



Tool for Planning Temporary Water Supply Response in Drought Emergencies

Developed through collaboration between
the U.S. Bureau of Reclamation and
Oklahoma Water Resources Board





The purpose of this Tool is to help water resource and utility professionals meet the challenge of providing emergency water supplies to communities under the influence of severe drought.

The objective of the Tool is to assist in planning for water shortages by familiarizing users with alternative sources, treatment processes, distribution options, short term equipment solutions for treatment, and regulatory processes related to emergency situations.

A new Emergency Drought Relief Fund, enabled through HB 1923, includes \$3 million for future drought mitigation and projects. While details have yet to be resolved, in the event of a gubernatorial drought declaration, expenditures will be approved through an Emergency Drought Commission consisting of the Secretary of Agriculture and Executive Directors of the OWRB and Oklahoma Conservation Commission.





Using This Tool

-  Click on this icon to go to other **websites** with useful information.
-  Click on letter buttons to go to main sections.
-  Click on number buttons to go to subsections.
-  Click on this icon to go to **documents or worksheets** included with this tool.
-  Click on this arrow to return to the previous page.
-  Click on this arrow to go to the next page.
-  Click on this icon to return to the main menu.





Goals for Users



- ✓ Knowledge of drought planning resources.
- ✓ An estimate of emergency water supply requirements.
- ✓ Knowledge of potential sources of emergency water.
- ✓ Knowledge of how those sources need to be treated, waste that will be generated, and how to manage that waste.
- ✓ Ideas for distribution of emergency water.
- ✓ A clear plan for navigating the regulatory process.
- ✓ Knowledge of sources of equipment.
- ✓ Strategies for involving the public.
- ✓ Knowledge of potential sources of funding.





Disclaimers



The Bureau of Reclamation and the State of Oklahoma have developed this Tool as a service to the public. The tool offers a wide range of information to meet as many needs as possible, including links to other organizational sites. Every effort has been made to provide accurate data according to available resources. However, neither the authors nor any other party involved in the preparation of the material and data available on or through this tool represent that the information provided here is in every respect complete and accurate and are not responsible for errors or omissions.

Presentation of information on commercial products does not constitute an endorsement of that product or commercial enterprise.

Do check local sources for any equipment and service needs.





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- [D](#) Ancillary Equipment for New Sources
- [E](#) Water Treatment
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- [L](#) Potential Funding Sources
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Preparation



A Now is the best time to think about what to do in an emergency. The State of Oklahoma, Environmental Protection Agency (EPA), Federal Emergency Management Agency (FEMA), Centers for Disease Control (CDC), Department of Homeland Security (DHS), water industry professional organizations, and the United Nations, have produced documents to assist in preparing emergency plans for a wide range of events, including drought.

- 1** State Resources
- 2** Federal Resources
- 3** Professional Organizations





Preparation State Resources



- A** **1**
- @** [The Oklahoma Drought Management Plan](#) outlines membership and responsibilities as well as the sequence of state drought response actions. It also identifies drought-related capabilities of local, state, and federal entities.
 - @** [The Oklahoma Department of Emergency Management](#) acts as the lead state coordinator in drought response with the mission of preparing for, responding to, recovering from, and mitigating against disasters and emergencies.





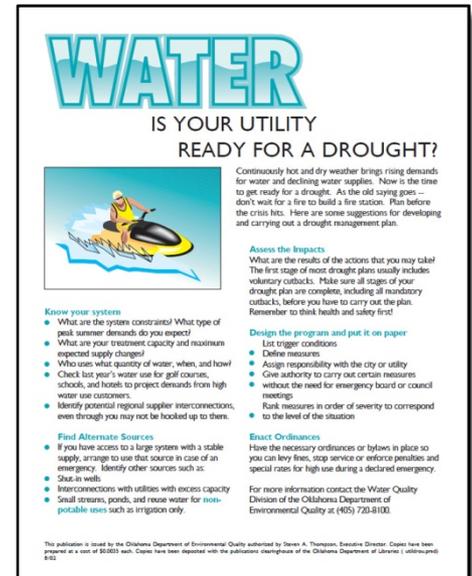
Preparation State Resources



A 1

The Oklahoma Department of Environmental Quality (ODEQ) features the following resources:

- [@ Templates for public water system emergency response plans](#)
- [@ Water Rationing Report](#)
- [@ Factsheet: Is Your Utility Ready for a Drought?](#)
- [@ Factsheet: Water Emergency Procedures](#)
- [@ Community Drought Impact Contact List](#)





Preparation State Resources



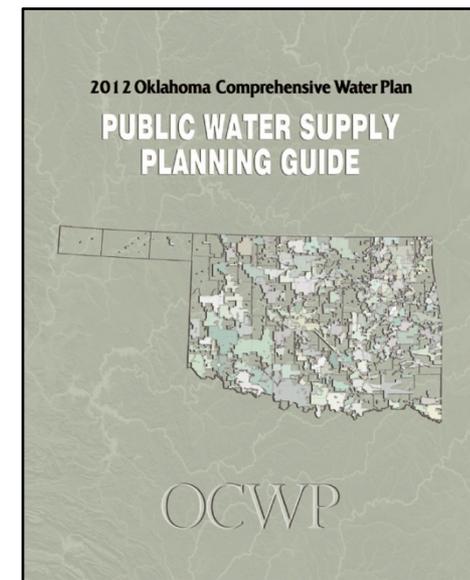
A **1**
The Oklahoma Water Resources Board (OWRB) features the following resources:

@ [Drought & Water Resource Monitoring](#) web page

- Forecasts, Outlooks, & Indicators
- Streamflow Conditions
- Reservoir Storage
- Groundwater Levels

@ [Oklahoma Comprehensive Water Plan](#) web page

@ [Oklahoma Public Water Supply Planning Guide](#)





Preparation State Resources



A 1

@ The Oklahoma Water Resources Center Drought web page features the following resources:

@ Livestock (cattle) Producers drought resources page

@ Crop Producers drought resources page

@ Residential Homeowners drought resources page





Preparation

Federal Resources



A **2**
@ The National Drought Mitigation Center website features the [Drought-Ready Communities](#) page.

The US Environmental Protection Agency (EPA) features the following resources:

@ [Severe Drought Resources](#) page

@ [Tabletop exercise tool for Water Systems: Emergency Preparedness, Response, & Climate Resiliency \(TTX Tool\)](#)

@ The National Integrated Drought Information System (NIDIS) website features the [US Drought Portal](#).

@ The Bureau of Reclamation website features the [Drought Program](#) page.

@ The United States Geological Survey (USGS) website features the [Water Watch](#) page.





Preparation Professional Organizations



A

3

The American Water Works Association features the following resources:

- @ [Drought Preparedness and Response](#) manual.
- @ [Water Shortage Contingency Planning Checklist](#).

The Water Environment Research Foundation features the following resources:

- @ [Climate Change](#) page.
- @ [Resource Recovery](#) page.
- @ [Security & Emergency Response](#) page.
- @ [Water Reuse](#) page.





Water Capacity Requirements



B

How much water do you need? Here are some considerations for narrowing in on the critical supply for an emergency.

- ✓ The minimum necessary for health and sanitation.
- ✓ The minimum necessary to keep the distribution system functioning.
- ✓ The maximum that you can get and treat reliably.

This section provides references to help define your emergency water requirement.

- 1 Water Capacity Requirements
- 2 Minimum Water Supply Recommendations





Water Capacity Requirements



B

1



Public water systems are regulated by Oklahoma Department of Environmental Quality (ODEQ) [Rules and Regulations](#).

Oklahoma Administrative Code 252:626-19-1 requires that hydraulic analysis of the system demonstrates that (1) a minimum of 25 psi should be maintained through out the distribution system, and (2) flows are calculated to be more than one gallon per minute per service connection.





Water Capacity Requirements

B 1

When water supply available for treatment decreases, conservation measures can assist in keeping the distribution system filled. However, water must also be kept fresh to prevent build up of disinfection by-products in the distribution system.



The EPA has provided a [Quick Reference Guide for comprehensive Disinfectants and Disinfectant Byproducts Rules \(Stage 1 & 2\)](#).

If levels are above the MCL further treatment to remove organic material may be necessary.

See the Water Treatment section  for more treatment recommendations.



Comprehensive Disinfectants and Disinfection Byproducts Rules (Stage 1 and Stage 2): Quick Reference Guide

Overview of the Rules

Title: Stage 1 Disinfectants and Disinfection Byproducts Rule (Stage 1 DDBPR) 63 FR 6930, December 16, 1998, Vol. 63, No. 241
Stage 2 Disinfectants and Disinfection Byproducts Rule (Stage 2 DDBPR) 71 FR 388, January 4, 2006, Vol. 71, No. 2

Purpose: Improve public health protection by reducing exposure to disinfection byproducts. Some disinfectants and disinfection byproducts (DBPs) have been shown to cause cancer and reproductive effects in lab animals and suggested bladder cancer and reproductive effects in humans.

General Description: The DDBPRs require public water systems (PWSs) to:
 • Comply with established maximum contaminant levels (MCLs) and operational evaluation level (OEL) for DBPs, and maximum residual disinfection levels (MRDLs) for disinfection residuals.
 • Conduct an initial evaluation of their distribution system.
 In addition, PWSs using conventional filtration are required to remove specific percentages of organic material that may lead to form DBPs through the implementation of a treatment technique.

Utilities Covered: The DDBPRs apply to all sizes of community water systems (CWSs) and nontransient noncommunity water systems (NTNCSs) that add a disinfectant other than ultraviolet (UV) light to their disinfected water, and transient noncommunity water systems (TNCWSs) that add chlorine dioxide.

This document provides a summary of federal drinking water requirements. To ensure full compliance, please consult the federal regulations at 40 CFR 141 and any approved state requirements.

Overview of Requirements

This table shows how the requirements for the Stage 2 DDBPR build on the existing requirements established in the Stage 1 DDBPR. For more information on changes in monitoring requirements, see Table 1.

	Stage 1 DDBPR	Stage 2 DDBPR	For More Info:
Coverage	All CWSs and NTNCSs that add disinfectant other than UV light and TNCWSs that treat with chlorine dioxide. Consecutive systems that disinfected water treated with a disinfectant other than UV light.	✓ ✓	
THMs & HAAs MCL Compliance	MCL compliance is calculated using the sample interval average (SIA) calculation for all monitoring locations across the system. MCL compliance is calculated using the location RAA (LRAA) for each monitoring location in the distribution system.	✓ ✓	See Table 3 and Table 4.
Regulated Contaminants & Disinfectants	Contaminants		
	Total Trihalomethanes (TTHM)	✓	✓
	5 Halooxetic Acids (HAAs)	✓	✓
	Bromate	✓	Regulated under Stage 1 DDBPR
	Chlorite	✓	Regulated under Stage 1 DDBPR
Disinfectants			
Chlorineochloramines	✓	Regulated under Stage 1 DDBPR	
Chlorine dioxide	✓	Regulated under Stage 1 DDBPR	
Operational Evaluation	If an operational evaluation level (OEL) is established, systems must evaluate practices and identify DBP mitigation actions.	✓	See Table 5.

1. A new analytical method for bromate was approved with the Stage 2 DDBPR.





Water Capacity Requirements Minimum Water Supply Recommendations



B 2

@ The World Health Organization’s publication [Emergency Water Supply, Chapter 7](#) provides information for establishing and protecting centralized and decentralized water supplies and recommends a minimum water supply capacity of four gallons per person per day.

@ The Centers for Disease Control and Prevention (CDC) [Emergency Water Supplies](#) web page recommends storing at least one gallon per person per day and keeping a three-day supply.

@ The CDC’s publication [Emergency Water Supply Planning Guide for Hospitals and Health Care Facilities](#) also recommends methods for estimating critical water supply needs.





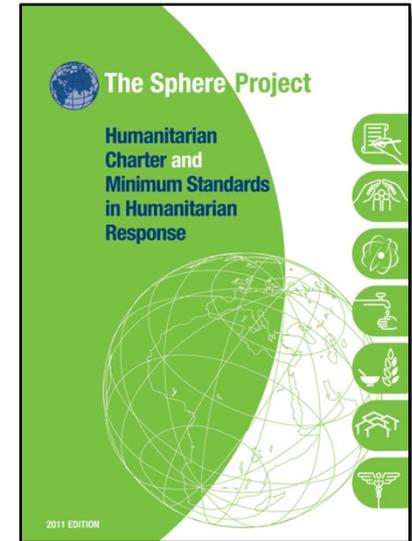
Water Capacity Requirements

Minimum Water Supply Recommendations

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2

-  [The Sphere Project Handbook](#) provides a section on the minimum standards in water supply, sanitation, and hygiene promotion.
-  Use the “Capacity” tab of the [Planning Spreadsheet](#) to calculate minimum water requirements based on recommendations from the World Health Organization, Centers for Disease Control, and Sphere Handbook.





Alternative Sources



When water supplies are depleted, the following alternative sources may be considered:

- 1 Conservation
- 2 Water System Partnerships
- 3 Additional Surface Water
- 4 Additional Groundwater
- 5 Reusing Wastewater
- 6 Hauling Water

 Use the “Alternative Sources” Tab of the [Planning Spreadsheet](#) to inventory potential sources.





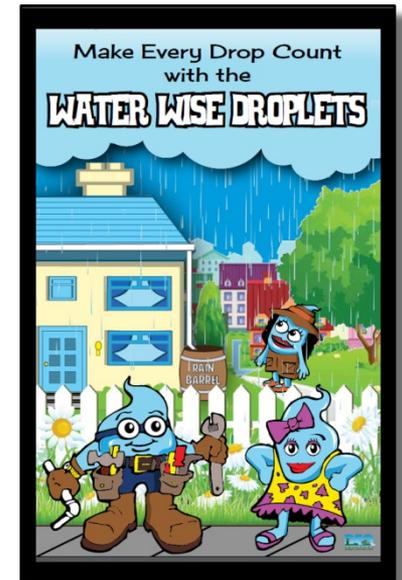
Alternative Sources Conservation



[@](#) The OWRB's [Water Conservation](#) web page provides information on the Water for 2060 Act and Advisory Council and provides numerous links and resources.

The ODEQ's website provides water conservation fact sheets on the following topics:

- [@](#) [Conserving Water in the Kitchen and Laundry Room](#)
- [@](#) [Conserving Water Outdoors](#)
- [@](#) [Conserving Water in the Bathroom](#)
- [@](#) [Water Costs Money, Don't Waste It!](#)
- [@](#) [Make Every Drop Count with the Water Wise Droplets](#) (coloring book)



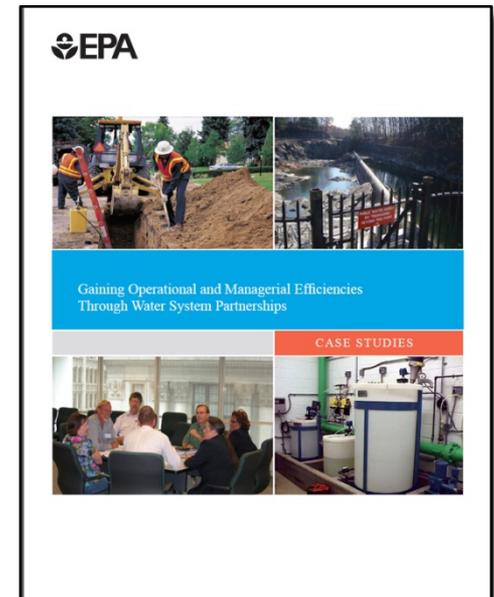


Alternative Sources Water System Partnerships

C 2

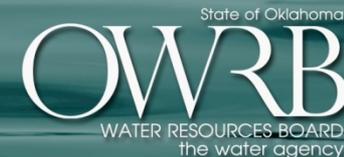
If there are neighboring communities with a reliable water supply, it may be possible to work together to identify possibilities for an inter-connection of distribution systems.

- @ The EPA document [Gaining Operational and Managerial Efficiencies Through Water System Partnerships: Case Studies](#) describes a variety of water utility partnerships from organizational to structural.





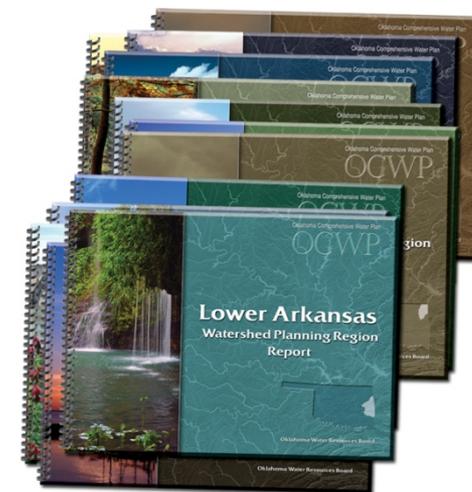
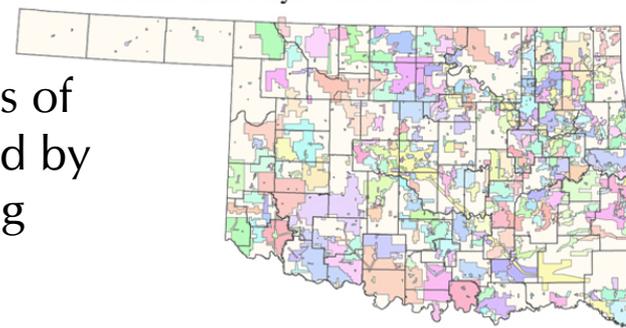
Alternative Sources Water System Partnerships



C 2

- @ The OWRB provides detailed information about [Rural Water Systems](#), including maps of their approximate boundaries statewide and by county, which may be helpful in identifying interconnection possibilities.
- @ Provider specific information for long-term needs can be found in the OWRB's [2012 OCWP Watershed Planning Region Reports](#).
- @ The ODEQ [Public Water Supply](#) web page has additional information.

Rural Water Systems of Oklahoma





Alternative Sources Additional Surface Water



C 3

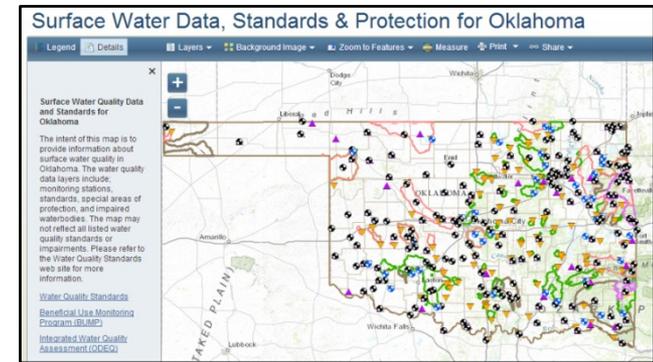
@ The [OWRB website](#) provides the following surface water resources:

@ [Locating Available Water](#) web page

@ [Water Quality Monitoring](#) web page

@ [Interactive map](#) linked directly to stream gage and surface water quality data

@ The [OCWP web page](#), featuring the [Public Water Supply Planning Guide](#) with information on locating additional sources of water





Alternative Sources Additional Surface Water



C 3

Due to a combination of evaporative losses, decreased precipitation, and discharge of waste water, surface water may become brackish. Increased nutrient levels can result in algal blooms. Some algae produce toxic compounds that are difficult to remove in conventional treatment systems. Ultrafiltration is an excellent method for removing suspended solids, turbidity and micro-organisms.

Do not chlorinate or otherwise disinfect before ultrafiltration of brackish surface water, to prevent breaking algal cell membrane and releasing toxins.



The Bureau of Reclamation's [Brackish Water Desalination web page](#) has more information and links to studies and reports.

Brackish Water Desalination

Brackish water desalination focuses on the use of alternative water resources that exhibit higher TDS (total dissolved solids) than seawater (in the range of 1,000 mg/l TDS to 25,000 mg/l TDS). Brackish water can be found in coastal areas (bays and estuaries, where fresh water mixes with salt water), in deserts (where it is usually referred to as saline water), and in surface waters (salt marshes, for instance, contain water). Brackish water sources produce a number of challenges for use:

- Water salinity allows for a broader range of applicable treatment technologies than seawater desalination
- Water composition can include large concentrations of sparingly soluble carbonate and silica salts that can cause scaling
- The affect of long term pumping of brackish ground water aquifers on fresh groundwater resources is unknown
- Issues of concentrate discharge are related to inland concentrate management

Desalination and Water Purification Research Program Reports

Report Title	Performing Agency	Date	Report #	See also
Nanofiltration of a High Salinity Groundwater on the Hopi Reservation	Northern Arizona University, Flagstaff AZ	May 1995	3	
Brackish Groundwater Treatment and Concentrate Disposal for the Horned Lizard in El Paso, Texas	El Paso TX; University of Texas at El Paso	April 1999	32	



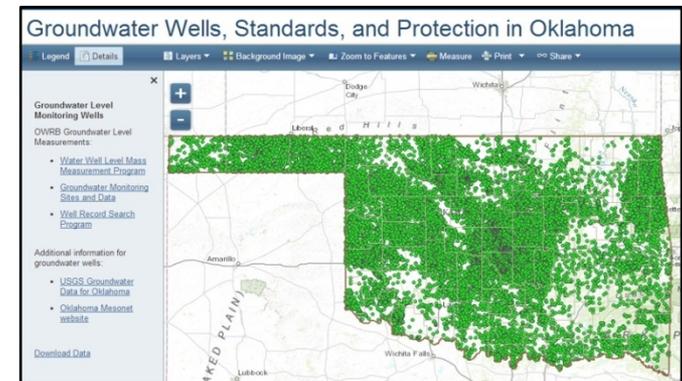
C **4**
@ The [OWRB website](#) provides the following groundwater resources:

@ [Locating Available Water](#) web page

@ [Water Quality Monitoring](#) web page

@ [Interactive map](#) linked directly to groundwater data, including well logs and water level monitors

@ [OCWP web page](#), featuring the [Public Water Supply Planning Guide](#) with information on locating additional sources of water





Alternative Sources Additional Groundwater



C 4

@ The ODEQ [Groundwater web page](#) contains several groundwater quality links, including a list of [maps showing levels of Total Dissolved Solids, Sulfates and Nitrates in Oklahoma's major aquifers](#).

@ The [USGS Groundwater data for Oklahoma web page](#) provides information on current and historical water levels at select sites.





Alternative Sources Additional Groundwater



C 4

Well Services:

- @ Well jetting opens up clogged screens and can aid in restoring well productivity. Most licensed well drillers can provide this service. The OWRB licenses water well drillers in Oklahoma and provides a [public search page](#) for locating licensed drillers by activity and location.
- @ The [Oklahoma Ground Water Association](#) provides a membership directory and also provides links to a wealth of information concerning water well drilling in Oklahoma.





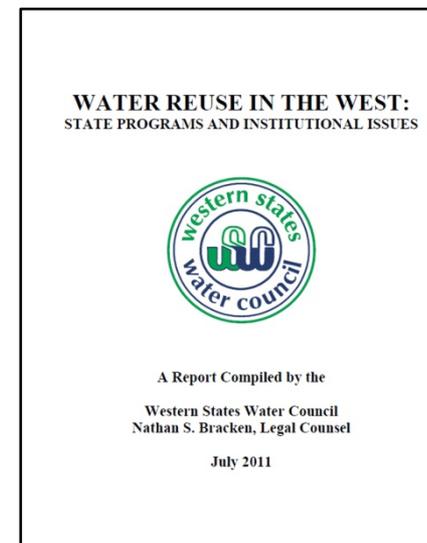
Alternative Sources

Reusing Wastewater



C 5

- @ The Western States Water Council report [Water Reuse in the West: State Programs and Institutional Issues](#) documents the state of water reuse in the western US. Water reuse issues for Oklahoma are discussed on page 35.
- @ The 2012 OCWP Supplemental Report [Marginal Quality Water Issues and Recommendations](#) is an evaluation of the potential use of treated wastewater effluent and other marginal quality water sources to meet some of Oklahoma's future water demands.





Alternative Sources

Reusing Wastewater



@ The ODEQ has developed [Rules for Operation and Maintenance of Water Reuse Systems](#) for reclaimed water Categories 2-5 (below):

Category 2: drip irrigation on orchards or vineyards; spray or drip irrigation on sod farms, public access landscapes and public use areas/sports complexes, including unrestricted access golf courses; toilet and urinal flushing; fire protection systems; commercial closed-loop air conditioning systems; vehicle and equipment washing (excluding self-service car washes); and range cattle watering. Category 3, 4, and 5 can also be permitted as category 2 reclaimed water.

Category 3 (4 and 5 uses can also be permitted): subsurface irrigation of orchards or vineyards; restricted access landscape irrigation; irrigation of livestock pasture; concrete mixing; dust control; aggregate washing/sieving; new restricted access golf course irrigation systems; industrial cooling towers and once-through cooling systems; and restricted access irrigation of sod farms. Category 4 and 5 can also be permitted as category 3 reclaimed water.

Category 4: soil compaction and similar construction activities; and existing restricted golf course irrigation systems utilizing water that has received primary treatment in lagoon systems. Permits to construct shall not be issued for new Category 4 restricted access golf course irrigation systems pending further research and evaluation of performance data collected from existing systems. Category 5 can also be permitted as Category 4 reclaimed water.

Category 5: restricted access pasture irrigation for range cattle; restricted access irrigation of fiber, seed, forage and similar crops; and irrigation of silviculture.





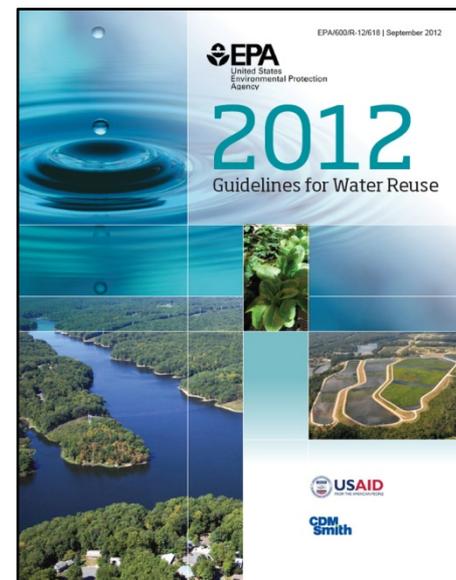
Alternative Sources

Reusing Wastewater

C 5

@ The EPA publication [2012 Guidelines for Water Reuse](#) contains the following information:

- Planning and Management considerations
- Types of Reuse Applications
- State Regulatory Programs for Water Reuse
- Regional Variations in Water Reuse
- Treatment Technologies for Protecting Public and Environmental Health
- Funding Water Reuse Systems
- Public Outreach, Participation, and Consultation
- Global Experiences in Water Reuse





Alternative Sources

Reusing Wastewater



@ Findings of the National Academies Press publication [Water Reuse: Expanding the Nation's Water Supply Through Reuse of Municipal Wastewater](#):

- *Municipal wastewater reuse offers the potential to significantly increase the nation's total available water resources.*
- *De facto reuse of wastewater effluent as a water supply is common in many of the nation's water systems.*
- *Natural systems are employed in most potable water reuse systems to provide an environmental buffer. However, it cannot be demonstrated that such "natural" barriers provide any public health protection that is not also available by other engineered processes.*
- *Reclamation facilities should develop monitoring and operational plans to respond to variability, equipment malfunctions, and operator error to ensure that reclaimed water released meets the appropriate quality standards for its use.*

@ See the Bureau of Reclamation's [Water Reuse web page](#) for more information.





Alternative Sources

Reusing Wastewater



C 5

@ The WaterReuse Research Foundation report titled [Low Cost Treatment Technologies for Small-Scale Water Reclamation Plants](#) identifies and evaluates established and innovative technologies that provide treatment of flows of less than one million gallons per day.

- *The report includes an extensive cost database, where the cost and operation data from existing small-scale wastewater treatment and water reuse facilities have been gathered and synthesized.*
- *The report concluded that natural systems (ponds plus wetlands) are the best economic alternative for small communities if inexpensive land is available and effluent water quality can satisfy the local regulations. If high water quality is desired and budget is available, non-membrane systems can be used. Membrane-based systems can be used if even higher water quality is needed and if budget allows.*





Alternative Sources

Hauling Water



Often the quickest way to provide an emergency water supply is to transport water in tankers from a nearby source and store the water in tanks and reservoirs. It is important to note that hauling water is often the most expensive alternative, but may be more expeditious for a moderate supply volume. Although Oklahoma does not specifically license water haulers, Oklahoma does require that commercial vehicles be registered based on size and weight through the Dept. of Public Safety.

- @ The state of Oregon provides [Drinking Water Hauling Guidelines](#) that describe types of tanker trucks that can be used and how they should be filled and cleaned.
- @ A source for water hauling companies in Oklahoma is [Bulkwaterdelivery.com](#).*

**Please note that some companies on this website do not haul potable water.*





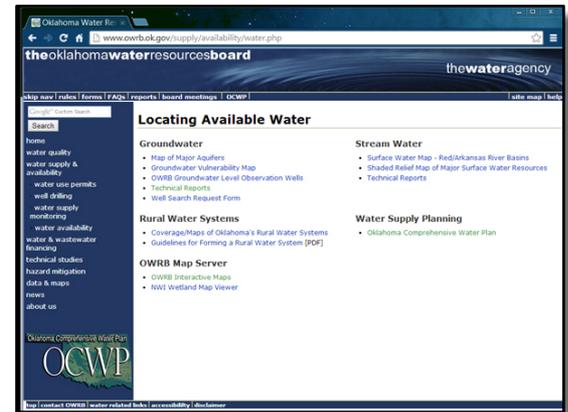
Alternative Sources Hauling Water



C 6

@ The OWRB's [Locating Available Water](#) web page provides information on locating a water supply.

See section F for information on storing hauled drinking water for distribution.





Ancillary Equipment for New Sources



D

Ancillary equipment may be needed for new sources of water.

1 Intakes

2 Pumps

3 Power



Kansas State University Agricultural Experiment Station and Cooperative Extension Service [Handbook for Livestock Producers and Landowners](#) has extensive information on water sources, intake, pumping, storage, alternative power and distribution systems for livestock. The information is equally valuable for temporary, or alternative water supplies for small towns.





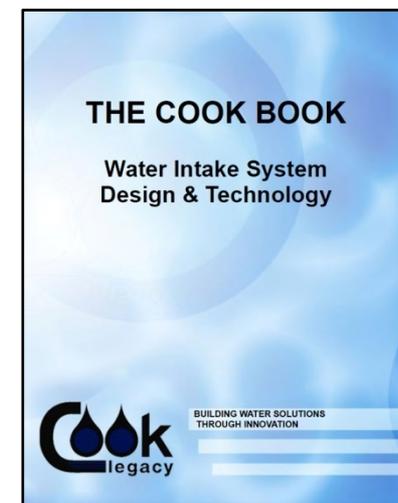
Ancillary Equipment for New Sources Intakes



D 1

Regulations require a screened intake for new surface sources. Examples of local suppliers are listed below:

- @ [Cook Legacy Water & Energy](#) specializes in screen systems of all kinds. They provide [The Cook Book: Water Intake System Design & Technology](#) that is helpful in learning more about screen systems.
- @ [Fluid Equipment](#) in Tulsa, Oklahoma, can help with choosing a screen solution for surface water intakes.
- @ [Hendrick Screen Company](#) has a sales representative in Sand Springs, Oklahoma.





Ancillary Equipment for New Sources

Pumps



D 2

@ Local pump suppliers can be identified on Thomasnet.com. Examples are listed below:

- @ [Arrow Pump & Supply](#)
Cushing, Stroud, Seminole, Ada, and Pawhuska, Oklahoma
- @ [Advanced Power, Inc](#)
Canton, Oklahoma
- @ [Bison Solar Pumps](#)
Balko, Oklahoma
- @ [Pumps of Oklahoma](#)
Oklahoma City, Oklahoma
- @ [Solar Power & Pump Co](#)
Elk City, Oklahoma
- @ [Tarby](#)
Claremore, Oklahoma
- @ [Tulsa Tool & Pump Co, Inc](#)
Tulsa, Oklahoma





Ancillary Equipment for New Sources

Power



D 3

It is a good idea to plan ahead for power outages during a drought. Some well pump suppliers provide solar or wind powered pumps. Examples of local suppliers are listed below:

-  [All Bolt Electric](#)
Harrah, Oklahoma
-  [Clifford Power Systems, Inc](#)
Oklahoma City and Tulsa, Oklahoma
-  [Oklahoma Generator](#)
Oklahoma City and Norman, Oklahoma
-  [Walters Power International](#)
Oklahoma City, Oklahoma





Ancillary Equipment for New Sources Power



D 3

Alternative energy should be considered for distributed pumping systems and temporary treatment systems. The following companies have solar, wind, geothermal, and/or biogas power systems:

-  [Bergey Windpower Co](#)
Norman, Oklahoma
-  [Green Wind and Solar](#)
Norman, Oklahoma
-  [Harvest Solar & Wind Power](#)
Tulsa, Oklahoma
-  [Ion Solar, LLC](#)
Tulsa, Oklahoma
-  [Solar Power & Pump Co](#)
Elk City, Oklahoma
-  [Sun City Solar Energy](#)
Tulsa and Oklahoma City, Oklahoma
-  [Sunrise Alternative Energy](#)
Edmond, Oklahoma

The [Energy Source Guide for Oklahoma](#) also lists other companies that do not have a website.





Water Treatment



E

- 1 Drinking Water Standards
- 2 Water Analysis
- 3 Protecting Public Health





Water Treatment Drinking Water Standards

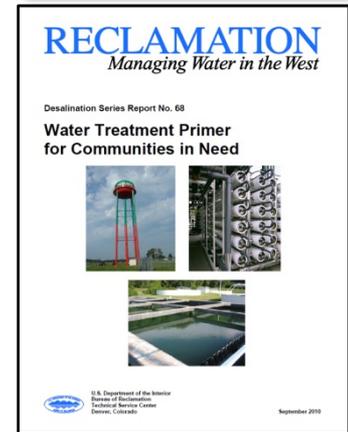


E 1

@ The minimum treatment required for potable water is determined by the ODEQ, which has adopted [EPA Primary Drinking Water Standards](#) designed to protect human health. The regulations address microorganisms, disinfectants, disinfection byproducts, inorganic and organic chemicals and radionuclides.

@ [Secondary water quality standards](#) are set for cosmetic or aesthetic effects.

@ The Bureau of Reclamation publication [Water Treatment Primer for Communities in Need](#) summarizes drinking water regulations, conventional and advanced treatment processes, and treatment for specific contaminants.





Water Treatment

Water Analysis

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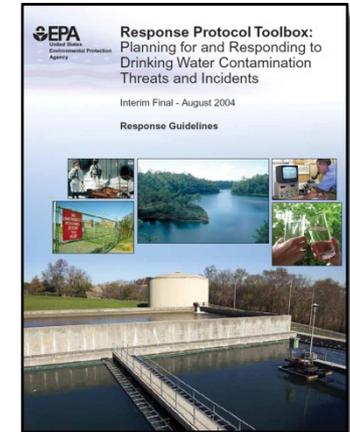
2



A water analysis should be performed before using a new water source. The EPA publication [Response Protocol Toolbox](#) describes EPA water source characterization protocol in chapter 3.



Record water analysis data on the [Planning Spreadsheet](#) H2OAnalysis tab. The Primary and Secondary Safe Drinking Water Standards are included on the H2OAnalysis to aid in identifying treatment goals.





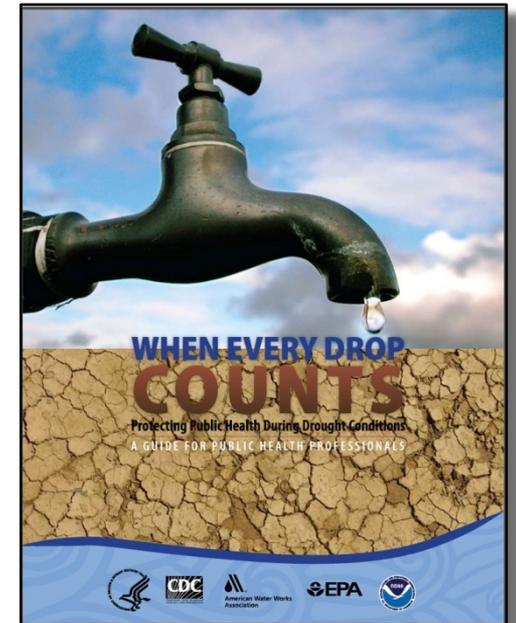
Water Treatment Protecting Public Health

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3



When Every Drop Counts: Protecting Public Health During Drought Conditions is a guide for public health professionals published by the Centers for Disease Control and Prevention's National Center for Environmental Health.



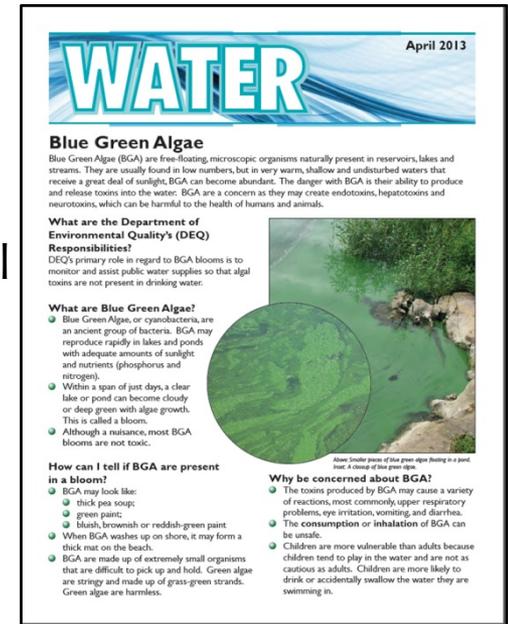


Water Treatment Protecting Public Health

E 3

Cyanobacteria (blue-green algae) can become a problem in warm surface water by producing cyanotoxins that can be harmful to animals and humans. The following resources provide additional information:

- [!\[\]\(85ae5496de65f6e4bb63257ba218ed6e_img.jpg\) ODEQ Blue Green Algae Fact Sheet \(ODEQ\)](#)
- [!\[\]\(0bae8c5091e2c9f8f09d8902eda9aebb_img.jpg\) EPA Cyanobacteria Factsheet \(EPA\)](#)
- [!\[\]\(869bff6e1f535ea464ec6a6cd2e60bae_img.jpg\) Cyanotoxin Removal in Drinking Water Treatment Process and Recreational Waters \(NEIWPC\)](#)



WATER April 2013

Blue Green Algae

Blue Green Algae (BGA) are free-floating, microscopic organisms naturally present in reservoirs, lakes and streams. They are usually found in low numbers, but in very warm, shallow and undisturbed waters that receive a great deal of sunlight, BGA can become abundant. The danger with BGA is their ability to produce and release toxins into the water. BGA are a concern as they may create endotoxins, hepatotoxins and neurotoxins, which can be harmful to the health of humans and animals.

What are the Department of Environmental Quality's (DEQ) Responsibilities?
DEQ's primary role in regard to BGA blooms is to monitor and assist public water supplies so that algal toxins are not present in drinking water.

What are Blue Green Algae?

- Blue Green Algae, or cyanobacteria, are an ancient group of bacteria. BGA may reproduce rapidly in lakes and ponds with adequate amounts of sunlight and nutrients (phosphorus and nitrogen).
- Within a span of just days, a clear lake or pond can become cloudy or deep green with algae growth. This is called a bloom.
- Although a nuisance, most BGA blooms are not toxic.

How can I tell if BGA are present in a bloom?

- BGA may look like:
 - thick pea soup;
 - green paint;
 - blue, brownish or reddish-green paint
- When BGA washes up on shore, it may form a thick mat on the beach.
- BGA are made up of extremely small organisms that are difficult to pick up and hold. Green algae are stringy and made up of grass-green strands. Green algae are harmless.

Why be concerned about BGA?

- The toxins produced by BGA may cause a variety of reactions, most commonly upper respiratory problems, eye irritation, vomiting and diarrhea.
- The consumption or inhalation of BGA can be unsafe.
- Children are more vulnerable than adults because children tend to play in the water and are not as cautious as adults. Children are more likely to drink or accidentally swallow the water they are swimming in.

Algae (smaller pieces of blue green algae floating in a pond, next to a cluster of blue-green algae)





Distribution and Storage

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When water supplies are depleted, distribution and storage decisions and activities must be considered:

- 1 Distribution Options
- 2 Blending and Re-mineralization
- 3 Temporary Water Storage
- 4 Disinfection of Tanks
- 5 Disinfection of Containers





Distribution and Storage

Distribution Options



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With a reduced water supply, it can be difficult to keep the distribution system full of water with acceptable quality. The following resources and considerations pertain to distribution options.

Distribution water quality:

- @ The Awwa Research Foundation's State of the Science report titled [Advancing the Science of Water: AwwaRF and Distribution System Water Quality](#) is a resource for disinfectant residuals and decay; lead, copper, and corrosion; distribution system modeling; distribution system monitoring and sampling; pressure transients and intrusion; and water quality maintenance and operations.
- @ The North Carolina AWWA-WEA publication [Distribution System Water Quality Control](#) describes the water quality issues and control measures undertaken by the City of Raleigh, NC, during a drought in 2007.





Distribution and Storage

Distribution Options



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Disinfection and pressurization protect drinking water in the distribution system from contamination. Other countries deliver non-potable water only periodically and leave the system un-pressurized the rest of the day or week. This is not an attractive option since we are used to getting potable water from our faucet. However, it may become the only option when water supply is extremely limited.

If the distribution system is designed in segments, then one segment can be filled at a time with extra disinfection residual. As a short term emergency strategy, point of use treatment systems such as carbon filter pitchers can be distributed to treat tap water for drinking and cooking.

@ Refer to [EPA Environmental Technology Verification Reports](#) for Point of Use treatment.





Distribution and Storage

Distribution Options



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Public water dispensary:

- @ The World Health Organization's publication [Environmental Health in Emergencies and Disasters: a Practical Guide](#) provides information in chapter 7 on using water tankers, temporary water distribution stands, water containers, and facilities for personal hygiene.





Distribution and Storage Blending and Re-mineralization



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When introducing a new water quality of highly treated water to a distribution system, it is important to stabilize the water to prevent piping corrosion.

- @ The World Health Organization's publication [Safe Drinking-Water from Desalination](#) provides information in chapter 6 on blending desalted water with other sources (in order to protect storage and distribution plumbing) and re-mineralization (to increase the concentration of important nutritional minerals).





Distribution and Storage

Temporary Water Storage



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Temporary storage bladder tanks provide easily transportable water storage in a wide variety of sizes. Examples of suppliers are listed below:

-  [Husky Portable Containment](#)
Dewey, OK
-  [Interstate Products, Inc.](#)
Sarasota, FL
-  [Aero Tec Laboratories](#)
Ramsey, NJ
-  [Basic Concepts, Inc.](#)
Anderson, SC





Distribution and Storage Disinfection of Tanks



F 4

@ The World Health Organization's Cleaning and disinfecting water storage tanks and tankers Technical Note includes considerations for using tanks that have been converted from another purpose, instructions for disinfecting the tank, chlorine testing to ensure disinfectant is sufficiently rinsed out, and considerations for disposal of waste liquids.

World Health Organization WEDC

TECHNICAL NOTES ON DRINKING-WATER, SANITATION AND HYGIENE IN EMERGENCIES

3

Cleaning and disinfecting water storage tanks and tankers

In an emergency situation, it is often necessary to quickly provide a basic water supply for the affected population. This may be because the normal systems of supply have been damaged or destroyed. The most common, immediate solution is to hire vehicles and tanks that have been used for other purposes or to retrieve collapsible tanks from an emergency store. In either case, they must be cleaned and disinfected before being used. This technical note outlines a four-step approach to cleaning and disinfecting water tanks and tankers.



Procedural steps

In the case of an emergency, it is an acceptable practice to disinfect tanks that are polluted or not in use so that drinking-water can be transported and stored safely. Figure 3.1 presents the four-step approach to cleaning and disinfecting water tanks.

Note: Large quantities of clean water will be required to clean and treat tanks before they can be used to transport or store water.

Step 1: Select the tanks to use

Tanks should be selected based on three considerations: normal use, ease of cleaning and water storage hygiene.

Disinfected tanks should only have been used for holding food-grade liquids, for example, milk, cooking oils, fuel, juices, wines and spirits or vinegar. Tanks previously used for holding non food-grade liquids such as fuel and sewage should not be used. Tanks that previously held water but have been out of use for some time must also be cleaned and disinfected as described below under Steps 2 and 3.

Tanks must be easy to clean. This means they must be accessible for cleaning and have no sharp corners that may hold dirt and so prevent the removal of food deposits.

Water will only remain clean if stored safely. Tanks must therefore be covered and fitted with an access point with a lockable lid.

Step 2: Cleaning

Empty the tank

Open the outlet valve or tap and drain out any remaining liquid. Collect the liquids so that they can be safely disposed of (see Step 4).

In the case of tankers, outlet valves are usually located at the back so parking it on a slope will help to ensure that all the liquid can be discharged (see Figure 3.2, overleaf).

Permanent storage tanks are usually fitted with a washdown pipe that draws liquid from the base. Use this, rather than the normal outlet valve, for emptying.

Step 3: Clean the tanks and trailers to use

Clean the tanks and trailers

Step 4: Disinfect the tanks and trailers

Safely dispose of fuel waste

Figure 3.1
Steps for cleaning and disinfecting water tanks and tankers

Scrub the internal surfaces of the tank

Use a mixture of detergent and hot water (powdered laundry detergent will do) to scrub and clean all internal surfaces of the tank. This can be done with a stiff brush or a high pressure jet. Attaching the brush to a long pole may make it possible to clean the tank without entering it (Figure 3.3).

TECHNICAL NOTES ON DRINKING-WATER, SANITATION AND HYGIENE IN EMERGENCIES

31





Distribution and Storage

Disinfection of Containers



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- @ The Centers for Disease Control and Prevention provides a web page with [information on cleaning and storage of water containers](#) that includes instructions for cleaning and sanitizing water containers, properties of acceptable water containers, proper labeling and storage of water containers, and instructions for disinfecting water at home.





Waste Management Municipal Water Treatment



G **@** Wastewater discharges are regulated by the ODEQ Water Quality Division. Visit the [General Permits](#) web page for information on permitting. Staff listed on the Water Quality Division [Contacts](#) page are available to address program-specific questions.

- 1** Desalination Concentrate: Brackish Water
- 2** Desalination Concentrate: Land Application/Irrigation
- 3** Desalination Concentrate: Discharge to Treatment Plant
- 4** Desalination Concentrate: Deep Well Injection
- 5** Solid Waste Management





Waste Management Desalination Concentrate



All water treatment desalination processes generate a concentrated waste stream. The following information should be considered:

The recovery rate, or efficiency of the system, is calculated by dividing the volume of treated water produced by the volume of water fed into the system.

Brackish water nanofiltration and reverse osmosis recovery rates range from 50% to 85% depending on the water composition and system design.

Small reverse osmosis systems have a low recovery rate of 5-7%.

The volume of concentrate is proportionate to recovery rates and water quality.





Waste Management Desalination Concentrate



Local engineering firms can determine the best concentrate management solution for your situation. In some cases it will be best to maximize recovery (and smallest concentrate volume with maximum TDS). In other cases it will be best to minimize recovery (and increase concentrate volume with minimum TDS) so that it can be used locally for beneficial purposes.





Waste Management Desalination Concentrate: Brackish Water

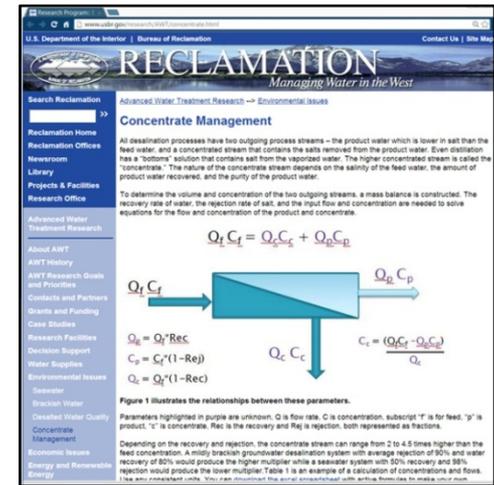


G 1

@ The Bureau of Reclamation's [Concentrate Management Research](#) web page provides a list of Federally funded reports on concentrate issues and management processes.

@ The [Central Arizona Salinity Study: Phase II Concentrate Management](#) provides a comparison of concentrate management solutions and costs.

@ The [Existing & Emerging Concentrate Minimization & Disposal Practices for Membrane Systems](#), published in the 2006 Florida Water Resources Journal, provides a description of concentrate management methods.





Waste Management

Desalination Concentrate: Land Application/Irrigation



-  The WaterReuse Foundation's [Salinity Management Guide](#) identifies liquid waste land applications, featuring information on the following topics:
 -  [Sodium Absorption Ratio \(SAR\)](#)
 -  [Using Electrolyte Concentration and SAR to evaluate water](#)

-  Reclamation's [Water Reuse Study for Big Bear, California](#) compares RO and NF concentrate quality to secondary municipal wastewater for irrigation water potential. This report includes analysis of SAR, conductivity, and fitness for irrigation.





Waste Management

Desalination Concentrate: Discharge to Treatment Plant



Discharge to a wastewater treatment facility may be an option depending on the composition of the concentrate and other flows into the system.

This option should be discussed with your engineer, wastewater treatment system management, and ODEQ Water Quality Division contact.





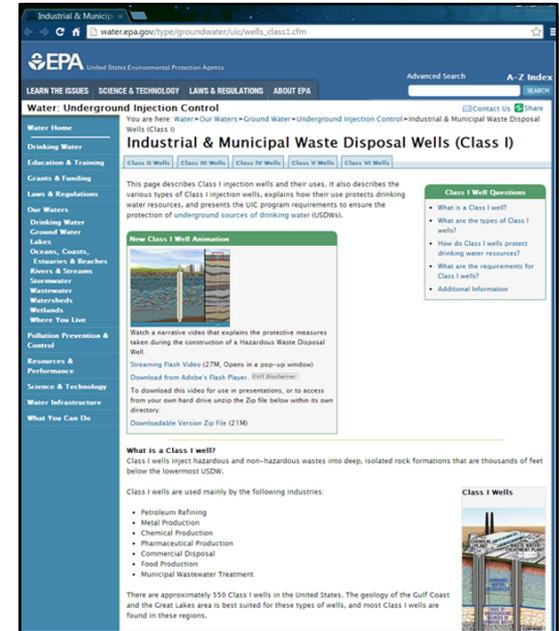
Waste Management Desalination Concentrate: Deep Well Injection



G 4

@ The EPA's Industrial & Municipal Waste Disposal Wells (Class I) web page defines Class I injection wells and their uses.

@ Waste disposal by deep well injection is regulated by the ODEQ. The Land Protection Division Underground Injection Control group oversees underground injection control activities. Under Title 252, Chapter 652.





Waste Management

Solid Waste Management



G 5

Solid waste might be generated during a drought from the existing water treatment plant if hazardous water sources contaminate the media or high water recovery precipitates solids during treatment.

- @ The ODEQ Land Protection Division's [Solid Waste Management section](#) reviews permit applications for solid waste disposal.





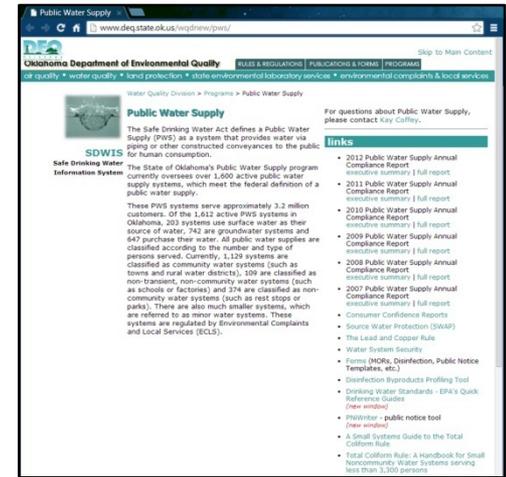
Regulatory Requirements



@ The ODEQ's Water Quality Division is responsible for regulating facilities that produce and distribute public drinking water and that treat, transport, store, and discharge wastewater.

@ The division's Public Water Supply program currently oversees over 1,600 active public water supply systems.

@ Systems serving fewer than 15 connections or 25 people are regulated by the Environmental Complaints and Local Services Division.





Commercially Available Packaged Treatment Systems¹



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- 1 Mobile/Containerized Treatment Units
- 2 Commercial System Sources
- 3 Air Stripping Equipment²

¹ List of systems developed through a review of companies that sell or rent mobile treatment equipment.

² Air stripping technology could be used for any source of water that contains VOCs, but is more commonly seen in groundwater.





Commercially Available Packaged Treatment Systems

Mobile/Containerized Treatment Units



I 1

Water treatment systems designed and built by the private industry have the capabilities to treat many types of source water:

- Brackish Surface Water
- Produced Water
- Secondary Wastewater
- Groundwater



Example: Commercial and Industrial RO Systems
[Applied Membranes, Inc.](#)

Certain mobile and containerized systems are emphasized base on their ability to treat the potential alternative water resources.



A number of companies specialize in the design and construction of mobile or containerized water treatment systems, a number of which are included in the Equipment Sources list tab in the [Planning Spreadsheet](#).





Commercially Available Packaged Treatment Systems

Mobile/Containerized Treatment Units



System Types	Advantages and Disadvantages
Smaller Mobile Units ($< 100,000$ gpd)	<ul style="list-style-type: none">• Highly mobile light weight truck or double axel trailer mounted units easy to transport• Smaller capacity systems
Larger Mobile Units (up to 500,000 gpd)	<ul style="list-style-type: none">• Process configuration is inclusive of multiple process options allowing for the treatment of a variety of source waters• Set design configurations and processes equipped on all systems regardless of source water application
Custom Containerized Systems	<ul style="list-style-type: none">• Highly customizable to water source; eliminates extraneous processes• Specific design for a set water chemistry• Mounted in 20 to 40 ft containers; requires crane and commercial transport to move containers to new locations





Commercially Available Packaged Treatment Systems

Mobile/Containerized Treatment Units



- @** Portable Water Purification System example:
[Outpost A system by Aqua Sun International](#)
*This system is a multi-powered (solar, grid or portable generator) water purification system capable of producing potable water from non-saline water sources.
Production: 17,280 gpd at a rate of up to 720 gph or 12 gpm.*
- *Treatment process train includes filtration and UV disinfection.*
 - *Filter can be substituted for lead, mercury, arsenic, and fluoride reduction filters to target specific contaminants.*
 - *With a replacement parts kit the system is 58" x 42" x 46" and 330 lbs.*
 - *All water contact components carry a NSF Approval Rating and the ultraviolet light carries a Certificate of Analysis.*
 - *Price quoted at \$7,400 and availability will depend on the number of units ordered.*





Commercially Available Packaged Treatment Systems

Mobile/Containerized Treatment Units



1 1

@ Portable Complete Reverse Osmosis (RO) System example:
[Series J RO Water Filtration System by Applied Membranes, Inc.](#)
Designed to produce low dissolved solids water from tap or well water, these commercial RO systems use highly efficient Reverse Osmosis Membranes. Production: 11,500-28,800 gallons per day.

- Heavy duty powder coated frame.
- SS High pressure components, SS Pump.
- Microprocessor Controlled Operation.
- Conservatively engineered for reliable long term performance.
- Factory tested to ensure trouble-free operation.





Commercially Available Packaged Treatment Systems Mobile/Containerized Treatment Units



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@ Larger Mobile Water Treatment System example:
[Aquamove Mobile RO Trailer by Veolia Water Solutions and Technologies](#)
Capable of treating a variety of source waters, the 300 gpm (432,000 gpd) system can be configured as a 100-135 gpm two pass unit.

- *Treatment process: multimedia, carbon, iron removal, or softening pretreatment, depending on source water, followed by RO membrane filtration.*
- *Trailer dimensions: 53' x 8.5' x 13.5'*
- *Weight: 55,000/75,000 lbs. (shipping/operating)*
- *Requires three phase power 460V/3Ph/60Hz at 60-100 amps.*
- *Trailers are only available for lease.*
- *Trailers are available on a first come first serve basis.*
- *Trailers can be prepared and transported to a field site in 48 to 72 hours.*





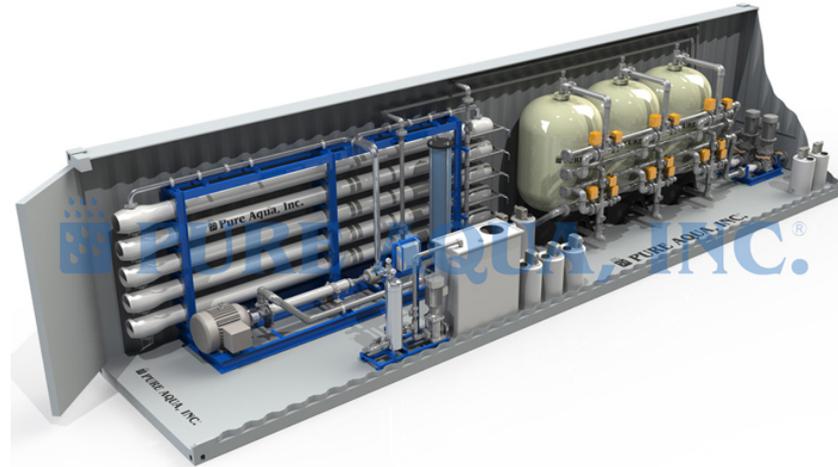
Commercially Available Packaged Treatment Systems Mobile/Containerized Treatment Units



1 1

@ Containerized Water Treatment System example:
[Containerized RO Water Treatment System by Pure Aqua, Inc.](#)
Customizable with various configurations for any source water application, capacities range from 30,000 gpd to 900,000 gpd.

- *Systems are generally mounted in 20 ft. containers.*
- *Containers require 460V/3Ph/60Hz power supply.*
- *Cost of the system dictated by source water.*
- *Lead time to manufacture is 8-10 weeks from receipt of order.*





Commercially Available Packaged Treatment Systems

Commercial System Sources



1 2

Several examples of mobile systems are listed below:

- [!\[\]\(327b047b5862263ea17d00fe03631e4a_img.jpg\) Applied Membranes](#)
- [!\[\]\(33d7f1af2f8e9632b4d55ebe2d731c29_img.jpg\) Aqua Sun](#)
- [!\[\]\(579947b13f4012c7d9768fa1dae2bda3_img.jpg\) Environmental Improvements Inc.](#)
- [!\[\]\(fceb0ca0ef219cdd6df9a992d9615fa7_img.jpg\) First Water](#)
- [!\[\]\(9f0589ee8aaa477f697531e8cf4a8500_img.jpg\) Forever Pure](#)
- [!\[\]\(06d6d367be6014e1d8486c68d015942d_img.jpg\) GE Water](#)
- [!\[\]\(5c981a1c56bdcbea4df849952a14c1d6_img.jpg\) Lifestream Water Purification Equipment](#)
- [!\[\]\(00e78b4cbc66bb3660fbceaf8868e8c2_img.jpg\) Noah Water](#)
- [!\[\]\(fe3eec169cf532fc8c45e46e212197c8_img.jpg\) Pall Corporation](#)
- [!\[\]\(64f95810eacb6f535c5dac4550508314_img.jpg\) Pure Aqua](#)
- [!\[\]\(76267ac5706dfcaadca8f553fee0e24e_img.jpg\) RODI Systems](#)
- [!\[\]\(9dcbd08c421989b47b9e175c370c7e2a_img.jpg\) Veolia](#)
- [!\[\]\(8a65112ac0c1241c2cd36e62235ac9ee_img.jpg\) Water Control Inc](#)

Presentation of commercial products does not constitute an endorsement of that product or commercial enterprise.





Commercially Available Packaged Treatment Systems

Air Stripping Equipment



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Air stripping technology could be used for any source of water that contains VOCs but is more commonly seen in groundwater. Air stripping is primarily used for removing volatile organics chemicals (VOCs).



Air Stripping Unit example:

[STAT 180 Air Stripper Skid by Caronair](#)

Units are either trailer mounted or skid mounted and can be used for VOC removal; equipped with either diesel or electrically powered blowers, and can accommodate gravity or pump out discharge. Flow rate up to 200 gpm.

- *Can be provided as a stand-alone treatment or part of a fully integrated treatment system.*
- *Transfer pump mounted on skid.*
- *Skid mounted with controls.*





Federal Sources For Treatment Systems



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Federal resources can be called into service if the President declares a state of emergency (requested by Governor).

- @ The Department of Defense Reserves and National Guard have access to military expeditionary [water treatment equipment](#) with capacities ranging from 5 gal/min to 100 kgal/day.

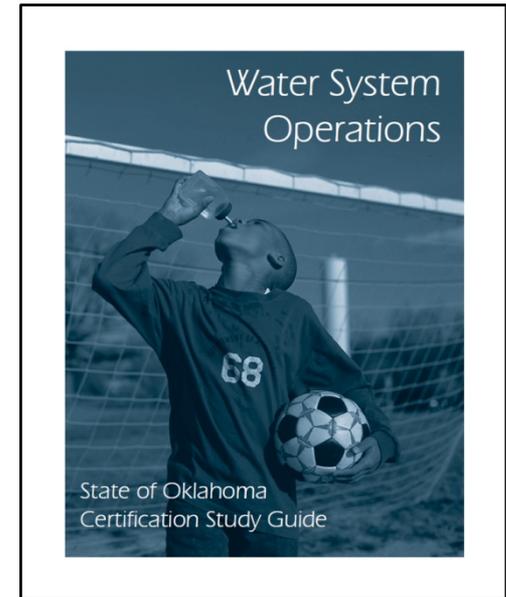




Water Treatment Operator Requirements

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- @ The Oklahoma Department of Environmental Quality (ODEQ) regulations describe the [certification process](#) for Water and Wastewater works operators.
- @ A [Water System Operations Certification Study Guide](#) is also available on the ODEQ website.





Potential Funding Sources



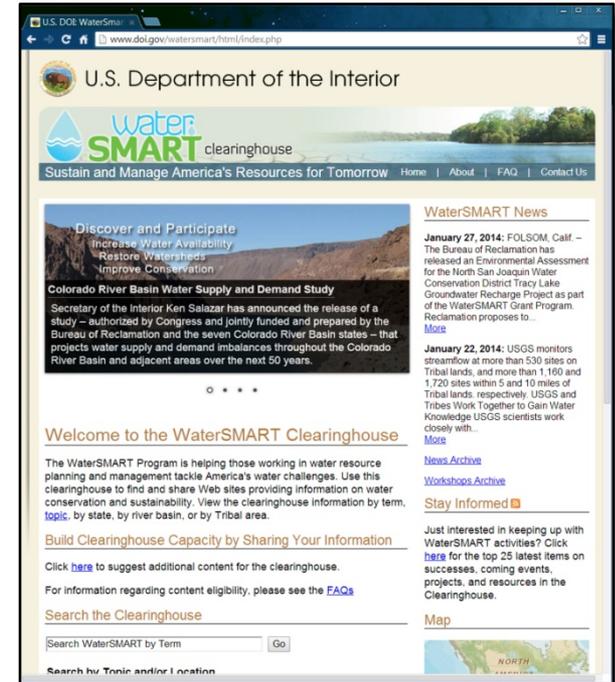
L

State of Oklahoma:

- @ [OWRB Loan and Grant Programs](#)
- @ [Emergency Drought Relief Fund](#)

Bureau of Reclamation, OK-TX Area Office:

- @ [WaterSMART Program](#)
- @ [Title XVI Program, Water Reclamation and Reuse Program](#)
- @ [Reclamation Activities in Oklahoma](#)
- @ [USDA Farm Service Agency](#)





Public Communication and Involvement



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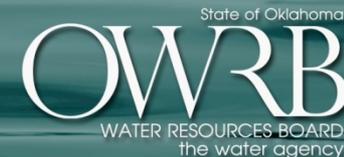
Successful conservation messages must be targeted to local communities, focusing on specific water situations. Key components of community outreach efforts should address the following topics:

- What is the source of the local water supply?
- How sufficient is the supply?
- What visible sign will indicate to the public the need to conserve?
- How will the water utility help with conservation?
- Ideas for increasing water efficiency





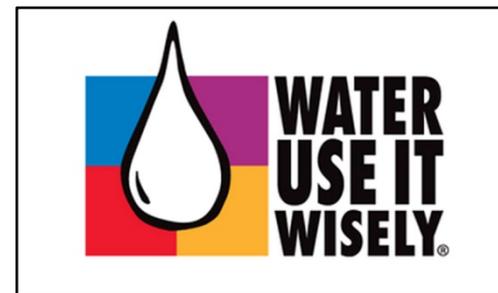
Public Communication and Involvement



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Online public outreach resources:

- [@ Protecting Water for People and Nature](#)
Global Water Program, The Nature Conservancy
- [@ Water Use it Wisely](#)
- [@ Water Conservation web page](#)
Oklahoma Water Resources Board
- [@ Drought Resources web page](#)
Oklahoma Water Resources Center
- [@ California Water Awareness Campaign](#)
- [@ Elementary Water Conservation Trailhead](#)
Spokane Aquifer Joint Board
- [@ Texas Conservation Education](#)
Texas Water Development Board





Model Drought Management Plans

N

Model community drought management and response plans from other states:

- @ South Carolina
- @ Colorado
- @ Florida Rural Water Association
- @ Tennessee
- @ Texas
- @ Kansas
- @ Various states and other sources





Contacts



Name	Organization	Role	Phone	Email
Terri Sparks	Oklahoma Water Resources Board	Technical Assistance	405-530-8800	terri.sparks@owrb.ok.gov
Collins Balcombe	US Bureau of Reclamation	Reclamation Programs	512-899-4150	cbalcombe@usbr.gov
Michelle Chapman	US Bureau of Reclamation	Technical Assistance	303-445-2264	mchapman@usbr.gov

