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# EC98-751 Farm*A*Syst Nebraska's System for Assessing Water Contamination Risk Fact Sheet 9: Improving Livestock Manure Storage

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# Farm•A•Syst

FACT SHEET 9

Nebraska's Farm Assessment System for Assessing the Risk of Water Contamination

# Improving Livestock Manure Storage

Storing livestock manures involves accumulating manure and other discharges in a storage structure until the manure can be land applied. From an environmental standpoint, storage can be either positive or negative. The environmental safety of collecting large amounts of manure in one place for an extended period depends on three things:

1. The design and construction of the storage facility.
2. The proper land application of the manure once it leaves the storage facility.
3. The physical and chemical characteristics of the soil and subsurface geologic materials within the storage area and area to which any runoff might flow.

Manure storage is an important manure management option for livestock producers. Stored manure can be applied to the soil when nutrient uptake by crops can be maximized and weather related losses minimized. Preplant applications of manure incorporated into the soil ensures **maximum crop nutrient value**, while reducing risks of water contamination.

Storage reduces the need for land application of manure on frozen or snow covered soils. Storage saves wear and tear on farm equipment, conserves nutrients contained in the manure and minimizes manure nutrient leaching and runoff. Storage is also valuable during extended periods of bad weather or when crops are actively growing.

## 1. Long-term storage

Livestock manure can be stored either in solid, semi-solid, slurry, or liquid states.

- Solid facilities use walls and slabs for stacking manure with heavy bedding additions.
- Semi-solid facilities use pumps to move manure into containment areas, and may separate solids from liquids.
- Liquid lagoons or slurry facilities hold manure in tanks, pits, or bermed areas.

Groundwater contamination can occur if the facility is not structurally sound, thus allowing seepage into the soil. A threat to surface water exists if pit liquid levels are not managed properly and the potential for overfilling exists. Liquid storage systems may use pumps and pipes for transferring manure and other discharges from the barn to the storage structure. These must be properly designed, installed, and maintained to ensure they do not leak.

Each time they are emptied, carefully check **steel and concrete structures** for cracks or the loss of watertight seals. Periodically, walk around above-ground storage and look for evidence of seepage or leaking. If any breaks are apparent, repair them immediately.

Earthen storages and lagoons require regular inspection. Freezing and thawing, wetting and drying, bank erosion from agitation equipment, and weed growth will encourage seepage into the underlying

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soils or subsurface geologic material. Groundwater contamination will result if the subsurface materials do not have sufficient ability to break down contaminants contained in the leachate. Some maintenance is necessary to insure an indefinite lifetime for an earthen storage pit or lagoon.

Seepage from in-ground storage facilities is not always easy to recognize, but here are two telltale signs:

- A properly designed manure storage or treatment lagoon has the capacity to handle manure and/or runoff from a specific number of animals for a known number of days. If a storage facility is receiving the designated amounts of manure or runoff but is filling at a slower rate, then leaking is possible.
- Evaporation from liquid storage is minimal, particularly with manure from dairy or beef cattle, which forms a crust when it is stored. If liquid must be added before the pits can be agitated and pumped, the structure may be leaking.

Some storage facilities of solid or semi-solid manure are designed to allow the liquid fraction to separate from solid manure. Structures such as picket or slotted dams can be used to hold back solids and allow liquids to be removed. It is preferred that the liquid fraction be conveyed to a storage pond for eventual distribution on crop land.

Grass filter strips provide an alternative to a storage pond for handling the liquid fraction from a slotted dam storage. A grassed filter must be carefully designed to avoid surface runoff and excess nutrient loading. Such systems should not be considered on sites with coarse-textured soils, creviced bedrock or shallow water tables. It also is important to ensure that the highly concentrated effluent does not "burn" vegetation in the filter strip. A thick, healthy stand of vegetation allows runoff to seep into the soil and uses the nutrients in the water. Grass must be harvested to remove those nutrients. Filter strips require specific approval of Nebraska DEQ if substituted for a storage pond.

Another option is to build a roof over the structure to eliminate additional water being added to the manure stack. Roofed storage systems require adequate bedding to absorb and retain liquids.

## 2. Nebraska requirements for manure control facilities

Long-term manure storage and runoff control facilities are required by the Nebraska Environmental Protection Act for existing or proposed livestock operations when this manure and runoff violate or threaten to violate surface and groundwater quality standards or discharge into the waters of Nebraska.

*Nebraska law states that it is the responsibility of the owner or operator for any livestock operation,* ***regardless of size,*** *with a potential water pollution problem to contact the Department of Environmental Quality to determine if storage or runoff control facilities are required.* Control facilities are defined as any structure or combination of structures used to control manure or runoff until it can be managed in a proper manner. Control facilities may include:

- diversion terraces
- holding ponds
- debris basins
- liquid manure storage
- lagoons
- other devices utilized to control manure and runoff

If livestock manure or runoff control facilities are required by the Nebraska Department of Environmental Quality (NDEQ), the permit application must be signed by a registered professional engineer. NDEQ has separate permit applications for Open Lot Feeding (Form WP-41) and Confined Feeding or Dairy Barn (Form WP-42).

**Open Lot Feeding.** Livestock manure and runoff from an open lot may be controlled through a single retention structure, a combination of debris basins and holding ponds, or any other manure control system approved by NDEQ. The open lot control facility must have sufficient capacity to contain all runoff from the drainage area which would result from a 25-year 24-hour rainfall event plus the expected average runoff for the

month of June rainfall. Surface drainage should be diverted around the livestock operation and the control facility to the maximum extent possible. If the open lot exceeds 25 acres, the Nebraska Department of Water Resources requirements for dam construction may apply:

**Confined Feeding or Dairy Barn. There** are three design possibilities for confinement facilities.

1. Liquid manure storage in a pit, tank, holding pond or combination designed to retain all livestock manure for at least 180 days.
2. Lagoon for biological treatment of manure which must provide 180 days storage in addition to a permanent pool for manure treatment.
3. Other manure control system approved by NDEQ.

If the storage or lagoon is open to the weather, any of these options must be of sufficient capacity to contain all normal precipitation, all rainfall from a 25-year 24-hour rainfall event, livestock manure and other discharges (e.g. clean up water) from the housed operation, and 1 foot of storage freeboard.

## 3. Short term storage

Short-term storage (usually 30-90 days) is an option available only to Nebraska livestock facilities that do not require an NDEQ permit. It allows them to hold livestock manure during periods when daily spreading may not be feasible (such as bad weather), 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 systems are often used by producers who **stack manure in fields,** particularly during periods of bad weather. This is not a recommended practice. It poses a contamination threat to surface water and groundwater. If manure is frequently stacked in fields, construction of a solid storage facility should be strongly considered.

Many farmers scrape manure into **piles in the livestock yard** rather than haul it during bad weather or busy work periods. This practice is an acceptable short-term storage for active feedlots. Research indicates that in an active feedlot, an impermeable surface forms on the top layer of the feeding pens minimizing the change of groundwater contamination below the pen. Also, scraping and piling the feedlot creates cleaner and drier conditions for cattle loafing on the majority of the feedlot. Manure piles in the livestock yard should only be used as a short-term solution. Eventually the seal beneath the manure pile will begin to break down and groundwater contamination becomes a possibility. Livestock yards that are no longer active will leach into the groundwater and must be cleaned off.

Manure piling in the livestock yard is not acceptable for milking cows. Regulations governing milk production do not allow milking cows to come in contact with stacked manure.

Some farmers have **open housing** for replacement dairy animals where manure is allowed to accumulate for extended periods of time. Roofs on these structures keep rain and snow off the manure. These structures are environmentally safe if they are protected from surface water runoff, and if adequate bedding is provided to absorb liquids in the manure. To minimize water quality impacts, provide adequate bedding to reduce seepage, and clean these sheds are frequently as possible.

## 4. Manure storage location

The location of livestock manure storage in relation to any domestic well is an important factor in protecting the farm water supply. For temporary manure stacks and permanent earthen storage facilities, the minimum separation distance from a domestic well allowed by Nebraska law is 100 feet. Separation distance between storage and surface water such as streams and lakes also should be considered. A separation distance between storage and surface water of 500 feet or more is preferred. Attempt to use local

terrain to establish a natural barrier to drainage between the storage and surface water.

Livestock manure control facilities must not be located (according to Nebraska Health and Human Services System regulations):

- within 100 feet of any well in domestic use;
- within a Class GA area around a public drinking water supply well, unless the owner or operator furnishes Nebraska DEQ with acceptable documentation which supports that groundwater will not be contaminated;
- in an area in which substantial threat of the beneficial use of surface waters will be impaired; or
- in an area in which groundwater may be contaminated. Percolation must be tested *prior to storage filling* and not exceed 0.25 inches per day.

For additional clarification of this issue, review Chapter 10 of *Title 130-Rules and Regulations Pertaining to Livestock Waste Control* of the Nebraska Department of Environmental Quality.

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 well might affect the potential for contamination, see *Worksheet* and *Fact Sheet 3, Drinking Water Well Condition*.)

These well separation minimum distances may help you to protect your own well. However, poorly designed or poorly maintained livestock manure storage facilities may still contaminate the groundwater that supplies other local drinking water wells. Protecting the groundwater 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, is another important factor. These are among the site vulnerability characteristics in *Worksheet 2, Site Evaluation.*

Depth to water table is sometimes available in the county soil survey, but this varies from county to county. Your local Extension Educator, Natural Resources Conservation Service, Natural Resources District, or well driller also may be able to help you gather this information.

## 5. Other management factors

Some Nebraska counties have enacted manure storage facility ordinances, requiring storage facilities to be sited and constructed according to county-adopted engineering standards. Siting a livestock facility and livestock manure or runoff control facilities must be done with zoning and nuisance laws in mind. Contact your county zoning commission or Natural Resources District for more information.

If manure storage causes water contamination, the NDEQ can issue a violation notice and fines and require corrective measures. Contact NDEQ for information about state regulations.

## 6. Abandoned pits

An abandoned storage, especially an earthen one, can pose significant water quality problems. The problems associated with abandoned pits include insect population, odor control, overflow if the pit is not emptied, or increased seepage if the pit's banks dry and crack. There has been research indicating that abandoned pits should be maintained for 10-20 years at which point the pit will have stabilized and become similar to a pond. Pits that are designed for minimal collection of runoff should be completely emptied, filled in, graded, and seeded. Dealing with an abandoned storage site is an area of continued study. Contact your local Extension office, NRD, or NRCS office for more information about dealing with abandoned pits. Manure packs from pole sheds no longer in use should also be removed and the manure land-applied. If manure is stacked in fields, it should be removed as soon as conditions permit.

## CONTACTS AND REFERENCES

**Who to call about...**

**Manure storage or runoff control needs, designing appropriate structures:**

Your local University of Nebraska Cooperative Extension office, Natural Resources Conservation Service office, Natural Resources District Office, or Nebraska Department of Environmental Quality can give you more information regarding manure storage and water quality requirements, including copies of NDEQ's feedlot regulations and BMPs. Contact NDEQ Permits and Compliance Section at (402) 471-4239.

**Cost-sharing funds:**

Financial assistance for animal manure management practices, including manure storage, may be available as part of a priority watershed plan, through the Natural Resources Conservation Service, Consolidated Farm Services Agency (includes former ASCS programs), Natural Resources District, and other federal and state programs.

**Animal manure management:**

Approval from the Nebraska Department of Environmental Quality must be obtained by the livestock owner or operator with sufficient evidence that the operation will not pollute the waters of the state of Nebraska. Department of Environmental Quality, Permit and Compliance Section Suite 400, 1200 N Street, The Atrium, Lincoln, NE 68509-8922, (402) 471-4239.

**Manure testing:**

Commercial laboratories are available. Contact your county University of Nebraska Cooperative Extension Educator, or Nebraska Cattlemen at 1335 H Street, Lincoln, NE 68508, (402) 475-2333. Nebraska DEQ (see above address) can also provide a listing of commercial laboratories and consultants.

**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.)

**Drinking Water Quality:**

*Perspectives on Nitrates,* Extension Circular EC90-2502. $2. (1)

*Drinking Water: Nitrate-Nitrogen,* NebGuide G85-763. (1)

*Understanding Groundwater,* NebGuide G93-1128 (1).

*Drinking Water: Bacteria,* NebGuide G90-989. (1)

*Water Testing Laboratories,* NebGuide G89-907. (1)

*Well Water, Nitrates, and the "Blue Baby" Syndrome Methemoglobinemia,* NebFact NF91-49. (1)

**Animal health effects of nitrates:**

*Water Quality and Requirements for Dairy Cattle.* NebGuide G93-1138. (1)

*Nitrates in Livestock Feeding,* NebGuide G74-170. (1)

*Livestock Water Quality,* NebGuide G79-467. (1)

*Perspectives on Nitrates,* Extension Circular EC90-2502. $2. (1)

**Planning and design of livestock manure storage facilities:**

*Livestock Waste Facilities Handbook,* Midwest Plan Service MWPS-18. (2)

*Concrete Manure Storage Handbook,* Midwest Plan Service MWPS-36. (2)

*Lagoons for Management of Livestock Manure,* Extension Circular EC96-779. (1)

**Land application of livestock manure:**

*Livestock Waste Facilities Handbook,* Midwest Plan Service MWPS-18. $8. (2)

*Liquid Manure Application Systems: Design, Management, and Environmental Assessment,* NRAES-79. $20. (4)

**Publications available from...**

1. Your local University of Nebraska Cooperative Extension Office or directly from IANR Communications and Information Technology, 105 Ag Communications Building, P.O. Box 830918, University of Nebraska-Lincoln, Lincoln, NE 68583-0918, (402) 472-9712.

2. Midwest Plan Service publications are available through your local University of Nebraska Cooperative Extension Office or Agricultural Engineering Plan Service, 219A LW Chase Hall, P.O. Box 830727, University of Nebraska-Lincoln, Lincoln, NE 68583-0727 (402) 472-1646.

3. Nebraska Cattlemen, 1335 H Street, Lincoln, NE 68508, (402) 475-2333.

4. Northeast Regional Agricultural Engineering Service, Riley Robb Hall, Cornell University, Ithaca, NY 14853, (607) 2555-7654.

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