



# *Animal* **Manure Storage** *to* **Protect Groundwater**

**Kristine A. Uhlman**, Extension Program Specialist—Water Resources

**Diane E. Boellstorff**, Corresponding Author; Assistant Professor and Extension Water Resources Specialist

**Saqib Mukhtar**, Professor and Associate Department Head, Department of Biological and Agricultural Engineering

**Mark L. McFarland**, Professor and Associate Department Head, Department of Soil and Crop Sciences  
 The Texas A&M University System

If not managed properly, animal manure and process-generated wastewater can contaminate groundwater, which is the underground water that replenishes wells and springs. It is the source of drinking water for many Texans.

Millions of gallons of groundwater may be located under the typical home site, farm, or ranch. This water can be polluted by materials from fuel tanks, livestock pens, septic systems, and storage areas for manure, wastewater, fertilizers, or pesticides.

The management decisions you make on your property 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.

To protect your groundwater supplies, store manure and wastewater in an environmentally sound manner until you can apply it to land for crop production. The safety of storing large amounts of manure in one place for extended periods depends on:

- The physical and chemical characteristics of the soil in the storage area, as

well as those of the geologic materials underground

- The design and construction of the storage site, including the control of potential drainage and seepage

An animal feeding operation is a lot or facility where animals are held and fed for a total of 45 days or more in any 12-month period. Any feeding operation can qualify as a concentrated animal feeding operation (CAFO) if it significantly pollutes water resources. To operate, CAFOs must have permits from the Texas Commission on Environmental Quality (TCEQ).

CAFOs are defined according to the type and number of animals on a site. If you have more than 150 horses, 300 head of beef cattle, or 200 head of dairy cattle, contact the TCEQ to determine if you need a water-quality protection permit.

The requirements may differ by county; for example, Bosque, Comanche, Erath, Hamilton, Hopkins, Johnson, Rains, and Wood Counties allow fewer livestock on site than do other Texas counties.

Texas law requires that a water well-head be separated from any livestock yard, feeding operation, or manure storage and

**Table 1.** Questions to help landowners determine whether the storage of livestock manure may be threatening their well water.

YES	NO	QUESTIONS
<input type="checkbox"/>	<input type="checkbox"/>	1. Do you store animal manure and wastewater on your property for more than 90 days?
<input type="checkbox"/>	<input type="checkbox"/>	2. Do you store manure and wastewater on your property for shorter periods (30 to 90 days)?
<input type="checkbox"/>	<input type="checkbox"/>	3. Do you store manure and wastewater closer than 150 feet from a water well?
<input type="checkbox"/>	<input type="checkbox"/>	4. Do you use lagoons or basins for manure and wastewater storage?
<input type="checkbox"/>	<input type="checkbox"/>	5. Do you know how to have manure tested and how to calculate the appropriate land application rates?
<input type="checkbox"/>	<input type="checkbox"/>	6. Are any abandoned manure and wastewater storage facilities on your property?

use area by at least 150 feet. However, to protect your well water, also adopt management practices that further reduce the potential for contamination.

The questions in Table 1 may help you identify potential risks associated with storing animal manure and wastewater. Many of these situations can lead to contamination of your drinking water.

If you answer *yes* or do not know the answer to any question, you may have a high-risk situation on the property. Information on how to address each question follows.

### **1. Do you store animal manure and wastewater on your property for more than 90 days?**

Animal manure can be stored in solid, slurry, or liquid states:

- **Solid** manure is stacked against walls and on slabs.
- **Slurry** is pumped into containment areas.
- **Liquid** manure is held in tanks or manure storage ponds or lagoons, where some manure solids may settle out and accumulate in the bottom as sludge.

Liquid and slurry storage systems are self-contained. Manure and wastewater can contaminate groundwater if the storage systems are not structurally sound or are not emptied when needed.

Liquid storage systems use pumps and pipes or flushed manure channels to convey manure and wastewater from the barn and alleys to the storage structure. These must be installed properly and main-

tained carefully to ensure that they do not leak or overflow.

Each time a steel or concrete structure is emptied, carefully check it for cracks or leaks in seals that should be watertight. Repair all damage immediately. Likewise, check the embankments and bottom of emptied manure storage basins to make sure that the liner materials are not, damaged, cracked or eroded.

Although seepage from in-ground manure and wastewater storage facilities is not always easy to recognize, there are some telltale signs. A pit may be leaking if:

- Liquids must be added to the wastewater before it can be agitated and pumped. A crust should form over a liquid storage pit, which will minimize evaporation.
- The pit does not fill to the level that it was designed to reach in a specific period. For example: A pit was designed to store manure from a set number of animals for 120 days. It may be leaking if it receives the designated manure amounts but does not fill to the design level in 120 days.

Some solid manure facilities are designed to allow seepage from the stack. They must collect and treat the waste seepage. Do not use them on sites with coarse-textured soils, fractured bedrock, or shallow water tables.

The best way to handle seepage is to channel it into a watertight holding pond or storage tank. If a holding pond cannot be built, another option is to erect a roof over the manure storage structure to keep

rain out of the stack. Roofed storage systems must have extra bedding to absorb and retain the liquid part of the manure.

## **2. Do you store manure and wastewater on your property for shorter periods (30 to 90 days)?**

Short-term (usually 30 to 90 days) storage facilities allow producers to hold manure and wastewater when:

- Bad weather makes applying the manure unfeasible
- Crops are growing and the land is unavailable for applying manure
- Not enough land is available to handle frequent hauling and utilization of manure
- There is not enough time to apply all the manure

Stacking manure in or near fields even short-term is not recommended. No matter how it is done, the exposed storage can contaminate surface water and groundwater. If you stack manure in fields often, build a short-term storage facility.

Another disadvantage of short-term storage is that the manure must be handled twice. However, short-term storage structures can be designed to facilitate handling as well as effectively protect surface water and groundwater.

To store manure for extended periods, open housing such as a pole shed is often used. The roof will keep rain off the manure. These sheds are relatively safe for water quality if:

- They are protected from surface water runoff
- Enough bedding is provided to absorb liquids and reduce seepage
- They are cleaned as often as possible

In bad weather or busy work periods, do not scrape the manure into piles in the animal lot. It poses risks to herd health and water sources. Instead, haul the manure to a long-term storage facility.

Compared to short-term techniques, long-term storage practices and structures can better protect water quality and handle unplanned events such as major storms.

## **3. Do you store manure and wastewater closer than 150 feet from a water well?**

Texas regulations require that all animal manure and wastewater storage facilities be at least 150 feet from a water well. However, to keep the farm's water

supply safe, a separation distance of 250 feet or more from the well is strongly recommended.

For temporary manure stacks and earthen storage facilities, the minimum separation distance should be at least 250 feet.

Make every effort to meet the current recommendations and exceed the regulations whenever possible.

## **4. Do you use lagoons or basins for manure and wastewater storage?**

The TCEQ implements the regulations governing CAFOs. Even if your lagoons or holding ponds are not subject to CAFO rules, following them can protect your groundwater from seepage.

TCEQ regulations require that CAFO wastewater retention facilities be made of compacted or original soil that allows less seepage than would 1.5 feet of soil that is clayey and has a hydraulic conductivity of  $1 \times 10^{-7}$  cm/sec, as designed and documented by a licensed Texas professional engineer.

Also, fence any animal manure and wastewater storage structures that may create a safety hazard for animals and humans.

For more information on lagoon management, see the Texas A&M AgriLife Extension Service publications *Proper Lagoon Management to Reduce Odor and Excessive Sludge Accumulation* (E-9) and *Closure of Lagoons and Earthen Manure Storage Structures* (B-6122).

## **5. Do you know how to have manure tested and how to calculate the appropriate land application rates?**

If managed properly, manure can safely be applied to the land to provide nutrients for crops. Apply solid and liquid manure to land using rates and methods that prevent it from polluting surface water and groundwater.

Stored manure can be easily tested to determine its nutrient levels. When taking samples of manure, make sure that they are representative of the source. Collect and thoroughly mix at least 10 subsamples to produce one composite sample for analysis.

Have the soil and manure analyzed so you can provide the nutrients that the crop needs. Do not apply more manure than the crop needs. Credit the manure nutrients in the fertilizer program for the field.

Instructions for collecting soil samples are available in the Texas A&M AgriLife Extension Service publication titled, *Testing Your Soil: How to Collect and Send Samples* (E-534).

For more information, see the AgriLife Extension publications *Managing Crop Nutrients through Soil, Manure and Effluent Testing* (E-536) and *Using Animal Manure and Wastewater for Crops and Pastures: Know and Take Credit for your N, P and K* (E-47).

## 6. Are any abandoned manure and wastewater storage facilities on your property?

Completely empty all abandoned storage structures. Remove the liners of earthen manure and wastewater storage facilities to a depth of about 2 feet and spread them over disposal areas. Fill and level the remaining hole.

Also remove the manure packs from structures and lots that are no longer used, and apply the manure to land at agronomic rates. If manure is stacked in fields, remove it as soon as conditions permit.

Contaminants in the well water may be odorless, tasteless, and invisible to the naked eye. To detect any contamination, have your well water tested every year. Have it analyzed for nitrates and *E. coli* contamination, the most likely constituents to pollute groundwater from manure handling. The *Texas Well Owner Network: Texas Well Owner's Guide to Water Supply* recommends well water treatment options if water quality has been compromised.

You can be fined for any significant surface water or groundwater contamination, and the TCEQ could require corrective measures. Contact the local Natural Resources Conservation Service office or your county Extension agent for information about local ordinances and state regulations.

## Summary

Follow these management practices to help prevent stored animal waste from contaminating your groundwater:

- Store manure and wastewater in facilities built according to accepted engineering standards.
- Empty liquid manure pits often enough to prevent waste from flowing over the top.
- Check pipes, manure pits, storage structures, and other storage or conveyances for signs of leaks or deterioration.

- Make sure that your manure storage facility is at least 150 feet (preferably 250 feet) from any water well, stream, or pond.
- Calculate your manure and wastewater application rates according to the results of soil and manure tests and the needs of the crop to be grown.

## For more information

- Assessing Your Livestock Manure Storage*. By G. E. Conatser. 1996. University of Tennessee–Knoxville, SP484 J, 6 pp.
- Closure of Lagoons and Earthen Manure Storage Structures*. By S. Mukhtar and J. D. Walker. 2002. Texas A&M AgriLife Extension Publication B-6122, 12 pp.
- Concentrated Animal Feeding Operations (CAFO) Water Quality General Permit*. Texas Commission on Environmental Quality (TCEQ) Water Quality Division. Phone: 512.239.4674. <http://www.tceq.texas.gov/permitting/wastewater/cafo/cafo.html>.
- Design and Construction Guidelines for Considering Seepage from Agricultural Waste Storage Ponds and Treatment Lagoons*. U.S. Department of Agriculture Soil Conservation Service. Technical Note 716. 1993. 37 pp. <http://www.epa.gov/region6/6en/w/cafo/tech716.pdf>.
- Managing Crop Nutrients through Soil, Manure and Effluent Testing*. By M. L. McFarland, T. L. Provin and S. E. Feagley. 1998. Texas A&M AgriLife Extension publication E-536, 6 pp.
- Proper Lagoon Management to Reduce Odor and Excessive Sludge Accumulation*. By S. Mukhtar. 1999. Texas A&M AgriLife Extension publication E-9, 2 pp.
- Testing Your Soil: How to Collect and Send Samples*. By T. L. Provin and J. L. Pitt. 1999. Texas A&M AgriLife Extension publication E-534, 4 pp.
- Texas Ground Water Protection Committee: <http://www.tgpc.state.tx.us/index.php>.
- Texas Well Owner Network: <http://twon.tamu.edu/>.
- Texas Well Owner Network: Texas Well Owner's Guide to Water Supply*. By K. Uhlman, D. Boellstorff, M. L. McFarland, B. Clayton, and J. W. Smith. 2013. Texas A&M AgriLife Extension publication B-6257, 96 pp.

TEX-A-SYST: *Reducing the Risk of Groundwater Contamination by Improving Livestock Manure Storage and Treatment Facilities*. By B. L. Harris, D. W. Hoffman and F. J. Mazac Jr. 1997. Texas A&M AgriLife Extension publication B-6030, 8 pp.

USDA–Natural Resources Conservation Service.  
101 South Main, Temple, TX 76501. Phone:

254.742.9800. <http://www.tx.nrcs.usda.gov/contact/>.

*Using Animal Manure and Wastewater for Crops and Pastures. Know and Take Credit for your N, P and K*. By S. Mukhtar. 2000. Texas A&M AgriLife Extension publication E-47, 4 pp.

### Acknowledgment

Support for this publication is provided through Clean Water Act§319(h) Nonpoint Source funding from the Texas State Soil and Water Conservation Board and the U.S. Environmental Protection Agency under Agreement No. 13-08.

*Photo by Kristine Uhlman, former Texas A&M AgriLife Extension Program Specialist-Water Resources*

T W O N  
T E X A S  
W e l l O w n e r  
N E T W O R K



  
Texas Water  
Resources Institute  
*make every drop count*

### Texas A&M AgriLife Extension Service

[AgriLifeExtension.tamu.edu](http://AgriLifeExtension.tamu.edu)

More Extension publications can be found at [AgriLifeBookstore.org](http://AgriLifeBookstore.org)

Educational programs of the Texas A&M AgriLife Extension Service are open to all people without regard to race, color, sex, religion, national origin, age, disability, genetic information, or veteran status.

---

The Texas A&M University System, U.S. Department of Agriculture, and the County Commissioners Courts of Texas Cooperating.

Produced by Texas A&M AgriLife Communications