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AGRICULTURAL EXTENSION SERVICE
SP484 J

TENNESSEE FARM•A•SYST

Assessing Your Livestock Manure Storage

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The goal of this *Farm•A•Syst* factsheet is to help you protect and improve the groundwater that supplies your drinking water as well as the ponds, lakes, rivers, and streams that make Tennessee beautiful.

The following questions are designed to help you pinpoint potential problem areas on your farmstead. These problem areas may contribute to the contamination of your drinking water if they are not managed properly.

If your answer to any of these questions is *YES*, or if you don't know the answer, you may have a high-risk situation in your home or on your farmstead. Refer to the fact section with the same number as that question (under the heading, "What you should know about . . .") for more information.

YES	NO	
❑	❑	1. Do you store manure in an earthen pit or lagoon that was not designed and approved by the Natural Resources Conservation Service, or NRCS?
❑	❑	2. Do you store manure in a silo storage structure that was not designed or approved by NRCS or that leaks?
❑	❑	3. Do you store manure (either short-term or long-term) in a location that is less than 100 feet from a well?
❑	❑	4. Do you stack manure on soil that has a coarse texture (such as sands or sandy loam), or that has limestone bedrock or a water table shallower than 20 feet?
❑	❑	5. Do you ever apply manure to the field when the ground is frozen, covered with snow, or saturated with water?
❑	❑	6. Do you ever apply manure to an area that is 100 feet or less from a water well, stream, pond, or sinkhole?
❑	❑	7. Do you ever apply manure to land without testing the soil to determine its nutrient needs, or the manure to determine its nutrient content?
❑	❑	8. Do you ever apply manure to the land without calibrating the spreader?

Don't be alarmed if you answered *YES* to many or even all of these questions. That does not automatically mean you have a water-quality problem. It may, however, tell you that change is needed to avoid potential problems. In the same way, answering *NO* to every question does not mean you are *not* at risk.

Why should you care?

Groundwater is the underground water that supplies wells and springs and recharges surface water bodies. It is the source of drinking water for many Tennesseans. Up to 20 million gallons of groundwater may be stored under the typical farmstead—stored within 100 feet below fertilizer and pesticide storage areas, fuel tanks, livestock pens, and septic systems, all potentially major sources of pollution. The management decisions you make on your farmstead can significantly affect the quality of your drinking water and your family's health. These decisions can also affect your potential legal liability and the value of your property.

Surface water includes bodies such as ponds, lakes, rivers, and streams. Besides their aesthetic and recreational value, they are often an important source of drinking water for livestock.

Storing livestock waste allows farmers to spread manure when conditions are right for nutrient use by crops. Accumulating manure in a concentrated area, however, can be risky to the environment and to human and animal health.

Facilities for manure stored in liquid form on the farmstead sometimes leak or burst, releasing large volumes of pollutants. Manure in earthen pits can form a fairly tight seal of organic matter that limits the potential of contaminants to **leach** (move *with water* down through soil), but seasonal filling and emptying can cause the seal to break down. Short-term solid-manure storage and abandoned storage areas can also be sources of groundwater contamination by nitrates. Manure can contribute nutrients and disease-causing organisms to both surface and groundwater. One of these nutrients, nitrate, causes health problems in infants under six months of age when it is found in high levels in drinking water. The U.S. Environmental Protection Agency (EPA) recommends an upper limit of 10 parts per million (ppm) for safe drinking water.

Young livestock are also susceptible to health problems from too much nitrogen. Levels of more than 10 ppm in the water supply may be harmful, especially in combination with high levels of nitrogen from feed sources.

Fecal bacteria in livestock waste can contaminate groundwater if waste seeps into nearby wells, causing such infectious diseases as dysentery, typhoid, and hepatitis. Organic materials, which may cause an undesirable taste and odor in drinking water, are not known to be dangerous to your health, but their presence does suggest that other contaminants are flowing directly into groundwater.

Farm•A•Syst is only for your own use and benefit. It is a voluntary program intended to provide general information about protecting and improving water quality. Information from a *Farm•A•Syst* assessment will not be collected by Extension or any other outside agency and should remain in your private records.

What you should know about . . .

1. Earthen storage pits

You should store manure in a clay-lined manure-storage facility constructed according to specific engineering standards, not simply in an excavation. These standards can be found in engineering handbooks, NRCS technical guides, or state regulations.

Liquid and semi-solid storage systems should be self-contained. Groundwater contamination can occur if the facility is not structurally sound and allows waste materials to seep into the soil. A threat to surface water exists if pits are not emptied frequently enough, causing wastes to flow over the top of the structure. Liquid storage systems require gravity or the use of pumps and pipes for moving wastes from the barn to the storage structure. These must be carefully installed and maintained to ensure that they do not leak.

Each time the pits are emptied, carefully check the walls to be sure that the lining materials have not been worn away by pit agitation.

Over time, repeated freezing and thawing, as well as wetting and drying, may cause the sidewalls of earthen pits to crack and erode, allowing wastes to seep into the underlying soil or geologic material. Earthworm channels can also allow wastewater to move

through the liner. Groundwater contamination will result if the soil does not have sufficient ability to break down contaminants as they leach. Evidence suggests that the life of earthen pits may be as short as ten years.

While seepage from pits is not always easy to recognize, there are some telltale signs:

*A properly designed structure has the capacity to handle wastes from a specific number of animals for a specific number of days. If a pit designed for 180 days of storage and receiving designated waste amounts has not needed pumping for a year, the pit is almost certainly leaking.

*Evaporation from liquid storage pits is minimal, particularly in manure from dairy cattle, which forms a crust when it is stored. If liquids have to be added before the pit can be agitated and pumped, it may be leaking. Monitoring wells installed upslope and downslope from the pit can confirm the seepage.

2. Aboveground storage structures

Certain site limitations, such as shallow soils, can make the installation of underground animal waste facilities impossible. Aboveground alternatives include the following:

- **concrete stave:** concrete panels bound together with cables or bolts and sealed between panels
- **poured-concrete structure:** poured concrete reinforced with steel (may be used by dairy farmers for a dry stack when covered)
- **glass-lined steel structure:** steel panels bolted together and lined inside and out with glass to provide **corrosion** (rust) protection

These structures should be liquid-tight and located on a concrete pad.

Each time they are emptied, carefully check steel and concrete structures for cracks or loss of water-tight seals. If breaks are apparent, repair them immediately.

3. Location relative to wells

Because fecal bacteria in livestock waste can contaminate groundwater, the location of livestock manure storage in relation to any well is an important factor in protecting the farm water supply. Temporary manure stacks and earthen storage facilities, under regulations established by the TDEC Division of Water Supply, are considered "animal pens or feedlots," which currently require a minimum distance of 100 feet from a well. For liquid-tight manure storage structures, the minimum separation distance should also be at least 100 feet.

Minimum separation distances apply to new well installation and to the distance from existing wells to new waste-storage facility construction. Existing wells are required by law only to meet separation requirements in effect at the time of well construction. However, you should make every effort to meet current regulations whenever possible, since they are based on more current knowledge about pollution risks to drinking water.

Observing these separation distances when siting a new facility is a good way to help protect your drinking water. Locating manure storage facilities downslope from the well is also important for the protection of your water supply. (For more information about separation distances, and how the condition of your well can affect the potential for contamination, see Factsheet #2, *Assessing Your Private Well*.)

While observing minimum separation distances may help to protect your own well, poorly designed or poorly maintained livestock waste-storage facilities can still contaminate the groundwater that supplies other local drinking water wells. Protecting your groundwater resources is important to help protect your neighbors' wells, as well as the drinking-water supplies of future generations.

The depth to the seasonal high water table or to fractured bedrock, as well as the soil type at the waste storage location, also influences the risk of well contamination.

The depth to the water table is sometimes available in the county soil survey, but this varies from county to county. Your county Extension agent or Natural Resources Conservation Service (NRCS) staff may also be able to help you gather this information.

4. Soil types and depth to groundwater

Soil types are very important in determining whether a contaminant breaks down harmlessly or leaches into groundwater. Because most of the breakdown of contaminants occurs in the soil, there is a greater potential for groundwater contamination in areas where contaminants are able to move quickly through the soil.

Sandy soils drain rapidly through large pores and have few clay particles, which attract some contaminants. Large amounts of rainfall can pass quickly through these soils and carry dissolved contaminants into groundwater. Clay soils, on the other hand, are made up of extremely small particles that slow the movement of water through the soil. Contaminants also stick tightly to clay surfaces.

While stuck to soil particles, contaminants are broken down by bacteria and other soil organisms, and by reactions with minerals and natural chemicals in the soil. Most chemical and biological breakdown takes place in the surface layers, where the soil tends to be warm, moist, well-aerated, and high in organic matter, providing an excellent environment for the chemical and biological breakdown of these contaminants.

The soil's natural purification capability is limited. Certain conditions, such as heavy rainfall or manure spills, may overload the soil's purification capacity, allowing contaminants to move through the soil relatively quickly. In such cases, the soil type and the distance a contaminant must travel to groundwater determine whether that contaminant actually reaches the groundwater. The thicker the soil above the groundwater, the more time the soil has to purify the water passing through it. This means there is less chance of contamination from the ground surface.

Bedrock geology also influences groundwater pollution when the aquifer is below the bedrock surface. The movement of contaminants in fractured rock or limestone is difficult to predict. It is extremely important to locate your manure storage site as far away as possible from any **sinkhole**, which is a depression that drains directly to groundwater through holes in the underlying limestone bedrock.

For more information on this subject, refer to *PB484 C, Assessing Your Farmstead Site.*

5. Timing of application to land

The timing of manure application is extremely important if conditions such as the type of soil or the depth to groundwater create an environmental hazard. Fall applications allow the most time for the manure to break down and make nutrients available for crop use. While this is generally beneficial, it can lead to water-quality problems if conditions on the site make the leaching of nitrogen a concern. Fall applications of manure are generally not recommended for coarse-textured soils.

Applying manure in the spring allows less time for nitrogen to leach before it is used by the growing crop. However, spring application also leaves less time for the decomposition of the manure, which releases important nutrients for the crop, and generally delays fieldwork and contributes to soil compaction if heavy equipment is used for application.

Many producers apply manure in the winter. While it is likely that some nitrogen will be lost in runoff because of frozen or saturated ground, the extra time allowed for manure to break down makes some nitrogen available for crop use. The potential for nutrient runoff during winter applications to frozen, sloping soils is high. If manure is applied to frozen soils and there is runoff from snowmelt or rain, contaminants in the manure will be carried with the runoff. This poses a risk to surface and groundwater.

6. Location of manure application

Manure applied within 100 feet of wells, streams, ponds, or sinkholes creates a hazardous situation. Manure can quickly contaminate surface or groundwater, and you should use extreme caution when applying it. Planting a grass filter strip between the field of application and the water source or sinkhole is recommended.

7. Application rates

Manure application rates should be based on satisfying crop nutrient requirements. Nitrogen is usually the determining factor in figuring application rates because of its tendency to leach. (Some states limit phosphorus application as well.) Recommended application rates are based on a nutrient analysis of your manure and a soil test. Crops generally produce better after light applications repeated several times than after a few heavy applications.

When estimating effective application rates, it is important to remember that a large portion of the nitrogen in liquid manure (typically 70 to 90%) is in the form of ammonium nitrogen. Some of the ammonia will vaporize during and immediately after application and will be lost into the atmosphere.

Also, nitrogen readily transforms from ammonia to nitrate in most soils. If nitrogen is overapplied and enough rain falls to cause percolation below the root zone, the nitrate concentration in groundwater may be elevated. Limit applications of manure to what the crop requires, especially in fields that are tile-drained.

8. Spreader calibration

Manure cannot be used effectively if you do not know how much you are applying. Calibrating your spreader periodically is a simple and effective way for you to make sure that you are properly using the nutrients in manure without risking harm to the environment.

Remember:

- Store manure in a clay-lined storage facility constructed according to accepted engineering standards.
- If you store manure in an earthen pit, be sure to empty the pit frequently enough so that waste does not flow over the top.
- When you empty the pit, check the walls for signs of erosion.
- Check the pipes from the barn to the storage structure periodically to ensure that they do not leak.
- Use a liquid-tight aboveground manure storage structure when soils do not permit an underground structure to be constructed.
- Make sure your manure-storage facility is at least 100 feet from any drinking-water well, stream, pond, or sinkhole.
- Base your manure application rates on the type of soil you have and the nutrient content of the manure. Never apply manure without conducting tests on both the soil and the manure.
- Plant a grass filter strip between the area of waste application and any water source or sinkhole.
- Apply manure in several light loads rather than a few heavy ones.

If you want more information . . .

Contact:

- Your county Extension office

- Tennessee Pork Producers Association
  1312 Central Court
  Hermitage, TN 37076
  (615)871-0610

- EPA Safe-Drinking-Water Hotline
  (M-F, 8:30 a.m.-5:00 p.m. EST)
  (800)426-4791

- Tennessee Department of Environment and Conservation (TDEC)
  Division of Water Pollution Control
  Field Offices

Memphis	(901)368-7939
Jackson	(901)661-6200
Nashville	(615)650-7240
Chattanooga	(423)634-5745
Knoxville	(423)594-6035
Johnson City	(423)854-5400

- Agricultural Nonpoint Water Pollution Control Fund
  Tennessee Department of Agriculture
  Division of Agricultural Resources
  P.O. Box 40627
  Melrose Station
  Nashville, TN 37204
  (615)360-0108

- Your local NRCS office

- Your local Soil Conservation District office

- Your local Farm Service Agency (FSA) office

Read:

- *Beef Housing and Equipment Handbook*. MWPS-6.
  Sheep Housing and Equipment Handbook. MWPS-3.
  Swine Housing and Equipment Handbook. MWPS-8.
  Dairy Housing and Equipment Handbook. MWPS-7.
  Livestock Waste Facilities Handbook. MWPS-18.

These publications are available from the Midwest Plan Service at

122 Davidson Hall
Iowa State University
Ames, IA 50011

•*Pork Industry Handbook*

Systems of Runoff Control. PIH 21.
Fertilizer Value of Swine Manure. PIH 25.
Controlling Odors from Swine Buildings. PIH 33.
Legal Guidelines for Swine Manure Management. PIH 35.
Lagoon Management. PIH 62.
Flushing Systems for Swine Buildings. PIH 63.
Swine Waste Management Alternatives. PIH 67.
Methane Gas from Swine Manure. PIH 76.
Pumping Liquid Manure from Swine Lagoons and Holding Ponds. PIH 91.
Gravity Drain Gutter Systems. PIH 95.
Scraper Systems for Removing Manure from Swine Facilities. PIH 105.

This publication is available from the University of Tennessee at

Swine Extension Office
P.O. Box 1071
Knoxville, TN 37901-1071

•*Animal Waste Management and Tennessee Agriculture.* PB 1459.
Swine Waste Management Alternatives. PB 1425.
Dairy Cattle Waste Management. PB 1422.
Preventing Water Contamination from Beef Cattle. PB 1426.

These publications are available from your University of Tennessee Agricultural Extension Service county office.

Download:

These sites on the World Wide Web (WWW) are good places to start when browsing the Internet for information about water quality:

•http://funnelweb.utcc.utk.edu/~utext
(University of Tennessee Agricultural Extension Service)

•http://www.epa.gov
(U.S. Environmental Protection Agency)

•http://www.usda.gov
(U.S. Department of Agriculture)

•http://h2o.usgs.gov
(U.S. Geological Survey)

•http://wwwdtnnsh.er.usgs.gov
(Tennessee division of USGS)

•http://hermes.ecn.purdue.edu:8001/server/water/water.html
(National Extension Water Quality Database Website, Purdue University)

•http://www.nppc.org/EnvironmentalSection/envmain.html
(National Pork Producers Council)

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