

# Successfully Plugging Your Abandoned Well

## A Statewide Problem

For decades, farms, towns, and businesses in Iowa have relied heavily on wells to supply their water. But as small farms merged into larger ones, communities expanded, and businesses depended more on public water systems, tens of thousands of old wells have been abandoned throughout the state.

Though old windmills or pump houses make some abandoned wells easy to spot, many are hidden beneath grass, brush, or collapsed buildings. These hidden holes can lead to personal injury or equipment damage. Worse yet, many hand-dug or bored wells are large enough to trap an unsuspecting child or pet.

Abandoned wells also threaten the quality of our drinking water. Missing or defective well caps and leaky casings allow bacteria and chemical contaminants to enter abandoned wells. Once inside, these contaminants can seep into the aquifer below and move laterally into active wells nearby.

## When to Plug?

The only way to reduce the threat of personal injury and groundwater contamination caused by abandoned wells is to plug them. With tens of thousands scattered throughout the state, considerable time and money will be needed to plug all abandoned wells. To get the most from the limited amount of time and money available, the Iowa Department of Natural Resources has established a plugging schedule (Table 1) that places highest priority on plugging wells that pose the greatest threat to personal safety and groundwater quality. *This schedule applies to all wells abandoned before April 25, 1990. Wells abandoned after that date are to be plugged within 90 days of the time of abandonment.*

## Can I Plug My Own Well?

Iowa regulations **do** allow well owners to plug their own wells, provided the well owner does the work. If another person is paid to do the work, that person must be a state-certified water well contractor.

Regardless of whether the owner or a contractor plugs the well, Iowa law requires the well owner to certify (on DNR Form 542-1266 "Abandoned Well Plugging Record,") that plugging was done according to state requirements. This report must include confirmation of the well plugging by your county's "designated agent" in charge of well plugging programs, or by a state-certified water well contractor.

Well owners planning to plug a well should contact their county's "designated agent" *before* beginning the work. That person can recommend approved sealing materials and plugging procedures that will help "do-it-yourselfers" avoid bridging, excessive settling, and other common mistakes that frequently lead to time-consuming replugging efforts and groundwater contamination.

## Recommended Plugging Materials

There's more to plugging a well than simply dumping something inside the casing. Materials used to plug a well must be strong, durable, and free from contaminants. To prevent migration of contaminants through the well bore and into valuable underground water sources, key parts of the well must be sealed with *water-tight* plugging materials.

**Sealing Materials** — The most important well plugging materials are called "sealing" materials. They are watertight substances that prevent water and contaminants from entering and seeping through abandoned wells. Neat cement and bentonite clay are commonly used sealing materials.

Neat cement is a slurry of Portland cement and water (six gallons of water and one sack of cement, with no

Table 1. Deadlines for plugging abandoned wells

Type of abandoned well	Plugging Deadline
Any abandoned well within 200 feet of an active water well.	July 1, 1993
Abandoned wells within 660 feet of industrial waste sites, petroleum storage areas, agrichemical storage or mixing areas, feedlots, or other point sources of contamination.	July 1, 1993
Wells 18 inches or greater in diameter <b>and</b> less than 100 feet deep. (Class I well)	July 1, 1995
Wells less than 18 inches in diameter <b>or</b> more than 100 feet deep. (Class II well)	July 1, 2000
Sandpoint well (Class III well)	July 1, 2000

sand or gravel). A well may be sealed with neat cement by pumping the cement through a small pipe lowered to the bottom of the well. As the cement slurry fills the well, it displaces water standing inside the casing. After the well is filled, the injection pipe is removed. Within a few hours the cement hardens to form a long-lasting plug that blocks contaminant migration through the well.

Bentonite clay may be purchased as powder, chips, or pellets. A well may be sealed with bentonite two ways: pump a slurry of bentonite powder into the well the same way neat cement is applied, or pour dry bentonite chips or pellets into the well.

Bentonite slurry gels in a matter of minutes to form a soft plug that is impermeable as long as it remains moist. If allowed to dry out, however, bentonite slurry will crack. To prevent cracking, Iowa's well-plugging regulations call for a cap of cement or concrete to be placed at the top of wells plugged with bentonite slurry.

Dry bentonite chips or pellets swell eight to ten times their original size when they absorb moisture. As swelling occurs, sections of a well filled with dry bentonite become tightly packed with a dense impermeable plug.

**Fill Materials** — In many cases the easiest and most effective way to plug a well is to fill it with a sealing material. But if a well is unusually large or deep, complete plugging with sealing materials becomes very expensive.

When complete plugging with sealing materials is not economical, Iowa law allows *certain portions* of a well to be plugged with "fill" materials. Approved fill materials include clean sand, gravel or pea gravel, agricultural lime, or crushed stone. Because fill materials are not watertight, *they must be used with sealing materials* so contaminants cannot migrate through the abandoned well.

Figures 1-4 illustrate how alternating layers of fill and sealing materials may be used to plug very large or deep wells. Keep in mind, however, that bringing fill materials to the well site and installing them in the proper sequence (as shown in Figures 1-4) adds to the cost of well plugging. So the use of fill materials saves money only when the well is quite broad or deep. Consult local contractors or your county's designated agent for recommendations on fill materials for your particular well. In many instances, complete plugging with sealing materials will be the most cost-effective approach.

### Plugging Procedures

Good planning is the first step in plugging any well. Professional well contractors start by carefully measuring the depth and diameter of the well to determine the amount of plugging materials needed. This approach helps to avoid ordering excess plugging materials, or running short of materials and having to pay for additional deliveries. Table 2 shows how many linear feet of well is filled by commonly used plugging materials (i.e. sand, cement, and bentonite chips).

Regardless of the type of well to be plugged, all pumps, piping, and other internal obstructions should be removed before attempting to install plugging materials. If internal obstructions cannot be completely removed, the well should be filled with neat cement or bentonite slurry. These materials are more likely than granular bentonite to flow around obstructions and completely plug the well.

Iowa law also requires the top four feet of well casing to be removed. Sealing material placed at the top of

Table 2. Feet of well that can be filled by common plugging materials

Well Diameter (inches) <sup>1</sup>	Feet of well filled by commonly used plugging materials		
	Sand <sup>2</sup>	Cement <sup>3</sup>	Bentonite Chips <sup>4</sup>
2	41.70	50.46	31.30
4	10.41	12.60	7.90
5	6.67	8.06	5.10
6	4.63	5.60	3.50
8	2.60	3.15	2.00
10	1.67	2.02	1.30
12	1.16	1.40	0.89
18	0.51	0.62	0.39
24	0.29	0.35	0.22
30	0.19	0.22	0.14
36	0.13	0.16	0.10

<sup>1</sup> Inside diameter of well casing

<sup>2</sup> Feet filled by 100 lb. of damp sand

<sup>3</sup> Casing filled by cement slurry consisting of one 94 lb. sack Portland cement and 6 gallons water

<sup>4</sup> Feet filled by 50-lb. bag of 3/8- to 3/4-inch bentonite chips

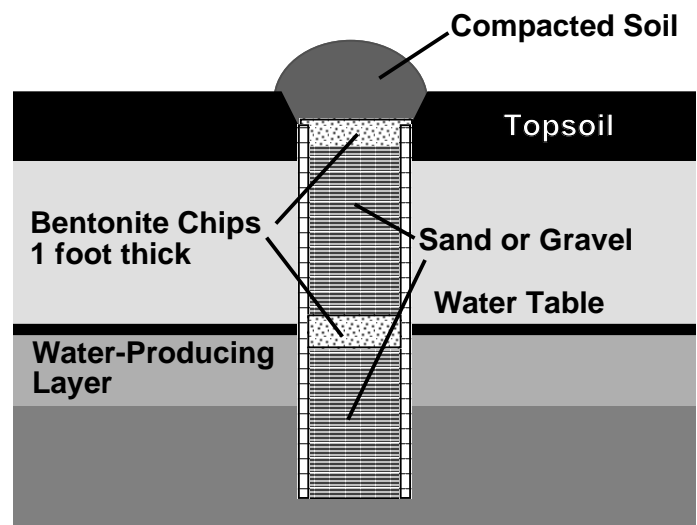


Figure 1. Recommended placement of plugging materials in shallow, large-diameter (Class I) wells.

the well should extend a couple of inches above and around the outside of the cut-off casing to reduce seepage down the outside of the casing.

Finally, compacted soil should be mounded over the well site. This is done to prevent water from collecting above the abandoned well.

## Beware of Bridging

The most frequent problem when plugging a well is bridging. This occurs when granular sealing or fill materials (bentonite chips, sand, ag lime, etc.) are dumped into the top of a well too rapidly. When this happens, plugging materials often get temporarily wedged inside the well casing. The result is a partially plugged well that eventually may collapse and reopen.

Bridging is most likely to occur in wells that are 12 inches in diameter or less. One way to eliminate bridging in narrow wells is to completely fill them with cement or bentonite slurry.

If granular plugging materials are used they must be poured *very slowly* to avoid bridging. Continuous agitation, with a rod or weighted rope, will also help reduce the likelihood of bridging as the plugging materials settle.

The rod or rope also can be used as a probe to monitor the location of the top of the plug as material is poured into the well. If the top of the plug rises more quickly than anticipated (see Table 2), a bridge has formed. The sooner this bridge is detected, the easier it will be to dislodge.

## Placement of Plugging Materials

Recognizing that several well types are used in Iowa, the Department of Natural Resources developed well

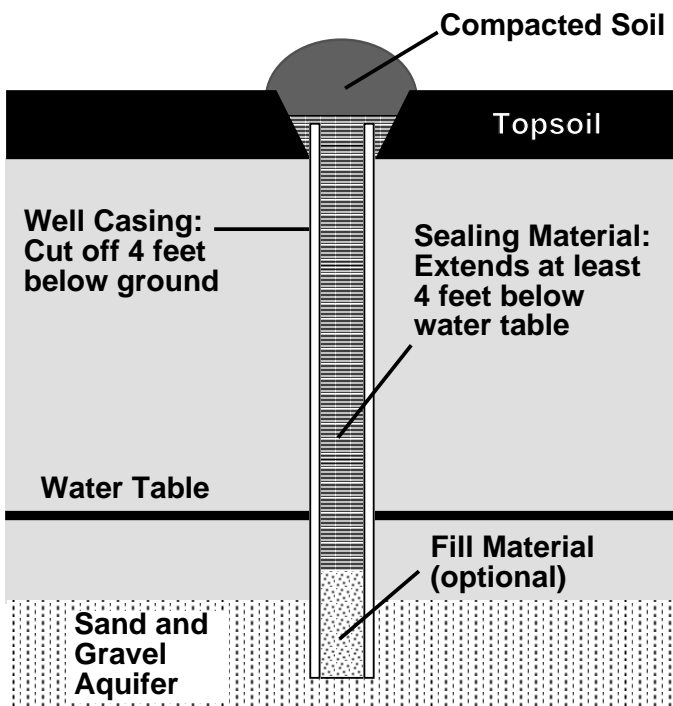


Figure 2. Recommended placement of plugging materials in Class II sand and gravel wells.

plugging rules for three general classes of wells.

Class I wells are those measuring 18 inches or more in diameter *and* less than 100 feet deep. Large and relatively shallow wells like these are typical in southern and western parts of the state. Figure 1 illustrates a recommended plugging scheme for Class I wells.

Because Class I wells typically measure 1 1/2 to 3 feet across, it generally is considered prohibitively expensive to completely fill them with sealing materials. So Class I wells are sealed using two 1-foot-thick layers of bentonite pellets or chips. These are placed at the water table and the top of the well. The remainder of the well is filled with less expensive filling materials.

Class II wells include any *bedrock* well, any well less than 18 inches in diameter (regardless of depth), or any well *more* than 100 feet deep (regardless of diameter). Wells in this class are most common in the northeastern half of the state where productive bedrock or sand and gravel aquifers are readily accessible.

In the case of unusually large or deep Class II wells, Iowa well-plugging regulations permit use of alternating layers of sealing and fill materials to reduce plugging costs. Figures 2, 3, and 4 illustrate how these layers are to be placed inside wells that tap sand and gravel aquifers, and wells tapping one or more bedrock aquifers.

Keep in mind, however, that use of fill materials is optional. As noted earlier, the costs of trucking in fill materials and placing them at the correct location inside a well may exceed any savings derived by reducing the quantity of sealing materials needed. Furthermore, use of fill materials requires accurate placement of the alternating layers of fill and sealing materials. If well construction records are *not* available to indicate exact depths to water-producing zones (as is often the case for old wells),

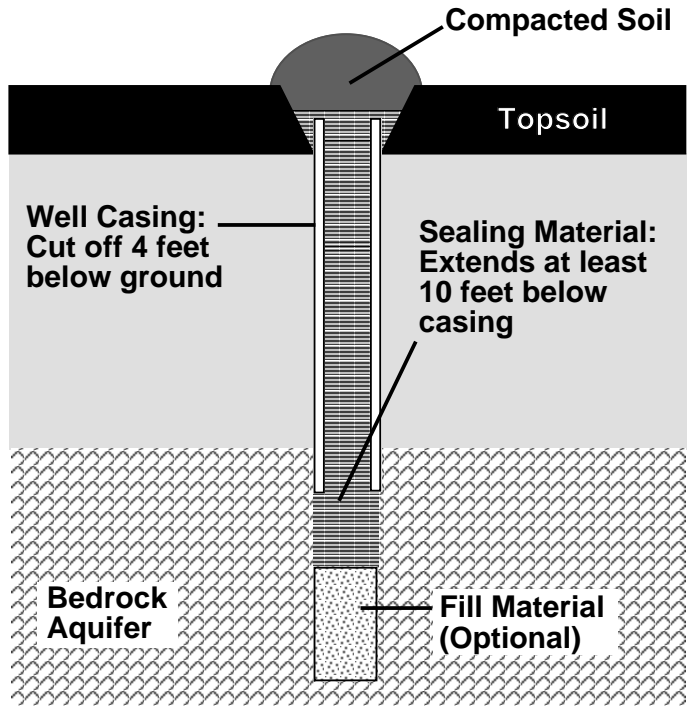


Figure 3. Placement of plugging materials in Class II wells tapping a single bedrock aquifer.

the best way to ensure thorough sealing of Class II wells is to completely fill them with sealing material.

Sandpoint wells (Class III) consist of a pointed well screen attached to 1 1/2- or 2-inch diameter pipe. These are driven into the ground to reach shallow water-bearing sand and gravel deposits. Sandpoints generally are less than 50 feet deep, and the preferred method for abandoning them is to extract the pipe and screen, and allow the hole to collapse. If the pipe cannot be extracted, it should be cut off four feet below ground and filled with neat cement or bentonite products.

## Standby Wells

Wells that currently are not used, but that may be used in the future, need *not* be plugged. As long as a well does not permit entry of contaminants it can be legally designated as a "standby" well. However, the standby designation must not be used as an excuse to avoid plugging a defective well. To prevent further contaminant entry, defective wells should be repaired or permanently plugged.

## Cost-Sharing Grants for Well Plugging

To encourage plugging of abandoned wells Iowa provides cost-sharing money through the Grants to Counties Program. This program pays up to \$200 of plugging costs for eligible participants.

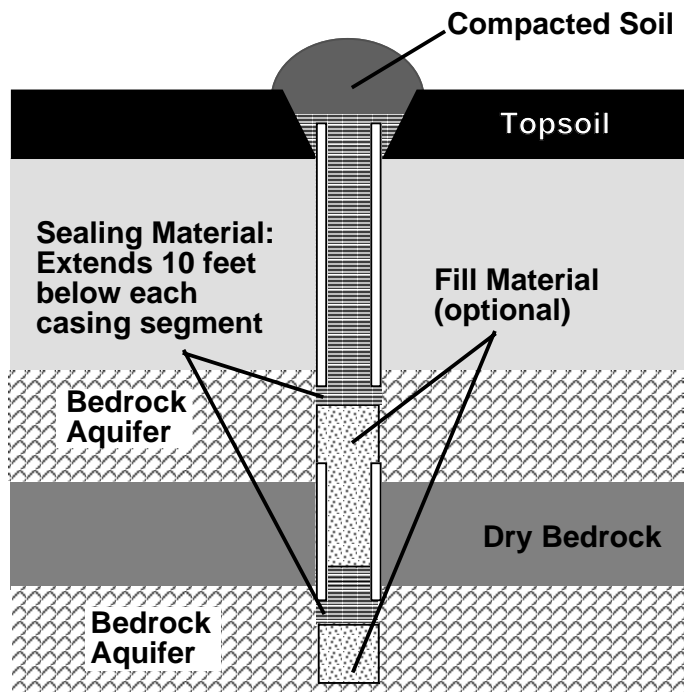


Figure 4. Placement of plugging materials in Class II wells tapping two or more bedrock aquifers.

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To be eligible for the cost-sharing money, your county board of supervisors must submit a short grant proposal to the Iowa Department of Natural Resources and agree to administer the program locally. For more information about cost-sharing money for well plugging in your county, contact your board of supervisors or county environmental health officer.

## It's Up to Us

It won't be easy to convince everyone to plug abandoned wells. Proper well plugging takes time and money, and costs vary considerably with well depth, diameter, and the geology of the area.

Some will say that well plugging is like "pouring money down a hole." But open wells threaten our safety and our most precious water resources. By spending a few hundred dollars to plug an abandoned well, you may prevent contamination of *your* drinking water or avoid a serious accident involving *your* family or friends!

## For More Information

Information presented in this fact sheet summarizes key provisions of Iowa well-plugging regulations implemented by the Iowa Department of Natural Resources in April of 1990. For a complete copy of these rules contact your county health department or the Iowa Department of Natural Resources.

Members of the water well industry and others who desire a more detailed discussion of well plugging practices may obtain "Guidelines for Plugging Abandoned Wells," Technical Information Series #15, from the Geological Survey Bureau of the Iowa Department of Natural Resources (phone 319-335-1575).

Service clubs and other groups wanting to learn more about abandoned wells may borrow an 18-minute slide/tape presentation "Plugging Abandoned Wells." This informative program was developed through the Targeted Education Program of the Iowa Department of Agriculture and Land Stewardship, and is available at Iowa State University county extension offices.

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