Tech Brief

PUBLISHED BY THE NATIONAL ENVIRONMENTAL SERVICES CENTER

Well Maintenance and Groundwater Protection

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Summary

More than 88 million American residents have their drinking water supplied by community systems that rely on groundwater as a primary source, while another 42 million get water from individually owned wells. Given this reality, maintaining public and private wells, and preventing groundwater contamination is of utmost importance. This *Tech Brief* discuses steps that can be taken to help maintain the life of a well, and to ensure your drinking water is safe.

When most of us think about water, we think about water we can see: lakes, rivers, streams, and oceans. But as much as a third of the world's freshwater supplies are out of sight in groundwater—the water that fills cracks in beds of rocks and sand. Fed by rain and snowmelt, these supplies can take dozens or even hundreds of years to replenish. This groundwater plays a vital role in supplying drinking water for a significant proportion of the population.

Of the nearly 55,000 community drinking water systems in the U.S., 80 percent use groundwater as their source. Most of these are small and very small systems (i.e., fewer than 3,300 customers). Additionally, an estimated 15 percent of the population gets water from private wells. There are, of course, differences between individual wells and public, community systems supplied by groundwater, but there are also many concepts that apply to both.

Groundwater Quality

When it comes to well water, many believe that water comes from the ground pure and pristine. The reality is that groundwater can be contaminated by a number of substances, including iron, manganese, carbon dioxide, arsenic, radon, iron, hydrogen sulfide, and sulfur bacteria.

As water flows in rivers and streams and filters through soil and rock, it absorbs many of the substances it touches. The water quality in an aquifer depends on the nature of the rock, sand, or soil in the aquifer, and what contaminants are in the area. The dissolved minerals and gases, and the amount of suspended matter determines water quality. Some contaminants are harmless, but some compounds may make the water unpalatable and even unsafe.

One basic measurement of water quality is the total dissolved solids (TDS), a reflection of the total amount of solids remaining when a water sample is evaporated. Water is made up of major constituents, such as chloride, sulfate, carbonate, and bicarbonate, and minor constituents, like iron, manganese, fluoride, nitrate, strontium, and boron. In addition, trace elements, such as arsenic, lead, cadmium, and chromium may be present. The trace elements are extremely important in determining water quality.

Wellhead Protection

Wellhead protection is a way to prevent drinking water from becoming polluted by managing potential sources of contamination in an area that supplies water to a public or private well. The 1986 Safe Drinking Water Act (SDWA) Amendments required states to develop wellhead protection programs to prevent contamination of public groundwater supplies. The key steps in developing a wellhead protection program are:

- Delineate the land area to be protected;
- Inventory potential sources of contamination;
- Implement strategies to manage these contaminant sources (these strategies often focus on public awareness and education programs); and
- Develop contingency plans for emergencies.

Although wellhead protection programs are only mandated for public systems, private well owners should also be concerned with protecting the area surrounding their wells.

Table 1 has Washington states's minimum horizontal separations for wellheads and various activities from their onsite regulations. These distances may vary in your area, please check you local or state codes for the required distance.

Table 1

Minimum Horizontal Separations

Items Requiring Setback	From edge of disposal component and reserve area	From septic tank, holding tank, containment vessel, pump chamber, and distribution box	From building sewer, collection, and non-perforated distribution line[1]
Non-public well or suction line	100 ft.	50 ft.	50 ft.
Public drinking water well	100 ft.	100 ft.	100 ft.
Public drinking water spring,[3]	200 ft.	200 ft.	100 ft.
Spring or surface water used as drinking water source[2,3]	100 ft.	50 ft.	50 ft.
Pressurized water supply line[4]	10 ft.	10 ft.	10 ft.
Properly decommissioned well[5]	10 ft.	N/A	N/A
Surface water[3]			
Marine water	100 ft.	50 ft.	10 ft.
Fresh water	100 ft.	50 ft.	10 ft.
Building foundation	10 ft. [6]	5 ft. [6]	2 ft.
Property or easement line[6]	5 ft.	5 ft.	N/A
Interceptor/curtain drains/drainage ditches			
Down-gradient [7]	30 ft.	5 ft.	N/A
Up-gradient [7]	10 ft.	N/A	N/A
Down-gradient cuts or banks with at least 5 ft. of original, undisturbed soil above a restrictive layer due to a structural or textural change	25 ft.	N/A	N/A
Down-gradient cuts or banks with less than 5 ft. of original, undisturbed, soil above a restrictive layer due to a structural or textural change	50 ft.	N/A	N/A

1. "Building sewer" as defined by the most current edition of the Uniform Plumbing Code. "Non-perforated distribution" includes pressure sewer transport lines.
2. If surface water is used as a public drinking water supply, the designer shall locate the OSS outside of the required sanitary control area.
3. Measured from the ordinary high-water mark.
4. The local health officer may approve a sewer transport line within 10 feet of a water supply line if the sewer line is constructed in accordance with section 2.4 of the Department of Ecology's "Criteria For Sewage Works Design," revised October 1985, or equivalent.
5. Before any component can be placed within 100 feet of a well, the designer shall submit a decommissioned water well report provided by a licensed well driller, which verifies that appropriate decommissioning procedures noted in chapter 173-160 WAC were followed. Once the well is properly decommissioned, it no longer provides a potential conduit to groundwater, but septic tanks, pump chambers, containment vessels or distribution boxes should not be placed directly over the site.
6. The local health officer may allow a reduced horizontal separation to not less than two feet where the property line, easement line, or building foundation is up-gradient.
7. The item is down-gradient when liquid will flow toward it upon encountering a water table or a restrictive layer. The item is up-gradient when liquid will flow away from it upon encountering a water table or restrictive layer.

Source: Washington Administrative Code, Chapter 246-272/On-site Sewage Systems

Test Your Water Regularly

Public water systems that use a well or surface water have to test regularly for contaminants mandated by the U.S. Environmental Protection Agency. The National Primary Drinking Water Standards includes 87 different contaminants, while the National Secondary Drinking Water Standards have an additional 15 contaminants.

Private well owners should also test their water regularly. The National Ground Water Association recommends that household well owners test their water at least annually for bacteria, nitrate, and any contaminants of local concern.

More frequent testing should be considered if:

- There is a change in the taste, odor, or appearance of the well water, or if a problem occurs such as a broken well cap, inundation by floodwaters, or a new contamination source;
- The well has a history of bacterial contamination;
- The septic system has recently malfunctioned;
- Family members or house guests have recurrent incidents of gastrointestinal illness;
- An infant is living in the home; or
- One wishes to monitor the efficiency and performance of home water treatment equipment.

Well owners should check with their local health or environmental health department for recommendations regarding the type and frequency of testing specific to their location.

Before Testing, Be Sure the System is Clean

Testing water from a dirty well can lead to false positives—the appearance of contamination even when the groundwater is clean. A dirty well also can create an environment for contaminants, particularly certain types of bacteria.

A qualified water well systems contractor can determine if your water well system needs to be cleaned by conducting an anaerobic bacteria test, a positive coliform test, or other tests showing an accumulation of debris in the well. Other possible indicators of a dirty well include cloudy water, low water flow, or taste and odor problems.

If the test results indicate the presence of anaerobic bacteria or coliform bacteria, or if you are experiencing cloudy water, low water flow, or taste and odor problems, then your well should be cleaned by a qualified water well systems contractor.

Maintenance for Public and Private Wells

Whether you are a certified operator working in a community system or a private well owner, there are steps you can take to keep your well in good shape.

- Keep contaminants away. Avoid mixing, using or storing hazardous chemicals, such as paint, fertilizer, pesticides, motor oil, gas, weed killer and other pollutants near the well.
- Don't allow back-siphonage. Use back flow prevention devices on all outside faucets with hose connections to help keep pollutants from back siphoning into the plumbing.
- Visually inspect exposed parts of the well. Make sure there are no cracks or damage to the well casing or well cap, and the well cap fits tightly. Also, ensure the area around the wellhead slopes away from the well, and is free of leaves, grass, and other debris.
- Seal abandoned wells. Abandoned and improperly constructed wells can be sources of potentially polluted groundwater, which could make your drinking water unsafe.
- Conserve and protect your water. Water conservation is becoming an ever-growing necessity throughout the world today, as the availability of drinking water constantly diminishes through things such as drought, contamination, and increases in population.
- Test the water regularly and keep the test results forever. These tests will establish a good baseline of the water quality.
- Always use licensed or certified water well drillers and pump installers when a well is constructed, a pump is installed, or the system is serviced.
- When landscaping, keep the top of your well at least one foot above the ground, this height may be be higher for public supply wells. Slope the ground away from your well for proper drainage.
- Take care in working or mowing around your well. A damaged casing could jeopardize the sanitary protection of your well. Don't pile snow, leaves or other materials around your well.
- Keep your well records in a safe place. These include the construction report, as well as annual water well system maintenance and water testing results.
- Always maintain proper separation between your well and buildings, waste systems, or chemical storage facilities.

Servicing Your Well

When well owners, private or public, try to service their own wells, they sometimes fail to solve the problem and may make it worse. Qualified professional water well system contractors use specialized equipment, materials, and techniques to keep well systems operational and water supplies safe.

Moreover, every time a well owner removes a well cap and attempts to service the well in some way, there's the potential to unwittingly introduce bacteria or other contaminants into the well. There's also the potential for dropping objects (tools for instance) into the well, getting the pump stuck in an effort to replace it, or even electrocution when working with submersible pumps.

General Resource Protection Well-Cross Section Definitions

Well seal:
A seal is a cylindrical layer of material, usually cement, bentonite, or clay, that surrounds the casing up to a certain depth in the well. It prevents runoff or other contaminants from entering the well, and serves to further protect the casing.

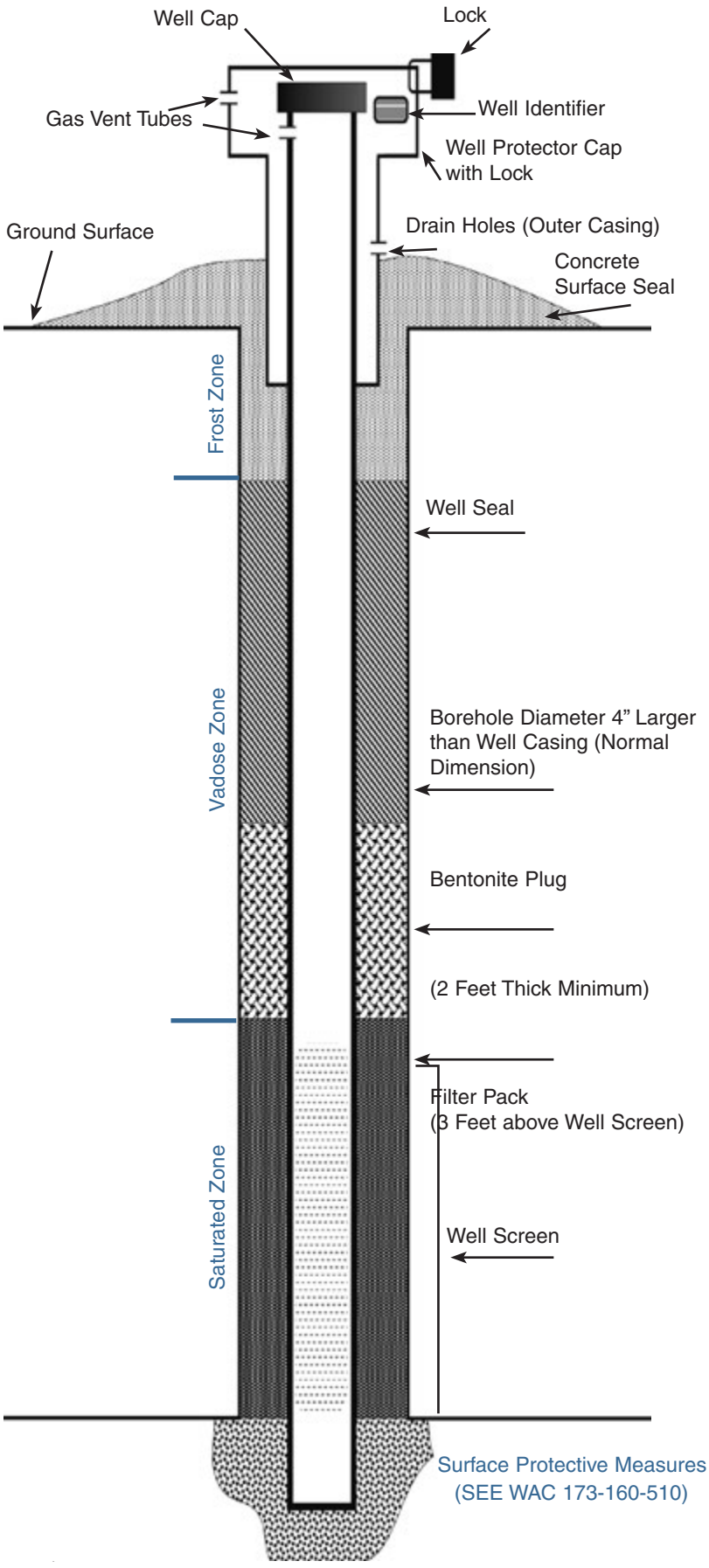
Well Screen:
Well screen is a cylindrical sieve-like structure that serves as the intake portion of the well. It is a metallic pipe that has holes or perforated sections or slotted sections that is placed in the water-carrying zones of the aquifer.

Filter pack:
A filter pack is made up of sand or gravel that is smooth, uniform, clean, well-rounded, and siliceous. It is placed in the annulus of the well between the borehole wall and the well screen to prevent formation material from entering the screen.

Vadose Zone:
This is the zone that contains water under pressure less than that of the atmospheric pressure. It is the layer of soil between the water table and the ground surface.

Potentiometric surface:
This is an imaginary surface representing the total head of groundwater in a confined aquifer that is defined by a level to which water will rise in the well.

General Resource Protection Well–Cross Section



Adapted from Groundwater and Wells, Second Edition by Fletcher G. Driscoll, Ph.D.

A well maintenance check-up should include four components. First, is a flow test to determine system output, along with a check of the water level before and during pumping (if possible), pump motor performance (check amp load, grounding, and line voltage), pressure tank and pressure switch contact, and general water quality (odor, cloudiness, etc.). Next, is an inspection of well equipment to assure that it is sanitary and meets local and state code requirements. Third, a test of your water for coliform bacteria and nitrates, and anything else of local concern. Finally, a clear, written report should be delivered to you following the check-up that explains results and recommendations, and includes all laboratory and other test results.

Disinfecting A Well

The prescence of fecal coliform bacteria in a drinking water supply indicates that contamination may be present, and the water is not safe for human consumption. For some well owners, a common and fairly simple solution to this problem is to shock chlorinate the well. Shock chlorination is a method of sanitizing a well with chlorine (most often house- hold bleach).

For a common, six-inch-diameter well with 150 feet of water, use three quarts of bleach added to four gallons of water. Table 2 (below) shows the amount of chlorine needed for disinfecting various well sizes. Pour this solution directly into the well.

In the house, open one faucet at a time and run them until you detect the smell of chlorine, then turn the faucet off. If you do not smell chlorine at each tap, add more chlorine solution to the well.

Let the chlorinated water sit in the well and lines for 12 to 24 hours. Flush the system by letting each faucet run until the smell of chlorine dissipates. If your home has an onsite wastewater system, open outside faucets first and let the water run on the ground to reduce the load on the septic system.

Retest the well water after waiting one to two weeks. If the bacteria problem persists, you may need to have continuous disinfection.

A drinking water well—be it for a community system or a household—is a big investment and should be maintained so that it has a long life. Properly functioning wells are also an important part of good public and environmental health, assuring that we have this critical resource for years to come.

Table 2.

Amount of chlorine needed for shock chlorination.

Laundry bleach (about 5.25% Hypochlorite)

Depth of water in well	Casing diameter				
	4-inch	6-inch	8-inch	10-inch	12-inch
10 feet	1/2 cup	1 cup	1 1/2 cups	1 pint	2 pint
25	1 cup	1 pint	2 pints	3 pints	4 1/2 pts
50	1 pint	1 quart	2 quarts	3 quarts	1 gal
100	1 quart	2 quarts	1 gal	1 1/2 gal	2 gal
150	3 QUARTS	3 QUARTS	1 1/2 gal	2 gal	3 gal

High-Test Hypochlorite (HTH 65-75% Hypochlorite)

Depth of water in well	Casing diameter				
	4-inch	6-inch	8-inch	10-inch	12-inch
10 feet	–	–	–	–	–
25	–	–	–	1/4 lb	1/2 lb
50	–	–	1/3 lb	1/2 lb	3/4 lb
100	–	1/3 lb	3/4 lb	1 lb	1 1/2 lb
150	1/4 lb	1/2 lb	1 lb	1 1/2 lb	4 lb

Source: http://ohioline.osu.edu/aex-fact/0318.html

For More Information

If you have a question about drinking water topics, including well maintenance and shock chlorination, call NESC's technical staff toll free at (800) 6248301 and select option "3."

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