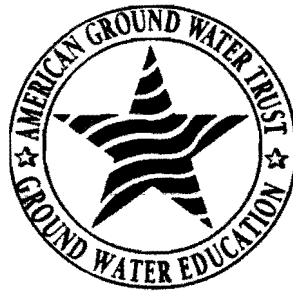


A Consumer Awareness Information Pamphlet

American Ground Water Trust



What Coloradoans Need to Know About Water Well Construction



**Colorado Water Well Contractors
Association**

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COLORADO WATER WELL CONTRACTORS ASSOCIATION

The Colorado Water Well Contractors Association (CWWCA) is a non-profit organization that has been a steward of Colorado's ground water since 1931. The CWWCA is a member of the American Ground Water Trust.

The CWWCA's members consist of water well drilling and pump contractors, geologists, hydrologists, engineers, state and local government employees, and ground water industry suppliers and manufacturers. Beyond maintaining high standards in the ground water industry, the CWWCA is devoted to providing continuing education to its members and furnishing accurate information to the public regarding the quantity, quality and availability of Colorado's ground water resources. The CWWCA works with government agencies, communities, land owners and industry to identify and solve problems associated with ground water use.

The CWWCA maintains lists of all licensed Colorado contractors and can refer callers to local contractors who are recognized as professionals in the ground water industry. For further information on contractors, ground water or the CWWCA contact:

Colorado Water Well Contractors Association

8674 West Warren Dr.
Lakewood, CO 80227
phone: 303-986-5035
fax: 303-986-8375

Information in this pamphlet is provided in good faith to inform the public about ground water and ground water related issues. In all cases, the Trust and the CWWCA urge consumers to contact local professionals and where appropriate, to refer to local codes, rules, regulations and laws.

PURPOSE OF THIS PAMPHLET

The American Ground Water Trust and the Colorado Water Well Contractors Association have prepared this consumer information pamphlet to help people in Colorado make good economic and environmental decisions about water wells. Securing and protecting a safe reliable water supply for a home is an important responsibility for home owners. There are many water supply specialists who provide water supply products and services; this pamphlet will assist you to obtain the professional help that you need.

GROUND WATER BASICS

What Is Ground Water?

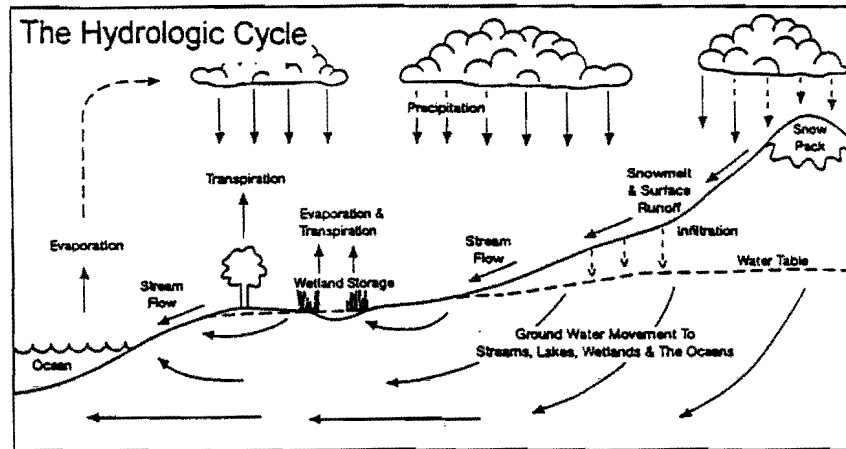
Ground water is water below the land surface that fills the spaces between grains of sediment and rocks, or fills cracks and fractures in the rock. Saturated zones in sediment such as sand and gravel, and in fractured rock formations, that receive, store, and transmit water to wells and springs are called aquifers.

Clean and plentiful ground water is a vital resource for personal and economic health everywhere in the United States. Each day, over 130 million Americans get their drinking water from ground water. Ground water is a very important source for homes, towns, industry and agriculture in Colorado. Over 50 percent of Colorado residents rely on ground water for their domestic supply.

The Hydrologic Cycle

Water in aquifers comes from rain and melted snow that filters through the soil. As the water moves down, plants consume a portion, some is evaporated, and some is retained by the soil. The rest seeps downwards, usually very slowly, to add water to the aquifer. This process is part of the hydrologic cycle. The amount and quality of ground water varies from place to place in Colorado because geology, climate, and land use are different. The quality of water from wells can be influenced by:

- natural factors, such as the type of rock, gravel, sand or soil
- or by pollution, for example from poorly managed agriculture, individual septic systems or community waste disposal.



Public education about contamination cause and effect, and community involvement in protecting local aquifers, are important aspects of ensuring safe drinking water in Colorado.

Potential Threats to Ground Water

Most ground water is of good quality because of the filtering process through the soil and the long travel time underground between the water occurring as rain and being pumped from a well. Human sources, such as homes, agriculture, industry and transportation, can pose threats. In general, the more people, the more the threats to ground water.

Common household chemicals (polish, thinners, paints, etc.), lawn and garden chemicals, faulty septic tanks, or an automobile oil change in the driveway can wreak havoc with ground water. However, the better informed that people are, the better are the prospects for protecting Colorado's ground water.

GROUND WATER PROTECTION

With your help, the professional work of ground water specialists and the regulation and technical work of government agencies can ensure safe drinking water. What you know, and what you do about contamination risks are important for the safety of water in homes and communities throughout Colorado.

What people should know

- Where their drinking water comes from
- How contamination occurs
- What they can do to prevent problems

What every person should do

- Handle domestic chemicals responsibly
- Protect water and earth from automotive fluids
- Maintain septic systems properly
- Use lawn and garden fertilizers and pesticides sparingly
- Safeguard the area around wells
- Always use licensed contractors for water wells
- Routinely check and maintain wells to prevent contamination

What communities should have

- Land-use policies, such as zoning
- Agricultural best management practices (BMP)
- Water resource management plans
- Programs protecting aquifers and wells
- Ground water education
- Well abandonment programs

HOW DO WE GET GROUND WATER?

Some ground water occurs at the surface as springs, but in most cases, a water well is needed to reach the aquifer where ground water is found. Today, most wells are constructed by drilling into the rock layers using drilling machines (rigs) to access water deep beneath the surface. In most cases electric pumps are used to raise the water to the surface.

The creation of a water well (a specially engineered hole in the ground) consists of several elements. After selecting the site to drill the well, (local codes and set-back requirements may limit choice), the process usually

includes drilling, development, testing and equipment installation.

Laws, Permits, Standards

Colorado has a complex set of laws controlling the use of ground water. Those laws require that a well permit be obtained from the State Engineer's Office prior to drilling a well and putting ground water to beneficial use. The State Engineer must evaluate each permit application, and some permits are denied if the well would cause injury to another vested water right. Property owners should not assume they can automatically get a well permit.

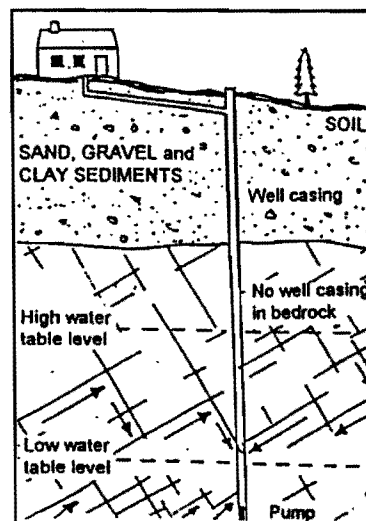
Colorado laws require that all well drillers and pump installers be licensed. They must also perform their work to comply with regulations which define minimum construction standards. These provisions protect the aquifers from contamination and also provide some assurance to a well owner that the well or pump are dependable. Contractors who do not comply with the construction standards can have their licenses suspended or revoked. Wells constructed without a permit or by unlicensed contractors would be considered as illegal wells and the owner would likely be ordered to plug and abandon them.

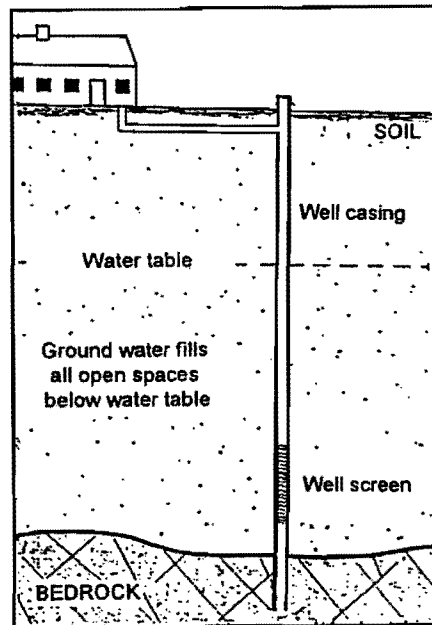
Property owners who use licensed contractors can obtain their assistance in obtaining the permit. One should obtain the permit and drill the well before building the house.

Drilling

The hole drilled for most home wells is six to twelve inches in diameter. The drilling method that the contractor decides is most appropriate will depend on the geologic formations, the required water yield and the type of drilling equipment available.

Drill rigs are expensive items (up to \$500,000) and the use of the equipment, often hundreds of feet below the surface, requires considerable skill.





Wells require casing to protect against possible contaminants at or near the ground surface. Casing may not be needed at depth in solid rock but wells in alluvial sands and gravels need casing to prevent cave-in. A well screen, or perforated casing, is specially designed to keep sand out but let water into the well. Screens can be expensive, but in some situations they are needed to ensure long term use of the well.

Well Development

The drilling process often uses specially formulated drilling mud to help carry the drilled pieces to the surface. Most drilling also creates finely ground rock material. All fine particles need to be removed from a well in order that it may efficiently produce water. The process of removing fine particles is called well development. Drillers usually do this by using compressed air or bailing equipment to agitate and remove water from the well until it runs clear. Proper well development is essential to have an efficient well, minimize pumping lifts and to obtain clean sand free water.

Yield Tests

Colorado requires the well driller to perform a well yield test. Test results are essential for selecting the right pump and knowing the well's limitations. Ideally, water will flow into the well at the same rate that it is removed by the pump. There are three important pieces of information needed for designing an efficient water system: the static water level, the pumping water level at various flow rates, and the time it takes for the water level to recover after pumping ceases. For low yield wells, a long term well test is recommended.

Low-Yield Wells

In some areas of Colorado, the subsurface geology is not capable of producing the amount of water normally expected from a domestic well (2-10 gallons per minute). However, with a properly sized storage tank or a controlled pumping system, a well producing as little as one g.p.m. can be adequate for domestic needs. In many domestic wells, several hundreds of gallons of water are already stored in the well. For every foot of water in a 6 inch diameter well, there are 1½ gallons in storage.

When properly designed and managed, low-yield water wells can provide a viable supply for a home. Let's use the example of a well capable of producing only one g.p.m. There are 1440 minutes in every day. If the well produced water throughout the day, 1440 gallons of water could be pumped into the storage tank. Assume that a family of four is served by the well and that each family member uses 75 gallons of water a day, or 300 gallons. Total consumption for the entire family would be less than 21 percent of the water stored in the tank. The well would be required to produce water only five hours a day in order to replenish the water used.

Low yield wells are often hydrofraced to improve their yields. The process involves down-hole equipment that creates high pressure to open or spread cracks or fractures.

HOW MUCH WATER - HOW MUCH MONEY?

How Much Water Do You Need?

If you plan wisely, a good, dependable water well can supply you with all the water you need now and in the future. A rule of thumb is to allow for between 75 and 150 gallons per person per day. You need to take into account the peak demand, for example when there may be extra guests at holidays or weekends. Outside use of water can pose much greater demands. You need to calculate the required well yield if your well is needed for additional water uses such as:

- | | |
|--|---|
| <input type="checkbox"/> Swimming pool | <input type="checkbox"/> Lawn and garden irrigation |
| <input type="checkbox"/> Fire protection | <input type="checkbox"/> Livestock watering |
| <input type="checkbox"/> Heating and cooling | |

For agricultural needs, dairy, irrigation etc., refer to a farm expert.

The well permit issued by the State Engineer may limit the well uses. Many new wells are limited to in-house use or to a specific volume of water per year. There may also be requirements that waste water effluents must be returned to the aquifer through a non-evaporative system. Failure to comply with use limits on the well permit can result in orders to cease and desist use of the well.

Where Should the Well Be Located?

There are three important considerations for siting a home water well.

- Away from any potential sources of contamination
- Convenient for power supply and close to the home
- Accessible for drilling and pump installation equipment (most wells will have to be serviced from time to time)

In some instances, where the geology is known to be difficult, it may be necessary to obtain advice from a hydrogeologist. In most cases, the driller's local experience will enable a site to be chosen. If possible, always locate the well at a higher elevation than any waste water septic system or other drainage systems. Local building codes will specify minimum acceptable distances between wells and other structures or sources of contamination.

Correct design and installation of water wells (casing, perforations, screens, etc.) is important to protect against contamination risks. In particular 20 feet of blank casing must be grouted in place below the land surface. Old and abandoned wells can pose particular risks and such wells should always be professionally decommissioned and sealed. The Colorado Board of Examiners has minimum standards for construction and abandonment of wells.

Pump selection

There are many different water pumps on the market. Most home-well pumps, unless used to irrigate gardens or water livestock, will only be used for a few minutes at a time or perhaps an hour or two each day. Most well drillers today also sell, install and service pumps. Before you and your contractor can decide on the appropriate pump, you need to know the following:

- How much water will be needed at peak demand

- Diameter of well at pumping level (the well diameter at this depth may be smaller than at ground level)
- The well's yield (gallons per minute)
- Water level drawdown at given pumping rates
- Depth of ground water below the surface (in some geologic conditions water levels will drop in drought conditions and the pump will therefore need to be placed deep in the well)
- Distance and elevation of the home above the well

If your drilling contractor does not sell or install pumps, you may arrange to contract the work to a licensed pump installation contractor. All technical water well installation work, including wiring and plumbing, should be performed by licensed contractors who will guarantee their work and render quick service when needed. If you need to save money, do such work as trenching, etc., yourself, but don't sacrifice quality and efficiency. For example, using an oversize or undersize pump, however cheaply you were able to buy it, will not be as efficient in water production, energy cost or reliability, as installing the correct pump for the job. Buying an undersized pressure tank or electric cable will shorten the life of the pump, eliminating any cost savings that might have occurred.

Testing Water Quality for Health and Safety

All new wells should be tested for bacteria and nitrate. In deciding whether or not water conditioning equipment is needed, tests should be made for acidity (pH), hardness and iron. For example, some garden plants have specific water quality tolerances. Many laboratories offer a home-owner package-deal for water analyses.

How Much Will a Well Cost?

Some contractors may offer a fixed price. Others will charge according to the depth drilled and the materials used. You can obtain an estimate of drilling and pump installation costs by contacting a local CWWCA member or consulting a neighboring well owner. The total cost of installing a well and pump system is often itemized in estimates as follows:

- Cost of permits
- Mobilization cost

- Drilling: cost per foot (will vary with diameter, some drilling costs increase with increased depth)
- Casing: cost per foot (depends on type used)
- Cost of other materials (such as screens, seals, etc.)
- Grouting, cementing (usually based on cost per sack)
- Developing (usually based on a per hour charge)
- Test pumping (usually based on a per hour charge)
- Pumping equipment, pipes, electric wire and controls, pressure tank and valves
- Excavation costs (trenching and backfill)
- Water quality laboratory analysis
- Water treatment, conditioning equipment such as a softener (this part of the water system is often quoted separately, after the water quality has been analyzed)

No ground water contractor wants to drill a "dry" hole, but when dealing with subsurface geology, it is difficult to guarantee finding water or to predict its quantity and quality.

Reputable contractors will keep the well owner apprised of his findings during the well construction and will openly discuss the adequacy of the well yield or the need to drill deeper to increase well yield or to grout off poor quality water. It is recommended that the well owner be in direct contact with the licensed well driller or pump installer to minimize misunderstandings. Sometimes building contractors will sub-contract the well drilling or pump installation thus preventing the well owner from entering into decisions with the well contractor. Knowledgeable well contractors should be able to construct a well to produce water if the aquifer contains water.

DO I NEED A CONTRACT?

It is recommended that a written contract be prepared and signed prior to starting any construction. This will provide the property owner an itemized list of expected costs. The contract should also identify any decision points such as maximum well depth, selection of pump, etc. Most contractors will have a printed form which can be completed for each job. The contract will reduce misunderstandings and include legal phrases to identify liabilities and responsibilities.

Be Aware of Unlicensed Contractors!

In Colorado, all water well drilling and pump installation contractors must be licensed. In the past, too many home owners have paid dearly for using amateurs or part-time, non-specialists. Check that your contractor is licensed, insured and experienced. Beware of high pressure or scare tactics, and “bonus offers” to get your business.

Home and building owners can become involved in litigation involving uninsured contractors. If an employee of an uninsured contractor is injured on the premises of your home or building, you may be responsible for his injuries or disabilities. In addition, you probably have no protection in the event of damage to your property or the property of others by the driller or pump installer during the course of the work.

PROFESSIONAL CONTRACTOR CHECK LIST

Is Your Contractor:

- ✓ **A CWWCA MEMBER.** A good basis to select a contractor is to choose one that has declared his commitment to the mission and ideals of the state ground water association and/or the National Ground Water Association.
- ✓ **LICENSED.** The State of Colorado has adopted standards for the licensing of drilling and pump installation contractors. Only those who meet the standards of testing qualify for a state license. Work must be pursuant to minimum standards.
- ✓ **WELL-ESTABLISHED.** A professional drilling and pump contractor will have a permanent place of business, a telephone number, a tax ID number and, where appropriate, a business license.
- ✓ **EXPERIENCED and KNOWLEDGEABLE.** Drilling or pump system installation skills cannot be learned overnight. Colorado requires two years of experience before a contractor can obtain a license. The contractor you select should be able to provide a list of customer references.
- ✓ **INSURED and COMMITTED TO SAFETY.** There are inherent dangers in drilling a well or installing a water system. The contractor who carries both worker’s compensation insurance and liability insurance has protected you in the event of damage to your property and injury to his workers while work is being performed on your property.

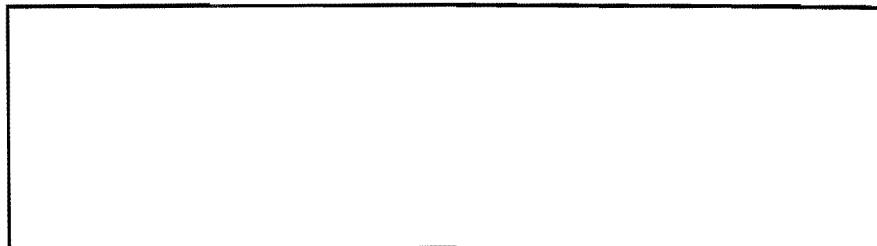
WATER WELL CONTRACT CHECK LIST

Does the Contract Contain:

- The Contractor's business address and State license number.
- A written proposal that details:
 - responsibility for obtaining all necessary permits
 - what work is to be done
 - materials to be used (casing type, drilling muds, etc.)
 - the charge for drilling (cost per foot)
 - type of equipment to be installed
 - the terms of any contractor or manufacturer guarantee on the well and well equipment
 - the expected date for starting and completing the work
 - payment schedule
 - details of client and contractor responsibility for site access and site clean-up
- Proof of the contractor's liability insurance while working on your job, to protect against:
 - personal injury to you or others
 - damage to your property
 - damage to the property of others
- Proof of worker's compensation insurance to protect the contractor's employees or sub-contractors while working on your job.

Be careful not to base your selection of contractor on price alone. The well system you purchase is permanent, and future changes may be much more expensive in the long run. Make sure that the bids and estimates are for comparable materials, service and guarantee. A low bid is not necessarily the best bargain. The contractor may not have included all the work quoted by competitors.

For more information regarding ground water in your area please contact:



AMERICAN GROUND WATER TRUST
Independent Authority on Ground Water

The American Ground Water Trust is a 501(c)(3) non-profit membership organization. The mission of the Trust is to protect America's ground water, promote public awareness of the environmental and economic importance of ground water and provide accurate information to assist public participation in water resources decisions.

To learn more about how you can protect your ground water:

- Call the Trust's consumer information line at (800) 423-7748.
- Join the American Ground Water Trust. [Well owners are important Trust members.]
- Contact the Trust about ground water issues and concerns in your town, region or state. The Trust will respond to your questions and recommend a course of action.
- Volunteer to help with educational programs and special events in your area.
- Request a list of Trust Educational Products.

American Ground Water Trust

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