

Properly Abandoning Water Wells

Water wells that are improperly abandoned are always a serious liability. Therefore it is imperative to the safety and well being of a community that special care is given to properly seal abandoned water wells. When ground water becomes contaminated, it is very difficult to clean up and it is a very expensive process. The proper way to handle this problem is to plug, seal and decommission all abandoned wells.



Many states offer financial incentive programs for well owners to properly abandon wells on their land. Some estimates show from one to four abandoned wells for every five wells in service. Most of these abandoned wells are expected to be in urban and suburban settings where municipal water has been brought into areas of high volumes of housing development that was once the home for on-site wells.

History shows that the construction of water wells using drilling machines dates back to the early to mid-1800. Around the turn of the century, it was common to see steel casing wells of 1 ½ inch to 4 inches in diameter. In the early days, wells were hand dug and were lined with stone, brick, wood, or concrete.

Household wells were taken out of service and abandoned without plugging. If a replacement well was needed, the old service line was severed. Occasionally the end of the water pipe was capped. In the early days hand pumps were often disconnected leaving pump rods and plungers in the well. Often abandoned wells were filled with fieldstones where drilled wells were capped by jamming something into the top. A municipal well might be abandoned by shearing off the pump column and it would drop into the bottom of the well. They would salvage the pump motor and place a cover over the well.

As a general rule, well owners did not recognize the potential threat to their new water well so they did not spend the money to plug the well. Older wells were buried 4 to 5 feet to protect against freezing. When a well is abandoned, the location can be easily forgotten. Vegetation will grow around covering the well site where is not visible to the naked eye. Many times during a demolition or the paving of a road, a well casing will be bulldozed or paved over.



The purpose of well abandonment is to restore the geology to its original hydrogeologic condition. It is also important to carry out proper abandonment procedures in order to prevent physical hazards, prevent pollution entrance and to prevent the intermixing of aquifers.

Most everybody alive in 1986 can remember the sensational rescue of Jessica McClure, the baby from Midland, Texas, who fell into an eight inch, abandoned well opening while playing in a backyard. The nation sat on the edge of their seats for some 58 hours as the rescue was played out

on televisions not only in the U. S., but around the world. The media attention to this dramatic rescue brought much needed attention to the problem of properly abandoning water wells.

There are more of these cases than we would like to imagine because an abandoned well has not been properly “covered up”.

A construction foreman in Port Orchard, Washington, fell into an abandoned well where a shopping center was under construction. He fell 20 feet into the well after he stepped on rotten boards that had been used to cover the well. He was in the process of sealing the well. He was briefly knocked unconscious by debris that fell into the well on top of him. When he awoke, he was in water. He was able to get out of the well by taking hold of bolts that were protruding from the wall of the well. He was treated for minor cuts and abrasions.

There are many sources of information regarding people falling into abandoned wells. Not all of them have a happy ending. In Italy, a 6-year old boy fell over 200 feet into a 16 inch abandoned well. He did not make it. When walking in old pastures or near old farm houses, one should always be conscious of the surrounding, since many abandoned wells are located on these type of properties.



If an unused well has not been properly abandoned, it allows for all types of pollutants to enter into the well. A scenario of such pollution is a well contractor deepening an existing 131 foot well to 356 feet in order to improve the well yield. Salt water under artesian pressure was encountered in a

shale bedrock formation. The well had to be abandoned and a replacement well dug 60 feet away to solve the problem.

When investigating the problem it was discovered that the contractor had only plugged the upper 5 feet of the old well. When the cement plug was removed, it was discovered that a pair of long underwear had been stuffed into the well casing as a bridge for the cement.

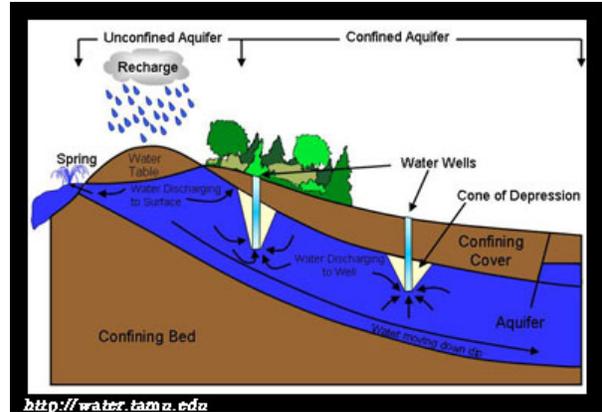
In order to fix the problem, the contractor was ordered to cement the old well from bottom to surface as required by the well code. After a few months, the owner notified the State that the water no longer tasted salty. The salt contamination had entered the new well by moving upward in the abandoned well.



When a local farmer complained about decreased milk production and dairy herd illness, the state and local health officials conducted a joint investigation. They discovered that coliform bacteria and iron bacteria were both found in the new well. There were two old abandoned wells found near the site. The farmer was instructed to

plug both wells before proceeding with further re-disinfection of the new well. As he was preparing to do this, he discovered that gray water from the laundry in the farmhouse basement had drained into the well. Improper sewage disposal into the well was probably the cause of the well contamination.

To prevent the intermixing of aquifers, proper well abandonment is a must. If the upper aquifer is contaminated and is not sealed through the restrictive or confining layer, the potential exists for contaminating the lower aquifer.



Contamination occurs when the natural restrictive barrier has been pierced and has been left open. It will then render the lower aquifer unusable because the poorer quality water in the upper aquifer will flow downward to the lower aquifer.

An abandoned well that is not properly sealed can cause loss of confining pressure. If the well penetrates a confined aquifer, sealing the well will help preserve the confined conditions. These confining conditions will allow the water to reach a certain level in the well. By reducing the confining pressure, it may cause water levels in neighboring wells to drop.

Many states strictly enforce the regulations concerning proper well abandonment procedures. Laws may vary from state to state.



One state estimated that there might be as many as 2 million unplugged abandoned wells in their state. They reported that “unplugged abandoned wells can threaten the quality of drinking water that is obtained from privately owned and community public drinking water supply wells.”

The Abandoned Well Management Program has implemented a program to coordinate statewide abandoned well location and plugging activities. Plugging abandoned wells protects the drinking water aquifers that supply nearly one-half of the state’s citizens. The purpose of the program is to identify and properly plug as many abandoned wells as possible. The Public Health Code gives the authority to regulate activities regarding abandoned wells. The Water Division conducts compliance and enforcement actions in cooperation with the Office of Criminal Investigations, the State office of the Attorney General and through Local Health Departments.

The Abandoned Well Management Program is funded pursuant to the Public Health Code and is implemented at the local level through local health Department Operations Grants. The Grant Programs include many activities such as conducting abandoned well search activities, contracting with registered well drilling contractors to plug abandoned wells, mapping active and abandoned wells, and development of local ordinances that discourage or prohibit the presence of abandoned wells inside community well head protection areas.

Some states have a grant program that will pay 100% of the costs of proper well abandonment if performed by a licensed well contractor who follows the grant program requirements.

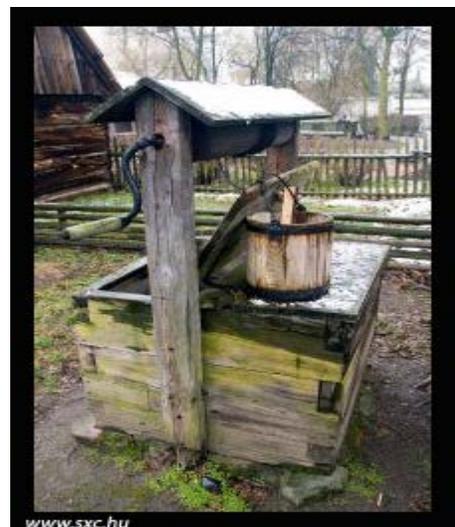
There are training programs available for well drilling contractors to provide them with information illustrating the hazards associated with unplugged abandoned wells and how to effectively plug them.

How to Plug an Abandoned Well

1. Pumps, drop-pipes, pump rods, packers, wire, check valves and all other debris or obstructions must be removed from the well. Registered well drilling contractors have the knowledge and proper equipment to perform this task.
2. The well depth and diameter must be measured in order to calculate the necessary amount of plugging material. Different types of wells require different plugging methods.
3. The well is plugged by a registered well drilling contractor.
4. An Abandoned Well Plugging Record is completed and submitted to the local health department, the well owner, and to the state within 60 days upon completion of the well plugging project.

Landowners should take every precaution to determine if there may be old and unused wells on their property. In order to this, they can:

1. Talk to Property Owner
2. Talk to Previous Owners
3. Talk to Relatives or acquaintances who may know about the property.
4. Talk to neighbors.
5. Talk to contractors who may have worked on the property.



6. Talk to Inspectors.

There is also physical evidence that a well may have been on the property, i.e.

1. Windmills or wishing wells
2. Casing visible above ground, concrete slab or basement floor
3. Small outbuildings.
4. Circular ring in cement or patch in the floor
5. Basement offset
6. Patch in step or concrete
7. Pit in yard or basement
8. Manhole cover
9. Crock, brick or stone structures
10. Hand pump, hydrant, or faucet in yard
11. Waterline or patched hole through basement floor or wall.
12. Water system components
13. Damp circular depression in yard
14. Additions, false walls, access panels which may “hide” well
15. Old building sites recognizable by an old foundation
- 16. Ornamental shrubs, flowers or trees outlining old home or farm sites**

What is an Abandoned Water Well?

Abandoned water wells can be divided into two categories – permanently abandoned wells and temporarily abandoned wells.

A permanently abandoned well is defined as meeting one of the following criteria:

- Has been permanently discontinued
- Is in such disrepair that it is no longer practical to use
- Has never been completed
- Is a threat to other groundwater resources
- Is a hazard to health or safety

Water wells may also be temporarily abandoned if the owner intends to someday use it as a source of groundwater, but it is not currently being used for that purpose or any other purpose.

Why is it Important to Plug Abandoned Wells?

There are three basic reasons for plugging abandoned water wells.

1. They are a safety hazard. There are reports of people falling into improperly abandoned wells every year.
2. They are a health hazard. Drinking water can be contaminated when gas traveling through abandoned shafts seeps into underground aquifers used for public consumption.
3. They threaten the environment. Illegal waste dumping may occur in open, uncased boreholes. Deteriorated pipes may allow movement of water between previously separated aquifers. This can compromise water quality.

Who is Responsible for Plugging an Abandoned Well?

The property owner is responsible for plugging abandoned water wells. If a contractor unsuccessfully drills a well – commonly called a “dry hole” – then the drilling contractor is responsible.

Locating Abandoned Wells

If you buy property or begin working on undeveloped land, first look for abandoned wells. There are many ways to go about this. You may want to search for water well drilling records or old billing statements. These may be available through contractors who drilled or serviced a well on the property, local water bureaus, or the local health department. Talk to property inspectors in the area. If that doesn't yield any information then walk the property. Look for pipes sticking out of the ground or through slabs, windmills, old hand pumps, electrical switch boxes, or any other clue that you think might indicate something has been abandoned on the property.

- Look for small outbuildings.
- Manhole covers are a good indicator.
- A pit or depression in the land could be a clue.
- You might want to use a metal detector to pick up any signal of buried hardware.
- A magnetometer or electro-magnetic detector might be helpful. These are usually available through groundwater consultants.
- A "snake" to follow the direction of pipes is a good tool.
- Shovels, hammers, chisels, and backhoes may be helpful tools.
- Neighbors or senior citizens are also excellent sources of information especially if they have lived in the area for a long period of time.

Plugging the Well

There are six key steps in properly plugging a well.

1. Measure the dimensions of the well. This is important so you will know how much material you will need to plug the well.

2. Remove all obstructions from the well. This is important so that the plugging material you use will be sure to reach the bottom of the well.
3. Disinfect the well by adding household bleach. This is important because the bleach will kill any microorganisms that may have fallen into the well while it was open.
4. Remove as much casing as possible. This is important so that when the well is plugged, the native soil will more easily bond with the plugging materials.
5. Fill the well with the plugging materials. Be sure that your plugging materials are clean so as not to contaminate any groundwater.
6. Complete the plugging report. This is important so there will be a record of the work. It also provides documentation to the local or state governing boards.

Restoring geological conditions to that which existed before the well was drilled is the concept behind plugging the well. But once you have located an abandoned well, then it is important to properly abandon it. Depending on the type of well, the procedure for abandonment may differ. The first step for all abandonment is to remove all pumps, pipes, pump rods, packers, wire, valves, or any other obstruction. In other words – remove all visible hardware. By this time you should have determined the type of well to be plugged and proceed accordingly.

Dug wells These are large wells made of cement, brick, stone, or tile. They have openings 12 to 48 inches in diameter. These wells should be filled with alternating layers of bentonite chips or pellets 6 inches thick and clean soil backfill no more than 10 feet thick. The final 6 inch bentonite layer should be placed 3 feet below finish grade, then the rest of the hole backfilled and capped in a way that will prevent settling or ponding of water over the original well site.

Drilled wells in Sand or Gravel Formations These types of wells should be “filled” with a compound of bentonite grout slurry, neat cement slurry, or by bentonite chips or pellets. These compounds should be emptied into the well through a tremie pipe that goes to the bottom of the well. The tremie pipe should be removed after or slowly during the plugging process. Neat cement slurry is a mixture of one 94 pound bag of Portland cement and not more than 6 gallons of water.

Wells in Bedrock Neat cement should be used to plug these types of wells. A pump and tremie pipe which reaches the bottom of the well will be necessary. The pipe should be removed gradually during the plugging process or after the cement begins to appear on the surface. Bedrock wells should be plugged by professional well drilling contractors.

Hand-Driven Point Wells Hand-driven wells can be plugged by dropping bentonite chips or pellets into the top of the well casing or by pouring neat cement through a funnel into a tremie pipe that reaches the bottom of the well. These wells are unique in their size – no more than 1 ¼ inches in diameter. As with other wells, be sure to remove the tremie pipe when filling is complete.

Flowing Wells These wells should be plugged only by registered well drilling contractors. Their special characteristics require special training.

Financial Assistance

Financial assistance may be available in the form of grants, loans, or a combination of both to follow the steps necessary to properly abandon an unused well. The following agencies might be helpful:

USDA (United States Department of Agriculture)

EPA (Environmental Protection Agency)

Local Homeowners Associations

Local water department

In conclusion, properly abandoning water wells is in the best interest of the property owner, the community, and the environment. The safety, health, and security of all concerned are worth the effort.

VOCABULARY

Abandoned well – A well that has not been used for six consecutive months.

A well is considered to be in-use in the following cases:

a non-deteriorated well which contains the casing, pump, and pump column

in good condition; or

a non-deteriorated well which has been capped

Aquifer – Geologic stratum or zone below the surface of the earth capable of producing groundwater.

Bentonite – A sodium hydrous aluminum silicate clay mineral (montmorillonite) commercially available in powdered, granular, or pellet form which is mixed with potable water and used for a variety of purposes including the stabilization of borehole walls during drilling, the control of potential or existing high fluid pressures encountered during drilling below a water table, and to provide a seal in the annular space between the well casing and borehole wall.

Bentonite grout – A fluid mixture of sodium bentonite and potable water mixed at manufacturers' specifications to a slurry consistency which can be pumped through a pipe directly into the annular space between the casing and the borehole wall. Its primary function is to seal the borehole in order to prevent the subsurface migration or communication of fluids.

Bridge – Plugging materials that lodge part way down in a well bore so as to obstruct passage of subsequent plugging materials to the bottom of the well bore.

Capped well – A well that is closed or capped with a covering capable of preventing surface pollutants from entering the well and sustaining weight of at least 400 pounds and constructed in such a way that the covering cannot be easily removed by hand.

Casing – A lightweight pipe which is installed in an excavated or drilled hole, temporarily or permanently, to maintain the hole sidewalls against caving, advance the borehole, and in conjunction with cementing and/or bentonite grouting, to confine the ground waters to their respective zones of origin, and to prevent surface contaminant infiltration.

Cement – A neat Portland or construction cement mixture of not more than seven gallons of water per 94 pound sack of dry cement, or a cement slurry which contains cement along with bentonite, gypsum or other additives.

Complainant – A person who has filed a complaint.

Completed water well – A water well which has sealed off access of undesirable water to the well bore by proper casing and/or cementing procedures.

Confining layer – Geologic stratum or zone below the surface of the earth that impedes the movement of groundwater.

Constituents – Elements, ions, compounds, or substances which may cause the degradation of the soil or ground water.

Foreign substance – Constituents that include re-circulated tail water and open-ditch water when a pump discharge pipe is submerged in the ditch.

Freshwater – Water whose bacteriological, physical, and chemical properties are such that it is suitable and feasible for beneficial use.

Granular sodium bentonite – Sized, coarse ground, untreated, sodium based bentonite (montmorillonite) which has the specific characteristic of swelling in freshwater.

Mud – A relatively homogenous, viscous fluid produced by the suspension of clay-size particles in water.

Neat Portland cement – A finely ground, carefully proportioned mixture of limestone and shale (sold commercially).

Plugging – An absolute sealing of the well bore.

Pollution – The alteration of the physical, thermal, chemical, or biological quality of, or the contamination of, any water that renders the water harmful, detrimental, or injurious to humans, animals, vegetation, or property, or the

public health, safety, or welfare, or impairs the usefulness or the public enjoyment of the water for any or reasonable purpose.

Public water system – A system supplying water to a number of connections or individuals.

Recovery well – A well constructed for the purpose of recovering undesirable groundwater for treatment or removal of contamination.

Tremie tube – A tube or pipe running to the bottom of a well that is used to transport plugging materials to the bottom of the well; tube is raised as bottom of the well is filled.

Undesirable water – Water that is injurious to human health and the environment or water that can cause pollution to land or other waters.

Well – A water well, injection well, dewatering well, monitoring well, piezometer well, observation well, or recovery well.