How Well Do You Know Your Water Well?

Groundwater and Water Wells in Colorado

Prepared by:
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Joe Bowden, PhD; CDS Environmental Services, LLC

In cooperation with the following agencies:
Colorado Division of Water Resources
Colorado Department of Public Health and Environment
Colorado Oil & Gas Conservation Commission

Agency Contacts

Colorado Division of Water Resources (CDWR)
303-866-3585
http://water.state.co.us/

Colorado Department of Public Health & Environment (CDPHE)
303-692-2000 or 1-800-886-7689 (in-state)
http://www.cdphe.state.co.us/

Colorado Oil & Gas Conservation Commission (COGCC)
303-894-2100
http://cogcc.state.co.us/

US EPA Safe Drinking Water
http://water.epa.gov/drink/

Information considered accurate as of October 2011

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Introduction

Due to the rural nature of much of Colorado, individual domestic water wells are a way of life for many of us. This informative booklet has been prepared as a reference guide for private water well owners throughout the state. In it you will find basic information concerning the groundwater that is supplied to you from your private water well. It includes information about:

- the occurrence of groundwater and different types of aquifers;
- how recharge and use of groundwater can affect the amount and quality of water available to you;
- water well permitting and water testing;
- contamination sources and set-backs;
- typical components of a water well and distribution system;
- water quality standards and test result interpretation;
- methane in groundwater;
- information concerning well maintenance and disinfection.

Also included are some handy tools such as a water well troubleshooting guide, a water treatment decision guide, a glossary of terms, and links to helpful internet web sites that deal with water issues.

Finally, the guide also contains contact information for various government agencies that can help answer questions that this document does not cover. People at these agencies have a great deal of very specific information about water and wells. They may be able to help you investigate and resolve problems or concerns that you may have.

It is our hope that you will keep this guide handy and use it to record information about your well and answer basic questions about groundwater and your water well for years to come.

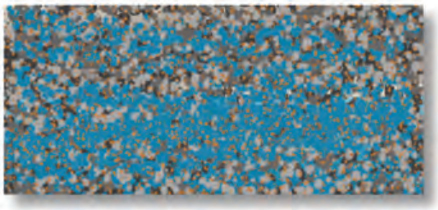
Aquifers and Water Use Basics

Aquifers are porous and permeable sediment or rock. Water is stored in the small spaces between sediment or rock grains and particles and moves very slowly through these interconnected "pore spaces". Groundwater can also be stored and move through small, interconnected and naturally occurring fractures found in some rocks like sandstone, granite, or shale. There is generally no such thing as "underground rivers or lakes" except in rare and special geologic conditions involving rocks known as limestone. Limestone aquifers are relatively rare in Colorado; however, Glenwood Springs is a example of groundwater discharged from a limestone aquifer.

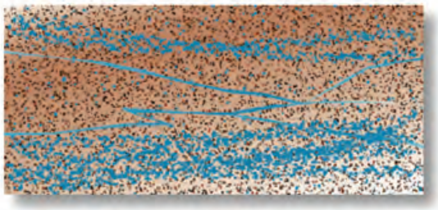
Aquifers are replenished through a process called "recharge." Rain, snowmelt and even irrigation water all soak into the ground and slowly move and accumulate to saturate pore spaces. Rivers, streams and irrigation ditches can also recharge aquifers. When drought occurs, or irrigation water is removed, recharge is diminished. Shallow river valley aquifers can be recharged quickly, but recharge water may take many years to reach deep bedrock aquifers.

Pumping groundwater from a well always causes a decline in groundwater levels at and near the well. This decline in groundwater level near the well also always causes a diversion of groundwater from its natural, possibly distant area of discharge. Pumping of a single well typically has a local effect on the groundwater-flow system. Pumping of many wells (sometimes hundreds or thousands of wells) in large areas can have regionally significant effects on groundwater systems. Too much groundwater pumping can exceed the recharge rate and groundwater levels in a given area will decline. This is called "Groundwater Mining."

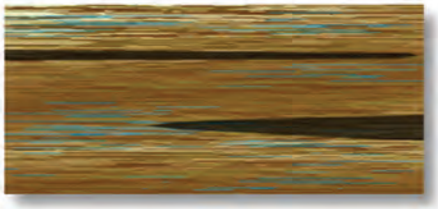
The figures below give an idea of how groundwater is found in different types of rock. Sand and gravel can hold lots of water because pore spaces are large and well connected. Sandstone has smaller pores that are less well connected so it often yields less water. Shale has very small pores that are not interconnected; therefore, shales normally yield very little water. Coal can yield large amounts of water, but will often contain some methane gas and hydrogen sulfide. In some areas, such as the Raton Basin near Trinidad, Colorado, coal seams found in shallow aquifers may be the same coal seams where natural gas production occurs. However, in other areas, such as the San Juan Basin near Durango, Colorado, the natural gas industry removes methane from the thick coal seams, sandstone and shale that are usually several thousand feet deeper than shallow aquifers. Crystalline rock (such as granite and limestone) has no pores and water must be drawn from interconnected naturally occurring fractures.



Sand and Gravel



Sandstone

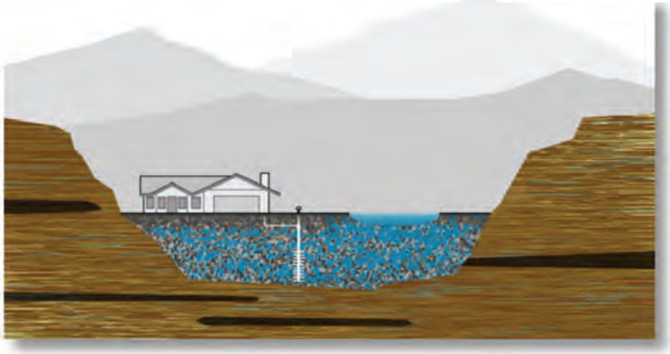


Shale and Coal

Crystalline Rock

Aquifers and Water Use Basics

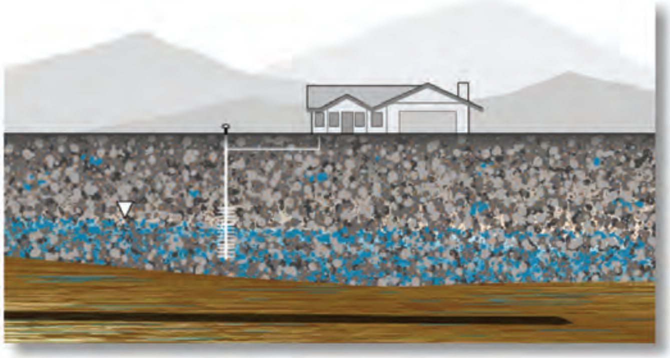
Colorado water wells typically tap into five different kinds of aquifers.



River Valley Aquifer

River Valley Aquifer

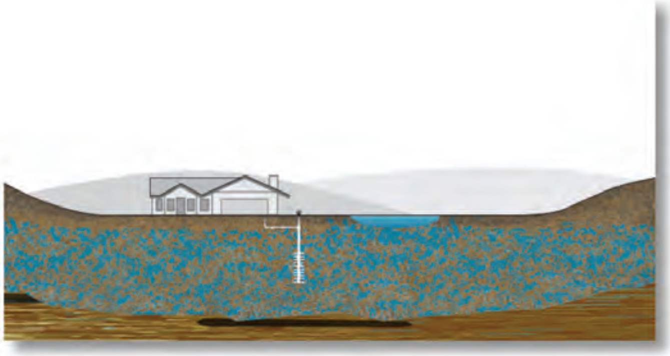
River valley aquifers are found in shallow loose sediments like gravel and sand next to rivers, streams and lakes. They are usually of limited extent within the immediate river or stream valley. These aquifers are recharged by the river flow and usually have good water quality and sustained yield because of the regular recharge from the river or lake. However, the groundwater is often close to the ground surface and is therefore very susceptible to pollution from adverse surface conditions or septic systems.



Glacial Outwash Aquifer

Glacial Outwash Aquifer

Glacial outwash aquifers are thick accumulations of unconsolidated sand and gravel deposited over large areas by alpine glaciers when they retreated many thousand years ago. Many high terraces in valleys and plains adjacent to or near the mountains are covered with these deposits. They are often developed areas for residences and agriculture. Recharge to this aquifer type is primarily from snowmelt, small mountain streams crossing to larger rivers or irrigation water used on farms and ranches. This aquifer type typically has good water quality and yield. However, as more water wells are drilled and fewer farms are irrigated, the aquifer can become depleted in certain areas.

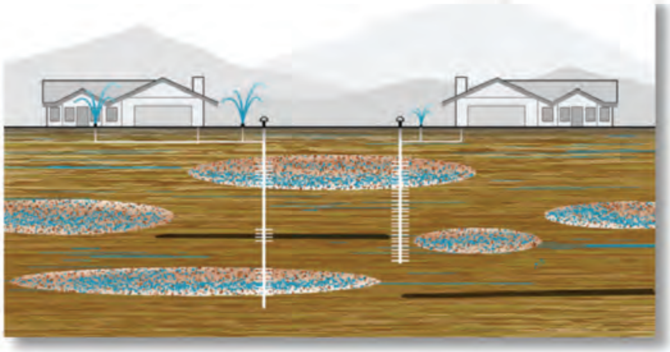


Dune Field Aquifer

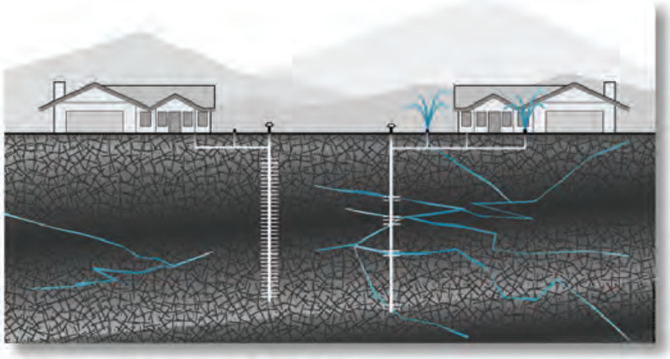
Dune Field Aquifer

Large areas of the eastern plains of Colorado are covered with wind deposited sand dunes that have been stabilized by vegetation. They are often called "Sand Hills." Rain, snowmelt and irrigation water have percolated into these large accumulations of unconsolidated sand and silt. The Sand Hills serve as an important shallow aquifer on the eastern plains. Water quality and yield from this aquifer type can be good, but they are susceptible to drought and groundwater mining.

Aquifers and Water Use Basics



Bedrock Shale and Sandstone Aquifer



Crystalline Fractured Aquifer

Bedrock Shale and Sandstone Aquifer
Bedrock shale and sandstone aquifers are often tapped in Colorado as these are the most common rock types in developable areas outside the high mountains. Most of these aquifers are made up of interbedded layers of sandstone and shale. More groundwater is generally found in sandstone than in shale. The yield and quality of water removed from bedrock aquifers can vary widely. In some areas dominated by shale it may not be possible to develop a well with good yield and water quality. And because recharge into bedrock aquifers is usually very slow, bedrock aquifers can easily suffer from the effects of groundwater mining.

Crystalline Fractured Aquifer
Crystalline fractured aquifers are most commonly found in mountain areas and include rocks such as granite, metamorphic quartzite and volcanic rocks. Fractured aquifers can also be found in areas with thick sandstone or limestone deposits. While these types of rocks have little or no pore spaces, groundwater can be stored and transported in interconnected naturally occurring fractures among the rock. Wells that are drilled into a network of fractures can yield water. However, a nearby well that does not intercept fractures may yield no water at all.

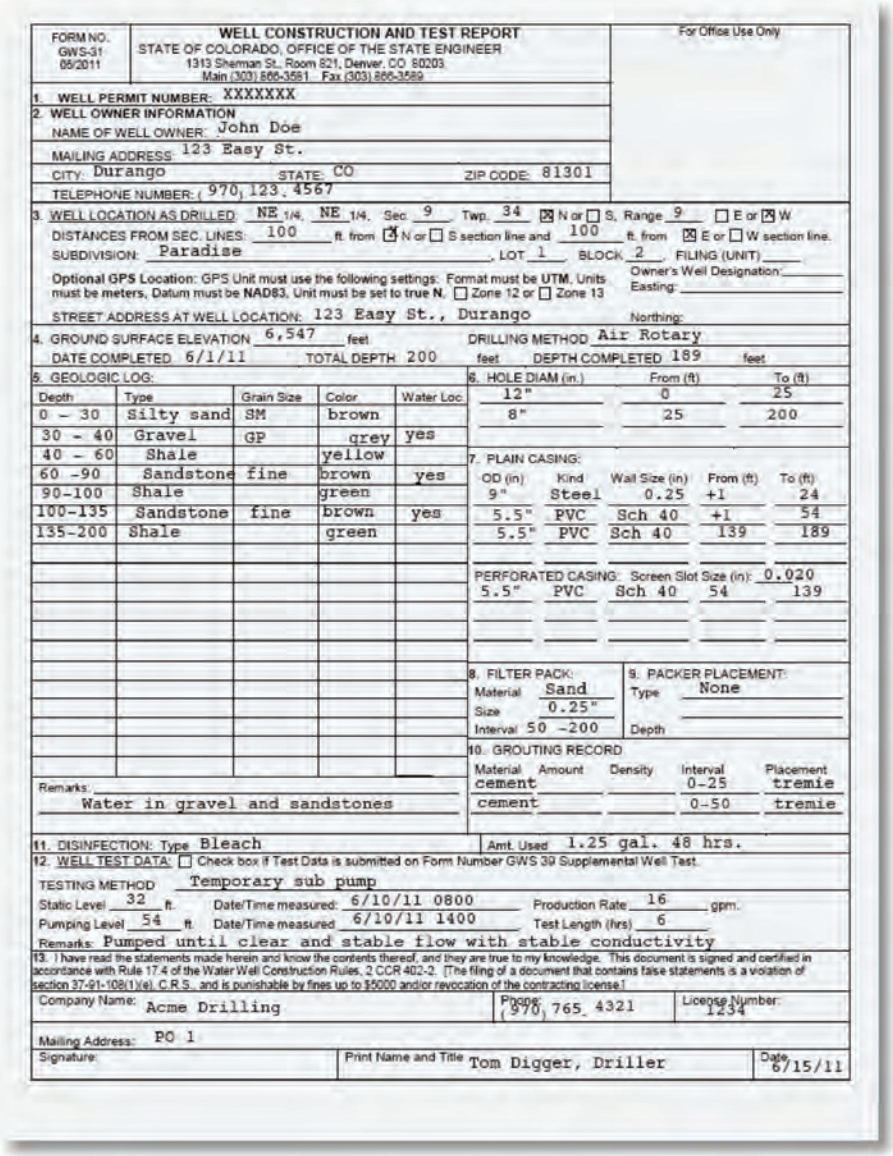
Water Well Permitting, Construction and Recordkeeping

The early stage of planning a new or replacement water well includes several steps. These steps include selecting a licensed drilling and pump contractor, selecting a well location that avoids contamination hazards, and obtaining a well permit. The Colorado Division of Water Resources requires that every new or replacement well be permitted before it is drilled, and that water wells must be drilled and constructed pursuant to Colorado Water Well Construction Rules (2 CCR 402-2). http://water.state.co.us/DWRIPub/Documents/constructionrules05.pdf

In general, the well permit application asks for ownership and proposed well location information, proposed construction details, water use and septic system information and the well driller's license number. http://water.state.co.us/groundwater/wellpermit/Pages/default.aspx

The Division of Water Resources (DWR) has several different types of possible well permits that can be issued. DWR form GWS-44 is used for most residential and livestock water wells. Based on certain water rights criteria the DWR may limit water to indoor use only for parcels of less than 35 acres, and to outdoor use of no more than 1 irrigated acre for parcels larger than 35 acres. In water critical areas (where water rights are over appropriated) the DWR may deny a new well permit altogether unless a landowner obtains appropriate replacement water rights. There are several areas in Colorado that are designated as water critical areas. Persons interested in purchasing undeveloped land should always contact DWR before purchasing the property to determine if a well permit can be issued for that particular parcel. It is also a good idea to contact a local geologist to assist in evaluating the

Sample Well Construction Report



FORM NO.
GWS-31
06/2011

WELL CONSTRUCTION AND TEST REPORT
STATE OF COLORADO, OFFICE OF THE STATE ENGINEER
1313 Sherman St., Room 821, Denver, CO 80203
Main (303) 866-3581 Fax (303) 866-3589

For Office Use Only

1. **WELL PERMIT NUMBER:** XXXXXXX

2. **WELL OWNER INFORMATION**
NAME OF WELL OWNER: John Doe
MAILING ADDRESS: 123 Easy St.
CITY: Durango STATE: CO ZIP CODE: 81301
TELEPHONE NUMBER: (970) 123 . 4567

3. WELL LOCATION AS DRILLED: NE 1/4, NE 1/4, Sec. 9, Twp. 34 ☒ N or ☐ S, Range 9 ☐ E or ☒ W
DISTANCES FROM SEC. LINES: 100 ft. from ☑ N or ☐ S section line and 100 ft. from ☒ E or ☐ W section line.
SUBDIVISION: Paradise, LOT 1, BLOCK 2, FILING (UNIT) ____
Optional GPS Location: GPS Unit must use the following settings: Format must be **UTM**, Units must be **meters**, Datum must be **NAD83**, Unit must be set to **true N.** ☐ Zone 12 or ☐ Zone 13
Owner's Well Designation: ____
Easting: ____
Northing:
STREET ADDRESS AT WELL LOCATION: 123 Easy St., Durango

4. GROUND SURFACE ELEVATION 6,547 feet DRILLING METHOD Air Rotary
DATE COMPLETED 6/1/11 TOTAL DEPTH 200 feet DEPTH COMPLETED 189 feet

5. GEOLOGIC LOG:

Depth	Type	Grain Size	Color	Water Loc.
0 – 30	Silty sand	SM	brown	
30 - 40	Gravel	GP	grey	yes
40 - 60	Shale		yellow	
60 -90	Sandstone	fine	brown	yes
90-100	Shale		green	
100-135	Sandstone	fine	brown	yes
135-200	Shale		green	

Remarks: Water in gravel and sandstones

6. HOLE DIAM (in.)

HOLE DIAM (in.)	From (ft)	To (ft)
12"	0	25
8"	25	200

7. PLAIN CASING:

OD (in)	Kind	Wall Size (in)	From (ft)	To (ft)
9"	Steel	0.25	+1	24
5.5"	PVC	Sch 40	+1	54
5.5"	PVC	Sch 40	139	189

PERFORATED CASING: Screen Slot Size (in): 0.020

5.5"	PVC	Sch 40	54	139

8. FILTER PACK:
Material Sand
Size 0.25"
Interval 50 -200

9. PACKER PLACEMENT:
Type None
Depth

10. GROUTING RECORD

Material	Amount	Density	Interval	Placement
cement			0-25	tremie
cement			0-50	tremie

11. DISINFECTION: Type Bleach Amt. Used 1.25 gal. 48 hrs.

12. WELL TEST DATA: ☐ Check box if Test Data is submitted on Form Number GWS 39 Supplemental Well Test.
TESTING METHOD Temporary sub pump
Static Level 32 ft. Date/Time measured: 6/10/11 0800 Production Rate 16 gpm.
Pumping Level 54 ft. Date/Time measured 6/10/11 1400 Test Length (hrs) 6
Remarks: Pumped until clear and stable flow with stable conductivity

13. I have read the statements made herein and know the contents thereof, and they are true to my knowledge. This document is signed and certified in accordance with Rule 17.4 of the Water Well Construction Rules, 2 CCR 402-2. [The filing of a document that contains false statements is a violation of section 37-91-108(1)(e), C.R.S., and is punishable by fines up to $5000 and/or revocation of the contracting license.]

Company Name: Acme Drilling
Phone: (970) 765. 4321
License Number: 1234
Mailing Address: PO 1
Signature:
Print Name and Title Tom Digger, Driller
Date 6/15/11

probability of developing a good well on the parcel.

Another early step in the well drilling process is planning for your water analysis and treatment. In Colorado, private well owners are responsible for the quality and quantity of their water supply. They are also responsible for determining what treatment equipment may be necessary for their well water. Before drilling a new well or sampling your existing well, you should contact a qualified analytical laboratory to discuss the appropriate analytical testing to be performed on your well water. You can obtain a list of qualified laboratories by contacting the Colorado Department of Public Health and Environment (CDPHE). (http://www.cdphe.state.co.us/wq/drinkingwater/PrivateWellInformation.html).

Also, you should obtain the necessary bottles and instruction on how to collect and preserve the water sample. Then, after the well is drilled, fully developed and disinfected you will be ready to collect your water sample and deliver it to the laboratory. Based on the analytical results, you can select appropriate treatment equipment (see Water Treatment Decision Guide on page 18).

As part of the well drilling process, the driller must record certain data that will be reported to DWR. This includes a record of the geologic formations penetrated (the well log), an as-built well construction record and diagram, and an accurate water level and well yield test. It is very important that the driller collects and records this information accurately. You may wish to ask the driller to collect and save samples of all the different soil and rock formations that were penetrated so that they can be examined later by a geologist. You will also want the licensed driller and pump installer to provide you with copies of all the diagrams and reports that must be submitted to DWR.

Have the water from your new well tested by a qualified analytical laboratory. Record the results for future reference.

If you have an existing well with no records, DWR can provide you with copies of the reports that were submitted by the driller when the well was drilled. You can find permit and basic construction information about the well at the DWR web site Well Permit Search function (http://www.dwr.state.co.us/WellPermitSearch/default.aspx). This web site will have all of the available scanned documents that have been submitted for your well.

Keep these records in a safe place. You will need to refer to these documents in the future when performing well maintenance or while evaluating well problems. Always keep detailed records of any maintenance or testing that is performed on the well.

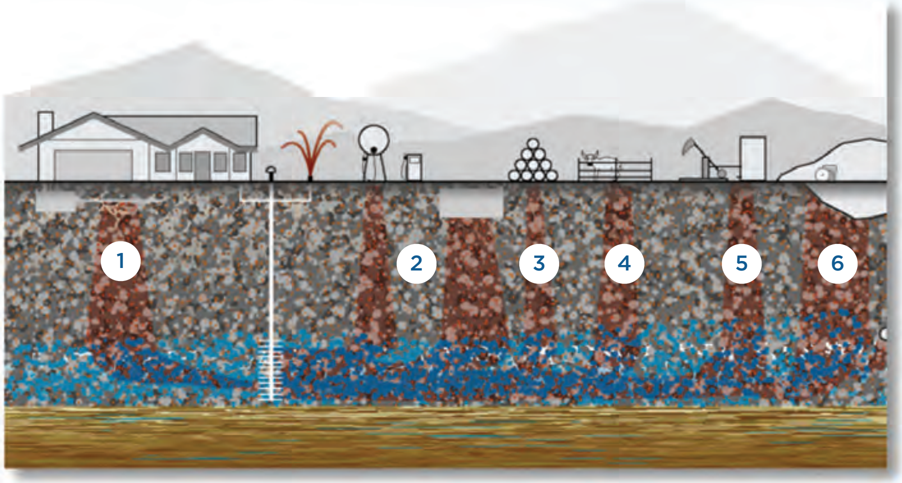
A section is provided in the back of this booklet that lets you record some of the basic construction and permit information for your well for your easy future reference.

Water Well Protection and Pollution Sources

Man-Made Pollutants

Groundwater pollution occurs when man-made products such as gasoline, oil, road salts, fertilizer, and chemicals get into the groundwater and cause it to become unsafe or unfit for human use. Some of the most common sources of pollutants are leaking fuel storage tanks, septic systems, animal holding pens (corrals), inappropriate chemical storage sites, landfills, and the widespread use of road salts and agricultural chemicals. In general, keep these facilities and materials as far away from your water well as possible. If possible, your well should be placed uphill of any potential contaminant source.

A domestic well can easily be polluted if it is not properly constructed or if unsafe materials are released into the well. Toxic materials spilled or dumped near a well can leach into the aquifer and pollute the groundwater drawn from that well, making polluted wells used for drinking water very dangerous.



Common Man-Made Pollutants

Individual septic systems, or those not connected to a city sewer system, can also be a serious pollution source. Septic systems are designed to slowly drain away human waste underground at a harmless rate. An improperly designed, located, constructed, or maintained septic system can leak bacteria, viruses, or household chemicals into groundwater causing serious problems. A permit is required to install, alter or repair a septic system in Colorado (5 CCR 1003-6), and the property owner is responsible for proper installation and maintenance of the system and for abatement of any nuisance arising from its failure. Contact your local or regional health department for more information on local septic system rules (including design and setbacks).

Landfills are another source of pollution. When properly constructed, contemporary landfills have a protective bottom layer to prevent pollutants from getting into our groundwater. But, if this protective layer fails, pollutants from the landfill can make their way down into the groundwater.

Finally, chemicals including fertilizers, insecticides and pesticides are washed into the ground by irrigation and precipitation and eventually end up in the groundwater if they are improperly applied.

1. Septic systems leach household waste into soil and neutralize many types of contaminants. However, a septic system should be at least 100 feet from a water well and chemicals should not be poured down the drain as these may not be effectively neutralized by the soil.

2. Fuel tanks and fueling operations can be a source of contamination of groundwater if there are leaks or spills. This can happen with both above-ground and underground tanks and pipelines. Do not store fuel or transfer fuel near a water well. Fix leaks and cleanup spills immediately.

3. Chemical storage, leaks or spills and improper chemical use can all be sources of groundwater contamination. Typical chemi-

cals stored in a household may include paint, solvents, fertilizer, herbicides, pesticides, cleaners and oil. Always use chemicals as instructed on the label. Do not store or use chemicals near (or in the same building as) your water well. Fix leaks and cleanup spills immediately.

4. Animal holding pens (corrals) tend to become areas of concentrated animal waste. Rain water and snowmelt can carry these wastes into groundwater. Do not situate animal holding pens near your water well. Use a minimum 100 foot offset as you should with your septic system. Also, do not bury a dead animal within 150 feet of a water well (preferably further).

5. Oil and gas production facilities can be a source of contaminants such as oil, condensate and produced water. Oil and gas facilities must be sited a minimum of 150 feet from residences and other occupied structures. Keep your water well at least that far from an oil & gas production facility. Also, if you notice anything leaking from an oil & gas facility immediately call the operator of the facility (there should be a sign at the facility with an emergency contact number) so that trained professionals can respond to correct the problem.

6. Landfills can be a source of contaminants that can leach into groundwater. All current municipal and county landfills must meet stringent requirements for construction and monitoring. However, historic landfills and private "ranch" landfills can be an unmonitored source of contaminants. If you have a private landfill then only place inert materials in it. Do not dispose of chemicals, petroleum products and other potential contaminants in private landfills. Information concerning disposing of your own solid waste on your own property is available from CDPHE at: http://www.cdphe.state.co.us/hm/onesownwaste.pdf

Natural Contaminants

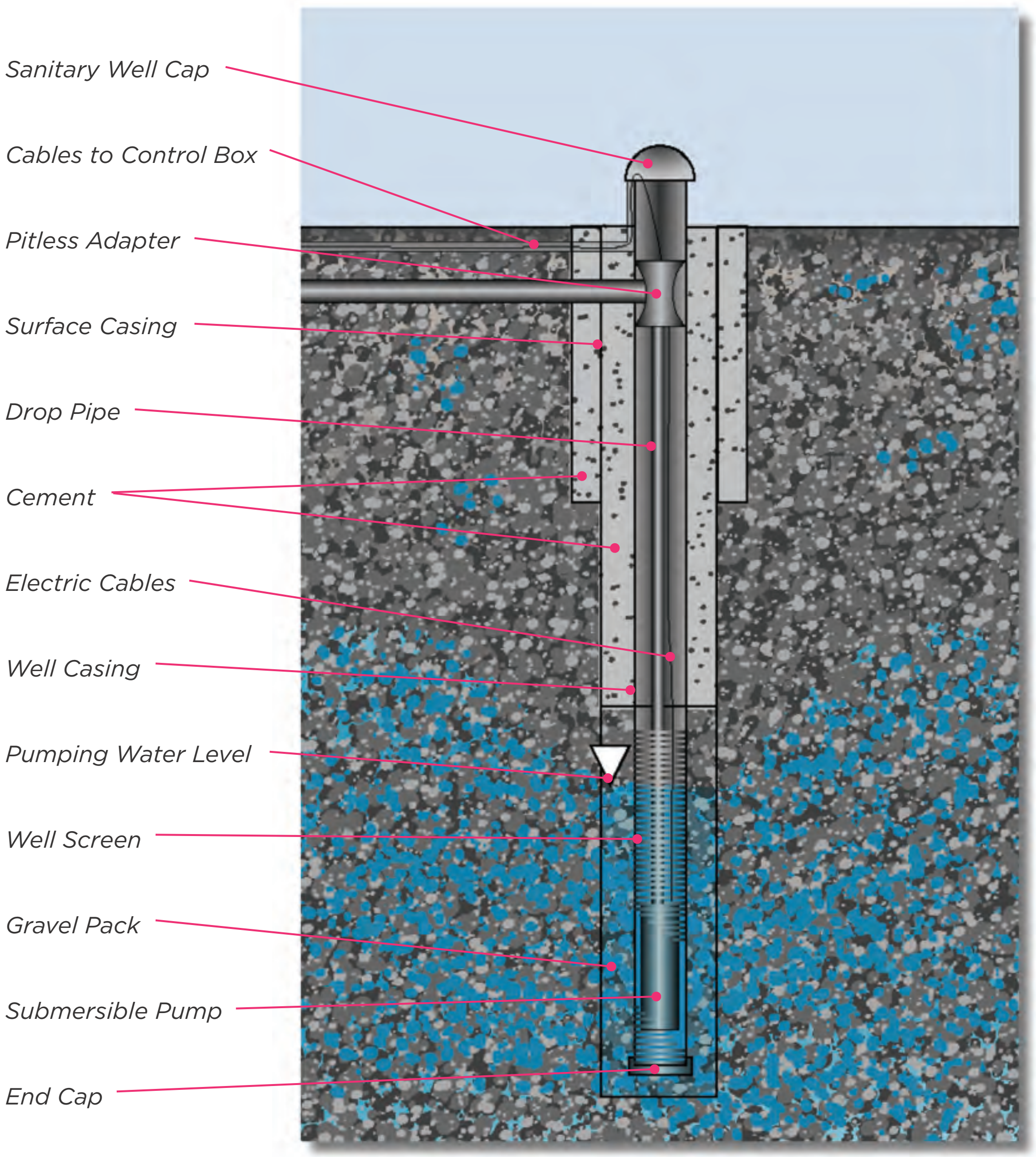
Contamination of groundwater is not always a result of the introduction of pollutants by human activities. Possible natural contaminants include trace elements such as arsenic and selenium, dissolved gases like methane and radon, and high concentrations of commonly occurring dissolved salts.

In Colorado, many groundwaters naturally contain arsenic, chloride, dissolved salts, fluoride, iron, magnesium, manganese, selenium, sulfate, radon, uranium, and other trace metals in concentrations exceeding recommended or mandatory standards for public drinking water established by the CDPHE, the U.S. EPA and the U.S. Public Health Service.

Anatomy of a Water Well

Typical Water Well Components
This schematic diagram represents a typical water well as constructed in a water table type aquifer.   While most wells are much deeper than illustrated here, all of the individual components are shown and labeled. The following list of water well terms helps explain the well components and other useful terms.

Knowing about the different components of a water well, and their function, will allow you to more effectively discuss your well with your licensed well driller or pump installer.



Anatomy of a Water Well

Typical Water System Terminology

Aquifer – A water bearing layer of sediment or rock with interconnected pore spaces or fractures that can store and deliver water to a well.

Borehole – The cylindrical hole drilled into the ground and aquifer.

Casing – Steel or PVC tubing placed in the borehole to keep the borehole open and to allow room to store water and install a pump.

Casing Stickup – The amount of casing that sticks up above the ground surface. This should be at least 1 foot.

Cement – Placed between the wall of the borehole and the casing and surface casing to prevent surface contamination from reaching the aquifer.

Cistern – A water holding tank, usually underground, used for storage or treatment of water before being delivered to the pressure tank and home. A cistern will usually be vented to allow gases such as methane and radon to escape.

Control Box – Electrical switch box that turns the well pump on and off.

Drop Pipe – Pipe placed in the casing to connect the pump to the surface.

Electrical Cable – Wiring from the pump control box to the pump that supplies power and command signals.

End Cap – Cap placed on the bottom of the casing to prevent sediment from flowing into the casing.

Gravel Pack – Gravel or sand placed between the borehole wall and the well screen to keep the borehole open and filter water before it enters the well.

Groundwater – Water stored beneath the surface of the earth that is transmitted through small, interconnected pores and fractures in sediment and rock.

Pitless Adapter – A device placed in the well casing that allows water to be diverted from the drop pipe to piping on the exterior of the well below the frost line.

Pressure Tank – A water holding tank equipped with an air bladder that regulates water pressure into the home and demand to the pump.

Pumping Water Level – The depth below the ground surface of the water level in the well when the pump is operating. This is always deeper than the static water level.

Sanitary Well Seal – A sealed cap on the top of the well casing that prevents surface contaminants from entering the inside of the well. It is also vented to allow gases such as methane and radon to escape the casing.

Submersible Pump – The most common type of water well pump includes the pump and pump motor placed at the bottom of the drop pipe below the pumping water level.

Static Water Level – The depth below ground surface of water when the pump is not operating. This level will vary seasonally and over longer time periods due to recharge, drought or groundwater mining.

Surface Casing – Steel casing at least 20 feet deep that is the first casing installed in a well that prevents surface contaminants from entering the well.

Treatment Equipment – Can include a variety of equipment designed to remove various water contaminants and purify groundwater before use.

Well Screen – Steel or PVC perforated pipe that water from the aquifer flows through to enter the well and pump.

Water Well Maintenance

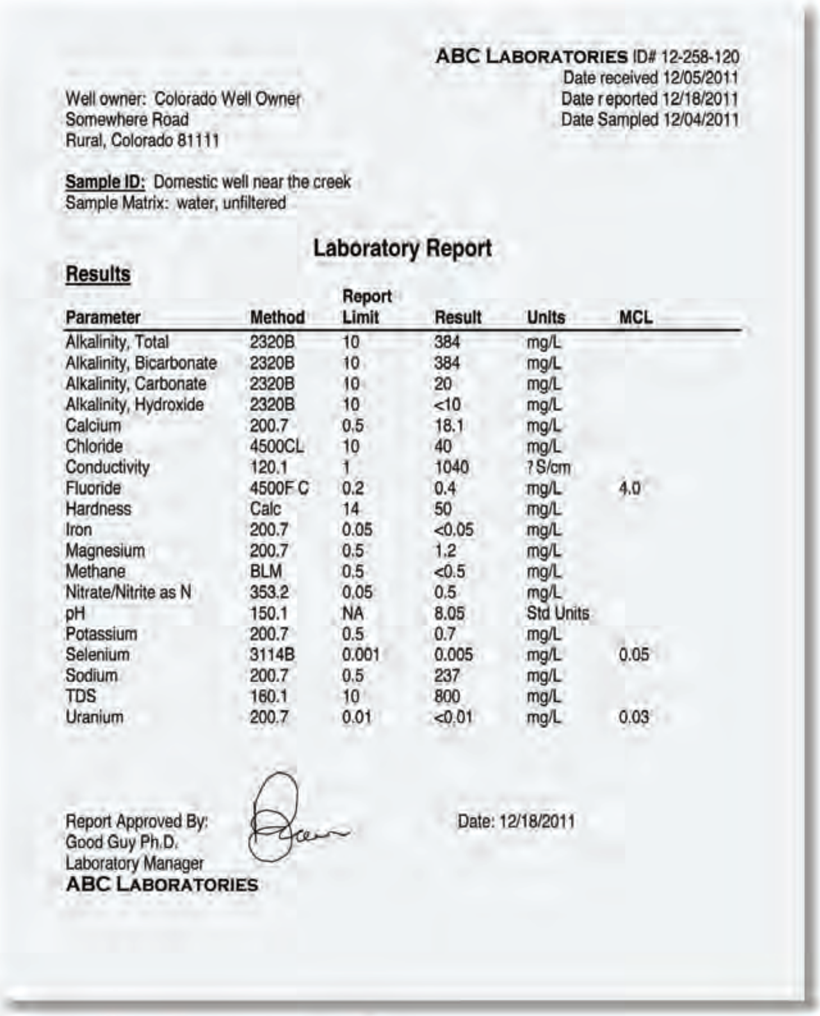
Properly constructed private water supply systems require routine maintenance. These simple steps will help protect your system and investment.

1. Always use licensed water well drillers and pump installers when a well is constructed, a pump is installed, a cistern is installed, or the system is serviced. Always ask to have a copy of their license or certification and insurance before they start any work on your well or system or before you sign any contract. A reputable professional will gladly ask their insurance carrier to provide you a certificate of insurance at no charge.
2. An annual well maintenance check, including a water chemistry and bacterial test, a check of the static water level, and a well yield test is recommended. Any source of drinking water should be checked any time there is a change in taste, odor or appearance, or anytime a water supply system is serviced.
3. Keep livestock, hazardous chemicals, such as paint, solvents fertilizer, pesticides, herbicides, fuel and motor oil far away from your well and pump house.
4. Periodically check the well cover or well cap on top of the well casing to ensure it is in good repair and the vent is clear.
5. Always maintain proper separation between your well and buildings, waste systems, chemical storage facilities and livestock corrals.
6. Do not allow back-siphonage. When mixing pesticides, fertilizers or other chemicals, do not put the hose inside the tank or container.
7. When landscaping, keep the top of your well at least one foot above the ground. Slope the ground away from your well for proper drainage.
8. Take care in working or mowing around your well. A damaged casing could jeopardize the sanitary protection of your well. Do not pile snow, leaves, or other materials around the well.
9. Keep your well records in a safe place. These include the construction report, as well as annual water well system maintenance, water testing results, routine measurements of well yield and static water level. A section is provided in the back of this booklet where you may record basic information about your well.
10. Be aware of changes in your well, the area around your well, or the water it provides.
11. A licensed water well contractor or pump installer can periodically measure the water level in your well and its production rate. They can also clean your well screen if there are indications of it becoming plugged by mineralization or bacteria. The pump installer can also clean and maintain your cistern if you have one.
12. When your well has come to the end of its serviceable life (usually more than 20 years), have your licensed well driller properly plug and abandon your well.

Water Quality Standards and Interpretation

Interpreting Your Water Test Report

Obtaining a water analysis from a testing laboratory is a necessary first step toward solving household water quality problems. Before testing, you may have had concerns about the safety of the water used in the household. Or, you may have noticed objectionable symptoms when using the water for drinking, cooking, or other household purposes. Perhaps you have routinely monitored your household water quality through periodic testing and have recently noticed differing results between tests for one or more indicators. To identify the source of contamination problems, as well as to determine the type of corrective action to take, a properly interpreted water analysis report is essential.



ABC LABORATORIES ID# 12-258-120
Date received 12/05/2011
Date reported 12/18/2011
Date Sampled 12/04/2011

Well owner: Colorado Well Owner
Somewhere Road
Rural, Colorado 81111

Sample ID: Domestic well near the creek
Sample Matrix: water, unfiltered

Laboratory Report

Results

Parameter	Method	Report Limit	Result	Units	MCL
Alkalinity, Total	2320B	10	384	mg/L	
Alkalinity, Bicarbonate	2320B	10	384	mg/L	
Alkalinity, Carbonate	2320B	10	20	mg/L	
Alkalinity, Hydroxide	2320B	10	<10	mg/L	
Calcium	200.7	0.5	18.1	mg/L	
Chloride	4500CL	10	40	mg/L	
Conductivity	120.1	1	1040	? S/cm	
Fluoride	4500F C	0.2	0.4	mg/L	4.0
Hardness	Calc	14	50	mg/L	
Iron	200.7	0.05	<0.05	mg/L	
Magnesium	200.7	0.5	1.2	mg/L	
Methane	BLM	0.5	<0.5	mg/L	
Nitrate/Nitrite as N	353.2	0.05	0.5	mg/L	
pH	150.1	NA	8.05	Std Units	
Potassium	200.7	0.5	0.7	mg/L	
Selenium	3114B	0.001	0.005	mg/L	0.05
Sodium	200.7	0.5	237	mg/L	
TDS	160.1	10	800	mg/L	
Uranium	200.7	0.01	<0.01	mg/L	0.03

Report Approved By:
Good Guy Ph.D.
Laboratory Manager
ABC LABORATORIES

Date: 12/18/2011

Sample Water Quality Analysis Report

Besides providing a laboratory report of the analysis for the naturally occurring constituents and pollutants or contaminants (if present), most water testing laboratories provide little additional explanation of test results beyond the units used and possibly a footnote or similar comment in the event that a problem contaminant is identified. The information provided below, along with the following glossary of water testing terms, may assist you in understanding a water analysis report for some common household water contaminants.

What Do the Numbers Mean?

Once a water testing laboratory has completed the analysis of your water, you will receive a report. It will contain a list of the natural constituents, possible contaminants and physical characteristics for which your water was tested and the measured concentration of each. The concentration is the amount of a given substance (weight) in a specific amount of water (volume). The most common concentration unit used is milligrams per liter (mg/L) which, is approximately equal to one part per million (ppm), or one part contaminant to one million parts water.

Water Quality Standards and Interpretation

How Much is too Much?

"Pure" water does not exist in nature and all natural water contains some dissolved mineral and salt constituents. In most cases, the levels of these naturally occurring constituents are beneficial or minimal and of little consequence. However, when certain constituent levels in household water are excessive, they may affect household activities and/or be detrimental to human, animal and plant health. Evaluating what levels of constituents are acceptable and understanding the nature of problems caused when the concentration is excessive and would be considered a contaminant of concern are the basic considerations in interpreting a household water analysis report.

Acceptable limits for evaluating the suitability and safety of your well water are established for many contaminants. Some established standards are set by nuisance considerations (taste, odor, staining, etc.) while many are based on health implications and are legally enforceable with respect to public water systems. These acceptable limits should be used as guidelines for your own water supply when evaluating your well water test results.

Whether you have the results of tests that you specifically requested, or you simply instructed the laboratory to conduct general or routine household water quality tests, you can use the following tables as a general guideline for the most common household water quality contaminants. These are divided into three categories: general indicators, nuisance impurities, and health contaminants. (Note: Some contaminants are evaluated on the basis of both nuisance and health criteria.)

Water Quality Standards and Interpretation

General Indicators

General water quality indicators are parameters used to indicate the possible presence of harmful contaminants. Testing for indicators may eliminate the need for costly tests for specific contaminants. Generally, if an indicator is excessive, the water supply may contain other contaminants as well, and further testing is recommended. For example, you are probably familiar with coliform bacteria. These harmless bacteria are present in the air, soil, vegetation, and all warm-blooded animals. A positive total coliform bacteria test result may be followed by tests for fecal coliform or E. coli bacteria which, if present, would confirm that sewage or animal waste is contaminating the water. Total dissolved solids (TDS) and pH are considered general water quality indicators, and may vary over time depending on well recharge characteristics. The tests listed in Table 1, along with a test for nitrate/nitrite (see Table 4), provide a good routine analysis (as often as once a year) for most rural water supplies, unless there is a reason to suspect other contaminants.

Table 1: General Water Quality Indicators

Indicator	Acceptable Limit	Indication
Bacteria	None Present	Possible bacterial or viral contamination from human sewage, animal waste, surface water or any one of a number of bacteria such as sulfate reducing, slime formers, iron, methanogenic, etc..
pH Value	6.5 to 8.5	An important overall measure of water quality, pH can alter corrosivity and solubility of contaminants. Low pH will cause pitting of pipes and fixtures and/or metallic taste. This may indicate that metals are being dissolved. At a high pH, the water will have a slippery feel or soda taste.
Total Dissolved Solids (TDS)	500 mg/L*	Dissolved minerals, like sodium, calcium, magnesium, iron or manganese. High TDS also may indicate excessive hardness (scaly deposits) and cause iron or mineral staining, or a salty, bitter taste.
Odor/Color		Can be indicative of high mineral content such as iron (red staining) or manganese (black staining). Rotten egg odor is indicative of hydrogen sulfide. Both color and odor indicate that your water should be tested.
Gas Bubbles		Can be indicative of dissolved gas such as methane. Sometimes is indicative of low water levels and air being trapped by the pump.

* TDS levels greater than 500 mg/l are found naturally in many water wells and public drinking water systems in the western states. Water with higher than 500 mg/l may cause mild and transient gastric upset and still be safe to drink. In many cases it is the only source of water.

Nuisance Impurities

Nuisance impurities are another category of contaminants. While these have no adverse health effects at low levels, they may make water unsuitable for many household purposes. Nuisance impurities may include iron, bacteria, chloride, and hardness. Table 2 lists some typical nuisance impurities you may see on your water analysis report. Acceptable limits for nuisance impurities come from the EPA Secondary Drinking Water Standards for public drinking water systems.

Table 2: Common Nuisance Impurities and Their Effects

Contaminant	Acceptable Limit	Effects
Chlorides	250 mg/L	Salty or brackish taste; corrosive; blackens and pits stainless steel and can cause green plants to yellow.
Copper (Cu)	1.3 mg/L	Blue-green stains on plumbing fixtures; bitter, metallic .
Iron (Fe)	0.3 mg/L	Metallic taste; discolored beverages; yellowish stains on laundry, reddish brown stains on fixtures.
Manganese (Mn)	0.05 mg/L	Black specks on fixtures; bitter taste.
Sulfates (SO_4)	250 mg/L	Bitter, medicinal taste; corrosive; may cause gastric upset and diarrhea.
Iron Bacteria		Orange to brown-colored slime in water, can cause an oil-like film on standing water, black-brown sludge in toilet tank.
Slime Bacteria		Jelly-like slime deposits in toilet tank, bottom of cisterns.
Sulfate Reducing Bacteria		Rotten egg or sewer-like like smell.
Zinc (Zn)	5 mg/L	Zinc is an essential element in our diet. Too little zinc can cause problems, but too much zinc is also harmful. Indication of galvanized pipe corrosion in older homes.

Water Hardness

Hardness is one contaminant you will also commonly see on the report. Hard water causes white, scaly deposits on plumbing fixtures and cooking appliances and decreased cleaning action of soaps and detergents. Hardness is the sum of the calcium and magnesium levels found in your water. Hard water can also cause buildup in hot water heaters and reduce their effective lifetime. Table 3 will help you interpret your water hardness parameters.

Hardness may be expressed in either milligrams per liter (mg/L) or grains per gallon (gpg). A gpg is used exclusively as a hardness unit and equals approximately 17 mg/L or ppm. Those water supplies falling in the hard-to-very hard categories may need to be softened. However, as with all water treatment, you should carefully consider the advantages and disadvantages of softening before making a decision on how to proceed.

Advantages and disadvantages of softening your water include:

- increased levels of sodium or potassium (depending on which type of salt is used in your softener system) in softened water;
- increased effectiveness of detergents and soaps;
- increased life of hot water heater elements;
- increased potential for pipe corrosion, and:
- negative impact on houseplants.

Since the levels of sodium and potassium can affect your health, consult your health professional about any impacts that softening your water may have on your health. If you have a heart condition or high blood pressure you must consult your health professional before drinking softened water.

Table 3: Hardness Classifications (Concentration of Hardness)

In Grains per Gallon	In Milligrams per Liter (mg/L)	Relative Hardness Level
Below 3.5	Below 60	Soft
3.5 to 7.0	60 to 120	Moderately Hard
7.0 to 10.5	120 to 180	Hard
10.5 and above	180 and above	Very Hard

Health Contaminants

The parameters outlined in Table 4 are some common contaminants that have known health effects. The table lists acceptable limits, potential health effects, and possible sources of the contaminant in public water systems, these contaminants are regulated under the EPA Primary Drinking Water Standards. You may want to test for these contaminants in your private water well to determine the quality of your water.

Table 4: Standards, Sources, and Potential Health Effects of Common Regulated Contaminants

Contaminant	Acceptable Limit	Sources	Potential Health Affects at High Concentration
Fecal Coliform Bacteria	zero	Human sewage and animal waste leaking into well or from ground water contamination	Gastrointestinal distress, shock. Infants, elderly, individuals with a compromised immune system and the sick are especially susceptible.
Fluoride (F)	4.0 mg/L	Fluoride is leached from natural deposits.	Mottling of teeth and brittle bones. If less than 0.7 mg/L contact your doctor or dentist for recommendations about the need for additional fluoride for small children and the elderly.
Selenium (Se)	0.05 mg/L	Selenium is leached from natural deposits.	Dangerous to humans and animals alike. Horses are especially susceptible exhibiting hoof [nail] damage, hair loss, still born foals, weight loss and with long term exposure, death. Human and other animals share the same symptoms.
Lead (Pb)	0.015 mg/L	Used in batteries; may be leached from brass faucets, lead caulking, lead pipes and lead soldered joints. Is also leached from natural deposits	Nervous disorders and mental impairment especially in fetuses, infants, and young children. Also, kidney damage, blood disorders and hypertension, low birth weights.
Arsenic (As)	0.05 mg/L	Arsenic is leached from natural deposits.	Dangerous to humans and animals alike. May cause skin damage, circulatory system problems and an increased risk of cancer.
Nitrates and Nitrites	10 mg/L as nitrate-N [1.0 mg/l as nitrite-N]	Byproduct of agricultural fertilization, human and animal waste leaching to groundwater; also leached from natural deposits.	Serious health threat for infants (birth to 6 months). Symptoms include shortness of breath and blue-baby disease; lower health threat to children and adults.
Radon (Rn)	30 pCi/L	Naturally-occurring radioactive gas formed from uranium decay; can seep into well water from surrounding rocks and be released in the air as it leaves the faucet.	Continued breathing of radon gas increases chances of lung cancer; may increase risk of stomach, colon, and bladder cancers.
Uranium (U)	0.03 mg/L	Uranium is leached from natural deposits	High levels suggest the presence of Radon gas. Increased risk of cancer and kidney toxicity.

Water Quality Standards and Interpretation

Methane in Groundwater

Methane is a colorless, odorless and tasteless gas, which is produced by biological decay of organic materials or by high temperatures and pressures acting on organic materials. These materials include coals, organic rich shales, landfill materials, compost piles and other accumulations of organic materials both above and underground. Methane is also produced in the digestive system of humans and animals, and has no known direct health effect. The specific source of methane found in groundwater in Colorado, can generally be determined by detailed and relatively expensive laboratory analysis.

Methane in water wells becomes a problem when it is allowed to build up in confined spaces and become a potential safety hazard. These high concentrations of methane can displace oxygen, or in the presence of a spark, can explode. Extensive testing for methane in water wells in Colorado has been conducted during the past twenty years. As a result of this testing, many believe that methane concentrations below 1 mg/L are considered harmless. Methane levels up to 7 mg/L usually are not a concern but should be monitored for changes. Also, care should be taken to ventilate confined spaces where well water is used. Above 7 mg/L additional monitoring and treatment should be considered and implemented. Treatment for removing or lowering the concentration of methane in the water delivered into a house is relatively simple and includes vented wellhead caps, cisterns, some form of aeration and ventilation to allow the methane to safely dissipate outdoors rather than accumulate within your home, well house or other confined space. When you find methane in your well water, additional regular testing and monitoring should be performed since methane levels can fluctuate over time.

Figures 1 and 2 on page 20 demonstrate two types of methane treatment, one a small cistern or tank method and the other a more detailed two chambered cistern. Details of operation are found with the figures. In addition, for lower levels of methane, a vented well cap may be a sufficient treatment. As a general rule, the higher the methane level the more aggressive the removal system must be.

The system in Figure 1 is suitable for low-to-medium levels of methane, whereas Figure 2 describes a system for higher levels of methane.

Water Quality Standards and Interpretation

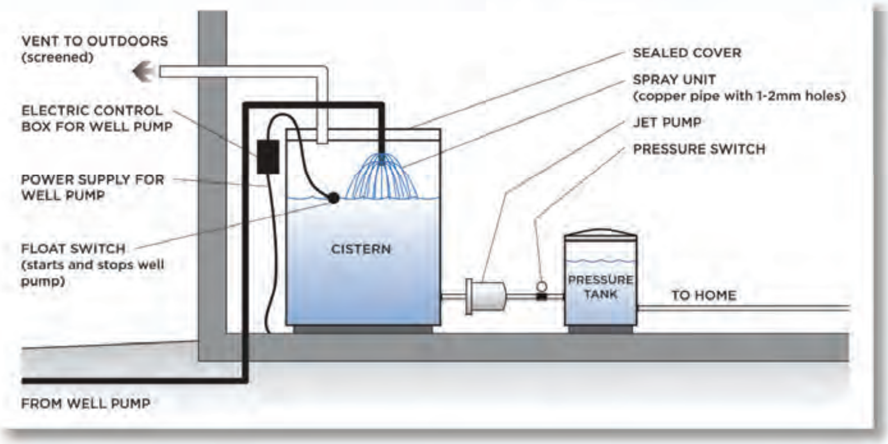


Figure 1: Small Cistern

Small Cistern
This small cistern system can be installed in a basement, garage, utility room or pump house. The active removal of methane is achieved by spraying the water into the open space of the cistern / tank and allowing the escaped gas to vent out.

Since methane is lighter than air it will rise to the top of the cistern and vent. The gas ***must*** be vented outside of any structure and never allowed to accumulate inside. Remember that this system should be installed by a licensed pump installer or plumber.

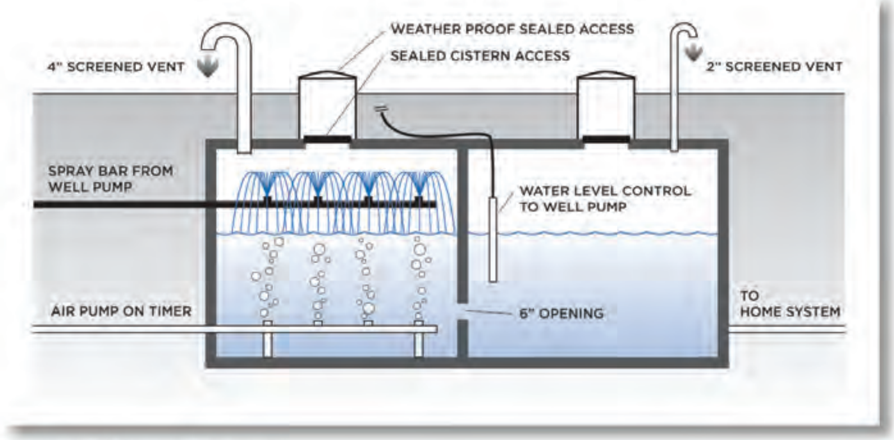


Figure 2: Large Cistern

Large Cistern
This system is an aggressive system and is usually installed outside and underground. In the active chamber one or two spray bars are installed about 15 - 20 inches below the top. One or two aeration bars are set about 12 inches above the bottom.

When the water in the passive chamber is low enough the controls turn on the well pump and the air pump (Jacuzzi type). The water sprays upward allowing much of the trapped methane to escape into the air. At the same time the aeration pump is blowing filtered air into the water further driving off any residual dissolved methane. When the pump refills the cistern (200 to 300 gallons) the air pump continues to blow for an additional 10 to 30 minutes to assure that all of the methane is removed. The methane free water moves into the passive (storage) side of the cistern which is also vented. The methane must be vented outside of any structure and never allowed to accumulate inside.

Because of the complexity of systems like this they should be installed by a licensed pump installer or plumber familiar with control systems.

Where Can I Get Additional Information?
Further assistance with interpretation of your household water quality test report is available. If you have any problems understanding the way the information is presented on the report, you should contact the testing laboratory directly for explanation. To assist you in evaluating the significance of your results, and any actions you should take to solve identified problems, or for further information on contaminants not discussed in this publication, you may want to contact your local Health Department or environmental professional. If you wish to

obtain more background information about the occurrence of contaminants and their effects on household water quality, particularly as it pertains to established drinking water standards, call the EPA Safe Drinking Water Hotline at (800) 426-4791. Or you can explore sites on the internet starting with one or more of the web sites listed in this booklet.

Where Can I Get Additional Help For Water Treatment?
Sources for water treatment assistance are usually found in most Yellow Pages under the headings of "Water Purify & Filter Equipment" or "Water Treatment Equipment, Service and Supplies". Additional assistance can often be found by talking to the local Health Department and in some cases the laboratory that analyzed your water. Care should be taken when a professional offers to test your water or demonstrates in-home water quality tests. Many of these in-home tests are difficult to perform and can provide misleading information. If possible use an independent testing laboratory that is certified. A listing of certified laboratories can be found at: http://www.cdphe.state.co.us/lr/pages/cert/SDWList.pdf .

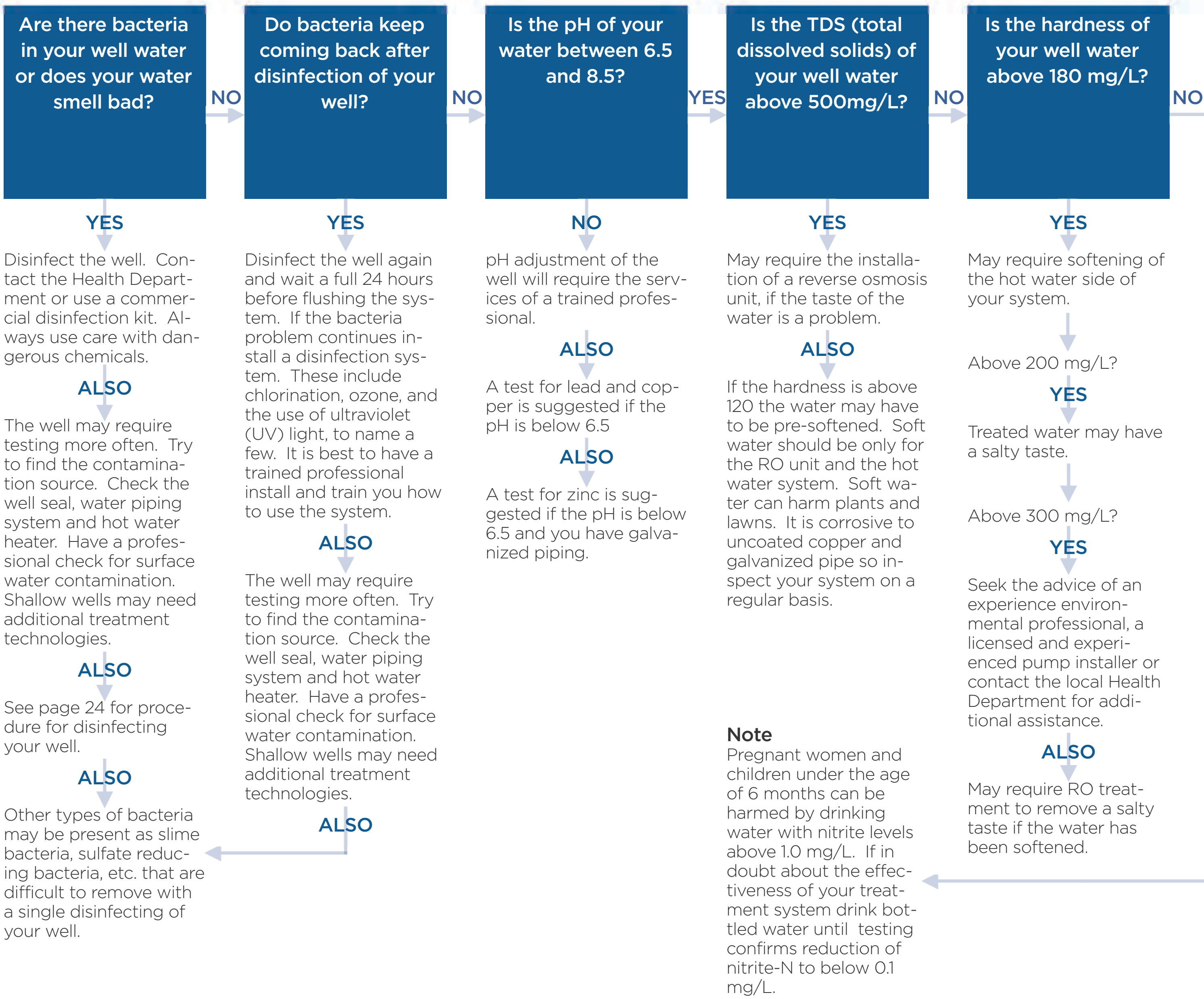
As with the use of any technical service, care should be taken to assure yourself that the professional you have chosen has specific experience in the treatment of your water's problems. Ask for references, certifications, training credentials and the names of others who have used their services. Check with the Better Business Bureau for consumer complaints. Ask how long the professional has been performing his services. Don't be shy. Obtain recommendations and quotations from more than one professional. Verify the terms of warranty claims on both equipment and installation. Ask to see the technical information on your proposed system before signing any contract.

If you have any doubts about the contract drawn up by the professional, seek legal assistance ***before*** signing. Look up web sites on the specific types of equipment that your professional recommends, talk to your friends, ask a lot of questions, and if you don't get answers, don't buy until your questions are answered. If you can't afford the entire system ask for a recommendation on a basic system to treat the major problem(s) to start with, and make sure that it will be compatible with any upgrades in the future.

Remember that you are the owner of a small domestic water treatment system; essentially a small version of the public systems in cities and towns.

Consequently, it will need to be maintained on a regular basis. Make sure that you are provided with the technical manuals for your system and ask your professional to set up a regular maintenance schedule for you to follow, including follow-up and annual visits by your professional. Record all system maintenance in the Basic Well Data section at the end of this booklet.

Water Treatment Decision Guide



Are there bacteria in your well water or does your water smell bad?

NO

YES

Disinfect the well. Contact the Health Department or use a commercial disinfection kit. Always use care with dangerous chemicals.

ALSO

The well may require testing more often. Try to find the contamination source. Check the well seal, water piping system and hot water heater. Have a professional check for surface water contamination. Shallow wells may need additional treatment technologies.

ALSO

See page 24 for procedure for disinfecting your well.

ALSO

Other types of bacteria may be present as slime bacteria, sulfate reducing bacteria, etc. that are difficult to remove with a single disinfecting of your well.

Do bacteria keep coming back after disinfection of your well?

NO

YES

Disinfect the well again and wait a full 24 hours before flushing the system. If the bacteria problem continues install a disinfection system. These include chlorination, ozone, and the use of ultraviolet (UV) light, to name a few. It is best to have a trained professional install and train you how to use the system.

ALSO

The well may require testing more often. Try to find the contamination source. Check the well seal, water piping system and hot water heater. Have a professional check for surface water contamination. Shallow wells may need additional treatment technologies.

ALSO

Is the pH of your water between 6.5 and 8.5?

YES

NO

pH adjustment of the well will require the services of a trained professional.

ALSO

A test for lead and copper is suggested if the pH is below 6.5

ALSO

A test for zinc is suggested if the pH is below 6.5 and you have galvanized piping.

Is the TDS (total dissolved solids) of your well water above 500mg/L?

NO

YES

May require the installation of a reverse osmosis unit, if the taste of the water is a problem.

ALSO

If the hardness is above 120 the water may have to be pre-softened. Soft water should be only for the RO unit and the hot water system. Soft water can harm plants and lawns. It is corrosive to uncoated copper and galvanized pipe so inspect your system on a regular basis.

Note

Pregnant women and children under the age of 6 months can be harmed by drinking water with nitrite levels above 1.0 mg/L. If in doubt about the effectiveness of your treatment system drink bottled water until testing confirms reduction of nitrite-N to below 0.1 mg/L.

Is the hardness of your well water above 180 mg/L?

NO

YES

May require softening of the hot water side of your system.

Above 200 mg/L?

YES

Treated water may have a salty taste.

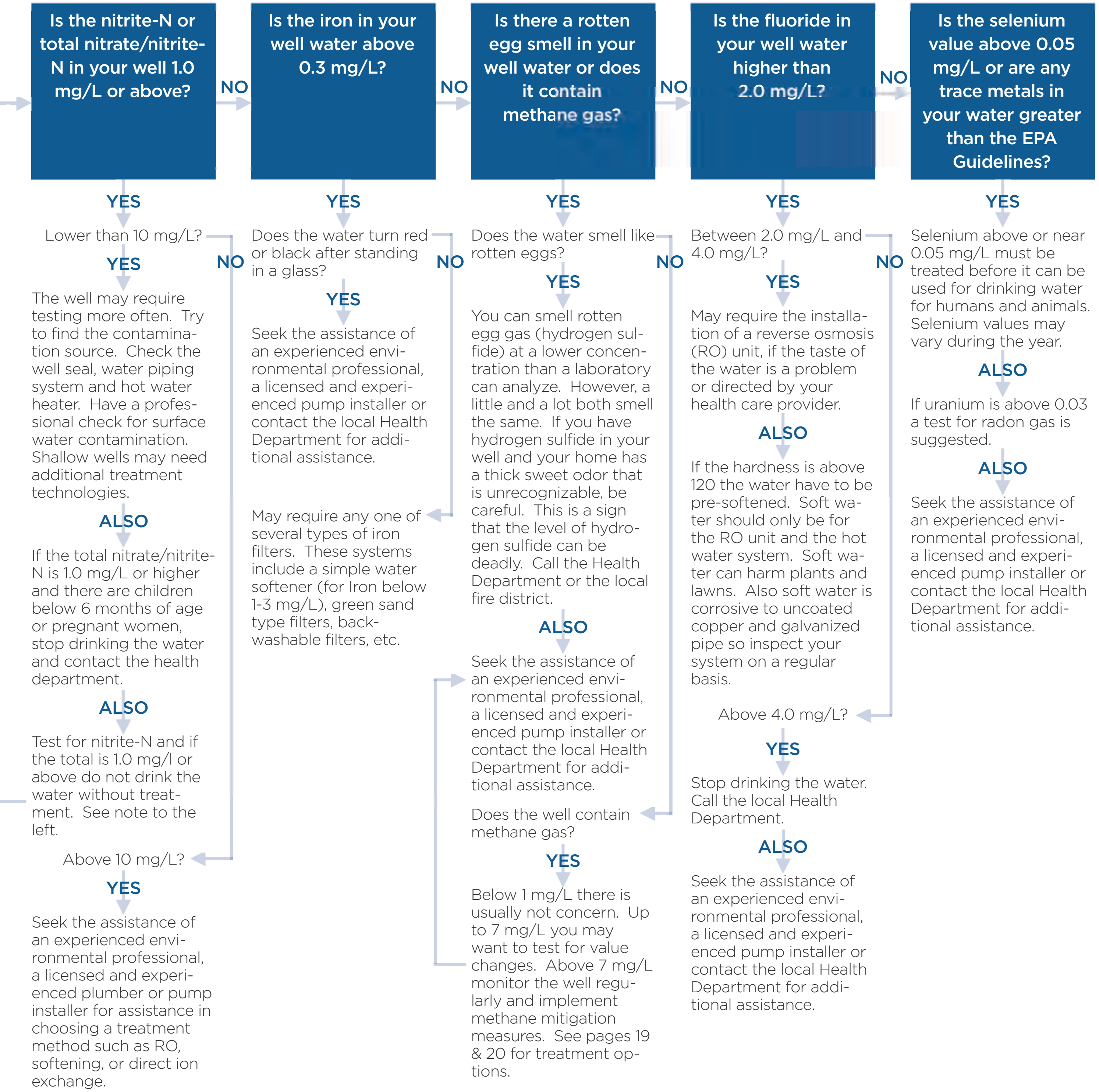
Above 300 mg/L?

YES

Seek the advice of an experience environmental professional, a licensed and experienced pump installer or contact the local Health Department for additional assistance.

ALSO

May require RO treatment to remove a salty taste if the water has been softened.



Is the nitrite-N or total nitrate/nitrite-N in your well 1.0 mg/L or above?

YES

Lower than 10 mg/L?

YES

The well may require testing more often. Try to find the contamination source. Check the well seal, water piping system and hot water heater. Have a professional check for surface water contamination. Shallow wells may need additional treatment technologies.

ALSO

If the total nitrate/nitrite-N is 1.0 mg/L or higher and there are children below 6 months of age or pregnant women, stop drinking the water and contact the health department.

ALSO

Test for nitrite-N and if the total is 1.0 mg/l or above do not drink the water without treatment. See note to the left.

NO

Above 10 mg/L?

YES

Seek the assistance of an experienced environmental professional, a licensed and experienced plumber or pump installer for assistance in choosing a treatment method such as RO, softening, or direct ion exchange.

NO

Is the iron in your well water above 0.3 mg/L?

YES

Does the water turn red or black after standing in a glass?

YES

Seek the assistance of an experienced environmental professional, a licensed and experienced pump installer or contact the local Health Department for additional assistance.

NO

May require any one of several types of iron filters. These systems include a simple water softener (for Iron below 1-3 mg/L), green sand type filters, backwashable filters, etc.

NO

Is there a rotten egg smell in your well water or does it contain methane gas?

YES

Does the water smell like rotten eggs?

YES

You can smell rotten egg gas (hydrogen sulfide) at a lower concentration than a laboratory can analyze. However, a little and a lot both smell the same. If you have hydrogen sulfide in your well and your home has a thick sweet odor that is unrecognizable, be careful. This is a sign that the level of hydrogen sulfide can be deadly. Call the Health Department or the local fire district.

ALSO

Seek the assistance of an experienced environmental professional, a licensed and experienced pump installer or contact the local Health Department for additional assistance.

NO

Does the well contain methane gas?

YES

Below 1 mg/L there is usually not concern. Up to 7 mg/L you may want to test for value changes. Above 7 mg/L monitor the well regularly and implement methane mitigation measures. See pages 19 & 20 for treatment options.

NO

Is the fluoride in your well water higher than 2.0 mg/L?

YES

Between 2.0 mg/L and 4.0 mg/L?

YES

May require the installation of a reverse osmosis (RO) unit, if the taste of the water is a problem or directed by your health care provider.

ALSO

If the hardness is above 120 the water have to be pre-softened. Soft water should only be for the RO unit and the hot water system. Soft water can harm plants and lawns. Also soft water is corrosive to uncoated copper and galvanized pipe so inspect your system on a regular basis.

NO

Above 4.0 mg/L?

YES

Stop drinking the water. Call the local Health Department.

ALSO

Seek the assistance of an experienced environmental professional, a licensed and experienced pump installer or contact the local Health Department for additional assistance.

NO

Is the selenium value above 0.05 mg/L or are any trace metals in your water greater than the EPA Guidelines?

YES

Selenium above or near 0.05 mg/L must be treated before it can be used for drinking water for humans and animals. Selenium values may vary during the year.

ALSO

If uranium is above 0.03 a test for radon gas is suggested.

ALSO

Seek the assistance of an experienced environmental professional, a licensed and experienced pump installer or contact the local Health Department for additional assistance.

Chlorination Techniques

When to treat your well with chlorine?

You should disinfect your well if your test for bacteria is positive, or following any construction, installation, maintenance, or repair of your well and other water systems. Disinfecting is essential if there has been flooding or other obvious signs of contamination in or around or in your well. The disinfecting process most often recommended is "shock chlorination". Shock chlorination is the process by which wells are sanitized using household chlorine bleach and is effective in home water systems such as wells, spring houses, and cisterns. Routine shock chlorination is NOT recommended for treating recurring bacteria problems. For these continuing chronic bacteria problems contact a reputable licensed water treatment expert who is familiar with your area.

What precautions should I take prior to chlorination?

Make sure that everyone in your home is warned not to use the water during the treatment process. Arrange for an alternative source of drinking water. Special care should be taken to ensure that children and older adults do not consume tap water during the treatment process. Unless you are familiar with water wells, and are comfortable working with chemicals, the well chlorination should be performed by a licensed water well contractor, pump installer or licensed plumber. If you have water treatment devices, consult with your water treatment company before beginning the chlorination process. Always use rubber gloves as well as a splash apron and eye protection when handling bleach. Avoid contact with the bleach. If you should splash this solution on your person or clothing, immediately rinse thoroughly with water.

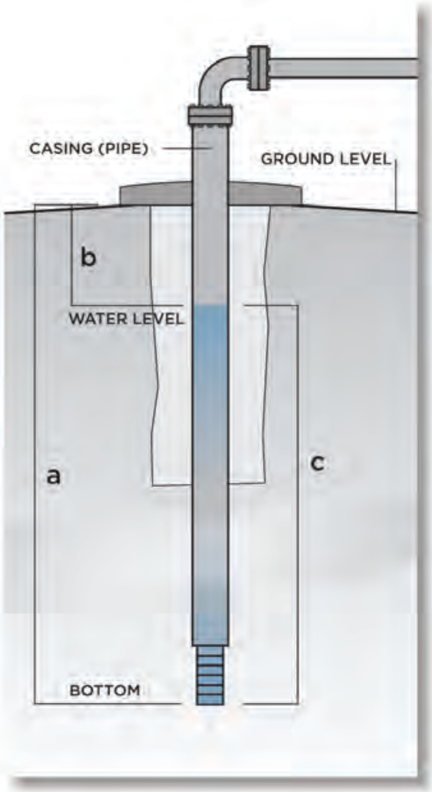


Figure 3: Well Capacity Calculation

How to determine the amount of Chlorine bleach to add to your well.

Use basic 5 % to 6% household laundry bleach (Sodium Hypochlorite). DO NOT USE any of the newer concentrated products, dry bleach or any of the "Fresh Scent," "Lemon Scent" or similar forms of bleach. The cheapest or generic brand is usually free of added materials.

Three pints of bleach should be added for every 100 gallons of standing water in the well. To determine the amount of standing water in your well you need three measurements (see Figure 3 to the left):

1. The diameter of your well which can be found in your drill log or from a measurement that your driller or pump installer can provide.
2. The total depth of your well (a), which you can obtain from your well's drill log or from a measurement provided by your driller or pump installer.
3. The depth from the top of your well to the top of the water (b). This measurement can also be provided by your driller or pump installer.

The depth of water in your well is calculated by subtracting measurement b from measurement a, which equals c (depth of water).

Chlorination Techniques

From the chart below determine how much standing water is in your well. Generally, there are two types of wells, drilled and bored. The inside diameter of the casing (well pipe) of a drilled well is typically from 4 to 8 inches. Bored wells are larger, ranging from 24 to 36 inches. Refer to the following table to determine your well's storage per foot of water. If you use a cistern, tank storage or have a hand dug well you will need to contact your local health department or pump installer for additional information and assistance to disinfect your system.

Table 5: Water storage per foot in various size boreholes.

Drilled Well Pipe	
Diameter (inches)	Storage per Foot of Water (gal/ft)
4″	0.653
6″	1.47
8″	2.61

Bored Well	
Diameter (inches)	Storage per Foot of Water (gal/ft)
24″	23.5
36″	52.9

Example: A drilled well with a 6" diameter has a storage per foot of water capacity of 1.47 gal/ft. Next multiply your total depth of water "c" times your storage per foot of water "s.' For example if we will assume that "c" is 204 ft. The volume of water in your well is: 204 feet x 1.47 gal/ft = 300 gal. To disinfect your system (well and piping to and in your home) add 3 pints of bleach into your well for every 100 gallons of water, or in this case nine (9) pints of household bleach. You will also need to add an extra three (3) pints to treat the household plumbing such as the pressure tank, hot water heater, and pipes. So for this example you will use a total of twelve (12) pints or 1.5 gallons of household bleach.

Basic Chlorination Technique

The following basic technique has been recommended by many Health Departments and other agencies. Many web sites have additional or more detailed instructions for the disinfection of domestic drinking water wells that have been determined to have bacterial contamination. There are three listed at the end of this section. If you use a commercially available disinfection kit follow the manufacturer's directions.

1. Before disinfection, inspect your water system (or have it inspected by a professional) to determine and correct any damage, faults or design problems that may exist. These problems may contribute to the bacterial contamination found in your well. Inspect all areas and surfaces that may be a source of dust or other contamination in and around the system. After every possible contamination source has been eliminated, the water supply should be disinfected as outlined below:
2. Wearing rubber gloves, a splash apron and eye protection, dilute the amount of bleach you determined (see procedure above) to be adequate for your well's water volume by first adding 2 to 3 gallons of water in a 5 gallon bucket and mixing carefully.
3. Remove the well seal at the top of the well. Now carefully pour the bleach mixture into your well using a large funnel. Wait about 15 minutes and run an additional 15 or 20 gallons of fresh water from a nearby hose bib into the funnel to treat the well bore sides.
4. Now open a cold water faucet in the system and run the water until you can smell the chlorine bleach odor. Turn off the faucet. Now do the same for ALL cold water faucets on the system. Also flush the toilets. Turn off your hot water heater and run hot water until you smell chlorine. Now repeat for all hot water faucets, to allow the piping and the heater to be treated.

Chlorination Techniques

5. Allow the bleach to remain in the entire system for 24 hours (at least overnight). During this wait period do not use the water for any purpose. This is to allow the disinfectant to kill all the bacteria within the system. After the overnight or 24 hour wait, flush out the remaining chlorine by turning on outside faucets letting them run until the chlorine smell dissipates. Finally, run the indoor faucets until the smell of chlorine is gone. Minimize the amount of the water going into your septic system, streams, rivers, ponds or lakes as the chlorine bleach may disrupt the operation of the septic system or kill wildlife.

6. Wells with excessive bacterial contamination or wells that contain slime, iron or sulfate reducing bacteria may require more than one treatment or the installation of a permanent disinfection system.
7. Two days after the system is flushed obtain a sterile sample bottle from your local Health Department or a certified laboratory and test for bacteria to assure that your treatment was effective. Take this sample as directed from a clean water tap that does not have an aeration head (a possible source of contamination) and take it back to the Health Department or laboratory as soon as possible (within 6 hours).

If your well does not respond to two or three treatments, as described above, contact a licensed pump installer, a water treatment specialist or a licensed plumber familiar with water treatment systems.

Helpful web sites:

Boulder County web site
http://www.waterwell.cc/CHLORIN.HTM

University of Georgia web site
www.fcs.uga.edu/pubs/PDF/HACE-858-4.pdf

Lake County Illinois web site
http://www.lakecountyil.gov/Health/want/Documents/WellChlorination.pdf

Trouble Shooting Guide

Q – Why does water not come from my well anymore?
A – There may be several reasons why water is not delivered from a well. First check your breaker box to see if the breaker is tripped. You should call a licensed pump installer to check the pump and pump control equipment, which may have failed. The pump installer can also check the water level in the well. Overuse of the aquifer may have dropped the static groundwater level below the depth of your well or pump. The pump may have to be reset at a lower level or the well replaced with a deeper well.

Q – Why does my well seem to pump less water than it used to?
A – Over time minerals or bacteria can constrict your water well screen or your water system pump or piping. Overuse or seasonal lack of recharge of the aquifer can also cause the static groundwater level to drop and thus decrease the amount of water that can enter the well. A licensed well driller or pump installer can clean your well screen and check your pump, piping and water level. They can also measure the yield of your well and compare it to the yield when the well was drilled. Keep good records of all of these checks and maintenance activities as they can be used in the future to help diagnose problems. Record these in the Data section at the end of this booklet.

Q – Why does my pump seem to run every time I turn on the tap?
A – The pressure in your water system is regulated by a pressure tank so that the pump does not have to be run every time there is demand for water. The tank has an air bladder in it that can rupture. Have a licensed pump installer or plumber check the pressure tank and the pump control unit.

Q – Why does my water leave stains on fixtures and clothes?
A – Your water likely has lots of dissolved minerals in it. Have the water tested by a laboratory to determine its chemical composition. You can then use the Water Treatment Decision Guide in this booklet, or call a licensed pump installer to help you decide what treatment equipment may be appropriate for your well and water.

Q – Why is there a lot of sediment in my water?
A – Your well may have been improperly developed to remove excess drilling fluids and sediment when it was drilled. Or your well casing or well seals may have failed. Your cistern (if you have one) may also need cleaning or is damaged. Have a licensed well driller or pump installer inspect the system and determine the source of the sediment.

Q – Why does my water smell like sulfur or have sewer like smell.
A – Your well probably has bacteria in it. Have the water tested for bacteria immediately. The local Health Department or a licensed pump installer can help disinfect the well and find the source of the bacteria.

Q – Why does my water smell or taste like chemicals?
A – Your well may be polluted with chemicals. **Stop using the water immediately.** Call the Health Department to help you find out where the source of the chemical contamination may be and what to analyze your water for. Have the water tested by a laboratory for likely chemical pollutants.

Q – Why does my water fizz?
A – Your well water has gas dissolved in it. This gas may be harmless air or carbon dioxide. It may also be methane or radon. Have the water tested by a laboratory to determine what the gas is and whether or not a treatment system is necessary. A licensed pump installer can find air leaks in the water system if that is the indicated problem. The pump installer can also help with the appropriate treatment system.

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Acidic – descriptive term used in reference to water having a pH of less than 7; pertains to the corrosiveness of water.

Acute Health Effects (acute toxicity) – Any poisonous effect with a sudden and/or severe onset produced within a short period of time after using contaminated water, resulting in mild to severe biological harm or illness. Acute symptoms include, but are not limited to, upset stomach, loose stool, bowel upset, and gastrointestinal difficulties. If symptoms occur as a result of drinking contaminated water, medical attention should be sought promptly.

Aesthetic Characteristics – The non-health related characteristics of water that make it desirable for human use. Generally taste, color, odor, and turbidity are considered to be aesthetic characteristics.

Alkaline – A water sample having a pH greater than 7 is alkaline (non-acidic).

Certified Testing Laboratory – A laboratory certified by the CDPHE as qualified to test drinking water. Information about local state-approved laboratories is available at the Health Department. See the web site list at the end of this booklet for a list of certified labs.

CDPHE – Colorado Department of Public Health and Environment is responsible for the enforcement of EPA public drinking water regulations within the State of Colorado. CDPHE works with EPA, local health departments and when needed with sovereign Indian Tribes, who often have their own environmental departments. See the web site list at the end of this booklet for a link to CDPHE.

Chronic Health Effects – Chronic means long-term. Chronic health effects occur and persist as a result of repeated or long term use of contaminated water. Often, it takes many months or years of exposure for chronic health effects to occur. Chronic health effects include irreversible damage to internal organs, and changes to our gene structure, which can result in cancer, birth defects, disabilities, and additional problems.

Coliform Bacteria – A type of bacteria that is found in the intestinal tract of all animals, including humans. These bacteria are used as an indicator of well cleanliness. If the coliform test is unacceptable, it is an indicator that your well is polluted and that additional tests or treatments are advisable. If the disinfection of your well does not remove the coliform bacteria seek the assistance of your local Health Department. Unacceptable coliform tests are usually seen on your report as: TNTC (too numerous to count) and confluent growth. You may need to call your licensed pump installer or a water treatment professional to assist in treating chronic bacteria problems.

Concentration – The amount of a given substance (weight) in a specific amount of water (volume) and is often expressed as mg/L or ppm.

Contaminants – Naturally occurring substances when present in high enough levels make water unfit for drinking and/or other household uses. Some contaminants are man-made or come from human activities such as farming, mining, livestock, etc.

Corrosive Water – Water that is acidic or "soft" may be corrosive and may deteriorate plumbing and leach toxic metals such as lead, zinc and copper from pipes.

Corrosivity Index – One of the methods for assessing the scale dissolving (corrosive) or scale forming potential of water. A positive number indicates a tendency to deposit calcium and magnesium carbonates. If the result is negative, it is an indication that the water will dissolve carbonates and enhance corrosion.

Detection Limit – The minimum concentration of a substance that may be measured in the laboratory and reported in the given testing method. Many laboratory reports will state what the detection limit is for each contaminant.

Disinfection – The destruction of all pathogenic organisms, with chlorine, ozone, ultraviolet light or heating.

EPA – The abbreviation for the Environmental Protection Agency, properly called, "the United States Environmental Protection Agency". This agency has the responsibility of developing and enforcing Primary Drinking Water Standards for public drinking water systems. EPA does not regulate private wells or cisterns. The EPA also develops, but does not enforce, Secondary Drinking Water Standards. See the web site list at the end of this booklet for a link to EPA.

Grains per Gallon (gpg) – Apothecaries' weight of a chemical substance in one gallon of water used in the water-conditioning trade to indicate hardness of water. One gpg equals approximately 17 mg/L of hardness.

Hardness – A water quality problem in many areas in Colorado. Hardness is a relative term. It describes the content of the dissolved minerals, calcium and magnesium, and is reported as grains per gallon or mg/l. Water with less than 3.5 grains per gallon (60 mg/l) is considered "soft"; while hard water above 7 grains per gallon (120 mg/l) may affect the appearance of plumbing fixtures, the lifespan of water heaters, and the efficiency of detergents.

Health Risk – The risk or likelihood that a chemical will adversely affect a person's health. Estimating health risks of various chemicals is a complex and inexact science.

Heavy Metals – Elements with higher molecular weights, which are generally toxic in low concentrations to plant and animal life. Examples include mercury, chromium, cadmium, arsenic, selenium, and lead.

Hydrogen Sulfide – A hazardous, poison gas that smells like rotten eggs. It is sometimes produced by bacteria in well waters. It can be found in local water wells at concentrations that are a nuisance but are not poisonous. However in high concentrations the gas can accumulate in low areas and become toxic and/or explosive. Use caution when you smell hydrogen sulfide.

Iron Bacteria – Microorganisms that feed on iron in the water. They may appear as a slimy rust-colored coating on the interior surface of a toilet flush tank or as a dark colored glob of gelatinous material or sand-like lumps of black sediment in the water. Iron bacteria colonies will sometimes float on the surface of a standing body of water and have an iridescent sheen that is often mistaken for an oil spill.

Maximum Contaminant Level (MCL) – The maximum level of a contaminant which is permitted in public water supplies. Maximum contaminant levels are specified in the Primary Drinking Water Standards set by EPA and the CDPHE for contaminants that affect the safety of public drinking water.

Methane – A colorless, odorless, flammable, lighter-than-air gas that can be found in water wells which are completed in coal seams, or other zones that contain trapped gasses. Although methane is not a poison, if it is allowed to accumulate in confined spaces it can pose a risk for explosion or fire. Methane is easily removed by proper venting.

Milligrams per Liter (mg/L) – Metric weight of a substance in a liter of water. 1 mg/ L = 1 ounce per 7,500 gallons. (1 mg/L = approximately 1 ppm in water)

Nitrate/nitrite-N – A salt form of the element nitrogen. The presence of nitrates and/or nitrites in a water supply generally indicates pollution by human or animal waste, and/or commercial fertilizer. These materials are very dangerous for children below the age of six months.

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Nuisance Contaminants – Contaminants that affect aesthetic or functional aspects of water quality and have little or no impact on health. They are managed in public drinking water systems as Secondary Maximum Contaminant Level (MCL) Standards.

Organic Chemicals – Those chemicals that contain carbon. If not properly handled, stored, transported, and disposed, organic chemicals can pollute water supplies. These can include trihalomethanes, pesticides, volatile organic compounds such as benzene, toluene, ethylbenzene, and xylenes (constituents of crude oil, condensate, and gasoline) and in some areas pharmaceuticals.

Parts per Million (ppm) – Concentration of a substance on a weight basis in water. 1 ppm = 1 pound of a contaminant per million pounds of water (1 ppm in water = approximately 1 mg/L)

Pathogens – Live organisms that contaminate water. Examples include bacteria, viruses, and parasites such as Giardia.

pH – A factor used to measure the acidity and alkalinity of water. Values for pH fall on a scale ranging from 0 to 14. Water that has a pH of 7 is neutral; water that is acid has a pH lower than 7 and water that is alkaline has a pH greater than 7. The secondary standard for drinking water is a pH between 6.5 and 8.5.

Pollutants – Man-made substances introduced to the environment that at high enough levels can make water unfit for human, animal, or plant consumption or use.

Potable Water – Water that is fit for drinking.

Primary Drinking Water Standards – The Primary Drinking Water Standards for public water supplies are published by the EPA and monitored, and enforced the CDPHE. Primary standards regulate contaminants which pose serious health risks to the water user. The primary standards are only enforceable in public water systems and should be used as a guide for your personal drinking water well. For a link to these standards see the web site list in this booklet for a link to CDPHE or the EPA.

Private Water Systems – Any systems which do not meet the definition of public water systems, for example, a private individual water source, such as a residential water well. Private water systems are not regulated by local health departments, the CDPHE or the EPA.

Public Water System – In Colorado, a public water system is one that serves at least 15 connections (for example households) or at least 25 individuals. CDPHE and EPA regulations apply to public water systems.

Pure – Without contaminants or pollutants.

Radon – A tasteless, odorless, colorless radioactive gas formed from decay of uranium in rocks. Radon has been found dissolved in some groundwater supplies. Activities that release radon as vapor from water include showering, bathing, and cooking. High concentrations of radon are known to be carcinogenic and are linked with increased risk of lung and other cancers. Radon is easily removed from water by purging with air and venting

Safe – The level of a contaminant or pollutant is low enough that no health problems will occur.

Scale – Mineral deposits which build up on the inside of water pipes and water-using appliances, like coffee pots and water heaters. It is made of calcium and magnesium carbonates and usually associated with hard water. Small amounts of scale are helpful in preventing leaching of metal from pipes.

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Secondary Drinking Water Standards – The Secondary Drinking Water Standards are published by the EPA. Secondary Standards set desirable/acceptable levels for nuisance contaminants, which affect taste, odor, color, and other aesthetic and functional qualities of the water supply. These secondary standards are not enforced by law, but rather are guidelines for public water treatment plants and state governments. These guidelines are helpful as you read the laboratory results from your well. For a link to these standards see the web site list in this booklet for a link to CDPHE or the EPA.

Total Dissolved Solids (TDS) – A good general indicator of water quality, which measures the total amount of dissolved minerals, metals, and salts. Water with more than 500 milligrams per liter TDS is of marginal quality and may contain undesirable amounts of calcium, magnesium, sulfates, chlorides, or other salts for human consumption. Many wells produce water that has much higher levels of TDS and in many areas may be the only source of water. High levels of TDS are often safe to drink, but may cause transient gastric problems. These higher levels of TDS can be removed, but often at a higher cost than routine water treatment..

Toxic Metals – Arsenic, barium, chromium, mercury, selenium, lead, and other toxic metals are regulated by EPA Primary Drinking Water Standards. Toxic metals may be naturally occurring in rock and soil, or may pollute water as a result of runoff or leaching from industrial or agricultural sites, mining activities or hazardous waste disposal.

Toxicity – The toxicity (poisonous effect) of a water contaminant depends on the concentration of the contaminant in the water and the period of time the contaminated water is consumed. Any chemical can be toxic, if you swallow enough of it. Also, people react differently to different toxic substances; some people may be harmed more than others. Pregnant and nursing women, the elderly, infants, ill or malnourished people, and people taking medication or that have a compromised immune system may be especially vulnerable to certain contaminants.

Turbidity – A cloudy condition in water due to suspended clay or organic matter. Turbidity can be treated with filters.

Volatile Organic Chemicals (VOCs) – Hydrocarbon containing compounds which evaporate readily and are expensive to analyze. Primary Drinking Water Standards set limits for several volatile organic chemicals, including the solvents such as trichloroethylene and carbon tetrachloride, and the gasoline component, benzene. Tests for VOC compounds are not routine and tend to be fairly expensive because of the difficult and precise laboratory work involved. Low levels of VOC's can be treated with activated charcoal filter systems. Treated water must be tested to assure that the treatment has reduced the VOC's to a safe level before using as drinking water. Filters must be replaced often.

Water Quality – In general is determined by these characteristics: safety, taste, color, smell, corrosivity, staining, pH, hardness, and chemical composition of dissolved solids.

Text and glossary are freely adapted from publications provided by various state and local agencies and the Colorado Department of Public Health & Environment.

Record of Basic Well Data

Use this form to help document the history of your well.

General Information

Owner's Name:

Owner's Address:

Permit #:	Well Location:
Driller Name:	Phone #:
Pump Installer Name:	Phone #:
Date Drilled:	Pump Installation Date:

Installation Data

Well Depth:	Surface Casing Depth:	Production Casing Diameter:
Cement Interval:		Well Screen Interval:
Pump Size & Type:		Pump Depth:

Water Levels		**Yield Rates**	
Initial Static Water Level (feet bgs):		Initial Yield Rate (gpm):	
Subsequent Static Water Levels		Subsequent Yield Rate	
feet bgs:	Date:	gpm	Date
feet bgs:	Date:	gpm	Date
feet bgs:	Date:	gpm	Date
feet bgs:	Date:	gpm	Date
feet bgs:	Date:	gpm	Date
feet bgs:	Date:	gpm	Date

Well Maintenance – Record dates and descriptions of work performed.

Additional Notes:

Helpful Water Web Sites

US Environmental Protection Agency
- http://www.epa.gov
- http://water.epa.gov/drink/
- http://water.epa.gov/lawsregs/rulesregs/sdwa/currentregulations.cfm
- http://water.epa.gov/learn/kids/drinkingwater/index.cfm (stuff for kids to do)
- http://water.epa.gov/drink/info/well/index.cfm

Radon
- http://www.epa.gov/radon/

US Geological Survey
- http://www.usgs.gov/water/
- http://water.usgs.gov/ogw/

Colorado Department of Public Health & Environment
- http://www.cdphe.state.co.us/
- http://www.cdphe.state.co.us/wq/drinkingwater/PrivateWellInformation.html

Colorado Division of Water Resources
- http://water.state.co.us/Home/Pages/default.aspx
- http://water.state.co.us/groundwater/Pages/default.aspx
- http://water.state.co.us/groundwater/wellpermit/Pages/default.aspx
- http://www.dwr.state.co.us/WellPermitSearch/default.aspx
- http://water.state.co.us/DWRIPub/Documents/constructionrules05.pdf

Colorado Oil & Gas Conservation Commission
- http://cogcc.state.co.us/

Colorado State University Extension Service - Water Related Resources
- http://www.ext.colostate.edu/pubs/water/water_related.html

The Groundwater Foundation
- http://www.groundwater.org/gi/gi.html

National Groundwater Association
- http://www.ngwa.org/Fundamentals/Pages/default.aspx
- http://www.wellowner2.org/2009/

Water Quality Association
- http://www.wqa.org/landing.cfm?section=3