HOME* A*SYST
Home Assessment System

Chapter 10. Protecting Your Drinking Water Well

Keeping your well water free of harmful contaminants is a top priority for your health and the environment. This chapter helps you examine how you manage your well and how activities on or near your property may affect water quality. This chapter covers:

1. Well location
- How close is your well to potential pollution sources?
- How might your soil type affect water quality?

2. Well construction
- Do you know the age of your well, its depth and how it was installed?
- Is your well casing properly sealed?

3. Water testing and unused wells
- Have tests of your well water revealed any potential problems?
- Are abandoned wells on your property sealed to prevent movement of contaminants?

Michigan Groundwater Stewardship Program

MICHIGAN STATE UNIVERSITY EXTENSION

Why should you be concerned?

The two sources of drinking water are surface water and groundwater. In metropolitan Detroit, for example, more than 3 million urban and suburban residents depend on surface water for their municipal drinking water supply. This surface water is obtained from Lake Huron and the Detroit River. Nationwide and in Michigan, about 95 percent of rural residents use groundwater for their drinking water. Private wells, tapping into local groundwater sources, provide clean, safe drinking water (Figure 1). However, if these wells are improperly constructed or poorly maintained, they can provide a pathway for fertilizers, bacteria, pesticides or other toxins to contaminate the water supply. Once in groundwater, contaminants can flow from your property to a neighbor's well or from beneath a neighbor's property to your well.

These contaminants, which often have no odor or color, are difficult and expensive to remove. Your only options may be to treat the water after pumping, drill a new well or obtain water from another source.

Some rural residents use other water sources such as lakes, rivers or cisterns for their drinking water. Public health officials advise against using these unsanitary water sources for drinking water. Additional information on how to safeguard all water resources may be sought from local Extension educators, local conservation district staff members, state and federal environmental agencies, local health department offices and the library.

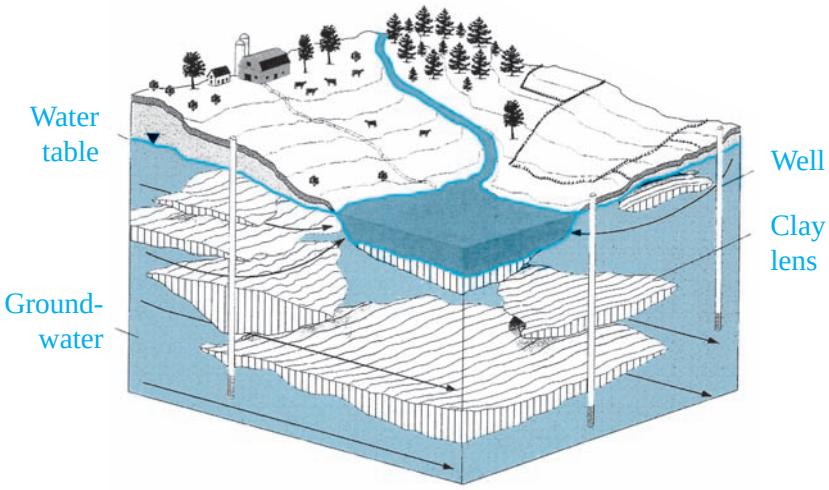


Figure 1: Cross-section of land showing land surface features, water table, clay and sand layers, and wells. *"Understanding Groundwater." Institute of Water Research/Center for Remote Sensing, MSU.*

Part 1 – Well Location

Your well's location in relation to other features on or near your property will determine part of your potential pollution risk. How near your well is to sources of pollution and whether the well is downhill (downgradient) from these sources are the primary concerns. At the end of Part 1, fill out the assessment table to determine your possible well location risks. The information below will help you answer the questions in the assessment.

What pollution sources might reach your well?

Groundwater is water below the land surface that completely fills the pore spaces of soils and void spaces of rock formations. Whether groundwater is just below the surface or hundreds of feet down, the location of your well on the land surface is very important. Installing a well in a safe place takes careful planning and consideration of such factors as where the well is located in relation to potential pollution sources. When possible, the well should be located where surface water (storm runoff, for example) drains away from it. If a well is downhill from an aboveground leaking fuel storage tank or an overfertilized farm field, it runs a greater risk of contamination than a well on the uphill side of these pollutant sources. In areas where the water table is near the surface, groundwater often flows in the same direction as surface water. Surface slope, however, does not always indicate the direction a pollutant might flow once it gets into groundwater. Changing the location or depth of your well may protect your water supply but not the groundwater itself. Any condition likely to cause groundwater contamination should be eliminated, even if your well is far removed from the potential source.

Most states require that new wells be located a minimum distance from sources of potential pollution (Figure 2). The Michigan Water Well Construction and Pump Installation Code provides minimum well isolation distances from various contamination sources and buildings. In general, it is best to provide as much separation as possible between your well and any potential contamination source—at least 50 feet. Additional distances are needed for some contamination sources. For example, agricultural chemical/fertilizer storage or preparation areas should be set 150 feet from any residential water well, and fuel storage (both buried and aboveground tanks greater than 1,100 gallons without secondary containment) should be 300 feet from the well. Separating your well from a contamination source may reduce the chance of pollution, but it does not guarantee that the well will be safe.

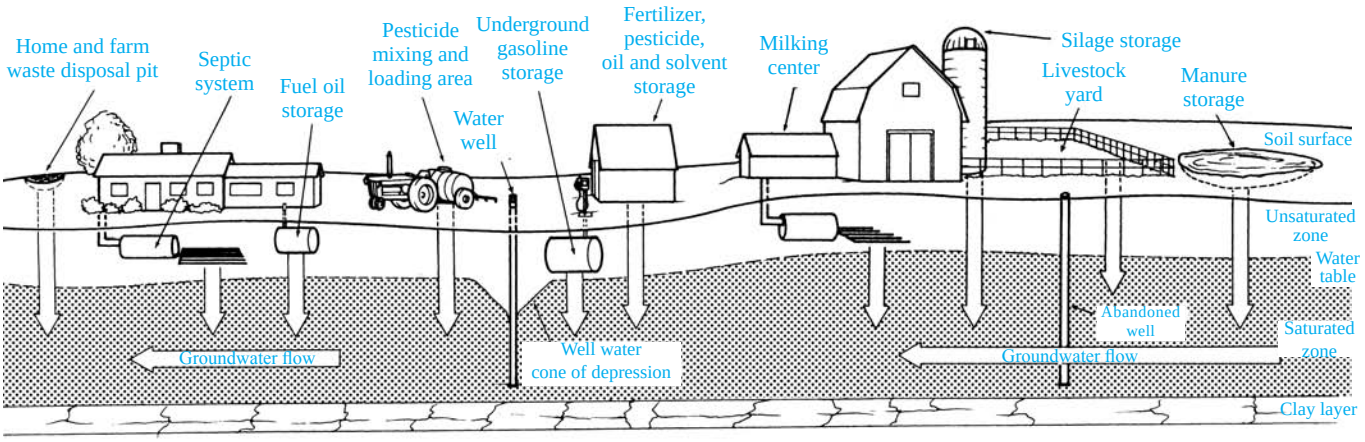


Figure 2: Illustration of possible sources of groundwater contamination. Common to most farmsteads are sources of nitrate contamination such as manure, milking center wastewater and nitrogen fertilizers, which must be properly managed to protect groundwater. Likewise, city dwellers have to consider their animal waste, chemical storage and fertilizers to protect their city water supply.

What's underground? Soil and bedrock type, distance to the water table

Pollutant risks are greater when the **water table** (top of the saturated area) is near the surface because contaminants do not have to travel far to reach the water. Contamination is more likely if soils are thin (a few feet above bedrock) or if they are highly porous (sandy or gravelly). If bedrock below the soil is fractured (has cracks that allow water to seep down rapidly, such as limestone) then groundwater contamination is more likely. Check with neighbors, well logs from your local health department, local farmers or well drilling companies to learn more about what's under your property.

✔ Assessment 1 – Risks Related to Well Location

Use the following assessment to rate your well location risks. For each question, put your risk level (low, medium or high) in the column labeled "Your risk." Although some choices may not correspond exactly to your situation, choose the response that fits best. Refer to Part 1 above if you need more information to complete the table.

	Low risk/ recommended	Medium risk/ potential hazard	High risk/ unsafe situation	Your risk
Position of well in relation to pollution sources	Well is uphill (upgradient) from all pollution sources. Surface water doesn't reach well or is diverted.	Well level with or uphill from most pollutant sources. Some surface water runoff may reach well.	Well located downhill (downgradient) from pollution sources or in pit or depression. Surface water runoff reaches well.	
Separation distances between private well and pollution sources	Meets or exceeds all state minimum required distances: 10' - surface water 50' - septic tank, drainfield, animal yard, fuel storage 150' - pesticide/fertilizer storage or mixing	Meets minimum distance requirements for some but not all pollution sources.	Does not meet minimum separation distances for most or all potential sources (required to be at least 50 feet from well).	
Soil type	Fine-textured soils such as clay loams and silty clay.	Medium-textured soils, such as loam.	Coarse-textured soils such as sands, sandy loam or gravel.	
Subsurface conditions	Water table deeper than 30 feet.	Water table at 20 to 30 feet.	Water table or fractured bedrock shallower than 20 feet.	

A boxed risk level indicates level required for Residential Environmental Assurance Program certification.

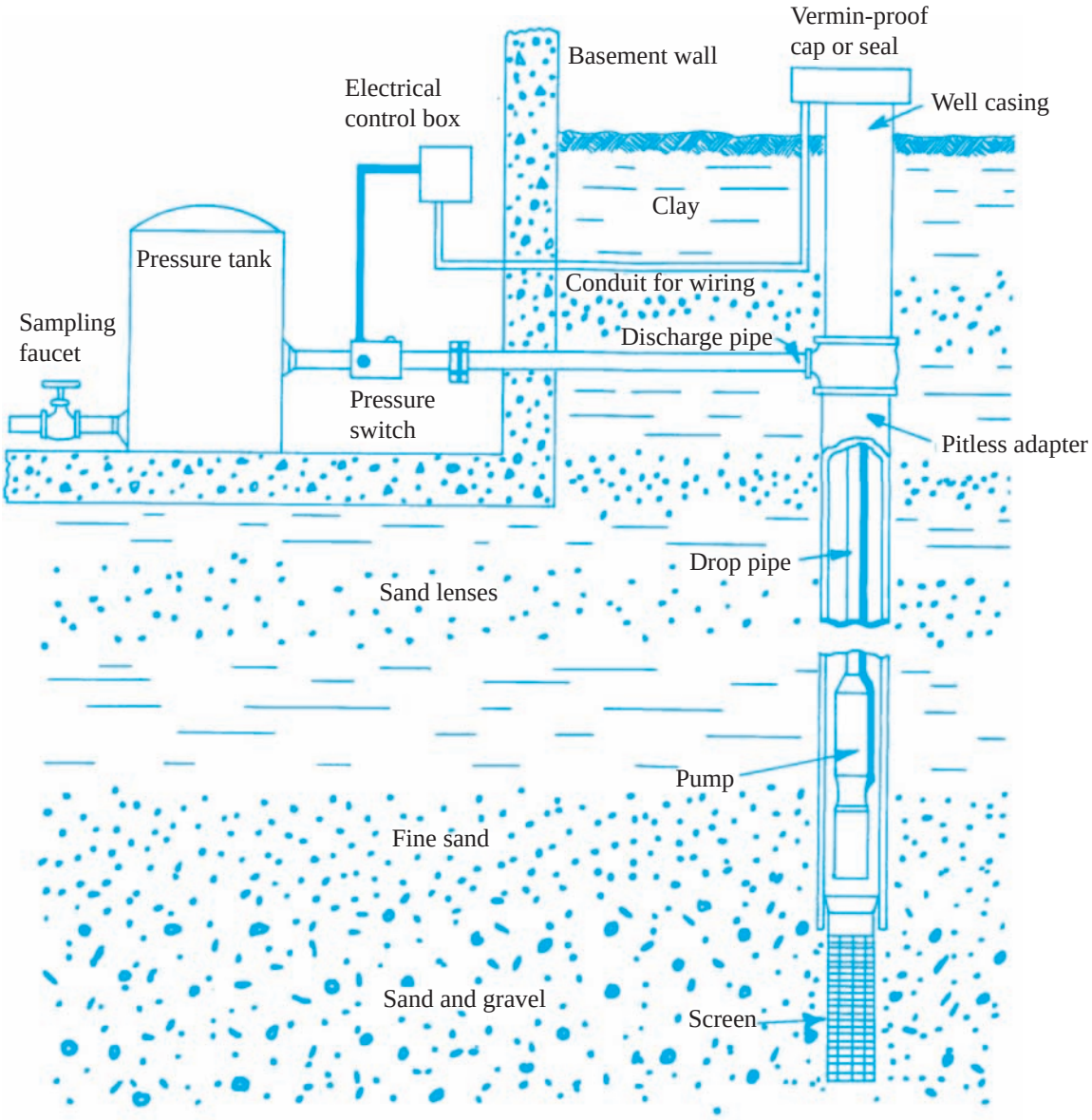
Responding to risks

Your goal is to lower your risks. Turn to the Action Checklist at the end of the chapter to record the medium and high risks you identified. Use the recommendations above to help you plan actions to reduce your risks.

Part 2 – Well Construction and Maintenance

Old or poorly designed wells increase the risk of groundwater contamination by allowing surface water to reach the water table without being filtered through soil. If a well is located in a depression or pit or if it is not properly sealed and capped, surface water carrying nitrates, bacteria, viruses, pesticides and other pollutants may flow directly into your drinking water.

You wouldn't let a car go too long without a tune-up or oil change. Your well deserves the same attention. Good maintenance means keeping the well area clean and accessible, keeping pollutants as far away as possible, and periodically having a qualified well driller or pump installer check the well when problems are suspected. Be sure to check periodically that the well cap and vent are intact and secure. At the end of Part 2, fill out the assessment to determine risks related to well design or condition.



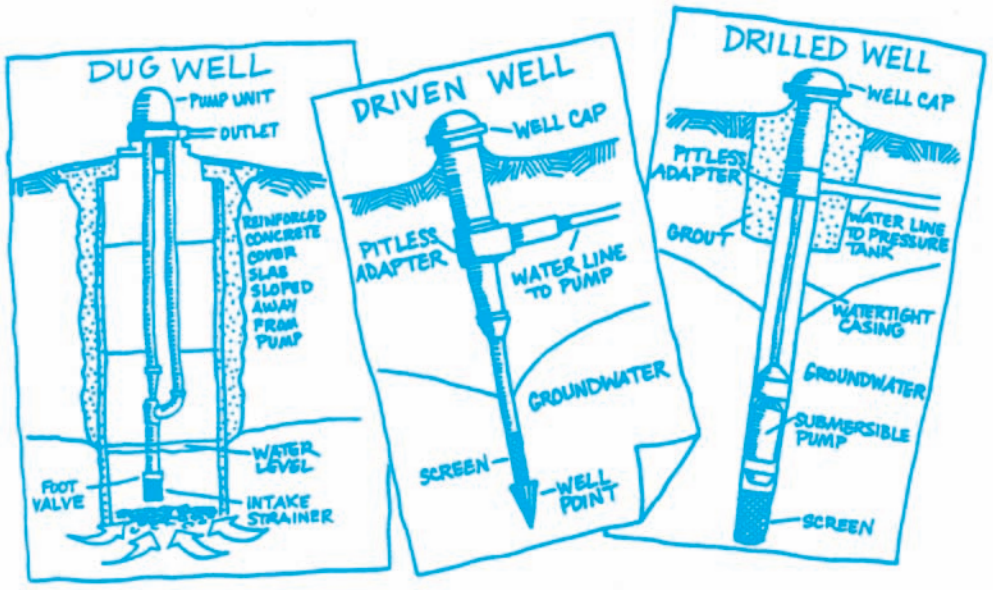
Adapted from "Planning Your Well: Guidelines for Safe, Dependable Drinking Water." University of Illinois-Champaign Cooperative Extension, 1998.

How old is your well?

Well age is an important factor in predicting the likelihood of contamination. Wells constructed more than 70 years ago are likely to be shallow and poorly constructed. Older well pumps are more likely to leak lubricating oils, which can get into the water. Older wells are also more likely to have thinner casings, which may be cracked or corroded. Even wells with modern casings that are 30 to 40 years old are subject to corrosion and perforation. If you have an older well, you may want to have it inspected by a registered well driller.

What type of well do you have?

A **dug well** is a large-diameter hole, usually more than 2 feet wide, and constructed by hand or with a large boring machine. Dug wells are usually shallow and poorly protected from surface water runoff. They pose a high public health and safety risk. **Driven-point (sand point) wells**, which pose a moderate to high risk, are constructed by driving lengths of pipe into the ground. These wells are normally around 2 inches in diameter and less than 50 feet deep and can be installed only in areas with loose soils such as sand. All other types of wells are **drilled wells** which, for residential use, are commonly 4 to 8 inches in diameter.



Are your well casings and well cap protecting your water?

Well drillers install a steel or plastic pipe casing to prevent collapse of the hole after drilling. The space between the casing and the sides of the hole offers a direct channel for surface water—and pollutants—to reach the water table. To seal off this channel, drillers fill the space with **grout** (cement or a special type of clay called bentonite). Older drilled wells may not be grouted. If your water turns cloudy after a heavy rain or spring thaw, the space surrounding the well casing may have a defective grout seal. You should visually inspect your well casing for holes or cracks or space around the casing. Examine the part that extends from the ground. If you can move the casing around by pushing it, you may have a problem with your well casing's ability to keep out contaminants. Sometimes, damaged casings can be detected by listening for water running down into the well when the pump is not running. If you hear water, there might be a crack or hole in the casing, or your casing may not reach down to the water table. Either situation is risky.

The depth of casing required for your well depends on the depth to groundwater and the nature of the soils and bedrock below. A minimum of 25 feet of casing is required in Michigan for all wells. The well cap should be firmly attached to the casing, with a screened vent allowing only air to enter. Newer well caps provide protection from insects with a screened vent and gasket. They can quickly be identified by the presence of vertical screws. Older caps have no screen or gasket and have screws going horizontal to the well casing. The cap must be at least 1 foot above the soil surface. Wiring for the pump should be secured in an electric conduit pipe.

Is your well shallow or deep?

As rain and surface water soak into the soil, they may carry pollutants down to the water table. In some places, this process happens quickly—in weeks, days or even hours. Local geologic conditions determine how long this takes. Shallow wells, which draw from groundwater nearest the land surface, are most likely to be affected by local sources of contamination. However, deep wells do not guarantee protection from contamination.

Does your water piping system have backflow prevention?

Backflow of contaminated water into your water supply can occur from back pressure and/or back-siphonage. This can happen in a public or private water system. If the drinking water system is connected directly to another piping system or process (cross-connection) that operates at a higher system pressure, back pressure backflow can occur. Typical causes of back pressure backflow include: nonpotable piping systems equipped with pumping equipment such as irrigation well interconnected with a potable system, steam or hot water boilers, or exchange heaters. Anti-backflow devices should be installed on all faucets with hose connections. This reduces the risk of contaminated water reentering your plumbing from laundry, appliances, sinks, swimming pools, irrigation systems, hot tubs and garden hoses. Inexpensive devices for faucets with hose connections can be purchased from plumbing suppliers. Contact your local plumbing inspector for information on the proper back-siphoning device for your situation.

When was your well last inspected?

Well equipment doesn't last forever. Every 10 to 20 years, your well will require mechanical attention from a registered well driller or pump installer. In addition to water test results, you should keep well construction details as well as the dates and results of maintenance visits for the well and pump. It is important to *keep good records* so you and future owners can follow a good maintenance schedule. Your water well record (well log) can be obtained from your local health department or from the company that drilled your well. If neither of these sources has your well record on file, you can obtain records from the online Michigan Department of Environmental Quality Scanned Water Well Record Retrieval System (www.deq.state.mi.us/well-logs/). This system contains water well records from 1965 through 1999. Some historic records for wells submitted prior to 1965 may also be available. Newer well records are accessible online at http://wellviewer.rsgis.msu.edu/default.htm.

✔ Assessment 2 – Risks Related to Well Type and Condition

Use the following assessment to rate risks related to well type, well casing and backflow. For each question, put your risk level (low, medium or high) in the column labeled "Your risk." Although some choices may not correspond exactly to your situation, choose the response that fits best. Refer to Part 2 above if you need more information to complete the table.

	Low risk/ recommended	Medium risk/ potential hazard	High risk/ unsafe situation	Your risk
Well age	Less than 20 years old.	20 to 70 years old.	More than 70 years ago.	
Well type	Drilled well.	Driven-point (sand point).	Dug well.	
Casing height above land surface	At least 12 inches above the surface.	At surface or up to 8 inches above.	Casing below surface or in pit or basement.	
Well casing and cap	Grouted, drilled well. No holes or cracks. Cap tightly attached. Cap with gasket and screened vent (vertical screws present).	Driven, ungrouted well. No holes or cracks visible. Cap without gasket or screened vent (horizontal screws present).	Ungrouted drilled or dug well. Holes or cracks in casing visible. Cap loose or missing. Running water can be heard.	
Casing depth	Casing extends more than 100 feet below water table.	Casing extends 10 to 100 feet below water table.	Casing extends less than 10 feet below table.	
Backflow prevention	Anti-backflow devices installed on faucets with hose connections. No cross-connections between water supplies.	No anti-backflow devices. No cross-connections between water supplies.	No anti-backflow devices. Cross-connections between water supplies.	
Well inspection and tune-up	Well inspected within the past 10 years.	Well inspected 10 to 20 years ago.	Last well inspection unknown, or done over 20 years ago.	

A boxed risk level indicates level required for Residential Environmental Assurance Program certification.

Responding to risks

Your goal is to lower your risk. Turn to the Action Checklist at the end of the chapter to record the medium and high risks you identified. Use the recommendations in Part 2 to help you plan actions to reduce your risks.

Part 3 – Water Testing and Unused Wells

Water testing helps you monitor water quality and identify potential risks to your health. Contaminants may enter drinking water from many sources. One important source is old, abandoned wells which, if improperly sealed, can provide a direct route for contaminants to enter groundwater. It is important to identify older or abandoned wells and take appropriate action. Although this part of the chapter focuses on local sources, contaminants can also come from sources outside your property boundaries. At the end of Part 3, fill out the assessment to determine water quality risks related to water contaminants and old wells.

When was your water last tested?

At a minimum, your water should be tested each year for the two most common indicators of trouble: coliform bacteria and nitrates. If you haven't had a full-spectrum, comprehensive water test, then you don't know the basic characteristics of your water. A more complete water analysis for a private well will tell you about its hardness, alkalinity, conductivity, iron, nitrate, sodium and chloride content. In addition, you may choose to obtain a broad-scan test of your water quality for other contaminants, such as pesticides. A good source of information is your local health department or even your neighbors. Ask them what their tests have revealed.

What contaminants should you look for?

You should test for the contaminants that might be found at your location. For example, if you have lead pipes, soldered copper joints or brass parts in the pump, test for the presence of lead. Test for volatile organic compounds (VOCs) if there has been nearby use or a spill of oil, liquid fuels or solvents.

Pesticide tests, though expensive, may be justified if your well has high nitrate levels—more than 10 milligrams per liter (mg/l) of nitrate-nitrogen (NO_3-N) or 45 mg/l of nitrate (NO_3)—and if pesticides are used routinely in the immediate area. Test also if a pesticide spill has occurred near the well. Pesticides are more likely to be a problem if your well is shallow, has less than 15 feet of casing below the water table, or is located in sandy soil and is downslope from irrigated lands where pesticides are used.

In some areas of Michigan, there are certain concerns to be aware of that may be potential sources of drinking water contamination. Near Alpena, Rogers City, Monroe and parts of the Upper Peninsula in special geographic areas called karsts, the underlying bedrock is made up of carbonate rocks such as limestone (Figure 3). Over time, the rock may dissolve away, creating pathways for contaminants to reach drinking water sources. In other areas, naturally occurring arsenic can be found in groundwater. Southeastern Michigan is one such area (Figure 4).

In certain instances—for example, during an emergency when water supplies might have been contaminated with bacteria—local health departments may advise residents to boil water before drinking it. This is often called a boil water advisory. Boiling water is not advised if the water is contaminated with nitrates because boiling it will concentrate the nitrates, making it more harmful

Figure 3: Bedrock areas of concern. *"Understanding Groundwater." Institute of Water Research/Center for Remote Sensing, MSU.*

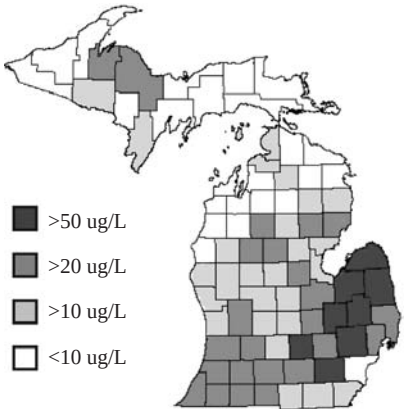


Figure 4: Michigan's groundwater arsenic levels by county. *Michigan Department of Environmental Quality.*

when consumed. This is a particular concern for pregnant women, infants, children or those who may be chronically ill. To be sure your water is safe, follow the guidelines by your local officials and your health department or visit www.epa.gov/safewater/faq/emerg.html for more information about disinfection of drinking water. You can seek further advice on water testing from your county MSU Extension office or health department. You should test your water more than once a year if someone in the household is pregnant or nursing; unexplained illnesses occur in the family; your neighbors find a dangerous contaminant in their water; you note a change in water taste, odor, color or clarity; or you have a spill or backflow of chemicals or fuels into or near your well. Water can be tested by either public or private laboratories certified by the Department of Environmental Quality. Keep records of your results to monitor water quality over time.

Are there any unused or abandoned wells on your property?

Many properties have wells that are no longer used. Sites with older homes often have an abandoned shallow well that was installed when the house was built. If not properly filled and sealed, these wells can provide waterborne pollutants a direct channel to groundwater. Contact your local health department's environmental health division for information on closing abandoned wells and the form for recording the closure. A registered well driller may be hired to close these wells. Effective well plugging calls for experience with well construction materials and methods, as well as knowledge of the geology of the site. Costs will vary with well depth, diameter, difficulty in removing well parts in the casing and soil/rock type. The money spent sealing a well will be a bargain compared with the potential costs of cleanup or the loss of property value if contamination occurs.

✔ Assessment 3 – Water Testing and Abandoned Wells

Use the following assessment to rate risks related to well type, well casing and backflow. For each question, put your risk level (low, medium or high) in the column labeled "Your risk." Although some choices may not correspond exactly to your situation, choose the response that fits best. Refer to Part 3 above if you need more information to complete the table.

	Low risk/ recommended	Medium risk/ potential hazard	High risk/ unsafe situation	Your risk
Water testing	Water test consistently meets standards for bacteria, nitrate and other contaminants. No change in color, odor, taste or clarity.	Some tests do not meet standards.	No water testing done or results unsatisfactory in meeting standards. Water discolored after rainstorm or during spring melt. Noticeable changes in color, odor and taste.	
Unused wells	No unused wells present or they have been properly sealed.	Unused wells not sealed but capped and isolated from contaminants.	Unused, unsealed well in poor condition and/or near pollution sources, or uncapped.	

A boxed risk level indicates level required for Residential Environmental Assurance Program certification.

Responding to risks

Your goal is to lower your risk. Turn to the Action Checklist on the next page to record the medium and high risks you identified. Use the recommendations above to help you plan actions to reduce your risks.

✔ Action Checklist

When you finish the assessment tables, go back over the questions and list below every high and medium risk you identified. For each of these risks, write down the improvements you plan to make. Use recommendations from this chapter and from other resources. Pick a target date to keep you on schedule for making the changes. You don't have to do everything at once, but try to eliminate the most serious risks as soon as you can. Often it helps to start with inexpensive actions first.

Write all high and medium risks here.	What can you do to reduce the risk?	Target date for action:
Example: Water hasn't been tested for 10 years. Smells different than it used to.	Have sample tested. Contact local health department for laboratory test bottles.	One week from today: June 15

Resources

Drinking water quality standards:

Michigan Department of Environmental Quality Drinking Water Bureau
517-355-8184; www.michigan.gov/deq

U.S. Environmental Protection Agency Safe Drinking Water Hotline
1-800-426-4791 (toll-free); www.epa.gov/safewater

National Drinking Water Clearinghouse
www.nesc.wvu.edu/ndwc/ndwc_index.htm

U.S. Geological Survey Michigan Water Science Center
http://mi.water.usgs.gov

Drilling and sealing wells: Contact your local well driller, county health department or the Michigan Department of Environmental Quality Water Bureau (517-241-1413).
Plugging Abandoned Wells. MSU Extension bulletin WQ40.

Groundwater, geology and locating wells: Contact the Michigan Department of Environmental Quality, Office of Geological Survey (517-241-1515), your local conservation district, the county health department or the Groundwater Mapping website (gwmap.rsgis.msu.edu). You can also check this website or with the health department to obtain well logs.

Well water testing: Contact the environmental health division of your local health department, your county MSU Extension office or certified private testing laboratories.

This chapter was written by Bill McGowan, Agriculture/Water Quality Extension, University of Delaware Cooperative Extension, and adapted for Michigan by Lois Wolfson, Ruth Kline-Robach, Ted Loudon, Roberta Dow and Jim Bardenhagen, Michigan State University Extension. Updated in 2008.