



# Municipal Drought Management Plan Guidance Document

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- Colorado River Water Conservation District
- Northern Colorado Water Conservancy District
- National Drought Mitigation Center (NDMC)

## 1.0 INTRODUCTION TO THE MUNICIPAL DROUGHT MANAGEMENT GUIDANCE DOCUMENT

Drought is a common natural phenomenon in the State of Colorado and can significantly reduce available municipal water supplies. In order to appropriately address and reduce drought-related impacts, it is imperative for municipal water providers throughout the state to anticipate and plan for droughts. The CWCB developed this document as a means to assist municipal providers with drought planning. This Guidance Document is a reference tool that water providers and local governments throughout the state can use in developing local drought management plans. The objectives are as follows:

- Provide a comprehensive background on municipal drought management planning and recommend drought mitigation and response planning steps and components useful in developing local plans;
- Disclose the essential and recommended elements of an effective local drought management plan; and
- Ensure that the Guidance Document is applicable and useful to statewide stakeholders that vary by geographic location, size, water supply sources, financial resources, etc.

### 1.1 Scope of Document

This Guidance Document provides a comprehensive overview of municipal drought management planning in Colorado for an audience that has a moderate level of experience in water resources planning. The document is not intended for the planning of catastrophic supply interruptions or drought planning outside of municipal or local water providers.

Providers will find that some of the information presented in this Guidance Document is not applicable to their water supply system or individual drought management planning effort. Furthermore, some providers may not have sufficient data to address all of the recommendations presented in this document. The intent of this document is to provide a comprehensive overview of drought management planning. The document is intended to be used to the extent that it is beneficial to individual providers. However, there are essential components of a municipal drought management plan that should be incorporated into every plan which are discussed in detail in Section 4.0 and summarized in Section 5.0.

This document should be used in conjunction with the information presented on the CWCB website as well as in CWCB's [Drought Toolbox](#). Information and data on the CWCB website and [Drought Toolbox](#) are updated routinely, providing the most up-to-date information on drought management planning.

### 1.2 Document Organization

This Guidance Document is organized into the following sections:

- Section 3.0 – Details the general purpose, scope, and general organization of the document.



- Section 1.0 – Discusses the definitions of a drought; the importance and purpose of drought management planning; and the relationships between drought management planning, water supply reliability planning, and conservation planning.
- Section 2.0 – Addresses the State and CWCB’s role in local drought management planning.
- Section 4.0 – Introduces the eight steps common to drought management planning and provides a detailed description of each step. This information should be used in conjunction with Section 5.0 and CWCB’s [Drought Toolbox](#) when developing local drought management plans.
- Section 5.0 – Provides a template for a municipal drought management plan that corresponds with the eight-step drought management planning process detailed in Section 4.0. This section also provides lists of recommended content and corresponding level of importance for each of the eight planning steps. Providers may use this template as an organizational checklist to ensure that information important to their drought management planning effort is incorporated into the final plan.
- Appendix A – Provides a series of worksheets that providers may use as a toolkit to generate ideas, organize information, and format data for direct incorporation into their plans. Similar to the Guidance Document, all worksheet content is not applicable to every provider. Providers should use the worksheet to the extent beneficial to their situation.
- Appendix B – Provides a conceptual approach of how water supply reliability planning can be used to assist in drought management planning.
- Appendix C – Provides examples of Denver Water and the City of Boulder’s staged drought response program.

## 2.0 INTRODUCTION TO DROUGHT MANAGEMENT PLANNING

Drought is a common to every climate throughout the world. In developed countries, it affects more people than any other natural hazard and is one of the most complex and difficult natural hazards to evaluate and plan for. Drought can appear quickly or slowly, last for a season or many years, and can occur locally, regionally, or statewide. This section provides a general overview on drought and drought management planning and discusses the relationships between drought planning and other water resources planning efforts.

### 2.1 What is a Drought?

Drought may be defined as “a period of abnormally dry weather sufficiently long enough to cause a serious hydrological imbalance.”<sup>1</sup> This occurs when a normal amount of moisture is unavailable to satisfy an area’s typical water consumption, which results in a water shortage. Drought should not be viewed as merely a physical phenomenon or natural event. A drought’s impacts on a society are a result of both the natural event (less precipitation than normal) and the demand people place on water supplies. Figure 1 illustrates a drought impact from the 2002 drought in Colorado.

**Figure 1 Horsetooth Reservoir Boat Ramps in 2002 Drought**



According to the NDMC, drought may be classified as meteorological, agricultural, socioeconomical, and/or hydrological:<sup>2</sup>

- Meteorological drought is usually an expression of precipitation’s departure from normal over some period of time. Meteorological measurements are the first indicators of drought.
- Agricultural drought occurs when there is not enough soil moisture to meet the needs of a particular crop at a particular time. Agricultural drought happens after meteorological

<sup>1</sup> Glossary of Meteorology, 2nd edition. 2000. American Meteorological Society

<sup>2</sup> National Drought Mitigation Center. 2010. Accessed at: <http://www.drought.unl.edu/whatis/concept.htm>.

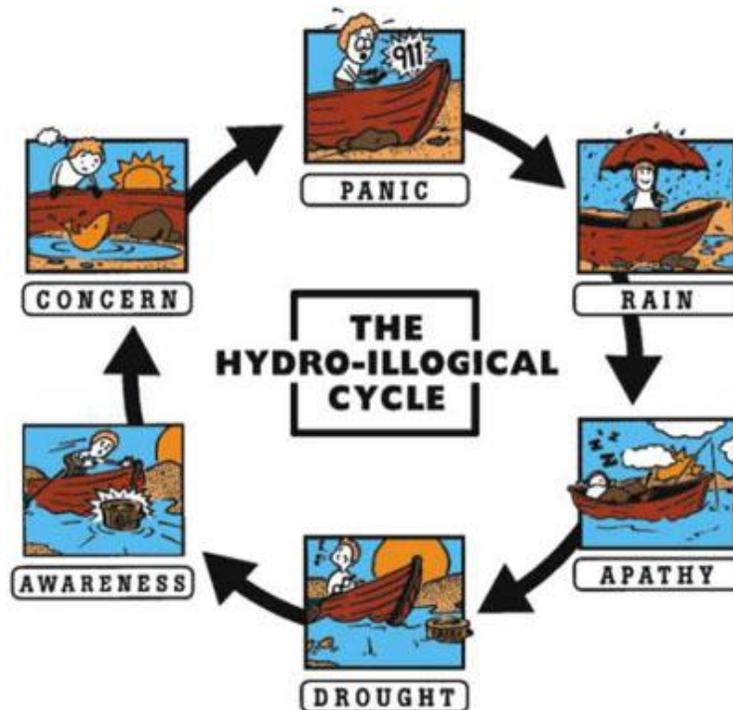
drought but before hydrological drought. Agriculture is usually the first economic sector to be affected by drought.

- Hydrological drought refers to deficiencies in surface and subsurface water supplies. It is measured as streamflow and as lake, reservoir, and groundwater levels. There is a time lag between lack of rain and reduced water in streams, rivers, lakes, and reservoirs. As such, hydrological measurements are not the earliest indicators of drought. When precipitation is reduced or deficient over an extended period of time, this shortage is reflected in declining surface and subsurface water levels.
- Socioeconomic drought occurs when physical water shortage starts to affect people, either individually or collectively. Or, in more abstract terms, most socioeconomic definitions of drought associate it with the supply and demand of an economic good.

## 2.2 Drought Management Planning

A drought does not usually have a clearly defined beginning or end and is difficult to predict. Traditionally, many water users have reacted to droughts in the manner depicted in Figure 2. During normal and wet years, water users are often apathetic to drought and do not take action to prepare for droughts. When a drought does occur, water users are not sufficiently prepared and often are too late in responding to it. As a result, drought impacts are much more severe than if water users had developed a drought mitigation and response plan in advance that would have enabled a more timely response.

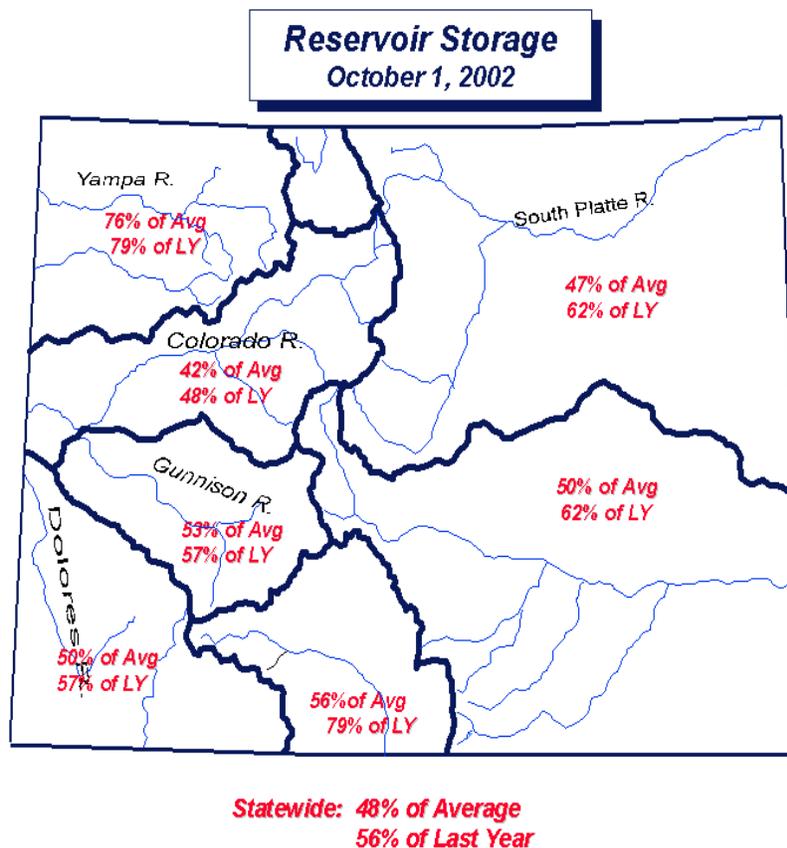
**Figure 2 The Hydro-illogical Cycle**



Source: National Drought Mitigation Center

Droughts are a natural phenomenon of Colorado's climate and as such Colorado municipal water providers need to anticipate and plan for droughts. The need for drought planning was emphasized for many municipal water providers during the statewide 2001 to 2003 drought. This was Colorado's most intense drought since streamflow recording began. In 2002, Colorado streamflows were generally the lowest in over 100 years of records, and tree ring data suggest that flows were probably the lowest in 300 to 500 years. Reservoir levels, shown in Figure 3, were 48% of normal. Although the 2001 to 2003 drought was relatively intense, evidence indicates that droughts of this magnitude will occur again. Coupled with climate change, future droughts could be more severe and of a longer duration. With Colorado's continued growth placing a higher demand on finite water supplies, it is imperative that municipal water providers be properly prepared for droughts.

**Figure 3 2002 Reservoir Storage Status Map**



Source: Luecke, Daniel F., Morris et al., 2003.

The main objective of municipal drought planning is to preserve essential public services and minimize the adverse effects of a water supply emergency on public health and safety, economic activity, environmental resources, and individual lifestyles. Effective drought management plans remove the "crisis" from drought response efforts, reduce the hardship caused by water shortages, and raise public confidence in the actions taken to address the water supply shortage.

Drought management planning is based on the following principles:

- 
- Periods of below average precipitation will occur and are unpreventable; therefore, it can be anticipated that drought-related water shortages will occur at some point in time.
  - The potential risks and impacts of drought can be considered and evaluated in advance of the actual event.
  - Response measures can be determined and implementation procedures defined in advance to avoid, minimize, or mitigate the risks and impacts of drought-related shortages.
  - Drought management planning includes drought mitigation and drought response planning.
    - Drought mitigation refers to actions taken in advance of a drought that reduce potential drought-related impacts when the event occurs.
    - Drought response planning refers to the conditions under which a drought-induced water supply shortage occurs and specifies the actions that should be taken in response.

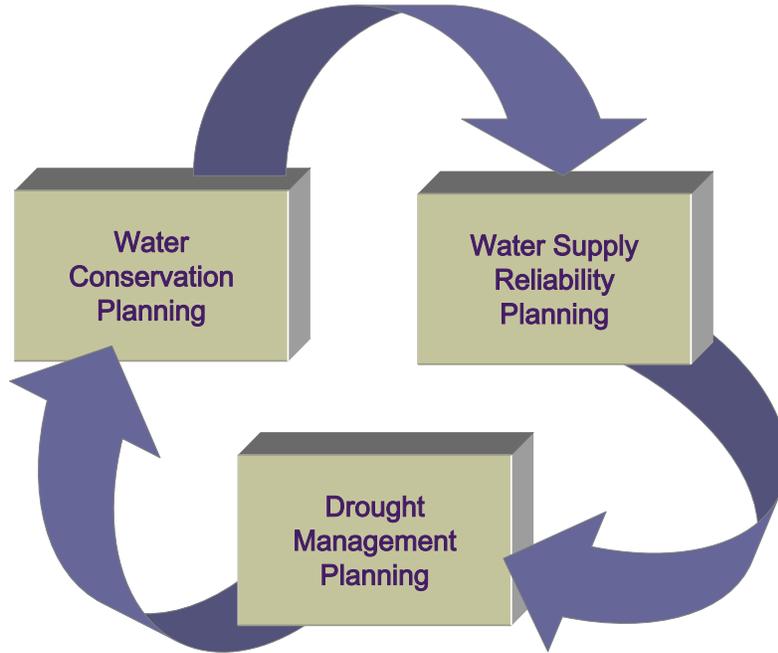
## 2.3 Drought Management, Water Supply Reliability, and Water Conservation Planning

Drought management, water supply reliability, and conservation planning are closely interrelated processes as reflected in Figure 4. While each of these processes has a unique purpose, each process is interrelated with the others. For example, the severity of a water shortage during a drought is highly dependent on the reliability of water supplies. Furthermore, conservation can be an integral component to a provider's water supply reliability planning by reducing customer demands. Effective water resource planning recognizes the link between each of these processes and the need to coordinate all three planning efforts.

### 2.3.1 Water Conservation and Drought Management Planning

Water conservation planning involves a combination of strategies for reducing water demand (i.e., improving water use efficiency or increasing reuse of water for water providers that own water rights). The main objective of a water conservation plan is to achieve lasting, long-term improvement in water use efficiency while reducing overall water demands.

In contrast, a drought management plan focuses on mitigation and response strategies that can provide short-term relief from temporary drought-related water supply shortages. Drought response measures often achieve temporary savings through changes in customer behavior during a drought. This may involve mandatory water restrictions for certain types of water use on a temporary basis. Drought mitigation generally applies to measures taken prior to a drought to avoid or reduce impacts during a drought.

**Figure 4 Conservation, Water Supply Reliability and Drought Planning**

Conservation strategies that result in an ongoing reduction in water demand can provide long-term drought mitigation benefits. For example, irrigation audits for parks, which are often employed as a conservation measure, can identify changes that will reduce the park's water demands on a permanent basis. This consequently reduces impacts during a drought water shortage if some of the supplies saved as a result of the audit are retained to improve the reliability of the overall water system rather than committed to a new use elsewhere.

In contrast to mitigation, water saving measures that are reserved for temporarily reducing water demand during a drought are more accurately considered to be short-term drought response strategies and not conservation. Whether a particular strategy is defined as solely conservation, drought mitigation, drought response, or a combination of any of these depends on the timing of the measure, how the measure is implemented by the provider, and the permanency of the change in water use.

Table 1 lists examples of conservation measures that may be implemented for long-term drought mitigation or solely as a temporary drought response strategy. Some of these strategies could be used to a limited degree as conservation measures or more extensively as voluntary or mandatory drought response measures. Measures involving alteration of fixtures or irrigation systems may not be suitable for rapid deployment in the event of a drought, but are worth initiating at the start of a drought when public awareness is heightened and the measures can produce important benefits should the drought be prolonged. Water conservation planning and drought management planning are linked together. Conservation measures included in a conservation plan could be incorporated as drought mitigation in the drought management plan.

It is recommended that conservation measures included in a conservation plan that also provide long-term drought mitigation benefits be incorporated as drought mitigation in the drought



management plan. Section 4.3.1 provides additional information on water supply reliability planning.

**Table 1 Conservation Measures, Drought Mitigation, and Drought Response Strategies**

Conservation Measures	Drought Strategies	
	Long-term Mitigation	Short-term Response Strategy
Irrigation audits for parks and open spaces	X	X
Install water saving fixtures, toilets, and/or appliances	X	
Eliminate/reduce turf and landscaping irrigation	X	X
Reduce irrigation on parks and landscaping	X	X
Limit outdoor watering to specific times of the day	X	X
Limit number of watering days per week	X	X
Set time limit for watering	X	X
Prohibit watering during certain times of the year		X
Conversion of sprinkler to low volume irrigation where appropriate	X	
Identify high water use customers and develop water saving targets	X	X

**2.3.2 Conservation and Demand Hardening**

Demand hardening is a concept described by the following: “By saving water, long-term conservation can also reduce the water saving potential for short-term demand management strategies during water shortages.”<sup>3</sup> For instance, during times of a drought, savings achieved through outdoor watering restrictions may be used for more essential indoor uses. If the amount of irrigated turf is reduced in advance of a drought through conservation measures, a reduced “water savings potential or buffer” through outdoor irrigation savings is available during times of drought.

Whether this “buffer” is actually greater prior to conservation than with conservation largely depends on how the saved water is used during normal and wet years. If saved water is stored in a reservoir as drought reserves or temporarily leased for agricultural use, the conserved water would be available during times of drought. Consequently, if the water saved through conservation is used to supply new growth, the savings may not be available during drought periods.

The intricacies of how certain conservation efforts affect the reliability of a provider’s water supply during a time of drought are complex. The effects of demand hardening will vary widely among providers. It is not the intent of this document to define how providers perceive and experience demand hardening within their water supply systems, but rather to introduce the concept. Providers may need to address this issue while developing their drought management and conservation plans.

<sup>3</sup> Flory, J.E., and T. Panella, 1994.

### **3.0 ROLE OF THE STATE AND DROUGHT MANAGEMENT PLANNING RESOURCES**

The State has a vested interest in supporting local drought management planning. CWCB's Office of Water Conservation and Drought Planning (OWCDP) promotes water conservation and drought planning through a variety of activities, including the development of this Guidance Document. The OWCDP is the lead agency responsible for the update and implementation of the Colorado Drought Mitigation and Response Plan. Section 3.0 addresses the State's role in local drought management planning, how local plans link with the State Plan, how the State may assist providers in the development of municipal drought management plans, and provides additional resources that providers may use to develop drought management plans.

#### **3.1 State Drought Mitigation and Response Plan and Local Drought Management Planning**

The intent of the Colorado Drought Mitigation and Response Plan (State Drought Plan) is to provide an effective and systematic means for the State of Colorado to mitigate and respond to drought problems, which may occur over the short or long term. The State Drought Plan is an annex to the State of Colorado Multi-Hazard Mitigation Plan and is revised every three years in accordance with Federal Emergency Management Agency (FEMA) state mitigation planning requirements per the Disaster Mitigation Act (DMA) of 2000. It underwent a major revision in 2010 which resulted in: an enhanced link between state and local drought planning efforts; the development of this Guidance Document; and web-based resources for drought planning. In addition, the State Drought Plan contains useful reference for local planning including information regarding: previous droughts; actions taken by the State in responding to droughts; state-level drought monitoring, triggers, indices, and thresholds; and mitigation and response measures. The Plan can be referenced through the CWCB website.

The Disaster Mitigation Act of 2000 requires that state and local hazard mitigation plans are "linked." CWCB is developing a database to track key information in local plans, including items such as basic entity information, potential impacts identified in the local plans, and drought mitigation measures that each entity employs. Thus, the State Drought Plan will incorporate local-level drought planning information in future updates. Local plans will be used to inform State drought planning efforts to ensure that local needs and plans are taken into consideration.

Another effort of the 2010 update process was the development of detailed methods to gauge the impacts of drought on municipal water supplies, recreation and tourism, socioeconomic elements, agriculture, energy, and the environment. The results of this detailed vulnerability assessment can be used to assist and inform local planning efforts. The State also intends to develop tools to improve the assessment of local drought impacts so that informed and timely response measures can be implemented during times of drought.

Local municipal drought management plans should be coordinated with the State Drought Plan and other local plans including county or municipal level multi-hazard mitigation plans and emergency operations plans to reduce redundancy and capitalize on joint efforts. Regional, county, or municipal multi-hazard mitigation plan may be a source of information on drought



history and vulnerability, and may contain mitigation action strategies that may benefit or enhance local planning efforts.

## 3.2 Role of CWCB and Local Drought Management Planning

In 2004, the Colorado General Assembly passed House Bill 04-1365, which expanded the mission and duties of CWCB's Office of Water Conservation and Drought Planning (OWCDP) to reflect the State's involvement in drought mitigation and response planning and the need to provide more information relating to drought and water conservation to water users and the public.

OWCDP provides public information and technical and financial assistance for water conservation and drought planning. Drought planning is promoted by encouraging and assisting communities to prepare and implement drought mitigation plans and by monitoring drought impacts and informing the public, media, and state officials.

Specifically the OWCDP provides the following:

- Maintains a clearinghouse of water conservation and drought information and disseminates that information to the public;
- Provides technical assistance and evaluates and approves water conservation and drought mitigation plans;
- Provides financial assistance for water conservation planning, water efficiency, drought mitigation planning, and public education and outreach through the Water Efficiency Grant Program;
- Provides leadership through the Water Availability Task Force to monitor, forecast, mitigate, and prepare for drought; and
- Coordinates with multiple state and local agencies to provide public information.

### 3.2.1 Technical Assistance

The OWCDP provides a portfolio of drought planning resources that providers may use to develop drought management plans. These resources may be accessed through CWCB's [Drought Toolbox](#) and include:

- Frequently Asked Questions (FAQs) – Raises awareness and educates the public about drought.
- Resources for Local Drought Planning – Contains links to the Guidance Document, potential funding sources, drought assistance programs, examples of municipal drought management plans submitted to the CWCB for approval, information on drought impacts experienced by

local entities statewide, and other resources water providers and local governments can use for drought planning.

- Funding Sources – Provides a list of current and potential funding sources.
- Technical Resources – Provides links to drought monitoring data and other monitoring resources.
- Current Drought Status – Provides information on the current drought status in Colorado.
- Contacts – Provides regional and field contacts useful to the public and local governments for drought-related information.
- Internet Resources – Provides links to other drought-related websites.
- Climate Change – Discusses drought and climate change.

The [Drought Toolbox](#) will be updated routinely, providing the most up-to-date information on drought management planning.

The OWCDP may be contacted directly for drought-related information and technical assistance at 303-866-3441. The CWCB website also provides [key contact](#) information.

### **3.2.2 Financial Assistance**

The OWCDP also administers the Water Efficiency Grant Program, which provides financial assistance to communities, water providers, and eligible agencies for water conservation and drought-related activities and projects. Additional information on this program is provided on CWCB's [financial assistance](#) webpage.

## 4.0 STEPS TO DROUGHT MANAGEMENT PLANNING

This section may be used in conjunction with Section 5.0 to develop drought management plans. This section details a step-by-step process providers may use in developing municipal drought management plans, while Section 5.0 provides a corresponding template that municipalities may directly incorporate into the framework of their plans.

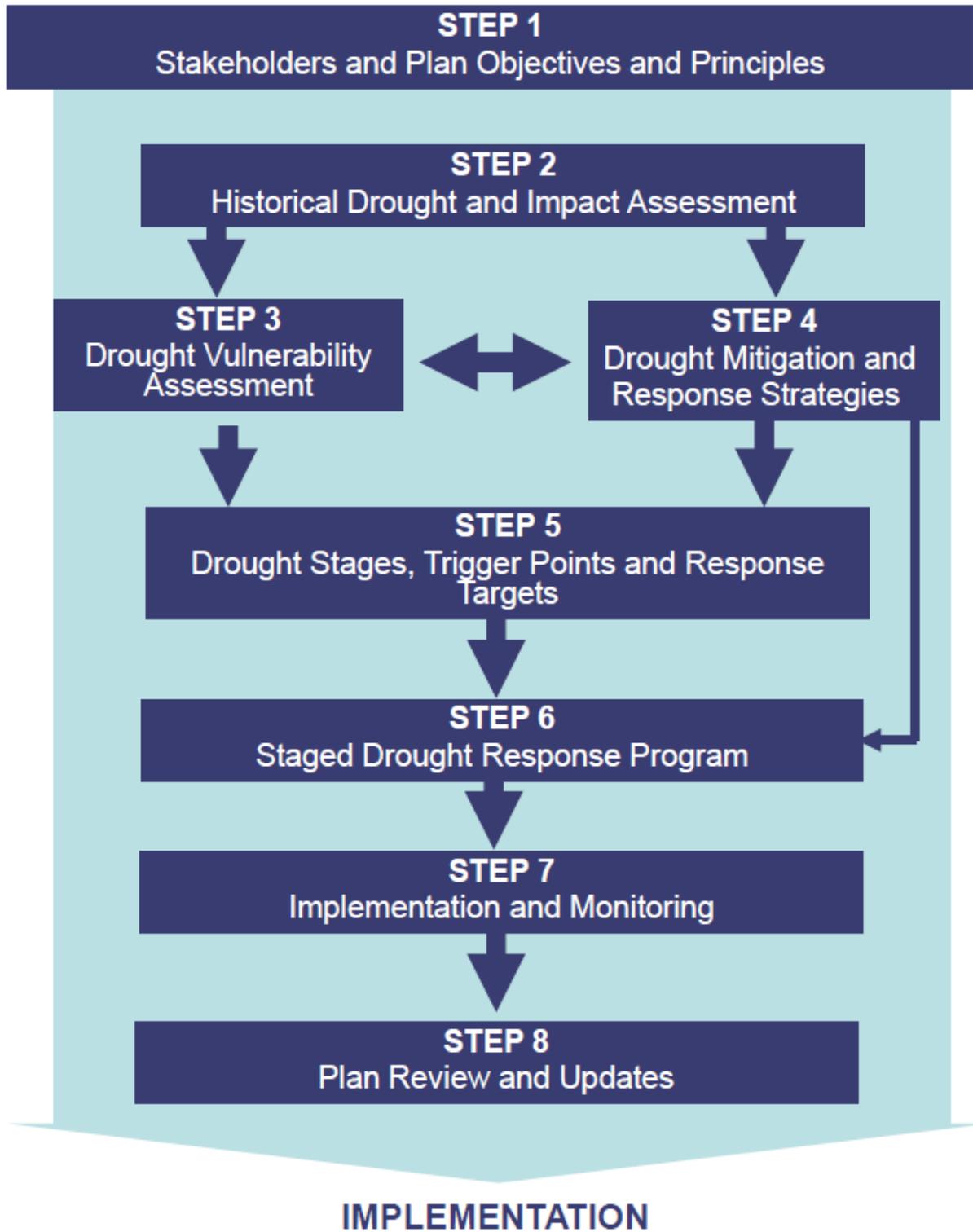
The drought planning process consists of the following eight drought planning steps. These steps are illustrated in Figure 5.

- *Step 1: Stakeholders and Plan Objectives and Principles* – Focuses on the preliminary steps necessary to initiate the development of a drought management plan. This includes developing a planning team, securing stakeholder involvement, and developing plan objectives and operating principles.
- *Step 2: Historical Drought and Impact Assessment* – Evaluation of the severity of historic droughts and corresponding effects on a provider’s water supply system and service area demands. This step also includes the identification of specific drought-related impacts and an evaluation of historic drought mitigation measures and response strategies. This information is useful for the screening and selection of future drought mitigation and response strategies in Step 4.
- *Step 3: Drought Vulnerability Assessment* – Review of water supply reliability planning efforts. Information from water supply reliability planning may be useful in identifying drought trigger mechanisms and response targets in Step 5. This step also includes the identification of potential drought impacts and perceived severity of impacts. This information is useful when identifying drought mitigation and response strategies in Step 4.
- *Step 4: Drought Mitigation and Response Strategies* – Selection of a combination of mitigation and response strategies. Drought mitigation is to be implemented prior to a drought to avoid and/or reduce potential future drought impacts. Drought response strategies will be further refined in Step 6 in accordance with individual drought stages (severity). This step also includes guidance for the development of a public education and awareness strategy.
- *Step 5: Drought Stages, Trigger Points, and Response Targets* – Identification of drought stages and corresponding drought trigger points and response targets. These may be specific criteria adhered to during a drought or simply guidelines that a provider can incorporate into the drought monitoring and response efforts.
- *Step 6: Staged Drought Response Program* – Development of the specific drought response measures for each drought stage using the response strategies developed in Step 4. These response measures should describe the actions necessary for water providers and customers need to take to reduce water demand and enhance water supplies during each individual

drought stage. This step may also include the development of a public drought education campaign plan.

- *Step 7: Implementation and Monitoring* – Implementation of the drought management plan, which includes an action plan for: mitigation; monitoring of drought indicators; drought declaration protocol; implementation and enforcement of the staged drought response program; revenue planning; and monitoring of the drought response effort.
- *Step 8: Plan Review and Updates* – Establish formal processes to review, approve, and update the drought management plan. This may include a public review process, review and approval by the local government (e.g., city council/board), adoption of necessary policy, and a plan for future updates.

Figure 5 Eight-Steps to Municipal Drought Management Planning



## 4.1 Step 1 – Stakeholders and Plan Objectives and Principles

Step 1 focuses on the preliminary actions needed to initiate the development of a drought management plan. This includes an interactive stakeholder process that facilitates the inclusion of a variety of perspectives during plan development. This also includes the development of plan objectives and operating principles that reflect the values of the provider and stakeholder group. These objectives and operating principles facilitate a guidance framework for the development and implementation of the plan.

### 4.1.1 Drought Planning Committee

Drought management plans are most effective when a drought planning committee (Drought Committee) that includes stakeholders from throughout the water provider's organization is involved throughout the development of the plan. Plans that are developed within a "vacuum" of only one or a few people risk the potential of community conflicts or water supply system complications when water supplies are stressed during times of drought. An interactive, collaborative stakeholder process provides valuable insight and perspectives necessary for an effective, comprehensive drought management plan.

It is recommended that a minimum of two meetings be held with the Drought Committee as the plan is being developed. These meetings should focus on the development of the drought management plan objectives and operating principles and facilitate a means to collect and review data and receive feedback on specific aspects of the plan. The Drought Committee should also have an opportunity to review and comment on the final drought management plan. The Drought Committee could also be activated during times of drought to coordinate and implement specific drought response activities and make recommendations to appropriate decision makers.



In order for the Drought Committee to reflect the multidisciplinary nature of drought, it is recommended that the Drought Committee consist of decision makers and representatives from throughout the municipality's local government. At a minimum, this should include senior staff representing key water-related departments such as parks, water and wastewater treatment facilities, etc. All departments potentially affected by drought should be also considered as potential stakeholders. For instance, the financial, planning, and public works

departments could be affected if water bill formats are to be modified, revenue changes are seen in response to a drought or additional capital improvements are needed or accelerated, such as leak repair or well maintenance.

The Drought Committee's stakeholders will vary for each individual provider. Smaller providers whose water system staff consists of one to three people may have a much smaller Drought Committee than a provider supplying water to a major metropolitan area. The following list of potential stakeholders may be used as a starting point in identifying stakeholders for the Drought

Committee. Depending on the organizational structure of a particular water provider, one individual may hold several of these stakeholder duties.<sup>4</sup>

- City or General Manager – provide overall direction on the drought response.
- Drought Response Team Leader – lead the coordination, gather and disseminate information. Make key support staff assignments, clarify roles, and communicate with broad array of interested parties.
- Water Treatment Manager – provide guidance on treatment operations and capabilities.
- Water Quality Manager – provide guidance on drinking water quality and quality issues related to potential alternative supplies.
- Water Resources Manager – provide guidance on water source availability, water rights yields, reservoir storage levels, and opportunities for use of non-potable water.
- Finance Manager – provide cost estimates for supply alternatives and demand reduction programs, customer database improvements and bill format changes, expected lost revenue estimates, recommend rate changes, and use of the revenue stabilization fund.
- Conservation Manager – provide water use reduction measures management, cost estimates to achieve demand reductions, and act as a liaison with green industry and large water users.
- Planning/Engineering Manager –lead efforts for new connection water use projections, new and expanded supply infrastructure, interconnection planning, and water quality treatment improvements.
- Operations Manager – oversee meter reading frequency, meter accuracy, and system water loss audit and repair.
- Customer Service – provide current information about the state of the program to customers.
- Administrative staff – hire staff, purchase equipment, and negotiate union contract adjustments.
- Legal staff – review legality of program, rate changes, interagency agreements and contracts, and the need for board or council approval of actions.
- Communications Director – oversee messaging, customer relations, media relations, press releases, and coordination with wholesale customers.

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<sup>4</sup> The majority of stakeholders presented in this list were taken directly from the State of California’s Urban Drought Guidebook 2008 Updated Edition developed by the Department of Water Resources.

Regional and public collaboration at the onset of the drought management plan development can provide numerous benefits. The following ideas may be evaluated by the Drought Committee and incorporated into the drought management plan development process to improve overall regional and public collaboration:<sup>5</sup>

- Establish a community advisory committee;
- Organize meetings with sanitary districts, local cities, counties, tribes, water suppliers, regional health and water quality boards, etc;
- Establish a regional public communication program; and
- If others use the same sources, coordinate withdrawals and pumping quantity and timing.

While it is highly recommended that a public review process take place at some point in the plan development, there are many forums in which this may occur. Interested members of the public and special interest groups may be included in the Drought Committee or an advisory committee. This could include key business owners, golf course manager(s), representatives from non-profit groups, large homeowner associations, or public school districts. A public advisory group could also be developed to review the plan development during key stages. A general public review process involving the distribution of the draft Drought Plan and/or public meetings are also options. Additional information on public involvement is provided in Sections 4.4.3 and 4.6.2.

#### 4.1.2 Objectives and Operating Principles

As previously mentioned, the Drought Committee should initially be tasked with development of a set of drought management plan objectives and operating principles. The plan objectives should clearly state the purpose of the plan. The drought operating principles should provide a set of guidance criteria that the Drought Committee can return to while developing the plan and also when making decisions in times of a drought. The American Water Works Association (AWWA) Drought Management Handbook provides the following list of questions when developing objectives and operating principles;<sup>6</sup>

##### City of Boulder's Drought Plan Objectives

- Planning for droughts before they occur
- Identifying and classifying a drought given knowledge of our water supply and use
- Responding to a drought by increasing supply and decreasing demand

- Which water uses should be restricted during drought conditions? Which water uses can tolerate drought conditions better than others?
- Should potential drought restrictions apply across-the-board or be directed only to certain water uses? Should non-essential uses be banned?
- What about water uses that are often

<sup>5</sup> These ideas were taken directly from the State of California's Urban Drought Guidebook 2008 Updated Edition developed by the Department of Water Resources

<sup>6</sup> Source: AWWA. 2002. Drought Management Handbook. pg 4.

overlooked during droughts, such as recreation and instream uses? How should fish and wildlife and other environmental concerns be incorporated into the plan?

- What legal or institutional requirements affect the community? Do minimum flow requirements exist for certain streams? Do reservoir conservation requirements need to be met? Are there sufficient streamflows for waste assimilation purposes? Do these requirements conflict with other water uses?
- What effect would priority-setting have on water cost and on equity considerations such as equal access to water service?

### **Aurora Water's Declaration of Policy, Purpose and Intent**

In order to conserve the available water supply and protect the integrity of water supply facilities, with particular regards for domestic water use, sanitation, and fire protection, and to protect and preserve public health, welfare, and safety and minimize the adverse impacts of water supply shortage or other water supply emergency conditions, Aurora Water hereby adopts the following regulation and restriction on the delivery and consumption of water.

These questions are not applicable to all providers. Similarly, there are likely additional factors not mentioned here that providers should consider when developing drought objectives and principles. Nevertheless, it is essential that a provider's water use priorities are reflected in either the objectives or operating principles.

Generally, a municipal water provider's priorities will assume essential human needs are the primary priority with economic, quality of life, and environmental considerations as secondary priorities. An example of water use priorities developed by the City of Santa Cruz, California in

a study to examine the degree of hardship that could occur under different hypothetical drought scenarios includes:<sup>7</sup>

- Health and safety – This is the highest priority use of water. All residential interior and non-residential sanitary uses are assumed to fall under this priority, as is all usage at the wastewater treatment plant.
- Business – This second priority use of water includes all usage that is related to commercial activity in the city. All nonsanitary uses in the business class are assigned this priority, as are all uses by the agriculture, industrial, golf, municipal, and miscellaneous classes of service.
- Outdoor irrigation – This lowest priority use includes all outdoor usage in single family or multi-family homes, University of California Santa Cruz, and large landscape classes.

The following list is another example of priorities with the first priority being the highest then decreasing sequentially in importance:

- Health and safety – interior residential, essential commercial, school use, sanitation, hospitals, and fire fighting;

<sup>7</sup> Source: American Water Works Association. 2002. Drought Management Handbook. Pp 55 -71.

- Commercial and industrial – use necessary to maintain economic base and protect jobs;
- Water for new construction;
- Large landscaping features on public parks – direct water to trees and shrubs;
- Large residential landscaping features – direct water to trees and shrubs; and
- Outdoor residential turf irrigation.

The plan objectives and operating principles play an important role in guiding the development and implementation of the mitigation and response strategies. The drought management plan will be most effective if these objectives and principles generally reflect the values of a provider's service area and it is recommended that the public also has an opportunity to review these objectives and principles. This is discussed in further detail in Section 4.8.4.

## 4.2 Step 2 – Historic Drought and Impact Assessment

Information from historic drought events can provide important benchmarks and insight for projecting and planning for future drought conditions. This includes an assessment of the historic frequency, duration, and spatial extent of past droughts as well as characterizing demands, supply availability, storage, and impacts during these drought periods.

### 4.2.1 Historic Assessment of Drought, Available Supplies, and Demands

Water supply reliability is a function of how well supplies meet demands over time and under various hydrologic conditions. During times of drought, available water supplies typically decrease (see Figure 6). Demands may either increase in response to less rainfall and higher outdoor evapotranspiration rates or decrease due to drought response measures such as outdoor watering restrictions.

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**Figure 6 Carter Reservoir During 2002 Drought**



A historic assessment of drought, available supplies, and demands focuses on the following:

- *Identification and characterization of historic drought periods* – What drought indicators and data may be used to characterize historic drought periods (i.e., percentage snowpack)? How can these data be used to characterize the severity, frequency, and spatial extent of previous droughts?
- *Supply assessment* – What changes were observed in the availability of water supplies (e.g., direct flows, storage amounts, groundwater levels, etc.) during previous droughts? How did these changes correlate to the identified drought indicators and data? Are there other factors that contributed to water supply availability (i.e., mechanical issues or water quality) during the drought?
- *Demand assessment* – What changes were observed in customer water demands? Did water demands increase or decrease and what factors caused the change? Can general relationship(s) be established between drought response measures implemented in the past and their corresponding demand reductions? If so, is there sufficient data available to evaluate the effectiveness of specific drought response measures that were implemented?

#### 4.2.2 Drought Indicators and Characterization of Historic Drought Periods

There are a variety of drought related resources, indices,<sup>8</sup> and hydrologic data that can be used to identify and characterize drought. In addition to analyzing data to recognize emerging drought, understanding of past drought data can also be useful. The Colorado Drought Mitigation and Response Plan has a summary of historic drought periods and can be a useful reference to begin researching past drought impacts. Another source of historic drought information may be local multi-hazard mitigation plans.

The following drought indicators may be used by providers to characterize current and historic hydrologic conditions and assess drought severity relative to normal hydrologic conditions. Additional information on each of these drought indicators is provided in CWCB's [Drought Toolbox](#).

- U.S. Drought Monitor – provides a weekly national drought summary and map. The map uses a drought severity classification system to illustrate drought conditions around the country.



- Standardized Precipitation Index (SPI) – Probability index based on precipitation.
- Surface Water Supply Index (SWSI) – This index was developed to describe drought severity where water availability is driven by winter snow accumulation and subsequent melt. The input variables of this index are currently being

<sup>8</sup> Additional information on drought indices is provided in CWCB's [Drought Toolbox](#).

modified to only include observed streamflows, forecasted streamflows, and reservoir storage data. The specific input variables used for the index will vary according to time of year.

- Colorado Modified Palmer Drought Index (CMPDI) – A standardized index based on soil moisture.
- Observed streamflows – Streamflows recorded at key gage locations.
- Natural streamflows – Observed streamflows adjusted to account for upstream water diversions and importations.
- Reservoir levels – Reservoir surface elevation and/or storage in key reservoirs.
- Precipitation records – Precipitation records within a specific watershed.
- Snowpack – Snow depth, percentage water content, percentage of annual average snowpack.
- Snowpack sublimation – Loss of snowpack characterized by snow turning directly into water vapor without passing through the liquid stage.
- Groundwater levels – Groundwater level elevations.
- Administration of the river – Call data during the drought period.
- Soil moisture content.
- Evapotranspiration rates.

CWCB's [Drought Toolbox](#) lists a variety of resources that may be accessed to obtain data for each of the drought indicators listed above.

### 4.2.3 Supply Assessment

The extent to which a municipal water supply system is affected by drought depends on a variety of factors. These include the severity and duration of a drought event, specific water supply sources, seniority of water rights, drought storage reserves, and drought mitigation and response measures in place to address potential shortages. Providers can learn a great deal about their water supply systems and envision how they may behave during future drought conditions by assessing water supply availability and storage during historic drought periods.

Providers may use the following applicable data to characterize water supplies during historic drought periods:

- Water treatment plant(s) production;

### Summary of Historical Water Supply Conditions for 2002 Drought

In 2002, Colorado experienced a statewide drought declaration. The Ute Water Conservancy District's primary water source and the Lower Molina Power Plant were out of water by mid-July and the Vega Reservoir did not fill. The Town of Palisade's Cabin Reservoir only reached 75 percent of normal, yet spring sources remained steady. The City of Grand Junction's Purdy Mesa and Juniata Reservoirs began the season about 75 percent full following runoff, with about 1,100 acre feet of municipal water available on top of Grand Mesa. The Historic User Pool only received approximately 75 to 80 percent of full allocation but had water for the full irrigation season.

Source: Clifton Water District, City of Grand Junction, Town of Palisade and Ute Water Conservancy District 2003 Drought Response Plan

- Reservoir storage and releases;
- Supplies available through direct flow water rights;
- River call records;
- Wholesale water supply allocation;
- Well production data (valuable insight may also be gained by comparing maximum production levels to groundwater levels if data is available);
- Non-potable raw water production including ditch water diversions;
- Reclaimed water use; and
- Supplies purchased or leased.

Other factors that impact a provider's water supply system should be identified such as water quality or operational and mechanical issues that can arise due to drought conditions.

#### 4.2.4 Demand Assessment

Changes in water demands during historic drought periods are a valuable data source to assess customer water use behavior and total water demands changes that may occur during future droughts. This information can also be used to evaluate the effectiveness of historic drought mitigation and response efforts. There are a variety of ways water demand data may be used to evaluate customer behavior and the overall effectiveness of specific drought response measures, including:

- Total water demands – water usage by all customers within the service area. This may be used to measure the overall drought response of the entire customer base.
- Per capita demand<sup>9</sup> – total water usage per service area population. This information is useful when comparing water demands over time in a service area that has experienced significant growth and developmental changes (i.e., comparing water demands of a service area for two different drought periods).

<sup>9</sup> There are a variety of ways per capita water demand may be estimated. For example, one of the most common methods for estimating per capita water use is dividing the total water demand by population within the service area. A thorough discussion of how these various methods and the associated advantages/disadvantages of each is beyond the scope of this document.

- Total water demands by customer type – total water usage by customer types (e.g., residential, industrial, parks, etc.) This may be used to characterize the effectiveness of drought response measures targeted at specific customer types.
- Per capita demand estimates by customer type – average individual water use by customer type. This is also useful to characterize the effectiveness of specific drought response measures targeted at specific customer types.

### **Aurora Water Lessons Learned From the 2002 Drought**

During the 2002 drought, Aurora Water's storage reached 25 percent of total capacity. Aurora Water learned that they were not sufficiently prepared for droughts as extreme as experienced 2002. In response, Aurora Water developed a variety of tools to enhance water supply forecasting and planning guidance during drought periods. This included a Drought Contingency Plan, a water supply forecasting model based on reservoir levels, and an annual water management plan that sets the water restrictions and level of enforcement for the upcoming year. The 2002 drought also initiated the development of the Prairie Waters Project which, on completion, will increase Aurora's water supply by 20 percent reusing return flows.

- Indoor and outdoor demands – total indoor and outdoor water use. Provides ability to assess effectiveness of drought response measures that focus on either indoor or outdoor water use.
- Peak period demands – use during the maximum hour, day and month. This is used to assess adequacy of infrastructure capacity to meet water demands and determine any specific use limitations that may need to be imposed during a drought.

While these data may improve the overall predictability of future customer demand response to a drought, billing systems are often not set up to record customer demand data to such a level of detail. For example, a typical billing system for a small or medium sized provider may only record

water use by a generic account number without differentiating the type of customer class (residential vs. industrial). Furthermore, many small providers may not have the means to permanently retain historic billing data. This information can be extremely valuable for water supply reliability, conservation, and drought related planning efforts. While not a requirement, it is recommended that these billing systems be updated in order to improve the overall sophistication of drought planning and water resources planning. At a minimum, providers are encouraged to have a billing system that retains historic water usage records and that these data are routinely consolidated to provide total monthly and annual demands. It is also important to note that detailed demand information may be useful for water supply reliability planning purposes in developing projections of future water demands, including water needs during times of drought.

#### **4.2.5 Historic Drought Impact, Mitigation, and Response Assessment**

Droughts can impact municipalities in a variety of ways. Table 2 provides a list of impacts that can directly affect municipal providers. In addition to these impacts, there are a variety of community, societal, economic, environmental, and recreational impacts that can affect a municipality.



**Table 2 Drought Related Impacts on Municipal Providers**

Drought Related Provider Impacts
Loss of revenue from reduction in water sales
Reduction in municipal well production
Reduction in storage reserves
Disruption of water supplies
Degraded water quality
Higher water treatment costs
Sediment and fire debris loading to reservoirs following a wildfire
Increased costs and staff time to implement drought plan
Increased data/information needs to monitor and implement drought mitigation plan
Costs to acquire/develop new water supplies/water rights transfers
Costs to increase water use efficiency
Public favorable/unfavorable perception of provider regarding drought response
Scarcity of equipment and other water related services (i.e., contractors to repair wells)

Information on historic drought impacts can be useful for the screening and selection of future drought mitigation and response strategies discussed in Step 4. A series of worksheets have been developed to assist with this process. *Worksheet A* provides a detailed list of potential drought impacts that providers may use to record historic drought impacts and identify corresponding mitigation and response measures previously implemented to address the impact. *Worksheets B and C* list potential drought mitigation and response strategies. Providers may use this list to identify specific measures and response strategies implemented during past periods of drought.

**2002 Drought and Billing System**

During the 2002 drought, Pagosa Area Water and Sanitation District learned that their water conservation plan did not properly address their rate structure for large commercial customers during drought conditions. Water bills for some large commercial accounts were disproportionately escalated up to \$2000 to \$3000. Consequently, many commercial customers had to be issued rebates. This required a significant amount of staff time and was exceptionally stressful in the middle of the drought.

This information, coupled with demand data discussed in Section 4.2.4, provides a means to assess the effectiveness of historic drought mitigation and response strategies by comparing water demands to the mitigation and response measures that were historically implemented. Additional available information, such as the number of rebates distributed during the drought period or conclusions from a public survey on the drought response effort, can also prove valuable in assessing the effectiveness of historic drought mitigation and response efforts. *Worksheet A* also provides a means to qualitatively rank the overall effectiveness of the historic mitigation and response strategies, as well as document any challenges faced while addressing those impacts.

### 4.3 Step 3 – Drought Vulnerability Assessment

Step 3 addresses water supply reliability planning and the identification of future potential drought impacts. This information is helpful in selecting the drought mitigation and response strategies described in Step 4.

#### 4.3.1 Water Supply Reliability and Drought Management Planning

Water supply reliability may be defined as the ability of a water supply system to meet the needs of its customers during times of stress. The reliability of a provider's water supply system depends on a multitude of factors such as specific water source(s), seniority of water rights, storage capacities and amounts, and rate of customer demand growth. Many providers throughout the State have found it necessary to assess the reliability of their supplies under stressed drought conditions in order to ensure that they have sufficient supplies to meet anticipated current and future water demands. This is often referred to as water supply reliability planning.

In contrast, drought management planning generally focuses on the mitigation actions and response strategies a provider may implement to lessen drought impacts. Nevertheless, water supply reliability planning is an important component of ensuring sufficient supplies during times of drought. While water supply reliability planning is beyond the scope of this document, the development of drought management plans should closely tie with water supply reliability planning. Conversely, future water supply reliability planning efforts may be enhanced through the insight gained from the development of a drought management plan.

The Statewide Water Supply Initiative Phase 2 (SWSI 2) effort documented several concepts that may be useful for providers in understanding water supply reliability and developing drought management plans. These include the following:

- Safe yield or firm yield – The maximum volume of water that can be delivered by an entire system over a realistic hydrologic period that includes the drought records.
- Absolute reliability – This is similar to safe yield or firm yield. It is a measure of how well a water supply system performs during a critical drought, based upon historic hydrologic data.
- Design reliability – Applies a “factor of safety” to the absolute reliability. For example, less storage than actually exists may be assumed for water supply reliability modeling purposes or hypothetical hydrology may be applied that includes more severe droughts.
- Reliability criteria – Allowable shortages and their respective frequencies that a water provider is willing to tolerate without failing in its service commitment to customers.

Several Colorado municipal water suppliers, such as Boulder and Denver Water, are moving away from water supply planning based on firm yield to planning based on reliability criteria. Firm yield planning often does not incorporate assumptions of deliberately-reduced water demands during droughts, but assumes that normal water deliveries will be made under all conditions until a water system is pushed to its limits, often as modeled against performance



during an historic multi-year drought. The water system is then designed to meet this limit. Reliability-based water planning considers droughts to be expected natural events with an occurrence interval that can be determined from the historic record. It is then assumed that measures will be taken during drought periods to reduce water demand by predetermined amounts. Under this construct, reductions of sufficient magnitude are planned to assure that drought water use restrictions do not occur with any greater frequency over a period of many years than the community thinks is acceptable. The water system is then designed so that the acceptable frequency of drought-related water supply reductions is not exceeded.

While drought management planning efforts may not implicitly involve a water supply reliability assessment, the same terms and concepts used for water supply reliability planning should be incorporated into the drought management planning to avoid potential confusion and help streamline the drought and water supply reliability planning processes. Appendix B describes a conceptual approach that providers may use to model water supply reliability and incorporate it into drought planning.

### 4.3.2 Drought Impacts Assessment

The drought vulnerability of a municipality is largely dependent on potential future drought-related impacts. The identification of these impacts coupled with the development of appropriate mitigation and response measures can reduce the drought vulnerability of a municipality. Table 2 and [Worksheet A](#) provides a list of potential impacts that can adversely affect municipal providers during a future drought. These resources may be used to identify potential future drought-related impacts for drought planning purposes. [Worksheet A](#) also provides a means to prioritize and rank the perceived severity of the vulnerability.

## 4.4 Step 4 – Drought Mitigation and Response Strategies

Step 4 involves the screening and selection of drought mitigation and response strategies. These strategies will include actions that may be implemented to address potential impacts either prior to a drought (mitigation) or in direct response to a drought (response strategies). In Step 6, the selected response strategies are refined into specific response measures that focus on specific actions to be taken for identified drought severity levels.

### 4.4.1 Overview of Mitigation and Response Strategies

Common drought mitigation activities are listed in Table 3. As previously discussed, drought mitigation is distinctly different from drought response. However, some of the items identified in Table 3 may be considered both mitigation and response strategies.

**Table 3 Common Mitigation and Response Strategies**

Mitigation and Response Strategies	Long-term Mitigation Actions	Short-term Response Strategy
<b><i>Elements of a Drought Management Plan</i></b>		
Monitor drought indicators (snowpack, streamflow, etc.)	X	X
Improve accuracy of runoff and water supply forecasts	X	
Identify state and federal assistance	X	X
Provide emergency water to domestic well users		X
Establish drought reserves	X	
Draw from drought reserves		X
Rehabilitate operating wells	X	X
Increase use of recycled/reclaimed water	X	X
Utilize ditch water or treated effluent for irrigating landscaping/parks	X	X
Build new facilities to enhance diversion or divert new supplies	X	
Implement a cloud seeding program	X	X
Conduct water distribution system audits	X	X
Repair leaks in water distribution system	X	X
Reduce water distribution system pressure		X
Replace inaccurate meters	X	
Educate staff on how to save water	X	X
Install water saving fixtures, toilets, and/or appliances	X	
Reduce street cleaning, sidewalk and driveway washing		X
Limit outdoor watering to specific times of the day	X	X
Limit number of watering days per week	X	X
Convert sprinkler to low volume irrigation where appropriate	X	X
Enforce indoor water restrictions		X
Enforce reduction of water-cooled air conditioning		X
Turn off indoor and outdoor ornamental fountains		X
Require car washes to install water recycling technology and/or other Best Management Practices (BMPs)	X	X

The distinction between mitigation and response depends on the timing and how the provider intends to implement the strategy. For instance, the rehabilitation of wells (i.e., restoring the production of wells to their most efficient condition through various treatments and construction methods) can be viewed as mitigation if done routinely to ensure that wells are at their maximum production level when a drought occurs. Conversely, well rehabilitation may be a response strategy if wells are rehabilitated following declaration of a drought.

Mitigation and response strategies that focus on the management of water supplies and the water supply system are generally referred to as supply-side actions; whereas demand-side mitigation and response strategies focus on actions the provider can take to encourage reductions in their customer water demands. This section provides a background on commonly implemented supply- and demand-side mitigation and response strategies.

#### 4.4.2 Supply-Side Mitigation and Response Strategies<sup>10</sup>

A comprehensive list of supply-side mitigation and response strategies are provided in *Worksheet B*. These supply-side mitigation and response strategies include:

- Elements of a drought management plan;
- Water supply augmentation;
- Water rights management and coordination with other entities;
- Increase water use efficiency; and
- Emergency response.



Implementation of supply augmentation is often difficult because few of these actions can be undertaken quickly. Also, many of these methods involve balancing environmental and jurisdictional considerations. Finally, if reserves are used, these supplies must eventually be replenished. Despite the inherent difficulties with using supply augmentation options, even minimal supply augmentation programs have been helpful in water shortage situations. Developing extra water supplies increases utility credibility with customers by demonstrating that the water supplier is maximizing its efforts to deal with the water shortage. Also, supply augmentation can provide a water shortage buffer in case of multi-year shortages or can be used to minimize the amount of demand reduction needed to meet temporary supply deficits.

Providers with surface water supplies may be able to use the “dead storage” in a reservoir, located below the normal outlet down to the reservoir bottom or the legal minimum pool. Additionally, lower quality water can be blended with higher quality supplies or special treatment devices may be installed. Groundwater wells can often be deepened and the pump-rate increased for limited periods of time. In some groundwater basins, it may be possible during emergencies to temporarily increase the annual amount pumped. Well drillers often have waiting lists for their services during water shortages, so planning ahead can help ensure increased groundwater production when it is needed. It may also be possible to attract new recycled water customers during a drought.

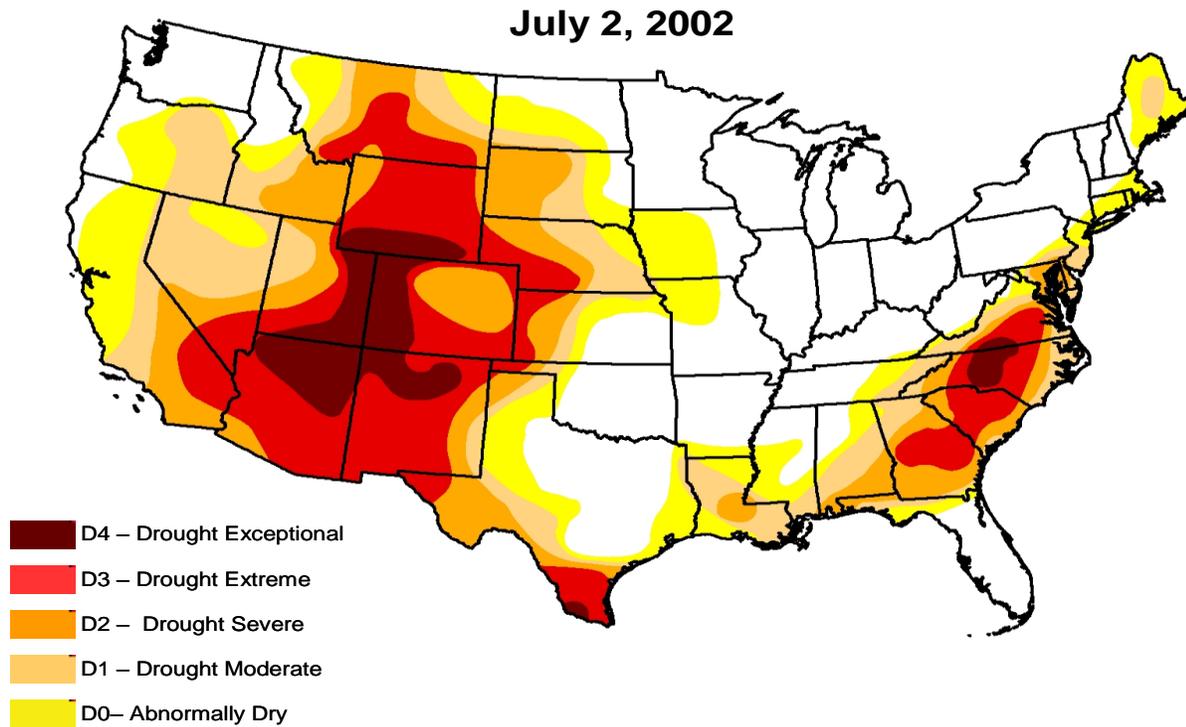
<sup>10</sup> A large portion of information presented in this section was taken directly from California’s Urban Drought Guidebook 2008 Updated Edition developed by the Department of Water Resources.



During extreme shortages, expensive new water supplies may be the only supply-side solution to meeting demands. Desalination, brackish water nano-filtration, temporary pipelines, and even water importation by train or truck may become necessary. Nano-filtration can also be used to improve the quality of recycled water.

Agricultural water transfers also provide a means for municipalities to acquire additional supplies in preparation for droughts. Purchase and leaseback transfers are one of the most common types of agricultural transfers in Colorado. Municipalities in Colorado usually purchase agricultural water rights without any commitment in the sale agreement to lease use of the water back to the seller when it is not needed for municipal use. Many municipalities lease any excess annual water supplies they have acquired in this manner to agricultural users, possibly including the original seller, under short-term leases, but curtail agricultural leasing programs in drought years. However, purchase agreements with leaseback provisions are becoming more common. In a purchase/leaseback agreement, a municipality purchases agricultural water rights with the agreement that it will lease back water to the selling farmer under predetermined hydrologic conditions (i.e., wet and normal years), and reserves the right to use the water for municipal purposes during dry periods. Interruptible supply agreements are another means for municipalities to expand water supplies during a drought. Under these arrangements, the farmer owns the agricultural water rights and temporarily transfers this water to municipalities during dry periods. Current water law allows interruptible supply agreements to be approved by the State Engineer without Water Court approval as long three transfers or less occur in a ten-year period. Agricultural water transfers require that the acquired water rights be relatively senior water rights or have associated reservoir storage in order to realize sufficient water yields during dry periods.

In 2002, providers invoked a variety of drought clauses included in contracts that allowed them to increase municipal supplies through mechanisms such as reduction of bypass requirements and interruption of agricultural leases. Denver Water invoked drought reservations that allowed it to reduce its minimum flow bypasses at its Fraser Basin points of diversion and at Strontia Springs Reservoir and to stop others' irrigation diversions temporarily above Williams Fork Reservoir. The City of Boulder invoked a drought reservation clause in its instream flow agreements with the CWCB in order to use senior water rights for municipal purposes. Boulder had previously conveyed these rights to the CWCB for instream flow purposes, but had retained ownership of the right to use the water in a drought.

**Figure 7 Drought Monitor**

Source: National Drought Monitor

Providers can also demonstrate a visible commitment to efficient water use, both before and during droughts. Actions that make a provider's operating system more efficient and save water set a good example for the public. System water audits can identify major water losses. Once a provider quantifies their system losses, leak detection, repair programs, and a possible meter replacement program may be instituted. Municipalities can also coordinate fire department pressure checks with main flushing to accomplish both tasks with the same water.

Water suppliers can reduce system pressure as permitted by fire-fighting standards and to the extent that water quality is not threatened from potential groundwater inflow to treated water distribution piping. Comparison of water use records of two similar Denver neighborhoods indicated that homes with lower water pressure use an average of six percent less water than those with higher pressure.

The South Florida Water Management District's Water Shortage Plan requires system pressure reductions when there is even a moderate water shortage. South Florida water authorities are asked to reduce pressure to 45 psi at the point of use (i.e., the meter). The utility then notifies local fire departments to make arrangements to restore pressure quickly in case of fire. Other water providers avoid using pressure reduction as a conservation measure during moderate drought stages because reduced pressure may cause irrigation systems to function poorly and pressure cannot be restored quickly in the event of fire.

### 4.4.3 Demand-Side Response Strategies

In addition to supply-side, demand-side mitigation and response strategies are necessary to conserve existing water supply during a drought. Demand reduction is the most straightforward way to address water shortages. Curtailment of water demand is directed at supplier and customer uses that are inefficient, wasteful, or able to be temporarily reduced or suspended. With proper planning, municipal water demands can be quickly and flexibly reduced, with relatively low cost in response to drought through the use of watering restriction programs and appropriate water rate structures coupled with focused public information programs. In 2002, Colorado cities and towns reduced their normal water demand by an average of about 10 percent or 100,000 acre-feet. Municipal demand reduction in 2002 allowed cities to cope with an extraordinary drought while sustaining only relatively minor, temporary damages.<sup>11</sup> A comprehensive list of options for demand-side strategies, listed by customer type, is provided in [Worksheet C](#).

Actions to reduce water use during a drought can be taken by water providers themselves before asking customers to do the same. One example is to reduce or stop turf irrigation and install low volume irrigation systems for shrubs and trees at all agency facilities. When appropriate, providers can implement water theft prevention programs, generally targeting street cleaners, water trucks, and construction sites. These programs save water and have high visibility. Thus, they complement the public education programs. “Water pirating” may become more common when local private wells go dry, especially in rural and foothill regions with inadequate supplies, and the need for water greatly increases. Customers will then be motivated to request a “hook-up” from their local provider. A supplier can reduce water main flushing to the extent permissible by health and fire standards, recycle water used to backwash treatment plant filters, and flush existing wells to develop the maximum flow possible.

Many demand-side strategies may be implemented as voluntary measures, be incentive-based (i.e., rebates/giveaways), or be mandatory. Drought surcharges are also a quick way to reduce demand and maintain adequate revenues to meet financial obligations. This is discussed in further detail in Section 4.7.6.

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<sup>11</sup> Luecke, Daniel F., Morris, John and Hydrosphere Resource Consultants. 2003



### Summary of Front Range Municipal Response During 2002 and 2003 Drought

- Water managers' responses, though late in many cases, did have an effect on customer behavior and did achieve some reduction in customer demand. Initial efforts consisted of educational programs to encourage efficiency, and voluntary conservation programs followed by mandatory restrictions on outdoor water usage. Very few water providers adopted pricing surcharges or placed any restrictions on the issuance of new taps. Many providers invoked restrictions as a precautionary response in recognition that the current drought might not be over.
- Water savings achieved by municipal providers' drought response measures varied. Preliminary results suggested that, on average, municipal water users reduced their normal demand by about 10% between May 1, 2002 and April 30, 2003. In most communities the public response to efforts to reduce water use was positive.
- Some providers also implemented measures to increase their supplies and reduce their draw on storage reservoirs. These measures included cooperative arrangements with farmers, invoking special drought clauses to relax minimum bypass flows, drilling supplemental wells, trading supplies between users, building facilities to allow better use of existing water rights, and sharing the burden of shortages where the State Engineer was willing to relax administration of the priority system. (Hydrosphere doc)
- Virtually all water providers that enacted watering restrictions in 2002 had sufficient storage supplies to meet their normal demands throughout the year. They enacted watering restrictions as a precautionary measure, recognizing that there is no way of knowing how long the current drought may last.
- Denver Water, the State's largest water provider, implemented drought surcharges in 2002 and 2003.

#### 4.4.4 Coordination with Other Entities

Providers may greatly benefit by coordinating mitigation and response strategies with other entities in developing supply- and demand-side response strategies. This includes coordinating demand-response strategy programs and conveying a consistent regional drought message, developing supplemental supply purchases and agency interconnections, and coordinating regional demand reduction strategies and/or projects. The providers can share the cost of emergency supplies and improve demand reduction media messages and program costs.

Examples of coordination that occurred during the 2002 drought include:

- Lafayette traded Colorado-Big Thompson (CBT) water to Boulder for Boulder’s Baseline Reservoir water. This trade allowed each city to give up water that it controlled, but could not easily use in exchange for water that was more directly deliverable.<sup>12</sup>
- Eldora ski area acquired a lease on CBT water and traded that water to Louisville in exchange for using some of Louisville’s Marshall Reservoir water for increased snowmaking diversions from South Boulder Creek.

#### 4.4.5 Selection of Mitigation and Drought Response Strategies

Providers may find that several screening iterations may be necessary to develop a final list of feasible drought mitigation and response strategies. This Guidance Document recommends the following sequential screening steps:

1. Select preliminary mitigation and response strategies;
2. Conduct screening of the selected mitigation and response strategies;
3. Identify additional mitigation and response measures that could have been effective in addressing historical drought impacts identified in Step 2; and
4. Assess and refine combination of strategies as a whole.

#### Preliminary Selection of Mitigation and Response Strategies

*Worksheets B and C* provide a means to select preliminary supply- and demand-side mitigation and response strategies and specify whether the selected actions are to be implemented as mitigation or as response strategies. *Worksheet C* also provides a means to identify whether a demand-side strategy is to be promoted on a voluntary basis, encouraged through incentives, or mandated, and whether it will be included in coordination efforts with other entities. At this step of the planning process (Step 4), a demand-side strategy could be selected for implementation on a voluntary and mandatory basis. Step 6 further refines these strategies into measures where, for instance, water restrictions may be implemented on a voluntary basis for mild drought conditions and be mandatory under severe drought conditions.

#### Screening of Mitigation and Response Strategies

A series of factors should be considered when selecting and evaluating mitigation and response strategies. *Worksheets B and C* also provide a means to assign a “ranking value” to the selected mitigation and response strategies according to how well each mitigation measure and response strategy meets the following factors:

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<sup>12</sup> The Colorado Big Thompson Project consists of a series of reservoirs and a transbasin diversion from the Colorado River Basin to the South Platte River Basin. This project is operated and maintained by the Bureau of Reclamation and the Northern Colorado Water Conservation District (NCWCD)

- *Technical feasibility* – Is the selected mitigation or response strategy technically feasible and will it work as intended? Can implementation occur in a timely manner? Is there staff to implement the action?
- *Perceived benefits* – Will the selected mitigation or response strategy provide an adequate amount of water supplies and/or water savings?
- *Cost effectiveness* – How does the implementation cost compare with the benefits? This may simply be a qualitative assessment or quantitative comparison of ratios of implementation costs to the water savings cost benefit.
- *Public acceptance* – How favorably will the public react to the selected mitigation/response strategy? A review process of alternative means to engage the public would be beneficial to assess general public acceptance. This is discussed in further detail in Section 4.8.4.
- *Environmental sensitivity and extraneous other impacts* – What are the environmental benefits/costs to implementing the mitigation and/or response strategy? Is there an environmental issue or other extraneous impacts that should be further considered?

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**Figure 8** Xeriscape Landscape

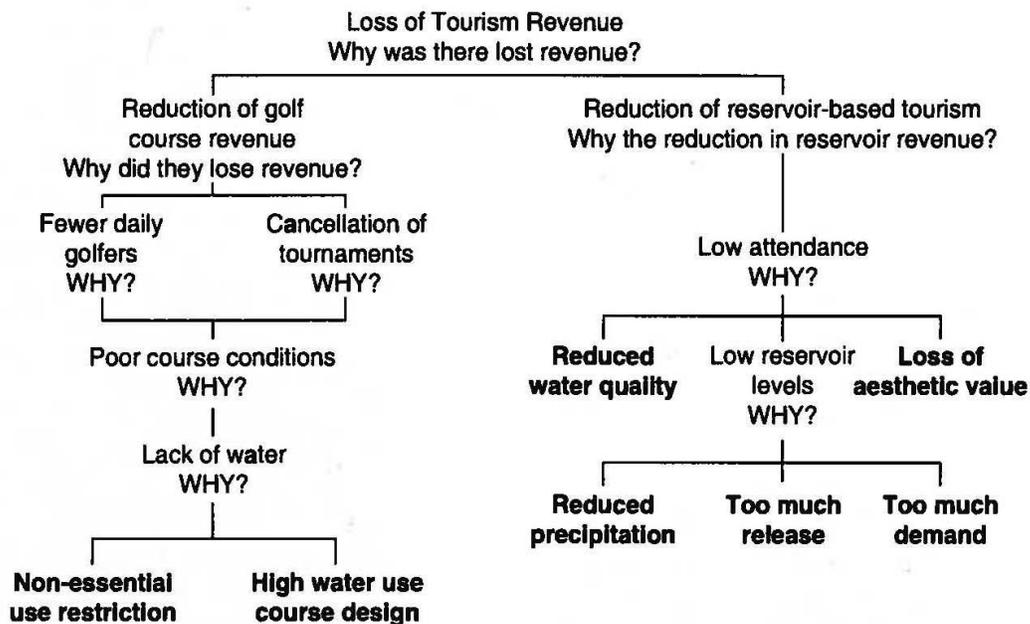


## Impact Specific Mitigation and Response Strategies

**Worksheet A** provides a means to develop additional drought mitigation and response strategies not included in **Worksheets B and C** that may be implemented to address specific future potential impacts identified during Step 3 of the planning process. Although not a requirement, some providers may find tree diagrams, as shown in Figure 9, a useful tool to identify underlying causes of a specific drought vulnerability. Some of these underlying causes could reasonably be addressed through mitigation and response strategies.

The example tree diagram exercise in Figure 9 shows that the reduction of tourism within a fictitious municipality is a result of low reservoir levels and poor golf course conditions. Several of the root causes for these conditions, shown in bold font, could be addressed to improve reservoir levels and golf course conditions. For instance, the tree diagram shows that one of the causes of poor golf course conditions during the drought is that the golf course has a high water use design. Xeriscaping (see Figure 8) and irrigation improvements could be installed to reduce water demand as a conservation and drought mitigation measure.<sup>13</sup> Discussions may also be held between the water provider and golf course to determine whether the provider's operations could be arranged to ensure a nominal amount of water for the preservation of essential features (e.g., greens, tees, fairways) during mild to moderate droughts.

**Figure 9 Example of a Municipal Impact Tree**



Source: Willhite et al. (2005) Drought Preparedness Planning: Building Institutional Capacity

<sup>13</sup> See Section 2.3.2 on demand hardening.



## Refinement of Collection of Mitigation and Response Strategies

The final step of this process evaluates the selected group of mitigation and response strategies to ensure that the final combination meets the following criteria:

- Compatible with the provider's water supply system and is feasible from an implementation standpoint;
- Consistent with the operating principles and objectives of the drought management plan;
- Fairly represents the needs of affected individuals and groups; and
- Sufficiently addresses potential water shortages and future impacts.

Refinements may be necessary later on in the drought planning process to ensure that these criteria still adequately meet or enhance certain aspects of the mitigation and drought response program. For instance, a provider may learn that drought surcharges inadvertently harm lower income families. In this situation, adjustments may be made to the drought surcharge rates or they may be eliminated altogether.

### 4.4.6 Public Drought Campaign Framework

A public drought education campaign (public drought campaign) is one of the most common ways to combat a water shortage and is essential to a drought management plan. Public drought campaigns raise awareness of the severity of a water shortage and can significantly reduce demand by influencing customer behavior. Public drought campaigns alone can result in water savings ranging from five to twenty percent, depending on the time, money, and effort spent.<sup>14</sup> These campaigns also complement other demand-side response strategies, resulting in higher water savings than could occur without public education.

There are a variety of synergistic benefits to coordinating conservation education programs and public drought campaigns. Many of the messages and information conveyed in a conservation education programs are similar to public drought campaigns. Furthermore, conservation education programs and public drought campaigns target similar audiences. Despite these similarities, the public drought campaign and conservation program should be distinguished from each other. Public drought campaigns focus on drought-related information and increase in level of seriousness during drought periods.

When developing a public drought campaign from scratch or modifying an existing public campaign, it is beneficial to review any past public drought campaign efforts and establish a basic framework for the campaign. The framework serves as a guidance tool for developing a detailed public drought campaign plan which is discussed in Step 6 of this drought management planning process. The framework identifies the following:

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<sup>14</sup> California's Urban Drought Guidebook 2008 Updated Edition developed by the Department of Water Resources

- Target audiences;
- Communication tools used to convey drought information;
- Primary messages to be conveyed; and
- Opportunities for coordinating with other entities.

The following recommendations are important to consider when developing the public drought campaign framework:<sup>15</sup>

- *Provide information to local decision makers* regarding why certain actions are needed, why special arrangements for communication and coordination will be called for, and the possible need for both emergency funds and emergency powers.
- *Encourage governmental bodies (e.g., park and fire departments, universities, recreational facilities and other water-dependent agencies) to provide leadership* by taking timely actions to reduce demand and provide examples to the public. Government actions can go beyond the efforts being asked of the public and occur quickly and at the initiation of the agencies themselves. The provider takes the lead and works with local elected officials and the media to promote cooperation and commitment from governments in its service area. Governments are willing to respond, especially if given technical guidance.
- *Provide detailed information to industry, schools, retailing, and other groups* that are asked to comply with specific use restrictions. Also, call upon these groups to suggest alternatives to the proposed rationing program that might achieve an equivalent level of demand reduction with potentially less economic harm. Innovative ideas have been generated by the private sector in past droughts. At a minimum, this approach will help ensure willing participation by demonstrating a genuine interest in their perspective.
- *Provide frequent briefings to the news media* to ensure timely and accurate communication. Be especially watchful for human interest stories. Telling the media of specific instances of an individual or group making sacrifices for the common good is a way the water supplier can show appreciation for conservation efforts.

#### **Regional Outdoor Irrigation Group**

Denver Water initiated the development of an Outdoor Irrigation Work Group near the end of 2002 to prepare for potential drought conditions in the spring and coordinate efforts concerning key drought-related matters. This Work Group consisted of 12 entities, the majority being municipalities in the northern Front Range. Outdoor irrigation recommendations were developed advocating a two-day per week water schedule, limited watering between 10:00 am and 6:00 pm, and regular monthly communication.

<sup>15</sup> These recommendations are taken directly from California's Urban Drought Guidebook 2008 Updated Edition. Pp 102-103. Developed by the Department of Water Resources

- *Coordination with other entities* to coordinate consistent drought-related messages from providers in the region, particularly in the same media markets. There are frequently significant differences in the supplies available to adjacent providers. If customers served by one provider are asked to reduce their water use as much as 30 percent while their neighbors served by another provider are only asked to conserve 10 or 15 percent, the equity of the program will be questioned. Coordination with other entities on the messages delivered to the public can help alleviate potential conflicts and improve overall water savings on a regional level.

Public drought campaigns can incorporate a great deal of creativity and there are multiple drought-related messages and techniques to convey this information. A list of initial ideas is provided in [Worksheet D](#), which consists of a matrix designed to help develop the initial framework. Additional ideas may be obtained from other drought management plans posted on CWCB's website.

#### 4.5 Step 5 – Drought Stages, Trigger Points, and Response Targets

Step 5 incorporates information from the previous steps to develop a set of drought stages that are essentially water supply alert levels typically representative of the severity of drought and how it affects a provider's system. Generally, trigger points are identified for each drought stage with corresponding response targets. Trigger points are drought indicator threshold values that differentiate drought stages (i.e., reservoir levels or percentage of average snowpack). Target responses are generally water use reduction goals established by the provider for each individual stage.

Table 4 provides an example that might be used by a typical municipality to define drought stages, trigger points,<sup>16</sup> and response targets. In this example, the initial drought stage, called "watch," is representative of an initially stressed water supply system where reservoir storage is 80 percent of the average storage normally observed in May. This stage has a targeted water savings of 10-15 percent. Stage 2 (warning) and Stage 3 (critical) necessitate an increasingly higher level of drought response. Stage 4 is representative of emergency conditions when reservoir storage is less than 25 percent of average requiring significant actions by the customers and the provider to maintain sufficient supplies for essential needs. Effective drought management plans initiate response actions prior to a Stage 4 level in order to avoid emergency conditions. Nevertheless, if a drought is severe enough (especially for long durations), Stage 4 responses could be unavoidable.

<sup>16</sup> For example, the trigger points developed by the City of Boulder are guidelines based on reservoir storage levels that the City will use to evaluate when a drought might be developing of sufficient severity to affect the City's water supplies occurs. The City will ultimately determine the best timing to declare or adjust a drought stage based on real-time conditions during a drought that include more than just storage levels.



**Table 4 Example of Drought Stages, Trigger Points and Response Targets**

Drought Stage	Trigger Point Reservoir Storage on May 15	Response Target Water Use Reduction Goal
Stage 1 – Watch	Less than 80 percent of average	10-15 percent
Stage 2 – Warning	Less than 65 percent of average	15-25 percent
Stage 3 – Critical	Less than 40 percent of average	25-40 percent
Stage 4 – Emergency	Less than 25 percent of average	40 percent

**4.5.1 Drought Stages**

The drought stages identified in Step 5 are an important component of the staged drought response program developed in Step 6 where three to five stages are recommended. This range sufficiently captures the variability of drought conditions without being overly burdensome. Programs with only two drought stages may jump too quickly from a warning level to a crisis situation while more than five stages could be tedious to implement.

The names of the drought stages can influence how the drought message is conveyed to and received by the public. For instance, a drought stage prematurely named emergency could result in a higher level of public concern than necessary. Conversely, a drought stage termed moderate when severe watering restrictions are implemented can undermine the public message to save water. Some providers may find it beneficial to establish a sequence of descriptive terms for water supply alert levels, such as “advisory,” “moderate,” “severe,” and “emergency.” Other providers that want more flexibility in portraying the drought stage when a drought actually occurs may find more generic terminology such as Stage 1, 2, 3, and 4 to be suitable.

**City of Aurora Drought Stages**

- Drought Watch – This stage is intended to give advance notice of a developing drought event. At this stage, the City can update and begin to implement its drought contingency plan and prepare its public audience. The City may urge its customers to voluntarily reduce water usage and will begin monitoring existing supplies so that they can be managed to cover an extended drought.
- Drought Warning – This stage is a notice of an impending and imminent severe drought condition. A warning declaration includes an increase of public awareness programs and increased voluntary reduction of water usage to achieve an overall (immediate) reduction in water demands.
- Drought Emergency – Drought emergency is the most severe stage. Under a drought emergency declaration, the City may, if warranted, implement stages of mandatory restrictions on non-essential and, in worse case scenarios, essential water uses.

The drought stage is to be communicated to the public through the Public Relations and Water Conservation Divisions.



Providers should also be aware of the public drought terminology used by neighboring municipalities. Discontinuity and public confusion can result if a municipality in a “crisis” drought stage is surrounded by entities that are only of a “moderate” stage. Although water supply availability can drastically differ among neighboring providers, many benefits can be achieved by coordinating the general drought message with nearby entities, especially for media coverage purposes.

#### 4.5.2 Drought Predictability and Trigger Points

Some providers may find it beneficial to develop trigger points during the drought planning process in advance of a drought. Others may find it more conducive to maintain the flexibility of declaring a drought and corresponding drought stage when the drought occurs using real-time drought indicator data. Flexibility can also be achieved by expressing trigger levels as ranges. For example, a drought plan could say that Stage X occurs when reservoirs are between Y percent full and Z percent full on a given date.

Trigger points established prior to a drought, such as those in Table 4, serve as a vehicle to declare drought and corresponding drought stages. As long as there is a high degree of confidence that the trigger points are reliable and representative of the provider’s system, this approach can offer the following advantages:

- Trigger points can remove some of the immediate liability of deciding on whether a drought should be declared.
- There can often be political pressure to declare or not declare a drought. Pre-established drought triggers can help alleviate this political pressure and enable decision makers to declare a drought based on sound scientific and engineering studies.
- The trigger points can be used as a tool to ensure the public that the provider has a good understanding of the water supply system and has proactively developed an accurate means to measure and address drought.
- Drought triggers may also be presented as ranges as opposed to the discrete values shown in Table 4. For instance, a trigger point range of 75 percent to 80 percent of average reservoir storage could be assigned to a Stage 1 drought. This offers the provider more flexibility regarding when to declare a drought. For instance, a Stage 1 drought could be declared at 80 percent or at 76 percent of average reservoir storage depending on the provider’s assessment of other drought related factors.

## Pagosa Area Water and Sanitation District's Trigger Points

Pagosa Area Water and Sanitation District did not have drought trigger points in 2002. As a result the Board of Directors had to make decisions every two weeks on the severity of water restrictions based on reservoir levels without a thorough study of the relationship between reservoir levels and supply reliability. This was a difficult decision-making process from a political standpoint. Pagosa Area Water and Sanitation District has subsequently developed the following trigger points to ensure preparedness for future droughts.

Between March 1<sup>st</sup> and October 1<sup>st</sup>, if

1. the percentage (ratio) derived by dividing the "combined useable capacity of Hatcher, Stevens, Pagosa, and Forest Lakes" by the "estimated annual demand for the current year" is less than the percentages below, and
2. the water supply into the reservoirs from Dutton Ditch and direct runoff does not appear to be adequate to fill the reservoirs, then the following restriction associated with percentages should be implemented:

### Drought Trigger Points

Ratio	Stage
90% or less	Voluntary status
70% or less	Level one restrictions
50% or less	Level two restrictions
40% or less	Level three restrictions
30% or less	Level four restrictions

Restrictions would typically be triggered from March through October as conditions warrant.

Providers that prefer to take a more real-time approach in declaring a drought and drought stages often do so in order to maintain an even higher level of flexibility with their decision making. Flexibility can be important for the following reasons:

- The general "appearance" and effects a particular drought may have on a provider's water supply system can vary dramatically depending on the severity, spatial extent, and duration of the drought, coupled with the fact that droughts are often unpredictable.
- Given the variable nature of droughts, it can be difficult to develop specific trigger points that clearly represent the impact that a drought can have on the water supply system and the impact may change during the course of the drought.
- There can be significant changes in a community between when the trigger points were developed and when a drought occurs. This is particularly true for municipalities experiencing high growth rates. Water demands can significantly increase, outdating the trigger points.



- The media may incorrectly interpret trigger points and unnecessarily heighten the public’s concern. Furthermore, a provider may find it necessary to adjust the predetermined trigger points to account for unforeseen conditions. This could inadvertently reduce confidence in the provider, if the media chooses to “hold the provider to the original numbers.”
- If trigger points are used, they do not need to be considered as hard and fast rules to be used in all situations. Every drought is different in its characteristics, so trigger points can be used to give an indication that a drought of concern might be developing. The trigger points can then be used in conjunction with other relevant real-time data to determine if a drought declaration should be made.

Boulder has decided to take such an intermediate approach. The city developed trigger points, yet has been diligent in emphasizing that these points are simply guidelines that the City may use to declare a drought and corresponding drought stage. Boulder’s Drought Management Plan states the following:

“These triggers reflect city water supply storage levels that require an active drought response by the city in order to avoid threatening the reliability of the city’s water supply and to avoid serious water supply shortages. They were developed through modeling studies of the city’s water supply system. It should be noted that any drought response triggers should be used only as a guideline. The City of Boulder should carefully evaluate these triggers and other factors unique to the particular drought to determine the drought level for response.”<sup>17</sup>

At a minimum, providers using a “real-time declaration approach” should identify the drought indicator data that are monitored on a regular basis and would likely be used to determine drought severity. For both cases, it is important to discuss the timeframe of when the drought indicators/trigger points are relevant for predicting drought. For example, the drought triggers shown in Table 4 specify a reservoir level on May 15 during the spring runoff. Providers relying on mountain snowpack typically rely on the monitoring of snowpack conditions most heavily in March and April for drought prediction purposes when the mountains generally receive the greatest amount of moisture just prior to runoff.

Some of the types of drought indicator data that providers may reference are provided in Section 4.2.1 as well as in [Worksheet E](#). [Worksheet E](#) provides a means to specify drought indicators that are currently monitored and select additional beneficial indicators. [Worksheet E](#) also provides a column to designate the drought indicators used to develop the trigger points and specify the timing of when drought indicators/trigger point should be especially adhered to when monitoring drought. Two template table options are provided where providers can fill in the

<sup>17</sup> City of Boulder’s Drought Plan Volume 1



drought stages, triggers, and response targets. These tables can be cut and pasted directly into the provider's plan.

It is important for providers to ensure that the official drought declaration and corresponding drought stage designation occur in a timely manner. If a drought is declared too late or actions are not taken early enough to reduce water use, supplies can be severely depleted and strict water restrictions and economic impacts may be required that could have been avoided. Conversely, premature drought declarations can result in unnecessary mandatory water restrictions and associated impacts while customers lose confidence in the provider.

### 4.5.3 Response Targets

Response targets or goals specify the level of action necessary to conserve water. As with the drought stages and triggers, it is important that response targets appropriately reflect the severity of a drought and are representative of supply conditions. They also should be realistic water use reduction goals. Targets that are too high may require unnecessary hardship, while targets that are not high enough may not elicit an adequate response.

Response targets may simply specify an absolute amount of savings (acre-feet) or a percentage of savings as compared to normal conditions.. Alternatively, response targets may be established as a group or type of actions that might be taken as a result of a drought with a particular severity, such as “Level 1 Restrictions” or “Voluntary requests to reduce water use.”<sup>18</sup> Annual and/or seasonal water use reduction response targets may be developed. Targets for individual customer types can also be developed.

A response target can be defined once a drought is underway and its severity is known. However, there are benefits to developing response targets prior to a drought occurrence based on water supply planning and/or water system modeling. It is beyond the scope of this document to detail steps involved in water supply planning and modeling, other than to note that, at a minimum, maintaining documentation of past hydrology and/or water supply yields, current water system performance capabilities, and current levels of water demand will greatly assist in producing an appropriate drought response effort when needed.

### 4.5.4 Summary of Considerations

In summary, the following questions are beneficial to review when developing drought stages, trigger points, and response targets:

- How many drought management stages are appropriate for the provider's water system and, if the stages are named, what names best represent the general message conveyed to the public for each stage?

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<sup>18</sup> Note: These actions are not to replace the staged drought response program discussed in Step 6 (Section 4.6). For instance, a response target of “Level 1 Restrictions” may have a corresponding staged drought response program detailing the specific Level 1 Restrictions such as voluntary restrictions to lawn watering to two times a week and hand watering of large landscape features.

- 
- Should trigger points be developed during this drought management planning effort (in advance of a drought) or be determined at the onset of a drought in order to maintain decision-making flexibility? Or is there a balance of the two approaches that is more useful for the provider’s drought response effort?
  - If trigger points are not established, what process will the provider use to determine the need to declare a drought and adjust drought stages? Details of this process should be identified in the Step 7.
  - What are the goals for a program responding to a particular stage of drought? Will response targets or goals be stated in terms of the amount of water reduction needed or in terms of the type of response actions taken?
  - Will response targets be established for each drought stage before a drought occurs or will the specific goals be established once the degree of response required by a particular drought is known? What level of water supply planning will be used to support the definition of drought response targets prior to a drought? What hydrologic and water system data will be useful to compile and document in preparation for decision making during a drought?
  - Do specific procedures need to be identified to “come out of a drought?” In other words, can certain criteria be developed to indicate that a drought is over? What procedures are necessary to de-escalate a drought stage?

#### 4.6 Step 6 – Staged Drought Response Program

The staged drought response program is the portion of the drought management plan that the public finds of greatest interest. This program specifies the drought response measures required when a drought occurs. These response measures include actions taken by the provider and by individual customers to meet the response targets specified in Step 5. These response measures are laid out by drought stage and generally increase in intensity from the initial warning stage (Stage 1) to the most critical drought stage.

It is important that the combinations of response options for each stage are appropriate for the severity of the water shortage. The actions taken should be adequate to deal with the drought situation while minimizing impacts on economic activity, environmental resources, and the lifestyle within a region.

The response strategies selected in Step 4 provide the initial means to develop individual response measures for each drought stage. Table 5 provides an example of response strategies and the corresponding response measures for a three-staged drought program. The response measures increase in water saving potential from mild drought conditions for Stage 1 to more severe conditions for Stage 3. *Worksheet F* provides a means to list the Step 4 selected response strategies and develop corresponding staged drought response measures similar to the example shown in Table 5.



**Table 5 Response Strategies and Corresponding Drought Measures**

Response Strategies	Drought Measures		
	Stage 1	Stage 2	Stage 3
Serve water in restaurants only upon request	Restaurants and catering businesses will be asked to voluntarily restrict serving water with meals except on customer's request.	Restaurants and catering businesses shall not automatically serve water with meals but may serve water when a customer requests it.	Restaurants and catering businesses shall not automatically serve water with meals but may serve water when a customer requests it.
Limit number of watering days per week	Customers will be asked to voluntarily reduce outdoor water use.	Water shall be limited to two days per week according to a watering schedule.	Water shall be limited to one day per week according to a watering schedule.
Establish percent water use reduction goals	Customers in the high public use category shall manage water use in a way that reduces their seasonal water use by 10 percent.	Customers in the high public use category shall manage water use in a way that reduces their seasonal water use by 20 percent.	Customers in the high public use category shall manage water use in a way that reduces their seasonal water use by 40 percent.

The drought management plans posted on CWCB’s website provide numerous examples of staged drought response programs. These plans can be used to generate ideas and formulate a new plan. Appendix C also provides an example of Denver Water’s staged drought response program which is a common format to present staged drought management plans. [Worksheet G](#) provides a template for providers using a similar format.

Although enforcement is discussed in greater detail in Section 4.7 (Step 7), it is important to mention here that staged drought response plans often summarize how the response measures will be enforced for each individual stage. This places a level of liability on the customer.

A consolidated table summarizing the drought stages, triggers, response targets, response measures, and corresponding enforcement is also an effective means to convey information to the public. It also serves as a useful reference for internal purposes that could be distributed as a “stand alone” summary of the drought management plan. Appendix C provides an example of the City of Boulder’s drought response program summary table. [Worksheet H](#) provides a template that providers can use to develop their own summary tables. Staged drought response tables may be distributed to the public, posted on the provider’s website, or included in an executive summary to the drought management plan.

**4.6.1 Summary of Staged Drought Response Program Considerations**

Prior to finalizing the staged drought response program, it is worthwhile to review the following considerations to help ensure that the program will be effective and appropriately address drought:

- Do the response measures and enforcement appropriately reflect the drought management plan’s objectives and principles developed in Step 1?

- 
- Is implementation and enforcement of the staged drought response program feasible and realistic? Will it likely meet the response targets? Are any adjustments necessary to make the staged drought response program more compatible with the provider’s water supply system?
  - What is the timeline between when the measure is implemented and when water savings are realized? Does this timing fit within the staged drought response targets?
  - Does the program provide sufficient flexibility if response measures and/or drought stages need to be adjusted during a drought in order to address unforeseen conditions? Particular focus should be placed on how the staged drought response plan is presented in the drought management plan. One suggestion is to include text in the plan stating that “the staged drought response plan is based on the best available information to date and future adjustments may be necessary prior to or during drought periods to sufficiently address water shortages.”
  - How receptive is the public to the staged drought response plan? It is recommended that the staged drought response program be incorporated into the public review process discussed in Section 4.8.4.
  - Does the staged drought response plan fairly represent the needs of affected individuals and groups? Are some groups adversely affected more so than others? Can adjustments or compensation be made to address a potential issue?
  - How will the effectiveness of the response measures be monitored? Monitoring is important to ensure that the response program is effectively meeting its targeted goals and in identifying adjustments that can be made to further enhance the program.

#### 4.6.2 Public Drought Campaign Plan

Detailed public drought campaign plans may be developed as a component of the staged drought response program. These plans lay out the specific public drought campaign activities by individual drought stage. Detailed public response programs can also be developed just prior to a drought declaration in order to appropriately address up-to-date conditions. Providers may also simply develop public drought campaign guidelines for each stage and then develop the detailed plan prior to the drought declaration.<sup>19</sup>

Regardless of when the detailed public drought campaign is developed, it is important to continue a certain level of public drought education in normal years. This maintains public awareness of Colorado’s semiarid climate and its susceptibility to drought, which can shorten the public response time when a drought does occur.

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<sup>19</sup> The public drought campaign framework in Step 3 should be used to develop the detailed public drought campaign plan.



The remainder of this section provides tips on the implementation of public drought campaigns and can be useful when developing a detailed campaign. The majority of this information is taken directly from California's Urban Drought Guidebook 2008 Updated Edition developed by the Department of Water Resources.

- Provide information to the public on a regular basis about the water supply situation, what actions are being proposed or being taken, how those actions will mitigate supply shortages, and how well customers are meeting program goals.
- When appealing to customers for water use reductions, act equitably, credibly and consistently. Demonstrate to the public that the provider is doing everything possible to minimize the shortage. Pursue supply options vigorously; if new supplies are too costly or not achievable in a short time, communicate that fact. Publicity about changes in provider operation and maintenance practices that conserve water is helpful. Also, provide accurate information concerning supply status (i.e., reservoir and ground water levels), water use reductions, and other pertinent information to all company personnel, especially those briefing the media or involved with public education, as well as meter readers and billing department employees.
- Development of a public information campaign may specify a timeframe for conveying drought information such as Denver Water's drought communication Plan which lays out a series of actions to implement at the potential onset of a drought starting in February through May.
- In dealing with the media, have one person speak for the provider. Immediately respond to media inquiries to maintain communication links and to avoid media representatives seeking alternative, less informed information sources. Good communication provides opportunities for a water supplier to tell its story and ensures that knowledgeable people will be called upon to speak on the issues.
- Before developing water shortage related public information strategies, there are several important issues to keep in mind about program focus and content. First, emphasize that the water supply situation is unpredictable and may change from month to month. No one can be certain when the situation will improve. Even if precipitation increases, the effect on the water supply may not be immediate. The provider needs to proceed cautiously by starting demand reduction programs early and avoid relaxing any measures too soon. Also, customers need to realize that the drought impact is not uniform across a state or region and that the problem will be more severe in some areas and less severe in others.
- Some classes of customers may carry the burden of coping with the water shortage more than others. Some groups with high potential for reduction may be asked to reduce water use more than others, but avoid discrimination within a class of customers. Landscape irrigation may have to be curtailed. Conversely, it may be decided to minimize water reductions to commercial or industrial users.



## Denver Water's Outline for a Drought Communication Plan

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

### February

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

### March

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

### April

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

### May

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

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

Additional information on drought and budget revenue implications is provided in Section 4.7.6.

- Avoid being placed in an adversarial position. Focus on the emergency at hand without blame implied toward the provider's management or a customer class. It is important to tailor the public information program to the type of community served. For large decentralized areas, methods that allow the water supplier to reach many customers relatively inexpensively such as websites, email, direct mail, bill inserts, and media advertisements are appropriate. Smaller, close knit communities with central business districts may also be well served by a central information center.
- Public information programs provide long-term benefits by increasing the customers' understanding of their water use and of the provider's operations. Such an understanding will be useful in generating public support for future efforts regarding rate increases or new efficiency and supply projects.
- When undertaking any public information effort, it is crucial that the information be accurate and consistent and that requested use reductions be commensurate with the seriousness of the situation. In other words, the customer must understand what the trigger conditions are, what the consequences of the different stages of drought are, and how the emergency measures will help relieve or minimize the problem.

## 4.7 Step 7 – Implementation and Monitoring

Step 7 addresses the implementation of the drought management plan. Implementation involves carrying out a mitigation plan, monitoring drought indicators on a regular basis, following drought declaration protocol, implementation and enforcement of the staged drought response program, revenue planning, and monitoring of the drought response effort and making appropriate changes when necessary. It is important that the general processes, schedule, and roles and responsibilities are defined in advance in order to facilitate an effective drought response and avoid/minimize drought related impacts.

### 4.7.1 Mitigation Action Plan

Mitigation typically occurs prior to a drought. Given the unpredictable nature of droughts, the sooner providers are able to carry out mitigation efforts, the sooner they will be prepared for a drought that could occur any year. Mitigation action plans should provide sufficient guidance to carry out the mitigation effort. They can either be in the form of a document defining the details of mitigation actions or simply be a general mitigation schedule.

At a minimum, mitigation plans should include the general actions necessary to implement each of the mitigation items selected in Step 4 and detail: a schedule of milestones that a provider can realistically meet; division/staff responsible for administration of the project; and funding sources. An example of a mitigation schedule is provided in Table 6.



**Table 6 Example of a Mitigation Action Plan**

Mitigation	Implementation Activities	Milestone Deadlines	Administration	Funding
Finalize Drought Management Plan	Plan reviewed by City Council	July 2010	Water resources planning division	General fund
Update Conservation Plan	Consolidate monitoring data	March 2011	Water conservation division	General fund
	Draft Plan Completed	June 2011	Water conservation division	General fund
Construction of additional storage for drought reserves	Drought Storage Reserves Feasibility Study	October 2010	Water resources planning division	General fund
	Complete permitting	October 2011	Water resources planning division	General fund
	Complete construction	September 2012	Operations and facilities	Bonds
Increase use of reclaimed water	Expand reclamation facility	September 2013	Operations and facilities	Bonds
	Develop storage and distribution system	June 2014	Operations and facilities	Bonds

A template of a mitigation schedule similar to the example above is provided in [Worksheet I](#).

**4.7.2 Monitoring of Drought Indicators**

In order to accurately assess drought conditions and the potential severity of a drought, it is imperative that providers closely monitor drought indicator data. The intensity of the monitoring effort will vary seasonally and annually. Typically, wet springs and winters with high snowfall amounts will not require a significant amount of monitoring outside of recording snowfall and precipitation events. However, intense monitoring efforts and internal discussions among water resources staff will likely be necessary in early spring and summer following winters with below average snowfall.

The following components of a drought indicators monitoring effort should be defined:

- Identification of drought indicator data monitored on an annual and seasonal basis and how this data is acquired.
- General schedule of when the monitoring is conducted including monitoring frequency. Address how the intensity of monitoring may change during abnormally dry seasons.
- Drought forecast conditions. Providers may incorporate drought indicator data to develop their own models or methodology to forecast drought conditions or rely on other regional/neighboring forecasts.
- Entities or staff responsible for monitoring and forecasting drought conditions.

- Protocol for recording and archiving monitoring data.

*Worksheets J and K* provide a means to record drought demands and track water supplies during drought periods. While these worksheets may not necessarily be useful for the immediate development of a drought plan, they may be used as a means to monitor and record actual drought conditions in real time. Following a drought, this data can be incorporated into the historical drought assessment (Step 2) in future drought plan updates. *Worksheet J* provides a means to record total projected water demands and allocate these demands by priority. *Worksheet K* provides a template for recording drought indicator data.

### 4.7.3 Drought Declaration

The appearance and nature of droughts can be variable and, as previously discussed, providers may find it difficult to develop a set of hard and fast rules to declare an official drought. Whether specific trigger points are clearly defined prior to a drought or left to the expertise of the provider and existing drought indicator data, the general decision making process for publicly declaring a drought and a drought stage should be clearly outlined including the following:

- General guidelines used by the staff to assess drought conditions. This may include pre-determined drought trigger points, real-time drought indicator data, existing storage and projected demands for the season and judgment based on past experience, and understanding of the provider's water supply system.
- Identify decision makers (i.e., city council/board) responsible for officially declaring a drought.
- If the decision makers are not the same people responsible for drought monitoring and assessment, develop a protocol for how drought information from water resources staff is conveyed to the decision makers. This could be facilitated through the development of a stakeholder drought management team similar to Drought Committee discussed in Step 1, a series of meetings among staff and decision makers, official report(s) documenting drought conditions and recommendations, etc.
- Identify the person responsible for delivering the official drought declaration and corresponding drought stage to the public.
- Describe the timing of when the decision makers are informed of a potential upcoming drought and, subsequently, when a drought may be officially declared to the public, initiating the staged drought response program. Timing may vary on a drought-by-drought basis depending on various conditions of a particular drought. Disclose considerations taken regarding the timing of when to inform the public.
- Identify procedures needed to “come out of a drought.” Can certain criteria be developed to indicate that a drought is over? What procedures are necessary to de-escalate a drought stage?



#### 4.7.4 Implementation of the Staged Drought Response Program

The implementation of the staged drought response program can require significant coordination among different departments and staff. It is essential that a series of guidelines or, if necessary, a detailed plan is developed to clarify roles and responsibilities for implementation of the program. The following factors should be considered when developing a set of guidelines or detailed plan:



- Staff responsible for administering and implementing the staged drought response program. Additional staff may need to be hired.
  - Primary staff responsible for communicating the drought message to the public. This needs to be a clear and consistent message.
  - Staff responsible for administering and implementing the public drought campaign. Additional staff may need to be hired depending on the scale of the program.
- Communication and coordination protocol among entities/staff administering the public drought campaign, staged drought response program, and drought monitoring. This may be developed in advance of a drought or defined more specifically at the onset of a drought when staff are initiating the staged drought response program. At minimum, regular staff meetings and communication will be necessary among all involved personnel to ensure that the program is properly carried out.

#### 4.7.5 Enforcement of the Staged Drought Response Program

Mandatory response strategies such as water restrictions often necessitate a means of enforcement beyond simple education in order for customers to appropriately respond. Warnings, citations, fines, and, in severe cases, installation of flow restrictors inhibiting a customer’s water use or terminating service altogether are common enforcement mechanisms. The severity of a penalty can often increase with the number of violations. Table 7 provides an example of penalties associated with irrigating during prohibited times and wasteful use of water.

**Table 7 Examples of Staged Drought Response Program Enforcement**

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

Source: Urban Drought Guidebook 2008 Updated Edition



Providers may need to use existing staff or hire temporary staff to patrol the service area and enforce drought response measures. These patrollers can be referred to by a variety of names. Denver Water uses “drought monitors” while other ideas include “water cops” or “waste busters.” The main focus of these patrollers is to educate the customers on saving water and offer assistance; however, citations and penalties should also be delivered when warranted to enforce the program. Patrollers also offer a visible reminder to the public of the seriousness of the situation.

There are a variety of other tools that can be used to encourage compliance with mandatory response measures. Photos or videos made during periods when irrigation is not allowed can also be a useful tool in demonstrating to managers and non-residential property owners that their irrigation systems are in need of repair or adjustment. Conversations local government employees have in the community can also influence customer behavior. Customer phone and web-based hotlines can also be effective. Community members can report the location of infractions which can save a great deal of time and money by targeting monitoring efforts and increase the credibility of the provider if response is quick. However, one disadvantage of this approach is that tensions among a community can be intensified if neighbors use the reporting system as a means to “get back” at another neighbor or conversely a neighbor who is reported takes the report personally. Police may also be used as an effective means to communicate the conservation message; however, police are generally not used for enforcement purposes unless there is a specific problem with a customer.

The level of enforcement and corresponding amount of resources a provider uses for enforcement increases with each drought stage. For instance, a Stage 1 warning level may not warrant severe enough conditions for the cost expenditure to hire additional staff for enforcement. However, Stage 3 critical conditions may necessitate the need for temporary staff to patrol the service area and assess penalties for infractions. Table 8 provides an example of Denver Water and Pagosa Area Water and Sanitation District’s enforcement program for Stage 2 and Stage 3 drought conditions:



**Table 8 Denver Water and Pagosa Area Water and Sanitation District Enforcement**

No. of Violations	Denver Water			Pagosa Area Water and Sanitation District
	Stage 1 Drought	Stage 2 Drought	Stage 3 Drought	
First	n/a	The owner or occupant will be advised in writing that a monetary charge will be added to the water bill for subsequent violations	The owner or occupant will be advised in writing that a monetary charge will be added to the water bill for subsequent violations	Written warning, water conservation level notification sheet delivered and educational information offered
Second	n/a	The owner of occupant advised in writing, and a \$250 charge may be added to the water bill	The owner of occupant advised in writing, and a \$1,000 charge may be added to the water bill	\$100 fine, water conservation level notification sheet delivered
Third	n/a	The owner of occupant advised in writing, and a \$500 charge may be added to the water bill	The owner of occupant advised in writing, and a \$1,500 charge may be added to the water bill. In addition Denver Water may install a flow restrictor on the service line to remain in place during the irrigation season or may temporarily suspend service until the cause of the violation is corrected and all outstanding penalty and water service charges have been paid.	\$250 fine, water conservation level notification sheet delivered
Fourth	n/a	The owner of occupant advised in writing, and a \$1,000 charge may be added to the water bill. In addition, Denver Water may install a flow restrictor on the service line to remain in place during the irrigation season or may temporarily suspend service until the cause of the violation is corrected and all outstanding penalty and water service charges have been paid.	see above	\$500 fine, water conservation level notification sheet delivered

An appeal process for customers charged of violations is also recommended. This enables customers to present their case and be considered for an exemption depending on the circumstances. Policy conditions should be developed to specify conditions under which exceptions can be made for certain violations. For instance, under certain providers’ plans, a customer served a citation for irrigating new turf grass may be exempt from the water restrictions for the early drought stages. Alternatives may also be provided to customers instead of paying a fine such as a mandatory water conservation classes, interior and exterior water use efficiency retrofits, water audits, etc.

#### 4.7.6 Summary of Enforcement Plan Components

The following components need to be considered when developing an enforcement plan. Some of these components may involve specific decisions more appropriately made just prior to a drought declaration. However, it is important that each of these components is addressed during this planning process.

- Develop enforcement policies appropriate for each drought stage.
- Identify the level of monitoring/patrolling necessary for each drought stage. Who will be responsible for patrolling the service area and issuing citations? Will additional temporary staff need to be hired? What training will be necessary?
- Identify how information on the enforcement will be conveyed to the public.
- Develop an appeals process and possible exemptions to enforcement procedures under certain circumstances.
- Identify who is responsible for administration of the enforcement effort and approving exceptions to the enforcement policy.

#### 4.7.7 Revenue Implications and a Financial Budgeting Plan

A reduction in customer water use can result in a revenue shortfall for providers. Increased costs associated with implementation of the staged drought response program can further intensify the shortfall. As the staged drought response program is developed and implemented, it is important to consider the provider's current financial situation and plan accordingly.

Revenue budgets are often balanced by either raising water rates or by imposing a drought surcharge. Providers may also consider establishing financial reserves for drought/emergency situations and seek any available external drought funding assistance.

### Pagosa Area Water and Sanitation District's Financial Incentive: Rate Structure for Each Level

- *Voluntary Water Conservation Level:* Standard rate structure applies.
- *Water Conservation Level 1:* Standard rate structure applies with the addition of a Drought Surcharge per 1,000 gallons of use over 8,000 and up to 20,000 gallons of water per equivalent unit. The Drought Surcharge is increased per 1,000 for use over 20,000 gallons of water per equivalent unit.
- *Water Conservation Level 2:* Two times the standard rate structure will apply to gallons used. The Drought Surcharge remains in place but is unchanged from that of Level 1.
- *Water Conservation Level 3:* Three times the standard rate structure will apply to the gallons used. The Drought Surcharge remains in place but is unchanged from that of Level 1.
- *Water Conservation Level 4:* Four times the standard rate structure will apply to the gallons used. The Drought Surcharge remains in place but is unchanged from that of Level 1.

Regardless of the method(s) selected to incorporate into a revenue program, the following steps may be used to evaluate and balance the budget:

- Estimate lost revenue by projecting the amount of water use reduction. The staged response targets may be incorporated into this evaluation if they are representative of actual water savings.
- Estimate additional costs incurred by the drought. This may include additional expenses necessary for new drought supplies, increased water quality monitoring, administration and enforcement of the staged drought response program, drought public campaign, enforcement etc.
- Determine whether water rate adjustments or surcharges are necessary and at what associated amounts.
- If water rates need to be raised, educate the public why the rates are being raised and why additional resources are needed to conserve and manage supplies during times of drought.
- Compare actual revenue with forecast revenue and adjust water rates/surcharges appropriately.

## Denver Water Surcharge

During drought conditions, Denver Water will be forced to confront three potentially conflicting objectives: (1) to quickly reduce the volume of water used by its customers; (2) to maintain adequate revenues to meet its financial obligations; and (3) to address the opposing needs of existing demand and growth. Drought pricing can be an effective tool in managing these objectives, and drought surcharges must be considered as part of an overall demand reduction and financial stabilization program. Denver Water will consider several guiding principles in developing surcharges.

- *There is a relationship between price and demand.* In theory, customers respond to an increase in price by reducing demand. The question is at what price level will the customer respond? The answer varies based on a number of factors.
- *Surcharges will be incorporated into an overall program to increase customer awareness of the drought's severity and the importance of saving water.* Customers respond to the "basket of programs" concept, which includes surcharges. Drought pricing plays a role in creating an environment in which customers recognize the importance of reducing water use.
- *Surcharges may apply to current water demands, new taps, or other demands on the water supply.* There is concern about issuing new taps when existing customers are subject to surcharges. Applying various forms of surcharges to different types of demands on the water supply provides an equitable method allowing all customers to share the burden of the reduced supply.
- *Surcharges are less effective by themselves.* Industry studies and Denver Water's own customer surveys indicate that surcharges are more effective at reducing water use when combined with other restrictions to create an atmosphere that promotes water savings. Customer response to price signals varies depending on several factors such as affluence, billing frequency, and the normal cost of water. Empirical data show that customers respond to temporary water pricing strategies as part of a water savings environment.
- *Surcharges are separate from rates.* Rates are based on cost. They are established to recover particular kinds of costs specified by the Denver City Charter. The purpose of drought surcharges, on the other hand, is to raise awareness of the value of water, to reduce water use, and to penalize those who don't comply with drought restrictions. These goals are better accomplished when surcharges are implemented as a temporary measure outside the cost-of-service rate structure.
- *Surcharges should match the severity of the drought.* Because every drought is different, each one may require a different set of responses. Surcharges must be structured to help create an atmosphere of appropriate water savings.
- *Surcharges must be feasible for computer systems to handle.* Denver Water must be able to respond to drought conditions quickly and efficiently. Any change in water use charges must be manageable with only moderate modifications to existing computer systems. Substantial changes reduce response times and contribute to errors. Because internal coordination is critical, staff members from Customer Service, Information Technology, Accounting, and other relevant sections will be included in discussions of surcharge options.

## Denver Water Surcharge - Continued

- *Surcharges should be tailored for different customer groups and monitored for effect.* A one-size surcharge does not fit all. Commercial and industrial customers use water differently from residential customers. Large-volume public use customers may need some accommodation. The surcharge structure must be flexible enough to promote water savings while still addressing diverse customer needs.
- *Surcharges should reflect overall drought response philosophies.* Because all surcharge structures divide customers into groups, no surcharge structure is 100 percent “fair”. Some customers may pay a surcharge even if they comply with the other restrictions. In addition to raising awareness of the value of water and encouraging temporary reductions in use, surcharges can supplement revenues if necessary.
- *Surcharges may need to be seasonally adjusted.* In Colorado’s semi-arid climate, water use is greater in summer than in winter. Outdoor use is more discretionary than indoor use, and surcharges should be adjusted to assist in maintaining a water savings environment. Because restrictions to reduce indoor use are difficult to design, adjusting surcharge thresholds can be more effective at monitoring and reducing indoor water demand in winter.
- *Public input and information are key to customer understanding of surcharges.* When surcharges are designed and implemented, the public must have adequate opportunities for input, the surcharge must help create an atmosphere of water savings, and the public must receive adequate information to fully understand the surcharge program.
- *Surcharges are temporary measures.* The criteria that determine when surcharges will be lifted should be specified before the surcharges are imposed. This will reinforce the temporary nature of the surcharge in the minds of customers.
- *Equity issues related to removing the surcharge should be addressed in advance.* The specified conditions leading to termination of surcharges do not always occur at the end of a billing period. Criteria for lifting the surcharge once the specified conditions occur should be considered ahead of time.

### 4.7.8 Monitoring of Plan Effectiveness

Monitoring provides the information and data necessary to focus drought management plan improvements on actions that best increase the effectiveness of the overall plan. Monitoring is both an ongoing and post-drought evaluation process. Ongoing monitoring may include testing



components of the drought management plan when a drought is not occurring. This could simply involve an exercise where staff presents what they would do in the event of a drought according to their roles specified in the drought management plan. This exercise can provide valuable insight into coordination difficulties among staff and departments, shortcomings of the drought management plan, and conflicting interpretations of the plan itself. Furthermore, staff changes can result in confusion of roles and responsibilities and an activity that help staff work this out can significantly improve the provider's internal response to drought when a drought does occur.

Monitoring data provides a means to assess the effectiveness of the drought mitigation and response measures during a drought, make adjustments to the response measures if necessary, and develop recommendations for updating and improving the plan. Documentation and thorough collection of monitoring data are critical to ensure that the lessons learned from past droughts remain within the institutional memory.

The staff/departments responsible for data collection, evaluation, and providing recommendations to the decision makers should be disclosed in the drought management plan and the type of monitoring data collected should also be specified. This may include the following:

- *Demand data* – Comparison of average historical demand data to demands during a drought provides insight into the effectiveness of the drought response measures. Section 4.2.1 provides detailed information on the types of demand data and associated advantages of collecting such information.
- *Lessons learned* – Key issues, challenges, and concerns during implementation of the staged drought response plan.
- *Conditions of the water supply system* – This may include reservoir levels, water treatment plant production, call data, water obtained from direct flow rights, storage rights, groundwater pumping, etc. This information is crucial to carefully managing the system during periods of shortages and generating data that may be applied to future drought planning efforts.
- *Public perceptions and response to the drought* – Public opinion can be gathered in a variety of ways during and immediately following a drought. This includes documenting comments provided at public meetings or public city council/board meetings, electronic emails/letters sent to the provider, formal public surveys, etc.
- *Administrative staged drought response program data* – This may include the number of citations delivered to customers, number of incentives distributed, number of hotline calls received, etc. Records should also be maintained on the level of effort the staff put into facilitating the staged drought response measures and public education campaign.

## 4.8 Step 8 – Plan Review and Updates

Step 8 involves the formal processes necessary to review, approve, and update the drought management plan. This includes a public review process, review and approval by the local government (i.e., city council/board), adoption of necessary policy, and plan for a future updates.

### 4.8.1 Public Review Process

A public review process is important to the development of effective drought management plans. This process can reduce future objections and conflict during drought periods and also help ensure that the plan reflects the general values of the community. Providers should follow the appropriate rules, codes, or ordinances to make the draft drought management plan available for public review and comment. If there are no rules, codes, or ordinances governing the entity's public planning process, then each provider should publish a draft plan, give public notice of the plan, make such plan publicly available, and solicit comments from the public for a period of not less than sixty days after the date on which the draft plan is made publicly available. Reference shall be made in the public notice to the elements of a plan that have already been implemented.

The public may be involved in a variety of ways during the development of the drought management plan. Key public representatives can be included on the Drought Committee or a separate public advisory group can be developed to discuss key elements of the plan during its development. A public advisory group and/or frequent public meetings during a drought may prove beneficial in addressing public questions and conflict.

Prior to final approval of the plan, the public should have the opportunity to review and comment on the plan. Draft plans can be presented on the provider's website, emailed, and available in hard copy at the provider's office. Public meetings can also be scheduled to address public feedback.

### 4.8.2 Adoption of Ordinances and Official Agreements

Implementation of the drought management plan can require the development of new policy. For example an official drought declaration policy authorizing a specific staff member or elected official to declare the drought may be necessary. Water wasting ordinances and enforcement policies may also be necessary. As the drought management plan is being developed, it is important to identify the specific policy necessary for implementation, draft the policy, and have the policy approved through official processes. This ensures that the plan can legally be implemented in times of drought. Official agreements with entities the provider may coordinate with during a drought may also help speed response time when a drought occurs.

### 4.8.3 Plan Approval

Decision makers including city council/board members should have an opportunity to review drought management plans and comment before the document is finalized. Plans that are officially approved or adopted tend to hold more credit when a drought arises than documents that decision makers have not had an opportunity to review and discuss. The drought management plan itself should document the approval or formal adoption of the plan.

#### 4.8.4 Periodic Review and Update

Drought management planning is most effective when viewed as an ongoing process rather than a discrete process that results in a shelved document only reviewed at the onset of a drought. That said, it is recommended that the drought management plan be updated, at a minimum, every five years. It is recommended that the following is included in a drought management plan:

- Frequency of when the plan is to be updated;
- Anticipated date of the next plan update; and
- Who is to take the lead in initiating the plan update and collect monitoring data.

### 5.0 ORGANIZATION AND CONTENT – TEMPLATE FOR A MUNICIPAL DROUGHT MANAGEMENT PLAN

This section provides recommendations on the organization and content of municipal drought management plans according to the eight common drought planning steps introduced in Section 4.0. A template for a drought management plan is also provided that may be used by municipalities in developing their own individual plans.

#### 5.1 Organizational Tips for Drought Management Plans

Drought management plans are important documents water management staff and decision makers rely on to implement drought mitigation and appropriately respond to a drought. These plans can also be an important tool in managing public expectations and behavior during times of a drought. The following items address how the planning document may be organized to best meet the needs of the public, decision makers, and water management staff. Please note that these items are merely tips that providers may incorporate into their planning process and not requirements.

- *Executive summary* – Executive summaries provide an effective means to convey the basic information excluding the onerous details that only the water management staff may be concerned with. These summaries can be directed towards the public, media, and decision makers. At a minimum, executive summaries should address: the selected drought mitigation measures; staged drought response program; drought stages, triggers, and response targets; and the information and process used by the decision makers to declare a drought. Condensed fact sheets may also be useful in conveying the highlights of the plan to the public and decision makers.
- *Multiple documents* – Some providers may find it appropriate to split the drought management plan into two documents. The first document may provide the basic content of the plan and be written in layman terms for the public, media, and decision makers, while the second more detailed version could provide the technical details and background needed by water management staff to implement the plan.

- *Appendices* – Appendices are another means to separate detailed technical information from the rest of the document. These may include documentation of drought specific policies and ordinances, detailed water supply reliability planning data incorporated into the drought management plan, detailed historical demand and water supply data, etc.
- *Example Drought Management Plans* – Drought management plans submitted to the State are posted on CWCB’s website. These plans may provide additional ideas on organization and report format.

## 5.2 How to Use the Template

Providers throughout the state have a diverse portfolio of water rights and water supply sources and are presented with unique drought-related challenges. Drought management planning must be customized to the needs of each individual municipality and also fit within the financial constraints dedicated to developing a drought management plan. Large municipal providers that have complex water supply systems and a large customer base will likely require more detailed plans than a small provider with a relatively simple system and limited budget for drought planning. One of the biggest challenges in developing the template in Section 5.3 was developing a tool that would be applicable to the diverse needs of each provider within the state.

The template provides a framework that municipalities may use to develop drought management plans. The template is organized according to the eight-step planning process introduced in Section 4.0 where, with exception to the introduction, each of the main sections corresponds with one of the eight planning steps. Each of the subsections includes a checklist of recommended content. Providers may use these checklists as a means to ensure that they are including all applicable information in their plans.

The template provides a comprehensive overview of information that can be included in drought management plans. Some of this information will not be applicable to certain municipalities while others may not have the resources to develop a detailed plan that includes all of the information. Furthermore, the organizational structure may not be suitable for all providers. Modifications to the template to better reflect a provider’s system and needs are anticipated and acceptable.

The objective of the template is to not lay out a list of “requirements” municipalities must include in their plans, but rather present providers with a list of possibilities and allow the provider to decide what information is applicable and beneficial for their drought management purposes. However, there are essential items necessary for development of effective drought management plans. The left-hand column of the template addresses the level of importance and purpose of each checklist item using the following designations:

- *Essential* – This information is necessary for effective drought mitigation and response planning and must be included in the drought management plan to be approved by the State.
- *Beneficial* – While not essential, this information provides an added value to the effectiveness of drought planning and may be necessary for some providers.

- 
- *Public* – This information is optional yet may enhance the overall readability and usability of the document for public educational purposes. This includes background information, concepts, and terminology that is important for the layperson to understand.
  - *Documentation* – While this may not directly influence the effectiveness of the current drought planning effort, this provides good foundational information that can be built on for other studies/future drought updates and can increase the overall usability of the document.

The template should be used in conjunction with the detailed drought planning information in Section 4.0 and the worksheets provided in Appendix A. These worksheets are noted in the template where appropriate and provide a useful resource for generating ideas, organizing information, and formatting data for direct incorporation into the plan.

### 5.3 Template for a Drought Management Plan

The following template is organized in a manner where providers can choose to directly use the section and subsection headings in their individual reports. Each for the sections corresponds to the eight planning steps introduced in Section 4.0. For example, Section 1 addresses Step 1, Stakeholders and Plan Objectives and Principles.



Essential	Beneficial	Public	Document
	Δ	□	
	Δ	□	
	Δ	□ +	
	Δ		

## Introduction

This section introduces the concept of drought management planning and provides a general background on service area and existing water supplies. Information on historical drought planning efforts and how they differ from water conservation could also be addressed. While this information is not essential for planning, it provides useful background material.

## Profile of Existing System

Objective: Provide an overview of the existing system and service area. This should be fairly general information and does not entail disclosure of “sensitive” information that could result in future public safety concerns.

- Δ □  Profile of service area – map or description of the service area and discussion of key water related infrastructure (e.g., water treatment plants, reservoirs, well fields, etc.)
- Δ □  Profile of existing supplies – general overview of the provider’s water supplies, storage facilities, and other supply information applicable to drought planning.
- Δ □ +  Customer profile – average annual retail water delivered to customers (acre-foot), number of homes/customers within the service area, and profile of customer types (e.g., percentage of industrial, commercial, single residential, etc.)

## Drought Mitigation and Response Planning

Objective: Provide a general description of drought mitigation and response planning. Background information on drought mitigation and response planning is provided in Sections 2.2 and 2.3 and also in the [Drought Toolbox](#).

- General description of a drought. See Section 2.1.
- Explanation of how a drought affects the provider’s water supplies.
- Purpose and benefits of drought mitigation and response planning.
- Introduce difference between drought mitigation and drought response planning.
- Δ □  Description of how the drought management plan is coordinated with the State Drought Plan and other local plans, including county or municipal level multi-hazard mitigation plans and emergency operation plans, to reduce redundancy and capitalize on joint efforts. County multi-hazard mitigation plans may be a source of information on drought history and vulnerability and often contain mitigation action strategies that may benefit or enhance local planning efforts.



Essential	Beneficial	Public	Document
	Δ	□	
	Δ	□	
		□	
		□	
◆		+	
	□		
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## Historical Drought Planning Efforts

Objective: Describe historical drought planning efforts.

- Overview of historical drought planning efforts.
- Explanation of modifications made to the current drought planning effort and how this plan is an improvement to historical efforts.

## Drought Planning and Water Conservation

Objective: Drought mitigation, response planning, and conservation planning are closely interrelated processes. Effective planning coordinates all three planning efforts. It is recommended that conservation measures included in a conservation plan, which also provide long-term drought mitigation benefits, also be incorporated as drought mitigation in the drought management plan. This section defines and explains the relationships between drought mitigation planning, drought response planning, and water conservation. Additional information on this may be found in Section 2.3.1.

- Difference between drought and conservation planning. (Some providers may consider conservation as a means of drought mitigation. If this is the case, discuss how conservation is integral to drought mitigation.)
- Brief summary of conservation efforts to date.

### 1.0 Stakeholders, Objectives, and Principles

This section introduces the stakeholder process and basic objectives of the drought management plan.

#### 1.1 Drought Planning Committee

Objective: The members and size of the Drought Committee will vary among providers. Larger providers will likely have a more involved stakeholder process than smaller providers with limited drought planning resources and staff. This section provides an overview of the stakeholder process. See Section 4.1.1 for more information.

- Importance of a stakeholder process.
- Role of the Drought Committee in the development of the drought management plan.
- Explanation of the Drought Committee selection process.
- Drought Committee members including their job title and description of expertise.



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- Summary of the Drought Committee planning meetings held during the drought management plan development process.
- Appendix containing meeting materials (meeting agendas, minutes, presentations, etc.)

### 1.2 Objectives of the Drought Management Plan

Objective: Introduce the basic objectives and operating principles of the plan and describe how these objectives are integrated into the broader water management planning efforts. See Section 4.1.2 for more information.

- List of the objectives and operating principles.
- Discussion of how the objectives and operating principles reflect water use priorities during periods of a drought.
- List of water use priorities (i.e., a) essential water needs, b) social or economic impacts, and c) nonessential uses such as outdoor irrigation).
- Discussion of how the operating principles were incorporated into the plan development and how these principles will be considered during implementation (i.e., “The operating principles are reflective of the community’s values and will be reviewed prior to implementing mandatory water use reductions.”)

### 2.0 Historical Drought and Impact Assessment

This section provides an overview of historical droughts and corresponding changes to supplies and demands. Drought related impacts and lessons learned from previous droughts are also included. While the availability of historical data will vary among providers, the main objective of this section is to consolidate available data to provide insight for projecting and planning for future drought conditions.

#### 2.1 Historical Assessment of Drought, Available Supplies, and Demands

Objective: Assess historical water supplies and demands from previous droughts. Provide as much beneficial detail as possible based on available historical data and institutional memory. See Section 4.2.1 for additional information.

- Discussion of significant historical droughts and how they affected water supplies. This may include information on past reservoir levels, precipitation, streamflows, snowpack, groundwater levels, wholesale supplies, water quality issues, etc. Provide tables/figures that assist in describing historical conditions (i.e., hydrographs).



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- Description of existing operational factors, concepts, and terms that are important when explaining drought planning to the public (e.g., drought reserves, firm yield/safe yield, water quality considerations, water rights, etc.)
- Description of historical changes to water demands as a result of drought and/or drought response/mitigation measures. Provide applicable quantitative data if available. This may include total water demands, per capita water demands (gpcd), demands by customer type, indoor and outdoor usage, etc.
- Lessons learned from previous drought(s) and recommendations for how implementation of drought mitigation/response measures should be altered to better respond to future drought.

## 2.2 Historical Drought Impact, Mitigation and Response Assessment

Objective: Review and discuss historical drought impacts and mitigation and response measures taken to reduce the impacts. Provide as much beneficial detail as possible based on available historical data and institutional memory. See Section 4.2.2 for additional information.

- Impacts experienced during historical droughts or current drought. **Worksheet A** provides a list of drought related impacts and a means to identify historical and current impacts.
- Available drought-related economic loss data and any additional information useful for characterizing historical impacts. This may also be provided in a supplemental document as an appendix.
- Mitigation measures historically implemented to minimize drought impacts. Mitigation measures taken prior to a drought to avoid or reduce impacts during a drought. Demand- and supply-side historical mitigation measures may be identified using **Worksheets B and C**, respectively.
- Drought response measures implemented during previous drought(s) and overall effectiveness of these measures. Demand- and supply-side historical response measures may be identified using **Worksheets B and C**, respectively.

## 3.0 Drought Vulnerability Assessment

This section provides an overview of water supply reliability and drought management planning and identifies potential future drought impacts. This information is useful for selecting the drought mitigation and response strategies described in Step 4.

### 3.1 Water Supply Reliability and Drought Management Planning

Objective: Present the approach used for the water supply reliability assessment. See Section 4.3.1 for additional information.



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- Summary of water supply reliability planning efforts. For example, disclose raw water master planning studies, forecasting models, etc.
- If not previously discussed, disclose key terminology used to define water supply reliability and how it is measured (e.g., firm yield, safe yield, etc.)
- Description of how water supply reliability planning is related to drought planning (i.e., water supply reliability planning efforts target sufficient supplies to meet essential customer needs for a drought equivalent to the 2002 drought).
- If applicable, address how climate change has been incorporated into water supply reliability planning.
- Description of other factors that could influence either the quality or quantity of water supplies, or demands that are not directly incorporated into water supply reliability studies (e.g., water quality issues, severe cases of droughts in sequential years, Colorado River Compact call, etc.)

### 3.2 Drought Impact Assessment

Objective: Identify potential future drought impacts. See Section 4.3.2 for additional information.

- Potential impacts that could occur during future droughts. **Worksheet A** may be used to identify potential impacts.
- Discussion of the relative priorities assigned to the potential impacts. This information may be best represented as a table listing the potential impacts and corresponding priority with follow-up discussion. **Worksheet A** provides a means to record these priorities.

### 4.0 Drought Mitigation and Response Strategies

This section discusses the selected drought mitigation and response strategies. As discussed in Section 2.3.1, drought response measures often achieve temporary savings through changes in customer behavior during a drought. This may involve mandatory water restrictions for certain types of water use on a temporary basis. Drought mitigation generally applies to measures taken prior to a drought to avoid or reduce impacts during a drought.

#### 4.1 Drought Mitigation Measures

Objective: Introduce existing and planned drought mitigation measures. These measures should be integrated into water supply management planning efforts and operations prior to a drought in order to reduce the severity of future droughts. See Section 4.4 for additional information.

- List of drought mitigation measures.
- Worksheets B and C** list potential mitigation actions and provide a means to



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select and screen measures. **Worksheet A** facilitates the development of new mitigation actions that specifically address preidentified potential impacts. These processes are described in greater detail in Section 4.4.2.

- Discussion of the criteria used to select the mitigation measures. Section 4.4.2 provides a list of suggested criteria.
- If conservation is being considered as a component of drought mitigation, discussion of how the existing conservation measures provide drought mitigation. See Section 2.3.1 for additional discussion.

## 4.2 Supply-Side Response Strategies

Objective: Provide an overview of the supply-side response strategies. See Section 4.4 for additional information.

- List of the selected supply-side response strategies. Supply-side strategies listed in **Worksheet B** may be used as an initial reference source for generating strategy ideas. Specific details related to each strategy should be included. For example, if the “lower reservoir intake strategy” is selected, information should also be provided on the specific reservoir(s) in which the intake will be lowered.
- Discussion of the criteria used to select the supply-side strategies. Section 4.4.2 provides a list of suggested criteria.
- Discussion of how the selection process is reflective of the Step 1 objectives and operating principles.

## 4.3 Demand-Side Response Strategies

Objective: Provide an overview of the demand-side response strategies taken when drought is imminent or occurring. See Section 4.4 for additional information.

- List of the selected demand-side response strategies. Demand-side strategies listed in **Worksheet C** may be used as an initial reference source for identifying strategies. This worksheet is also useful for identifying whether the strategy is to be implemented on a voluntary, incentive, or mandatory basis. For example, strategies may be voluntary for a Stage 1 drought and elevated to mandatory under more drought severe conditions. Coordination with other entities may also be beneficial and can be noted in **Worksheet C**. Similar to the supply-side strategies, details related to the future implementation of each strategy should be included.
- Discussion of the criteria used to select the demand-side strategies. Section 4.4.2 provides a list of suggested criteria.
- Discussion of how the selection process is reflective of the Step 1 objectives and operating principles.



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#### 4.4 Drought Public Information Campaign

Objective: Provide the drought public campaign framework. See Section 4.4.3 for additional information.

- List of the public drought campaign goals.
- Discussion of how the public drought campaign will be differentiated from the public conservation education program and how synergistic benefits can be developed between the two programs.
- General components of the public drought campaign. This includes the types of audiences to be targeted, communication tools to be used to convey drought related information, specific key information to convey, and opportunities for future synergies. **Worksheet D** may be used as a means to develop this framework.
- Prescribed messages targeted towards the public to be released through public information outlets during various drought stages. These could be detailed in an appendix.

#### 5.0 Drought Stages, Trigger Points, and Response Targets

This section presents the drought stages, trigger points, and response targets and how they are incorporated into a drought declaration and response effort. Information is also provided on how these drought stages, trigger points, and response targets were developed and challenges related to the unpredictable nature of drought.

##### 5.1 Drought Stages, Trigger Points, and Response Targets

Objective: Present the drought stages, response targets and, if applicable, corresponding drought trigger points. This should also include an explanation of how drought indicators and/or drought trigger points are used to determine and declare drought stages to the public. See Section 4.5 for additional information. Information on drought indicators is provided in the [Drought Toolbox](#).

- Presentation of the drought stages and, if applicable, corresponding drought trigger points and response targets. The tables included in **Worksheet E** may be used to present the drought stages, trigger points, and response targets.



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- Explanation of how the drought stage depends upon the severity of the drought and that the amount of water that must be saved increases with the severity of the drought. For example, Stage 1 may involve voluntary saving measures while Stage 3 may require significant mandatory reduction of outdoor lawn watering).
- If applicable, approach used to develop the drought trigger points and response targets.

## 5.2 Drought Declaration and Predictability

Objective: Provide a brief discussion of the challenges involved in early detection of a drought, how drought indicator data help characterize a drought, and other factors that influence drought declaration. See Section 4.5.2 for additional information.

- Discussion of how weather patterns in Colorado can be unpredictable and the overall challenges in early detection of drought. Example(s) of past unpredicted weather events may be beneficial.
- List of selected drought indicators and description of how these indicators are reflective of water supply conditions.
- If applicable, significance of the selected drought trigger(s). In other words, why were these trigger(s) selected as opposed to other drought indicators.
- Discussion of how the drought indicators, triggers, and other pertinent data are incorporated into the decision making process of declaring a drought.
- Summary of how drought indicators will be monitored and general frequency of monitoring. Address critical times of year when monitoring is particularly important for identifying drought conditions (i.e., reservoir storage near the end of runoff).
- Advantages and disadvantages of declaring a drought early versus delaying declaration of a drought stage until later in the season. Address the balance between prematurely declaring a drought and waiting too long to respond.
- Discussion of how droughts can behave differently and the necessity for flexibility in declaring a drought stage (i.e., a multi-year drought could result in water shortages greater than anticipated requiring drought stages, trigger points, and response targets to be adjusted accordingly).



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## 6.0 Staged Drought Response Program

This section outlines the drought response measures corresponding to each of the drought stages developed in Step 5. See Section 4.6 for additional information.

- Supply- and demand-side response measures by drought stage. **Worksheet F** may be used to divide the strategies into individual measures according to drought stage. **Worksheet G** provides a template for presenting the supply- and demand-side measures.
- Provide a summary table that highlights the drought stages, trigger points, response targets and a summary of drought response measures. **Worksheet H** provides a template that may be used to summarize the staged drought response program (for insert into an executive summary, fact sheet for public distribution, etc.)
- Provide detailed staged public drought campaign plan if the provider chooses to include a detailed public drought campaign plan as a component of the staged drought response program. If appropriate, this may be an appendix or supplemental document. See Section 4.6.2 for additional information.

## 7.0 Implementation and Monitoring

This section addresses the coordination necessary to fully implement the drought management plan. This includes mitigation plan, drought indicator monitoring, drought declaration protocol, implementation and enforcement of the staged drought response program, revenue planning, and monitoring of the drought response effort and making appropriate changes when necessary.

### 7.1 Mitigation Action Plan

Objective: Present the schedule and procedures necessary to implement the drought mitigation. See Section 4.7.1 for additional information.

- +  **Worksheet I** provides a means to summarize the majority of information listed below in a table.
- List of the drought mitigation actions.
- Steps necessary to implement each mitigation action.
- Milestone deadlines.
- Entities/staff responsible for administrating the mitigation action.
- List of funding sources.



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## 7.2 Monitoring of Drought Indicators

Objective: Discuss the approach used to monitor drought indicators, including the schedule, monitoring methodology, and roles and responsibilities of the entities/staff responsible for monitoring the drought indicators. See Section 4.7.2 for additional information.

- Drought data monitored on an annual and seasonal basis.
- Frequency monitoring and general schedule. Address how intensity of monitoring effort may increase during drought periods.
- Entities/staff responsible for drought monitoring.
- Protocol for recording and archiving monitoring data.

## 7.3 Drought Declarations

Objective: Describe the decision-making process necessary to publicly declare a drought and the corresponding drought stage and how this information is conveyed to the public. See Section 4.7.3 for additional information.

- Summary of guidelines (e.g., trigger points and/or drought indicator data) used by staff to evaluate drought conditions.
- If applicable, approach and/or resources used to forecast drought.
- Decision maker(s) responsible for declaring a drought and corresponding drought stages.
- If applicable, protocol for conveying drought information and recommendations from staff to decision makers.
- Discussion of importance in identifying and declaring drought in a timely manner. Address timing of when decision-makers are informed and, subsequently, when the public is informed of a drought declaration.
- Staff or entity responsible for announcing drought declaration to the public.

## 7.4 Implementation of the Staged Drought Response Program

Objective: Describe the roles and responsibilities of implementing the staged drought response program. See Section 4.7.4 for additional information.

- Entities/staff responsible for administering the staged drought response program.
- If applicable, discuss additional staff that would need to be hired.
- Staff responsible for administering the drought public campaign.



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- Communication and coordination protocol among entities/staff.

### 7.5 Enforcement of the Staged Drought Response Program

Objective: Describe the policy, roles and responsibilities, and activities necessary to enforce the drought response plan. See Section 4.7.5 for additional information.

- Enforcement policies appropriate for each drought stage. *Worksheets G and H* provide options of how the specific enforcement policies and/or activities may be presented.
- Identify the level of monitoring/patrolling necessary for each drought stage. Who will be responsible for patrolling the service area and issuing citations? Will additional temporary staff need to be hired? What training will be necessary?
- Identify how information on the enforcement will be conveyed to the public.
- Develop an appeals process and possible exemptions to enforcement procedures under certain circumstances.
- Identify who is responsible for administration of the enforcement effort and approving exceptions to the enforcement policy.

### 7.6 Revenue Implications and Financial Budgeting Plan

Objective: Discuss the potential for revenue loss when customers reduce water use in response to drought and how this will be addressed. Quantitative estimates of revenue implications, water rate adjustments, or other budgetary modifications can be an involved and highly technical process that may be beyond the scope and financial resources for this effort. If the provider chooses to not pursue a detailed financial revenue analysis as a component of this Plan, this section should, at minimum, outline the steps and resources necessary to address this issue if revenues should be significantly impacted from future drought response efforts. See Section 4.7.6 for additional information.

- Introduction to how the reduction in water use can reduce revenue and financially stress providers.
- Estimates and/or qualitative discussion of potential revenue reductions and how this would impact the average residential and business customer.
- Financial resources necessary to implement the response programs, including the public drought campaign, stated drought response program, and any additional funds necessary to intensify drought monitoring efforts.
- Describe the strategies for addressing revenue losses. Include the general timing of when these strategies would be implemented relative to the declaration of a drought.



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Detailed estimates of potential revenue loss and specific actions taken by the provider to mitigate these losses (i.e., create a special fund prior to the drought to offset revenue losses during the drought, drought surcharges or raise water rates). Provide the assumptions and details of the financial analysis in an appendix or supplemental document.

Discuss how the drought surcharges and/or water rate increases would be conveyed to the public.

### 7.7 Monitoring of Plan Effectiveness

Objective: Describe the data collection and assessment activities in place to monitor the overall effectiveness of the plan. See Section 4.7.7 for additional information.

Schedule an exercise to test the implementation of the Plan.

Data to be collected. This should include demand data, lessons learned, conditions of the water supply system during the drought (e.g., storage amounts), public perceptions and general response to the drought, and administrative staged drought response program data (e.g., number of citations delivered).

Staff/entities responsible for the data collection, evaluation, and recommendations on Plan improvements.

### 8.0 Formal Plan Approval and Updates

This section addresses the public review and formal adoption process for the necessary ordinance(s) and agreement(s) of the Plan. Information is also provided on the maintenance and anticipated update of the Plan.

#### 8.1 Public Review Process

Objective: This section summarizes the public’s role in development of the Plan. See Section 4.8.1 for additional information.

A public review process is necessary to ensure that the public has had an opportunity to review and comment on the Plan. Providers should follow the appropriate rules, codes, or ordinances to make the draft Plan available for public review and comment. If there are no rules, codes, or ordinances governing the entity’s public planning process, each provider should publish a draft Plan, give public notice of the Plan, make such plan publicly available, and solicit comments from the public for a period of not less than sixty days after the date on which the draft Plan is made publicly available. Reference shall be made in the public notice to the elements of a Plan that have already been implemented.



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- If members from the general public are on the Drought Committee, describe their involvement.
- Description of the public review process and how the public may access the Plan.
- +  Summary of public comments and meetings held during the Plan development process.
- +  Appendix of the public meeting minutes and public comments and how those comments were addressed within the Plan.

### 8.2 Adoption of Ordinances and Official Agreements

Objective: Summarize the ordinances and official agreements adopted to implement the Plan. See Section 4.8.2 for additional information.

- Summary of the ordinance(s) and policy necessary to implement the Plan. This may include policy changes to: facilitate the formal declaration of a drought; implement and enforce the staged drought response program and drought public campaign; and adopt revenue changes, etc.
- Official agreement(s) needed with other entities for drought-related coordination purposes.
- +  Official copies of the ordinance(s) and/or official agreement(s) may be included in an appendix.
- +  Challenges encountered to develop and approve the ordinance(s) and/or official agreement(s).

### 8.3 Drought Management Plan Approval

Objective: Briefly summarize the formal process for Plan adoption. Note: For some water suppliers, formal approval of its Plan may not be desirable. See Section 4.8.3 for additional information.

- Government body that either approved or officially adopted the Plan.
- Date of approval/adoption.
- Potential conflicts/issues with the approval/adoption.
- +  Copy of the official approval/adoption document in appendix.

### 8.4 Periodic Review and Update

Objective: Summarize the anticipated timing of Plan updates and the processes that will occur to facilitate the update. See Section 4.8.4 for additional information.

- Frequency of when the Plan will be updated. Recommend every five years.



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- Anticipated date of the next update.
- Staff responsible for taking the lead in initiating the Plan update and collecting appropriate data.
- Process of how the recommendations for Plan improvements will be incorporated into updated plans.

## 9.0 Suggested Appendices

This section provides a list of appendices that may be applicable to include with the Plan.

- +  Drought Committee meeting materials (e.g., meeting agendas, minutes, presentations, etc.)
- +  Public drought campaign prescribed messages.
- +  Supplemental technical information and data. This may include studies on demand reduction and revenue impacts, historical drought impact studies/reports, or supplemental data/information on the water supply vulnerability assessment, etc.
- +  Public meeting minutes and comments.
- +  Official copies of the adopted ordinance(s) and/or official agreement(s).
- +  Copy of the Plan approval document.



## 6.0 REFERENCES

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## Appendix A Guidance Document Worksheets

This appendix provides a series of worksheets in support of the development of drought management plans. This worksheet collection is essentially a toolkit intended to assist providers with generating ideas, organizing information, and formatting data for direct incorporation into the plan. If appropriate, portions of the worksheet tables or tables in their entirety can be inserted directly into the drought management plan or appendices. All of the items in the worksheets and worksheets themselves may not be applicable to every provider and should be used at the provider's own discretion. Each worksheet includes a set of instructions in blue font. The following worksheets are provided:

- Worksheet A – Historical Drought Impact, Future Impacts, and Mitigation
- Worksheet B – Supply-Side Mitigation and Response Strategies
- Worksheet C – Demand-Side Mitigation and Response Strategies
- Worksheet D – Drought Public Information Campaign
- Worksheet E – Drought Stages, Trigger Points, and Response Targets
- Worksheet F – Staged Drought Response Program
- Worksheet G – Drought Mitigation and Staged Drought Response Program
- Worksheet H – Summary of Drought Mitigation and Staged Drought Response Program
- Worksheet I – Mitigation Action Plan
- Worksheet J – Demand Projection and Priority Allocation
- Worksheet K – Drought Monitoring



# Historical Drought Impacts, Future Potential Impacts, and Mitigation

Historical, Existing and Potential Drought Impacts <a href="#">[1]</a>	Step 2 - Historical Drought Assessment					Step 3 - Vulnerability Assessment		Step 4 - Drought Mitigation and Response Strategies		
	Historical Impact <a href="#">[2]</a>	Existing Impact <a href="#">[3]</a>	Ranking of Drought Impact Severity <a href="#">[4]</a>	Historical/Existing Mitigation & Response Strategies <a href="#">[5]</a>	Effectiveness of Historical/Existing Mitigation & Response Strategies <a href="#">[6]</a>	Comments <a href="#">[7]</a>	Potential Future Impact <a href="#">[8]</a>	Potential Impact Priority <a href="#">[9]</a>	Mitigation <a href="#">[10]</a>	Response Strategies <a href="#">[11]</a>
Decreased land prices										
Land subsidence as a result of groundwater depletions										
Income loss to farmers that indirectly affects municipal businesses										
Loss to recreation and tourist industry										
Reduction of economic development										
Increase in food prices										
Restrictions/limitations on landscaping harms landscaping companies										
Impacts to large scale commercial water users (i.e., golf courses)										
Loss in hydropower energy										
<a href="#">List other economic related impacts</a>										
<b>Environmental and Recreational</b>										
Increased risk of frequency and severity of wildfires										
Beetle kill										
Stress to surrounding natural environment										
Loss of wetlands										
Lower streamflows										
Lower lake/reservoir levels										
Increased susceptibility to plant disease										
Increased wind and water erosion										
Reduced flow from springs										
Air quality effects (i.e. dust and pollutants)										
Visual and landscape quality (i.e., dust, vegetative cover, etc.)										
Stress to fish and other wildlife										
Lower water quality in streams and/or lakes/reservoirs										
Campfire bans										
Land subsidence										
<a href="#">List other environmental and recreational related impacts</a>										

# Supply-Side Mitigation and Response Strategies

## WORKSHEET B - SUPPLY-SIDE MITIGATION AND RESPONSE STRATEGIES

**Instructions:**

- [1] This column provides a list of supply-side response strategies. List additional strategies identified using Worksheet A or alternative sources
- [2] This column identifies long-term mitigation actions.
- [3] This column identifies short-term response strategies.
- [4] Preliminary Selection: Identify the mitigation and response strategies that meet the following
  - Enter "existing" for all mitigation and response strategies included in existing drought management plans that will continue to be used in the future
  - Enter "new" for all mitigation and response strategies are to be considered for this drought management planning effort
  - Enter "eliminated" for all existing mitigation and response strategies that will no longer be used in the future
- [5] Specify whether the selected "existing" and "new" mitigation and response strategies are to be implemented as mitigation or short-term response strategies by entering an "X" in the appropriate column.
- [6] Screening: Specify how well the selected mitigation and response measures meet the criteria to the right of these instructions by entering the following ranking value
  - Enter "1" for mitigation and response strategies that meet one of the five screening criteria.
  - Enter "2" for mitigation and response strategies that meet two of the five screening criteria.
  - Enter "3" for mitigation and response strategies that meet three of the five screening criteria.
  - Enter "4" for mitigation and response strategies that meet four of the five screening criteria.
  - Enter "5" for mitigation and response strategies that meet five of the five screening criteria.
- [7] Enter an X for selected mitigation and response strategies following the screening process.
- [8] If necessary provide additional explanation of why a mitigation or response strategy was retained or eliminated.

[6] Screening Criteria:

- a) Technical feasibility
- b) Perceived benefits
- c) Cost effectiveness
- d) Public acceptance
- e) Environmental sensitivity and other extraneous impacts

Supply-Side Mitigation and Response Strategies [1]	Long-term Mitigation Actions [2]	Short-term Response Strategy [3]	Preliminary Selection of Mitigation and Response Strategies	Selection of Planning Horizon [5]		Screening Ranking Value [6]	Post-Screening Selection of Mitigation and Response Strategies	Comments [8]
				Long-term Mitigation Actions	Short-term Response Strategy			
<b>Elements of a Drought Management Plan</b>								
Establish drought response principles, objectives, and priorities	X							
Establish authority and process for declaring a drought emergency	X							
Develop drought stages, trigger points, and response targets	X							
Prepare ordinances on drought measures	X							
Evaluate historical drought impacts	X							
Monitor drought indicators (snowpack, streamflow, etc.)	X	X						
Monitor water quality	X	X						
Track public perception and effectiveness of drought measures	X	X						
Improve accuracy of runoff and water supply forecasts	X							
<i>List additional strategies identified using Worksheet A or alternative sources</i>								
<b>Emergency Response</b>								
Declare a drought emergency		X						
Establish water hauling programs	X	X						
Restrict/prohibit new taps		X						
Identify state and federal assistance	X	X						
Provide emergency water to domestic well users		X						
Import water by truck/train		X						
<i>List additional strategies identified using Worksheet A or alternative sources</i>								
<b>Public Education and Relations</b>								
Establish a public advisory committee	X	X						
Develop Drought Public Education Campaign with long- and short-term strategies. (See Worksheet D)	X	X						
Extend boat ramps and docks for recreational use when reservoirs are low	X	X						
<i>List additional strategies identified using Worksheet A or alternative sources</i>								

## Supply-Side Mitigation and Response Strategies

Supply-Side Mitigation and Response Strategies [1]	Long-term Mitigation Actions [2]	Short-term Response Strategy [3]	Preliminary Selection of Mitigation and Response Strategies	Selection of Planning Horizon [5]		Screening Ranking Value [6]	Post-Screening Selection of Mitigation and Response Strategies	Comments [8]
				Long-term Mitigation Actions	Short-term Response Strategy			
<b>Water Supply Augmentation</b>								
Establish drought reserves	X							
Draw from drought reserves		X						
Increase groundwater pumping		X						
Deepen wells	X	X						
Develop supplemental groundwater/conjunctive use	X							
Reactivate abandoned wells		X						
Flush existing wells to develop maximum flow rates	X	X						
Blend primary supply with water of lesser quality to increase supplies		X						
Rehabilitate operating wells	X	X						
Employ desalination of brackish groundwater	X							
Increase use of recycled water	X	X						
Utilize ditch water or treated effluent for irrigating landscaping/parks	X	X						
Build new facilities to enhance diversion or divert new supplies	X							
Lower reservoir intake structures	X	X						
Use reservoir dead storage		X						
Acquire additional storage	X							
Build emergency dams	X	X						
Reactivate abandoned dams	X	X						
Cloud seeding	X	X						
<i>List additional strategies identified using Worksheet A or alternative sources</i>								
<b>Water Rights Management and Cooperative Agreements</b>								
Call back water rights that others are allowed to use		X						
Pay senior water user to not place a "call" on the river		X						
Pay upstream water user to allow diversion of more water		X						
Purchase water from other entities (i.e., neighboring cities, federal projects)		X						
Arrange for exchanges	X	X						
Lease irrigation rights from farmers		X						
Lease private wells		X						
Cancel municipal leases of water to farmers		X						
Use irrigation decrees		X						
Invoke drought reservations that allow reduction in bypass requirements		X						
Negotiate purchases or 'options'	X	X						
Renegotiate contractually controlled supplies	X	X						
Develop water transfers with other entities	X	X						
Develop water bank to facilitate water transfers in times of drought	X							
Develop interconnects with other entities	X	X						
Trade water supplies with other entities to increase yield		X						
<i>List additional strategies identified using Worksheet A or alternative sources</i>								
<b>Improve Water Distribution Efficiency</b>								
Conduct distribution system water audit	X	X						
Repair leaks in distribution system	X	X						
Reduce distribution system pressure		X						
Replace inaccurate meters	X							
Calibrate all production, commercial, industrial, and zone meters	X							
Install meters at key distribution points to isolate areas of overuse and probable leakage	X							
Minimize reservoir spills	X	X						
Change operations to optimize efficiency and distribution of supplies	X	X						
Change pattern of water storage and release operations to optimize efficiency	X	X						
Reduce reservoir evaporation (i.e., reduce storage in reservoirs with high evaporation rates)	X	X						
Reduce reservoir seepage (i.e., reduce storage in reservoirs with high seepage rates)	X	X						
Recirculate wash water	X							
Enhance efficiency of water treatment facilities	X							
<i>List additional strategies identified using Worksheet A or alternative sources</i>								

# Demand-Side Mitigation and Response Strategies

## WORKSHEET C - DEMAND-SIDE MITIGATION AND RESPONSE STRATEGIES

**Instructions:**

- [1] This column provides a list of demand-side response strategies. List additional strategies identified using Worksheet A or alternative sources.
- [2] This column identifies the long-term mitigation actions.
- [3] This column identifies the short-term response strategies.
- [4] Conduct screening: Identify the mitigation and response strategies that meet the following on a promotion/voluntary, incentive, mandatory, coordination basis:
  - Enter "existing" for all mitigation and response strategies included in existing drought management plans that will continue to be used in the future.
  - Enter "new" for all mitigation and response strategies are to be considered for this drought management planning effort.
  - Enter "eliminated" for all existing mitigation and response strategies that will no longer be used in the future.
- [5] Specify whether the selected "existing" and "new" mitigation and response strategies are to be implemented as mitigation or short-term response strategies by entering an "X" in the appropriate column.
- [6] Screening: Specify how well the selected mitigation and response measures meet the criteria to the right of these instructions by entering the following ranking value:
  - Enter "1" for mitigation and response strategies that meet one of the five screening criteria.
  - Enter "2" for mitigation and response strategies that meet two of the five screening criteria.
  - Enter "3" for mitigation and response strategies that meet three of the five screening criteria.
  - Enter "4" for mitigation and response strategies that meet four of the five screening criteria.
  - Enter "5" for mitigation and response strategies that meet five of the five screening criteria.
- [7] Enter an X for selected mitigation and response strategies following the screening process.
- [8] If necessary provide additional explanation of why a mitigation or response strategy was retained or eliminated.

**[6] Screening Criteria:**

- a) Technical feasibility
- b) Perceived benefits
- c) Cost effectiveness
- d) Public acceptance
- e) Environmental sensitivity and other extraneous impacts

Mitigation and Demand-Side Response Strategies <small>[1]</small>	Type of Strategy		Selection of Mitigation and Response Strategies <small>[4]</small>				Selection of Planning Horizon <small>[5]</small>		Screening Ranking Value <small>[6]</small>	Post-Screening Selection of Mitigation and Response Strategies <small>[7]</small>	Comments <small>[8]</small>
	Long-term Mitigation Actions <small>[2]</small>	Short-term Response Strategy <small>[3]</small>	Promote/Voluntary	Incentive Based	Mandatory	Coordinate with Other Entities	Long-term Mitigation Actions	Short-term Response Strategy			
<b>Provider/Municipality</b>											
Develop drought public education campaign with long-term and short-term demand management strategies	X	X									
Identify high water use customers and develop water saving targets	X	X									
Implement conservation measures that also provide water saving benefits during drought periods (i.e., water fixture rebates)	X										
Restrict the issuance of new taps		X									
Implement drought surcharges		X									
Implement a modified rate structure for drought periods	X	X									
Conduct irrigation audits on Provider/Municipal parks and open spaces	X	X									
Educate provider/municipal staff on how to save water	X	X									
Provide instructional resources to business on developing an office/business specific drought mitigation and response plan	X	X									
Eliminate/reduce irrigation on provider/municipal owned parks and landscaping	X	X									
Limit outdoor watering to specific times of the day	X	X									
Limit number of watering days per week	X	X									
Set time limit for watering	X	X									
Prohibit watering during fall, winter, and early spring		X									
Convert sprinklers to low volume irrigation where appropriate	X										
Restrict outdoor misting devices		X									
Reduce street cleaning, sidewalk, and driveway washing		X									
Limit/prevent washing of city fleet vehicles		X									
Limit hydrant washing and flushing		X									
Limit use of water for fire training		X									
Eliminate all fire hydrant uses except those required for public safety		X									
Turn off ornamental fountains in buildings and parks		X									
Install water saving fixtures, toilets, and/or appliances in provider/municipal-owned buildings	X										
Conduct indoor water audits	X	X									
<i>List additional strategies identified using Worksheet A or alternative sources</i>											
<b>Residential</b>											
Enforce landscape watering restrictions	X	X									
Limit outdoor watering to specific times of the day	X	X									
Limit number of watering days per week	X	X									
Set time limit for watering	X	X									
Prohibit lawn watering during fall, winter, and early spring		X									

# Demand-Side Mitigation and Response Strategies

Mitigation and Demand-Side Response Strategies <a href="#">[1]</a>	Type of Strategy		Selection of Mitigation and Response Strategies <a href="#">[4]</a>				Selection of Planning Horizon <a href="#">[5]</a>		Screening Ranking Value <a href="#">[6]</a>	Post-Screening Selection of Mitigation and Response Strategies <a href="#">[7]</a>	Comments <a href="#">[8]</a>
	Long-term Mitigation Actions <a href="#">[2]</a>	Short-term Response Strategy <a href="#">[3]</a>	Promote/Voluntary	Incentive Based	Mandatory	Coordinate with Other Entities	Long-term Mitigation Actions	Short-term Response Strategy			
	Limit watering to hand-held hose or no-volume nonspray device		X								
Promote outdoor water audits	X	X									
Convert sprinklers to low volume irrigation where appropriate	X	X									
Limit/restrict outdoor misting devices	X	X									
Limit/prohibit installation of new sod, seeding, and/or other landscaping		X									
Enforce policy guidelines/limitations for installation of new sod and/or other landscaping	X	X									
Enforce restrictions on spraying of impervious surfaces		X									
Prohibit/limit vehicle washing		X									
Prohibit/limit nonrecirculating fountains		X									
Prohibit/limit filling and use of swimming pools		X									
Enforce indoor water restrictions		X									
Promote indoor water audits	X	X									
Promote/require installation of water efficient appliances (e.g., dishwashers, clothes washer)	X	X									
Promote/require graywater use	X	X									
Provide acoustical meters to assist customers in identifying leaks	X	X									
Require water efficient fixtures and/or appliances on house resale or remodeling	X	X									
Provide historical monthly water usage on water bills	X	X									
Promote/enforce reduction of water-cooled air conditioning		X									
<a href="#">List additional strategies identified using Worksheet A or alternative sources</a>											
<b>Commercial</b>											
Prohibit/limit use of construction water		X									
Enforce policy guidelines/limitations for installation of new sod and/or other landscaping	X	X									
Enforce outdoor landscape watering restrictions	X	X									
Promote/require indoor and outdoor water audits where applicable	X	X									
Turn off indoor and outdoor ornamental fountains		X									
Prohibit/limit filling and use of swimming pools		X									
Promote/enforce installation of water efficient fixtures and appliances (i.e., toilets, faucets, etc.)	X	X									
Turn off public drinking fountains		X									
Promote reduction of water-cooled air conditioning		X									
Promote/require buildings with water-cooled air conditioning to raise the temperature modestly		X									
Prohibit/limit dealership washing of vehicles		X									
Enforce water use restrictions on commercial car washes		X									
Promote commercial car washes to install water recycling technology and/or other BMPs	X	X									
Promote/enforce service of water in restaurants only upon request	X	X									
Promote/enforce reduction in frequency of linen and towel washing in hotels	X	X									
Provide instructional resources on developing a business/office specific conservation plan	X	X									
<a href="#">List additional strategies identified using Worksheet A or alternative sources</a>											
<b>Industrial</b>											
Prohibit/limit use of construction water		X									
Enforce policy guidelines/limitations for installation of new sod and/or other landscaping	X	X									
Enforce outdoor landscape watering restrictions	X	X									
Promote/require indoor and outdoor audits where applicable	X	X									
Promote reduction of water-cooled air conditioning		X									
Require buildings with water-cooled air conditioning to raise the temperature modestly		X									
Promote/require conversion of cooling towers and other industrial water using processes	X										
<a href="#">List additional strategies identified using Worksheet A or alternative sources</a>											

# Drought Public Information Campaign

## WORKSHEET D - DROUGHT PUBLIC INFORMATION CAMPAIGN

**Instructions:**

- [1] Select the drought information to convey to the public prior to a drought (long-term mitigation) in response to declaration of a drought (long-term response), or for both scenarios. Enter "yes," "maybe," or "no" in each column.
- [2] Select the targeted audience and corresponding communication tool(s) for each of the drought components selected in column [1] by entering the appropriate letter designation(s) for each of the applicable communication tools identified in the communications tools listed to the right.
- [3] Enter additional ideas.
- [4] Enter an "X" for all components where coordination with other entities is a likely possibility.

**Communication Tools**

- a Website devoted to drought and water conservation tips
- b Water bill (monthly water use targets and actual consumption)
- c Establish drought hotline & train staff to operate hotline
- d Newspaper articles
- e Television
- f Reach out to general media
- g City & county websites
- h Water bill inserts
- i Distribution of brochures
- j Seminars/special programs
- k Broadly distributed emails
- l School outreach/educational programs (field trips, speakers, curriculum)
- m Mail fliers
- n Public meetings
- o Distribution of water conservation tools (rain meter, sink aerators, etc)
- p Booths at special events
- q Billboards
- r Social networking media
- s Email
- t Meetings
- u Phone

*Insert other communication tools [3]*

	Screening [1]		Targeted Audience [2]														Coordinate with Other Entities [4]	
	Long-term Mitigation Actions	Short-term Reponse Strategy	Decision makers/policy makers	Governmental bodies/city departments (i.e. parks, fire department)	Community recreational facilities	Media	Single-family residential	Multi-family residential	HOAs	Commercial business owners	Commercial business employees	School facility managers	School children	Industrial businesses	Specific targeted businesses (local nurseries, landscape architects, health facilities)	Large water users (golf courses)		<i>Insert other audience members [3]</i>
<b>Public Information Campaign Components</b>																		
Drought Information to Convey to the Public																		
Status of current drought conditions and drought stage																		
Long-term sustainability of water supply system																		
Where customers may access drought mitigation plan																		
Measures and/or impacts that customers can expect if drought continues or intensifies																		
Factors that could influence water supply services and cost of services																		
Water provider's actions to save water and/or acquire new water																		
Policy recommendations, requirements, and penalties																		
Enforcement of drought policies																		
Explanation of rate increases/drought surcharge																		
Increase advertisement of conservation incentives in conservation and drought plans																		
Water conservation savings tips																		
Landscaping tips during a drought (i.e., which plants to convert to drip, which to save, which to let die)																		
Post-drought landscape revival information																		
Use of gray water where legal and appropriate																		
Promote existing xeriscape gardens																		

# Drought Public Information Campaign

Public Information Campaign Components	Screening [1]		Targeted Audience [2]														Coordinate with Other Entities [4]	
	Long-term Mitigation Actions	Short-term Reponse Strategy	Decision makers/policy makers	Governmental bodies/city departments (i.e. parks, fire department)	Community recreational facilities	Media	Single-family residential	Multi-family residential	HOAs	Commercial business owners	Commercial business employees	School facility managers	School children	Industrial businesses	Specific targeted businesses (local nurseries, landscape architects, health facilities)	Large water users (golf courses)		Insert other audience members [3]
Ways to clean sidewalks, driveways, and other hard surfaces without using hoses																		
Ways to wash vehicles to minimize water waste																		
Water saving targets and actual consumption by individual customer, city, sector, etc.																		
Instruction to customers on how to set up a water use plan for their homes or business																		
Instructions on how to track water use within the home																		
Publicize efforts of individuals and businesses as examples of how to reduce water use																		
Encourage intense public discussion and media involvement concerning ways to reduce water use while minimizing impacts (i.e., landscaping impacts)																		
Do-it-yourself water waste reduction/water savings brochure																		
Provide customers with a drought report card at the year showing monthly/annual water use pre-drought and during the drought																		
Insert additional information to convey to the public [3]																		

# Drought Stages, Trigger Points and, Response Targets

## WORKSHEET E - DROUGHT STAGES, TRIGGER POINTS, AND RESPONSE TARGETS

Instructions:

- [1] List additional drought indicators that may be used to monitor drought not included in this list.
- [2] Identify drought indicators currently used to monitor drought by entering a "X".
- [3] Identify new drought indicators that will be monitored as a result of this planning effort by entering a "X".
- [4] Identify the key drought indicators that will be used to develop trigger points by entering a "X". (This will not be applicable for providers choosing not to develop trigger points).
- [5] List the time period in which the trigger point is effective (i.e. reservoir level trigger point - **late May**).
- [6] List drought stages.
- [7] List drought trigger points corresponding to each stage.
- [8] List response targets corresponding to each stage.

Identification of Drought Indicators and Development of Trigger Points				
Drought Indicators <span style="color: blue;">[1]</span>	Currently Monitored <span style="color: blue;">[2]</span>	New Drought Indicator <span style="color: blue;">[3]</span>	Key Drought Indicator Selected to Develop Trigger Points <span style="color: blue;">[4]</span>	Timing <span style="color: blue;">[5]</span>
Standard Precipitation Index (SPI)				
Surface Water Supply Index (SWSI)				
Modified Palmer Drought Index				
Streamflows				
Reservoir levels				
Precipitation records				
Snowpack				
Groundwater levels				
River administration (call data)				
Soil moisture				
Evapotranspiration				
<i>Add additional drought indicators</i>				

Drought Stages, Trigger Points, and Response Targets			
Stage <span style="color: blue;">[6]</span>	Drought Trigger Point(s) <span style="color: blue;">[7]</span>	Response Targets <span style="color: blue;">[8]</span>	

# Staged Drought Response Program

## WORKSHEET F - STAGED DROUGHT RESPONSE PROGRAM

Instructions:

- [1] List the supply-side response strategies selected for the Plan by appropriate category (Step 3). Categories in this worksheet may be modified to match the Plan.
- [2] Replace Stage 1, Stage 2, etc. to match the drought stage names in the Plan (Step 4). This worksheet includes five stages as a default. Delete or add stages to match the Plan.
- [3] Insert the appropriate drought measures corresponding to each response strategy.
- [4] List the public education campaign activities selected for the Plan (Step 3).
- [5] List the public education campaign activities by drought stage (Step 6). If appropriate specify the targeted audience, communication tools, and information to convey.

Supply-Side Response Strategies					
Response Strategies [1]	Drought Stages [2] and [3]				
	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
<b>Water Supply Augmentation</b>					
<i>List selected response strategies</i>	<i>Stage 1 Drought Measure</i>	<i>Stage 2 Drought Measure</i>	<i>Stage 3 Drought Measure</i>	<i>Stage 4 Drought Measure</i>	<i>Stage 5 Drought Measure</i>
<b>Water Rights Management and Coordination with Other Entities</b>					
<i>List selected response strategies</i>	<i>Stage 1 Drought Measure</i>	<i>Stage 2 Drought Measure</i>	<i>Stage 3 Drought Measure</i>	<i>Stage 4 Drought Measure</i>	<i>Stage 5 Drought Measure</i>
<b>Increase Water Use Efficiency</b>					
<i>List selected response strategies</i>	<i>Stage 1 Drought Measure</i>	<i>Stage 2 Drought Measure</i>	<i>Stage 3 Drought Measure</i>	<i>Stage 4 Drought Measure</i>	<i>Stage 5 Drought Measure</i>
<b>Demand-Side Response Strategies</b>					
<b>Provider/Municipality</b>					
<i>List selected response strategies</i>	<i>Stage 1 Drought Measure</i>	<i>Stage 2 Drought Measure</i>	<i>Stage 3 Drought Measure</i>	<i>Stage 4 Drought Measure</i>	<i>Stage 5 Drought Measure</i>
<b>Residential</b>					
<i>List selected response strategies</i>	<i>Stage 1 Drought Measure</i>	<i>Stage 2 Drought Measure</i>	<i>Stage 3 Drought Measure</i>	<i>Stage 4 Drought Measure</i>	<i>Stage 5 Drought Measure</i>
<b>Commercial</b>					
<i>List selected response strategies</i>	<i>Stage 1 Drought Measure</i>	<i>Stage 2 Drought Measure</i>	<i>Stage 3 Drought Measure</i>	<i>Stage 4 Drought Measure</i>	<i>Stage 5 Drought Measure</i>
<b>Industrial</b>					
<i>List selected response strategies</i>					



## WORKSHEET G – DROUGHT MITIGATION AND STAGED DROUGHT RESPONSE PROGRAM

### Instructions:

This worksheet should be applied to each drought stage identified in the plan (Stage 6). If the plan includes 4 drought stages, this worksheet should be filled out four times with the appropriate targets and response measures for each individual stage. Note: mitigation measures included in this worksheet should specify a pre-drought “stage” and list the associated mitigation measures.

**Stage:** Insert drought stage name

**Drought Trigger Points:** Insert drought trigger point(s)

**Drought Stage and Trigger Summary:** Insert general description of the drought stage and/or summary of drought trigger response.

### Example from the City of Boulder’s Drought Response Plan

A drought at this stage [Stage 1] would primarily focus on using a voluntary program to reach the water use reduction target of 10 percent during the irrigation season. The water use reductions could come from elimination of leaks, waste, and unnecessary irrigation. It would not be anticipated that any noticeable damage to lawns or other landscaping areas would be incurred as a result of the voluntary reductions in water.

### Supply-Side Response Measures:

List supply-side response measures designated for this stage. This information may be organized by categories similar to the categories provided in Worksheet F. Include potential partnering opportunities.

### Demand-Side Response Measures:

List demand-side response measures designated for this stage. This information may be organized by categories similar to the categories provided in Worksheet F. Include potential partnering opportunities.

### Public Campaign

List public education campaign activities identified for this stage. Include potential partnering opportunities.

### Enforcement Procedures

If enforcement is necessary for some of the response measures, discuss the method and staff/others responsible for enforcement for each of the applicable response measures.

# Summary of Drought Mitigation and Staged Drought Response Program

## WORKSHEET H - SUMMARY OF DROUGHT MITIGATION AND STAGED DROUGHT RESPONSE PROGRAM

Instructions:

- [1] List the response strategies selected for the Plan by appropriate category (Step 3). Categories in this worksheet may be modified to match the Plan.
- [2] Replace Stage 1, Stage 2, etc. to match the drought stage names in the Plan (Step 4). Delete or add stages to match the Plan. Add appropriate drought triggers and response targets.
- [3] Insert the appropriate drought measures corresponding to each response strategy.
- [4] List the public education campaign activities selected for the Plan (Step 3).
- [5] List the public education campaign activities by drought stage (Step 6). If appropriate specify the targeted audience, communication tools, and information to convey.
- [6] List the enforcement activities by drought stage (Step 7).

Supply-Side Response Strategies [1]						
	Drought Stages [2] and [3]					
Drought Stage	Pre-drought Mitigation	Insert Stage 1	Insert Stage 2	Insert Stage 3	Insert Stage 4	Insert Stage 5
Trigger	n/a	Insert Stage 1 Trigger	Insert Stage 2 Trigger	Insert Stage 3 Trigger	Insert Stage 4 Trigger	Insert Stage 5 Trigger
Response Target	n/a	Insert Stage 1 Target	Insert Stage 2 Target	Insert Stage 3 Target	Insert Stage 4 Target	Insert Stage 5 Target
Water Supply Augmentation						
List selected response strategies	Insert mitigation measure	Stage 1 Drought Measure	Stage 2 Drought Measure	Stage 3 Drought Measure	Stage 4 Drought Measure	Stage 5 Drought Measure
Water Rights Management and Coordination with Other Entities						
List selected response strategies	Insert mitigation measure	Stage 1 Drought Measure	Stage 2 Drought Measure	Stage 3 Drought Measure	Stage 4 Drought Measure	Stage 5 Drought Measure
Increase Water Use Efficiency						
List selected response strategies	Insert mitigation measure	Stage 1 Drought Measure	Stage 2 Drought Measure	Stage 3 Drought Measure	Stage 4 Drought Measure	Stage 5 Drought Measure
Demand-Side Response Strategies [1]						
Provider/Municipality						
List selected response strategies	Insert mitigation measure	Stage 1 Drought Measure	Stage 2 Drought Measure	Stage 3 Drought Measure	Stage 4 Drought Measure	Stage 5 Drought Measure
Residential						
List selected response strategies	Insert mitigation measure	Stage 1 Drought Measure	Stage 2 Drought Measure	Stage 3 Drought Measure	Stage 4 Drought Measure	Stage 5 Drought Measure
Commercial						
List selected response strategies	Insert mitigation measure	Stage 1 Drought Measure	Stage 2 Drought Measure	Stage 3 Drought Measure	Stage 4 Drought Measure	Stage 5 Drought Measure
Industrial						
List selected response strategies	Insert mitigation measure	Stage 1 Drought Measure	Stage 2 Drought Measure	Stage 3 Drought Measure	Stage 4 Drought Measure	Stage 5 Drought Measure
Public Education Campaign Activities [4], [5]						
Public Education Campaign Activities	Pre-drought activities	Stage 1 Activities	Stage 2 Activities	Stage 3 Activities	Stage 4 Activities	Stage 5 Activities

## Summary of Drought Mitigation and Staged Drought Response Program

	Drought Stages [2] and [3]					
Drought Stage	<i>Pre-drought Mitigation</i>	<i>Insert Stage 1</i>	<i>Insert Stage 2</i>	<i>Insert Stage 3</i>	<i>Insert Stage 4</i>	<i>Insert Stage 5</i>
Trigger	<i>n/a</i>	<i>Insert Stage 1 Trigger</i>	<i>Insert Stage 2 Trigger</i>	<i>Insert Stage 3 Trigger</i>	<i>Insert Stage 4 Trigger</i>	<i>Insert Stage 5 Trigger</i>
Response Target	<i>n/a</i>	<i>Insert Stage 1 Target</i>	<i>Insert Stage 2 Target</i>	<i>Insert Stage 3 Target</i>	<i>Insert Stage 4 Target</i>	<i>Insert Stage 5 Target</i>
<b>Enforcement Activities [6]</b>						
<i>General description of enforcement</i>	<i>n/a</i>	<i>Stage 1 Activities</i>	<i>Stage 2 Activities</i>	<i>Stage 3 Activities</i>	<i>Stage 4 Activities</i>	<i>Stage 5 Activities</i>



# Demand Projection and Priority Allocation

## WORKSHEET J - DEMAND PROJECTION AND PRIORITY ALLOCATION

Instructions:

[1] Enter total monthly projected demands assuming drought conditions

[2] Enter demand priority names based on the water priorities developed in Step 1.

[3] Allocate the total monthly demands by priority for each respective month. For example, if the total monthly demand for January is 800 AF, 600 AF may be of high priority, 100 AF of medium priority, and the remaining 100 AF of low priority

Projected Drought Demands and Allocation of Demands				
	Total Demands [1]	Demand Priorities [2], [3]		
		Priority Name (i.e., high)	Priority Name (i.e., medium)	Priority Name (i.e., low)
January				
February				
March				
April				
May				
June				
July				
August				
September				
October				
November				
December				
<b>Annual Total</b>	<i>sum</i>	<i>sum</i>	<i>sum</i>	<i>sum</i>

# Drought Monitoring

## WORKSHEET K - DROUGHT MONITORING

Instructions: This worksheet can be used as a means to monitor and record drought conditions on a monthly basis

- [1] Enter appropriate year.
- [2] Enter appropriate month.
- [3] List the drought indices being monitored and corresponding monthly data
- [4] List monthly supplies (i.e., water treatment plant production).
- [5] List monthly demands (this may be actual demands or average historical monthly demands)
- [6] Determine shortage by taking difference of supplies and demands.
- [7] Record monthly storage if applicable.
- [8] Record groundwater levels if applicable.

Year [1]	Month [2]	Drought Indices [3]			Supplies [4]	Demands [5]	Shortage [6]	Storage [7]	Groundwater Levels [8]
		<i>Insert Drought Indicator</i>	<i>Insert Drought Indicator</i>	<i>Insert Drought Indicator</i>					

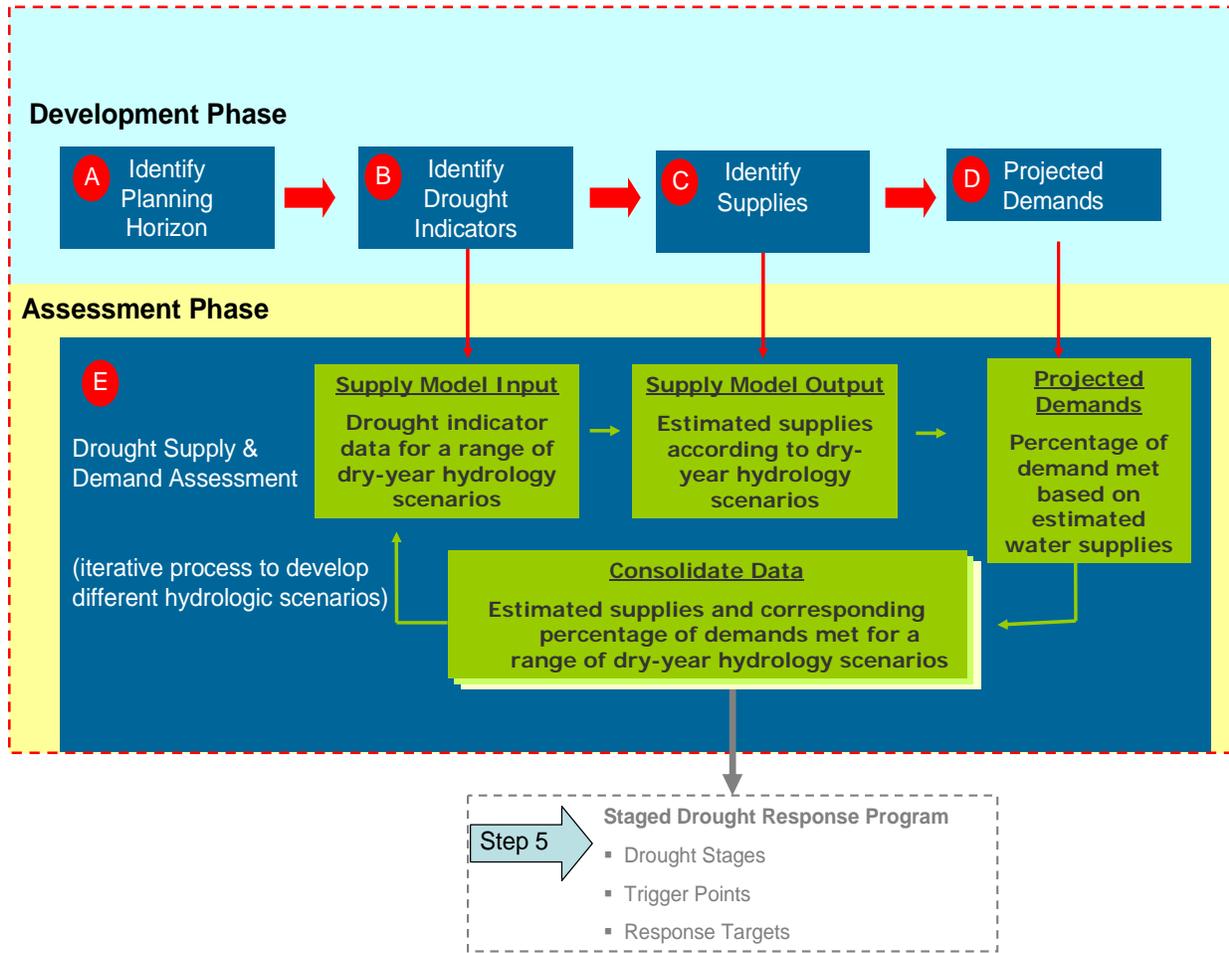


## Appendix B A Conceptual Approach to Drought and Water Supply Reliability Planning

While providers use a variety of methods and models for their water supply reliability and raw water master planning efforts, some providers may find the following five steps useful for combining water supply reliability planning and drought planning efforts (specifically the development of drought stages, trigger points, and response targets). These steps are illustrated in Figure 10. The first four steps, Steps A through D, focus on the initial decisions necessary to conduct Step E, which is an iterative drought supply and demand assessment.

- *Step A Identify Planning Horizon* – The planning horizon should take into consideration future growth and be within a timeframe that population and water demand can realistically be projected.
- *Step B Identify Drought Indicators* – This step involves the selection of drought indicators strategic to the development of drought trigger points. These indicators should be representative of the water supply system.
- *Step C Identify Supplies* – Many providers have a complex portfolio of water supplies and some of these supplies may play very minor roles in the overall water availability during a drought. The significant sources of water worth carrying into the Step E assessment phase should be selected.
- *Step D Demands and Priorities* – This step includes the development of demand projections. For examples a provider may project a total annual water demand of 5,000 acre-feet by 2020. It is recommended that monthly demands are projected to capture the seasonal indoor and outdoor variability.

**Figure 10 Conceptual Approach to Drought and Municipal Water Supply Reliability Planning**



- *Step E Drought Supply and Demand Assessment* – Step E is an iterative modeling process intended to develop a collection of data for identifying representative drought stages, trigger points and response targets. This data collection specifically includes estimated supplies and demands for a range of dry-year hydrology scenarios. One iteration involves the estimation of the quantity of water supplies available under a specific hydrologic scenario and comparing these supplies to projected demands. A hydrologic scenario should be represented by the pre-identified drought indicators (i.e., reservoir storage and call data.). The final data should consist of the drought indicator data, estimated water supplies available, and percentage of demands met for a specific hydrologic scenario. Once a sufficient number of hydrologic scenario iterations have been conducted, the data can be used to develop a better understanding of how water supplies meet projected demands during drought conditions and how water supplies may subsequently be used to develop the drought stages, trigger points, and response targets.



## Appendix C Examples of Staged Drought Response Programs

The following examples are drawn from the 2003 City of Boulder Drought Plan and the 2004 Denver Water Drought Response plans. Relevant information from each entity follows the cover page for the respective plans.



# CITY OF BOULDER, COLORADO

## DROUGHT PLAN

Volume I

### Drought Response Plan

February 20, 2003

City of Boulder



Public Works Department



**HYDROSPHERE**  
Resource Consultants



**Table 9 Summary of Response Options/Actions for each Stage of the Drought**

		Stage I - Moderate	Stage II - Serious	Stage III - Severe	Stage IV - Extreme
<b>Landscape Material and Water Use</b>	<b>Lawn "No-Watering" Hours</b>	Voluntary reductions in watering hours. Recommend "no watering" between 10 a.m. - 6 p.m.	Assume 10 a.m. - 6 p.m.	Assume 10 a.m. - 6 p.m.	Prohibit all lawn watering.
	<b>Lawn Watering Restrictions</b>	Voluntary reductions. Recommend 2 days per week.	Mandatory. Assume watering allowed 2 days per week. May allow once or twice a week option (e.g., shorter time per zone twice a week versus longer time per zone once a week). Time duration for each zone will be designed based on type of sprinkler. If high precipitation rate sprinkler heads (stationary sprinkler heads, like spray heads), will allow shorter watering time per zone than if using low precipitation rate sprinkler heads (moving heads like impact or rotor heads).	Mandatory. Assume watering allowed 2 days per week. Time duration for each zone will be designed based on type of sprinkler. If high precipitation rate sprinkler heads (stationary sprinkler heads, like spray heads), will allow shorter watering time per zone than if using low precipitation rate sprinkler heads (moving heads like impact or rotor heads).	Prohibit all lawn watering.
	<b>Tree, Shrub, and Flower Garden Watering</b>	Voluntary reductions. Recommend deep root watering (hand, bubbler, drip or soaker hoses).	Designate two official watering days per month, during which hand, bubblers, drip or soaker hoses can be used any time. Hand, bubbler, drip or soaker hoses can be used during permitted times on regular lawn watering days.	Designate one or more official watering days per month, during which hand, bubblers, drip or soaker hoses can be used with possible time restrictions. Hand, bubbler, drip or soaker hoses can be used during permitted times on regular lawn watering days.	Probably designate official tree watering days.
	<b>Vegetable Gardens</b>	Voluntary reductions. Recommend only watering between 6 p.m. - 10 a.m. and only watering for up to two hours by hand, drip, bubblers, or soaker hoses.	Allow water any day of week, between 6 p.m. - 10 a.m., for up to two hours by hand, drip, bubblers, or soaker hoses.	Allow water any day of week, between 6 p.m. - 10 a.m., for up to two hours by hand, drip, bubblers, or soaker hoses.	Prohibit vegetable garden watering.
	<b>Landscape Changes/New Planting</b>	Allowed, but recommend postponement unless converting conventional to Xeriscape.	Allowed, but recommend postponement unless converting conventional to Xeriscape (required to follow watering restrictions even if putting in new landscape material).	Allowed, but strongly discourage unless converting conventional to Xeriscape (required to follow watering restrictions even if putting in new landscape material).	Prohibit all new landscaping including planting trees & shrubs.



		Stage I - Moderate	Stage II - Serious	Stage III - Severe	Stage IV - Extreme
<b>Other Outdoor Water Use</b>	<b>Swimming Pools - Private</b>	Encourage use of pool covers, fix leaks before filling pools, and other best management practices. Upon closing at end of season, reuse water for irrigation purposes to extent legally feasible.	Restrict filling. Require implement best management practices, such as fix leaks before filling, use of pool covers, lower water level, and use of cooler water temperature. Upon closing at end of season, reuse water for irrigation purposes to extent legally feasible.	Ban filling private swimming pools. Exceptions might be made for large condo and apartment complexes. Upon closing at end of season, reuse water for irrigation purposes to extent legally feasible.	Closed.
	<b>Ornamental Fountains/ Water Features</b>	Voluntary reduction. Allowed.	Small fountains, bubblers, ponds, and other water features allowed. Large shooting fountains prohibited unless using recirculating water.	Not allowed.	Not allowed.
	<b>Outdoor Hardscape Surfaces Restrictions</b>	Voluntary.	No washing streets, sidewalks, driveways, playgrounds, etc. except for health and safety reasons.	No washing streets, sidewalks, driveways, playgrounds, etc. except for health and safety reasons.	No washing streets, sidewalks, driveways, playgrounds, etc. except for health and safety reasons.
	<b>Power or Pressurized Washing</b>	Voluntary reductions. Allowed	Not allowed except for health and safety reasons or required maintenance	Not allowed except for health and safety reasons or required maintenance	Not allowed.
	<b>Ditch/Well Water</b>	Recommend posting sign indicating ditch or well water	Require posting sign indicating ditch or well water.	Require posting sign indicating ditch or well water.	Require posting sign indicating ditch or well water.
	<b>Dust Control</b>	Voluntary reductions in water use. Allowed.	Require use of alternative measures that does not include water.	Require use of alternative measures that does not include water.	Require use of alternative measures that does not include water.
	<b>Outdoor Car Washing (e.g., personal, dealers, company, government)</b>	Voluntary reductions. Allowed.	Restrict on dealer's lots, company/govt. fleets, personal. Allowed with a shut-off nozzle and bucket.	Eliminate curbside vehicle washing by all customers (including car dealers).	Not allowed.
<b>Commercial &amp; Institutional Water Use</b>	<b>Industrial, Commercial, &amp; Institutional use</b>	Voluntary reductions. Allowed.	Encourage implementation of best management practices for specific industries to reduce annual overall water use 14%.	Restrict non-essential uses and require implementation of best management practices for specific industries to reduce annual overall water use 22%.	Restrict non-essential uses and require implementation of best management practices for specific industries to reduce annual overall water use 40%.



		Stage I - Moderate	Stage II - Serious	Stage III - Severe	Stage IV - Extreme
	<b>Indoor Car Washing Facilities (e.g., commercial, institutional)</b>	Voluntary reductions in annual overall water use by 8%.	Encourage implementation of best management practices. Limit city fleet vehicle washing to 1 time/month unless vehicle is excessively dirty as determined by the supervisor (hand washing (bucket and shutoff hose) is permitted).	Require implementation of best management practices and require meet standard of 40 gallons or less per vehicle. Limit city fleet vehicle washing 1 time/6 weeks upon supervisor approval.	Not allowed unless car wash can meet standard of 15 gallons per vehicle. Limit city fleet vehicle washing to department head approval for safety reasons.
	<b>Public Schools (BVSD, CU)</b>	Reduce use by 10% during irrigation season with management plan.	Reduce use by 20% during irrigation season with management plan.	Require reduce use by 30% during irrigation season with management plan.	Require reduce use by 55% during irrigation season with management plan.
	<b>Greenhouses &amp; Nurseries</b>	Voluntary reductions	Encourage implementation of best management practices to reduce water use.	Mandatory use of recycling water for plants and require implementation of best management practices to reduce water use.	No outdoor watering. Mandatory use of recycling water for plants indoors (permanent enclosed structure) and require implementation of best management practices to reduce water use.
	<b>Restaurants</b>	Voluntary reductions in water use.	Encourage serving water on request only and reducing excess serving dishes to decrease the number of dishes that need to be washed.	Serve water on request only and reduce excess serving dishes to decrease the number of dishes that need to be washed.	Serve water on request only and reduce excess serving dishes to decrease the number of dishes that need to be washed.
	<b>Hotels &amp; Motels</b>	Voluntary reductions in water use.	Encourage changing sheets/towels no more than every four days for guests, unless necessary. Encourage use of signs that ask guests to take shorter showers	Require changing sheets/towels no more than every four days for guests, unless necessary. Require use of signs that ask guests to take shorter showers.	Require changing sheets/towels no more than every four days for guests, unless necessary. Require use of signs that ask guests to take shorter showers.
	<b>Athletic Clubs and City Recreation Centers</b>	Voluntary reductions in water use.	Encourage use of signs that ask members to take shorter showers, shut off showers when done, and report leaks.	Require use of signs that ask members to take shorter showers, shut off showers when done, and report leaks.	Require use of signs that ask members to take shorter showers, shut off showers when done, and report leaks.



		Stage I - Moderate	Stage II - Serious	Stage III - Severe	Stage IV - Extreme
City Water Use	<b>City Parks and Athletic Playing Fields (for more detail see Parks &amp; Recreation Drought Plan)</b>	Reduce use by 5% during irrigation season with management plan (allotment system).	Reduce use by 15% during irrigation season with management plan (allotment system). Following facilities will receive irrigation water in priority order: primary athletic fields; trees, shrubs, and other priority landscapes (not turf) in parks; turf in major park areas, satellite fields, flower beds, and Pearl Street Mall; neighborhood, pocket parks.	Reduce use by 25% during irrigation season with management plan (allotment system). Following facilities will receive irrigation water in priority order: primary athletic fields; newly planted or showing signs of stress landscapes; turf in major park areas and Pearl Street Mall; neighborhood, pocket parks.	Reduce use by 45% during irrigation season with management plan (allotment system). Attempt to sustain some mature trees.
	<b>Swimming Pools - Public</b>	Fix leaks and fill pools. Encourage use of pool covers during non-use times. Upon closing at end of season, reuse water for irrigation purposes to extent legally feasible.	Fix leaks and fill pools. Encourage use of pool covers from 10 a.m. - 6 p.m. during non-use times. Upon closing at end of season, reuse water for irrigation purposes to extent legally feasible.	Require pool covers from 10 a.m. - 6 p.m. during non-use times. Restrict or close public pools. Upon closing at end of season, reuse water for irrigation purposes to extent legally feasible.	Closed.
	<b>City Medians (for more detail see Transportation Landscape Guidelines)</b>	Reduce water use by 5% with management plan by allocating water resources based on a decision making hierarchy.	Reduce water use by 15% with management plan by allocating water resources based on a decision making hierarchy.	Reduce water use by 25% with management plan by allocating water resources based on a decision making hierarchy.	Reduce water use by 45% with management plan by allocating water resources based on a decision making hierarchy. Focus on highest priority landscape, such as heritage trees.
	<b>Fire Hydrants</b>		Eliminate all non-essential uses except require for public health and safety. For required flushing, capture and reuse water for irrigation purposes (coordinate w/ Parks and Rec).	Eliminate all non-essential uses except require for public health and safety. For required flushing, capture and reuse water for irrigation purposes (coordinate w/ Parks and Rec).	Eliminate all non-essential uses except require for public health and safety. For required flushing, capture and reuse water for irrigation purposes (coordinate w/ Parks and Rec).
	<b>Fire Dept. Staff Training/Testing</b>		If training/testing must occur, capture and reuse water for irrigation purposes (coordinate w/ Parks and Rec).	If training/testing must occur, capture and reuse water for irrigation purposes (coordinate w/ Parks and Rec).	If training/testing must occur, capture and reuse water for irrigation purposes (coordinate w/ Parks and Rec).



		Stage I - Moderate	Stage II - Serious	Stage III - Severe	Stage IV - Extreme
	<b>City Planning Dept. - required landscape installation for certificate of occupancy</b>	Recommend citizens suspend landscape installation and escrow payments for landscaping when water is available, unless parts can be installed with prevailing watering restrictions and the landscape material is truly waterwise (low or very low hydrozone).	Recommend citizens suspend landscape installation and escrow payments for landscaping when water is available, unless parts can be installed with prevailing watering restrictions and the landscape material is truly waterwise (low or very low hydrozone).	Suspend installation requirement and require escrow payments for landscaping when water is available, unless landscape installation is very low or low hydrozone.	Suspend landscape installation requirement and require escrow payments for landscaping when water is available.
<b>Other</b>	<b>Indoor Conservation (see City of Boulder Water Conservation Futures Study for more detail)</b>	Encourage customers to conserve water with the goal of reducing indoor water use by 5%.	Reduce indoor water use by 5%. Increase rebate funds for toilets, clothes washers, & "industrial process devices".	Intensify reductions of indoor use with the goal of reducing indoor water use by 10%.	Intensify reductions of indoor use with the goal of reducing indoor water use by 15%. Request no filling hot tubs, spas, and other "non-essential" use (not related to health and safety).
	<b>Humidifiers</b>	Voluntary reductions in use.	Promote reduction in use & adjust temp to require less water. Encourage turning off whole-house unit and relying on room-size units.	Promote reduction in use & adjust temp to require less water. Encourage turning off whole-house unit and relying on room-size units.	Promote reduction in use & adjust temp to require less water. Encourage turning off whole-house unit and relying on room-size units.
	<b>Swamp Coolers</b>	Voluntary reductions in use.	Promote reduction in use & adjust temp to require less water.	Promote reduction in use & adjust temp to require less water.	Promote reduction in use & adjust temp to require less water.
	<b>Public Water Consumption Data</b>		Consider a program that provides access to more detailed water consumption data information. Provide any customer option of installing personal, private water meter on incoming waterline.	Consider a program that provides access to more detailed water consumption data information. Provide any customer option of installing personal, private water meter on incoming waterline.	Consider a program that provides access to more detailed water consumption data information. Provide any customer option of installing personal, private water meter on incoming waterline.
	<b>Public Information/ Outreach</b>	Initiate campaign. Publish targets and actual consumption	Intensify campaign. Publish targets and actual consumption. Publish "water waste reduction/leak detection" brochure ("do it yourself" checklist). Drought report card at end of year. Provide customers post-drought landscape revival information.	Further intensify campaign. Publish targets and actual consumption. Publish "water waste reduction/leak detection" brochure ("do it yourself" checklist). Drought report card at end of year. Provide customers post-drought landscape revival information.	Further intensify campaign. Publish targets and actual consumption. Publish "water waste reduction/leak detection" brochure ("do it yourself" checklist). Drought report card at end of year. Publish ways to salvage landscape and most valuable trees. Provide customers post-drought landscape revival information.



		Stage I - Moderate	Stage II - Serious	Stage III - Severe	Stage IV - Extreme
	<b>Bulk Water</b>	Being evaluated to reduce water use.	Being evaluated to reduce water use.	Being evaluated to reduce water use.	Being evaluated to reduce water use.
	<b>Drought surcharge</b>	None.	Add drought surcharge	Add drought surcharge	Add drought surcharge
	<b>Enforcement</b>		Train City staff to police outdoor use & respond to complaints	Increase enforcement response measures	Increase enforcement measures
	<b>City staff resources</b>		Increase	Increase	Increase

\*\*It is important to note that the response actions listed in the summary table are only meant as parameters for the type of action that may be taken. Since every drought is different, the exact plan of action will have to be determined at that time

# Drought Response Plan



**May, 2004**

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## Stage 1 Drought Response

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**July 1 Storage Trigger:** Reservoirs less than 80% full  
**Use Reduction Target:** 10%

### *Description*

A Stage 1 Drought is triggered by actual or forecast July 1 reservoir storage of 80 percent. This stage is meant to warn customers that water levels are significantly below average and continued dry weather could trigger a Stage 2 Drought. Recommended responses to a Stage 1 Drought include:

- Set the tone for a dry irrigation season.
- Reduce water demand to prevent progression to a Stage 2 Drought.
- Request that customers voluntarily reduce their water use by 10 percent.
- Enact the Stage 1 Drought restriction clause in contracts.
- Warn of and prepare for a Stage 2 Drought.

As a part of responding to a Stage 1 Drought, Denver Water will:

- Acquaint customers with measures they can expect if the drought continues or intensifies.
- Invite public discussion on water use priorities and ways to cut water use.
- Contact special interest groups that use large volumes of water (for example, water recreation groups) to get their ideas and support.
- Publish suggestions for temporarily reducing water use.
- Require master meter water distributors to activate similar programs with their customers.

Denver Water's Drought Response Committee will monitor drought conditions and evaluate the effectiveness of the Stage 1 Drought response. Recommendations for adjusting the response will be submitted to the Board of Water Commissioners.

### *Voluntary Restrictions*

#### **Restaurants**

Restaurants and catering businesses will be asked to voluntarily restrict serving water with meals except at the customer's request.

#### **Lodging**

Lodging establishments will be asked to voluntarily reduce the frequency of sheet changing for guests staying more than one night, except for health or safety reasons. Food service operations in lodging establishments will be asked to voluntarily restrict serving water with meals except at the customer's request.

#### **Irrigation**

Customers will be asked to voluntarily reduce outdoor water use, using their own methods and Denver Water's suggestions.



Watering during the heat of the day is less efficient than watering during the morning and evening hours because of water losses through evaporation. To minimize water waste, watering is prohibited between the hours of 10:00 a.m. and 6:00 p.m. In addition, all permissible watering shall be conducted without any water waste (for example, avoid runoff on driveways or sidewalks).

#### **Water Budgets for Large-Volume Users**

Customers in the High Public Use category shall manage water use in a way that reduces their seasonal water use by 10 percent.

#### ***Surcharges***

A surcharge program may be designed to help achieve overall water reduction goals.

#### ***Fixed-Amount Water Contracts***

Water deliveries to customers who receive untreated water, nonpotable water or potable water under fixed-amount contracts will be restricted as follows:

- For agreements with provisions allowing reduced deliveries under drought conditions, the amount delivered shall be reduced by 10 percent.
- For agreements with provisions requiring the lessee to adopt the same or similar water use restrictions as Denver Water, the lessee shall implement the water use restrictions adopted by the Board.
- For agreements without these provisions, the Board may adopt drought surcharges or other methods to reduce water consumption outside Denver as necessary to provide an adequate supply of water to the people of Denver.



## Stage 2 Drought Response

---

**July 1 Storage Trigger:** Reservoirs less than 65% full  
**Use Reduction Target:** 30%

### *Description*

A Stage 2 Drought is triggered by actual or forecast July 1 reservoir storage of 65 percent. When July 1 reservoir levels are forecast at or below 70 percent, Denver Water will begin planning for a potential Stage 2 Drought. The staff may recommend activating a Stage 2 Drought response at a reservoir storage level of higher than 65 percent, depending on drought conditions and other indicators. A Stage 2 Drought imposes mandatory water use restrictions and requires a significant effort on the part of customers.

### *Mandatory Restrictions*

#### **Restaurants**

Restaurants and catering businesses shall not automatically serve water with meals but may serve water when a customer requests it. Restaurants must comply with Denver Water's signage requirements to explain this restriction.

#### **Lodging**

Lodging establishments shall not change sheets more often than every four days for guests staying more than one night, except for health or safety reasons. Food service operations in lodging establishments shall not automatically serve water with meals but may serve water when customers request it. Lodging establishments must comply with Denver Water's signage requirements to explain these restrictions.

#### **Turf Irrigation**

**Assigned times.** Each turf zone shall receive no more than 15 minutes of irrigation on average on the assigned watering day. All irrigation control systems must be programmed or operated manually to limit irrigation to 15 minutes per zone on average. Any area irrigated by a sprinkler attached to a movable hose shall also be limited to 15 minutes of watering on average on the assigned watering day. The Board of Water Commissioners may by formal action establish a maximum total amount of time during which irrigation may occur at a single property.

Watering during the heat of the day is less efficient than watering during the morning and evening hours because of water losses through evaporation. To minimize water waste, watering is prohibited between the hours of 10:00 a.m. and 6:00 p.m. In addition, all permissible watering shall be conducted without any water waste.

**Assigned days.** Watering shall be limited to two days per week in accordance with the schedule outlined in Table 3.

**Table 3. Landscape irrigation calendar under a Stage 2 Drought**

Type of Property	Watering Days
Single-family residential properties with odd-numbered addresses	Saturday and Wednesday
Single-family residential properties with even-numbered addresses	Sunday and Thursday
All others (multifamily residential properties; homeowners associations; commercial, industrial and government sites)	Tuesday and Friday
Parks, schools, athletic fields	Monday

**Irrigation of New Turf Sod**

Denver Water will work cooperatively with the landscape industry and customers to achieve compliance with recommended new turf sod installation guidelines. Denver Water staff may also conduct spot inspections of point-of-purchase sites and installations to ensure adequate education of customers and appropriate soil preparation.

New turf sod installations may be watered daily for up to 21 days, but not between 10:00 a.m. and 6:00 p.m.

**Irrigation of New Turf Seed**

New turf seed applications may be watered daily at any time for up to 28 days. This exemption does not apply to over-seeding of existing lawns.

**Water Budgets for Large-Volume Users**

Customers in the High Public Use category will be required to manage water use in a way that reduces their seasonal water use by 30 percent. Turf watering restrictions will not apply to them, so long as they accomplish irrigation without water waste.

**Irrigation of Trees and Shrubs**

Trees and shrubs may be watered by means of a hand-held hose or low-volume nonspray irrigation on assigned watering days. From May 1 to October 1, trees and shrubs may not be watered between the hours of 10:00 a.m. and 6:00 p.m.

**Irrigation of Flowers and Vegetables**

Flowers, vegetables, and plantings in community gardens may be watered any day except Monday by means of a hand-held hose or low-volume nonspray irrigation. From May 1 to October 1, nonspray irrigation may not occur between the hours of 10:00 a.m. and 6:00 p.m.

**Irrigation System Installation, Operation and Repair**

An irrigation system may be operated outside the watering schedule for installation, repair or reasonable maintenance, so long as the system is attended throughout the period of operation and water waste does not occur. All irrigation control systems must be reprogrammed or operated manually to operate in compliance with the watering calendar.



### Early Winterization and Spring Watch Programs

Outdoor lawn watering shall be prohibited between October 1 and May 1. Watering turf areas that are heavily used by the community—for example, athletic and playing fields, tees and greens at golf courses—is not prohibited but must be conducted without water waste.

### Outdoor Nonirrigation Uses

**Fountains and waterfalls.** Customers shall be prohibited from operating any existing outdoor fountain or waterfall that sprays water into the air.

**Outdoor misting devices.** Operating outdoor misting devices shall be prohibited.

### Vehicle Washing

**Personal vehicles.** Personal vehicles may be washed using only a bucket or a hand-held hose equipped with an automatic shutoff nozzle. From May 1 to October 1, personal vehicles may not be washed on Monday or between the hours of 10:00 a.m. and 6:00 p.m. From October 1 to May 1, personal vehicles may be washed without day-of-the-week or time-of-day restrictions.

**Fleet vehicles.** Vehicles used in commercial operations or fleets may be washed no more often than once per week, unless public safety requires more frequent washing, and only by means of a car wash or washing equipment certified by Denver Water.

**Commercial car washes.** Commercial car washes are subject to a certification program requiring implementation of industry best management practices to achieve a 30 percent water savings compared with the water use of nonrecycling car washes. Any commercial car wash that is not certified or in the process of becoming certified shall be deemed in violation of this provision.

### Power Washing

**Power washing by individuals.** Using water instead of a broom or mop to clean outdoor impervious surfaces such as sidewalks, driveways and patios is prohibited, except when cleaning with water is necessary for public health or safety reasons or when other cleaning methods are impractical. Power washing that is permitted may occur only on the assigned watering days indicated in Chapter 19 of Denver Water's Operating Rules and not between the hours of 10:00 a.m. and 6:00 p.m., except for immediate health or safety reasons.

**Commercial power washing.** Commercial enterprises for which cleaning with water is an essential element of business are not subject to day-of-the-week or time-of-day restrictions but shall use only high-efficiency equipment certified by Denver Water and must assure that water waste does not occur.

### Swimming Pools

No restrictions will be imposed on the use or operation of swimming pools.



### ***Surcharges***

A surcharge program will be designed to support the water use restrictions and to help achieve overall water use reduction goals.

### ***Fixed-Amount Water Contracts***

Water deliveries to customers who receive untreated water, nonpotable water or potable water under fixed-amount contracts will be restricted as follows:

- For agreements with provisions allowing reduced deliveries under drought conditions, the amount delivered shall be reduced by 30 percent.
- For agreements with provisions requiring the lessee to adopt the same or similar water use restrictions as Denver Water, the lessee shall implement the water use restrictions adopted by the Board.
- For agreements without these provisions, the Board may adopt drought surcharges or other methods to reduce water consumption outside Denver as necessary to provide an adequate supply of water to the people of Denver.
- Any water delivered by Denver Water between May 1 and October 1 shall not be used for spray irrigation between the hours of 10:00 a.m. and 6:00 p.m.

### ***Enforcement***

The customer (owner or occupant of the property) shall be responsible for complying with drought restrictions and with the terms of any exemption granted. Those who violate any Stage 2 Drought restriction will be subject to penalties.

#### **First Violation**

The owner or occupant will be advised in writing that a monetary charge will be added to the water bill for subsequent violations.

#### **Second Violation**

The owner or occupant will be advised in writing, and a \$250 charge may be added to the water bill.

#### **Third Violation**

The owner or occupant will be advised in writing, and a \$500 charge may be added to the water bill.

#### **Fourth and Subsequent Violations**

The owner or occupant will be advised in writing, and a \$1000 charge may be added to the water bill. In addition, Denver Water may install a flow restrictor on the service line to remain in place during the irrigation season or may temporarily suspend service until the cause of the violation is corrected and all outstanding penalty and water service charges have been paid.

## Stage 3 Drought Response

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**July 1 Storage Trigger:** Reservoirs less than 40% full

**Use Reduction Target:** 50%

### *Description*

A Stage 3 Drought is triggered by actual or forecast July 1 reservoir storage of 40 percent. A Stage 3 Drought imposes mandatory water restrictions on Denver Water's customers. Stage 3 Drought restrictions are severe and may result in significant damage to landscapes.

### *Mandatory Restrictions*

#### **Restaurants**

Restaurants and catering businesses shall not automatically serve water with meals but may serve water when a customer requests it. Restaurants must comply with Denver Water's signage requirements to explain this restriction.

#### **Lodging**

Lodging establishments shall not change sheets more often than every four days for guests staying more than one night, except for health or safety reasons. Food service operations in lodging establishments shall not automatically serve water with meals but may serve water if a customer requests it. Lodging establishments must comply with Denver Water's signage requirements to explain these restrictions.

#### **Turf Irrigation**

Irrigation of turf shall be **prohibited**.

#### **Irrigation of New Turf Sod**

Irrigation of new turf sod shall be **prohibited**.

#### **Irrigation of New Turf Seed**

Irrigation of new turf seed shall be **prohibited**.

#### **Water Budgets for Large-Volume Users**

Customers in the High Public Use category will be required to manage water use in a way that reduces their seasonal water use by 50 percent. Turf watering restrictions will not apply to them so long as they accomplish irrigation without water waste.

#### **Irrigation of Trees and Shrubs**

Existing trees and shrubs may be watered by means of a hand-held hose or low-volume nonspray irrigation no more than once a week in accordance with the schedule outlined in Table 4. From May 1 to October 1, trees and shrubs may not be watered between the hours of 10:00 a.m. and 6:00 p.m. No new trees or shrubs may be planted.

**Assigned days.** Irrigation of trees and shrubs shall be limited to one day per week in accordance with the schedule shown in Table 4.

**Table 4. Tree and shrub irrigation calendar under a Stage 3 Drought**

Type of Property	Watering Day
Single-family residential properties with odd-numbered addresses	Saturday
Single-family residential properties with even-numbered addresses	Sunday
All others (multifamily residences; homeowners associations; commercial, industrial and government sites)	Wednesday

### **Irrigation of Flowers and Vegetables**

Existing flowers, vegetables, and plantings in community gardens may be watered any day by means of a hand-held hose or low-volume nonspray irrigation. From May 1 to October 1, these plants may not be watered between the hours of 10:00 a.m. and 6:00 p.m. No new flowers or vegetables may be planted.

### **Irrigation System Installation, Operation and Repair**

An irrigation system may be operated for installation or repair, so long as the system is attended throughout the period of operation and water waste does not occur.

### **Outdoor Nonirrigation Uses**

**Fountains and waterfalls.** Customers shall be prohibited from operating any existing outdoor fountain or waterfall that sprays water into the air. No new outdoor fountain or waterfall may be put into operation during a Stage 3 Drought.

**Misting devices.** Operating outdoor misting devices shall be prohibited.

### **Vehicle Washing**

**Personal vehicles.** Washing personal vehicles shall be prohibited except at commercial car washes certified by Denver Water.

**Fleet vehicles.** Vehicles used in commercial operations or fleets may be washed no more often than once a month, unless public safety requires more frequent washing. Fleet vehicles may be washed only by means of a car wash or washing equipment certified by Denver Water.

**Commercial car washes.** Commercial car washes are subject to a certification program requiring a 50 percent water savings compared with the water use of nonrecycling car washes. Any commercial car wash that is not certified or in the process of becoming certified shall close down its washing operations three days each week, as designated by Denver Water, in order to save water.

## Power Washing

**Power washing by individuals.** Using water instead of a broom or mop to clean outdoor impervious surfaces such as sidewalks, driveways and patios is prohibited, except when cleaning with water is necessary for immediate public health or safety reasons.

**Commercial power washing.** Commercial enterprises shall clean with water only for health or safety purposes and shall use only high-efficiency equipment certified by Denver Water and assure that water waste does not occur.

## Swimming Pools

Single-family residential pools shall not be filled or refilled. Operation of other pools will be permitted.

## Hydrant Permits

Water obtained by means of a hydrant permit shall not be used to clean equipment or for any other use prohibited during a Stage 3 Drought.

## Surcharges

A surcharge program will be designed to support the water use restrictions and to help achieve overall water use reduction goals.

## Fixed-Amount Water Contracts

Water deliveries to customers who receive untreated water, nonpotable water or potable water under fixed-amount contracts will be restricted as follows:

- For agreements with provisions allowing reduced deliveries under drought conditions, the amount delivered shall be reduced by 50 percent.
- For agreements with provisions requiring the lessee to adopt the same or similar water use restrictions as Denver Water, the lessee shall implement the water use restrictions adopted by the Board.
- For agreements without these provisions, the Board may adopt drought surcharges or other methods to reduce water consumption outside Denver as necessary to provide an adequate supply of water to the people of Denver.
- Any water delivered by Denver Water between May 1 and October 1 shall not be used for otherwise permissible irrigation between the hours of 10:00 a.m. and 6:00 p.m.

## Enforcement

The customer (owner or occupant of the property) shall be responsible for complying with the drought restrictions and with the terms of any exemption. Those who violate any Stage 3 Drought restriction will be subject to penalties.



**First Violation**

The owner or occupant will be advised in writing that a monetary charge will be added to the water bill for subsequent violations.

**Second Violation**

The owner or occupant will be advised in writing, and a \$1000 charge may be added to the water bill.

**Third and Subsequent Violations**

The owner or occupant will be advised in writing, and a \$1500 charge may be added to the water bill. In addition, Denver Water may install a flow restrictor on the service line to remain in place during the irrigation season or may temporarily suspend service until the cause of the violation is corrected and all outstanding penalty and water service charges have been paid.



## Stage 4 Drought Response

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**July 1 Storage Trigger:** Reservoirs are 25% full

**Use Reduction Target:** 66% reduction

### *Description*

A Stage 4 Drought is triggered by actual or forecast July 1 reservoir storage of 25 percent. A Stage 4 Drought activates a rationing program for Denver Water's customers. **Conditions that would lead to a Stage 4 Drought are highly unlikely.** However, if combined reservoir storage falls below 25% full, Denver Water will implement a **rationing program** to ensure that customers receive water for essential uses for an indefinite period of time. No outdoor watering will be allowed, and indoor water use will be restricted. Stage 4 Drought restrictions are severe and will probably result in long-term damage to landscapes.

### *Mandatory Restrictions*

#### **Turf Irrigation**

Irrigation of turf shall be **prohibited**.

#### **Irrigation of Trees and Shrubs**

Outdoor watering shall be limited to monthly tree watering.

#### **Outdoor Nonirrigation Uses**

Nonessential water uses shall be eliminated.

#### **Indoor Water Use**

A rationing program will be designed to minimize indoor water use.