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FARM •A• SYST
Farmstead Assessment System

Reducing the Risk of Surface and Ground Water Contamination by

Improving Livestock Manure Storage & Utilization

January 2000 **Utah Farm •A•Syst - Fact Sheet #7**

Storage of livestock manure involves storing manure in some type of structure until conditions are suitable for land application. Manure storage can provide environmental benefits by allowing manure to be stored until it can be safely spread and used by a growing crop. The environmental safety of collecting large amounts of manure in one place for an extended period depends on three things:

- Design and construction of the storage facility,
- Physical and chemical characteristics of the soil and subsurface geologic materials within the storage area, and
- Proper land application of manure once it leaves the storage facility.

Manure storage is an important management option available to livestock producers. Stored manure can be applied to the soil at those times of the year when crops are not actively growing, when the ground is not frozen or covered by snow, or following harvest. Applying at these times allows manure to be injected or incorporated by tillage immediately following application. Handling manure in this way ensures the farmer of the maximum nutrient value from the manure materials, while reducing risks of ground water and surface water contamination from the over application of nutrients.

Stored manure can be sampled and tested to determine how much nitrogen, phosphorus, and potassium it contains. (When sampling manure, be sure to obtain as representative a sample as possible.) This information, combined with a knowledge of the amount of manure previously applied, enables a farmer to determine whether additional commercial fertilizer is needed to meet realistic crop production and environmental protection goals.

For glossary, see page 2 of Worksheet #7

1. Long-term storage

Manure storage increases a producer's flexibility regarding the timing of land applications. This improves efficiency, conserves nutrients contained in the manure, and minimizes manure nutrient leaching and runoff. Storage is also valuable during extended periods of bad weather and when crops are actively growing, making application impractical. Livestock manure can be stored either in solid, semi-solid or liquid states.

- Solid facilities use walls and slabs for piling of heavily bedded or frozen manure.

- Semi-solid facilities use pumps to move manure into storage areas where some solids may be separated from liquids.

- Liquid facilities hold manure in tanks, pits, earthen lagoons, evaporation ponds or bermed areas.

Liquid and semi-solid storage systems are self-contained. Ground water contamination can occur if the facility is not structurally sound, allowing nutrients and pathogens to seep into the soil. A threat to surface water exists if pits are not emptied frequently enough, allowing manure to overflow the structure. Liquid storage systems often require the use of pumps and pipes for moving water to an area where it can flush the manure from the barn to the storage structure. They must be carefully installed and maintained to ensure that they do not leak.

Each time the structures are emptied, carefully check **steel and concrete structures** for cracks or the loss of watertight seals. If any breaks are apparent, repair them immediately. Likewise, check the walls of **earthen manure storage pits** to be certain that liner materials have not eroded away.

After a period of years, freezing and thawing, as well as wetting and drying, may cause the sidewalls of earthen pits to crack and erode, allowing manure to seep into the underlying soil or subsurface geologic material. Earthworm channels, gopher dens, and other animal burrows can also allow wastewater to move through the liner. Subsurface materials have the ability to filter some contaminants from the leachate, and microorganisms can break down many contaminants. However, the degree to which this occurs depends, in part, on the depth to which the contaminants are leached. Microorganisms decrease in number at greater soil depths.

Studies suggest that the effective life for properly designed earthen pits is probably 10 years. Unfortunately, many pits are not lined properly, so they fail to function shortly after installation. While seepage from earthen manure storage facilities is not always easy to recognize, the following are some tell-tale signs:

- A properly designed structure has the capacity to handle manure from a specific number of animals for a known number of days. If a pit designed for 120 days of storage has been receiving designated manure amounts for a year without needing pumping, the pit is almost certainly leaking or was improperly designed.

- Evaporation from liquid storage pits is minimal, particularly with manure from dairy cattle, which forms a crust when it is stored. If milkhouse water is added to the manure, additional liquids will probably not be required to enable the pit to be agitated and pumped. If additional water is needed, the pit may be leaking. (Monitoring wells installed around the pit upslope and downslope would be required to confirm the seepage.)

Some **solid or semi-solid manure storage systems** are designed to allow minor seepage from the piled manure. In these instances, structure design must include containment and/or treatment for the liquids that seep out. This type of facility should only be used temporarily and ONLY IF CONDITIONS ALLOW.

•For example, structures such as picket dams can be used to hold back solids when manure is piled if an ample area of grass filter strips is used to remove remaining pollutants in runoff water. This system should never be considered on sites with coarse-textured soils, creviced bedrock, or shallow water tables. It is unacceptable to use this type of system on steeply sloped lands or sites near a surface water body. Care must always be taken to ensure that the system is not overloaded, especially during periods of heavy precipitation.

•The best way to handle seepage is to channel it into a lined watertight holding pond or storage tank. In those areas where sufficient land area is unavailable for constructing filter strips, or where constructing a holding pond is not feasible, it may be necessary to build a covered (and curbed) storage area to prevent additional water from being added to temporarily piled manure.

2. Short-term storage

Short-term storage (usually 30-90 days) is an option that is available under certain conditions. It allows farmers to hold livestock manure during periods of bad weather when daily spreading may not be feasible, when crops are growing and land is not available for applying manure or when there is a shortage of crop acres to handle daily hauling and spreading of manure without the threat of runoff. Short term storage does not replace a properly planned long-term storage facility. Livestock growers who plan to routinely concentrate livestock should develop a plan to reduce the need for any short-term storage system for their operation.

Short-term storage, which is restricted primarily to solid manure, has the disadvantage of requiring that the manure be handled twice.

Short-term storage systems may be applicable for those farmers who often have to **pile manure in fields,** particularly during periods of bad weather. This is never a recommended practice, since no matter how it is done, it poses a contamination threat to surface water and ground water.

Many farmers have **open housing** for young stock, such as pole sheds where manure is allowed to accumulate for extended periods of time. Roofs on these structures keep rain and snow off the manure. These structures act as short-term storage facilities and are relatively safe for water quality if they are protected from surface water runoff and if adequate bedding is provided to reduce seepage by absorbing liquids in the manure. To minimize water quality impacts from infiltration, clean these sheds as frequently as possible.

3. Manure storage location

The location of livestock manure storage in relation to any well is an important factor in protecting the farm water supply. For manure storage lagoons greater than 4 million gallons, the minimum separation distance from a public well is 100 feet if in a confined aquifer or 250 day travel time if in an unconfined aquifer (Public Drinking Water Rule UAC R309-113). For liquid-tight manure storage structures, no minimum separation distance is specified but as much distance as possible should be provided.

• Minimum separation distances regulate new well installation or the distance from existing wells to new manure storage facilities. Existing wells are required by law only to meet separation requirements in effect at the time of well construction. Make every effort, however, to exceed “old regulations” and strive to meet current regulations when possible.

• 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 protection of your water supply. (For more information about separation distances and how the condition of your water well might affect the potential for contamination, see Worksheet and Fact Sheet #1: *Drinking Water Well Condition*.)

• While observing these minimum well separation distances may help to protect your own well, poorly designed or poorly maintained livestock manure storage facilities could still contaminate the ground water that supplies other local drinking water wells. Protecting the ground water resource as a whole can help protect your neighbors’ wells as well as possible drinking water supplies for future generations.

Depth to seasonal high water table or fractured bedrock, along with soil type at the manure storage location, are other important factors. These are among the site vulnerability characteristics in Worksheet #9: *Site Evaluation.*

Depth to water table is sometimes available in the county soil survey, but this varies even in the same county. Your local Natural Resources Conservation Service office or county Extension Agent may also be able to help you gather this information.

Distance from surface water and landslope are also important considerations. Manure storage facilities should be located as far away from water sources as possible and in an area where manure will not runoff into surface water.

4. Abandoned Pits

Abandoned manure storage pits, especially earthen ones, can pose significant water quality problems. Any abandoned structure should be completely emptied. In the case of earthen waste storage facilities, liner materials (to a depth of about two feet) should be removed and spread over croplands. The remaining hole should be filled and leveled. Manure packs from pole sheds no longer in use should also be removed and the manure land applied. If manure is piled in fields, it should be removed and applied at appropriate agronomic rates as soon as conditions permit.

5. Site Characteristics

Sites with coarse textured soils and low water holding capacity have a high potential for leaching of nutrients, particularly nitrates, and microorganisms into the ground water. Irrigation water should be managed to avoid over irrigation.

6. Livestock Manure Application Practices

Yearly soil testing will provide information to assure that nitrates and phosphorus are not building up in the soil. Application rates can be modified if nutrient levels are building too high. Manure should be applied based on the nitrogen or phosphorus needs of the crop. Manure that is incorporated

immediately after application will retain more of its nutrient value than if not incorporated. Manure should not be applied to frozen or snow covered ground unless all runoff can be controlled.

When ground is adjacent to an irrigation ditch or other water source, an appropriate set back area should be maintained. Manure should not be applied in the set back area. The distance across the set back area is determined by slope, vegetative cover, type of irrigation and other factors that influence runoff.

For maximum nutrient and environmental benefit, manure should be incorporated with soil immediately after application or applied on sites with heavy vegetative cover.

7. Land Management Practices

Application equipment should be calibrated annually. Local NRCS employees or USU Extension County Agents can provide information on calibrating your equipment. Manure applications should be based on crop needs. The amount of manure produced, along with the nutrient content, should be balanced with the amount of acres needed for proper distribution. Where the cropable acreage is not adequate, manure may be distributed to other lands (i.e., rangeland, neighbors, etc.) or may be composted. Composted manure can be used as bedding, a feed supplement, or soil amendment.

Sprinkler irrigation generally has better efficiencies than flood irrigation in Utah. Low irrigation efficiencies can cause surface and ground water pollution problems due to excess runoff and/or deep percolation. Improved irrigation system efficiencies and good irrigation water management practices will reduce pollution potentials.

8. Other Management Considerations

Utah code (UAC R317-6) requires that all **new** livestock manure storage facilities with capacity greater than 4 million gallons and which receives manure from over 1000 animal units (one animal unit is the equivalent of one 1000-lb. slaughter steer) must apply for a construction permit and a ground water discharge permit from the Utah Division of Water Quality. Smaller systems may not need an individual ground water discharge permit, provided their manure lagoons have obtained a construction permit from DWQ or have been designed and certified to meet DWQ standards by the USDA Natural Resources Conservation Service. Lagoons must have an appropriate size for the amount of manure they will receive, and be lined with earthen or other materials to provide a liner hydraulic conductivity of no less than 1×10^{-7} cm/sec. Smaller facilities located within a designated wellhead protection area may also be required to apply for a ground water discharge permit.

An application for a ground water discharge permit must include a site specific description of wells, springs and water bodies located within one mile of the proposed facility, and information describing the existing ground water quality and its uses. The application must contain some means to monitor discharges from the facility and demonstrate that concentrations of contaminants in the ground water do not exceed the "protection levels" defined in the regulations as a result of the facility's operation. For most animal manure lagoon sites, monitor wells provide the most cost-effective means to make this demonstration. For more information on ground water or construction permits, contact the Utah Division of Water Quality at (801) 538-6146. For information on designing and constructing effective manure storage facilities contact the Natural Resources Conservation Service office nearest you.

Utah Code requires that no contaminated water is allowed to discharge into surface water that then leaves the farm.

Contacts and References

Who to call about . . .

Waste storage needs, designing appropriate structures

Your local Natural Resources Conservation Service office, or your county Extension office.

A permit to construct and operate an animal waste storage facility

Utah Department of Environmental Quality, Division of Water Quality (801) 538-6146.

What to read about...

Publications are available from sources listed at the end of the reference section. (Refer to number in parentheses after each publication.)

Handling, management and storage of livestock waste

Agricultural Waste Management Field Handbook. 1996. United States Department of Agriculture Natural Resources Conservation Service. (1)

Practice Standards, Section IV. United States Department of Agriculture Natural Resources Conservation Service Field Office Technical Guide. (1)

Manure Best Management Practices: A Practical Guide for Dairies in Colorado, Utah and New Mexico. 1999. Utah State University Extension. AGWM 04. (2)

National Dairy Database. 1994. (4) Over 400 publications (1,196 pages) on livestock manure management.

Planning and design of livestock waste storage facilities.

Agricultural Waste Management Field Handbook. 1996. United States Department of Agriculture Natural Resources Conservation Service. (1)

Livestock Waste Facilities Handbook, 3rd Edition. (MWPS-18) 1993. Midwest Plan Service. (3)

Practice Standards, Section IV. United States Department of Agriculture Natural Resources Conservation Service Field Office Technical Guide. (1)

Land application of livestock waste

Livestock Waste Facilities Handbook, 3rd Edition. (MWPS-18) 1993. Midwest Plan Service. (3)

Practice Standards, Section IV. United States Department of Agriculture Natural Resources Conservation Service Field Office Technical Guide. (1)

Publications available from . . .

1. Your local office of the USDA Natural Resources Conservation Service or your county Extension office .

2. Extension Publications, Utah State University, Logan, Utah 84322-4900. (Http://www.ext.usu.edu/publica/agpubs)

3. MidWest Plan Service, Ag and Biosystems, Engineering Extension, 207 Davidson Hall, Ames, IA 50011-3080. (515-294-6361. FAX (515-294-6361. Email: mwps@iastate.edu.

4. Animal Science Department, University of California, Davis, California 95616-8521. (916) 752-9391. Fax: (916) 752-0175.

Internet sites . . .

Utah NRCS Web Site: (http://www.ut.nres.usda.gov)

USU Extension Water Quality Web Site: Farm A Syst and Home A Syst (http://www.ext.usu.edu/natres/wq/a-syst.htm)

Utah Department of Agriculture and Food, Concentrated Animal Feeding Operations (http://www.ag.state.ut.us/divisns/mkt&cons/cafo.htm)

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Dean Maxwell - Utah Association of Conservation Districts
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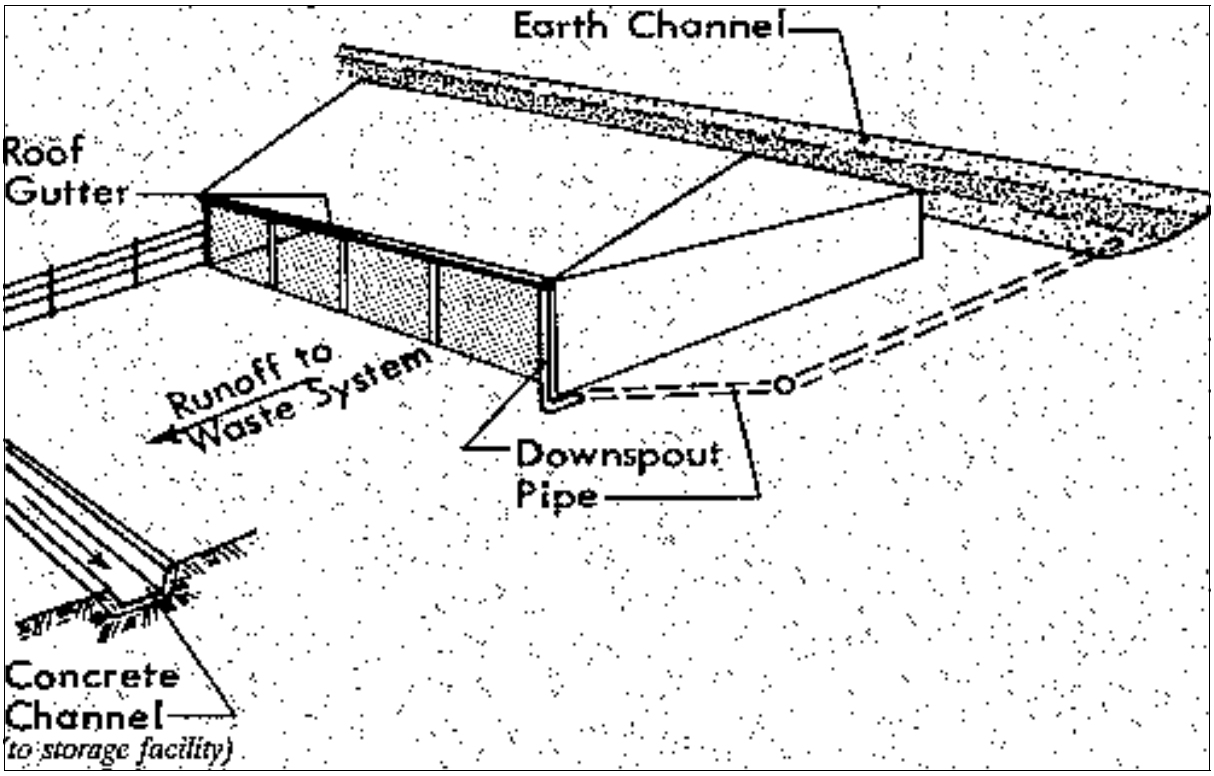
Percent of Original Content of Manure Retained by Various Management Systems

Management System	Beef			Dairy			Swine		
	N	*P*	*K*	*N*	*P*	*K*	*N*	*P*	*K*
Manure stored in open lot during cool, humid seasons.	55-70	70-80	55-70	70-85	85-95	85-95	55-70	65-80	55-70
Manure stored in open lot during hot, dry seasons	40-60	70-80	55-70	55-70	85-95	85-95			
Manure liquids and solids stored in covered watertight structure.	60-75	80-90	80-90	65-75	80-90	80-90			
Manure and bedding held in uncurbed, unroofed storage.				55-75	75-85	75-85			
Manure held in storage pond (diluted 50% or less).	60-75	80-90	80-90	65-80	80-95	80-95			

Source: USDA Soil Conservation Service



Use of gutters and open channels to divert clean water and control livestock yard runoff.