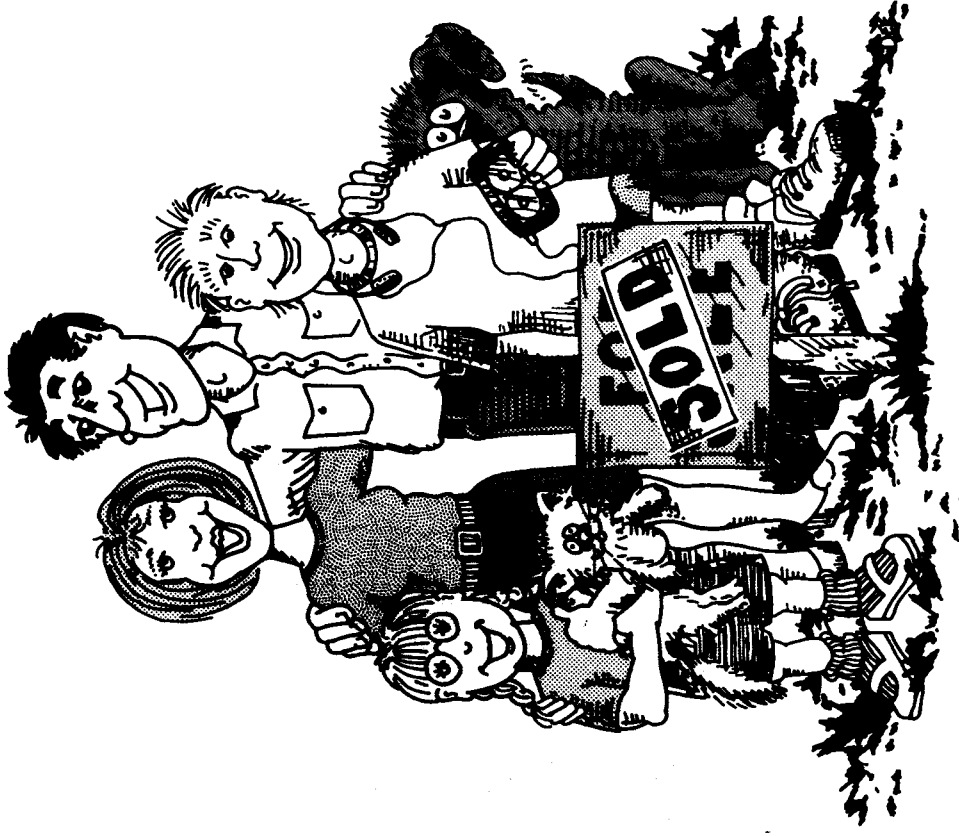


# So You Need a Water Well?

*A Consumer's Guide to Homeowners' Drinking Water*

Miscellaneous Publication No. 43



*Prepared cooperatively by the Nebraska Well Drillers  
Association and the Conservation and Survey Division  
Institute of Agriculture and Natural Resources  
University of Nebraska-Lincoln*



## Preface

Groundwater occurrence is not mysterious, but finding the right amount of good quality water and pumping it is complex. Licensed water well and pump installation contractors are available throughout Nebraska to construct wells and water delivery systems for your water needs. These professionals understand groundwater and have the knowledge to ensure that your well and water delivery system are properly constructed. Licensed water well and pump installation contractors have been tested by the state of Nebraska and must participate in continuing education programs. The Conservation and Survey Division of the University of Nebraska-Lincoln and the Nebraska Well Drillers Association have provided such short courses and workshops for the water well industry since 1929. In keeping with that tradition and to increase public and consumer awareness, the division and the association have cooperated to prepare this pamphlet.

The industry and the procedures to construct a water well system in Nebraska are tightly regulated by the Nebraska Department of Health and Human Services (NDOHHS). Regulations cover all phases of water well construction to assure a safe and sanitary water supply. Other regulations cover criteria for licensing and continuing education.

One of the first steps in selecting a home site without a public water supply is to determine the availability and adequacy of the site's water. Your water well contractor can advise you of the site's potential and will drill a test hole and complete a supply well. More than one test hole may be needed in some parts of the state to find a satisfactory well.

## What should I know about a water well?

When a family considers putting in a new water well, often one of the first questions asked is, "Can I get a well on my property?" This question is usually followed by more, such as: "How deep do I need to drill? How much water will I need? Where do I put the well? What about the cost? Is my groundwater safe and of good quality? Where do I get help?" or "What qualifications should my contractor have?" This brochure will address these concerns.

## What is groundwater and where is it?

Nebraska is blessed with abundant water underground, called *groundwater*. It fills the openings or pore spaces in sand, gravel and rock formations below the ground. The formation is said to be saturated when the pores are completely filled with water. A formation containing a usable amount of

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*This pamphlet was compiled by C.A. Flowerday and V.H. Dreeszen, Conservation and Survey Division, and Delynn Hay, Biological Systems Engineering, University of Nebraska-Lincoln. Lee Orton and Wayne Madsen, executive director and chair of the public relations committee, respectively, Nebraska Well Drillers Association, assisted and made many helpful comments.*

water is called an *aquifer*. Most aquifers in Nebraska are a mix of sand and gravel, but porous consolidated rocks and some fractured rocks are also aquifers in some parts of the state. An aquifer may be a single mass, a layer or a series of layers.

Groundwater is the major source of water supply in Nebraska. It is relatively plentiful and of good quality in most of the state and is used extensively as a supply for irrigation. It is also a vital and attractive resource for other uses, particularly for most municipal and industrial uses and virtually all private supplies. Private wells serve more than 350,000 Nebraskans.

Groundwater, like surface water, is a renewable resource that makes up part of the total cycle of water on the planet, which is a constant quantity changing forms and locations. This endless movement and use of water is called the *hydrologic cycle*. Groundwater is replenished mostly by precipitation and in some areas by infiltration from streams, lakes, ponds and irrigation canals. Precipitation, as rain, snow or ice, either runs off the land to streams or other surface water bodies or infiltrates into the soil. The majority of the precipitation enters the soil, but most of that water is evaporated from the soil surface or transpired by plants; the combination of the processes is called *evapotranspiration*. The remaining water in the soil can move slowly downward—a process called *percolation*—until it reaches the top of the saturated zone, known as the *water table*, where it adds to groundwater in storage. In areas of heavy use or during dry years, groundwater use can exceed aquifer recharge.

## Is groundwater the same throughout the state?

Nebraska's groundwater geology can be broken down into thirteen groundwater regions, which are identified on the following map. Within each region, groundwater occurs under similar kinds of conditions. The boundaries between the regions, in general, represent zones of gradual change. Site specific investigations are needed to determine the water supply of any site.

**Sand Hills—Region 1:** Large yields of good quality water can be obtained from the High Plains (Ogallala) aquifer. Sand and sandstones of the Ogallala Group, a large part of the High Plains aquifer, underlie the entire region but become thin toward the east. Runoff rarely occurs because precipitation readily infiltrates the sandy soils. Most groundwater either is lost by evapotranspiration from lakes between the dunes and from wet meadows or is discharged by seepage into streams that are known for their uniform flow.

**Platte River Valley—Region 2:** In most parts of the region, high yields of good quality water can be obtained from sand and gravel deposited during the last 1.6 million years. The Ogallala Group underlies the alluvium in parts of the North Platte River and South Platte River valleys and the Platte River valley as far east as Grand Island. It is also a source of water supply. Concentrations of dissolved solids in groundwater range from 500 to more than 1,000

river valleys. Water quality is generally good.

**Republican River Valley and Dissected Plains—Region 9:** Sand and gravel underlie the floodplains and terraces of the Republican River and its principal tributaries where they have cut into the uplands. Ogallala Group deposits are thickest in the northern and western parts of the region. Sand and gravel fill some ancient buried valleys. Bedrock deposits of shale and chalk underlie the entire region and either are exposed or are thinly mantled by loess on the south side of the Republican River, where good quality water is difficult to obtain.

**Nebraska Glacial Drift—Regions 10 and 11:** Glacial till, locally known as *boulder clay*, or sometimes as *rock flour*, is of low permeability and covers most of the region. Beneath these deposits, sand and gravel in ancient buried valleys and along stream valleys are one source of groundwater. Shales and sandstones underlie much of the region as bedrock, except for the southeastern part of Region 11, where older shales and limestones are the bedrock. Sandstone is an important aquifer in some places; however, in some locations, the groundwater can be slightly to very salty. These sandstone sediments are extremely variable, and prediction of yields from them is difficult.

In wells pumping from perched water tables (an isolated mound of groundwater above a layer of clay or silt) in the glaciated part of the state, yield may be a problem, particularly during drought. In such a case, if the water is not too mineralized, the solution often is to drill deeper into a lower aquifer or bedrock. In low yield situations, a storage tank or more than one pressure tank can be used to supply larger quantities of water.

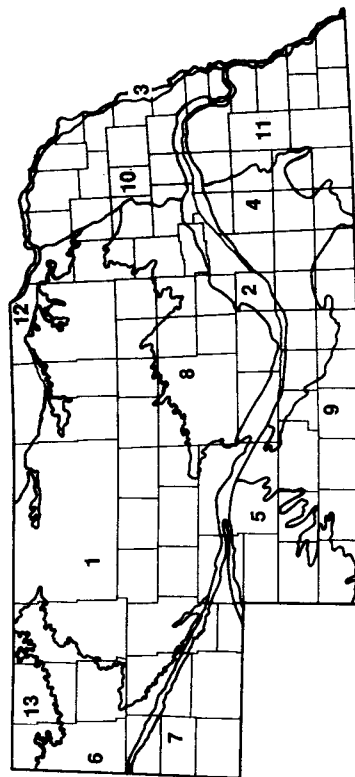
**North Central Tableland—Region 12:** The floodplains and terraces of the Niobrara River and its tributaries overlie sand and gravel deposits that generally yield small to moderate amounts of water. Where the eastwardly thinning sand, sandstone and sand and gravel deposits have been eroded away, groundwater is available only by drilling several hundred feet to tap deeper sandstones. Nitrates are a concern in the Holt Table area of Holt County.

**Hat Creek-White River Drainage Basin—Region 13:** Because fine grained deposits and bedrock occur at the surface and underlie the region, groundwater is difficult to obtain here. Small yields are obtained from deposits underlying the river valleys and from sand lenses or fracture zones where a fractured siltstone is saturated.

### Is my groundwater safe and of good quality?

Groundwater quality is generally good to very good in most parts of the state due to the filtering that takes place during the travel time to the saturated zone and because the rocks it passes through and resides in generally are not highly soluble. However, the nature of the rocks, soils, climate, slope or land use affect the quality of the local and regional groundwater.

Human effects on water quality include contamination resulting from



Nebraska's Groundwater Regions

milligrams per liter in the shallow aquifer throughout most of the western two-thirds of the region. The highest concentrations occur in the South Platte River valley. The water quality there is affected primarily by dissolved minerals carried from soils by infiltrating precipitation and irrigation water. In some parts of the Platte River valley, nitrate problems have developed.

**Missouri River Lowlands—Region 3:** Large yield wells can be developed in the sand and gravel aquifer. Groundwater is more mineralized than that in the lower Platte River valley, and iron and manganese concentrations may be higher than desired.

**South Central Plains—Region 4:** Abundant groundwater can be found in this region. Sand and gravel or, in the west, sandstones yield large amounts of good quality water. Nitrate concentrations range from low to above maximum contaminant levels. Groundwater levels have risen in the west where water diverted from the Platte River is used for irrigation.

**Southwestern Tablelands—Region 5:** Sandstone, sand and gravel have been developed extensively. Pumping lifts of 200 feet or more are common. In much of the region, groundwater levels have declined progressively since development began.

**Panhandle Tablelands—Regions 6 and 7:** Although thick sequences of moderately permeable sediments of siltstone, sand, sandstone and gravel underlie the tablelands, wells are usually several hundred feet deep, and those of large capacity are restricted generally to areas underlain by coarse grained sediments. Rocks beside major drainage courses usually are not saturated. In Region 7, wells also derive water from fractures in the siltstone under the valleys of Pumpkin and Lodgepole creeks and in Sidney Draw. Sidney and the surrounding area have experienced some nitrate contamination.

**East Central Dissected Plains—Region 8:** Ogallala Group deposits underlie the western two-thirds of the region, becoming thinner toward the east. In the central and eastern parts of the region, sand and gravel deposits, covered by loess (wind-blown silt, or dust), are thickest within ancient buried

excessive application of pesticides and fertilizers or spills, poorly designed or maintained wastewater systems, poorly designed solid waste disposal sites (landfills), or improper use or disposal of manure, automotive additives and fluids, degreasers, cleaning liquids, lawn chemicals, paints or thinners, batteries or other forms of hazardous waste. The only way to determine the quality and safety of groundwater is to have it tested. We all have a responsibility for protecting the resource, and efforts to do so must be complete.

#### **What is needed to protect groundwater quality?**

Protection of groundwater quality depends on the efforts of individuals, communities, natural resources districts and local, state and federal governments. A well informed citizenry is probably the most effective barrier to contamination, and a conscientious and cooperative relationship between the public sector agencies that regulate groundwater quality and private businesses and citizens is likely the second most important consideration.

In educating residents, state and local governments and nonprofit organizations generally emphasize that people need to know how drinking water gets to the tap and from what sources it is pumped. They also need to understand how pollution occurs and what households have to do to properly dispose of waste, both commercial and biological. Protecting the area a few hundred feet around wells is essential, as is the use of licensed water well contractors to construct water wells and water systems.

#### **Do I need to test for water quality?**

Even though groundwater quality throughout the state is generally good, it is wise to test the water from a new well. Because of precautions taken by your water well contractor during construction, your water should contain no harmful bacteria, but this can be determined only by testing. At a minimum, the water from a new well should be tested for bacteria and nitrates. In addition, annual tests for bacteria and nitrates will help assure you that your water supply continues to be safe. Other water testing could include information on sulfate, chloride, pH, total dissolved solids, and hardness. This early information will help you learn, after later testing, if changes have occurred in your groundwater quality. Your water well contractor, NDOHHS, water testing labs or other water quality agencies can advise you on whether additional testing is needed for specific situations.

The sampling can be done by the water well contractor, who will also arrange for the testing. Testing can be done at the NDOHHS lab or another approved commercial or government facility. Some NRDs will do limited testing of private water supplies. Some city/county health departments require that new wells be tested for water quality.

Some naturally occurring inorganic chemicals may pose a problem or a nuisance. Most of Nebraska's groundwater is hard to very hard. Iron and/or manganese above certain concentrations in some parts of the state can cause

staining of clothes and plumbing fixtures. Water from the Dakota Group of sandstones in eastern Nebraska may contain higher than desirable total dissolved solids, sodium, chloride or sulfates. Modern methods are available to treat most mineralized water in Nebraska.

#### **How much water will I need?**

The general rule of thumb is to allow for 75-150 gallons per day of use by each person in a household. Any use beyond domestic needs should be considered separately, such as for a swimming pool, livestock use or lawn and garden watering.

#### **Where do I put the well?**

Aside from making sure the supply is adequate, the most important issues are staying away from potential pollution, having access to electricity and making sure the well is convenient to install and service. Water well contractors, for the most part, will know where to find groundwater. And they are aware of all setback regulations from potential sources of contamination.

#### **Do I need a permit?**

Some local governments, including NRD-administered water management areas, may require permits. Your licensed water well contractor will advise you and help you acquire the right permits. Once completed, the water well must be registered with the state Department of Water Resources. That registration requires submitting information provided on forms available to your water well contractor.

#### **How does one drill and construct a well?**

The drilling equipment most commonly used in Nebraska is a hydraulic rotary machine. A drill bit cuts the hole, and the cuttings are removed by the drilling fluid. Most drill holes for domestic wells are 9-10 inches in diameter. After drilling, the water well contractor will put a watertight casing in the hole to prevent contaminants at or near the surface from entering the well. State regulations specify the casing that can be used. Plastic casing is most often used. A well screen is joined to the casing at one or more intervals in the water bearing sections. In much of the state, specially selected sand and/or gravel (a gravel pack) is placed around the well to fill the space between the bore hole casing and the screen. Both the gravel pack and the screen are used to stabilize the aquifer and keep the well from pumping sand. In a few areas of the state where wells are completed in consolidated rock, casing is set into the top of the bedrock and the water bearing rock is not cased or screened.

Other regulations to prevent contamination of the well and groundwater supply have been adopted by the state as developed by health officials and the state Water Well Standards and Contractors' Licensing Board. In addition to well siting and casing regulations, the upper part of the borehole and the

ment of Health and Human Services, in 1995 the Conservation and Survey Division published *Guidelines for Decommissioning Water Wells—How to Plug Water Wells*, a landowners' guide to legal requirements and proper techniques. The booklet is available from the division for \$3.00. Nebraska residents should add city and state sales tax. Also, please add \$1.50 for mailing and handling.

### Does the well need to be cleaned after drilling?

Getting all the fine material out of the well is called *well development*. A special drilling fluid called *mud* carries sediment and cuttings of rock to the surface. This mud contains clay, silt and sand that must be removed from the well cavity. The well is cleaned by pumping with compressed air, the contractor's pump or by bailing. To ensure a sanitary well, regulations also require chlorination of the drilling mud and the sand or gravel pack. Chlorination eliminates both harmful bacteria and harmless, but problem causing, iron bacteria. The final step in preparing a well for the pump is disinfection; then the disinfectant is flushed from the well.

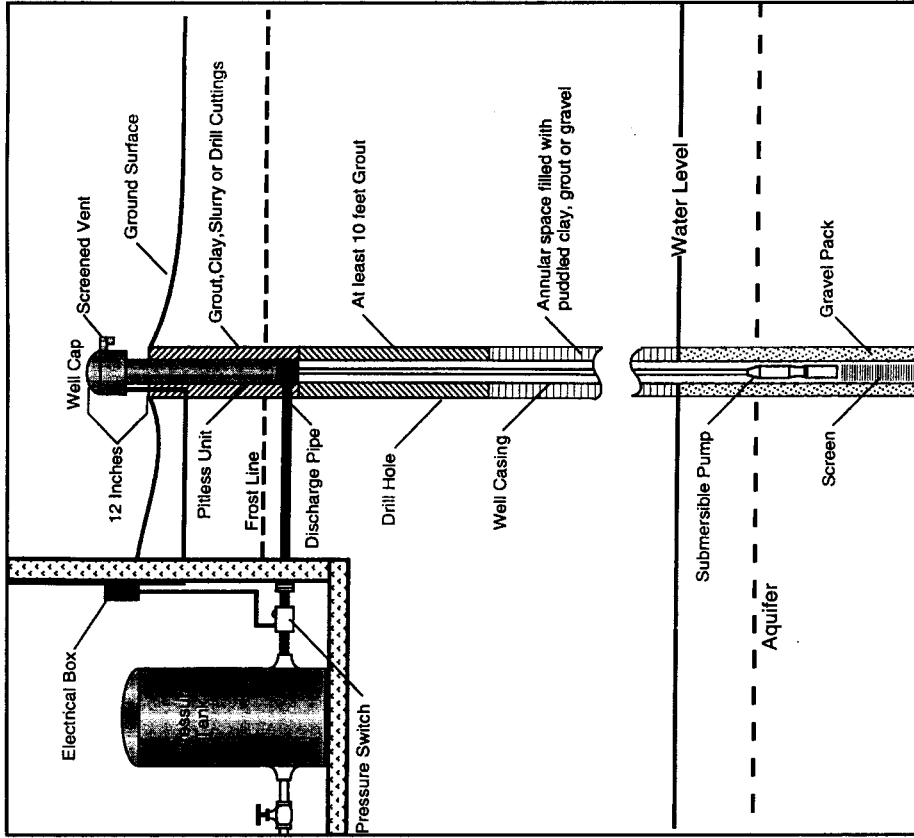
### Does the well need to be test pumped?

The contractor will measure the depth to water (static water level) after the well has been developed. The well will then be test pumped to determine pumping characteristics. The four important pieces of information regarding the performance of the well are: the static water level; the water level during pumping; how long before the water returns to its pre-pumping level; and the yield in gallons per minute. A sample of water may be collected at this time for water quality analysis.

### How do I choose a pump?

Your contractor can help you choose a pump. Most sell, install and service water well pumps or work with a pump installation contractor who specializes in that part of the water well process. To choose one, though, you need to know the total water required, the potential yield of the well, the non-pumping or static water level and the pumping water level. The pump should be set sufficiently deep to account for seasonal change and the potential of temporary lowering of water levels due to pumping of nearby wells. The type of pump used almost exclusively for new wells is called a submersible pump.

The pump, electrical components and connections to the water line are all underground. The pump and well are protected and sealed with a cap on the well that protrudes at least 12 inches above ground. Other information needed to determine pump choice is the drawdown at peak demand, the depth of water, especially during drought, and the house's elevation above and distance from the well. All additional work, such as plumbing and wiring, should be performed by licensed contractors.



**Typical installation of a submersible pump and pitless unit; pressure tank is in the basement of the home. Wiring to submersible pump is not shown.**

space to the top of the screen must be sealed by the correct placement of grouting materials. These exacting requirements are crucial to acquiring and maintaining a safe and dependable supply.

Another consideration is the possibility of an old well on the property that is out of use. In such a situation, the landowner is responsible by law for plugging it properly, so that contamination from flooding or runoff does not travel down the well or behind the casing and contaminate groundwater. Since most older wells do not meet present standards, always contact a licensed water well contractor about checking an older well for its suitability for use, as well as for sealing inactive water wells. Some NRDs provide cost sharing funds based on formulas that vary from one NRD to another. Contact your NRD for more information. In cooperation with the Nebraska Depart-

### How do I get the water to my house?

After the pump has been installed, an underground connector, commonly called a "pitless unit" or adapter, will be installed to carry the water to your house or point of use. Most water systems use a pressure tank to prevent the pump from running each time water is used and to smooth out water pressure in the system. The tank also stores a small quantity of water under pressure. The pressure tank may be buried in a pit no closer than 10 feet from the well or installed in the house or in a heated, above-ground building.

### How do I select a water well contractor?

Your water well contractor should visit with you to determine your needs and to explain the steps in meeting those needs and developing a water system for you. He or she should discuss the cost based on knowledge of the area, including depth of the well, depth to water, probable yield, anticipated water quality, need for a permit, registration of the well, location of the well site, preparation of a contract and timetable for construction.

As stated before, all water well contractors and pump installers have to be licensed. Many contractors have both licenses. Each is required to carry public liability and property damage insurance. The contractor's insurance provides for coverage in case of a worker's compensation claim or property or personal damages. Check with nearby homeowners or landowners when selecting, and ask the contractor for a list of customer references. Another significant credential is membership in the state or national water well association. Member contractors in your area can be obtained by contacting the state association at: Nebraska Well Drillers Association; 100 North 8<sup>th</sup> Street, Suite 200; Lincoln, NE 68508; (402) 476-0162

### What about the cost?

While some contractors may have a fixed price, most will charge for each part of the job, and the amount will depend on the extent and difficulty of work needed. The list of itemized costs is usually as follows: 1) permits; 2) drilling, usually in terms of cost per foot; 3) casing, usually in cost per foot; 4) cost of screens, seals and so on; 5) grouting and cementing; 6) developing, usually in terms of cost per hour; 7) pump testing; 8) pump, pipes and related material; 9) water quality testing; and 10) water conditioning equipment, such as a softener. Your contractor should be able to give you a fairly accurate estimate.

### What should the contract have in it?

A written contract is the best way to ensure that you and your contractor have the same expectations about the work to be done. Besides the contractor's address and license number, the contract should contain the following items:

- The responsibility for acquiring all permits;
- What work is proposed;
- What materials will be used and their cost;
- The cost for drilling;
- The type of equipment that will be used;
- Any guarantee or warranty and its terms;
- The payment schedule;
- Responsibilities of contractor and client for access and clean up;

In addition, you want to see proof of the contractor's liability and worker's compensation insurance.

### What kind of record should I keep?

All new or replacement wells must be registered with the Nebraska Department of Water Resources in Lincoln. Your contractor will have the necessary forms. *You should be certain the registration is completed and submitted and keep a copy of this registration for your permanent records.* All relevant information about your well is contained in this registration form.

### Where can I get more information if I need it?

Besides the Nebraska Well Drillers Association, other important organizations to contact for help are:

- The Nebraska Department of Health and Human Services, Licensing and Regulation, in Lincoln;
- Water Well Standards and Contractors Licensing Board in Lincoln;
- The Conservation and Survey Division at the University of Nebraska-Lincoln, or one of the field offices in Norfolk, North Platte and Scottsbluff;
- Cooperative Extension Division, University of Nebraska-Lincoln;
- Your local natural resources district;
- Your city or county health department; and
- Your local city or village government.