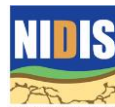


Drought-Ready Communities

A Guide to Community Drought Preparedness



Lower Platte River
CORRIDOR ALLIANCE



Contact Us

The Drought Ready Communities research team is seeking additional resources to work with organizations and communities to make community-level drought planning more widespread. One of our goals is to expand the collection of case studies detailing different communities' experiences with different parts of the process.

For more information on how your community can become involved, to share your experiences in drought planning, or for any other questions, please contact one of the research team members:

- Mark Svoboda, Principal Investigator, National Drought Mitigation Center, Lincoln, NE, 402-472-8238, msvoboda2@unl.edu
- Kelly Helm Smith, National Drought Mitigation Center, 402-472-3373, ksmith2@unl.edu
- Melissa Widhalm, National Drought Mitigation Center, 402-472-3172, mwidhalm3@unl.edu
- Donna Woudenberg, National Drought Mitigation Center, 402-472-8287, dwoudenberg2@unl.edu
- Cody Knutson, National Drought Mitigation Center, 402-472-6718, cknutson1@unl.edu
- Meghan Sittler, Lower Platte River Corridor Alliance, Lincoln, NE, 402-476-2729, msittler@lpsnrd.org
- Jim Angel, Illinois State Climatologist, 217-333-0729, jimangel@illinois.edu
- Mike Spinar, Midwestern Regional Climate Center and Illinois State Water Survey, 217-265-6356
- Mark Shafer, Oklahoma Climatological Survey, 405-325-3044, mshafer@mesonet.org
- Renee McPherson, Oklahoma Climatological Survey, renee@mesonet.org
- Heather Lazrus, University of Oklahoma, lazrus@ou.edu

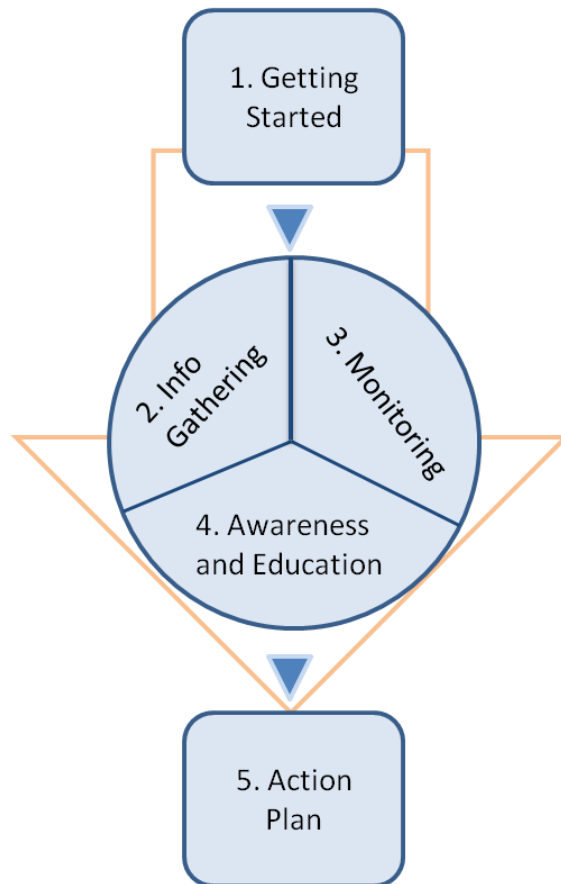
Sponsorship and Partners

The Drought Ready Communities project that produced this *Guide to Community Drought Preparedness* was made possible with funding from the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Climate Program Office, Sectoral Applications Research Program, and from the National Integrated Drought Information System.

Project partners included the National Drought Mitigation Center, the Oklahoma Climatological Survey, the Illinois State Water Survey, and the Lower Platte River Corridor Alliance.

Drought Risk

Community Stakeholders



Drought-Ready

Outcomes:

- Understand past droughts and impacts on community
- Implement system to monitor drought and impacts
- Establish regular communication about drought conditions and impacts
- Know what actions to take before and during a drought

Benefits:

- Increased community awareness of water, climate, and drought
- Reduce dollar losses during next drought
- Reduce stress during next drought
- Protect animals and plants from drought impacts
- Increase community resilience

Table of Contents

Introduction to Drought-Ready Communities	4
Section 1. Getting Started: Invite the Community to Participate, Commit to the Process	7
1.1 Establish a leadership team that includes individuals with responsibility for monitoring, communication, and implementation	7
1.2 Identify stakeholders or groups in the community that may need additional resources to participate in the Drought-Ready Communities process	8
1.3 Include government agencies and regulators	9
1.4 Develop a contact list	9
1.5 Gather community perceptions of drought	10
Section 2. Information Gathering: Understand Water Sources and Uses, Develop a Drought History .	11
2.1 Identify water sources and uses	11
2.2 Learn how drought has affected the community in the past	12
2.3 Gather data on water and climate	13
2.4 List factors that affect the severity of drought impacts	15
Section 3. Establish Monitoring: How You Will Recognize and Communicate About Drought	17
3.1 Identify drought indicators that will be used by the community	17
3.2 Identify drought impact indicators for your community	18
3.3 Develop a drought monitoring communication plan	19
Section 4. Plan a Public Awareness and Education Campaign	22
Section 5. Taking Action: Planning Responses to Reduce Impacts	24
5.1 Determine and prioritize possible strategies to take before and in response to drought	24
5.2 Link response actions to drought indicators	25
Wrapping Up and Conclusion	27
Appendix A. Worksheets	28
Worksheet 1: Benefits of Drought Planning	29

Worksheet 2: Contact List	31
Worksheet 3: Perceptions of Drought	32
Worksheet 4: Available Water Supplies	35
Worksheet 5: Top Water Users	36
Worksheet 6: Cost-Benefit Comparison	37
Worksheet 7: Linking Thresholds to Actions	38
Appendix B. Background Material and Case Studies	39
Background on Jurisdiction	39
Case Study: Decatur, Illinois – Linking Indicators to Actions	41
Case Study: Norman, Oklahoma – Drought History	44
Appendix C. Examples of Drought Response Actions	48

Introduction to Drought-Ready Communities

What is Drought?

Drought is a period of excessive dryness long or intense enough to affect agriculture, habitats, or people. It is difficult to define because it often develops slowly over months or years, and has different impacts depending on the location, time of year, and sector of the community you are focusing on. Although drought can and does cause severe and far-reaching impacts, it is not as tangible as other disasters, such as hurricanes and tornadoes.

What is a Drought-Ready Community?

A Drought-Ready Community has taken steps to:

- 1) Involve a representative cross section of the community;
- 2) Learn how drought has affected them in the past and how it would likely affect them in the future;
- 3) Set up a system to **monitor** and communicate about drought conditions in the community;
- 4) Prepare and document a set of actions to take before and in response to a drought;
- 5) Educate the public about water, drought, and the community's **drought plan**.

It should be noted that “Drought-Ready” is not “Drought Proof.” The drought monitoring, communications, and response plan developed during the process may help reduce the effects of drought.

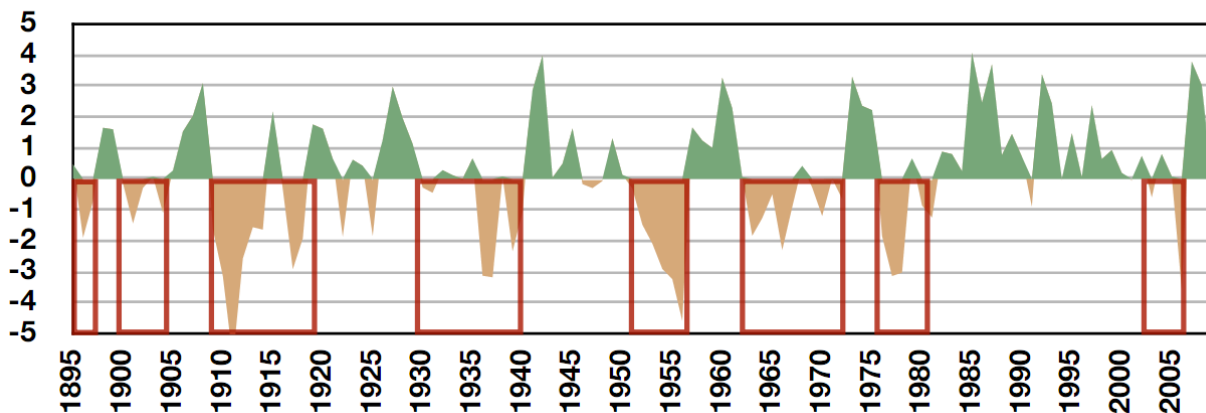
Why be a Drought-Ready Community?

Droughts can occur anywhere.

Between 1980 and 2009, droughts affected nearly every major region of the United States. For example, as of July 2010, Hawaii, one of the wettest states in the United States, had been experiencing severe drought since June 2008.

Droughts are a periodic phenomenon and will happen again.

Palmer Drought Severity Index for Central Oklahoma



The graph above shows the Palmer Drought Severity Index (PDSI), one commonly-used measure of dryness, which rates dry and wet conditions on a scale from -5 to +5. This particular plot, for Central Oklahoma, has red boxes drawn to represent drought periods. As you can see, multi-year droughts are the norm, rather than the exception, for the area.

Droughts have a variety of impacts.

Drought can result in many negative impacts to a community, including:

- Loss of lawns and cracked foundations;
- Property damage or depreciation;
- Losses to businesses such as marinas and landscapers;
- Losses to industrial businesses using processed or non-potable water;
- Partial or complete shutdown of utilities relying on water for cooling;
- Crop, pasture, livestock, and forest damage;
- Increased fire hazard, including wildfires;
- Loss of wildlife and threats to habitat;
- Increased water demand;
- Reduced water supplies;
- Reduced water quality;
- Reduced population due to migration;
- Health effects from airborne particles.

Droughts are costly, in terms of both lives and property.

Out of ninety-six billion-dollar weather disasters since 1980, fifteen were droughts, and ten were fires, which frequently occur in drought conditions. The 1980 heat wave and drought in the central and eastern United States alone caused \$55.4 billion in damage (2007 dollars) and an estimated 10,000 deaths. Two out of the three disasters causing more than \$50 billion in damage (2007 dollars) during this period were droughts.

[\[http://www.ncdc.noaa.gov/oa/reports/billionz.html\]](http://www.ncdc.noaa.gov/oa/reports/billionz.html)

Research by the Multi-Hazard Mitigation Council in 2005 found that for every \$1 spent on hazard mitigation, \$4 was saved. Although the study focused on earthquake, flood, and wind hazards, it is likely that similar benefits would come from becoming Drought-Ready.

The Path to Drought Readiness

To complete the DRC process, a community should use this document and accompanying resources to guide them through a number of tasks. A summary of expected accomplishments to be completed in each section is described below.

Getting Started (Section 1)

This section takes a community through the initial steps of becoming Drought-Ready. Communities will form a leadership team, identify specific community benefits of drought planning, start a drought contact list, and gather community drought perceptions.

Information Gathering (Section 2)

This section will guide the community in assembling the best available information for decision making. The community will learn how to record information about its water sources and users, gather information about past drought events and impacts, and identify factors that could serve to reduce or intensify the local effects of drought.

Establish Monitoring (Section 3)

This section takes a community through the process of developing a monitoring system to assess its current drought status. In this step a community will identify pertinent drought indicators to monitor real-time conditions, designate one or more people to regularly monitor drought conditions, identify the types of impacts to be monitored, and develop a “Drought Monitoring Report” to be disseminated on a regular basis to interested people or groups.

Public Awareness and Education (Section 4)

This section details the development of a public awareness and education campaign to encourage public support of the Drought-Ready Community process. Specifically, it guides communities through the process of developing a strategy, gathering educational materials, and assigning an implementation schedule.

Planning Responses (Section 5)

This section synthesizes the materials developed in all the other sections. In Section 5, the community will create a list of strategies and actions that should be undertaken before and during a drought to reduce negative impacts, and identify specific thresholds to help decide when to implement the pre-defined actions during a drought.


Section 1. Getting Started: Invite the Community to Participate, Commit to the Process

Communities don't just become Drought-Ready. They require sustained leadership, energy, focus, and the ability to share a vision and coordinate action. Leadership on municipal drought planning typically comes from the city agency that is responsible for keeping the water flowing, but, particularly in smaller communities, a grassroots effort might provide the spark or even the ongoing focus and energy required to become a Drought-Ready Community. Regardless of whether the effort is initiated by officials or others within the community, it will eventually need buy-in from authorities, residents, and specific interests within the community.

1.1. Establish a leadership team that includes individuals with responsibility for monitoring, communication, and implementation.

Action Items

1. Commit to becoming a Drought-Ready Community today. It's not a question of if, but when, the next drought will happen. The sooner your community starts preparing for drought the better off you will be.
2. Identify stakeholders. Use Worksheet 1: The Benefits of Drought Planning to create a preliminary list of businesses and groups who would be most affected by drought. Let stakeholders know about the Drought-Ready Communities process and invite them to participate. Stakeholders may welcome the chance to work with others to reduce or eliminate the effects of drought.
3. Reach out to media leaders in the community. Getting buy-in from them early on contributes to publicity and positive PR throughout the Drought Ready process. In addition, focusing on educating media about drought before it happens may allow you to minimize that effort later.
4. Determine what level of public participation would be beneficial and feasible. Consider holding a town hall meeting to share basics about drought and how the community can benefit from being Drought-Ready. People may be very aware of how drought has affected their community in the past, and welcome the chance to prevent serious impacts in the future. A town hall meeting may be a good way to recruit citizen volunteers for a Drought-Ready Community task force or leadership team. Ask people to provide email addresses if they would like to receive regular updates. See Section 4 (Plan a Public Awareness and Education Campaign).
5. **Form a leadership team** with the collective ability to monitor drought and water supply, communicate with residents, and take action. This could include city officials, water officials, stakeholders, business and industry leaders, labor organizations, or people from non-profit organizations who are active in community-building activities.
6. Start a Drought-Ready Communities binder to keep a record of valuable information and decisions. It should ideally be publicly available and be regularly updated with meeting notices, minutes, reports, and other information. The binder, or documents from the binder, could be electronic and available on a website so the whole community can browse the materials.

 Start a Drought-Ready Communities binder and add the completed copy of Worksheet 1: Benefits of Drought Planning to it.

Resources

1. Appendix A, Worksheet 1: The Benefits of Drought Planning

1.2. Identify stakeholders or groups in the community that may need additional resources to participate in the Drought-Ready Communities process

This step helps ensure an inclusive process that can accommodate people from all walks of life who may be affected by drought. When working with a broad range of stakeholders, keep in mind:

- The timing of meetings is often a key determinant in who participates. For city officials and others who are paid to be part of the process, daytime meetings during regular working hours may seem convenient. For others, such as farmers and ranchers, meetings may need to be in the evening.
- The time of year may matter, too. In an agricultural community, meetings may need to be at times other than planting or harvest.
- Individuals with personal or professional care-giving responsibilities may require special allowances. For example, getting parents of young children to participate may require scheduling meetings around school schedules, holding a meeting near a park or other play area, or providing child care.
- People vulnerable to stress from extremes of temperature, humidity, or air pollution (for example, the elderly) may prefer meetings in certain venues or at certain times of day.
- Community members with a poor command of spoken and/or written English, or the hearing impaired, may require special accommodations, such as translators or interpreters, to participate. These may include the deaf and hard-of-hearing, immigrants, migrant workers, and non-native English speakers. Remember, immigrants, particularly undocumented workers, may be distrustful of any official process.
- Some cultural, ethnic, or religious groups, such as Native American tribes, may need special outreach in order to see the value in the process, or to want to contribute.
- Those struggling to meet physical or emotional needs may not see a planning meeting as a good use of time and energy. Remember, drought can exacerbate food insecurity and compound existing stresses.

Action Items

1. Find demographic data for the community. The U.S. Census is a good starting point. A local school district may have more up-to-date information.
2. Check with social service providers, both government and non-profit, about what have been the most successful accommodations for working with non-mainstream groups within the community. Meeting times, places, and formats could be considerations, as well as the presence of translators, advocates, or specific individuals.
3. Identify representatives of any minority or special-needs groups within the community that may be affected by drought, such as leaders of cultural centers, or advocates for farm workers or older people.

1.3. Include government agencies and regulators

Communities across the country are affected by federal, state, and local regulations. Federal regulations generally mandate standards and broad programs, which are implemented with certain variations by both state and local governments. Each state has differing requirements regarding how most of these regulations are implemented. It is essential that your community understand the regulations at all levels regardless of the type of water supply you have and any individual monitoring systems you have in place. Communities should have a list of resources for contact persons regarding regulations and programs. Although regulations can place demands on communities, having a thorough understanding of those regulations as well as responsible agencies and individuals can also provide insight into funding opportunities to update infrastructure, educate community members, and safeguard your water resources.

Action Items

1. Identify appropriate contacts at all levels of government who have regulatory duties for both surface and groundwater quality and quantity.
2. Review relevant regulations to ensure that you fully understand and can meet all requirements.
3. Contact the appropriate agencies as you work toward becoming Drought-Ready. Can the agencies assist you with any aspect of the Drought-Ready Communities process? Can they attend a meeting with the leadership team or the community? Can they provide resource material to assist your public awareness and education campaign? Can they help you find funding to place safeguards on your water supply or the development of your drought plan?
4. Keep in contact with agencies as you go through the Drought-Ready Communities process and after you have developed your community's drought plan.

Resources

1. Appendix B, Background on Jurisdiction

1.4. Develop a contact list

A master contact list will help maintain continuity and reduce the learning curve if new community members become involved in drought planning. The process of developing this list and defining roles may also reveal what resources are available to the community before, during, and after a drought, as well as highlighting any resources that might be missing.

Action Items

1. Use Worksheet 2: Contact List to begin developing a comprehensive list of drought contacts. Include the members of the **Leadership Team**.
2. Include a broad spectrum of **water users**, particularly those who can provide regular updates and serve as a communication conduit for a sector or group. Some examples of these groups include, but are not limited to, industrial water users, irrigators, labor groups, media outlets, non-profit organizations, landscapers, recreational and tourist businesses, neighborhood groups, and local politicians. Be sure to include people who specifically ask to be updated about the process.

3. List **local, regional, state, and federal agencies** that have jurisdiction over or data about the community's water supply, public health, agriculture, environmental quality, and other relevant areas. Include each agency's area of responsibility to the community and a contact person.
4. Investigate the ways in which social media, such as Facebook, MySpace, and Twitter, can be used to construct or augment a contact list. Remember, millions of people are using these resources.

 Add the Contact List to your Drought-Ready Communities binder.

Resources


1. Appendix A, Worksheet 2: Contact List
2. Appendix B, Background on Jurisdiction

1.5. Gather community perceptions of drought

Now that you have gathered a diverse group of stakeholders that are interested in helping the community become Drought-Ready, it's time to survey their knowledge about drought in the community. This information will be useful in many respects. First, it will provide subjective impact information, which will serve as the starting point of Section 2. It will also inform the Drought-Ready Communities leadership team about the monitoring and communications systems currently in place, the subject of Section 3. In addition, this information can highlight community misperceptions that can be addressed by the public awareness and education campaign, discussed in Section 4. Finally, it can provide an understanding of the different ways that people in the community think about drought.

Action Items

1. Compare perceptions of drought from among the different contacts. Use Worksheet 3 as a guide. Compile the results to give a picture of how drought and its impacts are seen by members of your community.

 Add Worksheet 3: Perceptions of Drought to your Drought-Ready Communities binder.

Resources

1. Appendix A, Worksheet 3: Perceptions of Drought

Section 2. Information Gathering: Understand Water Sources and Uses, Develop a Drought History

Droughts are both natural and social phenomena. Droughts can directly and indirectly affect a community in many ways, depending on the characteristics of the drought (severity, spatial extent, and duration) and the unique social aspects of the community. The steps within this section will guide you through gathering information about water sources and uses as well as historical climate and drought information for your area. Combined, this information will give you an accurate picture of past conditions, and it will serve as the foundation for developing effective drought monitoring and planning strategies tailored to the community.

2.1. Identify water sources and uses

This section will help you assess what water sources (supplies) and uses (demands) currently exist within the community. Droughts typically have noticeable effects on water supply and demand. Having baseline knowledge about water will help the community identify potential future impacts and provide a basis for comparison when a drought occurs. Note that “uses” and “users” may be very different. For example, the largest residential “user” might be a small fraction of the total water demand, although residential “use” constitutes the majority delivery type.

Action Items

1. Make a list of all available water supplies by source (e.g., reservoir, groundwater, river) with as many numerical measurements as possible. Use Worksheet 4: Available Water Supplies as a guide. Include:
 - a. The amount that comes from reservoirs, wells, rivers, etc.
 - b. Costs associated with different sources of water, including seasonal variations.
 - c. For each water source, note the typical proven capacity, maximum pumping rates, and minimum usable level (if applicable).
 - d. How drought affects water quality. Municipalities may need to filter sediment from water drawn from lower reservoirs. Well owners may need to test wells more frequently when there is less water to dilute contaminants.
2. Learn what proportion of water supply goes to various uses, such as residential, industrial, commercial/business, water deliveries (to surrounding areas), etc. Note major seasonal variations. If you do not have information on use by sector, refer to Action Item 3, below.
3. As a double-check that you’ve included all the “uses” in Item 2, make a record of the top water “users”. Use Worksheet 5: Top Water Users as a guide. If there are any concerns about the confidentiality of water use information, consider redacting this portion of the document in some fashion. Also, be sure to state how the top water users are defined (i.e., what the cut-off is). Include:
 - a. Their maximum, minimum, and average water use.
 - b. Peak usage time or month if there is significant variation throughout the year.

 Add Worksheets 4 and 5 to your Drought-Ready Communities binder.

Resources


1. Appendix A, Worksheet 4: Available Water Supplies
2. Appendix A, Worksheet 5: Top Water Users
3. Nebraska's Health and Human Services community water supply vulnerability document at http://carc.agr.ne.gov/pdf_files/MunicipalSubCommittee.pdf

2.2. Learn how drought has affected the community in the past

Droughts can result in a variety of impacts, such as changes in water availability, income declines for businesses, increased fire risk, health problems, environmental issues, and more. Gathering specific information about drought impacts in different sectors within the community can help ensure that responses to drought address actual rather than perceived needs, as well as include special needs or less visible groups (see Section 1.2). Taking time to examine impacts from as many droughts as possible over a long period of time may help a community judge the many and varied ways in which a drought can impact the community.

Action Items

1. Learn how each of the water sources and uses identified in 2.1 has been affected by drought in the past. Remember that drought can affect water quality and characteristics as well as supply. Drought impact information is available through a variety of sources. See the Resources section below for help getting started.
2. Develop a comprehensive list of impacts that have affected the community in the past or that would affect it in the future. It is recommended that impacts be grouped by affected sector.
3. Refer to the list of contacts developed in Section 1.4. At this point, having reviewed potential impacts in depth, are there other groups that also need special attention? For instance, rural communities with a lot of farm families and communities with a lot of agricultural workers will need to pay special attention to the economic and social needs of these populations.

 Add the list of historic impacts to your Drought-Ready Communities binder. Update Worksheet 1: Benefits of Drought Planning if needed to reflect benefits to other stakeholder groups you may have identified in this section.

Resources

1. Where to find information on drought impacts:
 - a. Local history, which could come from newspaper records, library clipping files and other holdings, the historical society, and residents' recent experiences and past memories. Remember to view this history in light of changes over time in climate, water supply, population, and industry.
 - b. The local water utility. Be sure to ask about how drought has affected or could affect water quality, too. Make sure the utility is keeping key records, such as when auxiliary

supplies are used to augment the main supply. Also, remember that corporate memory within an organization rarely extends much beyond 20 or 30 years because of position turnover.

- c. Worksheet 1: Benefits of Drought Planning, which provides a detailed list of impacts, broken down by environmental, social, and economic impacts. It can serve as a reminder or provide ideas about impacts to look for.
 - d. The Drought Impact Reporter (DIR), <http://droughtreporter.unl.edu/>, on-line since 2005, archives drought impacts from across the country, based on ways impacts are commonly reported in media and other sources. Note that, in some cases, historical drought information has been collected from newspaper archives and entered into the Drought Impact Reporter.
2. The National Drought Mitigation Center (NDMC) provides a detailed discussion about drought impacts at:
 - a. <http://drought.unl.edu/risk/impacts.htm>

2.3. Gather data on water and climate

Droughts are a normal part of climate in most areas. It is likely that your community has experienced more than one drought in the past, and they will certainly experience another drought sometime in the future. Identifying the occurrence of past droughts is another important step toward being able to better cope with future droughts.

In this section your community will gather and analyze water and climate data to gain a better understanding of your location's climate and drought history. Throughout this process you will answer the following questions:


- How much precipitation normally occurs and what time of year is it most abundant?
- How often does drought occur in this region?
- How severe have the droughts been?
- How widespread have the droughts been?
- How long have the droughts lasted?

As you conduct this exercise, remember that the relationship between precipitation, stream flow, and water supply can be quite complex. It is strongly recommended that you complete this step with some outside assistance, possibly from a hydrologist or engineer. If resources are limited or outside assistance cannot be obtained, complete this exercise to the best of your ability.

Action Items

1. Inventory all available records and monitoring systems concerning the community's water system. Remember to survey community-maintained, state, and federal networks, to find out what data are available. As you do this, answer the following questions:
 - a. How close are the nearest monitoring stations (well, stream gauge, reservoir intake, etc.)?

- b. How frequently are data gathered?
 - c. How far back do records go?
 - d. Do other stations, even if more distant, provide more complete and better quality data, while still being representative of your region? These may be used in place of your records; however, there's no substitute for local data. Collection of any missing data should begin immediately.
2. Find out what climate data are available from national, state, or regional sources that can help you understand your community's drought and climate history. Sometimes climate and weather observations may be combined from multiple sites to provide a more complete, longer climate record; these may be substituted in some cases for single-station observations in or near the community. You will likely want to answer many of the same questions as in Item 1, above.
3. Possibly with outside assistance from a NOAA Regional Climate Center, a state climatologist, a state hydrologist, or the water survey, interpret the data you have gathered. Also see Appendix B, Case Study: Norman, Oklahoma – Drought History for an example of a community's climate and water history.
 - a. Obtain or compute the average monthly, seasonal, and annual precipitation and temperature.
 - b. Define periods when a drought occurred. Take note of the severity, duration, and spatial extent of each drought. You might find the U.S. Drought Monitor, the Standardized Precipitation Index (SPI), and the Palmer Drought Severity Index to be great resources for identifying drought periods.
 - c. Compare data about water sources and uses with the periods of significant drought that you identify, to further understand the connection between drought and your community's hydrology.

 Include the analysis of past droughts in your binder.

Resources

1. Appendix B, Case Study: Norman, Oklahoma – Drought History, provides a detailed climate and water history for the city of Norman.
2. The community's state climatologist (SC): <http://www.stateclimate.org/>
3. A NOAA regional climate center (RCC): <http://www.ncdc.noaa.gov/oa/climate/regionalclimatecenters.html>
4. The National Drought Mitigation Center (NDMC)
 - a. Homepage: <http://drought.unl.edu>
 - b. How to create a local drought history: <http://drought.unl.edu/monitor/localdroughthistory.htm>
 - c. Climographs – graphs showing average monthly precipitation and temperature – for various locations across the United States: <http://drought.unl.edu/whatis/climographsdomesticenglish.htm>
 - d. Maps of Palmer Drought Severity Index 1895-1995: <http://drought.unl.edu/whatis/palmer/pdsihist.htm>
 - e. Archive of Standardized Precipitation Index: <http://drought.unl.edu/monitor/archivedspi.htm>

- f. Comparison of major drought indices: <http://drought.unl.edu/whatis/indices.htm>
5. U.S. Drought Monitor archive: <http://drought.unl.edu/dm/archive.html>
6. The National Climatic Data Center (NCDC) provides graphs showing time series of precipitation, temperature, and SPI and PDSI at the climate division level:
<http://www7.ncdc.noaa.gov/CDO/CDODivisionalSelect.jsp#>
7. Climate trend information for temperature and precipitation is available by state climate division at <http://cig.mesonet.org/~derek/public/timetraces/>, or at <http://www.southernclimate.org/products/trends.php> .
8. NOAA Climate Services provides a wealth of information to help with understanding climate and finding climate data: <http://www.climate.gov/>
9. The American Water Resources Association (AWRA): <http://www.awra.org/>
10. The American Water Works Association (AWWA): <http://www.awwa.org>

2.4. List factors that affect the severity of drought impacts

A direct relationship seldom exists between the degree of drought severity and the degree of impacts experienced by a community. This is because natural and social factors, both of which tend to change over time, can play a role in how the drought affects society, the economy, and the environment. These factors include, but are not limited to, the timing of a precipitation deficit, temperature, population growth, the development of new technologies or water supplies, and land use patterns.


For example, suppose a city experiences a precipitation deficit in the middle of an abnormally cool summer. The impacts of the drought on water supply and demand and water-sensitive activities could be quite different from the impacts in a year when normal or above-average temperatures were occurring. Also, consider a severe drought from 20 or 30 years ago. Would impacts be the same today, considering changes in water demand due to population changes, per capita water use trends, or new industry? In this section you will explore the circumstances that influence how drought affects your community.

Action Items

1. The community's water supply and demand have probably fluctuated over time, creating situations of water strain and plenty. With this in mind, gather any available information on long-lasting changes to the water supply and demand. Examples might include the development of a reservoir, a change in irrigation technique, or the opening of a new industrial plant.
2. List any natural and social factors that tend to increase or decrease the impact a drought can have on the community. Some of these factors affect water supply, and others affect demand.

Keep in mind that factors can be sector-specific. For example, temperature may influence impacts in agriculture but not tourism.

3. Pick at least two different droughts – one that was particularly severe according to the climate record, and another that was the most recent -- and compare their impacts. Consider this exercise an opportunity to identify any additional natural or social factors that may have been overlooked above.

 Include the list of factors that moderate or intensify the effects of drought in your binder, including background information on major changes to the community's water supply and demand.

Resources

1. Appendix B, Case Study: Norman, Oklahoma – Drought History, discusses how natural and social factors can result in severe impacts during relatively minor droughts.

Section 3. Establish Monitoring: How You Will Recognize and Communicate About Drought


As described in Section 2, many resources are available to evaluate past drought conditions and impacts. Many of these same resources, such as the U.S. Drought Monitor, can also be used in real-time to detect an emerging drought. Drought monitoring includes defining what to monitor and at what intervals, how information will be accessed and distributed, assigning individuals with the responsibility for routinely monitoring conditions and impacts, and informing others in the community based upon a defined schedule.

3.1. Identify drought indicators that will be used by the community

Drought reveals itself in many different ways. Consequently, you could choose from a multitude of drought indicators. For example, what are your primary sources of water? If you rely on groundwater, stream flow or reservoir levels may not be as important. How quickly do water shortages appear? If they appear quickly, more rapidly responding indicators may be more appropriate. The purpose of this section is to evaluate various drought indicators and determine what is most relevant to your community.

Action Items

1. Review the water, drought, and climate indicators identified in Section 2. Decide which indicators your community should regularly monitor, keeping in mind that some indicators may be historical while others may be current. You may wish to include at least one regional indicator that can provide broad information about the surrounding area and at least one local indicator directly tied to the community's water supply.
2. Assign responsibility for monitoring drought indicators to one or more people. Establish a regular schedule to monitor and report conditions to the Drought-Ready Communities team and others who are interested. Make sure that conditions are monitored at least monthly, even on groundwater systems.

 Add the water, drought, and climate indicators you chose, and the names of those responsible for monitoring them, to your binder.

Resources

1. The NIDIS Drought Portal has a section related to drought indicators that may be helpful: http://www.drought.gov/portal/server.pt/community/drought_indicators/223. Also keep in mind that some indicators are regional (for example, many reservoir-based indices are only produced in western states) and may not be available in your state. Ask the NIDIS Portal team (http://www.drought.gov/portal/server.pt/community/drought.gov/202//contact_us) for help. If an indicator of importance to you is not available on the NIDIS Portal, you can request that your indicator be added to their list.
2. Commonly used large-scale indicators:
 - a. U.S. Drought Monitor: <http://drought.unl.edu/dm/monitor.html>

- b. Standardized Precipitation Index: <http://www.wrcc.dri.edu/spi/spi.html>
 - c. Palmer Drought Severity Index: http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/regional_monitoring/palmer.gif
 - d. Crop Moisture Index: http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/regional_monitoring/cmi.gif
 - e. USDA/NASS Crop Reports: http://www.nass.usda.gov/Statistics_by_State/index.asp
 - f. Surface Water Supply Index: <http://www.wcc.nrcs.usda.gov/wsf/swsi.html>
 - g. Keetch-Byrum Drought Index (fire potential): <http://www.fs.fed.us/land/wfas/kbdi.png>
 - h. Mountain snowpack: <http://www.wcc.nrcs.usda.gov/cgibin/westsnow.pl>
3. General list of common local indicators (locally maintained data may also be available although it is not listed below):
- a. The National Weather Service’s Precipitation Analysis, showing current precipitation, as well as accumulated 7-, 14-, 30-, 60-day precipitation totals and amounts relative to normal : http://www.srh.noaa.gov/rfcshare/precip_analysis_new.php
 - b. Soil moisture: <http://www.emc.ncep.noaa.gov/mmb/nldas/drought/>
 - c. Stream flow measurements (U.S. Geological Survey): <http://waterwatch.usgs.gov>
 - d. Reservoir levels (not an exhaustive list)
 - i. <http://www.usbr.gov/main/water/> (Contains hourly, daily, weekly water supply information, etc., for the Great Plains and Western United States)
 - ii. http://www.pecad.fas.usda.gov/cropexplorer/global_reservoir/ (Satellite info on the largest lakes/crop coverage)
 - e. Well or groundwater levels (U.S. Geological Survey): <http://waterdata.usgs.gov/nwis/gw>
4. The National Drought Mitigation Center maintains a list of state drought contacts. These people specialize in drought issues and would be an excellent resource. They may be able to provide advice based on what other nearby communities use to monitor drought: <http://drought.unl.edu/plan/direct.htm>
5. For a discussion about drought indices, see the “Comparison of Drought Indices” page on the NDMC website: <http://drought.unl.edu/whatis/indices.htm>

3.2. Identify drought impact indicators for your community

In Section 2.2, you learned how drought has affected the community in the past. In this section, you will see whether there are specific ways to measure the impacts of an emerging or ongoing drought. Detecting drought’s impacts in the early stages, before they become a crisis, can help prevent some of the worst effects. Decision makers find drought impact information valuable since it can help them make informed decisions about water prioritizations, and it helps identify sectors in need of assistance. Unfortunately, information on drought impacts can be hard to find, particularly quantifiable data. Businesses, farm families, agricultural workers, and others are sometimes reluctant to share information about how drought is affecting them, either for competitive or personal reasons. In this section you will take steps that will help your community effectively monitor and communicate drought impacts.

Action Items

1. Review Section 2.2 and identify a representative or advocate for each group or sector that is likely to experience drought's impact. Ask this person to help detect and convey the impacts of drought, serving as a conduit of information between the Drought-Ready Communities team and the sector or group. Be sure there is a clear understanding whether, and at what point, submitted impact information will be made public. Also, don't forget to add this person to your Drought-Ready Communities contact list (Section 1.4).
2. Consult representatives for each group or sector (as determined in Action Item 1) to determine what impact information is most critical to track. Ideally, the information you track should include quantitative components such as number of businesses affected, number of people laid off from work, percent of water users experiencing restrictions, etc. Determine how this information will be collected and at what frequency. It is recommended that impact monitoring be done at least on a monthly basis.
3. Incorporate impact reporting into regular drought monitoring and communication, and submit impacts to the NDMC's Drought Impact Reporter database.



Add the list of impact information to track to your binder, including sector contacts, data/information that will be tracked, and a URL (web link) to the Drought Impact Reporter.

Resources

1. NDMC's Drought Impact Reporter
 - a. Homepage: <http://droughtreporter.unl.edu/>
 - b. Submit a Drought Impact: <http://droughtreporter.unl.edu/add.jsp>

Section 3.3. Develop a drought monitoring communication plan

A drought communication plan allows a community to organize much of the information that must be shared internally, with partner agencies, and with the general public during a disaster. As such, it is a vital part of being "Drought-Ready." The drought monitoring communication plan meets the following objectives:

- 1) It outlines when, how, what, and to whom drought status information will be disseminated.
- 2) It includes inter-agency communication, so that local decision makers and emergency managers are in the information loop.
- 3) It has provisions for updating state and national authorities, as needed.
- 4) It outlines provisions for alerting and communicating with the general public, including a method for handling information inquiries, which multiply rapidly during a disaster.
- 5) Information is disseminated on a timely basis, using appropriate language for the target audience(s).

Having a communication plan in place before drought occurs will increase the likelihood of timely communication of relevant information to officials, decision makers and emergency

managers, and the general public. Communication between those with specific roles and responsibilities to safeguard the public will increase efficiency and transparency in water management. Also, keeping the public well informed as drought intensifies may help people react more favorably when officials request steps such as reduced lawn watering, eliminating car washing, and shorter showers.

Action Items

1. Assess how information about drought was disseminated in the past. Who reported the information, and how was it released to the public? You may want to consult the drought impact history compiled in Section 2.2 as well as Worksheet 3: Perceptions of Drought.
2. Create a template for a regular drought information report. This report should include drought indicators identified in Section 3.1, and any impacts being reported, ideally using quantitative indicators identified in Section 3.2. The resources section below contains several examples of how various government agencies have chosen to communicate about drought to help you get started. Be sure to communicate about drought status in terms that people can relate to easily. For example, instead of talking about capacity in absolute terms, such as millions of gallons per day, use relative terms such as the equivalent in number of showers, the percentage of total water storage capacity of the municipal water supply available, or the water use compared with that of previous years.
3. Prepare and distribute the drought information report to a core group of people responsible for safeguarding the public, even when there is no drought. Include local media and any others who indicate interest. Having a regular publication, even in times of plentiful rain, will assure that those receiving the document are familiar with its content and format and the indices used so they will not have to overcome a learning curve when a drought strikes.
4. Identify any groups that need longer lead time or earlier warning, and incorporate more frequent or more detailed updates for those groups into the plan, if possible. For example, farmers may be able to make use of any available forecast information.
5. If you believe conditions in your area are not reflected properly in the U.S. Drought Monitor, contact your state climatologist or the local National Weather Service Forecast Office. You may also contact the Drought Monitor authors directly at DroughtMonitor@unl.edu.
6. Increase the frequency and scope of communication as drought develops. One great resource to utilize as you do so is a public information officer or other media specialist. Expand communication to a broader audience by:
 - a. Designating an individual to be responsible for communicating with the public. This person should be available by telephone or email to answer questions that arise during a drought situation. If a staff position is unavailable, consider seeking volunteers from the community to answer basic questions.
 - b. Identifying means of distributing information that you will use for timely communication during drought, such as bulletin boards, cable access channels, notes on water bills, websites, social networking sites (Facebook, Twitter, RSS feeds) , etc.
 - c. Developing press releases and other education and outreach materials to keep the public informed and to request or encourage behavior changes, such as voluntary conservation. Be sure to emphasize responses based on the triggering thresholds outlined in Section 5.2.



Add the drought information report template, the distribution list, and the schedule to your binder.

Resources

1. *National Weather Service (NWS) Drought Impact Statements* demonstrate how drought is communicated between NWS officials and the public.
Current statements: <http://www.weather.gov/ahps/hic/current/drought/>
2. The Arizona Department of Water Resources Drought Program does an excellent job disseminating drought status information to the public. Below is a link to the Arizona “Drought Status” webpage. It contains links to past and current monthly status documents and annual reports.
<http://www.azwater.gov/AzDWR/StatewidePlanning/Drought/DroughtStatus.htm>
3. The *Denver Water Drought Response Plan* discusses their Drought Communication Program, which contains three major components: public involvement, customer information, and media relations (p. 42). The plan also addresses internal communication.
http://www.denverwater.org/docs/assets/DD1F807E-BCDF-1B42-D5B4FD4EB681A7B3/drought_response_plan1.pdf
4. The City of San Diego maintains a website that uses a four-tiered, color-coded scale for communicating drought conditions to the public.
<http://www.sandiego.gov/water/>
5. The New Jersey Drought Department of Environmental Protection’s Drought Information website provides an example of how the Internet can be used to regularly update stakeholders about drought status and other drought-related information.
<http://www.njdrought.org/>
6. The Maryland Department of the Environment drought website provides another an example of how the Internet can be used to communicate drought status and other drought-related information to stakeholders.
<http://www.mde.state.md.us/Water/Drought/home/index.asp>

Section 4. Plan a Public Awareness and Education Campaign

Design a public awareness and education campaign that will help community members understand the benefits of planning for drought, the community's water supply and use, the local drought history, and water conservation techniques. Greater understanding is likely to lead to greater compliance when people need to conserve water in response to drought. It's also likely that people will begin to place more value on some of the long-term steps the community can take to be better prepared for the next drought, and to consider drought, climate, and water related issues in planning and decision making. To make a difference, information needs to be delivered consistently.

Key messages will vary, depending on the intent and the audience. Possibilities include:

- Where does the community's water come from and who uses it?
- What is drought and how has it affected the community in the past? How would it affect the community in the future?
- Benefits of planning for drought
- Community drought indicators, triggers, and responses
- Current drought status
- Water conservation measures for drought and non-drought times
- Watershed planning and protection

Information can be shared or delivered in many ways. Consider:

- Educational materials, activities, or programs for elementary, secondary, and post-secondary schools, and for Scout troops, 4-H groups, or other youth groups
- A display for community functions, local libraries, or meeting places
- Speakers willing to give presentations to local businesses or groups
- Coffee shop meetings or town hall meetings
- Reports or feature stories by local media sources
- Programs coordinated with local museums or the park district
- Internet sources, including a RSS Feed, blog, Twitter, and Facebook.

Action Items

1. Identify people interested in public awareness and education to create informational materials that will convey key messages to your community. Be sure to review these materials to see whether they need to be modified or translated for specific groups within your community – children, adults, cultural or ethnic groups, etc. It may help to consult Section 1.2 for special needs groups.
 - a. Consider many ways to reach various groups – pamphlets, billboards, newspaper advertisements or inserts, website content, public access cable programming, etc.
 - b. Consider the staff resources you have available to develop and distribute the materials, and find an option that works within your budget. Communities may find it useful to work with a marketing firm to develop and distribute information.
2. Identify community organizations or agencies that would be willing to collaborate by including Drought-Ready information in their publications or mailings. The local water utility is a likely collaborator. Other community organizations such as churches and any environmentally

oriented non-profit organizations may also be willing to include Drought-Ready information. Don't forget to include local media outlets. They are often a valuable resource for getting information out to the public.

3. Outline your strategy and gather educational materials, products, and activities. Refer to the resources below for guidance.
4. Devise an implementation schedule. Periodically update or refresh the materials and messages that you are distributing so the information does not become stale or overlooked.



Add the strategy, schedule, and any materials you produce to your binder.

Resources

1. The Groundwater Foundation: <http://www.groundwater.org/>
2. Drought Central: Nebraska State Government – General Public Drought Management Tips: <http://www.droughtcentral.nebraska.gov/>
3. Maryland Department of the Environment: Water Conservation: http://www.mde.state.md.us/Programs/WaterPrograms/Water_Consevation/index.asp
4. *Oklahoma Water Resources Board Strategic Plan, FY 2008-2012*; Public Outreach and Education (p. 14): <http://www.owrb.ok.gov/about/management/OWRBStrategicPlanFY2008.pdf>
5. State of Arizona: Water Conservation Education and Outreach: <http://www.adwr.state.az.us/azdwr/StatewidePlanning/Conservation2/Education/default.htm>
6. Save Water NC (good information and links for homes, businesses, government, etc): <http://savewaternc.org/>
7. Redwood City, California, “10 Gallon Challenge” : <http://www.redwoodcity.org/galloncount/>

Children’s Educational Materials and Websites

1. 42eXplore (eduScapes) – The Topic: Drought: <http://www.42explore2.com/drought.htm>
2. Environmental Protection Agency (EPA)
 - a. Water Cycle: The EPA's animated “Thirstin's Water Cycle” shows how water moves through the hydrologic cycle. Concepts include precipitation, aquifers, vapor, and clouds. http://www.epa.gov/safewater/kids/flash/flash_watercycle.html
 - b. Environmental Kids Club: The EPA's “Kids Page on Water” teaches kids how to care for this important resource. <http://www.epa.gov/kids/water.htm>
 - c. EPA WaterSense Kids: Provides kids with games, trivia, and tips on how to save water. <http://www.epa.gov/WaterSense/kids/>
 - d. *A Day in the Life of a Drop* is a set of activities designed to help students in grades 3–5 understand the connections between the source of the water they use and the ways their water use habits affect the environment and human health. http://www.epa.gov/watersense/resources/educational_materials.html
3. National Drought Mitigation Center: Drought for Kids: <http://drought.unl.edu/kids/index.htm>

Section 5. Taking Action: Planning Responses to Reduce Impacts

You have probably realized by now that your community can take steps ahead of time to reduce the anticipated effects of the next drought. Examples of steps that communities can take ahead of time include educating people about water conservation, encouraging alternatives to thirsty lawns, ensuring that new developments incorporate land-use practices that preserve watersheds and reduce paved area, interconnecting water sources, etc.

It's also helpful to plan responses to take during drought before the next one happens. Regularly consulting drought indicators makes it more likely that your community will be alerted to developing events in time to respond carefully and deliberately, before your community reaches a crisis stage. These response actions could include providing or accelerating distribution of awareness materials, voluntary or mandatory conservation measures, and notifying local social service or public health agencies of the potential for drought-related hardship. The key is to assess what steps your community should take to respond to the varying durations and intensities of drought. Remember to be inclusive – a good drought response plan includes more than just mandatory water conservation.

Equally important is the fact that a good drought response plan doesn't end when the drought does. A drought can be a powerful focusing event that increases community awareness and resolve. After a drought, be sure to capitalize on this attention and experience to improve the drought plan and possibly even employ additional strategies to further reduce drought impacts.

5.1. Determine and prioritize possible strategies to take before and in response to drought

Action Items

1. Review the lists of impacts and stakeholders from Section 2.2.
2. Review strategies used by other communities to respond to drought and reduce impacts. Appendix C provides a list of strategies that may apply to your community.
3. Brainstorm a list of any strategies, possibly including those discovered in Action Item 2, that could help with reducing or responding to the effects of drought in your community. Be sure to include strategies that can be taken both before and during a drought.
4. Evaluate each strategy according to its feasibility, equity, cost, and other considerations. Some actions will likely be termed a “worst-case scenario” for the community, but it may still be useful to include them for planning purposes. For each strategy, decide whether it requires action ahead of time or as a response to an emerging drought. For each item that requires action, assign a person or agency to be responsible, and decide or estimate the time and costs (if any) needed to complete the action. Worksheet 6 (Appendix A) can guide you through this process.



Add the list of response strategies and the evaluation from Worksheet 6 to your binder.

Resources

1. Appendix A, Worksheet 6: Cost-Benefit Comparison
2. Appendix C, Examples of Drought Response Actions


5.2. Link response actions to drought indicators

Now that you have identified steps to take to reduce the impacts of drought and indicators to detect emerging drought, decide when to take action. Some strategies listed in Section 5.1, such as developing a new water source, will need to be carried out before a drought occurs. Others won't need to be implemented until a drought occurs. Keep in mind that different levels of response will probably depend on drought severity, in addition to the type of impact. The following action items will help you determine when to employ actions based on varying levels of drought severity.

It is nearly impossible to predict how severe or long-lasting a drought will be. As your indicators creep toward the values that trigger response actions, there will be a tendency to wait and see whether or not the dry spell will evolve into a full-fledged drought. There is a natural tension here, because triggering too early can induce complacency in the community; however, waiting too long to institute action may put you in more dire straits later. That is why the use of triggers linked to potential impacts is important. They provide an agreed-upon set of measures that can inform response decisions. Setting appropriate triggers might seem like an intimidating task, but your community's knowledge of past events and water system limitations gained from Section 2 will allow initial values to be determined. Depending on available resources, the process of defining trigger values may be subjective or objective. Regardless, be sure to revisit this exercise after a drought occurs to improve the connection between drought severity and community response.

Action Items


1. Refer to Worksheet 6, Cost-Benefit Comparison, and identify the strategies on that list that will be implemented during drought.
2. Some strategies will probably need to be implemented in stages as drought severity changes while others will only require one level of action. For all strategies requiring incremental implementation, determine 2-5 levels of action that can be taken as drought severity increases. For example, the strategy "implement water restrictions" might result in the actions "voluntary restrictions," "mandatory restrictions," and "water rationing" for moderate, severe, and extreme drought triggers, respectively.
3. Determine the values (thresholds) at which your indicators will trigger the response actions identified in Action Item 2. Remember that actions may be triggered by a combination of indicators, or ranges of values.
4. Combine Action Items 2 and 3 using Worksheet 7: Linking Thresholds to Actions. See the case study from Decatur, Illinois, in Appendix B for an example of how one community linked thresholds to actions.
5. After a drought occurs, be sure to revisit the threshold values used to trigger response actions. If adjustments are needed, remember to update Worksheet 7.

 Add your thresholds and actions from Worksheet 7 to the Drought-Ready Communities binder, make it available to the community, and publicize it at least annually.

Resources

1. Appendix A, Worksheet 7: Linking Thresholds to Actions
2. Appendix B, Case Study: Decatur, Illinois – Linking Indicators to Actions
3. Other drought response plans are available on the NDMC website at <http://drought.unl.edu/plan/stateplans.htm>
4. A few notable drought plans that link drought responses to drought indicators:
 - a. *Denver Water Response Drought Plan*
http://www.denverwater.org/docs/assets/DD1F807E-BCDF-1B42-D5B4FD4EB681A7B3/drought_response_plan1.pdf
 - b. *Georgia Drought Management Plan*
<http://www.georgiaplanning.com/watertoolkit/Documents/WaterConservationDroughtManagement/DroughtMgtPlanFinal03.pdf>

Wrapping Up

 When you have completed all five sections of the Drought-Ready Communities process, your binder should include the following:

From Section 1, Getting Started

1. Worksheet 1: Benefits of Drought Planning
2. Worksheet 2: Contact List. Hopefully you thought of ways to expand your initial list as you went along.
3. Worksheet 3: Perceptions of Drought summarized list (you may want to keep individual responses as an appendix)

From Section 2, Information Gathering

4. Details about the community's water sources and users, including Worksheet 4: Available Water Supplies and Worksheet 5: Top Water Uses.
5. A list of all the ways that drought has affected the community in the past.
6. An analysis of past droughts
7. A list of factors that moderate or intensify the effects of drought, including background information on major changes to the community's water supply and demand.

From Section 3, Establish Monitoring

8. A list of drought indicators that your community should monitor regularly, including at least one large-scale climate-based indicator, and one locally generated indicator that is directly related to your community's water supply.
9. The name(s) of one or more people who will check the chosen drought indicators and the schedule for checking.
10. A list of drought impact indicators that are relevant for your community and details about who is responsible for collecting this information.
11. A drought information report template and the distribution list and schedule.

From Section 4, Public Awareness and Education

12. A strategy and schedule for a public awareness and education campaign.
13. Any presentations, pamphlets, templates for press releases, or other materials you have developed to publicize drought and response actions in your community.

From Section 5, Drought Response Planning

14. Worksheet 6: Cost-Benefit Comparison, which is an evaluated list of strategies to prevent and respond to drought impacts
15. Worksheet 7: Linking thresholds to actions

Appendix A: Worksheets

Worksheet 1: Benefits of Drought Planning

Worksheet 2: Contact List

Worksheet 3: Perceptions of Drought

Worksheet 4: Available Water Supplies

Worksheet 5: Top Water Users

Worksheet 6: Cost-Benefit Comparison

Worksheet 7: Linking Thresholds to Actions

Worksheet 1: The Benefits of Drought Planning	
Date:	
General Benefit	Specific Stakeholders, Groups, or Businesses
Economic Benefits	
Reduce or eliminate costs and losses to agricultural and/or livestock producers	
Reduce or eliminate costs and losses to industries directly or indirectly related to agricultural production (seed, feed, and weed companies; equipment dealers; etc.)	
Reduce or eliminate costs and losses to timber production	
Reduce or eliminate costs and losses to fishery production	
Reduce or eliminate costs and losses to recreation and tourism	
Reduce or eliminate impacts on energy-related businesses/agencies	
Reduce or eliminate impacts on water suppliers	
Reduce or eliminate costs and losses to the transportation industry (barge transport/navigability; trucking; etc.)	
Reduce or eliminate decline in food production and/or disruption of food supply	
Mitigate decreased land prices	
Reduce drought-related unemployment	
Reduce or eliminate reduction of economic development	
Reduce rural population loss	
Environmental Benefits	
Plant and animal communities are safer when drought-related wildfire is minimized or eliminated	
Plant and animal communities are healthier when drought-related water quality issues (depletion, pollution, contamination, etc.) are minimized or eliminated	
Maintain environmental aesthetics (visual quality of the landscape, health-recreational benefits)	
Reduce damage to plant or animal species, or loss of plant animal species (disease; mortality; migration)	
Preserve biodiversity	
Preserve wetlands	
Mitigate reductions in stream flow / river flow	
Mitigate low-water levels in reservoirs / lakes	
Mitigate groundwater depletion	
Reduce or eliminate wind and water erosion	
Reduce or eliminate air quality impacts	
Societal Benefits	
Reduce or eliminate impacts to physical health such as issues related to water quality (which can be affected by depletion) or respiratory ailments from more dust and particles in the air	

Reduce or eliminate safety issues related to wildfire threat	
Reduce or eliminate impacts to mental health (anxiety; depression)	
Mitigate potential conflict (user conflict; political conflict)	
Reduce or eliminate potential quality of life issues (increased poverty; migrations; rural population loss; etc.)	
Preserve cultural belief systems / cultural sites	
Reduce or eliminate public dissatisfaction with government action / response	
Assure current and future residents and businesses that the community is forward-thinking on drought and climate issues	
Attract grant money – granting entities typically regard planning favorably and planning may lead to more community resources	
Community education about drought and natural hazards, and an awareness of community planning and mitigation efforts, provides a sense of security and peace of mind for citizens, public agencies, and businesses	
Communities, families, and individuals benefit when drought planning is incorporated into new development or re-development efforts. For example, smart growth development can reduce the human footprint on the land, conserve natural watershed function, and create walkable communities that are good for public health and that reduce energy consumption.	
Benefits Specific to Your Community	

Most Recent Update:

Worksheet 2: Contact List

Date:

Name	Contact Number	Email	Mailing Address	Business/Sector	Preferred Area of Contribution	Notes

Worksheet 3: Perceptions of Drought

Drought-Ready Town Hall Discussion Questions

When you hear the word “drought,” what comes to your mind?

How do you know when you are entering a drought?

How is your community/organization/etc. affected by drought?

When have you experienced impacts of drought? What were those impacts? When were you impacted the worst?

What information would you like to have about drought that is not presently available?

Drought-Ready Town Hall Survey Questions

Are there any particular groups, businesses, or geographical areas in your community that are especially susceptible to drought?

What concerns, if any, do you have about how drought may affect your own business, home, or recreational opportunities?

Do you monitor drought conditions directly, such as looking at weather or drought indices? If so, what do you use? (e.g., precipitation departures, lake levels, crop conditions, etc.) and how do you access that information? (website, direct measurements)

Do you receive any kind of notification from other individuals or agencies? If so, from whom and how is that provided? Is this a routine message you receive regardless of whether your community is in drought or not?

When you become aware of or are alerted to drought, what do you do with that information?

Do you communicate drought status to other individuals, organizations, or city or county agencies? If so, to what groups and how (forums, newspaper, website, etc.)?

Are you familiar with the Drought Monitor? If yes, do you provide any comments to authors or other officials involved in the process? Do you know state or local people who participate in Drought Monitor discussions?

What information would you like to have about drought that is not presently available?

If you wanted to learn more about drought, how would you go about doing that?

Worksheet 6: Cost-Benefit Comparison

Date:

Potential Action	Cost	Feasibility	Effectiveness	Before	In Response	Assigned to

Appendix B: Background Material and Case Studies

Background on Jurisdiction

Below is a list of some of the major federal regulations affecting community water supply. State and local regulations in general are summarized as well.

Federal Agencies:

The Environmental Protection Agency (EPA; <http://www.epa.gov/regulations/>) is responsible for administering regulations preventing pollution of water bodies and ensuring safe drinking water. They are the primary federal agency with responsibilities impacting communities and water supplies. Some of the primary laws they administer:

- Clean Water Act (CWA) of 1972 (with amendments) <http://www.epa.gov/regulations/laws/cwa.html>
 - The CWA focus is on protecting surface waters from pollution. The law controls wastewater discharge and point and non-point source pollution, and was the foundation for the development of the National Pollution Discharge Elimination System (NPDES). A NPDES permit is required for municipal systems that discharge wastewater into surface waters.
- Safe Drinking Water Act (SDWA) <http://www.epa.gov/regulations/laws/sdwa.html>
 - The SDWA focus is protecting waters that are utilized for drinking water. Unlike the CWA, which is primarily focused on surface water, the SDWA focuses on both groundwater and surface water protections. Under this law, public water supplies are expected to meet certain minimum standards for the quality of water provided to its customers. The law also sets minimum standards for the protection of groundwater resources from pollution caused primarily by liquid contaminants.
- Endangered Species Act (ESA) <http://www.epa.gov/espp/>
 - The EPA, together with the United States Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration (NOAA) Fisheries Division, implement regulations for the protection of endangered species habitat. EPA's primary responsibility under this act is to ensure that the quality of critical marine or surface waters is protected.

State Agencies:

States are charged with implementing the federal regulations. Certain regulations are set by the federal government and apply to all states. Other regulatory programs may be implemented on a state-by-state basis by a single agency or several agencies.

The EPA provides a state-by-state look at regulations and their implementations at <http://www.epa.gov/lawsregs/states/index.html>

Local level:

Certain regulations or programs are often implemented by local entities such as conservation districts, natural resources districts, and local health departments. These entities also can have

the authority to place further restrictions on surface and groundwater use and protection. Often they are responsible for single landowners, but they also work collaboratively with state agencies and other entities to monitor and enforce water regulations and standards. State contacts should be able to guide you to local entities you may need contact.

Other organizations can assist your community with understanding and keeping up to date with regulations and opportunities for funding. Some of those organizations are listed below.

- The National Association of Conservation Districts: <http://www.nacdn.org/>
- The National Water Resource Association: <http://www.nwra.org/>
- The National Ground Water Association: <http://www.ngwa.org/>

Case Study: Decatur, Illinois – Linking Indicators to Actions

Overview of Decatur

Decatur is the 11th most populous city in Illinois, with a population of 81,860 ^[1]. It has a heavy agricultural-industrial economic base, anchored by the headquarters of Archer-Daniels-Midland (ADM) and Tate & Lyle Incorporated. In addition, Caterpillar, Inc., has a manufacturing plant in town. Because of the large water use by these corporations (ADM alone uses approximately 18 mgd)^[2,3], Decatur has a vested economic interest in maintaining a water supply larger than one would expect from a community its size.

Lake Decatur

Decatur’s primary water source, Lake Decatur, is an impounded reservoir built in 1922 and fed by the Sangamon River. The lake has a capacity of 22,000 acre-feet^[2]. Although it is relatively large, with a surface area of approximately 3,093 acres, it is quite shallow, with an average depth of approximately 6.8 ft^[4]. The drainage area of the reservoir is quite large, approximately 925 mi², so recharge can occur fairly quickly, even with moderate rainfall ^[4,5].

Lake Decatur serves the communities of Decatur, Harristown, Long Creek, and Mount Zion by means of a 36 mgd treatment plant. Another treatment plant, capable of providing 19 mgd, was sold to ADM in 1999^[4,6]. The north treatment plant, which serves ADM, requires the water level to be at least 610 ft asl. The south treatment plant requires 605 ft asl.^[7]

Decatur’s Drought Plan

As a result of the circumstances above, Decatur has put particular emphasis on rapid response to decreasing lake levels. Decatur’s drought plan focuses on the economic and social impact of a rapid decrease in the quality and availability of the primary water source. Because water demand, evaporation, precipitation, and lake level all tend to be lower in the winter months, and the lake level needs to be higher in the summer to dredge the shallow areas, the plan sets a target lake level of 614 ft asl between March 1 and December 15, and 612.5 ft asl between December 16 and February 28.

Decatur’s drought plan is shown below. It provides an example of how drought impacts, indicators, and thresholds relate to community actions at differing levels of drought intensity.

Impact	Indicators	Thresholds	Action(s) - Mar 1 to Dec 15	Action(s) - Dec 16 to Feb 28
Availability of usable water for industry/community.	Lake Level; Calendar Date; Dredging	613.5 ft asl	(1) Start Vulcan Gravel Pit well; (2) Release water from sediment storage site; (3) Inspect and clear DeWitt wellfield oxidation basin and discharge ditches.	None

No dredging of the lake can occur below this level.	Lake Level; Calendar Date; Dredging	613.0 ft asl	(1) Implement voluntary water conservation; (2) Provide top 10 customers with lake level projections; (3) Issue media release; (4) Start 4 DeWitt wells; (5) Start ADM East Plant wells.	None
	Lake Level; Calendar Date; Dredging	612.5 ft asl	(1) Apply for emergency permits for Lake Toko water use and Reas Bridge low flow dams; (2) Obtain bids for Lake Toko pumps and pipe.	None
	Lake Level; Calendar Date; Dredging	612.0 ft asl	(1) Implement mandatory water conservation; (2) Provide top 10 customers with lake level projections; (3) Issue media release.	(1) Implement voluntary water conservation; (2) Provide top 10 customers with lake level projections; (3) Issue media release; (4) Start Vulcan Gravel Pit well; (5) Start ADM East Plant wells; (6) Inspect and clear DeWitt wellfield oxidation basin and discharge ditches.
	Lake Level; Calendar Date; Dredging	611.5 ft asl	Monitor mandatory water conservation effectiveness.	(1) Start 4 DeWitt wells; (2) Apply for emergency permits for Lake Toko water use and Reas Bridge low flow dams; (3) Obtain bids for Lake Toko pumps and pipe.
	Lake Level; Calendar Date; Dredging	611.0 ft asl	ADM install Reas Bridge low flow dams.	(1) Implement voluntary water conservation; (2) Provide top 10 customers with lake level projections; (3) Issue media release.
	Lake Level; Calendar Date; Dredging	610.5 ft asl	Prepare to install Lake Toko pumps and pipeline.	ADM install Reas Bridge low flow dams.
Minimum lake level required for ADM water plant intakes.	Lake Level; Calendar Date; Dredging	610.0 ft asl	Install Lake Toko pumps and pipeline.	Install Lake Toko pumps and pipeline.

Minimum lake level required for South water plant intakes.	Lake Level; Calendar Date; Dredging	605.0 ft asl		
--	-------------------------------------	--------------	--	--

Sources

- [1] Illinois Cities by Population. http://www.maps-n-stats.com/us_il_population.html, accessed April 16, 2010.
- [2] Alexander, K., 2010: Personal Communication, 20 April, 2010.
- [3] Freeman, H., 2000: "Buried Resource. Decatur considers the vast Mahomet Aquifer a key part of its water strategy, but it's uncertain what effect drawing on the underground river will have." Decatur Herald & Review 12 March, 2000.
- [4] Hecht, J. and V. Knapp, 2008: Data for assessing drought vulnerability of Illinois' community surface water systems. Contract Report 2008-02. Available at: <http://www.isws.illinois.edu/pubdoc/CR/ISWSCR2008-02.pdf>
- [5] Knapp, V., 2009: Interview.
- [6] Editorial Staff, 1999: "1999 Newsmakers." Decatur Herald & Review 31 December, 1999.
- [7] City of Decatur Drought Plan. Obtained from Keith Alexander, Decatur City Water Management Director.

Case Study: Norman, Oklahoma – Drought History

As part of the Drought-Ready Communities development process, an applied meteorology and climatology class at the University of Oklahoma worked with officials in Norman, Oklahoma, to develop a climate history. Excerpts are below. The full report is also attached.

Has our city experienced drought?

Drought is a recurring condition in Norman and is part of our climate. Norman's climate history can provide us insight into what we may see in the future. Being a Drought-Ready Community means, in part, that we recognize how our climate has changed over time.

The Climate of Norman, Oklahoma

Temperature and precipitation are the two main elements of our climate. Because Norman is located in the middle latitudes, east of the Rocky Mountains and northwest of the Gulf of Mexico, its residents experience a wide range of weather conditions. Hence, our climate is highly variable, from year to year, season to season, and month to month.

Figure 1 shows the annual temperature (top) and annual precipitation (bottom) in central Oklahoma, including Norman, since 1895. The annual temperature for Norman averages 59.9 degrees Fahrenheit, while precipitation averages 34.5 inches. The warmest temperatures typically occur during July and August when there is a warm-season minimum in precipitation. Warmer-than-average periods have spanned the 1930s, the mid-1950s, and the late 1990s to recent years. Significant periods of drier-than-average conditions include the 1910s, 1930s, mid-1950s, and 1960s.

Drought in Norman, Oklahoma

Figure 3 displays the departure from normal precipitation and the Palmer Drought Severity Index for central Oklahoma from 1895 to 2009. It is evident from these drought indicators that Norman has experienced long and extreme droughts in its past. In addition, the most recent drought in 2006 pales in comparison to droughts of the past.

Climate, Water and Population in Historic Perspective

The past three decades have been significantly wetter than previous decades. Hence, the current generation of Norman residents have not experienced drought conditions as long or as intense as previous generations. While the 2006 drought was minor in terms of precipitation deficit, significant impacts occurred because of non-climate related factors. Population growth has increased Norman's demand for water, and per capita water usage is at an all-time high (Figures 9 and 10). As a result, even during years not suffering from drought, the City of Norman cannot supply enough water as demanded by users during part of the summer without accessing external supplies.

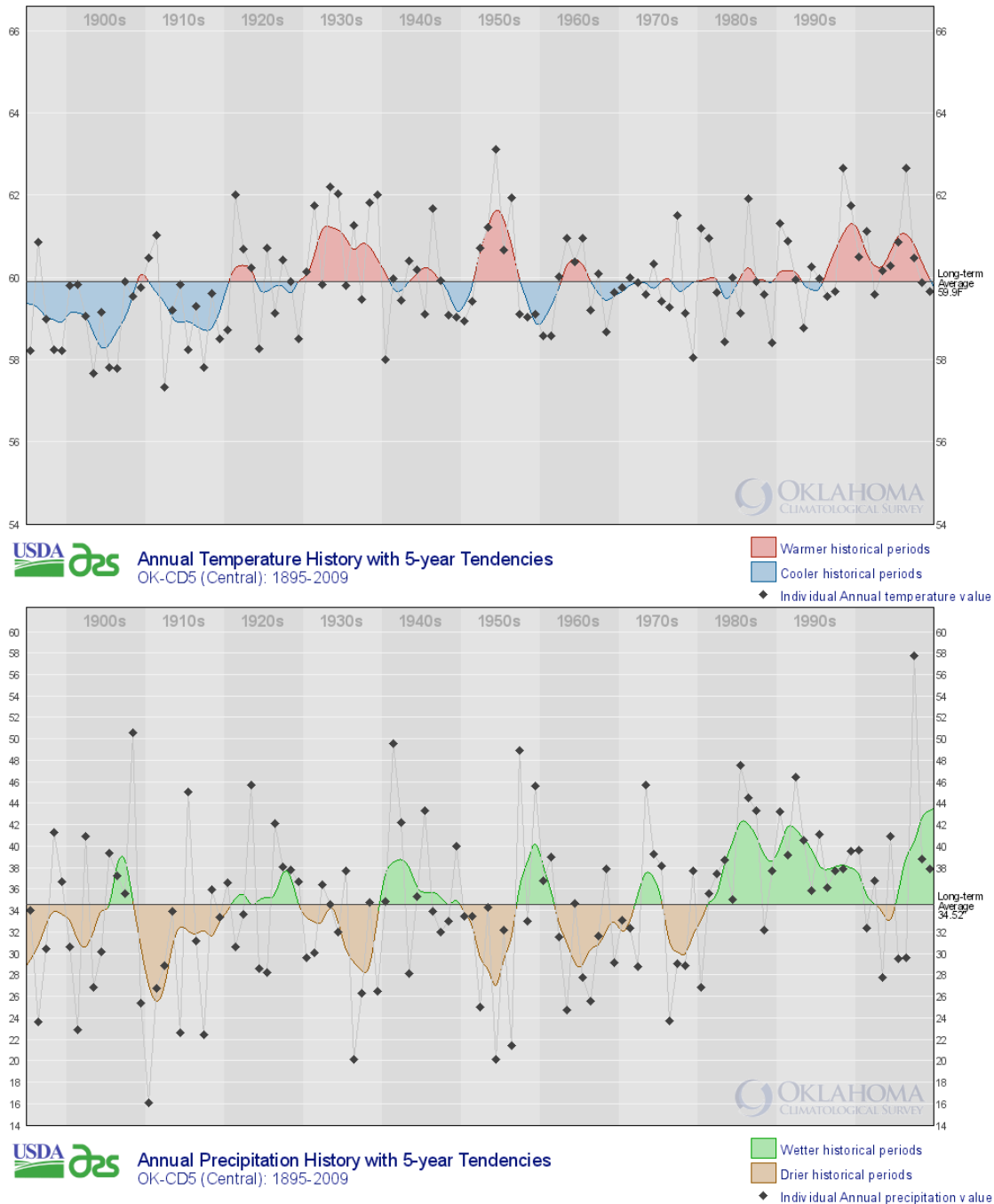


Figure 1. The average annual temperature (top graph) and total annual precipitation (bottom graph) in central Oklahoma from 1895 to 2009. To highlight warmer, cooler, wetter, or drier periods, 5-year moving averages are shaded. On the top graph, red shading (above the horizontal line) indicates warmer periods and blue shading (below the line) notes cooler periods than average. Similarly, on the bottom graph, green shading (above the horizontal line) highlights wetter periods and brown shading (below the line) highlights drier periods than average. Extended periods of relatively warm temperatures or low precipitation are outlined in red boxes.

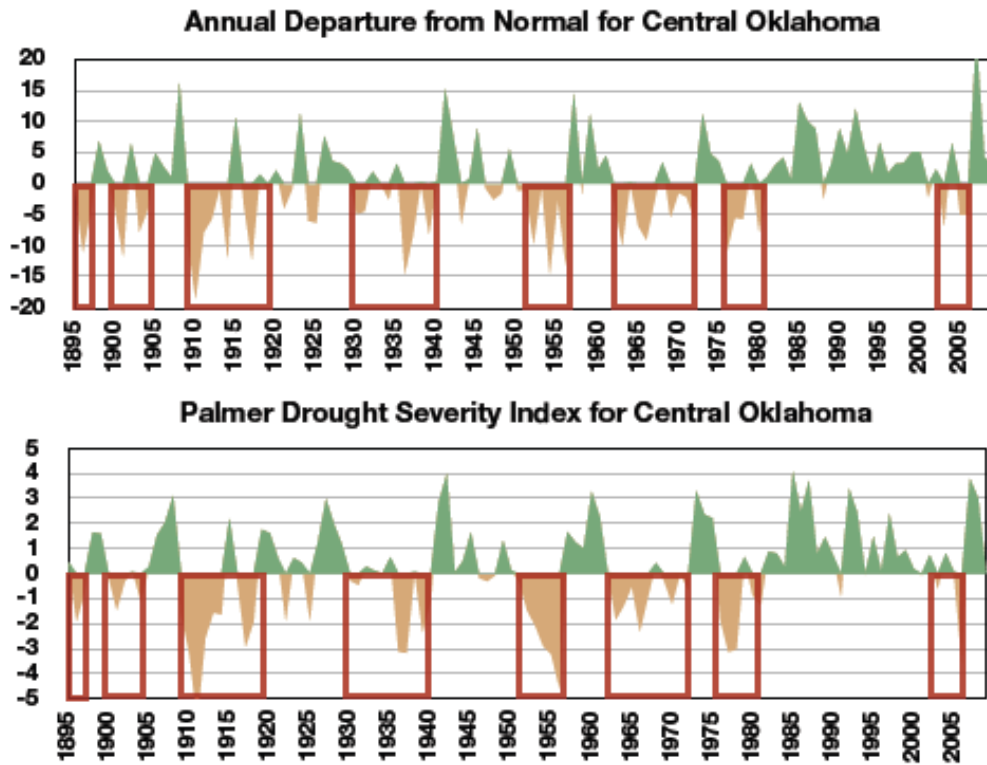


Figure 3. Top graph: Annual departure from normal precipitation (actual precipitation total for the year subtracted from the annual normal) for central Oklahoma from 1895 to 2009. Bottom graph: Palmer Drought Severity Index for central Oklahoma from 1895 to 2009. Red boxes outline the same drier-than-average periods highlighted in Figure 1.

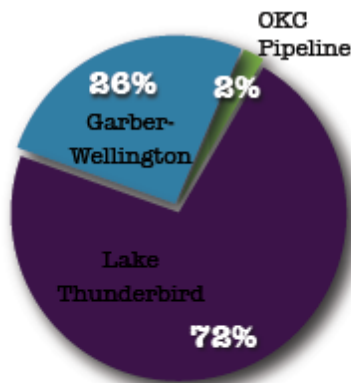


Figure 4. Sources of water for the City of Norman and its customers. On average, 72% of the water supply is from Lake Thunderbird (dark violet), 26% from the Garber-Wellington Aquifer, and 2% from the Oklahoma City pipelines.

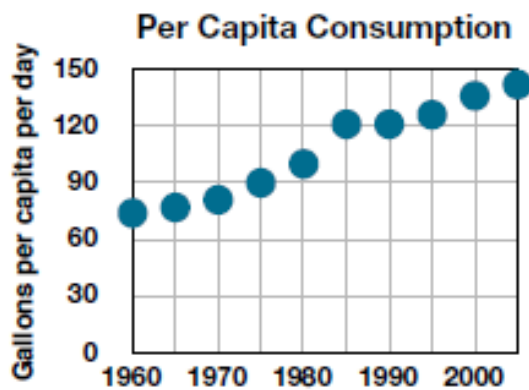


Figure 9. Daily water consumption per person from 1960 to present. Data courtesy of the City of Norman (Water Conservation Plan 2006).

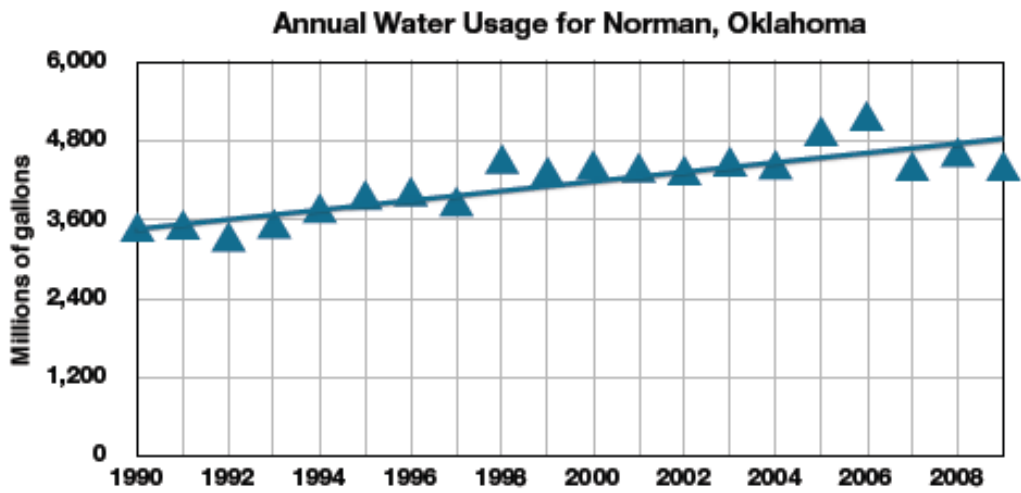


Figure 10. Annual water usage (in millions of gallons) for Norman from 1990 to present. Data courtesy of the City of Norman. The line depicts the average increase in water usage over the past two decades.

Appendix C. Examples of Drought Response Actions

Broad-spectrum Drought Resources

Drought Plans that Discuss Response Actions

1. The *Navajo Nation Drought Contingency Plan* has a section on Drought Mitigation (p. 50) that recommends short- and long-term actions for responding to drought and reducing impacts. Topics discussed include drought monitoring, domestic water hauling, public drinking water systems, irrigators and dryland farmers, ranchers (establishing a grazing policy, improving range management, reliability of livestock supplies), recreation, wildlife and forestry (fire prevention, forest restoration), and reuse of treated effluent.
 - http://drought.unl.edu/plan/Navajo_drought_pln2003.pdf
2. The *County Drought Mitigation Strategies* for all four counties in Hawaii provide examples of drought response actions implemented and being planned in relation to wildfire, agriculture and commerce, and water supply. Topics related to **wildfire** include conducting controlled burns, education programs, constructing firebreaks, modifying building codes, identifying helicopter-accessible water sources, closing forest areas, weather stations, and burn bans. Topics related to **agriculture and commerce** include repairing/upgrading ditch systems and water pumps, ag conservation programs, alternative irrigation techniques, crop selection, and developing a Green Business Program. Topics related to **water supply** include education programs, water restrictions, water metering, leak detection programs, rebate programs, water efficiency standards, supplementing water supplies, modified water rate structures, and system interconnections.
 - <http://hawaii.gov/dlnr/drought/preparedness/KauaiDroughtMitigationStrategies.pdf>
 - <http://hawaii.gov/dlnr/drought/preparedness/OahuDroughtMitigationStrategies.pdf>
 - <http://hawaii.gov/dlnr/drought/preparedness/MauiDroughtMitigationStrategies.pdf>
 - <http://hawaii.gov/dlnr/drought/preparedness/HawaiiDroughtMitigationStrategies.pdf>
3. The *Denver Water Drought Response Plan* discusses a Drought Communication Program, which contains three major components: public involvement, customer information, and media relations (p. 42). The plan also addresses internal communication.
 - http://www.denverwater.org/docs/assets/DD1F807E-BCDF-1B42-D5B4FD4EB681A7B3/drought_response_plan1.pdf

Drought Planning Guides

4. The *California Urban Drought Guidebook (2008)* provides specific examples of community supply augmentation and demand reduction strategies. Table 2 (p. 43) provides water augmentation methods and examples. Pages 42-64 focus on demand reduction options, including public information campaigns, landscape irrigation schedules, water restrictions and ordinances (for waste water, landscaping), modified water pricing, and tips for enforcement. Table 11 (p. 77) provides demand reduction measures by customer category (residential, commercial and institutional, industrial, new connections).
 - <http://www.cuwcc.org/WorkArea/showcontent.aspx?id=9740>

5. The *How to Reduce Drought Risk (1998)* document contains an appendix (p. E-1) with an at-a-glance list of potential drought risk reduction actions. Topics listed include assessment, legislation and public policy, water conservation/demand reduction, water supply augmentation, economic development, public education and participation, health and nutrition, media participation, conflict resolution, drought plans, technical assistance, and emergency response.
 - <http://drought.unl.edu/plan/handbook/risk.pdf>
6. *Dealing with Drought: A Handbook for Water Suppliers in British Columbia (Updated 2009)* discusses strategies to prepare for drought and minimize drought impacts primarily for water suppliers. Topics discussed include preparing drought management plans, improving water use efficiency, and communication and education. Also included is a matrix identifying appropriate responses for varying levels of drought (p. 14).
 - http://www.env.gov.bc.ca/wsd/public_safety/drought_info/cabinet/drought_handbook_2009v2.pdf
7. Section 6 (p. 41) in *Managing Water for Drought: A National Study of Water Management During Drought (1994)* discusses long-term (strategic) and short-term (tactical) response measures adopted by communities to address water supply and demand impacts. Table IX (p. 49) shows a list of typical strategic and tactical measures.
 - <http://www.iwr.usace.army.mil/docs/iwrreports/94nds8.pdf>
8. The *Executive Summary of Lessons Learned From the California Drought (1987-1992)*, published by the U.S. Army Corps of Engineers in 1995, includes a thorough overview of the progression of the drought, indices used to measure it, impacts, and executive orders/responses and their effectiveness during the California drought from 1987 to 1992.
 - <http://www.iwr.usace.army.mil/docs/iwrreports/94-NDS-6.pdf>
9. In 2001, a group of water resources managers and other decision makers in the Puget Sound area attended a workshop focused on regional drought preparedness. The *Final Summary of Workshop* outlines the lessons learned from that event.
 - <http://www.ecs.umass.edu/waterresources/projects/seattlevde2000/summary.htm>

Focused Drought Resources

Monitoring Plans

1. Monitoring and communicating drought conditions is a critical part of drought preparedness. The Arizona Department of Water Resources Drought Program does an excellent job disseminating drought status information to the public. Below are links to their Drought Status webpage, an example of their monthly status document, and an example of their annual report.
 - <http://www.azwater.gov/AzDWR/StatewidePlanning/Drought/DroughtStatus.htm>
 - <http://www.azwater.gov/AzDWR/StatewidePlanning/Drought/documents/aprildroughtstatusupdate.pdf>
 - <http://www.azwater.gov/azdwr/StatewidePlanning/Drought/documents/2009DroughtPreparednessAnnualReport.pdf>

City Drought Ordinances

2. San Antonio, Texas – Drought-tolerant Grass Ordinance:
 - <http://www.saws.org/conservation/ordinance/turfgrass/>
3. City of San Marcos, Texas – Drought Response Ordinance:
 - <http://www.ci.san-marcos.tx.us/departments/WWW/Docs/DroughtResponseOrdinance-Feb2009.pdf>
4. Eastern Municipal Water District (western Riverside County, California) – Water Shortage Contingency Plan (Ordinance No. 117.2):
 - <http://www.emwd.org/news/ordinances/Ord117.2.pdf>
5. Redwood City, California – Recycled Water Use Ordinance 2335:
 - http://www.ci.redwood-city.ca.us/publicworks/pdf/Recycled_Water_Ordinance_Info_Sheet_6-20-08.pdf

Ordinance information for the public:

- <http://www.ci.redwood-city.ca.us/publicworks/water/recycling/index.html>

Agriculture

6. *Grazing Animal Performance Under Drought Conditions* is an article discussing stocking strategies and animal performance during a drought. Along with background information about the impact of reduced forage quality on animal performance, the article lists destocking strategies aimed at maintaining herd performance.
 - <http://www.wyorange.net/Drought/anperf.html>
7. Financial Drought Assistance - Numerous financial assistance programs are available to help farmers and ranchers affected by drought. Assistance can be in the form of loans, grants, technical assistance, and other disaster assistance programs. The resources below provide information related to federal assistance. State and local programs may be available in some areas too.
 - <http://www.wyorange.net/Drought/droutaid.html>
 - <http://www.fsa.usda.gov/FSA/webapp?area=home&subject=diap&topic=landing>
8. Grazing productivity - Forage production can be greatly affected by drought conditions, leading to decreased animal health and productivity. The following resources provide livestock management options and grazing techniques to help manage forage production during drought and after. Topics discussed include selecting appropriate herd size, grazing rotations, subdividing pastures, re-seeding, weed control, and more.
 - <http://www.wyorange.net/Drought/mgthdrot.html>
 - <http://www.wyorange.net/Drought/offearly.html>
 - <http://www.ext.colostate.edu/pubs/natres/06112.html>

9. *Drought Resistant Soil* discusses background information on soil quality and techniques for improving soil quality and reducing erosion.
 - <http://attra.ncat.org/attra-pub/drought.html>
10. The Drought Planning and Management website, maintained by the University of Wyoming Cooperative Extension Service, is a collection of publications, presentations, and links focused on helping agricultural producers cope with drought. Strategies related to plant management, crop selection, livestock management, and financial assistance during drought are provided.
 - <http://www.wyorange.net/Drought/drought.html>
11. Planning for Drought on the Ranch is a website developed by the NDMC and their partners to help ranchers prepare for, respond to, and recover from drought. Included in this website is guidance for developing a drought plan, background information about drought, and strategies to employ before, during, and after a drought.
 - <http://drought.unl.edu/ranchplan/>

Fire Control and Safety

12. The Federal Emergency Management Agency (FEMA) has prepared a number of resources related to wildfire preparedness and response. Below are links to two FEMA guides: *Prepare for a Wildfire* and *What to do Before a Wildfire*. Included are tips for creating a fire safety zone and clearing brush and debris from around the home along with evacuation preparation.
 - http://www.fema.gov/hazard/wildfire/wf_prepare.shtm
 - http://www.fema.gov/hazard/wildfire/wf_before.shtm
13. The Firewise Communities program is a national, multi-agency effort to help communities reduce fire risk and effectively plan fire responses. The Firewise Communities website includes a section called “Firewise You Can Use”, which includes interactive modules , how-to guides, and other resources that can help a community prepare for and respond to wildfire.
 - <http://www.firewise.org/>
14. DisasterSafety.org: Wildfire is a website from The Institute for Business and Home Safety focused on providing resources to help homeowners, farmers and ranchers, and business owners reduce their risk of wildfire.
 - http://www.disastersafety.org/text.asp?id=wildfire_main
15. *Water Supply Sources For Berlin Township Fire Department* is a document highlighting the results of a research project that analyzed water supply source options for firefighting in Allenton, Michigan. Included in this study was a review of various water supply sources in use throughout the United States (p. 7-11). Sources include cisterns, ponds, static suction sources, pressurized systems, and others.
 - <http://www.usfa.dhs.gov/pdf/efop/efo35785.pdf>

16. A low-flow firetruck/hose is one example of maintaining firefighting ability while also conserving water resources.
- http://www.ccs-cobra.com/en/utrustning_sprint_eng.asp

Landscaping/Irrigation

17. *Turf and Landscape Irrigation Best Management Practices (2005)* aims to help policy makers and professionals save water and protect water quality. Relevant topics include irrigation system design, installation, maintenance, and management. Also discussed are irrigation efficiency, deficit irrigation techniques, drought planning, and more.
- <http://www.irrigation.org/WorkArea/DownloadAsset.aspx?id=1142>
18. *Drip Irrigation for Home Gardens (2005)* is a factsheet from Colorado State University Extension aimed at helping homeowners understand the benefits and uses of drip irrigation. Topics discussed include pros/cons of drip irrigation systems, design and installation, operation, and maintenance.
- <http://www.ext.colostate.edu/pubs/garden/04702.html>
19. *Improving Drought Tolerance in Your Florida Lawn* is a short document to help homeowners prepare their lawn for a drought. Specific topics covered include irrigation techniques, mowing practices, pest control, fertilization, and selecting turfgrass species.
- <http://www.tbwg.org/water/improving%20lawn%20drought%20tolerance.pdf>

Water Delivery

20. During drought situations, low pressure in a water system can lead to backflow. The American Backflow Prevention Association's FAQ discusses backflow, why it can be dangerous, and what can be done to prevent it.
- <http://abpa.org/faq.htm>

Conservation

21. The *California Water Efficiency Plan (20x2020)* describes a variety of practices (pp. 15-25) that can be employed to help reduce residential/commercial water use and increase water use efficiency. These practices include but are not limited to setting efficiency standards, retrofitting appliances, efficient landscape irrigation practices, recycled water use, and other best management practices.
- <http://www.water.ca.gov/wateruseefficiency/sb7/docs/20x2020plan.pdf>
22. Eartheasy: Solutions for Sustainable Living has developed a list of 25 ways to conserve water in the home and yard.
- http://www.eartheasy.com/live_water_saving.htm
23. WaterSense is an EPA-sponsored program aimed at promoting water use efficiency. Their website contains numerous resources to help consumers decrease indoor and outdoor water use, including information on water efficient products and practices, rebate programs, a water use calculator, and more.
- <http://www.epa.gov/watersense/index.html>

Greywater Use

24. Oasis Design has a website devoted to discussing greywater, with links to research, information about greywater, and designs for greywater systems.
 - <http://www.oasisdesign.net/greywater/index.htm>

25. The Cooperative Extension Service at New Mexico State University has a publication that discusses the safe use of greywater.
 - http://aces.nmsu.edu/pubs/_m/m-106.pdf