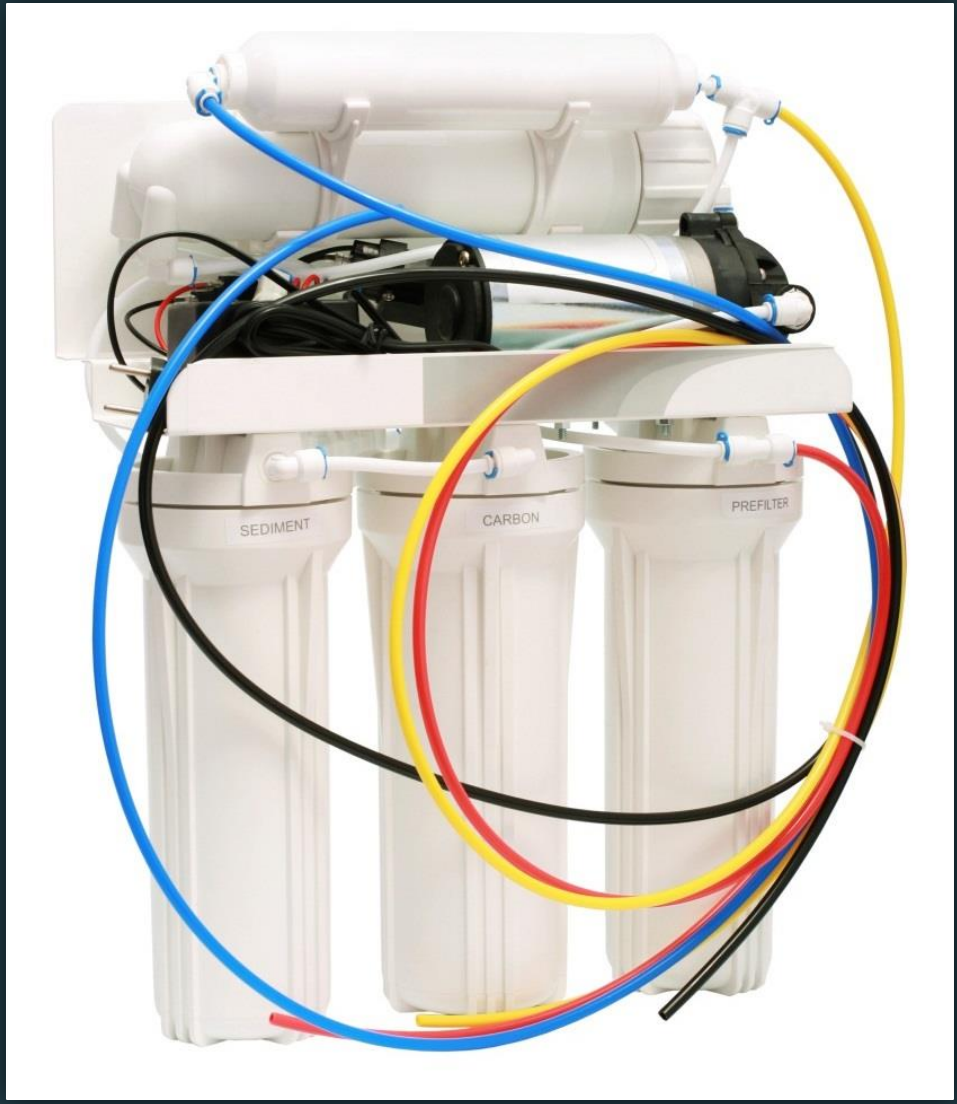
SESSION 8: *Water Treatment Options*

TWON
TEXAS
Well Owner
NETWORK

SESSION 8: Water Treatment Options

- Particle and microfiltration
- Activated carbon filter
- Reverse osmosis
- Distillation
- Ion exchange – water softening
- Disinfection
- Continuous chlorination
- Boiling



Water Treatment

- Test your well
- Locate contamination source if possible
- Check well construction
- Inspect septic system
- Eliminate source of contamination
- Consider drilling new well

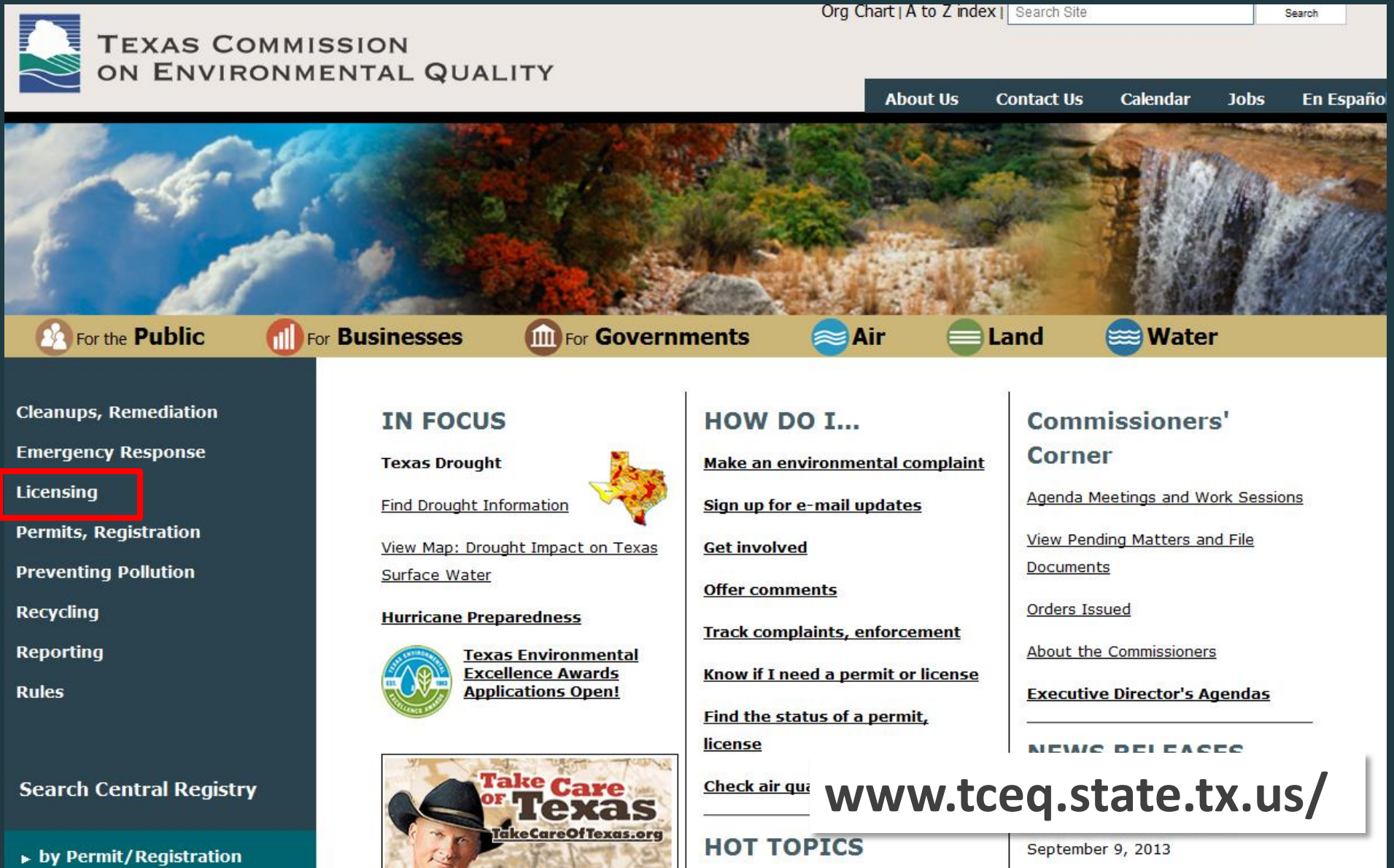
Point of Entry (POE)

Treats water as it enters a home, whole house

Point of use (POU)

Installed at the faucet

Licensed Water Treatment Specialists



Licensed Water Treatment Specialists

www.tceq.texas.gov/licensing

Licensed Water Treatment Specialists

TCEQ Search Licensing or Registration Information

Welcome to the TCEQ Licensing or Registration Information Search.

Please select one of the following options to begin the search process:

All License Types

- Search Individual Licensing Information
- Search Company Registration Information
- Group Search Criteria

Landscape Irrigation Only

- For Homeowners - Landscape Irrigator Search by Name or License
- For Homeowners - Landscape Irrigator Search by ZIP code, city, or county

- Landscape Irrigation License Search by Name or License Number
- Landscape Irrigation License Search by ZIP code, city, or county

www2.tceq.texas.gov/lic_dpa/index.cfm

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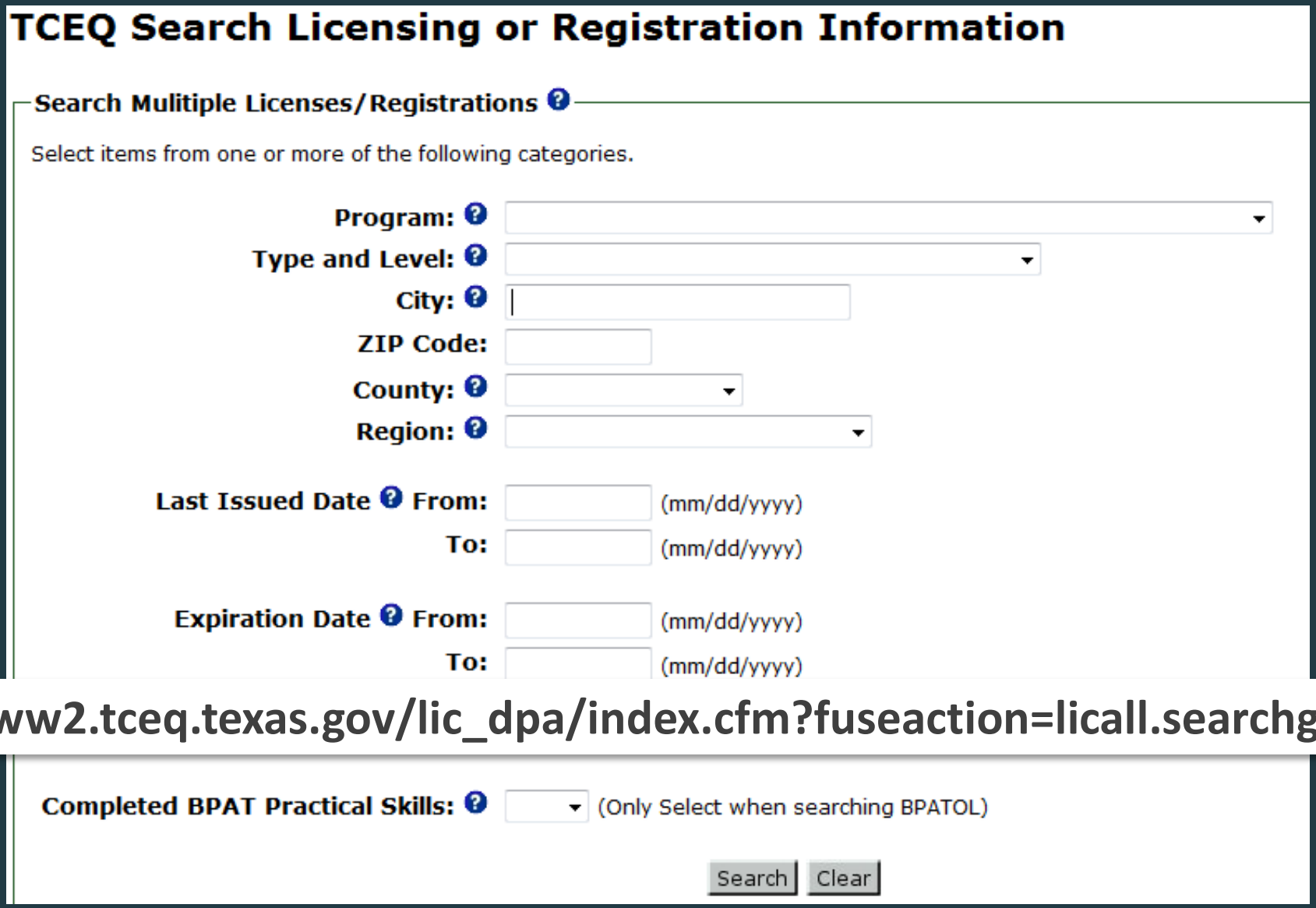

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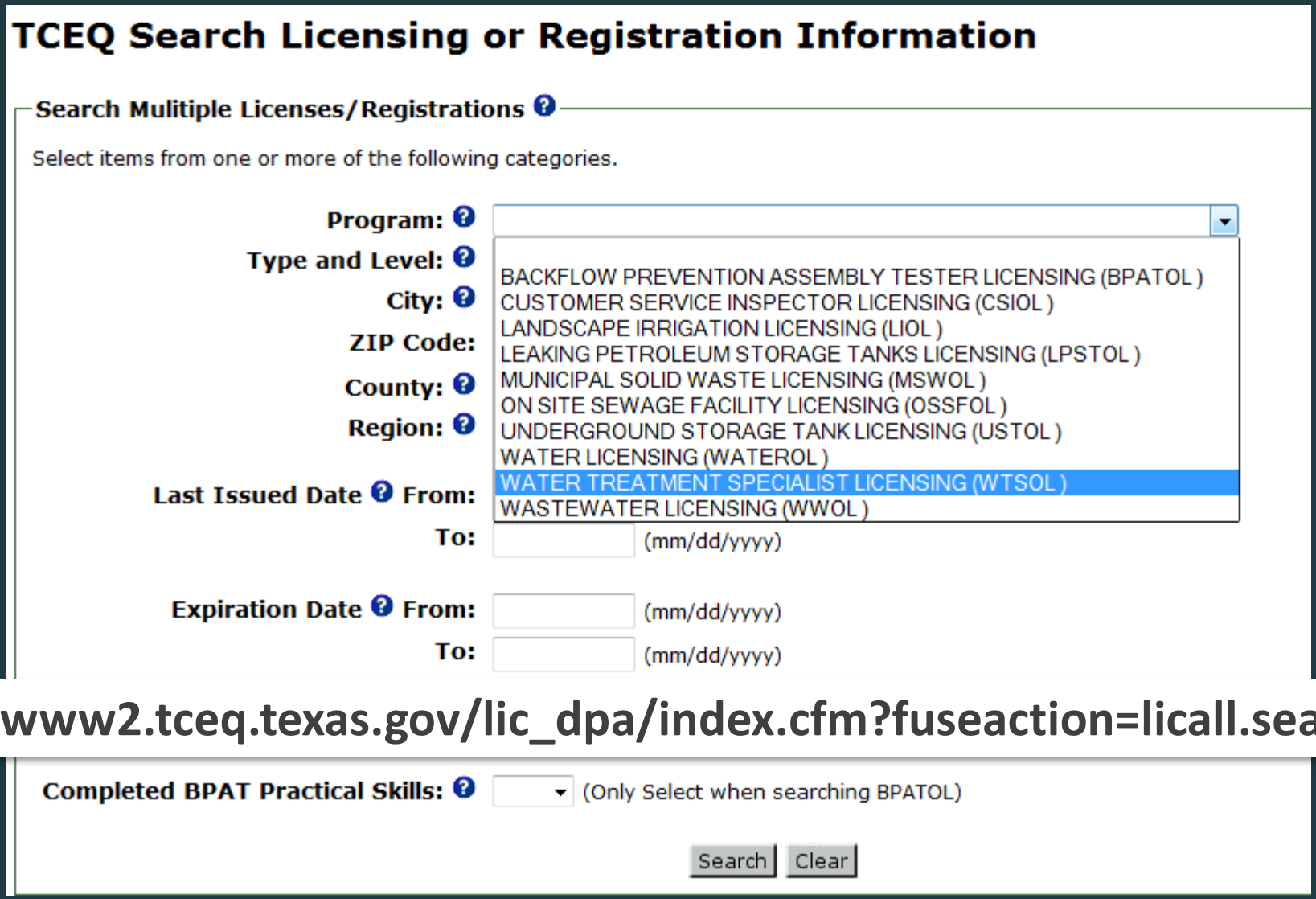

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Licensed Water Treatment Specialists

Licensing Query - Search Results List

Your Search Returned 4 Records.

Click on a licensee to view detailed information. You may also view and save this list as a MS Word document or as a tab-delimited text file. A list of results containing license type, license level, license number, effective date and expiration date is also available as a MS Word document.

1-4 of 4 Records

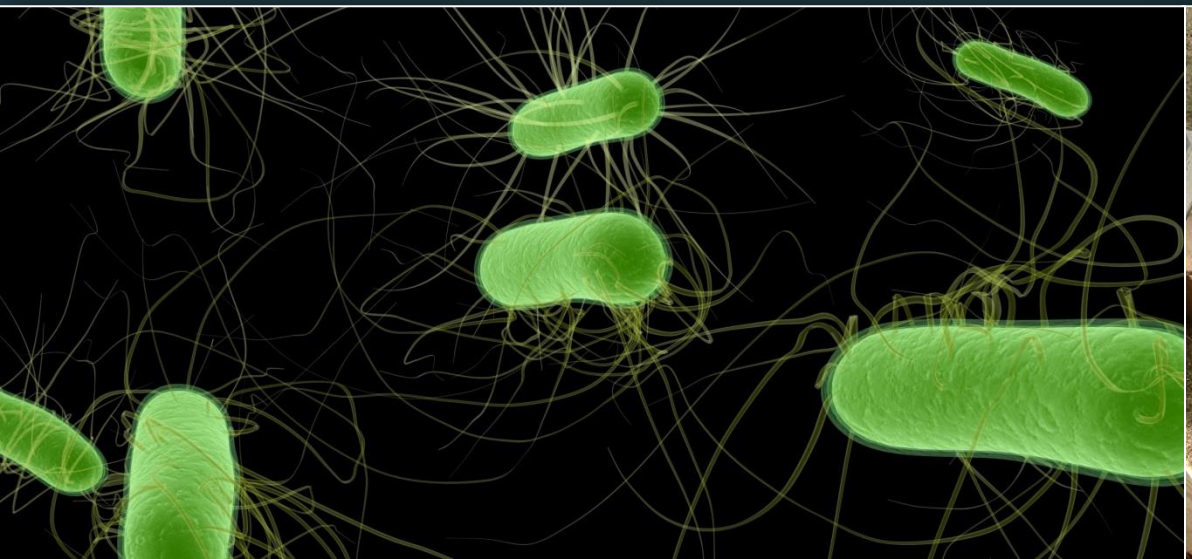
Name	Address	City	State	ZIP
BOEDEKER, ALAN C	PO BOX 1101	BRYAN	TX	77806-1101
CEPEDA, HECTOR M	2708 BROOKWAY DR	COLLEGE STATION	TX	77845-3838
OREAR, WESLEY D	3900 STATE HIGHWAY 6 S STE 102	COLLEGE STATION	TX	77845-5831
RAMIREZ, HECTOR	6 PARK PLACE	COLLEGE STATION	TX	77840

1-4 of 4 Records

The following search criteria was entered:
County: BRAZOS
Program: WTSOL

Bacteria

- Coliform bacteria
  - Indicator bacteria
  - Indicates risk from other disease-causing organisms
  - *E. coli*, from human and animal digestive systems
- Iron, manganese, and sulfur-reducing bacteria
  - Nuisance bacteria, not a health risk



Treating Bacteria

- If you have a positive test for fecal coliform bacteria, there are several steps that you should take:
  1. Boil all water intended for consumption
  2. Disinfect the well thoroughly with chlorine
  3. Monitor the water quality to ensure the problem does not recur

- If recurring, try to identify the source
- To kill bacteria and viruses:
  - Chlorination
  - Ultraviolet light
  - Ozone
  - Distillation

Treating Bacteria

Shock Chlorination

- Method of disinfecting a water well
- **Not a long term solution**
- Should be done anytime well system is "opened"
- **Recommended to contract a licensed well driller**
- If homeowner does it, make sure to follow correct procedure

	Laundry bleach (about 5.25% hypochlorite)				
Standing water depth in well (in feet)	Casing diameter				
	4 inches	6 inches	8 inches	10 inches	12 inches
10	1/2 cup	1 cup	1 1/2 cups	1 pint	2 pints
25	1 cup	1 pint	2 pints	3 pints	4 1/2 pints
50	1 pint	1 quart	2 quarts	3 quarts	1 gallon
100	1 quart	2 quarts	1 gallon	1 1/2 gallons	2 gallons
150	3 pints	3 quarts	1 1/2 gallons	2 gallons	3 gallons

Treating Bacteria

Shock Chlorination of Stored Water

- Check to see if storage tank is the source
- Determine the correct amount of chlorine

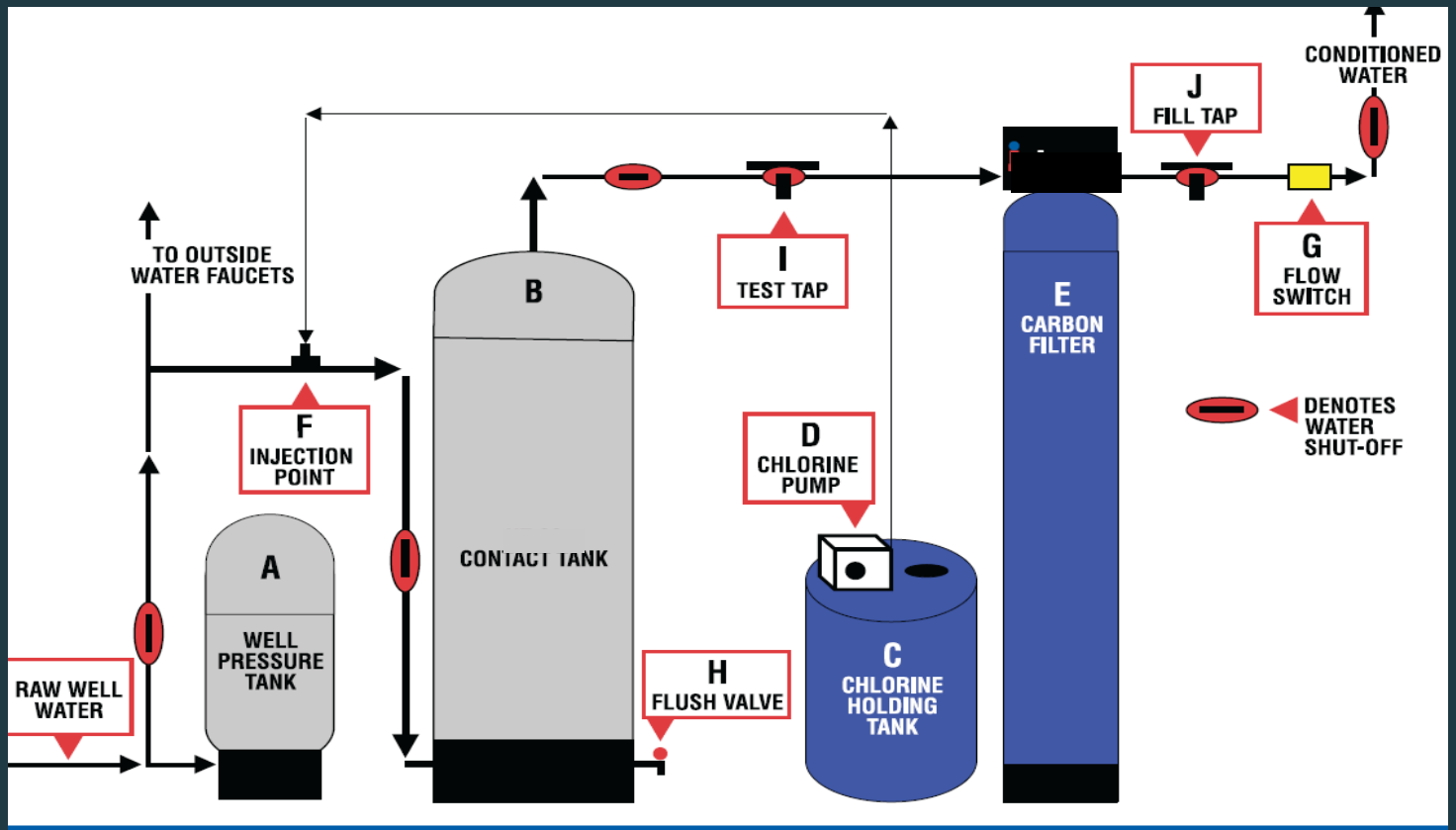
Table 1. Amount of chlorine product required to achieve a chlorine-to-water concentration of 200 ppm.

Chemical Product	Amount to Use Per 100 Gallons of Water*
Liquid laundry bleach (5.25% hypochlorite)	1.5 quarts or 48 liquid ounces
High-test calcium hypochloride (65-76% hypochloride)	4 ounces

Treating Bacteria

Continuous Chlorination

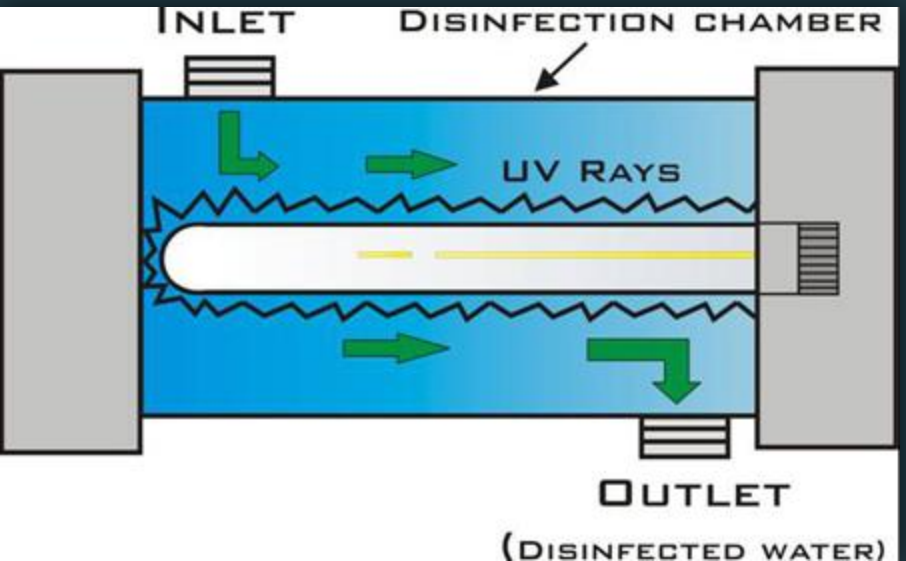
- Requires “contact time”
- Professionally installed
- Disinfection by-products

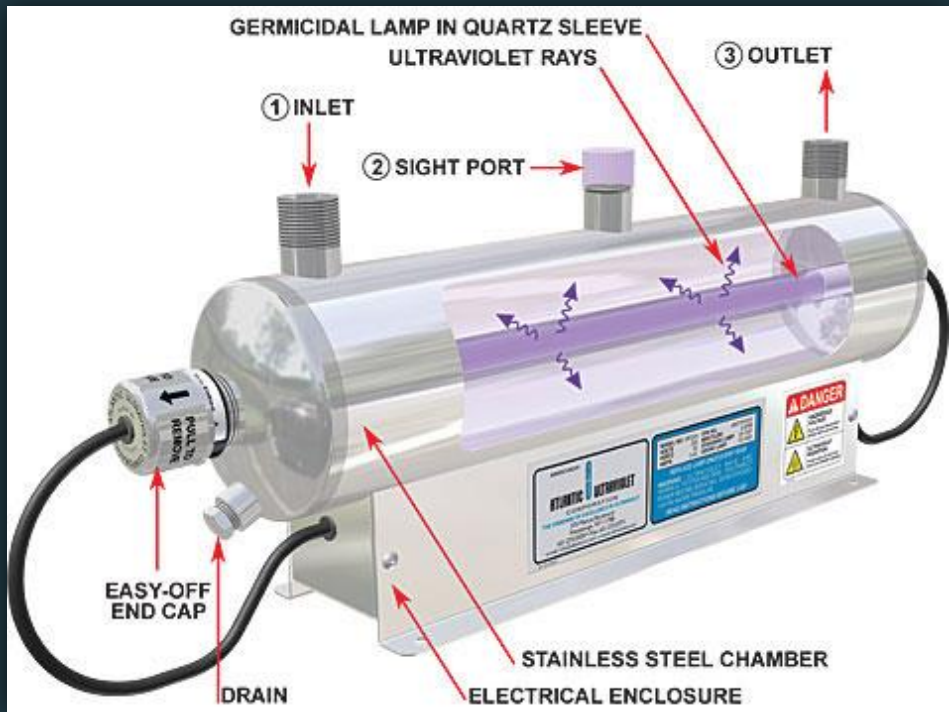


Treating Bacteria

Ultraviolet systems (UV)

- Disrupts bacteria life cycle
- More effective than chlorine
- Low cost to operate
- Easy to maintain
- No taste or odor

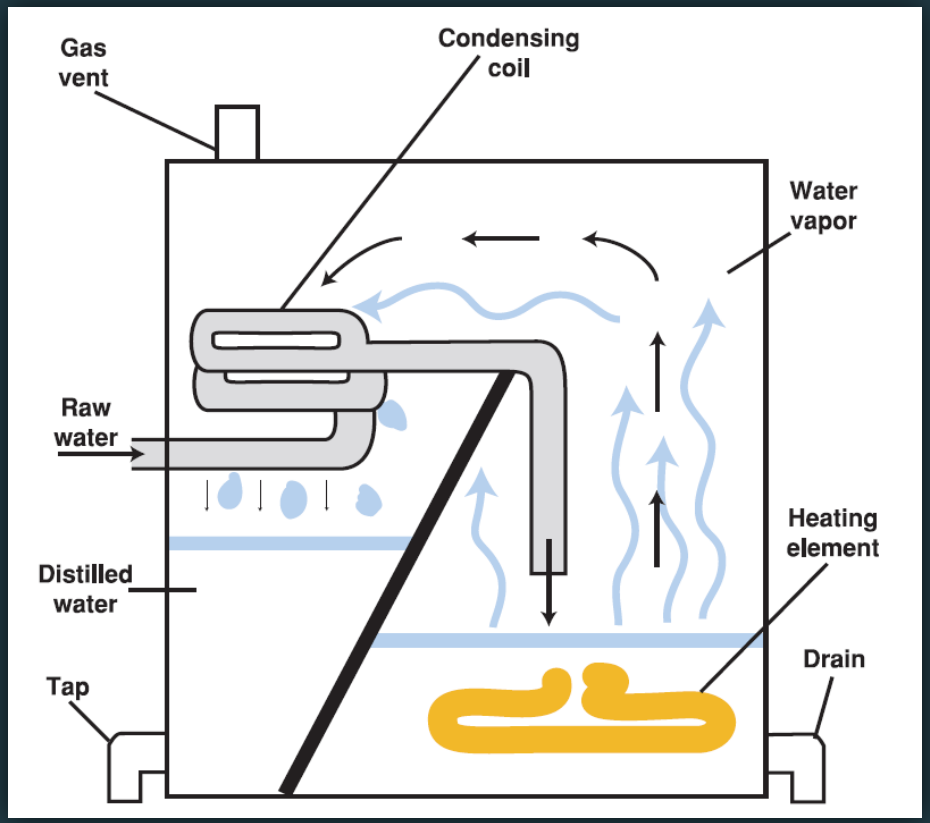




Treating Bacteria

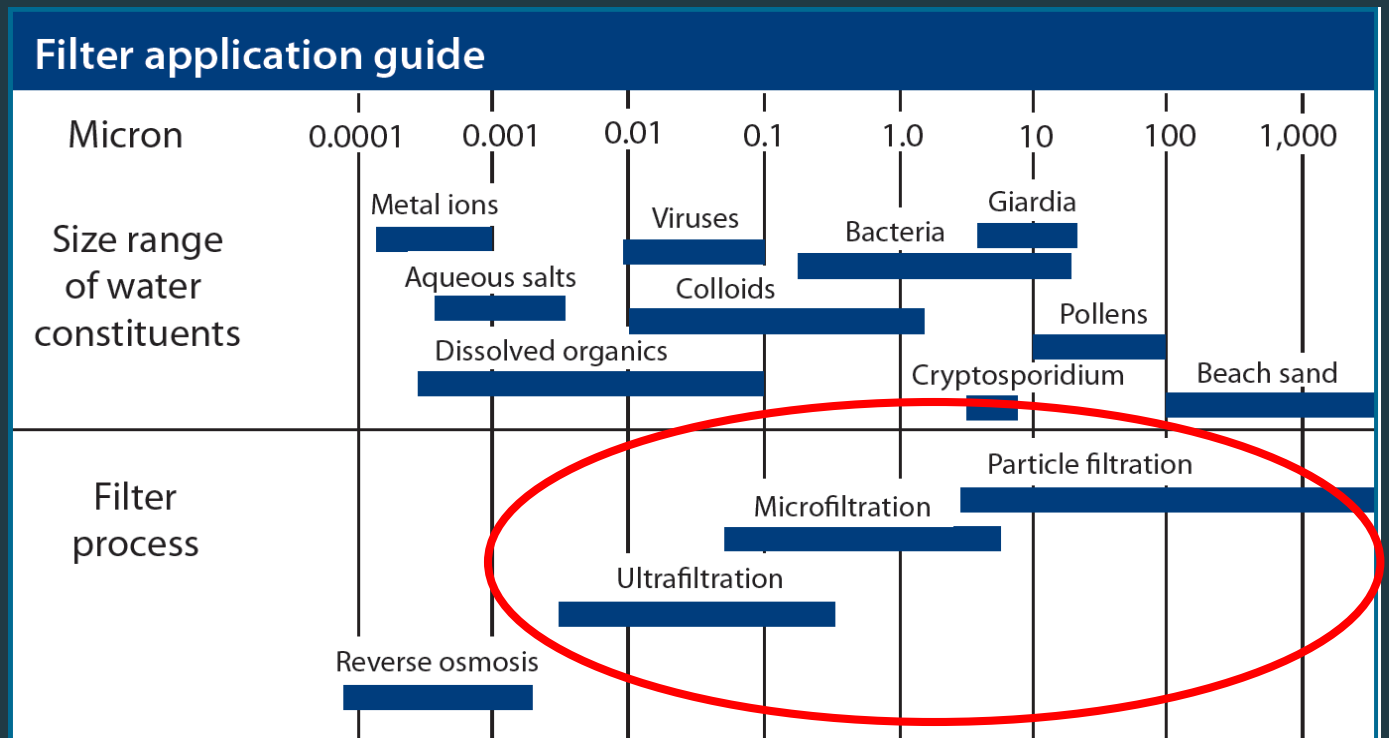
- Ozone Systems
  - Injects O_3: oxidizes
  - Treats bacteria, iron, manganese
  - Point-of-Entry
- Distillation
  - Removes inorganic contaminants
  - Volatile organic chemicals (VOCs) may vaporize along with water and re-contaminate water
  - Point-of-Use

Distillation



Filtration

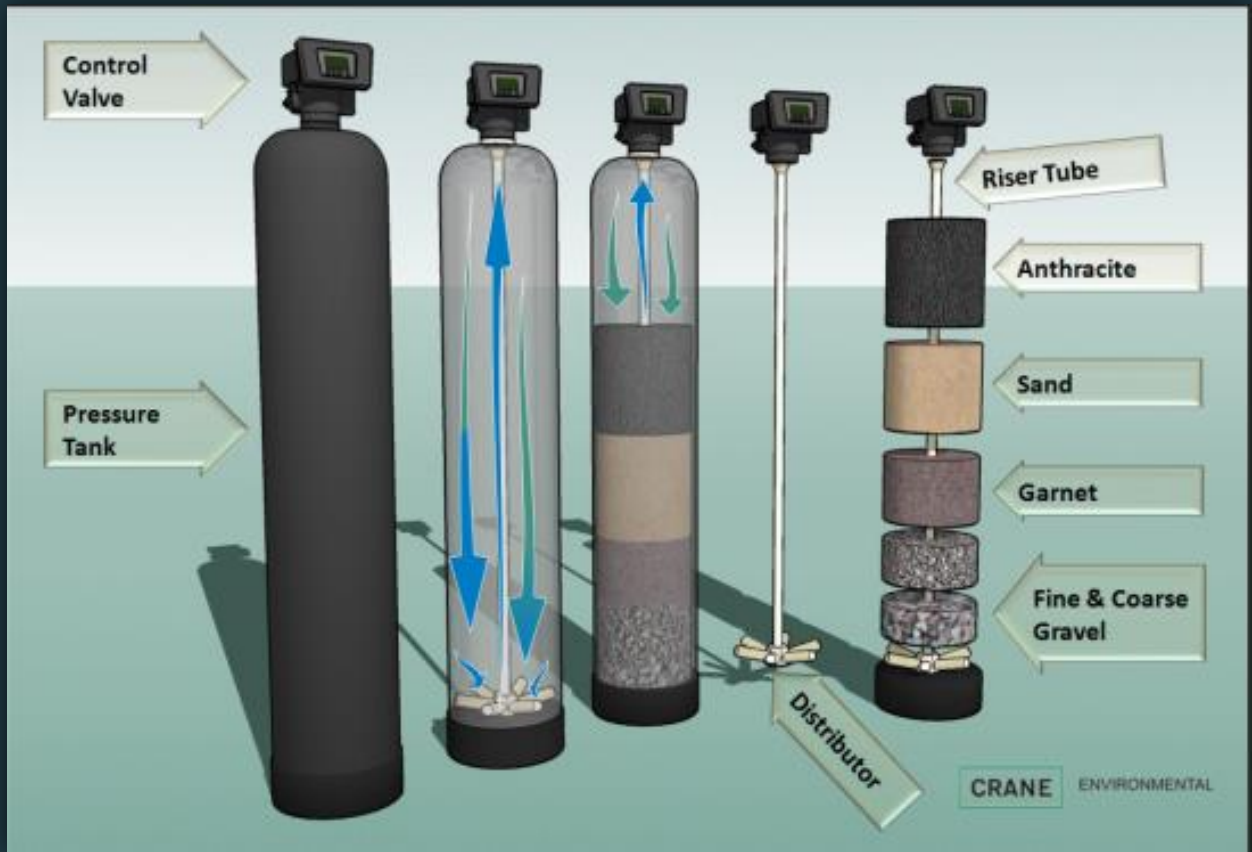
- Filtration
  - Several types of filters
  - Remove suspended solids
  - Filters are made to remove specific particles sizes
  - Can be used prior to other water treatments



Filtration

Media Filters

- Used for suspended solids
- Often used prior to other water treatment devices
- Requires back flushing
- Point-of-Entry



Filtration

Cartridges

- Primarily used for suspended solids
- Sized by pore space and flow rate

- Replace filters to avoid clogging
- Size by targeted contaminant

Activated Carbon Filters

- Coal or charcoal surface absorbs contaminants
- Processed to make large surface area available for adsorption or chemical reaction
- Replace carbon regularly
- Point-of-use
- Most common

May treat:

- *Chlorine*
- *Color*
- *Lead*
- *Radon*
- *Taste and odor*

Reverse Osmosis (RO)

- Effective for a variety of contaminants
- Pressure forces water through a membrane
- Point-of-use
- Could overwhelm septic

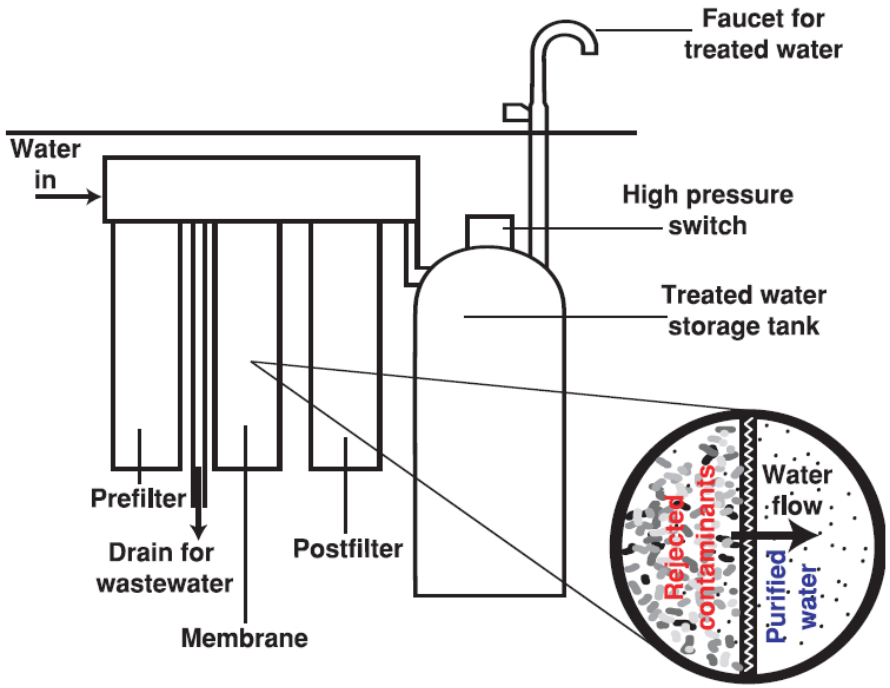
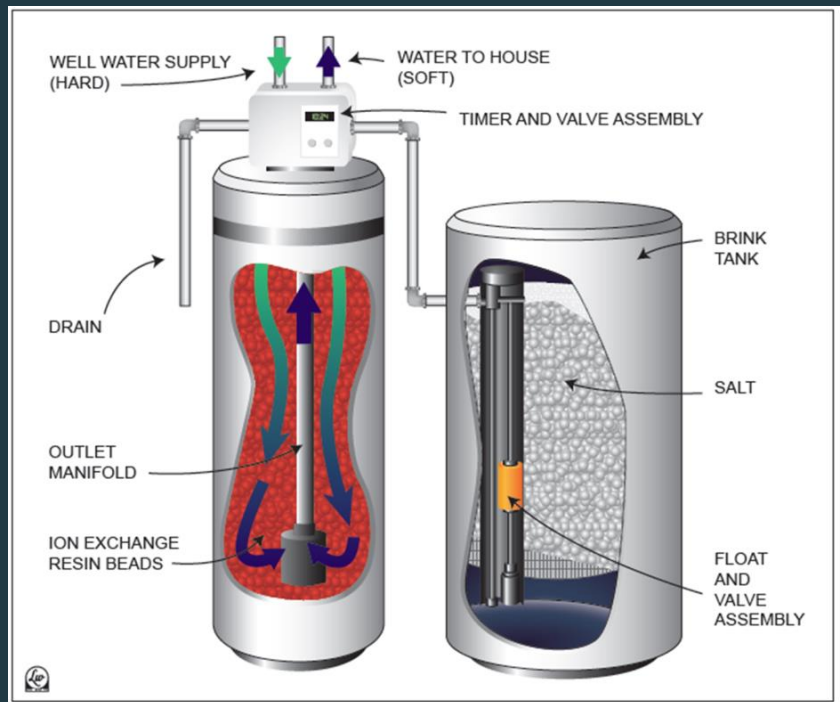


Figure 4. Reverse osmosis treatment unit (Adapted from Kneen et al., 1995 and USEPA, 2003).

Problem Pollutants	Aluminum, Arsenic, Asbestos, Barium, Cadmium, Chloride, Chlorine, Chromium, Copper, Fluoride, Iron, Hardness, Lead, Magnesium, Manganese, Mercury, Nitrate, Radium, Radon, Silver, Sodium, Sulfate, Endrin, Heptachlor, Lindane

Ion Exchange – Water Softener

- **Water softeners**
  - Calcium and magnesium ions exchanged with sodium or potassium
  - Can remove some dissolved metals
  - Will not remove particles, pathogens, organic chemicals
  - Works best if water has been pre-filtered
- Components
  - Resin tank
  - Brine tank
- Automatic
- Semiautomatic
- Manual regeneration
  - Recharge based on water usage NOT time
- Dispose of discharged brine properly



Ion Exchange – Water Softener

Replacing hardness with salinity will extend appliances, but may damage soils in the septic leach field

	Symptom	Cause	Treatment Devices
Visual (water appearance)	**Brown-orange stains or reddish slime or tint to water**	Presence of dissolved iron and iron bacteria	Low amounts: reduce with particle filter or during reverse osmosis or distillation treatments (POE or POU)
			High amounts: remove by potassium permanganate-regenerated oxidizing filter and particle filter (POE)
			Very high amounts: remove by chlorination followed by particle filter (POE)
			Consider well and distribution/storage shock chlorination to kill iron bacteria.
	Brownish color or rusty sediment	Suspended iron and manganese particles	Particle filter (POE)
Visual (Staining and deposits)	**Blackened or tarnished metal utensils and pipes**	High chloride and sulfate levels	Reverse osmosis unit (POE) or distillation unit (POU)
	Blackened or tarnished metal utensils and pipes	High water acidity and high hydrogen sulfide	Acid-neutralizing filters (calcite or calcite/magnesium oxide) (POE) or addition of alkaline chemicals such as lime
	Stains in showers, toilet bowls, and faucet ends	Hardness	Water softener (POE or POU)
	Excessive staining in showers and aluminum cookware	Salinity	Reverse osmosis unit or distillation unit (POU)
	Green water stains	Acidity	Acid neutralizing filters (POE) or addition of alkaline chemicals such as lime
	Soap deposits or excessive scaly deposits in plumbing and appliances	Hardness	Water softener or reverse osmosis or distillation (POE or POU)
	Excessive salt deposits	Alkalinity (high pH and sodium)	Reverse osmosis or distillation systems(POE)
			Consider acid neutralization of excessive alkalinity

	Symptom	Cause	Treatment Devices
Other visual	**Houseplants stunted or with burned leaf tips**	Salinity	Reverse osmosis unit or distillation unit (POU)
Taste	**Taste of chlorine, gasoline, or oil**	VOCs, including residual chlorine, disinfection byproducts, pesticides, or fuel (gasoline, diesel, oil products)	Activated charcoal filter or aeration(POE)
	Metallic taste	Acidity	Acid neutralizing filters (POE) or addition of alkaline chemicals such as lime
	Salty or bitter taste	High total dissolved solids, sodium, sulfates, or nitrates (salinity)	Reverse osmosis or distillation (POU)
Smell	**Chlorine-like smell**	*VOCs, including residual chlorine, disinfection byproducts, pesticides, gasoline products	Activated charcoal filter or aeration (POU)
	Gasoline-like smell	Gasoline, diesel, oil products	Activated charcoal filter or aeration (POU)
	Earthy, musty, or chemical smell	Algae products (geos-min and MIB)	Activated charcoal filter (POU)
	Rotten egg odor	Excessive acidity, lack of oxygen in water source, or contamination by hydrogen sulfide gas (occurs naturally in aquifers and sediments)	Oxidation of water during aeration (POE)
			or chlorination and a particle filter (POE)
			or oxidizing filter (POE) followed by anactivated carbon filter
			Acidity control may also be needed.

	Symptom	Cause	Treatment Devices
Illness	**Gastrointestinal problems such as diarrhea and vomiting**	Pathogens	Remove source of contamination. Reduce pathogens through chlorination,UV radiation, or ozonation (POE). Chloramine chemicals may be used after chlorination is completed in order to maintain acceptable chlorine residual levels.
Appliance/ hardware problems	**Early applicance failure**	*Hardness	Water softener (POE or POU)
	Poor evaporative cooler performance	Build-up of scale on pads (high hardness, high salinity)	Use bleed-off mechanism to prevent build-up of salts and minerals
	Blackened/tarnished metal utensils and pipes	High chloride levels	Reverse osmosis unit or distillation unit (POU)
	Blackened/tarnished metal utensils and pipes	High water acidity and high hydrogen sulfide	Acid-neutralizing filters (POE) or addition of alkaline chemicals such as lime

Resources on specific water quality issues available through: twon.tamu.edu and agrilifebookstore.org

TEXAS A&M AGRILIFE EXTENSION

SP-464
4/12

TWON TEXAS Well Owner NETWORK

Private Drinking Water Well Basics

Diane E. Boellstorff, Assistant Professor and Extension Water Resources Specialist
Kristine A. Uhlman, Extension Program Specialist – Water Resources, Texas
Mark L. McFarland, Professor and State Soil Fertility Specialist, Texas Ag
John W. Smith, Extension Program Specialist, Texas AgriLife Ext

Texas has stringent licensing requirements that require subc
completion reports to the State. Groundwater resources ma
protected locally through the creation of groundwater co
(GCDs) and Section 59, Article XVI of the Texas Constitutio
Code §35.001 establishes groundwater management areas
planning between GCDs. Private domestic well owners are
maintenance and monitoring of their own wells to assure safe

Where is your well?

The management of a private drinking water supply from a domestic well i
landowner. To protect your water supply, find and record the locations of
Maintain a file of all your well records – each well will have a unique well i
by the driller for reporting. The well tracking number is a 5 or 6-digit numb
tracking any additional historical information available for your well from t

- Texas Water Development Board (TWDB) Groundwater Dat

TEXAS A&M AGRILIFE EXTENSION

SP-465
4/12

TWON TEXAS Well Owner NETWORK

Well Owner Drought Response

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Diane E. Boellstorff, Assistant Professor and Extension Water Resources Specialist, Texas AgriLife Extension Service
Mark L. McFarland, Professor and State Soil Fertility Specialist, Texas AgriLife Extension Service

During periods of severe drought, groundwater resources are relied upon to provide water. The combination of increased pumping and the loss of recharge often results in lowered water table elevations. It should be noted that some aquifers are less reliant on recent recharge and/or may be responding to climate conditions that occurred during decades prior to the current drought. Regardless of the cause of lowered water tables, there are several best management practices recommended to protect your water supply.

- Monitor your pump. Rapid cycling of the pump on and off over short periods of time is the result of lowered water tables and slow static water level recovery. Rapid pump cycling will burn out the motor. Heat generated by a submersible pump in lowered water tables can damage the drop-pipe if it is constructed of PVC. Allow your pump to rest or, if possible, throttle-down your pumping rate

TEXAS A&M AGRILIFE EXTENSION

TWO
TEXA
Well Owne
NETWOR

Facts about Fracking ...and Your Drinking Water Well

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Diane E. Boellstorff, Assistant Professor and Extension Water Resources Specialist, Texas AgriLife Extension Se
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Revisions to the Safe Drinking Water Act by the Energy Policy Act of 2005 exempted key aspects of hydraulic fracturing from rules that had previously regulated the injection of fluids underground. Texas is the first state in the United States to require public disclosure of the chemicals used in the process, but private domestic well owners will remain responsible for the monitoring of their own wells to ensure safe drinking water.

Hydraulic fracturing:

The mechanical fracturing of water supply aquifers, oil/gas reservoirs, and for salt solution mining has existed for decades: new technology has made 'fracking' more prevalent. Hydraulic fracturing uses large quantities of water under pressure within a borehole to fracture the rock to increase production. In the water well industry, fracking can double the volume of yield in a well; in the oil/gas industry, fracking a well may be the difference between economic profit and loss.

Geology:

Liquids and gases move through the subsurface in either consolidated or unconsolidated rock material. Within unconsolidated material, like sands and gravels, the porous space between the rocks and grains are all interconnected. You cannot hydraulically fracture porous material because the pressure rapidly dissipates. In consolidated rock material, existing fracture and cracks in the rock may not be interconnected – forcing these factures to o and connect increases the porosity and permeability of the rock. Fracking allows liq and gases already within the rock to flow because of the increased permeability. Keep the fractures open and interconnected by propping them with sand or small ceramic beads is key. Fracking the vertical thickness production zone to increase porosity has be an industry practice since the 1940's.

New technology:

Vertical wells were the norm until the development of new drilling technology in t 1970's that allowed for directional subsurfa drilling. Used most commonly in the oil and

1

TEXAS A&M AGRILIFE EXTENSION

L-5490
8/07

Capping of Water Wells for Future Use

Bruce Lesikar and Justin Mechell*

Water is one of our state's most precious resources. Much of our groundwater comes from aquifers, which are underground layers of porous rock or sand containing water. Wells can be drilled into the aquifers to produce drinking water, irrigation water, and water for industry. Because groundwater supplies more than half of the water used in the state, all Texans must help protect the quality of this vital resource.

Groundwater has been pumped from water wells for many years. Over time, many wells around homes, farms, industrial sites and urban areas may no longer be needed. Wells that are no longer being used but might be needed in the future can be sealed with a cap that covers the top of the well casing pipe to prevent unauthorized access and contamination of the well. A cap is a temporary groundwater protection solution that allows a well to be used at a later time.

Can my well be capped?

A well can be capped only if it is in good condition and is in use. The Texas Department of Licensing and Regulation (TDLR) defines this as a "non-deteriorated well." A non-deteriorated well is one with a casing and pump in good condition. If your well is not in good condition it should be properly abandoned according to instructions in the Landowners Guide to Plugging Abandoned Water Wells (*http://www.tceq.state.tx.us/comm_exec/forms_pubs/pubs/rg/rg-347.html*).

You can inspect the condition of a well casing at the surface by searching for holes or cracks. Use a light to check the inside of the casing. If you can move the casing around by pushing against it, the casing is probably deteriorating. If you need assis-

Figure 1. The slab around this capped well must be repaired to keep water from entering the well bore hole.

*Professor and Extension Program Leader for Biological and Agricultural Engineering; and Extension Assistant; The Texas A&M University System.

AgriLIFE EXTENSION
Texas A&M System

B-6192
7-06

Drinking Water Problems: Radionuclides

Bruce J. Lesikar, Professor and Extension Agricultural Engineer, Texas Cooperative Extension,
Michael F. Hare,
Janie Hopkins, Manager G

Radionuclides are types of atoms that are radioactive. The most common radionuclides in drinking water are radium, radon and uranium.

Most of the radionuclides in drinking water occur naturally at very low levels and are not considered a public health concern. However, radionuclides can also be discharged into drinking water from human activity, such as from active nuclear power plants or other facilities that make or use radioactive substances.

People who are exposed to relatively high levels of radionuclides in drinking water for long periods may develop serious health problems, such as cancer, anemia, osteoporosis, cataracts, bone growths, kidney disease, liver disease and impaired immune systems.

What are the Sources of Radionuclides in Water?

Radiation comes from outer space, from the ground and even from within our own bodies. Radiation is all around us and has been present since the birth of this planet.

Most of the radionuclides present in drinking water are from natural sources. Naturally occurring radionuclides are created in the upper atmosphere and are found in the Earth's crust. They are found in certain types of rocks that contain trace amounts of the radioactive isotopes (forms) of uranium, thorium and/or actinium. As

TEXAS A&M AGRILIFE EXTENSION

L-5451
2-04

Drinking Water Problems: Iron and Manganese

Professor and Extension Soil Fertility Specialist
Professor and Extension Water Resources Specialist
The Texas A&M University System

w do iron and manganese enter drinking water?

ed manganese are common elements in the crust. As water percolates through soil and can dissolve these minerals and carry them groundwater. Also, iron pipes can corrode and iron into a household water supply.

w do I know if my water ntains iron or manganese?

pearance and/or taste of water can indicate sence of iron and manganese. For example, k-brown (iron) or black (manganese) particles visible when water is drawn from the tap. particles of iron and/or manganese may come rroded pipes or from the water supply itself. rticles form because oxygen in the plumbing is oxidizing and precipitating the iron and nese.

t is clear when it comes from the tap but s form and settle out after the water has sat while, the iron and/or manganese is in the supply itself. It is dissolved in the water and s invisible until it oxidizes and precipitates. nes water from the tap is a reddish color. caused by colloidal iron—iron that does not rticles large enough to precipitate. nese usually is dissolved in water, although shallow wells contain colloidal manganese es water a black tint.

TEXAS A&M AGRILIFE EXTENSION

L-5452
2-04

Drinking Water Problems: Lead

Monty C. Dozier, Assistant Professor and Extension Water Resources Specialist
Mark L. McFarland, Associate Professor and Extension Soil Fertility Specialist
The Texas A&M University System

Almost everyone knows that lead-based paint caused serious health problems (especially in children) before it was banned. But not everyone is aware that people can ingest lead from other sources such as contaminated food and drinking water. Imported foods in lead-soldered cans and foods served in lead-glazed ceramics or leaded crystal may contain lead. If your water comes from a public water system there is little cause for concern, because the law requires that public systems eliminate any sources of lead contamination. But if your water comes from a private well, it might contain enough lead to warrant action.

small amounts of it. Lead poisoning can cause a child's mental and physical development to be irreversibly stunted.

Lead in drinking water is not a main source of lead poisoning, but it can increase the amount of lead people are exposed to. This is particularly risky for infants who drink baby formulas and juices that are mixed with water containing lead. On average, about 10 to 20 percent of a child's lead exposure might come from drinking water; however, infants who are fed formula could get 40 to 60 percent of their lead intake from water.

The only way to detect lead poisoning is with a blood test. The Centers for Disease Control and

How does lead affect

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Texas A&M System

Drinking Water Problems: Corrosio

Mark L. McFarland, Tony L. Provin, and Diane E.

Corrosion is one of the most common problems affecting domestic water supplies. Chemical processes slowly dissolve metal, causing plumbing pipes, fixtures and water-using equipment to deteriorate and fail. Corrosion can cause three types of damage:

- The entire metal surface gradually thins and red stains appear in iron or steel plumbing systems or blue-green stains in copper and brass plumbing systems (Fig. 1).

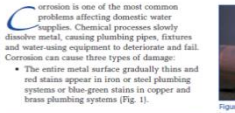

Figure 2. Pinhole leaks in copper tubing caus internal corrosion.

Figure 1. Corrosion at a connection on a water heater indicated by the blue-green color.

- Deep pits appear that can penetrat tank walls. This type of corrosion add significant amounts of iron or to the water, but can eventually pe a pipe or tank, and cause potentiall water damage to a home or busine
- Copper or other metals oxidize in a similar to the rusting of steel. It oft reduces water flow through supply and destroys water valves and othe control surfaces, creating leaks insi outside of valves and faucets. This corrosion is not necessarily caused chemistry, but by exposure to soil corrosive environments.

Professor and Extension Water Quality Coordinator, Professor and Extension Water Testing Laboratory Director, Assistant Professor and Extension Water Resources Specialist, Texas AgriLife Extension Service, The Texas A&M System

AgriLIFE EXTENSION
Texas A&M System

B-6184
3-08

Drinking Water Problems: Nitrates

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Rebecca H. Melton, Extension Assistant,
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The Texas A&M University System

Nitrogen is present in the environment in many forms. The earth's atmosphere consists of 70 percent nitrogen.

When nitrogen interacts with another element in the environment, it changes form and becomes a compound. Two kinds of nitrogen compounds found in nature are nitrates (NO_3) and nitrites (NO_2). Nitrates and nitrites are chemicals that are made up of nitrogen and oxygen and that combine with various organic (related to or derived from living organisms) and inorganic compounds. Once taken into the body, nitrates are converted into nitrites.

Nitrates occur naturally in drinking water. However, if there are high levels of nitrates in the water, it is probably caused by human activities such as the overuse of chemical fertilizers and improper disposal of human and animal wastes. These fertilizers and wastes contain nitrogen compounds that are converted to nitrates in the soil.

Nitrates dissolve easily in water and can move readily through soil into the drinking water supply. As nitrate accumulates in water, high levels can build up over time. For most adults, nitrates are unlikely to be harmful, even at elevated levels. But ingesting too much nitrate can be harmful for very young infants and susceptible adults.

Who regulates drinking water safety?

In 1974, the United States Congress passed the Safe Drinking Water Act. This law requires the U.S. Environmental Protection Agency (EPA) to determine the safe levels of chemicals for U.S. drinking water. The EPA conducts research to determine the level of a contaminant in drinking water that is safe for a person to consume over a lifetime and that water systems can reasonably be required to remove from drinking water, given present technology and resources. This safe level is called the maximum contaminant level (MCL). The MCL for nitrate-nitrogen is 10 milligrams per liter (mg/L), which is commonly referred to as parts per million (ppm). For nitrite-nitrogen, the MCL is 1 ppm.

The EPA's drinking water standards—and the regulations for ensuring that these standards are met—are called the National Primary Drinking Water Regulations. All public water supplies must abide by these regulations.

Although private water wells are not required to meet the national drinking standards, private well owners can use these standards to monitor the quality of their water. Just as public water suppliers may not deliver water containing contaminants over the MCL to the public, private well owners should not use water above MCL levels for human consumption.

How are people exposed to nitrate?

Because nitrate is a natural substance found in both water and plants, people are exposed to it primarily through the diet. In the United States, the average person consumes about 75 to 100 milligrams (mg) of nitrate per day.

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Questions?