



Albuquerque Bernalillo County  
Water Utility Authority

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# **Water Resources Management Strategy Implementation**

## **Drought Management Strategy**

**March 2012**



Albuquerque Bernalillo County Water Utility Authority Board

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## EXECUTIVE SUMMARY

This update of the Albuquerque Bernalillo County Water Authority (Water Authority) Drought Management Strategy (Strategy) was developed because the former strategy, which was adopted by the Albuquerque City Council when the water utility was managed by the City's Public Works Department. In addition, the Strategy was updated to conform to the Water Resources Management Strategy (WRMS) adopted by the Water Authority in 2007 consisting of thirteen policies and more than sixty recommendations for providing a safe, sustainable water supply.

The drought stages and their corresponding water use reduction methods are subject to approval by the Water Authority Board. In adopting drought stages, the Board will consider the severity of the drought, the amount by which annual groundwater pumping goals are projected to be exceeded and the amount by which the annual gallons per capita per day water usage goal are projected to be exceeded.

Water use reduction methods include: public education, increasing water waste fines, rebates for attending a class on drought, mandatory day-of-the-week watering schedules, changing the time of day watering restrictions, distributing low-flow showerheads and offering a rebate to customers who reduce their water use by at least 20%.

Whenever the majority of Bernalillo County is in severe drought according to the National Weather Service, the Water Authority will issue a Drought Advisory to educate the public about drought conditions and encourage voluntary conservation. Whenever a Drought Advisory is in effect, the Water Authority Board will be briefed on water use and drought conditions at the monthly Board meetings.

## INTRODUCTION

The Drought Management Strategy (Strategy) provides for a continuation of the drought management measures from the original Strategy adopted by the Albuquerque City Council in April 2003. When the Strategy was adopted, the utility was a part of the City of Albuquerque. The City established a task force to develop and finalize a drought management plan. This plan established four stages of drought and voluntary and mandatory drought response measures to protect and preserve the aquifer. The Water Authority utilized the recommended drought stages and corresponding drought response measures in 2006 and 2011 through resolution as a result of below average precipitation and/or above average temperatures from *La Niña* conditions. In 2008, the Water Authority began utilizing surface water in addition to ground water to provide its customers a safe and sustainable water supply. As a result, the Strategy needed to be updated as the original Strategy's drought stages were structured exclusively on groundwater use. In addition, lessons learned from the 2006 and 2011 droughts were used to design more appropriate drought stages and drought response measures. Similar to the original Strategy, this updated Strategy was reviewed by the Water Authority's Customer Advisory Committee before being adopted by the Water Authority Board and will be reviewed/updated every five years.

## BACKGROUND

The Water Authority now supplies about 102,000 acre-feet/year of water to more than 600,000 customers in the metropolitan area. Water is supplied from both the aquifer and from surface water.

In 2007, the Water Authority adopted a comprehensive Water Resources Management Strategy (WRMS) to update the 1997 strategy adopted by the City and to assure a safe and sustainable water supply for its customers to the year 2060. A town hall meeting was held in September 2007 to solicit public input on future water policy.

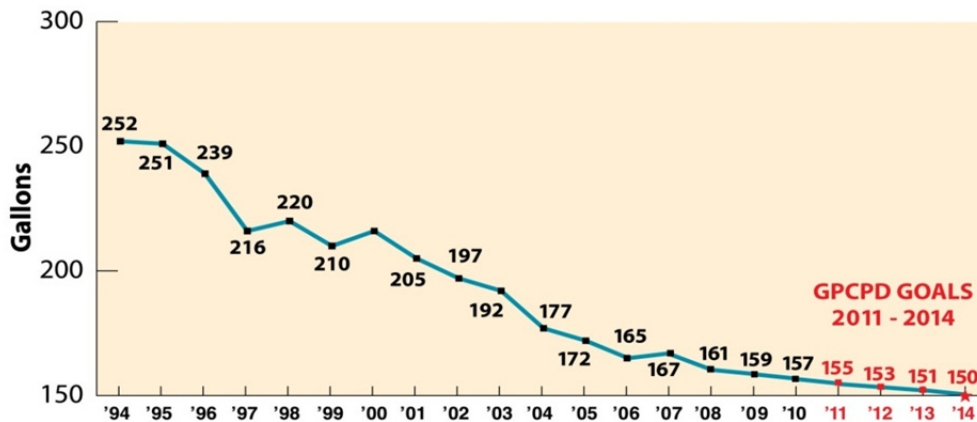
The 2007 WRMS consists of thirteen policies and more than sixty recommendations for providing a safe and sustainable water supply. This Strategy addresses Policy C of the WRMS which states that the Water Authority shall establish a ground-water drought reserve that maintains sufficient water in storage in the aquifer to provide water supply during a prolonged drought. In addition, this Strategy addresses Policy D, Recommendation 4 of the WRMS which states that the Water Authority should adopt and implement drought management measures as necessary to reduce demand during droughts.

Implementation of the WRMS, particularly the San Juan-Chama Drinking Water Project, is diversifying the water sources used and allowing recharge of the aquifer so that it can be maintained as a drought reserve. In the United States Geological Survey report, "Water-Level Data for the Albuquerque Basin and Adjacent Areas, Central New Mexico, Period of Record Through September 30, 2010" numerous graphs show water levels increasing or stabilizing in area wells.

Meanwhile, water use has been reduced. The City adopted an ambitious water conservation program in 1995 with the goal of reducing per capita water use by 30 percent to 175

gallons/person/day by 2004. This goal was achieved and the Water Authority established a further goal of reducing water use to 150 gallons/person/day (GPCPD) by 2014. By the end of 2010, usage stood at 157 GPCPD, so the conservation program is on track to meet its 2014 goal.

## Gallons Per Capita Per Day 1994 - 2010



## PURPOSE OF THE DROUGHT MANAGEMENT STRATEGY

The purpose of the Strategy is to reduce water use during a drought consistent with the goals and objectives of the WRMS. The water savings that are targeted during declaration of various stages of drought are intended to be short-term measures capable of producing water savings over time periods ranging from one month to one year, but no longer.

Implementation of the Strategy should be considered separately from the Water Authority's conservation program. The water conservation program is intended to provide for long-term water savings as opposed to a single year or irrigation season. The public messages for the Strategy will certainly promote education about the long-term need to conserve. However, the Water Authority will strive to achieve higher than average savings during a short period of time during a drought.

## ESTABLISHING ANNUAL WATER USAGE GOALS

Each year, staff will establish an annual demand goal pursuant to achievement of long-term conservation objectives. This goal along with the projected annual operations plan for groundwater and surface water usage will be presented to the Water Authority governing board.

The Strategy is intended to address increased water use solely resulting from drought and is not intended to be used to penalize its customers for slight periodic monthly or annual increases in per capita use or for increased groundwater use due to water quality or other unforeseen conditions that prevent diversion and direct use of the San Juan-Chama water as part of the Drinking Water Project.

For example, in 2011 the use of San Juan-Chama water was curtailed due to changes in water quality in the Rio Grande due to upstream fires. These types of issues will occur from time to time, but would not trigger the declaration of a drought.

## DECLARING A DROUGHT

Drought in the Water Authority's service area relates to the supply of surface water and the amount of ground water pumped during dry, high-demand periods. Because drought has its greatest impact in the summer and early fall (the highest water demand times of the year) drought mitigation focuses on these time periods and reducing outdoor water use.

When drought conditions exist or are anticipated to develop in our region, the Water Authority Board will be briefed on water usage and predicted drought conditions and will utilize this information to decide when to declare the drought stages. The approval of a drought stage by the Water Authority Board, will authorize the Water Authority's Executive Director to initiate all the measures associated with that drought stage. There are four levels of drought that can be declared and all but the Drought Advisory (a first stage early warning system that calls for increased education on drought and voluntary conservation) must be approved by the Water Authority Board based on water usage information, local and statewide drought conditions as defined by the National Weather Service, groundwater pumping and other information that may be requested or provided by staff or the public.

During drier than normal conditions per capita water demand may increase, and in addition, surface water may not be available. These two conditions combined would result in increased ground-water pumping when compared to normal or expected conditions. All of the drought mitigation measures are aimed at reducing demand, so it is appropriate to invoke these measures when demand has increased as a result of drought.

## DROUGHT DECLARATION CRITERIA

Each year the Water Authority sets an operational plan for use of ground water, surface water and reuse. The plan is established to preserve the aquifer for the long-term. The drought stages are tied to the operational plan and increases in customer water use.

There are three drought stages that can be declared along with an early alert system, the Drought Advisory. The Drought Advisory does not require mandatory conservation, but rather calls for increased public education. Each of the drought stages contains mandatory measures that are anticipated to reduce demand back to operational goals. The majority of water usage reduction methods are aimed at reducing outdoor water usage, because this is the use most likely to increase during a drought and because outdoor use is a consumptive use.

Not all of the methods to reduce water use are restrictive. For each drought stage there is a rebate or incentive also being offered to customers to increase their motivation to reduce their water use. This is a unique approach to drought management intended to maintain the positive relationship that has been developed over time with customers regarding water usage reduction.

A Drought Advisory is declared whenever the majority of Bernalillo County reaches Stage 3 – Severe Drought as defined by the National Weather Service, regardless of water usage patterns. Upon declaration of a Drought Advisory, the staff is directed to immediately increase public education on drought. The drought advisory is intended to be an early warning system for customers to alert them to the need for increased awareness of water use because the service area is experiencing a drought before an increase in water usage has occurred.

Use of the Drought Advisory was highly effective at keeping water demand under control during the Extreme Drought experienced by the service area in 2011. For this reason, this stage of drought awareness does not require Water Authority Board approval, so that staff may increase drought awareness quickly and thereby, hopefully, alleviate the need for additional measures.

If declaration of the Drought Advisory is ineffective at keeping water use consistent with the established goals, then further stages of drought may be adopted by the Board. Drought stages are linked to the annual groundwater pumping goal and the gallons per capita per day water usage goal as shown in the chart below.

Both of these criteria are important. The first establishes that groundwater supplies are being depleted and the second that the cause for the depletion is customer behavior. Based on an extended analysis of 1971-1998 hydrology data (as used in the State Engineer permitting process for the Drinking Water Project), a threshold of 20% of the operational goal for groundwater pumping would cause the Water Authority service area to enter Stage 1 drought conditions. Analysis of the 1971-1998 hydrology dataset extrapolated out to 2026, demonstrates that a drought would occur for 92 out of 673 months (13% of the months), which occur in 15 out of 56 years as shown in figure one. The response of customers to the Drought Advisory would determine whether it would be necessary to enter into any of the restrictive levels of the Strategy.

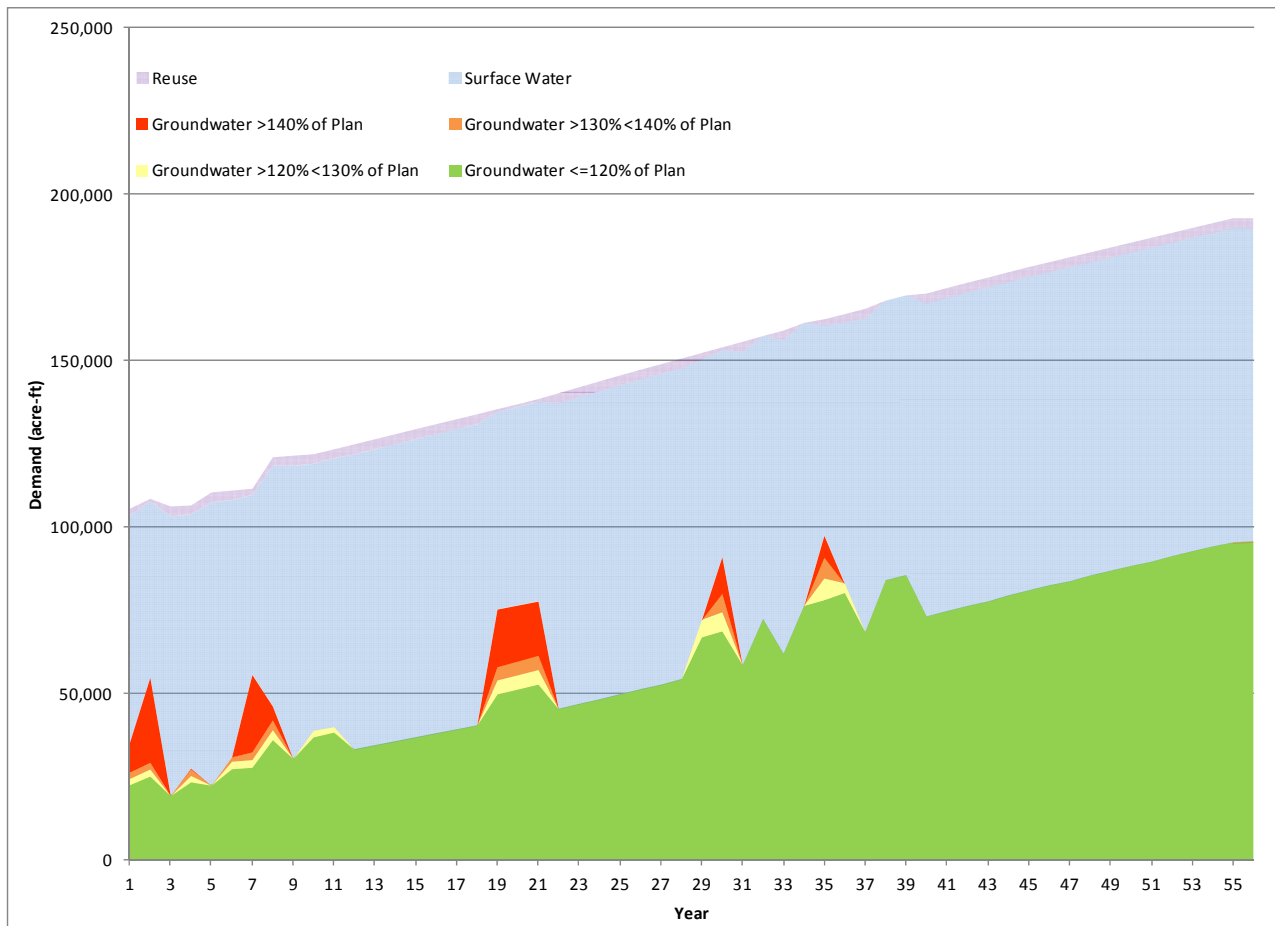
**Drought Stage Criteria Chart**

Groundwater Pumping /GPCD	Less than 120% of the GW pumping goal	Between 120% and 130% of GW pumping goal	Between 130% and 140% of GW pumping goal	More than 140% of the GW pumping goal
< 2 GPCD over the goal	None	None	None	Stage 1
2-4 GPCD over the goal	None	Stage 1	Stage 1	Stage 2
4-6 GPCD over the goal	None	Stage 1	Stage 2	Stage 3
> 6 GPCD over the goal	Stage 1	Stage 2	Stage 3	Stage 3



Figure 1 shows the anticipated demand for water over the next sixty years. Projected onto this demand are potential drought years. The potential severity of the drought is indicated with colors that match those in the Drought Stage Criteria Chart. Whether any of those drought stages are entered into will depend upon customer response to each drought stage.

**Figure 1.**



Figures 2 and 3 show estimations of excess production in acre-feet that could activate the drought stages as outlined in the chart above. The pumping volumes shown in the graphs below are examples based on current estimates. Each year the actual criteria will be based on the annual operational plan and the GPCD goal. Figures two and three are included as examples of how the two criteria will work together in determining the drought stages.

Figure 2.

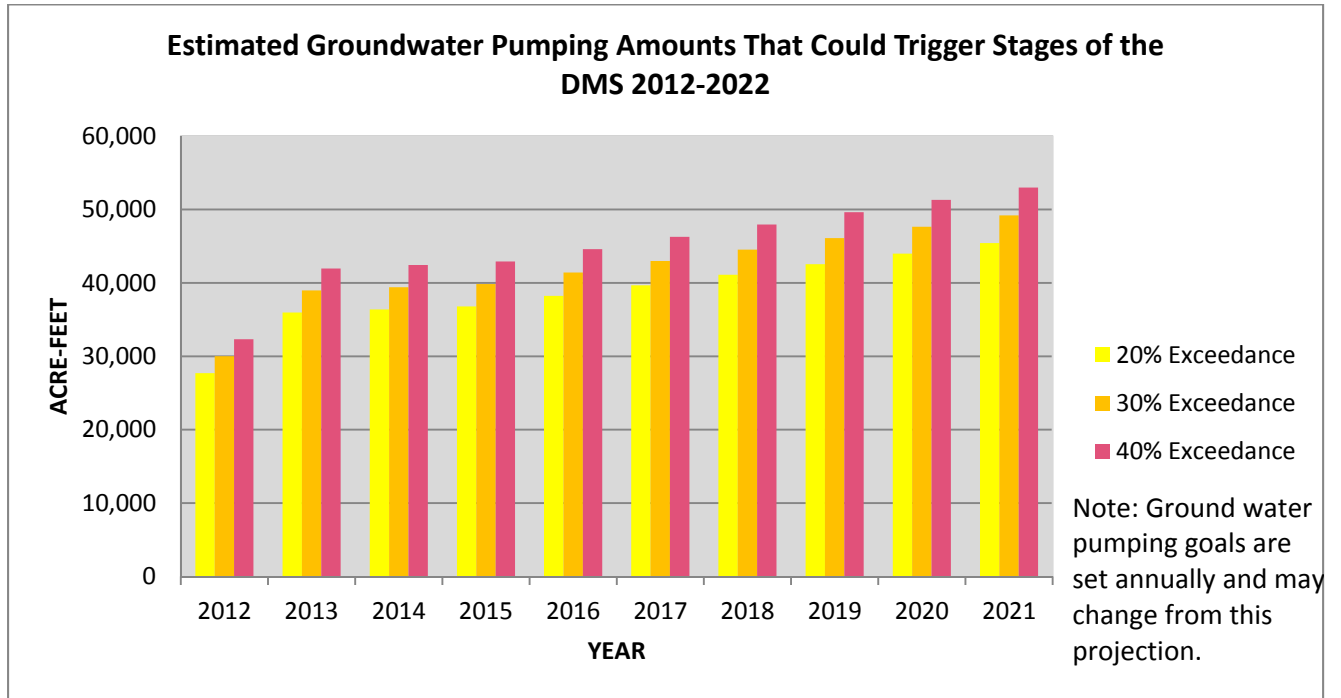
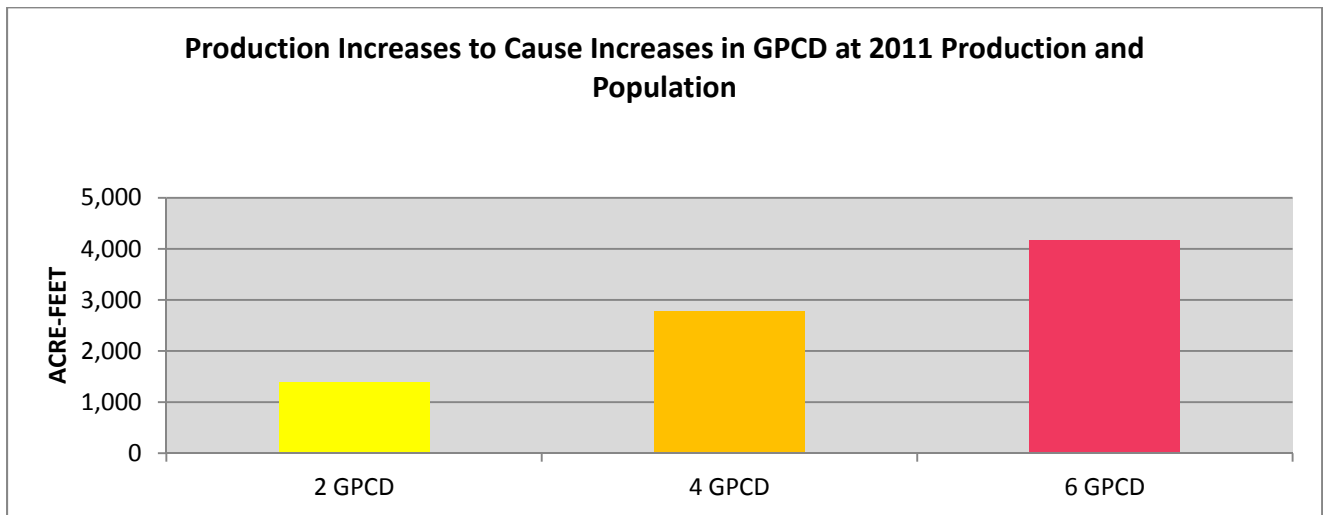


Figure 3.



**DROUGHT STAGES AND CORRESPONDING DROUGHT RESPONSE MEASURES**

Anticipated savings for the water reduction methods were calculated based on the 1997 Drought Management Strategy, water usage reductions seen in the droughts of 2006 and 2011, water usage reductions achieved by the Water Authority Conservation Program and the anticipated water use level at each drought stage based on the operational plan for 2012-2022. As the Drought Level increases, the anticipated savings from water usage reduction methods that have already been implemented at a lower level decreases.

Finally, the savings shown in the charts below are not cumulative. They are based solely upon the savings anticipated at that particular drought stage and the water use anticipated at that level of drought. Savings were calculated this way, because if the drought stage worsens then the methods being used in the previous drought stage were likely not sufficient to control water usage. Thus, they are anticipated to be not as effective at higher stages. For example: Public education is anticipated to be able to reduce annual groundwater production by 12% when used at the Drought Watch level, but is only anticipated to reduce water use by 2% at the Drought Warning stage. At the Drought Warning stage, customers will have been exposed to two increases in public education, one at the Drought Advisory level and another at the Drought Watch level, if these two educational efforts prove ineffective, it is unlikely that further increases in public education will achieve the necessary reductions in water use.

If the savings anticipated from adoption of the methods at a particular drought stage are not achieving the desired results but water use is still below the next drought stage threshold, the Water Authority Board may adopt an additional water usage reduction method from a higher drought stage or from recommendations from staff without moving to a higher drought stage. The Board may approve maintaining drought restrictions even as a drought decreases in severity in order to achieve the desired savings.

If an increase in funding is needed to accomplish any of the water use reduction methods, it will be presented to the Board for their approval at the time that the Drought Stage is approved.

<b>DROUGHT STAGE 1: DROUGHT WATCH</b>		
Water Use Reduction Method	Savings Goals as a percentage of total annual ground water production	Average Savings Goals in acre-feet (based on 2012-2022 goals)
Increase public education	12%	4,653
Double Fees for Wasting Water	5%	1,938
Offer Drought Smart \$20 rebate classes	3%	1,163
<b>TOTAL</b>	20%	7,754

<b>DROUGHT STAGE 2: DROUGHT WARNING</b>		
Water Use Reduction Method	Savings Goals as a percentage of total annual groundwater production	Average Savings Goals in acre-feet (based on 2012-2022 goals)
Increase public education	2%	840
Double Fees for Wasting Water	4%	1,680
Offer Drought Smart \$20 rebate	2%	840
Double Surcharges	10%	4,201
Water by the Numbers becomes mandatory	8%	3,360
Change Time of Day Watering Restrictions (no watering 9AM to 9PM)	2%	840
No variances granted to Time of Day Watering Restrictions	2%	840
Distribute low-flow showerheads and/or timers and educate on 5-minute showers	1%	421
<b>TOTAL</b>	<b>31%</b>	<b>13,021</b>

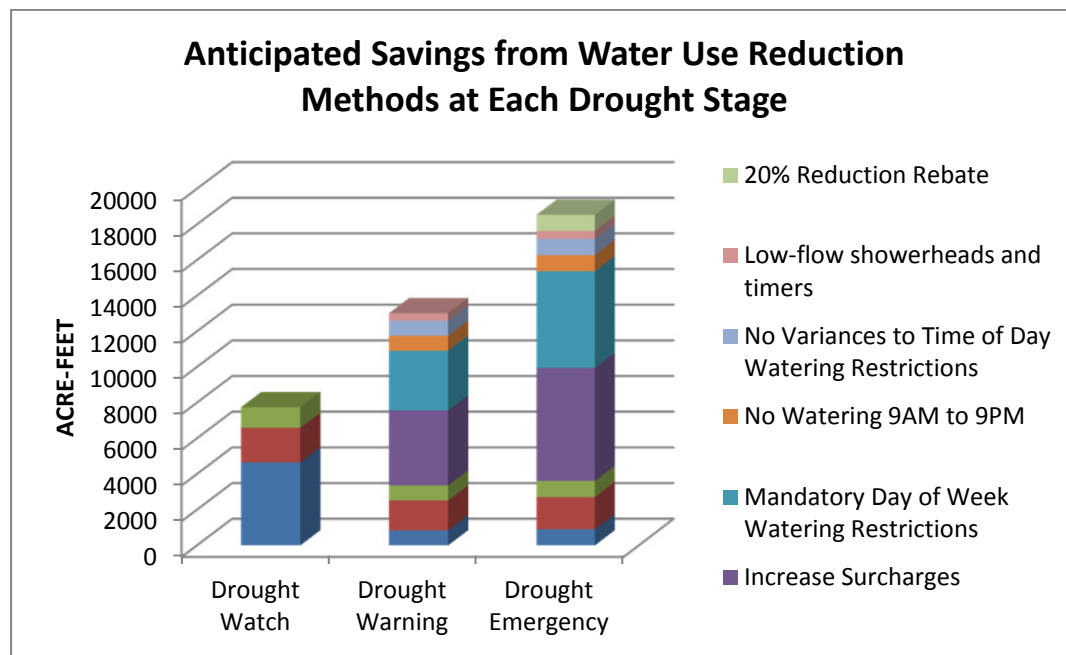
<b>DROUGHT STAGE 3: DROUGHT EMERGENCY</b>		
Water Use Reduction Method	Savings Goals as a percentage of total annual groundwater production	Average Savings Goals in acre-feet (based on 2012-2022 goals)
Increase public education	2%	904
Double Fees for Wasting Water	4%	1,809
Offer Drought Smart \$20 rebate	2%	904
Change Time of Day Watering Restrictions (no watering 9AM to 9PM)	2%	904
No variances granted to Time of Day Watering Restrictions	2%	904
Distribute low-flow showerheads and/or timers and educate on 5-minute showers	1%	452
Triple Surcharges	14%	6,333
Reduce mandatory Water by the Numbers by one day/week	12%	5,428
20% Reduction Rebate	2%	904
<b>TOTAL</b>	<b>41%</b>	<b>18,542</b>

If water use cannot be reduced sufficiently with the methods above and additional savings are needed methods may be adopted from the “Table of Options When More Savings Are Needed” found on page 11.

## DESCRIPTION OF THE WATER USE REDUCTION METHODS

The graph in Figure 4 shows the anticipated savings from each of the water usage reduction methods at each of the three mandatory drought stages. Details on implementation of each of the water use reduction methods follow below the graph.

**Figure 4.**



*Increase public education:* change water conservation communications to customers from the regular yearly message to one that educates on the current drought. A key component of the drought message will be the total number of gallons per day by which each customer needs to reduce his/her use. As drought stages increase, communicate the severity of the drought and the water use reduction methods being enacted. Education about each of the water use reduction methods adopted is critical to their success.

*Double fees for wasting water:* the Water Authority’s Water Waste Ordinance authorizes the imposition of fees for customers who put water into the public right of way, onto other private property or water during the Time of Day Watering Restriction period. Fees start at \$20 for the first violation of the ordinance and escalate to \$2,000. Under this method, the fee for the first violation would be \$40 and would continue to be double for each subsequent level. Eliminating water waste is the first step in reducing water use during drought.

*Offer Drought Smart \$20 Rebate:* the Water Authority currently offers a \$20 rebate to customers who attend a one-hour irrigation class called “WaterSmart.” During drought, this class would be changed to be “DroughtSmart” and would inform customers how to manage

their landscapes during drought. In addition, a video of the “DroughtSmart” class would be posted on our website to get the information to customers who are unable to attend the class.

*Distribute low-flow showerheads and/or timers and education on 5-minute showers:*

Showerheads and/or timers would be distributed at selected locations and mailed to customers who could not come get them. The Water Authority would also produce information to accompany the showerheads on the savings generated from taking 5-minute showers.

*Water by the Numbers Schedules:* the water conservation program educates customers year-round on appropriate watering schedules with the Water by the Numbers program, so many customers are already following a seasonal watering schedule. During drought, the Water Authority would establish watering days for even addresses and for odd addresses. Depending on the drought level, customers would be allowed to water on one, two or three of their allowed days. Any customer watering on the wrong day of the week would be issued a water waste fee by the Authority’s Water Use Compliance inspectors. Variances may be granted to this policy for large properties to allow them to water the entire landscape provided that no area of the landscape is watered more times per week than allowed by the policy.

*Change Time of Day Watering Restrictions (No Watering 9AM to 9PM):* regular time of day watering restrictions begin April 1 and end October 31 and prohibit watering from 11AM to 7PM. By adding another three hours to the prohibited period, additional water savings could be achieved because less water would be evaporating.

*No Variances Granted to Time of Day Watering Restrictions:* from April 1 through October 31 spray irrigation is not allowed from 11AM to 7PM, but customers may request a 30-day variance from this ordinance for re-seeding and planting sod. During a drought warning or emergency these variances would not be granted, except for safety considerations on public or educational playing fields. Variances may be granted for public and educational playing fields to ensure a safe playing surface.

*20% Reduction Rebate:* this rebate would be offered to customers who sign up for a program pledging to reduce their water use by 20% over last year’s use for a given period. The period of the rebate would vary depending on when the drought emergency was adopted. At the end of the set time period, customers who had reduced their use by 20% would receive a credit on their water bill. There may be a cap placed on the number of participants.

*Double or Triple Surcharges:* customers are assessed surcharges on their water bill for use in excess of two, three and four times their average winter water consumption during the irrigation season as set forth in the Water Authority Rate Ordinance. During a drought warning or emergency, the surcharges at each level would be doubled to encourage customers not to use more than two times their average winter water use during the drought.

## TABLE OF OPTIONS WHEN MORE SAVINGS ARE NEEDED

<b>Water Use Reduction Method</b>	<b>Savings Goals as a percentage of total annual groundwater production</b>	<b>Average Savings Goals in Acre-feet (based on 2012 -2022 goals)</b>
Reduce Surcharge Threshold by 25%	2%	904
Reduce Surcharge Threshold by 50%	3%	1,356
Quadruple Surcharge	18%	8,136
Triple Water Waste Fees	3%	1,356
Reduce Mandatory Water by the Numbers by two days/week	18%	8,136
Increase leak detection services	2%	904
Work with customers to reduce water intensive processes (e.g. fleet washing, nursery plant watering, power washing, construction)	1-4%	452 -1,808
Target large water users in all sectors (initiate/ follow up on audits, call customers to report on progress)	2%	904
Provide water conservation seminars to landscape firms	2%	904
Expand school programs on drought	3%	1,356
Increase an existing rebate to encourage higher levels of participation	2%	904





## **APPENDIX A**

### **SUMMARY OF CASE STUDIES DEMONSTRATING WATER SAVING METHODS AND RESULTS**

The case studies presented below support the water savings goals described in this report. A summary of these findings and comparisons to the Water Authority's Drought Management Strategy (Strategy) are presented in Table 1.

#### **PUBLIC EDUCATION CAMPAIGNS**

The city of Cary, North Carolina, put together a water conservation program that looked at the cost-effectiveness of various conservation methods (EPA, 2002). In doing so they evaluated the effectiveness of public education on water conservation and estimated that their planned public education campaign would result in 26 percent of total water savings by the year 2009 and 21 percent of total water savings by 2019. They estimated that the conservation program would reduce retail water production by 16 percent by 2028. Assuming the 2019 estimate of 21 percent water savings from public education would still apply in 2028, they would have achieved 3 percent of this total water savings as a result of the public education campaign alone. This estimate does not directly correlate with the Water Authority's Strategy goals for water savings due to public education during a drought, but it does quantify another water provider's estimate of the effectiveness of public education alone. All other water conservation and drought management plans reviewed in preparation of this section looked at the effectiveness of public education combined with other water saving strategies.

#### **INITIATION OF VOLUNTARY AND MANDATORY IRRIGATION WATERING RESTRICTIONS**

Kenney, Klein, and Clark (2004) conducted a study of water conservation measures implemented by several cities in Colorado's Front Range during drought conditions in the summer of 2002. During periods of mandatory restrictions, savings of 18 to 56 percent were seen, while voluntary restrictions saw only 4 to 12 percent savings. Many of the water providers also specified the time of day watering was to occur, special rules for irrigating trees, and allowances for hand watering. Restrictions, both voluntary and mandatory, were combined with public education campaigns and sometimes included other measures (e.g., price increases). Water providers in Thornton, Aurora, Denver Water, and Westminster limited lawn watering to once every three (3) days and saw an average reduction of 22 percent. Water providers in Fort Collins, Boulder, and Louisville limited lawn watering to twice a week and saw an average reduction of 33 percent. Water providers in Lafayette limited lawn watering to once a week and saw a reduction of 56 percent. For these studies, water use was calculated as "expected use per capita", which is a comparison of actual per capita use (deliveries) in 2002 with the level of use anticipated in 2002 had watering restrictions not been in effect and given the adverse climatic conditions associated with drought. They also saw similar results looking at "net use", which is a calculation that compares daily system-wide water deliveries in 2002 to the 2000 to 2001 average for the same dates.

**Table 1:** Summary of case studies and comparison to the Strategy

Category	Utility	Case Study Summaries		Corresponding Water Authority Goal
Public Education Campaigns	Cary, North Carolina	Estimated 3 percent water savings resulting from public education campaign.		In Stage 1, a 12 percent savings goal from public education. If drought escalates, assume 2 percent savings goal for Stages 2 and 3.
Initiation of Voluntary & Mandatory Irrigation Watering Restrictions	Survey of seven Denver-area water providers	Voluntary watering restrictions	4 to 12 percent water savings	Not Applicable
		Mandatory watering restrictions of once per 3 days	22 percent water savings (average of four water providers)	Not Applicable
		Mandatory watering restrictions of twice per week	33 percent water savings (average of three utilities)	“Water by the Numbers” becomes mandatory (31% percent water savings goal)
		Mandatory watering restrictions of once per week	56 percent water savings	Reduce mandatory “Water by the Numbers” by one day/week (41% percent water savings goal)
Surcharges	Denver Water	Surcharges are more effective when combined with a variety of other drought management options.		The Strategy combines surcharges with a variety of other conservation methods.
		Surcharges should match the severity of the drought.		Surcharges increase with each drought stage.
		Surcharges should be tailored to specific customer groups.		Surcharge volume is based on the amount of water the customer has used over their winter water use, so it is different for each customer.
		Surcharges should be implemented as temporary measures.		Surcharges are implemented with the drought stage and lifted when the stage is over.
Santa Cruz Demand Reduction Program	Santa Cruz, CA	Five stage reduction plan involving a variety of water conservation measures to realize demand reduction up to 50 percent. Plan was developed using estimated water savings achieved in previous drought situations by comparable water shortage management plans.		The Strategy implements similar water conservation methods and sets water savings goals of up to 41 percent.

The Water Authority’s Strategy implements similar methods to those described in Kenney, Klein, and Clark (2004) to achieve water savings and presents more conservative water savings goals than those presented above (e.g., The Water Authority lists a water savings goal of 31 percent for making “Watering by the Numbers” mandatory, while the Denver area water providers realized 33 percent average water savings for limiting lawn watering to twice per week.). Table 2 presents a comparison of Water Authority water savings goals to those realized by the municipalities described above.

**Table 2:** Comparison of Water Savings Realized by Denver Area Water Providers and Water Authority’s Strategy Water Savings Goals (NOTE: Each of these providers also implemented a variety of water conservation methods, including public education, rate increases, and water waste fees.)

	<b>Mandatory Irrigation Limit</b>		
	<b>Once Every 3 Days</b>	<b>Two Days per Week</b>	<b>One Day per Week</b>
Denver Area Water Providers*	22% average reduction realized	33% average reduction realized	56% average reduction realized
Water Authority’s Strategy Water Savings Goal	20% (Stage 1 water savings goal)	31% (Stage 2 water savings goal)	41% (Stage 3 water savings goal)

\*Kenney, Klein, and Clark (2004)

**SURCHARGES**

The *American Water Works Association (AWWA) Drought Preparedness and Response Manual* (AWWA, 2011) reported that Denver Water found surcharges are more effective when combined with a variety of other drought management options. By incorporating surcharges into an overall program to increase awareness of drought severity they found customers responded better and believed that this was because they had created an atmosphere where customers recognized the importance of water savings. They recommended that surcharges should match the severity of the drought. They recommended tailoring surcharges to different customer groups, because a one-size surcharge will not work with the variety of customers served. They recommended implementing surcharges as temporary measures and reinforced that the criteria determining when the surcharge is lifted should be specified before the surcharges are imposed to reinforce its temporary nature. These recommendations directly correspond to the methods implemented in the Water Authority’s Strategy.

**SANTA CRUZ DEMAND REDUCTION PROGRAM**

The *American Water Works Association (AWWA) Drought Preparedness and Response Manual* (AWWA, 2011) reported that Santa Cruz, California, updated their drought management plan (DMP) in 2009. They developed a five stage plan using estimated water savings achieved in previous drought situations by comparable water shortage management plans. The water

savings methods implemented at each stage and corresponding water savings goals presented in Table 3.

The water savings goals and methods described in the Santa Cruz DMP are comparable to those presented in the Water Authority's Strategy. The Santa Cruz DMP lists several activities not mentioned in the Water Authority's Strategy, such as coordinating conservation actions with other city departments and encouraging regular household meter reading and leak detection; however, these are actions that the Water Authority completes on a regular basis, regardless of whether they are in a drought situation.

**Table 3: Santa Cruz, California, Example Demand Reduction by Stage and Corresponding Water Savings Measured Initiated (AWWA, 2011)**

	Stage 1 (0-5% Deficiency)	Stage 2 (5-15% Deficiency)	Stage 3 (15-25% Deficiency)	Stage 4 (25-35% Deficiency)	Stage 5 (35-50% Deficiency)
	Water Shortage Alert	Water Shortage Warning	Emergency Water Shortage	Severe Water Shortage Emergency	Critical Water Shortage Emergency
Demand Reduction	0%	15%	25%	35%	50%
Measures Taken by Stage	<ul style="list-style-type: none"> <li>• Initiate public information and advertising campaign</li> <li>• Publicize suggestions and requirements to reduce water use</li> <li>• Adopt water shortage ordinance prohibiting nonessential uses</li> <li>• Step up enforcement of water waste</li> <li>• Coordinate conservation actions with other city departments, green industry</li> <li>• Voluntary water conservation requested of all customers</li> <li>• Adhere to water waste ordinance</li> <li>• Landscape irrigation restricted to early morning and evening</li> <li>• Nonessential water uses banned</li> <li>• Shutoff nozzles on all hoses used for any purpose</li> <li>• Encourage conversion to drip, low volume irrigation</li> </ul>	<ul style="list-style-type: none"> <li>• Intensify public information campaign</li> <li>• Send direct notices to all customers</li> <li>• Establish conservation hotline</li> <li>• Conduct workshops on large landscape requirements</li> <li>• Optimize existing water sources; intensify system leak detection and repair; suspend flushing</li> <li>• Increase water waste patrol</li> <li>• Convene and staff appeals board</li> <li>• Continue all Stage 1 measures</li> <li>• Landscape irrigation restricted to designated watering days and times</li> <li>• Require large landscapes to adhere to water budgets</li> <li>• Prohibit exterior washing of structures</li> <li>• Require large users to audit premises and repair leaks</li> <li>• Encourage regular household meter reading and leak detection</li> </ul>	<ul style="list-style-type: none"> <li>• Expand, intensify public information campaign</li> <li>• Provide regular media briefings; publish weekly consumption reports</li> <li>• Modify utility billing system and bill format to accommodate residential rationing, add penalty rates</li> <li>• Convert outside-city customers to monthly billing</li> <li>• Hire additional temporary staff in customer service, conservation, and water distribution</li> <li>• Give advance notice of possible moratorium on new connections if shortage continues</li> <li>• Institute water rationing for residential customers</li> <li>• Reduce water budgets for large landscapes</li> <li>• Require all commercial customers to prominently display “save water” signage and develop conservation plans</li> <li>• Maintain restrictions on exterior washing</li> <li>• Continue to promote regular household meter reading and leak detection</li> </ul>	<ul style="list-style-type: none"> <li>• Contract with advertising agency to carry out major publicity campaign</li> <li>• Continue to provide regular media briefings</li> <li>• Open centralized drought information center</li> <li>• Promote gray water use to save landscaping</li> <li>• Scale up appeals staff and frequency of hearings</li> <li>• Expand water waste enforcement to 24/7</li> <li>• Develop strategy to mitigate revenue losses and plan for continuing/escalating shortage</li> <li>• Reduce residential water allocations</li> <li>• Institute water rationing for commercial customers</li> <li>• Minimal water budgets for large landscape customers</li> <li>• Prohibit turf irrigation, installation in new development</li> <li>• Prohibition on on-site vehicle washing</li> <li>• Rescind hydrant and bulk water permits</li> </ul>	<ul style="list-style-type: none"> <li>• Continue all previous actions</li> <li>• Develop crisis communications plan and campaign</li> <li>• Establish emergency notification lists</li> <li>• Coordinate with CA Department of Public Health regarding water quality, public health issues and with law enforcement and other emergency response agencies to address enforcement challenges</li> <li>• Continue water waste enforcement 24/7</li> <li>• Further reduce residential water allocations</li> <li>• Reduce commercial water allocations</li> <li>• Prohibit outdoor irrigation</li> <li>• No water for recreational purposes, close pools</li> <li>• Continue all measures initiated in prior stages as appropriate</li> </ul>

## **REFERENCES**

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