C. BATES

WELL-DRILLING

by Robert Lis

For rural water supply, a deep drilled well gives the best protection against drought and contamination

Believe it or not, many people still get their water from dug wells, also called surface wells. These wells are anywhere from 5 to 25 feet deep and vary in diameter. And some other folks still get their water from springs, streams, and cisterns. All of these sources share one major problem: They are susceptible to contamination. Any water source near the surface of the ground is at risk of being polluted by fertilizers, manure, vermin, vandalism, and even the home's septic system.

As a county housing rehabilitation specialist, I often recommend to homeowners that they replace their shallow water source with a drilled well. Not only does this reduce the risk of contamination, but it also cures the other problem associated with shallow wells: In areas where the water table is naturally low, dug wells often run dry during the summer.

Siting a Well

The siting of a well is a combination of good sense and local health codes. The main issue is the minimum distance from any septic systems in the area — typically 100 feet. Some codes may also require that the well be uphill from the septic system.

Another condition dictated by code (and common sense) is the depth of the casing. A bare minimum of 30 feet is usually recommended if not demanded by code. But common sense and some codes dictate that the casing should extend down until bedrock is reached, even if the distance is greater than 30 feet. The security against contamination is worth the cost of the extra casing.

A final consideration is to site the well where it can be accessed for maintenance and where the drilling rig can set up to drill. A steep site may not work.

In the past, wells were often capped below grade and covered over. The idea was that this afforded better protection against contamination. But as properties change hands, homeowners lose track of where the well is located. I sometimes have to use a metal detector to find the well for repairs or to determine distance separations. In some cases, homeowners have even built porches or additions over a hidden well, making removal of the submersible pump or deepening of the well virtually impossible, since you have to locate the

The drill operator directs the slurry of rock fines and water away from the hole.

drilling rig directly over the well to accomplish either one of these tasks.

Contemporary codes require the well casing to extend above grade and to be covered with a cap held by two bolts. This is now considered better protection against contamination than a cap below grade, and it also allows easy access for maintenance.

Drilling

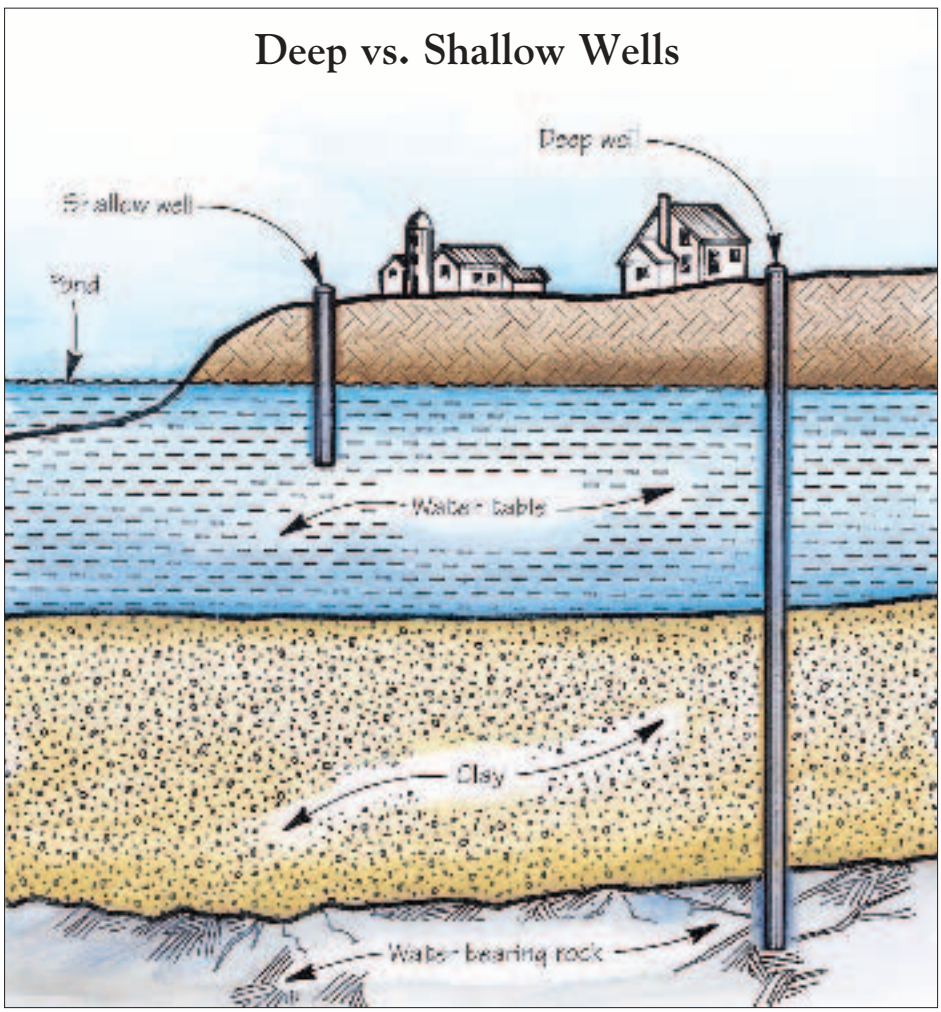
The hydraulic rotary drilling rig is the most common in my area. The rig is driven to the spot where the well is to be drilled, and the "driver" frame is raised into a vertical position. The rigs I am familiar with have a large "lazy Susan" loaded with six 40-foot sections of drill rod. This lazy Susan turns under the driver, which has been lifted to the top of the frame. The driver drops down, engages a section of drill rod, and drilling begins. When that 40-foot section is fully embedded in the ground, the operation is repeated: The drill is stopped, the driver is unscrewed and raised back to the top of the frame, the lazy Susan is swung over, and another 40-foot section of drill rod is connected. This operation repeats itself every 40 feet until a water-bearing formation is found.

Drilling is relatively fast. Hard rock will not stop or even noticeably slow down the drill. I have been told that a drill can go 1,000 feet in a day. To date, I haven't needed to drill beyond 500 feet. Including setup and tear-down, no driller has been on one of my jobs longer than three days, including trenching and making the connection to the house.

The drill produces a clean, smooth hole. However, the cuttings are thought to fill in the fractures that exist naturally in the rock and through which water flows. By working the drill up and down in the hole, the driller clears, or "develops," the well. For low-yield wells, a last-resort process called *hydrofracting* can clear the veins and fissures.

Hydrofracting. Proponents of this process say that it is 90% effective and usually increases a well's yield by at least 50%. The well driller fills the well with water from one of his trucks and then forces high air pressure down the well behind the water. This pressure blows the natural rock fractures clear of any drill cuttings or natural silts that may be plugging the veins.

Well drillers I have talked with claim that hydrofracting clears the veins in a 200-foot radius around the well. To ensure good results, hydrofracting is usually repeated two or three times at



At far left, the truck-mounted drill rig stands in upright position. At near left, the driver, raised to the top of the drilling rig's frame, has just engaged a section of drill rod from the "lazy Susan.

progressively deeper levels. In my area, hydrofracting adds $1,000 or more to the overall cost of the well.

Acceptable Yield

What is an acceptable yield? There's no one number that will apply to every well. Many of the banks in my area request five gallons per minute, but this is not always attainable. The answer is a combination of both the yield and the depth of the well.

The water that stands in the well while nobody is turning on a faucet is called "storage" — this is water that will eventually get used. A 6-inch-diameter well holds one and a half gallons of water per linear foot. Let's say a well has a 200-foot standing column of water: That's 300 gallons of storage. That much storage goes a long way toward meeting the water demand while the well is recharging. Even a yield of only one gallon per minute will replace the original 300 gallons every five hours (in the event you pumped the well dry).

Let's look at a hypothetical case. Say Neighbor A's contractor drills a 40-foot well that yields a robust five gallons per minute (the required yield of some banks in my area), while Neighbor B's contractor drills 250 feet for a yield of three gallons per minute. Does one have a better well than the other? Did the contractor who drilled only 40 feet stop there because the five-gallons-per-minute requirement was met and anything more would be gouging the customer? Did the contractor who drilled 250 feet do so because he's trying to put a kid through college? To answer these questions, we need to look below the surface, so to speak.

Neighbor A spent less money, but depending on his usage, it may be tricky to size a pump that can meet the demand without emptying the storage. Also, we must look at the quality of the water. Often, shallower water sources contain dirt, silt, and minerals that discolor or add odors to the water (this can happen in deeper wells, too). Neighbor A might have to install water-treatment equipment, which may or may not clear up the water. A treatment system could cost more than having drilled another 100 feet to a point where the water is clean and pure. What's more, if the local water table drops because of development or if contaminants from a local landfill leach into the aquifer, the shallower well is more likely to be affected. Neighbor A may eventually have to deepen his well.

Neighbor B, on the other hand, has depth on his side. He has more storage. His water is deep enough to be protected from most contaminants, and if a developer puts in a 30-unit subdivision nearby, there is already a 200-foot cushion paid for in the original cost.

Cost of Drilling

Drilling costs vary from region to region. In my area, the cost averages $7 per foot for drilling plus $6 per foot for casing. I've known drillers to routinely bid about a dollar per foot below the norm. But as in most construction matters, the low bid isn't always what it seems. A little research may show that the low-bidder's wells run deeper than other wells in the same area, meaning that the per-foot savings can be lost to the cost of a deeper well.

Abandoning a Well

Occasionally, a well becomes contaminated and has to be abandoned. Each case is different, but it's usually cheaper to drill than to pay a lab to find and install the correct treatment.

A careful abandonment procedure should be followed to prevent the contamination from traveling to the new well or to other wells sharing the aquifer. The process involves filling in the well from the bottom, thereby sealing out present and future contaminates. This can be done successfully with cement, but cement shrinks when it cures and thus may leave tiny spaces through which contaminants might still flow.

Bentonite — a kind of clay — is the preferred filler. It comes in pellets slightly larger than thumb size and is heavy enough to drop through water. When wet, bentonite swells to about 30 times its dry size, thus effectively plugging the well shaft. After the well is sealed, the remaining depth is filled with sand, and the top is cut off and covered below grade. ■

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