



# Protecting Wells from Contamination: Results from the Beaver Creek Watershed

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## **Background**

Several complementary projects in the Beaver Creek watershed in Fayette, Haywood, Shelby and Tipton counties in southwest Tennessee are evaluating how agricultural production affects water quality. These efforts originated with local farm leaders' concerns about claims that agriculture causes significant environmental damage.

Local interest led to a long-term study being conducted by the US Geological Survey (USGS) in partnership with the Tennessee Department of Agriculture (TDA), other state and federal agencies, academic institutions and the local farming community. The objectives are (1) to determine the nature and extent of the impacts of agriculture on surface and groundwater quality, (2) to identify and quantify factors and processes that control the fate and transport of pollutants, (3) to assess the effectiveness of best management practices and (4) to evaluate and adapt water quality monitoring techniques to improve their accuracy. Meeting these objectives should help develop useful tools for resource management agencies and for farmers.

Beaver Creek is also a priority watershed in Tennessee's 319 Nonpoint Source (NPS) Program. The Tennessee Department of Environment and Conservation (TDEC) is conducting chemical and biological monitoring to identify changes in overall surface water quality and is also tracking the implementation of best management practices with a geographic information system.

In addition, Beaver Creek is a hydrologic unit area (HUA) project of the US Department of Agriculture. The purpose of a HUA project is to solve water quality problems through voluntary efforts, share results with farmers and

Service (SCS) and The University of Tennessee Agricultural Extension Service (UTAES), in cooperation with other state and federal agencies.

The 95,000-plus acres in the watershed are nearly two thirds row crops. Cotton, soybeans and small grains are the primary crops; corn is also grown. Some beef cattle and a few small swine operations also exist. Mason, the largest town in the watershed, has about 470 residents. Beaver Creek offers a representative West Tennessee agricultural setting to answer important questions about NPS pollution and the effectiveness of various management practices in protecting surface and groundwater.

Work in Beaver Creek continues. However, some results from the USGS study are available now. They provide some insight into practices and activities that can influence water quality and the effects of our activities on the environment. This factsheet discusses some of the results from a well sampling project and suggested well protection practices.

## **The Well Study**

In July and August 1992, USGS, in cooperation with TDA and UTAES, sampled 398 domestic wells in Fayette, Haywood, Shelby and Tipton counties. Ninety-five of these wells were in the Beaver Creek watershed.

Unexpectedly variable amounts of nitrate, a form of nitrogen, were found. Nitrate occurs naturally in the environment, and low levels occur naturally in groundwater. Amounts of nitrate greater than natural "background" levels may indicate contamination from human activities.'

Depth is an important factor in well contamination. The deeper the well, the lower the chances of contamination, all other things being equal. Water containing contaminants may not move deep enough to reach deeper groundwater aquifers. Also, as contaminated water moves deeper, time and the amount of soil passed through increase. This in turn increases opportunities for contaminants to be broken down by physical and chemical processes, taken up by micro-organisms and plants or bound to soil particles.

Distance to the source of contamination is also important. The closer the source, the greater the chances of contamination. This is in part due to the decreased time and amount of soil the contaminated water will move through. Also, well contamination is often caused by contaminated water moving down the outside or inside of the well casing. The closer the source, the more likely contaminated water will reach the well. Finally, the closer the source, the lower the chances for dilution by uncontaminated water.

USGS examined well depth and land use around the well for 81 of the wells in the Beaver Creek watershed to see if these factors were associated with the high nitrate levels.

In looking at well depth, a relationship with nitrate was found. Water in wells deeper than 160 feet (45 meters) did not appear to be affected by nitrate sources on or near the land surface. Water in 16 percent of the shallower wells had amounts of nitrate greater than expected background levels.

Land use around wells less than 160 feet deep was examined for possible nitrate sources. Three sources were considered: (1) crop production (fertilizer application), (2) septic systems (human wastes) and (3) confined animal facilities (animal wastes).

This analysis found that wells within 100 feet of cropland receiving nitrogen fertilizer had increased levels of nitrate. Wells near septic systems or confined animal facilities also had increased levels of nitrate. However, nitrate amounts in wells near septic systems or confined animal facilities were significantly higher statistically than amounts in wells near cropland. The highest nitrate levels found were in wells near septic systems or confined animal facilities.

These animal facilities were not large commercial operations like dairies, feedlots or other major animal concentrations. One or two pleasure horses stabled near a well were sufficient to significantly increase nitrate concentrations in the shallow well water.

A long-term study is being conducted to further investigate cause-effect relations of contaminants in shallow groundwater in the Beaver Creek watershed. This study was limited by the relatively small number of wells near each kind of land use.

However, these results show the importance of protecting the area near a well to protect water quality.

### **Well Protection Recommendations**

This study in the Beaver Creek watershed shows it is important to protect well from nearby sources of

contamination. Six principals of well protection are:

- (1) proper location
- (2) proper construction
- (3) keep contaminants away from the well
- (4) prevent backflows
- (5) seal abandoned wells
- (6) inspect the well and test well water.

### **Proper Well Location**

The Beaver Creek study shows that if a well is in the wrong place, the risk of contamination increases. Unfortunately, convenience or cost rather than protection are priorities for some people.

In general, a well should be located on the highest ground available and as far away from possible sources of contamination as possible. Potential sources of contaminants in addition to fertilizers, septic systems and animal facilities include sewage sludge, fuel tanks and agricultural chemical mixing, loading or storage areas. According to Tennessee regulations, minimum distances for new wells are 100 feet from animal pens, lagoons or sludge disposal sites, 75 feet from sewer lines or pit privies and 50 feet from septic systems.

If a well must be located in an area subject to flooding, a watertight casing at least 2 feet above the maximum recorded flood level is required in Tennessee. Avoid low spots, depressions, pits or basement locations, since standing water can accumulate and seep into the well. A well should also be at least 5 feet from the drip line of any building, according to state regulations.

### **Proper Well Construction**

Contamination is often caused by a contaminant entering the well down the inside or around the outside of the well casing. A poorly constructed or sealed well creates a direct channel between the surface of the ground and the groundwater supply.

The Tennessee Department of Environment and Conservation established new rules for water well construction, repair and inspection/registration in 1993. The construction standards include:

The source of water must be at least 20 feet below the surface of the ground.

Water-bearing zones of less desirable quality, salt water, oil, gas or other material that might contaminate a source of fresh water must be sealed off.

Only water from a potable source or water treated with chlorine can be used in drilling.

Wells must be cased with watertight casing from at least 6 inches above to at least 20 feet below the land surface.

Space between the casing and bore hole wall must be back-filled with impervious material such as grout, bentonite chips or cuttings mixed with bentonite.

All wells must be disinfected upon completion of

construction, re-working, pump installation or repairs.

The ground surface around the well head must slope away from the well in all directions.

Wells drilled before August 5, 1993 are not subject to these regulations. But they deserve consideration since the intent of the regulations is to protect groundwater quality and human health. Key points are a well casing extending above ground, proper grouting, backfill level with the ground and sloping away etc.) from the well head, a waterproof seal at the top of the well and disinfection after construction or repair.

#### Keep Contaminants Away From the Well

The Beaver Creek study shows the importance of keeping potential sources of contamination away from the well. This also helps reduce chances of accidental spills around a well or contamination of the soil near a well.

Recommended minimum distances from potential contamination sources found around the farm or home are:

Animal pens or feedlots - 100 feet

Lagoons - 100 feet

Sewer lines or pit privies - 75 feet

Sludge disposal sites 100 feet

Septic tanks and drain fields - 50 feet

Fertilizer storage - 100 feet

Fuel storage - 100 feet

Pesticide storage, mixing or loading areas - 100 feet

Never store petroleum products, pesticides or other possible contaminants in the well house or near the well. Store, mix and load downslope from the well if at all possible.

Collect used oil in leakproof containers and take it to a collection point for recycling. Never dispose of used oil by dumping it on the ground or in streams.

Use shop and household chemicals (cleaners, solvents, etc.) for their intended purpose and properly dispose of the empty containers. Do not store these items or discard them near the well. Also, never dispose of chemicals by flushing them down the toilet or pouring them down the drain. They will enter the septic system or sewer lines and could contaminate shallow groundwater.

#### Backflow Prevention

Backflow that siphons pollutants into a well is a serious potential problem. Backflow typically happens when the pump shuts off unexpectedly because of a power failure, malfunction or other reason.

Most domestic wells have a foot valve or check valve to prevent the column of water in the well pipe from falling back into the well and creating a siphon effect. However, these valves often leak. A leak will allow the water to flow back into the well and create suction throughout the water delivery system. If you were mixing a tank of pesticide when this happened and the end of the hose was submerged the mixture, the siphoning effect could suck the entire tank of chemical into the well

This problem can be avoided by never submerging a hose in any material that could contaminate a well. Vacuum breakers are also available that will prevent backflow.

Backflow can also occur in irrigation or lawn sprinkler systems. Fertilizers or pesticides applied by injection into the irrigation water can be pulled back into the water supply. It is a safe practice as long as backflow prevention devices are properly installed and maintained.

### **Seal Abandoned Wells**

A well is a direct, open channel from the surface to groundwater. Any material entering the well moves directly to the groundwater without any impediment.

An abandoned well should never be used to dispose of anything that could contaminate groundwater. Areas near abandoned wells should not be used as locations to store fertilizers, pesticides, fuel or other materials that can contaminate water. Old well casings are often cracked or broken and spilled materials can easily enter the well.

Properly sealing abandoned wells is recommended. Licensed well contractors can provide guidance in properly sealing old wells.

### **Inspect Wells and Test Water**

Regular, routine inspections can help detect problems before they threaten the water supply. Cracks in the well casing or in the grout which seals the space between the casing and bore hole walls are points to check. Also, be sure no possible contaminants are in the well house or near the well.

The owner of a private well is responsible for the safety of the water from it. Routine testing to ensure that no contamination has occurred is recommended. Bacteria are the most common contaminant of well water in Tennessee and in the nation. Periodic testing through the county health department for bacteria is suggested. Testing for nitrate and other minerals every three years or so is also suggested.

Testing for pesticides, petroleum products or other organic compounds is usually not needed unless you suspect contamination from these sources. These tests are available from commercial laboratories. If at all possible, specify the particular chemical you suspect; otherwise, costs of analysis can be very high.

Public water supplies are regulated and routinely tested. Additional private testing is usually not needed. If

you suspect a problem, contact your water utility for information and assistance.

### **Summary**

Analysis of well water sampling results in the Beaver Creek watershed underlines the importance of keeping contaminants away from the wellhead. The bottom line is, to protect drinking water, keep contaminants away from the well. Most of us take ample supplies of good fresh water for granted. Following the six well protection principals discussed in this factsheet can help ensure its quality.

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*This material is based upon work supported by the US Department of Agriculture, Extension Service, under special project number 91-EHUA 1-0063.*

<sup>1</sup>Madison and Burnett report nitrate (as nitrate) concentrations greater than 13 milligrams per liter (mg/L) may indicate effects of human activities. The public drinking water standard in Tennessee is 45 mg/L.

SP392F-5M-1/95 R12-2001-14-001-95



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