DROUGHT RESPONSE AND **RECOVERY**

A Basic Guide for Water Utilities

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Overview and Navigation

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EPA

DISCLAIMER

This Guide provides practical solutions to help drinking water utilities respond to and recover from drought. This Guide is not intended to serve as regulatory guidance. Mention of trade names, products or services does not convey official U.S. Environmental Protection Agency (EPA) approval, endorsement or recommendation for use.

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OVERVIEW AND NAVIGATION

DROUGHT AND UTILITIES

Many states have experienced prolonged periods of abnormally dry or unusually hot weather that threaten the availability of water. This trend is projected to continue. Unlike other hazards, such as flooding and earthquakes, droughts develop gradually over months or years — and it may take an affected community or water utility just as long, if not longer, to recover.

Droughts can result in significant economic, social, environmental and water utility operational impacts, including:

- Loss of water supply.
- Poor source water quality that may affect treatment and the ability to meet drinking water standards.
- Stressed alternative and supplementary water sources due to high demand by other drought-affected users.
- Increased demand from customers.
- Increased costs and reduced revenues related to drought response.

WHAT IS DROUGHT RESILIENCE?

For water utilities, drought resilience is the ability to respond to immediate water supply threats, withstand drought impacts and recover quickly. Recovery includes considering long-term conditions and planning for permanent solutions. All utilities should plan to make their systems more resilient to the impacts of drought. This Guide can help utilities respond to and recover from drought.

Drought-resilient utilities:

- Take action to protect human health and the environment, while maintaining a minimum level of service for customers during drought.
- Manage decreases in water supply, increases in water demand and changes in water quality.
- Plan for future changes in weather and climate patterns that can reduce water supply.

Although drought is usually a prolonged and slow-moving disaster, impacts can sometimes escalate suddenly and cause water supply disruptions in a matter of weeks. That is why it is crucial for water utilities to have an emergency response plan for severe drought conditions, in addition to longer-term strategies to cope with declining water supplies.

Drought response includes taking immediate actions to maintain service to customers by increasing supplies and reducing water use. This involves ensuring water for essential services such as medical care, fire protection and general health and sanitation. For the purposes of this Guide, drought response actions are taken when a utility projects that their water supply may run out within 180 days (6 months).

OVERVIEW AND NAVIGATION (Continued)

Once drought conditions have lessened, utilities can begin drought recovery activities to restore service to previous or newly adjusted operating conditions. These activities may include lifting water use restrictions, replenishing water supply sources and regaining financial stability. Utilities can also explore incorporating new practices, projects and other mitigation measures into day-to-day operations to be less vulnerable to and better prepared for the next drought.

WHY DID EPA DEVELOP THE DROUGHT RESPONSE AND RECOVERY GUIDE?

EPA developed this Guide to help drinking water utilities become more resilient to drought. The Guide presents real-world examples, best practices and lessons learned in drought response and recovery.

Drought response and recovery activities in this Guide cover:

- **Staffing, Response Plans and Funding.** Establish staffing and drought response teams; develop drought response plans; consider funding and financing options.
- **Water Supply and Demand Management.** Estimate quantity of current water supplies; develop ways to reduce water use; identify potential supplemental water supplies.
- **Communication and Partnerships.** Establish and communicate key messages to customers and stakeholders; develop partnerships.

When working through the Guide, consider how the suggested actions may be adapted to your utility's priorities and available resources.

Note that your state may have specific rules prohibiting or regulating some of the response actions presented in this Guide. Check with your state regulators or legal counsel before putting any activities into practice.

Utilities can use this Guide as a preparedness tool if they are not currently experiencing a drought. To increase resilience to future droughts, utilities should have an effective year-round Water Conservation Program and Drought Response Plan in place prior to a drought. Actions taken before a drought occurs, such as implementing a leak detection and repair program, can increase available supplies and be more cost effective in the long term.

NAVIGATING THE GUIDE

The Guide is divided into four sections:

- **Staffing, Response Plans and Funding**
- **Water Supply and Demand Management**
- **Communication and Partnerships**
- **Case Studies and Videos**

Navigate within and between sections using the clickable links on the far left and buttons on the navigation bar at the bottom of each page. Click Next ▶ or ◀ Previous to move page by page through the Guide.

Section features:

- Call-out boxes highlighting best practices and real-world examples.
- Web links for learning more about specific topics.
- Easy-to-use worksheets for specific activities.

Note that all of the worksheets and links embedded throughout the guide, as well as additional resources related to drought response and recovery, can be found by clicking on "Resources" at the bottom of each page.

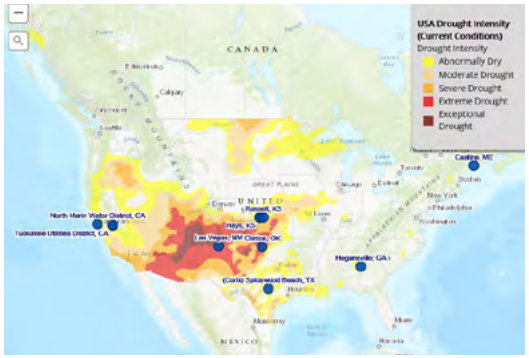
Navigate directly to the Case Studies and Videos section for more detail on the six case studies showcasing seven utilities that successfully responded to drought. Their best practices and real-world examples are referenced throughout the Guide. The Case Studies and Videos section will link you to the "Drought Response and Recovery Project for Water Utilities: Case Studies Map." This website features a geoplatform map that hosts short videos on each case study.

In addition to the six case studies, videos on the site also cover:

- System efficiency and new water sources
- Water demand
- Partnerships

WORKSHEETS

Look for this icon to open worksheets in Microsoft Word and Excel. You can fill in the worksheets and save the information to your computer.



Drought Response and Recovery Project for Water Utilities: Case Studies Map

VIDEOS

Clicking on these video icons will take you to the EPA's Drought Response and Recovery Project for Water Utilities: Case Studies Map website to view short videos.

You must be connected to the Internet to be taken to the website. The website features all the videos referenced in this Drought Guide. Click on the tabs at the top of the Case Studies Map website to browse through the videos. The Overview tab explains how to use the map.

STAFFING, RESPONSE PLANS AND FUNDING

DROUGHT RESPONSE TEAM

Drought response will involve internal coordination with utility staff and external collaboration with other partners and stakeholders. Designate a utility staff member to lead and coordinate drought response and planning activities. This person will put together a drought response team, which will include staff members who are involved in the management of the water system. For many smaller utilities, this may include the utility operator, city manager and city clerk. Other team members may include public information specialists, conservation coordinators, finance managers or legal counsel. This team will work with public and private partners and stakeholders throughout the drought response.

BEST PRACTICE: Establish a drought response team with utility staff knowledgeable in operations, communications, regulatory requirements, legal impacts and financial planning. Engage with operators often.

- **Tuolumne Utilities District, California.** The water utility's General Manager convened their drought response team — including the District Engineer, Water Master (Operations Manager) and Public Relations Manager — to evaluate conditions, explore water management and water supply options, formulate recommendations to the Board and implement suggested actions. Engaging this team in weekly meetings provided a way to jointly define the problem and ensured staff members were coordinating with each other and working together effectively.

Use Worksheet 1 to develop a list of drought response team members.

UTILITY STAFFING

Drought response activities may take priority over other routine tasks and maintenance, and can increase staff workloads. Overtime expenses may increase, which can impact the overall budget. During a drought, utility staff may need to:

- Respond to increased customer calls.
- Enforce water restrictions and respond to variance requests.
- Communicate regularly with local media and the public.

Consider hiring temporary staff or contractors, reassigning staff or requesting resources from your Water/Wastewater Agency Response Network (WARN).

After the Drought:

- Write an after action report that describes effective drought response actions and areas that could be improved.
- Identify new standard operating procedures for future water shortages and for routine operations.
- Keep your drought response team active by conducting drought preparedness activities.

DROUGHT RESPONSE PLANS

Utilities should have a drought response plan that establishes drought stages, designates readily identifiable drought triggers, sets reduction goals, describes water use restrictions and outlines enforcement provisions. In many states, drought response plans are required.

- **Develop or review your existing plan.** Are the conservation measures, demand restrictions and response actions adequate to respond to current drought conditions? Is the plan flexible enough to give your utility and its governing body the ability to declare a specific drought stage if unforeseen conditions occur? If not, you will need to revise your plan.
- **Check with local and state government officials, as well as your wholesale water providers.** Do they have an existing drought response plan you can leverage, or do they have requirements for utility drought response plans?

Use Worksheet 2 to help update or develop your drought response plan.

Use the Drought Response Plan Template to develop a complete drought response plan for your utility.

The following key topics should be included in your drought response plan:

- **Drought Stages and Triggers.** Drought stages define actions required to respond during various phases of drought severity. For example, Stage 1 could be to limit outdoor water use. Triggers are indicators that activate the drought stages. A trigger could be defined as reservoir or groundwater well levels dropping a number of feet within a certain time period or to a specific water level.
- **Water Use Reduction Goals.** Reduction goals can be expressed as percentage reductions from "normal" use or as reductions of a specific quantity in acre-feet or million gallons per day (MGD).
  - Have a clear understanding of what "normal" use is and update this definition at least every 5 years.
  - Monitor water use frequently to see if reduction goals are being met and adjust the plan as necessary. You may want to read meters of key customers or large water users more frequently to track their usage and ability to meet reduction goals during the drought.
- **Water Use Restrictions.** Restrictions are often designed to first reduce or eliminate nonessential uses such as outdoor watering, followed by more severe restrictions, as necessary.
  - Some utilities establish a per-person or per-household allocation (gallons per month), allowing customers to determine how they want to reduce their use to meet the allocation. Consider adding customer variance or appeal provisions for special circumstances.
  - Understand what your utility can achieve from certain water restrictions. If outdoor water use has gone down over the last decade, the potential savings from outdoor water use restrictions will need to be reduced from previous projections.
  - There is usually a time lag of a few months from when mandatory restrictions are announced and when customers actually reduce their water use. Factor this into your plan.
- **Enforcement Provisions.** Drought restrictions can be enforced through educational warnings, code enforcement citations, police tickets, fines, fees, surcharges and water service disconnections.
  - Verify enforcement procedures with legal staff, as some states may have statutory limits on allowed methods.

BEST PRACTICE: Establish a drought response plan that includes trigger levels and water use reduction measures. Develop a clear but flexible plan, including specific reduction goals and restrictions to address current and anticipated conditions. Do not wait for an emergency to occur before you develop a plan.

- **City of Russell, Kansas.** During 8 of the last 12 years, Russell declared Stage 3 or 4 of drought management. Having a drought response plan that clearly defines drought triggers and response actions for four drought stages helps their customers be prepared and enables them to take actions quickly when drought occurs.

After the Drought:

- Revise your drought response plan based on lessons learned, considering the following:
  - Did the drought stages, triggers and demand reduction measures achieve the anticipated results?
  - Were the demand reduction measures too prescriptive, or did they not provide enough direction to customers?
- Incorporate drought resilience plans or projects into multiyear capital improvement plans and budgets.
- Conduct a debrief with utility staff and partners shortly after the drought to discuss the effectiveness of and improvements to response activities.

TRAINING AND EXERCISING ON DROUGHT RESPONSE

Train all staff on drought impacts and response procedures by holding tabletop exercises or walking through drought response plans and procedures. Provide up-to-date information to office and customer service staff as well as operators. Invite representatives of the following entities to the exercises: nearby utilities, large water users, fire departments, emergency operations coordinators and other partners that will have a significant role in the drought response. Local emergency managers can help utilities develop and facilitate tabletop exercises.

BEST PRACTICE: "Practice the drought" with key staff in the utility or with external stakeholders to uncover the operational difficulties and details associated with drought contingency strategies before the next crisis begins.

- **(Corix)[1] Spicewood Beach Water System, Texas.** The utility's drought response plan included trucking water in as a back-up water supply. During the 2011 – 2012 drought, however, they had difficulty finding potable water-certified trucks and hauling routes with roads rated for the trucks' filled weight. They learned the importance of having a "Plan B," and the utility plans to conduct regular emergency preparedness exercises with key personnel.
- **Tuolumne Utilities District, California.** The District routinely participates in focused emergency response tabletop exercises with other local, county and state agencies. Each exercise focuses on a different scenario so participants can develop solutions for specific problems.

[1] *Corix is an investor-owned water company that purchased the Spicewood Beach Water System from the Lower Colorado River Authority in 2014.*

After the Drought:

Schedule an annual tabletop exercise to practice different drought scenarios. Potential topics include:

- Requirements for hauling potable water, including availability of tanker trucks, hauling routes, truck disinfection, maintenance and operational procedures for introducing water into the system.
- Identifying additional water sources or operational changes to expand water supplies.
- Procedures for communicating with customers and large water users.

FOR MORE INFORMATION ON EXERCISES, VISIT:

- U.S. EPA's Tabletop Exercise Tool for Water Systems: Emergency Preparedness, Response, and Climate Resiliency
- U.S. EPA's Workshop Planner for Climate Change and Extreme Events Adaptation

FUNDING AND FINANCING CONSIDERATIONS

Utility budgets can be significantly impacted during drought due to declining revenues from reduced water use and increasing costs of operations and drought response activities. These financial impacts can continue for an extended period of time, even after the drought has ended.

At the start of your drought response, estimate these losses and increased expenses for budget planning, so you can maintain critical services.

Use Worksheet 3 to put together an overall work plan and timeline for drought response activities.

BEST PRACTICE: Partner with local and regional entities to leverage available state and federal funds to reduce the impacts of rate increases on your customers.

- **(Corix) Spicewood Beach Water System, Texas.** The utility worked with their county judge and state officials to fund water supply projects. The county was awarded a $350,000 grant by the Texas Department of Agriculture, which made disaster relief funds available for drought projects.

Consider the following funding sources to help recover revenue and offset losses:

- **Conservation rate structure.** Tiered or base-excess use rates that are higher for greater volumes of water used encourage water conservation. Engage with large water users and community representatives before changing a rate structure to prepare customers for new rates. You may want to consider a rate structure design that recovers most of your utility's fixed costs in the base rate, while still ensuring that the rates are affordable for all customers.
- **Emergency pricing or surcharge.** This includes usage rates that can be applied as consumption increases, or rates that can be increased as the drought worsens. Work with your state to see if this type of charge is possible and what the approval process would be. In some states, these approvals can take months.
- **Dedicated conservation or drought response fund.** This includes a "set-aside" fund for conservation efforts or as a reserve fund for revenue stability during drought.
- **Dedicated sales tax.** A portion of sales tax revenue could be applied to drought response and resilience activities. Work with your state to see if this is possible for your city.
- **State funding.** This category includes available funds for emergency response, water planning, conservation, economic development or innovative technology. Check with your local, county or state officials to see if these funds are available and to help you with accessing them. Coordinate with officials to see if the governor can declare an emergency to access emergency response funds or request resources or other assistance.
- **Federal funding.** This includes grant or loan programs from federal agencies, including EPA's State Revolving Fund, Federal Emergency Management Agency's (FEMA's) Hazard Mitigation or Public Assistance Programs, and the U.S. Department of Agriculture's Rural Development Loan & Grant Program. Check agency websites or with local officials for eligibility requirements and applications.
- **Other assistance.** Mutual aid programs (such as WARN) or water sector associations, such as the National Rural Water Association, could provide in-kind services to help with:
  - Repairs, such as to line breaks due to shifting dry ground.
  - Resource loans for personnel (such as extra operators) or equipment (such as generators, pumps, water hauling trucks or portable treatment plants).

Utilities may be able to find local training opportunities on general financial management and rate setting to learn how to build reserves.

BEST PRACTICE: Implement a rate structure that will stabilize revenues to cover your fixed costs, but has conservation pricing (tiered and seasonal rates) to send a pricing signal to help reduce demand. Explore the option of adopting special drought rates.

- **(Corix) Spicewood Beach Water System, Texas.** The utility adopted a tiered rate approved by state regulators to encourage water conservation. The base rate covered approximately 80 percent of the utility's fixed costs, with the demand charges covering the rest; this provided revenue stability during the drought, when water demand was reduced.
- **City of Hogansville, Georgia.** The city promotes conservation year round through a tiered rate structure with higher water rates assessed for higher volumes of use. This rate structure also provided revenue stability for the city as customers' water demand dropped during the drought.

BEST PRACTICE: Supplement revenue from water rates with other sources of funding.

- **City of Clinton, Oklahoma.** Clinton residents passed a referendum authorizing the city to collect a half cent sales tax dedicated to funding a proposed groundwater project that would supplement their surface water supplies. The sales tax will increase in 4 years by an additional half cent.

After the Drought:

- Revenue recovery can be difficult, as water use may never come back to pre-drought levels. Working with local, county and state officials may help secure funding and technical assistance if you implement large projects to build longer-term drought resilience, such as new groundwater wells and interconnections.
- Continue to engage with state officials to get approval for a surcharge (if required), so that you will be able to activate it if needed during future droughts.

FOR MORE DROUGHT FINANCING INFORMATION, VISIT:

- U.S. EPA's Federal Funding for Utilities — Water/Wastewater — in National Disasters (Fed FUNDS)
- FEMA Climate Resilient Mitigation Activities Exit
- Alliance for Water Efficiency's "Financing Sustainable Water"

WATER SUPPLY AND DEMAND MANAGEMENT

Click on the video icon to go to the Drought Response and Recovery Project for Water Utilities: Case Studies Map to watch videos about utility water supply and demand actions.

During a drought, management actions for water supply and water demand should occur at the same time. Key actions include determining:

- How much supply is available.
- How to improve system efficiency.
- How to reduce customer demand.
- How to identify additional water supplies, if needed.

DETERMINE WATER SUPPLY AVAILABILITY

Understanding the conditions and characteristics of your water supplies is important, but it is critical during drought. During extreme drought, your utility should increase monitoring and look for changes every day. Start regularly monitoring water supplies and production capabilities and develop supply projections. Inexpensive well-sounding equipment to monitor groundwater levels may be an option for systems with groundwater sources. Monitoring weather forecasts can help you understand how long your water supply will last if the drought persists or worsens.

The following local, regional, state and federal resources may track water supply conditions and drought forecasts in your area:

- Neighboring water and power utilities.
- State water agencies.
- Local or regional water supply agencies, conservancy districts, groundwater management districts or river authorities.
- U.S. Geological Survey or reservoir owners and operators such as the U.S. Army Corps of Engineers or U.S. Bureau of Reclamation.

For many utilities, accessing available water becomes a challenge. In this case, consider the following measures:

- Constructing floating intake structures in rivers or reservoirs.
- Installing temporary low-head dams to increase water levels.
- Lowering a groundwater well pump.
- Rehabilitating or deepening an existing well.
- Adjusting well cycle time to allow for water level recovery.

Check with regulatory authorities to find out if you need a variance or permit to implement any of these measures until the drought emergency is over.

Be sure to increase sampling of source water during drought to continuously monitor water quality. Higher temperatures, low flows, changes in the watershed and dropping surface and groundwater levels can change water chemistry. These changes may require adjusting the treatment process to meet drinking water regulations. You should also increase sampling in distribution and storage to check the age of finished water.

BEST PRACTICE: Increase frequency of water supply and well production monitoring to detect changes in supply availability and forecast availability, if drought conditions persist or worsen.

- **Tuolumne Utilities District, California.** Throughout the fall and spring, the utility uses precipitation forecasts and snow surveys from national and state sources, such as the National Oceanic and Atmospheric Administration, National Weather Service and California Department of Water Resources, to estimate available water supply before peak summer use.

Use Worksheet 4 to estimate available water supply at your utility. The worksheet can be used for surface water and groundwater.

After the Drought:

- Continue or increase monitoring activities to maintain a full awareness of the condition of your water supply.
- Develop a plan to implement projects that address your long-term needs so your utility is more resilient to future droughts.

FOR MORE ON DROUGHT FORECASTING:

- U.S. Drought Monitor Exit
- U.S. Seasonal Drought Outlook Exit
- Snow Telemetry (SNOTEL) Snow Survey & Water Supply Forecasting Exit

IMPROVE SYSTEM EFFICIENCY

Implement measures to conserve water within your treatment and distribution system without affecting drinking water quality or other operational or regulatory requirements. During a drought, it is important to make improvements to your system first to set the example for your customers. Measures could include:

- Reducing pressure throughout all or part of the distribution system, while maintaining necessary pressure for "high priority" users such as hospitals and firefighters.
- Limiting main flushing as much as possible, while still meeting all regulatory requirements.
- Exploring beneficial uses for flushed water, such as irrigation, construction, fire-fighting storage or other non-drinking water uses.
- Recirculating backwash water to the head of your treatment plant.
- Aggressively finding and repairing leaks; consider including the following considerations and actions in your leak detection and repair program:
  - Authorizing overtime for construction crews.
  - Messaging, such as "Find It and Fix It," to immediately repair a leak on the customer side of the meter.
  - Encouraging self-policing by residents to alert the utility of system leaks.
  - Adopting an ordinance that requires customers to repair leaks within 7 days of being notified.
  - Providing a telephone hotline or website for customers to report leaks, with resources tied to field crew work orders to prioritize leak repairs over other maintenance activities.
  - Installing automated meter reading systems that can provide real-time water leak information.
  - Establishing a leak and minor plumbing repair program for low-income households.

BEST PRACTICE: Look for ways to manage your existing supplies through demand management, or modify system operations to increase supplies.

Involve your operators who understand how the system really works; leverage their ideas to reduce initial project costs and long-term operating costs.

- **Cities of Hays and Russell, Kansas.** Enhanced water treatment allows these utilities to blend lower quality groundwater with higher quality water sources, which enables them to use existing wells that would otherwise be abandoned. Both cities also routinely acidize their wells to maximize production rates.
- **City of Hogansville, Georgia.** The city has maintained many of the demand management practices initiated during its 2007 drought, such as reducing the frequency of main flushing and increasing information provided to customers to raise awareness of leaks and water use. Hogansville also installed all new meters citywide with software that provides "real time" water use data that helps them locate system leaks quickly.

After the Drought:

- Continue to implement your leak detection and repair program that ensures a prompt response mechanism for utility staff to make repairs. Prioritize and repair or replace components in the water distribution network that could lead to leaks.
- Look for other ways to use water efficiently throughout your utility or other departments, such as installing low-flow fixtures, retrofitting landscapes and replacing inefficient irrigation systems.
- Initiate a program to conduct annual water loss audits.

FOR MORE INFORMATION ON INCREASING SYSTEM EFFICIENCIES:

- U.S. EPA's WaterSense
- American Water Works Association (AWWA) Water Loss Control Audit Software

IDENTIFY WHERE WATER DEMAND CAN BE REDUCED

To develop demand reduction targets, identify critical water users and uses within your service area and estimate how much water is needed for these purposes. Critical water users could include:

- Hospitals
- Nursing homes
- Schools
- Fire departments
- Power generators
- Major industries, agricultural irrigators and employment centers important to the regional economy

After determining these essential uses, identify and prioritize non-essential uses such as outdoor landscaping, decorative pools, swimming pool refilling and irrigation of recreational facilities. Determine which uses can be reduced or eliminated during certain drought stages.

Collaborate with major water users to identify water-saving measures that they can take without harming their business. To earn their support and trust, be candid with them about current and projected water supplies. Users can often find creative ways to save water and will do so voluntarily, without the need for strict requirements and enforcement. Additionally, notify industrial, agricultural and medical users in advance if you anticipate changes in water quality due to new sources or changes in treatment, so they can change their processes, if needed.

During severe drought, some utilities calculate the amount of water needed for essential indoor uses like toilet flushing, bathing, cooking and cleaning, and allocate monthly water allowances for their customers. Reviewing customer billing data from the winter months may help you determine an appropriate monthly allowance per household.

Use Worksheet 5 to increase system efficiencies and identify water demand management measures.

BEST PRACTICE: Applying water conservation measures is one of the least costly "water supplies" that you can add to your portfolio. It can also help defer capital costs.

- **City of Russell, Kansas.** During the 2005 – 2006 drought, the city engaged its largest industry to reduce its water use. The industry responded with immediate measures that they have continued — resulting in a 63 percent usage reduction over a 10-year period.
- **City of Hays, Kansas**. Initially a drought response measure, conservation is now a year-round focus for the city. They emphasize use of a four-pronged approach — education, pricing, policies and rebates to encourage conservation. During the drought, the city enforces outdoor watering restrictions.

FOR MORE INFORMATION ON REDUCING WATER DEMAND:

- AWWA Drought Portal
- AWWA Conservation and Resource Management
- Alliance for Water Efficiency

After the Drought:

- Designate a water efficiency coordinator to manage and implement treatment and distribution system efficiency measures, and provide public information about water-saving practices to customers. This can be a part-time position and could be held by the same person designated to monitor drought conditions.
- Document how water demand in the system changed during drought response. Look at your production data to estimate the lag time between announcing reduction goals or mandating water use restrictions, and seeing a change in water use. This information can help you revise trigger levels for when mandatory restrictions are established.
- Establish a year-round conservation program that promotes water-saving habits and encourages customers, especially large water users, to adopt water conservation strategies in their day-to-day operations.

Consider including the following water use efficiency measures and programs in a year-round demand management program:

Policies, Service Rule Provisions, Ordinances and Building Codes

- Adopt an ordinance that would prohibit wasting water from sources such as customer leaks, runoff from driveways and sidewalks or irrigation overspray.
- Establish a minimum number of cycles of concentration for cooling towers.
- Establish year-round lawn and landscape irrigation schedules (with set time of day or days per week).
- Establish annual irrigation inspections for automatic sprinkler and irrigation systems.
- Promote the adoption of local building, plumbing, landscaping or other codes that specify water and energy efficiency standards required for new construction, irrigation systems or landscaping.
- Require that leak inspection and repair be conducted prior to property resale or lease.
- Require residential fixture and equipment retrofit or replacement upon property resale or lease.

Demand Management: Potential Conservation and Efficiency Measures

- Offer online or onsite water use and water efficiency check-ups and water-saving tips for your customers (landscapes, irrigation systems and indoor uses).
- Install hydrant locks to reduce water theft after coordinating with and providing training to local fire department responders.
- Set up rebate, distribution or installation programs for WaterSense or ENERGY STAR certified high-efficiency toilets, clothes washers, shower heads, water heaters, irrigation technology or other water-saving appliances. The amount of water savings will be determined by conditions specific to your area. A benefit-cost analysis is recommended prior to implementing any rebate program.

Additional Residential Conservation and Efficiency Measures

- Set up a water softener replacement program.
- Encourage installation of rain or freeze sensors for irrigation systems.
- Establish landscape and turf or irrigation system replacement programs.
- Encourage customers to report or repair leaks on their side of the meter.
- Consider offering incentives to the biggest water savers. Possible incentives include prizes, billing credits or other recognition.

Additional Commercial, Industrial and Institutional Conservation and Efficiency Measures

- Set up rebate, distribution or installation programs for WaterSense or ENERGY STAR certified high-efficiency urinals, commercial dishwasher systems or pre-rinse spray valves, ice machine replacement or similar appliances.
- Implement cooling tower audits.
- Set up a commercial vehicle washing and car wash system replacement program.
- Establish a rainwater capture or condensate reuse incentive program.

IDENTIFY ADDITIONAL WATER SUPPLIES

Setting demand reductions and maximizing existing supplies through operational or management changes may not be enough. In this case, explore the options listed below to obtain additional water. Always check with regulatory agencies to see what is allowed in your state and to understand if existing supplies may already be committed elsewhere.

- Build a pipeline to an existing water supply.
- Engage in bulk water purchases or leases.
- Establish emergency interconnections with nearby water or power utilities.
- Use temporary drinking water distribution centers, where customers can fill containers from portable tanks and haul the water to their homes.
- Haul water from nearby suppliers.
- Blend brackish or lower quality water with higher quality water sources at your existing water treatment plant, or lease portable treatment equipment to demineralize or desalinate the water.
- Enhance treatment of brackish or lower quality water.
- Swap lower quality water with agricultural or industrial users in exchange for raw water that can be treated at existing plants.
- Install a surface water infiltration gallery to access subsurface water flows.
- Raise the dam on small reservoirs or impoundments, or add sandbags to canals to raise water levels to existing intake structures.
- Use abandoned groundwater wells or surface water intakes.
- Acquire or develop unappropriated (unpermitted) groundwater or surface water sources.
- Drill new groundwater wells.
- Enhance aquifer storage and recovery, or enhance reservoir storage.
- Acquire temporary or emergency surface water rights or permits.
- Request temporary authorization from regulatory agencies to reduce water releases from reservoirs to keep more water in storage while still meeting essential flows needed for the environment, hydropower or other downstream uses.
- Reuse water from wastewater treatment plants or water main flushing for non-potable uses, such as landscape irrigation, vehicle washing or non-food crop irrigation.
- Explore the potential for both indirect and direct potable reuse, in accordance with drinking water treatment standards.

For some of these projects, it can take months to acquire the necessary approvals and even longer to complete the design and construction needed to make the source operational. Engage regulatory agencies and local planning organizations so that the design, approval and implementation are coordinated, efficient and compliant with regulatory standards.

Use Worksheet 6 to identify water sources that may be available for your utility.

BEST PRACTICE: Partner with your state's Water/Wastewater Agency Response Network (WARN) or other organizations to implement drought response strategies.

- **City of Las Vegas, New Mexico.** The city worked with the San Miguel County Office of Emergency Management (OEM), to set up a water distribution plan. The county OEM purchased 20,000 gallon portable storage tanks that could be distributed to pre-determined sites if necessary. Through New Mexico WARN, the city of Las Vegas has an agreement to borrow Albuquerque's water tanker trucks for water delivery to the portable storage tanks when needed.

BEST PRACTICE: Explore innovative approaches for water supply options — even those that have not been tried before.

- **(Corix) Spicewood Beach Water System, Texas.** After their alluvial wells stopped producing water, the utility developed the state's first surface water infiltration well gallery to access surface water from nearby Lake Travis through groundwater wells. They worked closely with regulators to develop treatment plant requirements for this supply.
- **City of Clinton, Oklahoma.** As a result of drought, the city plans to increase the number of available groundwater water sources and build a new water treatment plant, and collaborate with the Oklahoma Department of Environmental Quality to dispose of its water treatment residuals (reverse osmosis concentrate) via underground injection control wells, which will allow the utility to use brackish groundwater sources.
- **City of Las Vegas, New Mexico.** The city is exploring ways to increase water storage by: increasing storage capacity of Bradner Reservoir (raising the dam), recovering seepage from around the dam and pumping water back into the reservoir and pursuing an aquifer storage and recovery pilot project.

After the Drought:

- Explore alternative sources and adopt creative strategies for managing existing supplies to enhance long-term reliability.
- Engage with ongoing statewide or regional water planning processes to be sure that your water supply needs and preferred projects are covered by those plans.
- Consider initiating a countywide or watershed-wide water planning process to collaborate on cost-effective and sustainable long-term water supply solutions, so that you are better prepared for the next drought.

COMMUNICATION AND PARTNERSHIPS

Click on the video icon to go to the Drought Response and Recovery Project for Water Utilities: Case Studies Map to watch a video about utility partnership actions.

SHARE CONSISTENT MESSAGES WITH DIFFERENT AUDIENCES

You should develop targeted, simple messages that communicate drought severity and your response steps or actions. The information should clearly state what actions different customers are required to take in each drought stage to meet water reduction goals, and why the restrictions are needed. Plan on communicating frequently with your customers and stakeholders throughout the drought.

- Make your board, council and other decision makers aware of your drought response plan and status of the water supply, so they are ready to make tough decisions that will affect customers.
- Use social media and traditional media, as well as bill inserts, newsletters, door hangers, billboards and road signs.
- Work with local utilities and agencies to make sure that you are all communicating consistent messages.
- Collaborate with neighboring utilities to implement the same water use restrictions so that customers do not get confused — this is especially important if there is more than one water supplier in the area.
- Speak at local organization or club meetings. Open these meetings by giving community members a chance to ask questions about the drought situation and then having your utility provide detailed information.
- Engage major employers, local businesses and county officials to help spread drought-related messages and act as water conservation "models" within the community.
- Ask school and religious leaders, youth groups and service organizations to promote conservation to their students, congregations and members.

BEST PRACTICE: Frequent, frank communication — using all available methods — is critical for getting customers to understand the severity of the drought and encouraging them to reduce water use.

BEST PRACTICE: Know which venues and media your community typically uses to get information, and then gear messages to your target audience using the preferred channels.

- **Tuolumne Utilities District, California.** To ask customers to "please save water," the District used newspapers, radio and television, website updates, customer newsletters, presentations and signage. Partnering with a nearby utility, the Office of Emergency Services and the Tuolumne Band of the Me-Wuk Tribal Council, the District also conducted a joint radio campaign. They did not use social media outlets, as they knew their customers did not get information from these sources.
- **City of Clinton, Oklahoma.** A strong partnership with the local newspaper helped the city provide accurate information about the drought and potential solutions to customers. The city used newsletters, website updates and text messaging to provide drought updates for those customers who subscribed to a notification service similar to a "reverse 911" program that alerts residents of emergencies.

Work with key stakeholders and large water users to help generate ideas for establishing water restrictions that will have minimum impacts on businesses and operations, but still meet water reduction targets. You may also need to work directly with smaller local businesses to prepare them for potential reductions, especially businesses like car washes that may not be operating during extreme drought conditions.

BEST PRACTICE: Keep your messages clear, simple and consistent. Collaborate with other utilities and agencies to share the same message.

- **City of Las Vegas, Nevada.** An extensive outreach campaign by the city called "Our Future is Clear" includes frequent presentations, community meetings and media reports. The campaign uses consistent information and transparent accounting of progress on the city's long-range Water Enhancement Program. As a result of their effective outreach campaign, water use has been reduced by over 26 percent. It is now approximately 50 gallons of water per capita per day for residential customers and 78 gallons per capita per day for overall system usage.

TIPS FOR EFFECTIVE MESSAGING

- Prepare a presentation with talking points that utility staff can use to provide clear, accurate and consistent information to customers and the community.
- Include on your utility website's main page some easily accessible and useful information related to the current drought condition, project updates, conservation tips and how customers can access their own water use data from meters (if available).
- Highlight water saving success stories in newsletters, presentations or on your website.
- Consider translating outreach materials or using a Web-based translator on your website for non-English speaking customers.

After the Drought:

- Coordinate with other local utilities and agencies to announce the end of the drought emergency and water restrictions.
- Keep communicating frequently and frankly with all of your customers about the utility's drought recovery progress, including any changes to rates.
- Communicate the importance of your customers' continued support. Reframe messages from a focus on drought response to a focus on long-term water supply reliability. Continue to stress the importance of conserving water, actions the utility is taking, and actions the public can take. Partnering with EPA WaterSense can provide access to materials that help with communications.
- Engage with large water users and local businesses to help them prepare for the next drought.

FOR MORE INFORMATION ON MESSAGING:

- U.S. EPA's WaterSense
- U.S. EPA's Water Utility Public Awareness Kit
- Alliance for Water Efficiency's "Financing Sustainable Water" Communications Tools

ROLE OF PARTNERSHIPS

If you are in a drought, neighboring utilities are most likely experiencing similar challenges and also looking for solutions. Local and state agencies are also available to provide assistance throughout drought response and recovery. Reach out to local community partners, other utilities and agencies to share ideas and potential ways to save water and to find additional supplies. Utilities that have successfully responded to drought are those that initiated and sustained partnerships with groups such as:

- Other water utilities — exchange ideas, advocate for joint solutions and share media and public information messaging and costs.
- Local, county and state agencies — coordinate drought response activities, apply for funding, share resources and work through regulatory issues.
- Private sector and volunteer organizations such as Master Gardeners, civic groups or green industry representatives (landscaping and irrigation professionals) — share expertise on water-saving landscapes, fixtures and appliances.
- Large water users, watershed management groups, industries and other water rights holders — engage in creative water management ideas, such as managing releases from upstream dams to provide flow for diversion or groundwater recharge, or exchanging reclaimed water for raw water that can be treated for drinking.
- Local cities and fire departments — develop partnerships with neighboring communities to assist with water storage for fire-fighting, and enforce burn and fireworks bans.

Some drought response actions will require approvals from different local, state or federal organizations. For example, a new or changed water right, water treatment plant or water supply construction project is likely to require permits or approvals. In some states, approvals are needed for emergency water rates, water use restrictions or enforcement authority. Get decision makers from these organizations together in one room to work through issues. Come to the table with a full understanding of the regulations and requirements. You may want to involve legal staff to advise you on what restrictions and fines or other enforcement measures you are allowed to implement.

BEST PRACTICE: Partner with private sector and volunteer organizations that share common interests or special expertise, such as water-efficient landscaping.

- **City of Hays, Kansas.** To illustrate water-wise landscaping and set an example for the community, the city installed demonstration gardens and grass plots with informational placards. The city provided a list of the plants used in these projects to local nurseries and landscape vendors, who were then able to assist the public in completing water-efficient landscape retrofits throughout the community.
- **Tuolumne Utilities District, California.** The District developed a partnership with the volunteer group Master Gardeners, which provided relevant information to residents and the landscape industry by conducting workshops, seminars and events about water-saving landscaping and gardening strategies, rain barrels and the use of gray water (from showers and washing machines) for irrigation. The volunteers provided credible information and helped to spread the District's message of water conservation.

Use Worksheet 7 to develop a communications plan for your utility.

Use Worksheet 8 to develop a list of key community contacts.

After the Drought:

- Maintain relationships with the partners that you worked with during response. Continued coordination with your partners will help ensure the effectiveness of future drought response and long-term water supply planning efforts and will benefit your utility's other ongoing decision making, operational and regulatory activities.
- Work with local, county and state officials to help find technical and financial resources to support drought recovery and resilience projects.

RESOURCES

This section contains all of the worksheets and links embedded throughout the guide, as well as additional resources related to drought response and recovery.

Worksheets and Templates

Use these worksheets and templates as a starting point, and add to them as necessary. Save them to your computer before making any changes.

- Worksheet 1: Identify Members of the Drought Response Team
- Worksheet 2: Update or Develop a Drought Response Plan
- Drought Response Plan Template
- Worksheet 3: Initial Staffing and Funding Drought Activities
- Worksheet 4: Water Supply Availability (Note that Worksheet 4 has three spreadsheet tabs)
- Worksheet 5: System Efficiency, Water Demand and Customer Use
- Worksheet 6: Identify Additional Water Sources
- Worksheet 7: Sharing Consistent Messages with Different Audiences
- Worksheet 8: Community Contact List

Staffing, Response Plans and Funding Resources

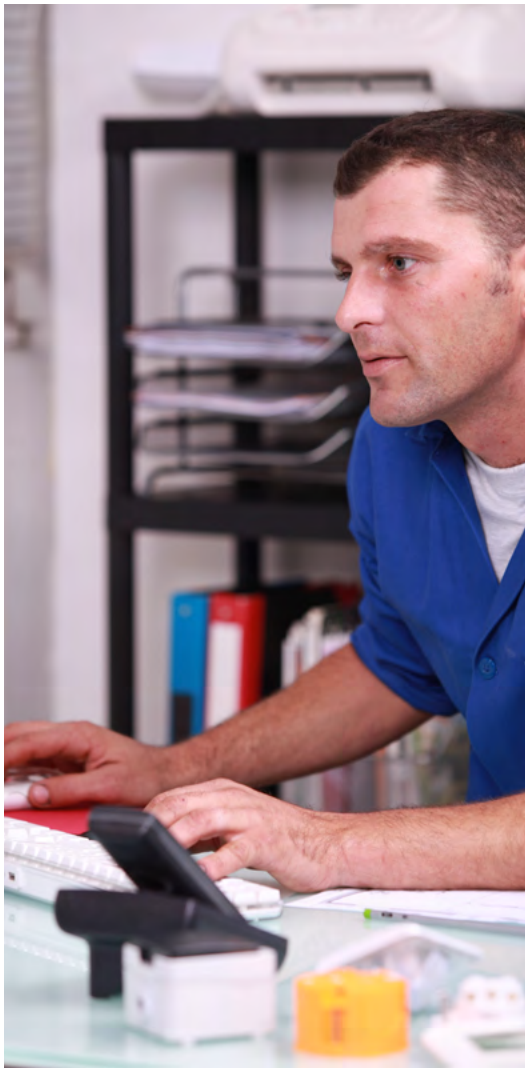
- U.S. EPA's Tabletop Exercise Tool for Water Systems: Emergency Preparedness, Response, and Climate Resiliency
- U.S. EPA's Workshop Planner for Climate Change and Extreme Events Adaptation
- U.S. EPA's Federal Funding for Utilities — Water/Wastewater — in National Disasters (Fed FUNDS)
- Federal Emergency Management Agency (FEMA) Climate Resilient Mitigation Activities Exit
- Alliance for Water Efficiency's (AWE) "Financing Sustainable Water"

Water Supply and Demand Management Resources

- U.S. Drought Monitor Exit
- U.S. Seasonal Drought Outlook Exit
- Snow Telemetry (SNOTEL) Snow Survey and Water Supply Forecasting Exit
- U.S. EPA's WaterSense
- American Water Works Association (AWWA) Water Loss Control Audit Software
- AWWA Drought Portal
- AWWA Conservation and Resource Management
- AWE Home Page

Communication and Partnerships Resources

- U.S. EPA's WaterSense
- U.S. EPA's Water Utility Public Awareness Kit
- AWE's "Financing Sustainable Water" Communications Tools



RESOURCES (Continued)

Case Study Resources

- Drought Response and Recovery Project for Water Utilities: Case Studies Map
- Tuolumne Utilities District, Sonora, California Exit
- (Corix) Spicewood Beach Water System, Spicewood, Texas Exit
- City of Las Vegas, New Mexico Exit
- City of Hogansville, Georgia Exit
- City of Hays, Kansas Exit
- City of Russell, Kansas Exit
- City of Clinton, Oklahoma Exit
- Castine Water Department, Town of Castine, Maine Exit
- North Marin Water District, Novato, California Exit

Additional Drought Resources

- U.S. Department of Agriculture (USDA) Rural Development Program Exit
- USDA Rural Development Disaster Assistance Exit
- Centers for Disease Control and Prevention (CDC) Drought Communication Toolkit Exit
- U.S. EPA's Drought Incident Action Checklist
- U.S. Bureau of Reclamation (USBR) AgriMet Partners & Water Resource Information Exit
- National Weather Service (NWS) Climate Prediction Center — Drought Information Exit
- USDA Disaster and Drought Information Exit
- U.S. EPA's Water Utility Response On-the-Go Mobile Website
- U.S. Geological Survey Water Science School — Land Subsidence Exit
- WateReuse Research Foundation Framework for Direct Potable Reuse

Contact Us

Please email WSD-Outreach@epa.gov with any questions or suggestions.

Microsoft Office or Adobe Acrobat may be required to view or print these files.

CASE STUDIES AND VIDEOS

The following case studies highlight small and medium-sized utilities that successfully responded to drought. Reflecting a broad range of situations — diverse geographies, water resources, response actions and funding approaches — these utilities' actual stories demonstrate solutions that work.

They provide examples of proven ways to reduce demand, access additional water supplies, communicate effectively, secure funding and develop partnerships to survive drought. Lessons learned by your peers may help you plan for and respond to drought by finding solutions that work for you and your community.

Note that your state may have specific rules that could prevent use of some the case study utilities' actions, so first check with your state regulators or legal counsel; even if that is the case, these innovative solutions may inspire other ideas to help your utility and community become drought resilient.

Click on the images to learn about solutions from each case study.


Tuolumne Utilities District, Sonora, California


(Corix) Spicewood Beach Water System, Spicewood, Texas


City of Las Vegas, New Mexico


City of Hogansville, Georgia

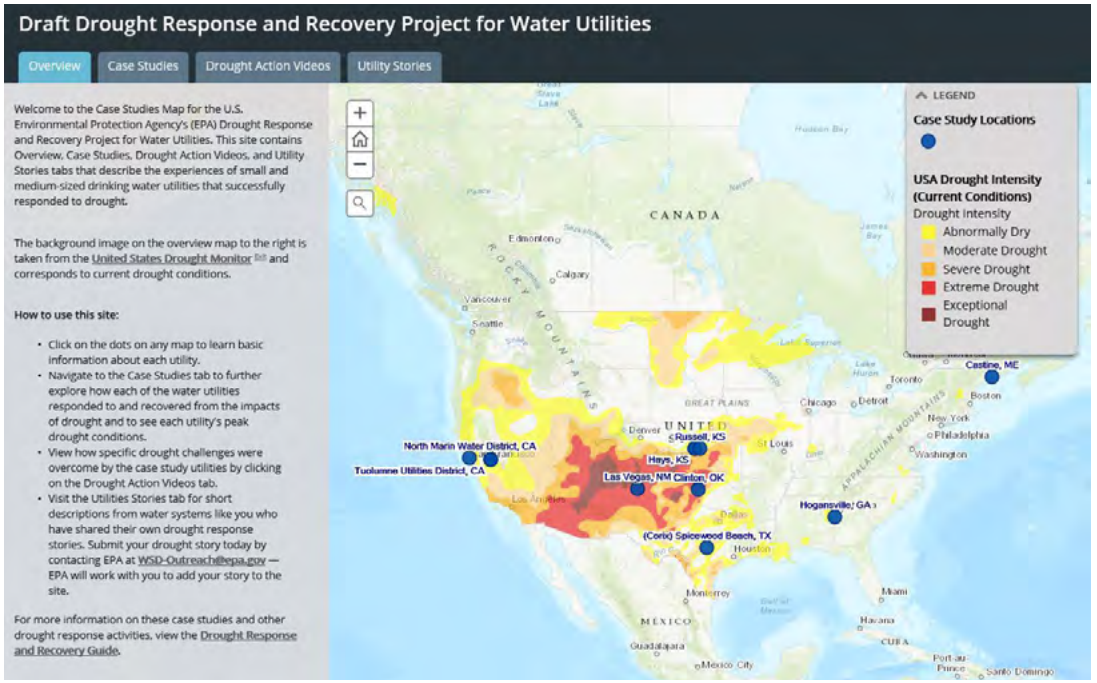

Cities of Hays and Russell, Kansas


City of Clinton, Oklahoma


Castine Water Department, Town of Castine, Maine


North Marin Water District, Novato, California

Click on the map to to exit the Drought Response and Recovery Guide and navigate to a website featuring a geoplatform map that hosts short videos on each case study.



CASE STUDY: Tuolumne Utilities District, Sonora, California

Click on the video icon to go to the Drought Response and Recovery Project for Water Utilities: Case Studies Map to watch a video about the utility's drought response.

SYSTEM DETAILS

- 14 treatment plants provide water for residential, commercial, industrial, wholesale, agricultural uses and fire suppression.
- Approximately 14,150 connections.
- Surface water stored in the Lyons and Pinecrest Reservoirs on Stanislaus River and released into the "Main Canal."
- Reservoirs and the Main Canal are owned and operated by the Pacific Gas and Electric Company (PG&E).
- Allocated approximately 17,000 acre-feet per year of surface water to treatment plants.
- 400 acre-feet per year groundwater used to supply three well systems.

IMPACT

For the Tuolumne Utilities District (TUD), 2013 was the second consecutive year of intense drought, with precipitation at 25 percent of the annual average of 32 inches. During the third quarter of 2013, TUD estimated that reservoir inflows and instream flows would reach an unprecedented low volume of water available for diversion in 2014. Water supplies in 2014 were estimated to be even less than those experienced during the driest year on record (1977), and these supplies could be depleted within 120 days at typical water consumption levels.

Based on hydrologic analyses and long-range weather forecasts that predicted historically low precipitation during the area's "wet season," on January 17, 2014, TUD prepared an outlook of water availability for the coming year. They shared this with their customers and elected leaders. On February 13, the TUD board prohibited all outdoor watering and asked customers to reduce water usage by 50 percent. By June 2, collected data indicated a reduction of 20 percent (compared to 2013 water use), followed by a reduction of 45 percent by the end of June and a 48 percent reduction by the end of July. This significantly improved the water supply outlook; however, it also significantly reduced TUD's operating revenues.

RESPONSE MEASURES

Staffing, Response Plans and Funding

TUD's General Manager convened his management team — District Engineer, Water Master (Operations Manager) and Public Relations Manager — to lead the drought response. The team engaged other staff from operations and engineering to help with tactical planning and implementation. TUD evaluated drought conditions, established water demand reduction measures for their customers as well as their water distribution system, explored additional water supply options and formulated recommendations to the board. This utility-wide team approach ensured that everyone in the utility defined the "problem" in the same way, shared a common understanding of the goals and strategies, and implemented drought response actions consistently.

During typical operations, TUD relies on grants and the State Revolving Fund loan program to supplement rate-based revenue for capital improvements. These outside funding sources were instrumental in completing drought response solutions during the 2014 drought. Local and state officials helped TUD identify potential funding sources, including approximately $768,000 to construct infrastructure needed to supplement existing water supplies: the New Melones Pump Station Project and expansion of the Matelot Reservoir.

Water Supply and Demand Management

TUD took important steps to increase their water supply; for example, they:

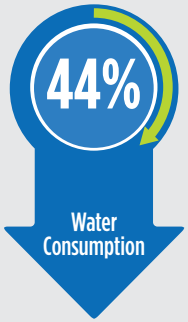
- Altered management of flows within the Main Canal; PG&E suspended their typical water releases for electricity generation.
- Activated lower water quality producing wells.
- Explored potential interconnections with other systems.
- Designed, funded and constructed a pipeline to convey water from the New Melones Reservoir to a TUD water treatment plant in just over a month.
- Implemented the Matelot Reservoir Expansion Project to increase surface water storage.

Through regulations, system operations improvements and customer conservation measures, TUD reduced overall water use by 33 percent from January to July 2014 (compared to 2013 water production).

CASE STUDY: Tuolumne Utilities District, Sonora, California (Continued)

TUD adopted **water restrictions** and **conservation measures** that led to a

44% reduction in water consumption in the month of May 2014 (compared to 2013).



TUD contacted **local** and **state officials** for potential funding sources and **received approximately**

$768,000

to fund **drought-related projects.**

As savings measures, TUD:

- Reduced evaporative losses by modifying typical delivery canal operations to cut off flow to two ditch canals that provided water for agricultural use and a golf course.
- Accelerated leak repairs in the ditches and distribution pipelines.
- Prohibited all outdoor irrigation.
- Asked customers to eliminate all non-essential water use.
- Enforced the mandatory water use reductions through verbal warnings, written notices (door hangers) and threatened fines.
- Worked with large water users on usage reduction:
  - CAL FIRE (fire department) reduced non-essential training to save water.
  - Sierra Pacific Industries, the largest water user in their system, invested in onsite water recycling and other efficiencies.

Communication and Partnerships

TUD implemented an exhaustive suite of communication tools to raise awareness about the drought, provide conservation tips and inform customers about mandatory conservation requirements. TUD communicated with customers through:

- Press releases, newspaper articles, radio and television interviews.
- Website updates and direct mailings.
- Public hearings, briefings at public meetings and presentations at civic organizations.
- Signage throughout the community.
- Distribution of "conservation kits" contributed by Home Depot and the California Corps.

TUD credits their network of partners with the success of the drought response. For instance, TUD worked collaboratively with the Twain Harte Community Services District to convene a meeting with county and state Office of Emergency Services (OES), California Department of Water Resources and other agencies that were able to provide support, address regulatory constraints or otherwise advance a solution to the drought.

LOOKING FORWARD

Drought response actions taken over the last few years to reduce demand and secure additional water supplies have prepared TUD for extended drought conditions. The utility continues to look for alternative and innovative water supplies, water storage opportunities and ways to maintain efficient water use, so as to increase their resilience to future droughts.

For more information, visit TUD's website Exit

BACK TO CASE STUDY HOME PAGE

CASE STUDY: (Corix) Spicewood Beach Water System, Spicewood, Texas

Click on the video icon to go to the Drought Response and Recovery Project for Water Utilities: Case Studies Map to watch a video about the utility's drought response.

SYSTEM DETAILS

- Rural water utility on the shores of Lake Travis in the lower Colorado River basin, 50 miles northwest of Austin, Texas.
- 435 connections serving approximately 1,100 people and a school.
- Formerly owned and operated by the Lower Colorado River Authority (LCRA) until purchased by Corix Utilities (Corix) in 2013.
- Historically relied on 2 alluvial groundwater wells until deeper alluvial, 175 – 200 gallons per minute (gpm) wells were drilled during 2003 – 2004.

IMPACT

Water supply reservoirs in the lower Colorado River basin had not been full since 2005, when central Texas experienced the driest and one of the hottest years on record in 2011. The Lower Colorado River Authority (LCRA) enacted drought management provisions as reservoir levels continued to drop within the basin. Although its alluvial groundwater wells were producing sufficient water supply to meet its own needs, as an LCRA-owned utility, the (Corix) Spicewood Beach Water System (Spicewood Beach) and its customers adopted the mandatory water use restrictions.

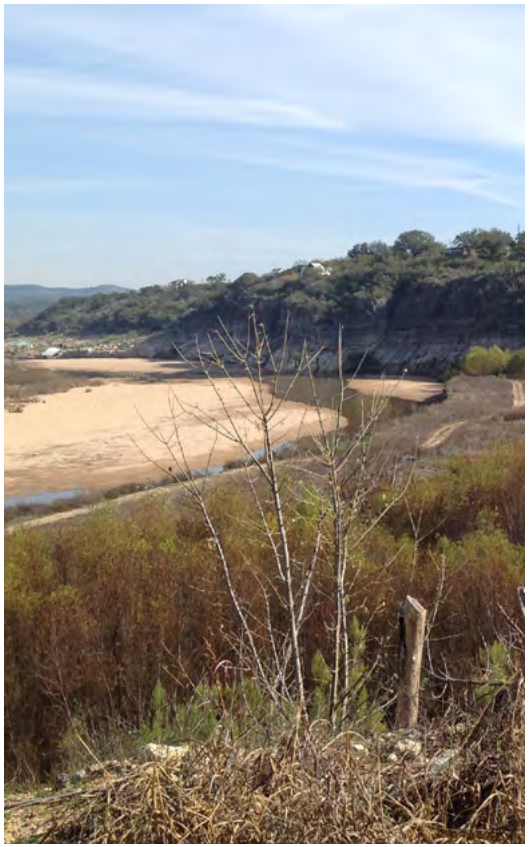
Spicewood Beach's well production began rapidly dropping beginning in December 2011. On January 17, 2012, the wells were producing 108 gallons per minute (gpm), falling below the service area's typical winter demand rate of 125 gpm. Within 10 days, production was at 56 gpm — less than half of what was needed to meet winter demand. By the end of January, the wells essentially stopped producing and the utility had insufficient water supplies to meet system needs. For 2 years, water was trucked in daily to meet basic health and safety needs.

RESPONSE MEASURES

Staffing, Response Plans and Funding

Spicewood Beach had two drought management plans: LCRA's Drought Contingency Plan, which established system-wide drought triggers based on combined storage in upstream storage reservoirs (Lake Buchanan and Lake Travis), and another plan with specific drought triggers for Spicewood Beach. Both plans included water use restrictions and emergency response actions; however, neither anticipated such a rapid loss of water supply. A Corix team, composed of their General Manager, Area Supervisor (operations manager) and Environmental Compliance Manager, sought to find alternative water supplies to maintain critical services while securing a longer-term solution. The team responded to unprecedented drought conditions while it was managing the transition from LCRA to Corix ownership.

One of the key challenges for Spicewood Beach during their drought response was managing utility finances. In addition to paying water hauling costs of approximately $35,000 per month, LCRA funded a $1.2 million alternative supply and treatment project. Corix managed day-to-day operations and was responsible for design and construction of the new system. Other funding sources included revenues from Corix's central Texas regional utility system as well as grants. The regional approach allowed capital costs, and the financial impact, to be spread across all customers in the region.



CASE STUDY: (Corix) Spicewood Beach Water System, Spicewood, Texas (Continued)

Corix has developed **UNIFORM RATES** for the utility system, covering **80%** of the utility's fixed costs.

LCRA **augmented water supply** by water hauling; approximately 5 or 6 tankers filled the storage tank every day.

A **$350,000 grant** through disaster relief funds was awarded to alleviate drought conditions.

Water Supply and Demand Management

While implementing a long-term solution, Spicewood Beach trucked five to six tankers of potable water to their distribution storage tank to supply water to customers each day for 2 years. During that time, Spicewood Beach put in place the following demand management strategies:

- Prohibited non-essential water use.
- Allocated 8,000 gallons of water. maximum per month per household.
- Conducted aggressive leak detection and repair.
- Reduced line flushing.
- Encouraged elementary schools to save water in kitchen and restroom facilities and motivated the students to save water at school and at home.

The utility explored a number of options before finally implementing the first surface water infiltration gallery in Texas. Substantial subsurface flow in the lake bed was discovered during a geologic bore. This led to an innovative project consisting of two 30- to 40-foot wells that draw water through the sands of the lake bed. The water is then conveyed approximately one-half mile for treatment.

To successfully permit and implement this project, Spicewood Beach staff:

- Collaborated with the Texas Commission on Environmental Quality (TCEQ) to determine the appropriate water treatment regulations.
- Worked with a prefabricated treatment plant manufacturer to build the 475,000 gallon per day plant that met all regulatory design standards.
- Integrated the new facilities with the raw water pipeline from the existing alluvial groundwater wells.
- Used utility staff for much of the construction, to reduce costs.

Communication and Partnerships

In addition to developing an innovative water supply project, an important aspect for the Spicewood Beach Water System drought response was engaging local, regional and state partners. State officials and agencies provided Spicewood Beach with technical assistance and financial resources throughout the drought. When the Texas Department of Agriculture announced its solicitation for grant proposals for public water supply systems on a first-come, first-served basis, Corix and LCRA officials worked with the Burnet County Judge and state officials to submit a grant proposal to fund the Spicewood Beach surface water project. Burnet County was awarded a $350,000 grant for the Spicewood Beach Water System, through disaster relief funds allotted for drought projects.

LOOKING FORWARD

Based on the lessons learned during their 2011 – 2014 drought response, Corix plans to revise its drought response plan. The utility also plans to conduct regular emergency preparedness exercises with key utility personnel including management, operations, financial and regulatory leads. Empowered by lessons learned from the last drought, as well as an innovative and reliable water supply source, Spicewood Beach is now well situated for future droughts.

For more information, visit Corix's website. Exit

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CASE STUDY: City of Las Vegas, New Mexico

Click on the video icon to go to the Drought Response and Recovery Project for Water Utilities: Case Studies Map to watch a video about the utility's drought response.

SYSTEM DETAILS

- County seat of San Miguel County in north central New Mexico.
- Population of approximately 18,000.
- 6,400 service connections.
- Average daily water demand of 1.4 million gallons per day.
- Ninety percent of its water supply comes from Gallinas River; 10 percent from groundwater.
- 500 acre-feet of storage capacity.

IMPACT

Located in the desert southwest, Las Vegas is accustomed to dry conditions; however, persistent drought has plagued the area for the last 10 years. Water availability changes seasonally with intermittent rainfall but at some point in three consecutive years — 2010, 2011 and 2012 — by Las Vegas estimates, it had less than 120 days of water available.

Supply in the Gallinas River is highly dependent on snowpack and on capturing and storing infrequent, but intense, rainfall. A 2004 Supreme Court decision made Las Vegas's water rights junior to irrigation rights in the watershed, which further reduced the reliability of their supply during drought or other low flow conditions. Additionally, in 2013, the city lost access to 500 acre-feet of storage with the Storrie Project Water Users Association when the storage lease term expired.

The loss of storage and senior water rights increased the city's vulnerability to drought. Questions of a reliable water supply prevented businesses from locating to the area, affecting overall economic vitality and impacting all residents. These impacts prompted the city to address immediate and long-term needs in its Water Enhancement Program.

RESPONSE MEASURES

Staffing, Response Plans and Funding

In 2011, Las Vegas adopted an Emergency Action Plan by resolution that establishes drought management measures and water use restrictions beyond those established in a June 2010 Water Conservation Ordinance. The plan includes 10 drought stages that build on the four stages in the ordinance. Learning from each year of drought and adapting to changes in their water supply, the utility is currently updating the drought stage trigger levels and response actions in their Emergency Action Plan.

The Water Enhancement Program is implemented through rolling 5-year capital plans. Funding comes from a variety of sources, including rate-based revenues, grants and loans. For example, a project to increase storage in Bradner Reservoir by raising the dam was estimated to cost $34 million. Las Vegas received a $10 million grant appropriated by the State legislature, $20 million from the State Revolving Fund administered by the New Mexico Finance Authority, and $4 million after qualifying as an economically disadvantaged community, administered by the Water Trust Board.

Water Supply and Demand Management

The 10 drought stages in the Emergency Action Plan correspond to stored water levels. For instance, Stage 0 corresponds to full storage, and Stage 10 corresponds to 10 percent of storage remaining. Water use restrictions and conservation measures are listed in the plan for each drought stage. In addition to the Emergency Action Plan, the city has adopted other water supply and demand management strategies. For example, the utility implemented a block rate structure in 2010, with a 62 percent rate increase across four blocks; the rate for the highest block is 10 times higher than that of the lowest block.

CASE STUDY: City of Las Vegas, New Mexico (Continued)

Las Vegas developed a 40-year long-term plan, including RESERVOIR STORAGE EXPANSION from 500 acre-feet to 2,300 acre-feet.

Reservoir storage to increase by 460%

Implemented a water enhancement program to reduce water use by 26%.

$34 million Estimated cost of the reservoir expansion, funded by grants and loans.

In addition to the drought water use restrictions and conservation rate, Las Vegas has implemented or is planning a comprehensive suite of emergency actions, multiple-year infrastructure projects and other utility system improvements. Water conservation and supply projects include the following:

- Leak identification and repair program.
- Automated meter-reading system.
- One-time bulk water purchase to augment their surface water rights.
- Construction of three additional brackish groundwater wells that will be blended with surface water to meet drinking water standards.
- Wastewater reuse system.
- Bradner Reservoir expansion project to increase storage capacity from 500 acre-feet to 2,300 acre-feet.
- Peterson Dam seepage recovery and pump back system.
- Standpipe available to supply treated water to residents on private wells that have gone dry.

Communication and Partnerships

Recognizing the importance of creating a water conservation ethic and broad support for costly water supply projects, the city has implemented an extensive outreach campaign called "Our Future is Clear." Through frequent presentations, community meetings and media reports, Las Vegas provides their customers with consistent information and transparent accounting of progress on the Water Enhancement Program. As a result of their effective outreach campaign, water use has been reduced by more than 26 percent to approximately 50 gallons of water per capita per day for residential customers, and 78 gallons per capita per day for overall system usage. Additionally, significant progress has been made on the water supply projects.

Partnerships have also been very important in Las Vegas's drought response activities. For example, the city worked with the mutual aid organization, New Mexico Water/Wastewater Agency Response Network (WARN), and the San Miguel County Office of Emergency Management (OEM) to set up water distribution sites during drought. The county OEM purchased 20,000 gallon storage tanks that could be distributed to pre-determined sites. Through a New Mexico WARN agreement, the city can borrow Albuquerque's water tanker for water delivery to the portable storage tanks.

LOOKING FORWARD

With experience and lessons learned from the decade-long drought, Las Vegas has developed effective measures to cope with different drought conditions. The city is currently updating drought stage trigger levels and response actions in its Emergency Action Plan and implementing a long-term Water Enhancement Program to diversify its water sources, which will better prepare the city for the next drought.

For more information, visit the city of Las Vegas's website. Exit

← BACK TO CASE STUDY HOME PAGE

CASE STUDY: City of Hogansville, Georgia

Click on the video icon to go to the Drought Response and Recovery Project for Water Utilities: Case Studies Map to watch a video about the utility's drought response.

SYSTEM DETAILS

- Located halfway between Atlanta and Columbus, Georgia.
- 1,750 connections serving approximately 3,000 customers.
- Large industrial park in adjacent Meriwether County.
- Diverted water from Flat Creek until an intake was constructed at the Blue Creek Reservoir in response to 1988 drought.
- Currently purchases treated water from city of LaGrange and Coweta County Water and Sewage Authority.

IMPACT

Hogansville was impacted by severe droughts in 1988, 2003 and 2007. At the height of the 1988 drought, the available water supply from Flat Creek was less than the city's demand of approximately 500,000 gallons per day, and the city trucked in water to meet basic needs. This situation drove the city to acquire water from the Blue Creek Reservoir — a more reliable source than diverting from Flat Creek. Even with the reservoir storage, however, the reservoir level was only 6 inches above the intake structure during the 2003 drought.

Estimating that the supply would last about 6 days at current demand, Hogansville put a portable pump at a lower point in the reservoir and pumped water to the treatment plant for 1 month until rain replenished the reservoir. During the 2007 drought, the Blue Creek Reservoir water level was down to approximately 1 foot for about 2 weeks until it was replenished by rainfall. Repeated droughts led the city to develop diverse and more reliable water sources to protect their community's quality of life and economic development opportunities.

RESPONSE MEASURES

Staffing, Response Plans and Funding

Hogansville maintains an all-hazards Emergency Preparedness Plan with Troup County; however, they did not have a specific drought management plan in place during the 1988, 2003 and 2007 droughts. A drought management plan was developed during 2011 – 2012, and was being updated in 2015.

The city promotes year-round conservation using a tiered rate structure, with higher water rates assigned for higher volumes of use. This rate structure provided revenue stability for the city as water demand dropped during the drought. Hogansville also instituted a Special-Purpose Local-Option Sales Tax (SPLOST) to fund capital projects. The city obtained additional funding through state emergency assistance funds (Immediate Threat and Danger grant) and a loan from the Georgia Environmental Financing Authority to build a pipeline to carry treated water from a neighboring utility.

Water Supply and Demand Management

During past droughts, Hogansville adopted a variety of water use reduction strategies, depending on the severity of the drought and availability of water supplies. The following actions have been taken since the 1988 drought to reduce customer demand and develop more reliable water supplies:

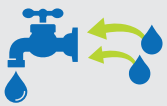
- 1988
  - Trucked in water.
  - Implemented a complete ban on outdoor watering.
  - Collaborated with the U.S. Army Corps of Engineers (USACE) and Georgia Environmental Protection Division (EPD) to reallocate storage capacity in the USACE Blue Creek Reservoir (USACE Flood Control Reservoir 15). This reallocation process required coordination with USACE and Georgia EPD to obtain necessary approvals and water rights.
- 2003
  - Installed portable pumps in a deeper part of the Blue Creek Reservoir.
  - Reduced water use by 10 percent after an odd and even day water schedule was established, followed by a complete outdoor watering ban.

CASE STUDY: City of Hogansville, Georgia (Continued)

Hogansville implemented an **aggressive leak detection and repair program**, including repair of a leak of **35,000 – 50,000 gallons of water per day.**

x 1,000

Hogansville **REALLOCATED** water reservoir storage capacity and acquired water from two neighboring systems to **enhance water supply reliability.**



- 2007
  - Began working with the city of LaGrange to construct a pipeline to transport finished water to Hogansville. LaGrange had surplus permitted water and treatment capacity.
  - Mandated a statewide reduction by 10 percent. Partnering with the Georgia Rural Water Association, the city was able to repair major leaks — including a notable leak of 35,000 – 50,000 gallons of water per day, thereby reducing non-revenue water by about 20 percent.
- 2008
  - Completed pipeline, and water started flowing from LaGrange in August 2008.

Currently, the city of Hogansville purchases treated water from the city of LaGrange and Coweta County and no longer diverts and treats water from Blue Creek Reservoir. These supplies proved reliable during more recent droughts, when many utilities in the region were facing water shortages.

Communication and Partnerships

The city of Hogansville effectively communicated with the public through media coverage of frequent briefings to the City Council. Local newspapers also published information on water use restrictions such as watering schedules.

Collaboration with USACE and Georgia EPD was required for the Blue Creek Reservoir reallocation in 1988. All participating governments needed to work together to negotiate the water purchasing agreements, and to develop a focused strategy that benefited all participants and the region as a whole. Building upon the regional partnerships, the city and adjacent Meriwether County developed a plan to meet growing water demands in the county's northern part by sharing the costs of new infrastructure, such as onsite storage tanks, with the large industrial park customers.

LOOKING FORWARD

The city has maintained many practices adopted during previous drought responses such as annual main flushing, enhanced leak detection and repair and customer water conservation awareness programs. The city is also revising its drought management plan to incorporate drought triggers and water use reduction measures during different drought stages. Furthermore, the city continues to plan for additional back-up supplies and infrastructure in the event of water main breaks, citizens' private wells going dry or longer-term drought that would affect the current water supply's reliability.

For more information, visit the *city of Hogansville's website.* Exit

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CASE STUDY: City of Hays and City of Russell, Kansas

Click on the video icon to go to the Drought Response and Recovery Project for Water Utilities: Case Studies Map to watch a video about the utilities' drought response.

SYSTEM DETAILS

- Located about 30 miles apart in central Kansas, the city of Hays and city of Russell share a groundwater source — the Smoky Hill River alluvium — and have worked together to respond to drought.

City of Hays	City of Russell
Population: 21,000 8,000 connections	Population: 4,500 2,400 connections
Large water users: battery factory, valve manufacturing plant, regional hospital (HaysMed)	Large water users: ethanol and gluten plant
Groundwater source from 31 wells: • Smoky Hill wellfield, upstream of Russell's Pfieffer wellfield in Smoky Hill River alluvium. • Big Creek Aquifer wellfield. • Dakota wellfield (produces brackish water, used as a back-up supply).	Groundwater and surface water sources: • Pfeifer wellfield (25 miles away in Smoky Hill River alluvium). • Surface water from Big Creek (has seasonal low-flows). • Stored water and water release rights from Cedar Bluff Reservoir, a U.S. Bureau of Reclamation reservoir upstream of the Smoky Hill wellfield.

IMPACT

The region has experienced drought periodically since the 1950s and twice during the past decade. The 2005 – 2006 drought was relatively brief but severe, requiring water use reductions in both communities. The 2011 – 2013 drought was longer and had a greater impact on the water supply of the city of Hays and city of Russell.

RESPONSE MEASURES

Staffing, Response Plans and Funding

Both cities have adopted drought response plans, and have internal drought teams that are led by the city manager and utility department staff under the direction of the City Council. The city of Russell's Municipal Water Conservation Plan clearly defines drought triggers and response actions for four drought stages. During 8 of the last 12 years, the city of Russell declared Stage 3 (Critical Water Stage) or Stage 4 (Water Emergency). The city of Hays has a three-stage drought response plan with established triggers, goals and response actions.

The cities have used a variety of funding sources to implement drought response actions and conservation. Both fund some drought response activities with their water rate revenue. Hays also implemented a 0.05 percent Water Conservation Sales Tax in 1995, and has used the State Revolving Fund to replace about 85 percent of its distribution system to reduce water loss. In the past 20 years, the city of Russell has replaced 80 percent of its water distribution lines, paid for with State Revolving Fund loans.

Water Supply and Demand Management

Both communities have in place year-round water conservation measures. During the 2005 – 2006 drought, the large industry users in Russell were asked to reduce water use to stretch limited supplies. They implemented ongoing measures, resulting in a 63 percent reduction over a 10-year period. Russell also has a water conservation education specialist who gives classes to local elementary school students, who then take

CASE STUDY: City of Hays and City of Russell, Kansas (Continued)

Both communities have implemented **year-round water conservation measures.**

The industries in Russell have **reduced water use** by **63 percent** over a **10-year period.**

Hays has a program **"Cash for Grass"** focusing on permanent reductions in outdoor water.

those tips home. During the 2011 – 2013 drought, Big Creek stopped flowing, causing Russell to rely more on groundwater and implement mandatory water use restrictions. Russell implemented a 25 percent reduction on industrial water use and a ban on outdoor water use. Prior to the drought, Russell's usage was between 140 and 150 gallons per person per day; by 2013, it had dropped to 81 gallons per person per day.

After a 1991 drought, Hays increased its focus on conservation. Hays' program emphasizes conservation through education, pricing, rebate programs and policies. For example, Hays implemented a "Cash for Grass" program that offers $1 per square foot for replacement of grass with less water-intensive landscaping, rebates for toilets and washing machines and a "green" plumbing code for in-home and outdoor irrigation usage for new development. Their full-time conservation specialist also provides educational programs. Water use in Hays is now about 95 gallons per person per day, down from a high of 220 gallons per day in the 1980s.

The cities also have implemented strategies to increase or better manage their water supply, including the following:

- Effluent reuse for irrigation.
- Maintenance program to rework wells (acidation treatment) and add variable speed pumps to enhance production and reduce energy costs.
- Groundwater well optimization through well operations and water-level monitoring practices.
- Requiring private groundwater well owners to follow outdoor water use restrictions.
- Enhanced water treatment and blending to use lower quality water.
- Joint purchase of the R9 Ranch (about 60 miles away from the existing Smokey Hill wellfield) to provide an estimated 8,000 acre-feet per year of groundwater supplies.
- Operations agreement between the Kansas Water Office, Kansas Department of Agriculture Division of Water Resources and the cities of Hays and Russell to effectively manage stored water and releases from Cedar Bluff Reservoir to recharge the Smoky Hill alluvium wellfields.

Communication and Partnerships

Both cities used various communication outlets, including newspaper, radio, TV and social media, to keep residents informed of the current stage of drought and the required actions they should take.

During the drought, the cities relied on partnerships with their customers to reduce water use. The cities also partnered with the state to time releases of a state-owned artificial recharge right at the Cedar Bluff Reservoir. Timing releases during the spring reduced losses to the stream and sufficiently replenished the Smoky Hill River alluvium, increasing both cities' wellfields. This partnership resulted in an effective and unique solution that the entities could not have achieved on their own.

LOOKING FORWARD

Both cities' effective water conservation programs have reduced water usage and created a conservation culture within the communities.

Hays and Russell plan to continue to work together to implement long-term strategies such as the wellfield at the R9 Ranch and to navigate the regulatory and financial constraints related to its use. They hope to expand the partnership to other communities in the region that would benefit from delivery of this additional water supply.

For more information, visit the *city of Hays* Exit and *city of Russell* Exit websites.

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CASE STUDY: City of Clinton, Oklahoma

Click on the video icon to go to the Drought Response and Recovery Project for Water Utilities: Case Studies Map to watch a video about the utility's drought response.

SYSTEM DETAILS

- Located approximately 90 miles west of Oklahoma City.
- Serves a population of 9,400 within the city limits, two large industrial water users, and a wholesale water customer (city of Arapaho) with a population of 1,000 – 1,500.
- Current average water use of 1.7 million gallons per day, with peak summer usage of 3.5 million gallons per day. Prior to implementing twice per week watering restrictions in April 2014, peak use reached 4.2 million gallons per day.
- Water supply includes raw water from Clinton Lake, treated water from the Foss Lake and groundwater.

IMPACT

During 2010, the water levels in Clinton Lake began to significantly decline. Adding to the city of Clinton's water supply concerns, a chlorine spill in 2011 damaged their water treatment plant and caused water quality changes in the lake. While the city was able to produce some water from Clinton Lake between August and October 2011, by October, the water level reached a historic low of about 2.5 feet.

As a key drought response action, the city purchased more treated water from Foss Lake. However, Foss Lake water levels kept dropping and reached 30 percent of capacity, causing concerns about the reliability of its supply. The fees for purchasing the additional Foss Lake supply were also costing the city approximately $1 million per year, which was not a sustainable cost over the long-term.

RESPONSE MEASURES

Staffing, Response Plans and Funding

Although Clinton's city manager coordinates drought response activities, the city did not have a drought plan in 2010 when Clinton Lake levels began declining. With no plan or regulations in place, the city made ad hoc decisions regarding response activities such as water use restrictions and additional water supply. Conservation measures required during drought were approved as needed by the City Council.

Reductions in water demand impacted the city's water-based revenues. To fund the new water supply projects, the city of Clinton raised water rates by 49 percent in January of 2015 and implemented a half-cent sales tax beginning in July of 2015. The voter-approved sales tax initiative also included an additional half-cent sales tax, effective October 1, 2019, to fund investments in water supply projects.

Water Supply and Demand Management

Back in 2012, Clinton implemented water use restrictions that began with limiting outdoor watering to twice a week from April to October of that year. Additional restrictions were gradually added until outdoor watering was limited to once per week for 2 hours. Another demand management strategy included onsite reuse by industries such as Mars Petcare, which implemented a project expected to save approximately 6 million gallons annually.

The city of Clinton then developed a water supply strategy to secure other long-term supplies, in addition to increasing the amount of treated water purchased from Foss Lake. The strategy includes developing a wellfield in the Washita River alluvial aquifer and obtaining a second groundwater supply from the Elk City aquifer through an agreement executed with the city of Canute.

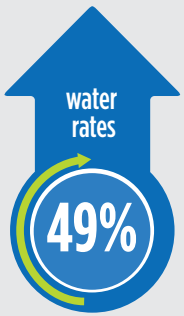
The long-term supply project includes constructing a 7-mile conveyance system from Canute to the Clinton water treatment plant, drilling the new groundwater wells and building a reverse osmosis (RO) plant to treat the poor quality raw water from the new Washita River wells. The city of Clinton is currently conducting test drilling operations and surface geophysics on the Washita River wellfield.

Communication and Partnerships

Partnerships have played an extremely important role in the city of Clinton's drought response and long-term water planning activities. As part of their response to the drought, the city and the state worked together to find a solution for disposing of concentrate from the RO plant. The concentrate cannot be discharged in area water bodies due to surface water quality standards. Class I Underground Injection Control (UIC) wells are prohibited in much of Oklahoma; however, other injection wells — Class V UIC wells — are allowed, subject to the rules of

CASE STUDY: City of Clinton, Oklahoma (Continued)

The City Council raised water rates by **49 percent** in 2015 to **promote water conservation**.



The city of Clinton began implementing a **voter-approved half cent sales tax** starting July 1, 2015, to fund **new water supply projects**.

the Oklahoma Corporation Commission. The Oklahoma Department of Environmental Quality (DEQ) received special approval from EPA to classify injection wells for disposal of drinking water plant brine concentrate (municipal waste) as Class V wells. This regulatory approval was key to the city's ability to develop the new groundwater sources. To enable cities like Clinton to implement similar solutions, legislation was passed to allow DEQ to adopt these rules, and the annual fees for the drinking water systems were lowered from $10,000 – $50,000 to $1,000 – $5,000.

Public information and communication were also critical to the city of Clinton's effective drought response. Customers were informed of conservation requirements and drought response activities through their water bill, the city website, town hall meetings, TV, Twitter, radio and a text messaging notification service. City employees, including trash collection personnel, meter readers and code enforcement officers, would also advise residents of water use violations when observed during routine field work. The city also met individually with key stakeholders, including the two industrial users, to discuss issues related to the drought — especially from changes in water quality as the surface water levels declined, resulting in higher concentrations of total dissolved solids.

LOOKING FORWARD

Rains during May and June 2015 substantially filled Clinton Lake and Foss Lake, and mandatory conservation measures were lifted. The city continues to develop its proposed groundwater projects and explore actions such as adopting a drought response plan and implementing a routine leak detection and repair program. Continued communication with the community will be important to maintaining support for these investments, now that the drought emergency has ended.

For more information, visit the *city of Clinton's website*. Exit

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CASE STUDY: Castine Water Department, Town of Castine, Maine

Click the video icon to go the Drought Response and Recovery Project Case Studies Map to watch a video about the utility's drought response.

SYSTEM DETAILS

- Located in eastern Maine on the Blue Hill Peninsula.
- Serves 370 connections and a population of 1,400 that grows to 2,000 during the summer.
- Largest customer is the Maine Maritime Academy.
- Average water use ranges between 50,000-60,000 gallons per day (gpd), with a peak use of 100,000 gpd.
- Water supplied from three wells and a horizontal well collector and filtration system considered Ground Water Under Direct Influence (of surface water).

IMPACT

Located on a peninsula with limited water supplies, Castine has historically faced challenges meeting peak water demands due to seasonal population fluctuations. In late summer and early fall, the town experiences a large population influx when the seasonal resident and Maine Maritime Academy student populations overlap, resulting in a brief but sharp increase in water demand. Despite several water shortages over the last 5-10 years, the town has been able to meet demand through careful monitoring and management of their three water supply wells, repairing system leaks and implementing mandatory water restrictions.

In the summer of 2015, the Castine Water Department was in the process of developing a new water source to meet their long-term water supply needs. During the approval process, the Department was also working on a much-needed infrastructure project to replace old water mains. However, numerous line breaks, coupled with the high volume of water required to flush the new mains, resulted in over a million gallons of water lost. These critical water losses, coupled with the normal end of summer water demand and one of the driest Septembers on record, left the Department unable to meet demand using their existing well water supply.

RESPONSE MEASURES

Staffing, Response Plans and Funding

As a small town with only one and a half full-time employees, Castine did not have a specific drought response plan in place. However, Castine did have an emergency water supply contingency plan for use during shortages, as required by the state primacy agency. Castine's plan included an agreement with Maine Water Company to purchase emergency water from the town of Bucksport, located approximately 17 miles away. Castine also prearranged a water hauling contract with a local dairy farm, since Castine and Bucksport did not have an interconnection. The actions mandated by the state-required contingency plan helped Castine successfully address their 2015 water shortage until the situation stabilized.

In order to fund their infrastructure projects, the town raised water rates. The rate increase also covered overtime pay for staff during the water shortage, though this was not considered a sustainable funding source for the future.

Water Supply and Demand Management

Castine pursued both short- and long-term solutions to their water supply challenges. During the 2015 drought, Castine implemented mandatory water use restrictions as a short-term solution, allowing for essential uses but prohibiting non-essential activities such as lawn watering and boat or vehicle washing. Mandatory restrictions reduced water use by 5,000-10,000 gallons per day, or nearly 15 percent of their average daily demand.

However, Castine was still unable to meet demands in late summer, and was forced to activate the emergency water supply contingency plan. For water hauling, the town obtained the necessary state permits, which required a licensed operator to be present for every facet of the operation. When the pre-arranged dairy farm was unable to provide a potable water truck, the town used a state primacy agency list of certified haulers to locate another truck. In the end, the truck made three trips daily between Bucksport and Castine for one month to supply up to 24,000 gallons of water per day to the system's clear well.

While hauling water addressed the immediate emergency, the town continued construction of their new source as their long-term water supply solution. The new source, completed in August of 2016, utilizes a horizontal well collector that captures surface water runoff which is naturally filtered through an underground sand layer. The natural sand filter removes algae and iron

CASE STUDY: Castine Water Department, Town of Castine, Maine (Continued)

Castine's Emergency Water Supply Contingency Plan allowed for a successful response to their water shortage.

Locating and repairing leaks, saved 10,000 – 20,000 gpd of water.

x 1,000

Horizontal well project leveraged natural sand filtration and existing treatment plant.

bacteria, reducing the costs of surface water treatment. The town also built a filtration plant (Battle Avenue plant) with a post-filter disinfection loop to treat the new source to surface water treatment standards. When another severe drought gripped Castine in late 2016, the new system was able to successfully meet water demand.

Communication and Partnerships

Many individuals and organizations contributed to Castine successfully mitigating the 2015 water shortage and implementing a long-term secondary supply.

- Permanent and seasonal residents exceeded the town's water use reduction goal of 10 percent. While reaching summer visitors was challenging, most people understood the critical situation and did their part.
- Maine Maritime Academy, the system's largest customer, continues to be a strong partner in managing water resources. They installed high-efficiency toilets and showers, and built a LEED™ certified building with a gray water system for toilet flushing. During the drought, the Academy engaged students to conserve water and stopped using food trays — saving water in their dining hall.
- Maine Rural Water assisted Castine during the drought emergency by having circuit riders locate leaks and repair them. The town welcomed this support because their one and a half full-time employees were managing water hauling and system operations.
- Maine Water, the private company that operates the Bucksport water system, was essential during the water shortage. Without the partnership providing emergency supply, Castine would have had a very difficult time responding to their supply shortage.
- Collaboration with the Maine Drinking Water Program before and during the drought proved valuable. The agency helped Castine prepare for the drought and expedited the necessary permits for the horizontal well.

LOOKING FORWARD

In early 2017, Castine asked Hancock County Emergency Management to facilitate a tabletop exercise that would test their water system under emergency weather conditions. Based on the town's previous drought experience, ongoing monitoring efforts and new source of water supply, the exercise showed that Castine was clearly better able to withstand and recover from future drought impacts.

The recent water shortages have reinforced Castine's commitment to a redundant, drought-resilient water supply, as well as overall emergency preparedness. The town will continue to aggressively control water loss in its system and monitor their water sources for changes over time. Through proactive planning and maintaining key partnerships, Castine will, in the words of one town official: "Always be prepared for Mother Nature, [because] you never know what she's gonna do."

For more information, visit the *town of Castine's website*. Exit

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CASE STUDY: North Marin Water District, Novato, California

Click the video icon to go the Drought Response and Recovery Project Case Studies Map to watch a video about the utility's drought response.

SYSTEM DETAILS

- North Marin Water District meets needs for approximately 61,000 people (20,000 connections).
- Water supply comes from Stafford Lake, imported surface water from the Russian River, conservation and recycling.
- Novato Sanitary District — created in 1925 — produces recycled water collected with their 60,000-population service area.
- Las Gallinas Valley Sanitary District — created in 1955 — produces recycled water collected within their 30,000-population service area.

IMPACT

Located in northern Marin County, California, the North Marin Water District (NMWD) relies on two surface water sources to meet customer demand: Stafford Lake and imported water from the nearby Russian River. NMWD has also actively promoted their water conservation and water recycling programs to bolster their existing supplies, which, in essence, created two additional water sources. Over the past 10 years, these programs have reduced drinking water use from 15.5 million gallons per day (MGD) to 10.2 MGD.

NMWD and its customers have had experience responding to many droughts. For example, during the severe drought of 2013 -2014, customers reduced their water use by 20 percent through voluntary participation in conservation programs, as well as adopting development codes requiring high-efficiency fixtures and efficient landscapes in new construction. By proactively developing diverse sources of water and managing water demand, NMWD was able to meet its needs during that challenging period.

The drought, however, continued to impact the state. In 2015, the governor imposed a statewide 25 percent combined reduction in urban water use. In order to meet the combined reduction, the State Water Resources Control Board adopted an emergency regulation that identified how much water each utility had to conserve based on their average residential water use. For NMWD, the emergency regulation mandated a 24 percent reduction, challenging the utility to find additional ways to reduce their water use beyond the 20 percent reduction that their previous conservation and recycling programs had already accomplished.

RESPONSE MEASURES

Staffing, Response Plans and Funding

As discussed, NMWD has ongoing conservation and recycled water programs, as well as a drought contingency plan. During periods of drought, these programs require additional staff time for evening patrols to monitor lawn watering restrictions, but NMWD has found this effort to be manageable with little impact on day to day operations.

In order to operate the recycling program, NMWD maintains active partnerships with two nearby wastewater utilities: The Novato Sanitary District (NSD) and the Las Gallinas Valley Sanitary District (LGVSD). Together, the three districts fund the recycled water program through a variety of sources: grants from the US Bureau of Reclamation, bond funds, bank loans, certificates of participation (purchased by the general public), rate structure changes and rate increases. Since 2013, NMWD's rates have increased by approximately five percent per year.

Water Supply and Demand Management

NMWD offers a broad range of rebates for customers to reduce their water use while also implementing mandatory non-essential water use prohibitions, such as lawn water outside of defined schedules. The rebates encourage residents to install high-efficiency toilets, clothes washers and irrigation controllers, and to participate in lawn removal ("Cash for Grass") programs. Participation in the rebate programs increased significantly during the 2013-2014 drought.

However, conservation measures alone were not enough to get NMWD to their 24 percent reduction requirement. Luckily, NMWD had been actively expanding their recycled water program. The program, which initially served a single golf course

CASE STUDY: North Marin Water District, Novato, California (Continued)

Considering water conservation as a source of supply helped the Water District prepare for drought.

Long-term partnerships provide a diverse water supply and **positive outcomes for water** and sanitary districts serving the Novato area.

North Marin Water District **meets 15% of water demand** with recycled water.

in 2007, expanded to bring recycled water to 44 large landscape irrigation customers just in time for the governor's mandate to go into effect. Recycled water currently represents about 15 percent of NMWD's total supply, and is used for outdoor irrigation, commercial car washes, construction, dust control and compaction. NMWD continues to expand recycled water and when the next phase is complete, the recycled water network will serve an additional 40 irrigation customers and total 25 percent of NMWD's supply.

NMWD also created a residential fill station program where customers could fill containers with recycled water for outdoor use. Initially, the station was manned full time by NMWD staff; however, to free up staff time, the District developed a training program for the safe handling and use of recycled water. Once residents passed a test and paid a small annual fee, they could self-serve at the fill station. Over 91 participants collected nearly 300,000 gallons during a 3-month period in 2015, and the program continues today.

Communication and Partnerships

NMWD uses a variety of methods to communicate with their customers, including social media and a semi-annual newsletter.

During the most recent drought, a coalition of nine agencies — including NMWD — partnered with the Sonoma Marin Saving Water Partnership to develop and publicize a consistent, region-wide message to customers encouraging them to conserve water.

NMWD's partnership with the two nearby wastewater utilities, NSD and LGVSD, proved instrumental in developing their recycled water program and meeting the governor's 2015 mandate. In 2007, they entered into an agreement that allowed NSD to upgrade its treatment system by building the Deer Island and, ultimately, the Davidson facilities that produce high quality recycled water for non-drinking water uses.

Using revenues received from the expanded recycled water network, LGVSD funded a "right-sized" expansion of their wastewater treatment plant to meet expected growth, thereby providing an alternative and beneficial method for meeting discharge permit prohibitions into San Pablo Bay during summer months. For NMWD, recycled water from Las Gallinas provides a drought-resilient water supply at an affordable cost.

LOOKING FORWARD

On April 7, 2017, the governor declared an end to the drought that began in 2013. By working together, NMWD and its partners not only met the challenge of the 24 percent reduction mandate, but also simultaneously prepared for growth and future drought conditions. The agencies plan to use their partnership to find even more ways to reduce demand in the future. Through continued collaboration, the districts will be well positioned to ensure potable supplies are available for the health, safety and prosperity of local communities no matter what drought challenges may come.

For more information, visit the *North Marin Water District*, Exit *Novato Sanitary Sewer District* Exit and *Las Gallinas Valley Sanitary District* Exit websites.

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