

PROTECTING GROUNDWATER THROUGH AGRICULTURAL BEST MANAGEMENT PRACTICES

A number of agricultural practices can contribute to groundwater pollution, if not properly managed. Contamination sources on a farm may include pesticides, fertilizers, animal waste, and underground storage tanks. This information sheet provides a general overview of some agricultural practices that can impact groundwater, discusses factors that can help determine the impact these practices will have on groundwater, and outlines best management practices to prevent groundwater contamination from agricultural practices. For more detail on each of these topics, see the [wellcare®](#) information sheets on [Proper Use and Disposal of Pesticides and Fertilizers](#) and [Protecting Groundwater by Managing Animal Waste](#).

Which Agricultural Practices Have an Impact on Groundwater?

- **Storage and Use of Pesticides and Fertilizers:** Improper storage, mixing, and application of pesticides and fertilizers may contribute to groundwater contamination.
- **Storage and Use of Animal Waste:** Nitrates from livestock production, feedlots, animal waste and other sources can leach through the soil and reach the groundwater.
- **Use of Under- or Above-ground Storage Tanks:** Buried or above ground tanks used to store gasoline, diesel fuel, heating oil, and other petroleum products can leak petroleum into groundwater if not properly installed and monitored.

What Contaminants May be Found on a Farm?

The following potential groundwater contaminants may be found in agricultural areas:

- Nutrients (Nitrogen and Phosphorus)
- Pesticides
- Microorganisms (Pathogens)
- Organic Matter

Nutrients

The risk of nutrients such as nitrogen and phosphorus reaching groundwater depends on the nutrient and the type of soil. Phosphorus is not very soluble in water and rarely reaches groundwater except in areas with sandy, clay-free soil.

Unlike phosphorus, nitrogen is water soluble and rapidly converts to nitrate, which can contaminate groundwater unless it is used up by plants. High nitrate levels can lead to health problems for high-risk individuals, as well as for young livestock. For more information on health effects of nitrate, see the [wellcare®](#) information sheet on [Nitrate and Nitrite & Well Water](#). The amount of nitrate in groundwater can be managed by properly applying nitrogen in the forms of animal waste and chemical fertilizers. Proper application involves proper amounts, placement and timing to ensure maximum nutrient uptake by plants and crops. To determine the appropriate amount of manure to apply, you need to know the amount of nitrogen in your manure, the amount of nitrogen already available in the soil and the amount of nitrogen your crop requires. Laboratories are available that can test your soil and manure for nutrient content. Your [state or local Cooperative Extension Office](#) can provide you with a list of soil and manure testing laboratories in your area.

Nitrate is removed from soil in two ways. First, plants use it as a nutrient. The key to preventing nitrate contamination is to apply only as much fertilizer or manure as crops can use during the growing season. Again, soil testing is the key to knowing the proper amounts of manure or fertilizer to use. Second, some microbes can remove nitrate from wet soils, reducing the risk of nitrate contamination of groundwater beneath these soils. In well-drained soils, little nitrate will be removed once it leaches below the root zone, and careful fertilizer and irrigation management are essential to prevent contamination.

Pesticides

Pesticides are most likely to leach through sandy soils that contain little organic matter. Pesticide breakdown is slower in these soils because there are fewer microbes, and leaching can be rapid through the large soil pores. While the coarse texture of these soils cannot be changed, the ability to bind pesticides may be improved by building up the organic matter.

Microorganisms (Pathogens)

Microorganisms (pathogens) live in animal intestinal tracts and are excreted in manure. If they reach surface water, they can cause disease in humans and livestock. Groundwater is largely protected from contamination by pathogens and microorganisms because of the physical (filtration), chemical (adsorption) and biological (predation and natural die-off) processes that occur as surface water travels through soil.

Organic Matter

Manure also contains organic matter. Organic matter serves as a food source for microorganisms. As microorganisms break down organic matter, they consume oxygen. When large amounts of organic matter reach streams or ponds, the microorganisms use all the dissolved oxygen in the process of breaking it down. Low levels of oxygen can kill fish and other aquatic life.

What Factors Determine How Farmstead Operations will Impact Groundwater?

The impact agricultural practices have on groundwater depends partly on the physical characteristics of the farmstead, including soil type, bedrock characteristics and depth to groundwater. Evaluating the site properties is an important step in protecting groundwater. To reduce agricultural impacts on groundwater quality, identify high risk environments and manage nutrients carefully in these areas. High risk environments include:

- Sandy soils
- Shallow-rooted crops
- High rainfall areas or areas with excess irrigation
- Shallow unprotected groundwater
- Wellheads

It is especially important to follow best management practices in these high-risk environments.

Soil and Water Quality

Soil can remove possible pollutants before they reach the groundwater. As water seeps through the soil toward groundwater, some pollutants become attached to the soil particles. Small organisms that naturally live on those soil particles digest the pollutants, changing them into harmless materials.

The amount of organic matter in the soil is also important. Soils high in organic matter provide an excellent environment for chemical and biological breakdown of many contaminants before they reach groundwater.

However, even in areas with ideal geologic conditions, poor management practices can lead to groundwater contamination, particularly under heavy rainfall conditions when runoff may occur.

What is Runoff?

Runoff occurs when the soil receives more water, from rain or irrigation, than it can hold. Farm areas where animals live can be more susceptible to runoff, such as when they are overgrazed or not covered with grass. Groundwater can be polluted when runoff containing bacteria (from manure), dissolved nutrients (from commercial fertilizers and manure) or pesticides move through the soil to the groundwater.

The rate at which water can enter the soil is known as the infiltration rate. Some areas around buildings, where the soil is compacted by animal or machine traffic, have very low infiltration rates. These areas produce runoff under most storm conditions. Roofs and paved areas have no infiltration. These areas increase the amount and rate of water that runs off nearby areas.

How Can I Protect Groundwater from Agricultural Practices?

Best Management Practices (BMPs) optimize crop growth and protect groundwater at the same time. Many BMPs can be implemented at little cost and may even reduce operational costs in the long term. To be most effective, BMPs should be used over a period of time. The following chart shows possible pollution problems on a farm and some BMPs to manage these problems:

Possible Pollution Problems	Best Management Practices
Domestic water wells located near livestock operations	<ul style="list-style-type: none"> Water wells should be located as far away as possible from potential pollution sources and these distances should meet or exceed all state, county or local requirements. Test water wells that are located near livestock operations for microorganisms, nitrate, total dissolved salts, and pH.
Unused or poorly sealed wells	<ul style="list-style-type: none"> Contact a licensed water well contractor to plug unused wells and repair poorly sealed wells.
Excessive pesticide use	<ul style="list-style-type: none"> Consider non-chemical pest control methods and prevention techniques. Use proper pesticide management and less toxic, rapidly degradable pesticides with low leaching potentials. See the wellcare® information sheet on <i>Proper Use and Disposal of Pesticides and Fertilizers</i> for more tips on proper use of pesticides, as well as procedures for storage and disposal of pesticides and their containers.
Excessive nutrients on a pasture	<ul style="list-style-type: none"> Collect and store manure in winter, then spread it on pastures when plants are actively growing. Consider split applications where appropriate. Apply manure and fertilizer based on crop needs as determined by soil testing. Apply nutrients at the root level. Consider crop rotation to recover nutrients left in the soil.
Manure deposited in streams or on stream banks	<ul style="list-style-type: none"> Use fencing to limit access to only small sections of streams. Use grass buffers between cropland and rivers to help slow runoff and filter pollutants from surface runoff. Provide alternate watering areas away from streams.

Possible Pollution Problems (continued)	Best Management Practices (continued)
Uncontained manure and mud in wet weather	<ul style="list-style-type: none"> • Cover stockpiled manure and bedding, especially in high rainfall areas. • Store manure at least 100 feet from domestic wells. • Direct clean runoff away from animal pastures, barns and manure storage piles. • Control grazing and keep livestock off pastures in the winter. Overgrazed pastures are potential sources of surface runoff and groundwater contamination due to compacted soils and lack of filtering vegetation. • See the wellcare® information sheet on Protecting Groundwater by Managing Animal Waste for more information on proper application and storage of manure.
Dead animal carcasses	<ul style="list-style-type: none"> • Follow local rules and regulations for managing dead animals. Dead animals should be taken care of promptly to reduce the risk of disease, rodents, odor or water pollution. Choices for managing animal deaths include by composting*, incinerating, approved burying, or removal by a commercial service. Disposal sites must be at least 100 feet from domestic wells or watercourses. Select composting and burial site so seasonal high water tables are no less than 2 feet below buried animals and the composting site. Cover buried animals with at least 2 feet of soil. <p><i>*Composting is practical for small animals, such as poultry and young pigs.</i></p>
Leakage or spills from storage tanks	<ul style="list-style-type: none"> • Follow Federal and state/local guidelines for tank location, design, installation, monitoring and closure.

Many state and local Cooperative Extension Offices have a wealth of information on these topics. To find your nearest Cooperative Extension Office, visit the U.S. Department of Agriculture Cooperative State Research, Education, and Extension Service website at <https://www.nifa.usda.gov/land-grant-colleges-and-universities-partner-website-directory>.

For More Information on Protecting Groundwater Through Agricultural Best Management Practices

Contact your licensed well contractor, local extension office, health department, state environmental agency, or the [wellcare® Hotline](#).



Information to help maintain and protect your water well system:

[wellcare®](#) is a program of the [Water Systems Council \(WSC\)](#). WSC is the only national organization solely focused on protecting the health and water supply of an estimated 23 million households nationwide who depend on private wells (according to the U.S. EPA).

This publication is one of more than 100 [wellcare®](#) information sheets available FREE at www.watersystemscouncil.org.

Well owners and others with questions about wells and well water can contact the [wellcare® Hotline](#) at 1-888-395-1033 or visit www.wellcarehotline.org to fill out a contact form or chat with us live!

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By joining the FREE [wellcare® Well Owners Network](#), you will receive regular information on how to maintain your well and protect your well water.

Contact us at 1-888-395-1033 or visit www.wellcarehotline.org to join!