to sell news. The questions like, “Are we in a drought?” or “Is the water shortage over?” are not silly questions from the media’s point of view. Reporters understand the thinking modes and perceptions of the general-public much better than water professionals. For them, once the water supply situation is called a water shortage, it automatically implies that behavior has to be changed from normal behavior to crisis behavior. Such a change is newsworthy.

2. **The media cannot improve on imprecise and ambiguous messages**.
   Most likely, the statements will become even more confusing after they are reported in the press. Only unambiguous and complete answers to questions that are asked by the press can be communicated clearly to the public.

3. **Media cannot explain complex water management issues**.
   What is very interesting to water professionals is usually “too dry” for newspapers, radio, and television. Long feature articles on water issues do not sell newspapers, but timely, well-written articles during a water shortage emergency will be read by concerned people.

Checklist for Keeping the Media Involved

____ 1. Create a media list to ensure that all available local media are used – select an official representative at each radio station, newspaper, and television station to serve as a point of contact for water shortage information released from your district. See Table below.
____ 2. Establish a public advisory committee
____ 3. Include public and media in the water shortage planning process
____ 4. Organize water shortage information meetings for the public and the media.
____ 5. Publish and distribute pamphlets on water conservation techniques and water shortage management strategies
____ 6. Organize workshops on water shortage related topics
____ 7. Prepare sample ordinances on water conservation
____ 8. Establish a water shortage information center
____ 9. Write reports for the media early in the course of the water shortage and prepare weekly press releases with current water shortage conditions
____10. Establish a list of authorities on water shortage that can be distributed to the media for further reference.
____11. Organize education activities for the media.
____12. Establish a budget for advertising water shortage programs
____13. Write reports for media early in the event
____14. Prepare reports on the efforts of the water district to conserve water – conjunctive use, system audits, meter retrofits, training for staff, etc.
____15. Establish or use an existing newsletter to provide an overview of water shortage activities, tips for conservation, articles showcasing local conservation efforts on the part of homeowners and businesses.
____16. Conduct press conferences as needed. Use on-location approach if photo opportunities exist (i.e., a local reservoir when reservoir is visibly low)

Table 14 - Use this table to create your media contact list. Be sure to include all media in your community**.**

Table 14

Media List				
TV Stations	**Contact**	**Address**	**Phone/Fax**	**Email**
Include Government Access Channels				
Print Media				
Include newspapers from local colleges				
Include news clipping services				
Radio Stations				
Chambers of Commerce				
Politicians				
County Board of Supervisors				
City Council				
Assembly				
Congress				

Source: Santa Barbara County Water Agency, 2001.

Findings Regarding Public Information From 1986-1992 Drought

During the 1986-1992 drought in California, the following findings were made regarding large-scale water shortage-related public awareness campaigns:

1. There was a statistically significant increase in the public's awareness of the water shortage after the campaign, and those who became aware of the water shortage through the campaign were more likely to believe in the seriousness of the water shortage and to conserve water. Television appeared to be the most effective medium for increasing awareness.
2. Even after the campaign, water users greatly underestimated the amount of water they used, but the error was less than before the campaign.
3. The people most willing to reduce water use were also the most likely to report they needed more information on how to do so.
4. The campaign increased trust that the agencies call for conservation was necessary and should be supported.
5. Support for farmers' use of water was greater after the campaign, while support for commercial and industrial use declined. It is generally accepted in social behavior research that conservation campaigns will be more effective if the sacrifices are equitable. This suggests that publicizing the equity of water shortage restrictions may be effective in reducing water use.

VII

ANALYZING REVENUE AND EXPENDITURE IMPACTS
(Staying Solvent)

A complete water shortage contingency plan should include an analysis of the fiscal impacts of augmenting water supplies and/or reducing demands, and the proposed measures to overcome those impacts, such as ways to fund new supplies or stabilize revenue when water sales decline. Water districts incur costs when new water supplies are developed to make up for shortages, including the costs associated with promoting conservation (staff, materials, fixtures, rebates, etc). As customers reduce their demand, revenue to the district will decline. It is important to develop a plan to address potential cost increases and revenue decreases.

In order to mitigate the financial impacts of a water shortage, a district can establish an emergency or reserve fund. The goal is to maintain the fund at 75% of average annual water department revenue. This fund will be used to stabilize rates during periods of water shortage or disasters affecting the water supply. The purpose of such a fund is to avoid the need for a rate increase in the midst of the shortage. However, even with the emergency fund, some rate increase may be necessary during a prolonged water shortage.

The experiences of California water purveyors during the 1986-91 drought shortage demonstrated that actual water use reductions by customers can be considerably larger than requested or planned on by the supplier. During the 1986-91 drought shortage water districts in Santa Barbara County experienced reductions in use of up to 55%. It may be difficult for districts to adopt rate increases necessitated by a 30 – 50% reduction in sales.

In the following tables you will document your district's water costs (fixed and variable costs of supply and efficiency programs and rate structure, and conduct a step-by-step analysis of how a water shortage may impact your revenues and expenditures. In addition, Resources Section 2, Part C outlines how to set up a Rate Stabilization Fund.

Table 15 – Use Table 15 to document the cost of producing and delivering each of your district's water supplies. There is a column for fixed costs and one for variable costs (operations and maintenance). This is important since fixed costs will not be impacted by a decline (or increase) in water demand. Also included are the district's ongoing costs to promote water use efficiency, which are included because they defer the need to add new supplies. This information will be utilized later to determine potential financial impacts during a water shortage.

Table 15

Water Production and Delivery Costs ($ Per Acre-Foot) Average Year			
Supplies*	**Fixed Costs**	**Variable (Operations and Maintenance) Costs**	**Total Costs**
Surface Water			
1.			
2.			
3.			
Groundwater			
Recycled Wastewater			
Imported Water			
State Water Project			
Ongoing Water Efficiency Program (Salaries, overhead, rebates, fixtures, materials)			
Total			

*****Supplies listed in Table 1
Conservation salaries, overhead, cost of supply, Groundwater production and purification, transmission and distribution, customer accounts, general and administrative, depreciation, capital projects

Table 16 – Complete the following table by identifying the number of accounts in each customer class (See Table 2), the total sales based on water deliveries to each customer class in the most recent average year, the fixed monthly charges (i.e. meter charge) for each customer class, and the total revenues for each customer class in that same year. This information will be utilized later to determine potential financial impacts during a water shortage. If your district uses designations for customer classes other than those listed, please substitute the customer class types that your district currently uses.

Table 16

Revenues/Water Sales to Customers (Most Recent Average Year - Specify)				
Customer Type*	**Number of Accounts by Meter Size****	**Average Sales ($ based on deliveries)**	**Fixed Monthly Service Charge** ($/month)	**Total Revenues ($)**
Single Family				
Multi-Family				
Commercial				
Industrial				
Institutional/Public				
Recreation				
Landscape				
Agriculture				
Total				

* Please include all meter sizes, add additional rows as needed in each customer category to include that information in the table.
**Table 2 has the totals for each customer class, but you will need to provide a breakdown by meter size for this table.

Table 17 – Complete the following table by projecting water deliveries during various hypothetical demand reduction levels for all your customer classes. The percentages listed in each column are for planning purposes only, and are not related to the reduction targets associated with the stages in Table 11. This is an important step because demand reduction levels may vary by customer class. This information will help you predict revenue impacts to the district.

Table 17

Projected Water Deliveries at Hypothetical Demand Reduction Levels					
Customer Type	**Average Deliveries* (AFY)****	**10% Reduction (AFY)**	**20% Reduction (AFY)**	**30% Reduction (AFY)**	**40% Reduction (AFY)**
Single Family					
Multi-Family					
Commercial					
Industrial					
Institutional/Public					
Recreation					
Landscape					
Agriculture					
Total					

*See Table 3 to get the average year deliveries (demand).
**AFY = Acre-feet per year
NOTE: This table is hypothetical and contains assumptions of shortages that may never occur.

Table 18 – Complete the following table by projecting how much revenue the district might lose as a result of reductions in deliveries (sales) at hypothetical levels as outlined in Table 17. The percentages listed in each column are for planning purposes only, and are not related to the reduction targets associated with the stages in Table 11.

Table 18

Predicted Revenue Loss By Customer Class at Hypothetical Demand Reduction Levels* (Assumes No Increase in Supply)					
Customer Type	**Average Sales* ($ based on deliveries)**	**Revenue with 10% Reduction $**	**Revenue with 20% Reduction $**	**Revenue with 30% Reduction $**	**Revenue with 40% Reduction $**
Single Family					
Multi-Family					
Commercial					
Industrial					
Institutional/Public					
Recreation					
Landscape					
Agriculture					
TOTAL Revenues					

***** See Table 16 - No monthly service charge included.

Table 19 –The following table will help you determine changes in operational costs due to developing new supplies and increasing conservation efforts during a drought. This information will help you to determine which additional supply sources produce the most water and are the most cost effective to meet customer needs. It is difficult to predict how much water conservation measures will save but it is important to consider the added costs. The conservation measures listed are standard actions taken by water districts during a drought and most, if not all, of these measures should be part of your drought response program. While decreased deliveries will reduce revenue, there may be change – an increase or a decrease – in operating costs (such as water treatment and energy) as a result of decreased demand. This will vary by district, depending on the source of supply. Please do not include ongoing revenues from fixed charges such as meter charge.

Table 19
Operational Costs During Drought

Additional Costs Associated with Drought	
Additional Water Supplies/Costs	
*New Supply 1 (Specify)**	
Maximum acre-feet per year	
% Increase in supply	
$ per acre-foot	
Cost subtotal ($ per acre-foot times acre-feet per year)	
New Supply 2 (Specify)	
Maximum acre-feet per year	
% Increase in supply	
$ per acre foot	
Cost subtotal ($ per acre-foot times acre-feet per year)	
New Supply 3(Specify)	
Maximum acre-feet per year	
% Increase in supply	
$ per acre foot	
Cost subtotal ($ per acre-foot times acre-feet per year)	
New Supply 4(Specify)	
Maximum acre-feet per year	
% Increase in supply	
$ per acre foot	
Cost subtotal ($ per acre-foot times acre-feet per year)	
Total Additional Acre-Feet (add all new supplies)	
Total Additional Cost of Supply (add all new costs)	
Additional Water Conservation Program Activities/Costs*	
Additional staff	$
Additional purchase of fixtures for distribution to customers (showerheads, etc)	$
Rebates for fixture purchases (i.e. toilets, high efficiency washing machines)	$
Additional public information and advertising expenses	$
Cost to establish and enforce rationing program	$
Total Additional Costs for Increased Water Conservation Activities	
TOTAL ADDITIONAL COSTS OF OPERATION DURING DROUGHT (Add lines for Additional Cost of Supply and Additional Cost for Conservation)	

*See Table 8 for list of new supplies.
** It is difficult to project water savings that will occur as a result of these measures

Table 20 – In this table you will identify the potential revenue deficit associated with providing additional water and services to your customers during a drought. Using this table, summarize your operating revenues and costs at predicted levels of shortage.

Table 20

Revenues and Expenditures Given Demand Reduction					
	Average Year $	**10% Reduction $***	**20% Reduction $***	**30% Reduction $***	**40% Reduction $***
1. Revenues Based on Sales (From Table 18)					
2. Revenues From Fixed Meter or Monthly Charges (Total From Table 16 - will be the same number in each column)					
3. Other Revenue (specify)					
4. Total Revenue (lines 1-3)					
5. Operating Expenses					
Salaries					
Utilities					
Cost of supply					
Production and purification					
Transmission and distribution					
Operations					
General and administrative					
Depreciation					
Capital projects / debt					
Other					
16. Sub-Total Operating Expenses					
17. Total Additional Costs of Operation During a Drought (Table 19)					
18. Total Operating Expenses (Add lines 16 and 17)					
19. Change in net revenue from average year (Subtract line 18 from line 4)					

*See Table 18

Table 21 –This table will help your district choose how to deal with a revenue deficit as identified in Table 20. Your district may want to take appropriate actions to create an emergency reserve or "buffer" before the drought begins. This can be accomplished by increasing the monthly meter charge or instituting a drought surcharge, increasing rates or changing rate structures, as well as other methods listed. It is preferable to avoid raising rates in the midst of the drought because the public views this as punishment for reducing their demand. Preparing for the uncertainty of revenue during a water shortage is sound management and will help your district avoid fiscal uncertainty in a crisis. Please see Resources Section 2, Part C for guidance in setting up a Rate Stabilization Fund.

Table 21

Means to Address Projected Revenue Deficit and/or Increased Supply Costs (Check those that apply)	
Meter Charge or Drought Surcharge	
Water Rate Increase or Change (i.e. to inclining block)	
Drought Reserves	
Reduction in Capital Program	
Other	

Completion of the tables in this section will assist you in understanding the impacts of reduced deliveries on your revenue and project the increased costs for new supplies and conservation measures which may need to be implemented in advance of, or during, a water shortage. You should now be able to identify the steps you will take to assure that you have adequate supplies and that you will have the funds to cover these additional costs.

Rate Stabilization Funds:

In order to mitigate the financial impacts of a water shortage, a district can establish an emergency fund. The goal is to maintain the fund at 75% of normal annual water department revenue. This fund will be used to stabilize rates during periods of water shortage or disasters affecting the water supply. The district will not have to increase rates as much or as often during a prolonged or severe shortage. However, even with the emergency fund, rate increases will be necessary during a prolonged water shortage. As described earlier in this plan, a Stage 2 shortage requires a 20% reduction in water deliveries, while Stage 3 requires a 35% reduction. The experiences of California water purveyors during the 1986-91 drought shortage demonstrated that actual water use reductions by customers can be considerably larger than requested by the supplier. During the 1986-91 drought shortage it was also difficult for several agencies to adopt the rate increases necessitated by a 20 – 50% reduction in sales. When a water shortage emergency is declared, the supply shortage will trigger the appropriate rationing stage and rate increase.

Water rates increase by the following percentages when the indicated stages are implemented:

Stage 1 – no rate increase.
Stage 2 – 25% increase over pre-shortage rates.

Stage 3 – 50% increase over pre-shortage rates.
Stage 4 – 100% increase over pre-shortage rates.
End of water shortage emergency – drop back to a 15% increase over pre-shortage rates.

Most California water districts that experienced water shortages found that it required several years for customer demand (gpcd) to return to pre-shortage levels, if they ever did. Thus, in anticipation of reduced sales following a shortage, the district's rates will be set at 115% of the pre-shortage rates. Because water use is projected at 90% of pre-shortage use, the 115% increase will generate sufficient income to equal expenses. Any excess revenues collected as a result of this rate adjustment would be used to re-establish the emergency fund.

VIII.
REFERENCES

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APPENDIX 1

Per-Capita Water Demand Trends in Santa Barbara County

Water Demand						
Water Purveyor	**Population Served 2003**	**M&I Water Demand (Acre-Feet Per Year)**	**Per-Capita Water Demand (Gallons per person per day)** Pre Drought **1980**	**(Gals per person per day)** During Drought **1990**	**(Gals per person per day)** Post Drought Wet Year **1998**	**(Gals per person per day)** Post Drought Dry Year **2003**
City of Buellton	4,000	1,136	299	262	206	253
Cal-Cities Water	38,252	8,109	216	247	205	220
Carpinteria Valley Water District	18,200	2,322	137	109	120	114
Casmalia CSD	200	22	65	72	NR	97
Cuyama CSD	820	178	417	255	180	194
Goleta Water District	85,000	9,501	164	86	103	100
City of Guadalupe	6,100	651	184	113	79	95
La Cumbre Mutual Water Company	4,900	1,642	312	260	229	299
City of Lompoc	41,671	4,788	128	123	97	103
Los Alamos CSD	1,300	290	280	252	NR	199
Mission Hills CSD	3,300	613	189	181	151	166
Montecito Water District	18,028	4,878	271	293	261	242
City of Santa Barbara	94,304	12,831	158	94	111	121
City of Santa Maria	82,148	12,568	196	179	129	137
Santa Ynez River ID #1	8,298	2,539	227	200	267	273
City of Solvang	5,383	1,383	379	369	217	229
Vandenberg Village CSD	5,802	1,310	233	189	160	217

APPENDIX 2

Conservation Actions for Residential Customers

Ongoing Water Efficiency Practices vs. Drought Conservation Measures

Indoors:

Ongoing:

- Repair leaking faucets and running toilets
- Do not use toilet as a wastebasket
- Install low-flow showerheads and put aerators on sink faucets
- Turn off the tap while brushing teeth, shaving, preparing food, etc.
- Wash only full loads in the washing machine or dishwasher
- Replace older, high water-using toilets with newer, ultra low-consumption models (1.6 gallons per flush)
- Use low-sudsing detergents to minimize amount of rinsing water needed
- Insulate water heaters and hot water pipes to reduce wasted water while waiting for hot water
- When washing dishes by hand, fill a rinse water pan instead of allowing water to run
- Adjust all water-using appliances to use the minimum amount of water/energy necessary
- Keep a bottle of drinking water in the refrigerator; this saves running the tap to get cooler water
- Sweep driveways and sidewalks instead of watering them down to clean them
- Purchase high efficiency washing machine (Approx. 15 gallons per load)

Drought Measures:

- Take shorter showers or shallower baths
- Use garbage disposal sparingly
- Collect water with a bucket while waiting for the shower water to heat up and use it later for watering indoor plants
- Flush toilets only when needed
- Comply with water district's drought measures as they are enacted

Outdoors:

Ongoing:

- Position sprinklers carefully to avoid watering adjacent paved areas
- Water in the evening or early in the day when evaporation rates are lower and wind is minimal
- Follow landscape irrigation guidelines to water plants only when necessary
- Don't mow lawns too short; taller grass retains moisture better

- Surround plants with mulch or rocks to retain soil moisture
- Install a shut-off valve on hoses to save water while watering plants or washing the car; wash vehicles less frequently
- Direct downspouts or gutters toward shrubbery or trees
- Use drought-tolerant and native vegetation in outdoor landscaping
- Use a broom, not a hose, to clean driveways, steps and sidewalks.
- Install ET (evapotranspiration) controllers to assure that you only give plants the water they need.
- Use a pool cover to minimize evaporation.

Drought Measures:

- Collect rainwater in a large bucket to use in outside areas
- Don't irrigate replaceable landscape plantings
- Do not wash vehicles
- Install graywater recycling system.
- Comply with water district's drought measures as they are enacted