

Animal Waste Storage and Management

WHY BE CONCERNED?

Runoff from livestock production facilities can carry manure, soil, microorganisms, and other potential pollutants that could contaminate surface water and groundwater sources. If not managed properly, animal wastes can affect water quality and human health.

Stored animal waste can be land applied 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. Storing animal waste properly can be quite technically involved and is often subject to regulations regarding design, location, maintenance, and monitoring of facilities—especially for operations with large numbers of animals. Structures for liquid or semi-solid animal waste can leak or rupture. Animal waste in earthen ponds can form a semi-impervious seal of organic matter that limits leaching potential, but seasonal filling and emptying can cause the seal to break down. Temporary abandoned and animal waste storage areas can also be sources of runoff to surface water or groundwater contamination by nitrates.

Animal waste or animal waste runoff that enters surface water supplies algae and aquatic plants with nutrients. When this increased plant material begins to die and decay, the dissolved oxygen level in the water often declines. If the dissolved oxygen levels become too low, fish kills occur. Some algae reproduce quickly when stimulated by enriched nutrient conditions, creating toxic algal blooms that can kill humans and animals.

Nitrogen from animal waste can also be a source of nitrates in groundwater. Nitrate levels above the federal and state drinking water standard of 10 milligrams per liter (mg/L; equivalent to parts per million for water measure) can pose health problems for infants under 6 months of age. This condition in infants is often described as methemoglobinemia (blue baby syndrome). Nitrates can also affect adults, but the evidence is uncertain. In addition, young livestock are susceptible to health problems from high nitrate-nitrogen levels in water, especially in combination with drought-stressed and other feed sources that are potentially high in nitrate-nitrogen.

Fecal and coliform bacteria and other pathogens in animal waste can contaminate surface and groundwater when the waste is improperly handled, causing such infectious diseases as dysentery, typhoid, and infectious hepatitis (Hepatitis A). Typical water purification practices such as chlorination are not effective in controlling some of the pathogens found in animal waste. Organic materials causing an undesirable taste and odor in drinking water are not known to be

dangerous to health, but their presence suggests that other contaminants may be in the drinking water.

Management of dead animals may also affect water quality. Improper management may introduce bacteria or nitrates into groundwater or surface water.

Everyone working around animal waste reception, transfer, and storage facilities should be aware of safe operating procedures for their system. Decomposing animal waste can produce toxic emissions that accumulate in low or enclosed places. Liquid or semi-solid animal waste may appear solid, but will not support a person's weight. Farm workers should also know how to respond in the case of emergencies related to malfunctioning storage facilities.

The goal of Pennsylvania Farm•A•Syst is to help you protect groundwater and surface water, shared resources which are important to everyone.

HOW TO RANK GROUNDWATER AND SURFACE WATER PROTECTION USING THIS WORKSHEET

- You can select from a wide range of animal waste storage conditions and practices that are related to potential groundwater or surface water contamination.
- You can rank your animal waste storage practices according to how they might affect groundwater or surface water.
- Based on your overall ratings, you can determine which of your conditions or practices are reasonably safe and effective, and which might require modification to better protect groundwater and surface water.

Information derived from Farm•A•Syst worksheets is intended only to provide general information and recommendations to farmers regarding their own farmstead practices. It is not the intent of this educational program to keep records of individual results. However, they may be shared with others who will help you develop a resource management plan.

HOW TO COMPLETE THE WORKSHEET

Follow the directions as listed on page 1 of the worksheet. The evaluation should take 15–30 minutes to complete and determine your ranking. Evaluate each site that is part of your farmstead. There are spaces provided to rank up to three sites on your farmstead. If you have more than three sites, please use another worksheet. If you are unfamiliar with any of the terms used, refer to the glossary provided with this worksheet.

WORKSHEET #9: ANIMAL WASTE STORAGE AND MANAGEMENT

Use a pencil in case you want to change an answer later. For each feature listed on the left that is appropriate for your farmstead, read across to the right and circle the statement that most closely describes conditions on your farmstead. Leave blank any features that don't apply to your farmstead. Find the corresponding "rank number" (4, 3, 2, 1) for each description you circled and enter that number in the

blank under "RANK." If the conditions in any one description do not match your situation exactly, use an in-between score of one-half unit; for example, 2.5 or 3.5. Directions for overall scoring appear at the end of the worksheet. Allow 15 to 30 minutes to complete the worksheet and to determine the level of groundwater and surface water protection that you are providing.

MANAGEMENT OR SITE CONDITIONS

	4 Best	3 Good	2 Fair	1 Poor	RANK (up to 3 sites)
WASTE STORAGE FACILITY					Site Identification
					#1 #2 #3
1. Waste storage structure	Designed and installed according to accepted engineering standards and specifications.* Properly maintained.#	—	Not designed to engineering standards, or design criteria unknown. No sign of leaks, cracks, or structural problems. Water table or fractured bedrock deeper than 2 feet.	Not designed to engineering standards, or design criteria unknown. Signs of leaks, cracks, or structural problems. Water table or fractured bedrock shallower than 2 feet.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
2. Earthen waste storage pond	Designed and installed according to accepted engineering standards and specifications.** Properly maintained.#	—	Not designed to engineering standards, or design criteria unknown. Constructed in medium- or fine-textured dense materials (silt loam, loam, clay loam, silty clay). Excessive vegetations, trees, etc., on embankment. Water table or fractured bedrock deeper than 2 feet below pond bottom. Earthen, concrete, or geosynthetic lining.	Not designed to engineering standards. Constructed in coarse-textured materials (sands, sandy loam), subject to overtopping, or enclosing embankment is unstable. Excessive vegetation, trees, etc., on embankment. Fractured bedrock or water table shallower than 2 feet below pond bottom. More than 10 years old. Earthen, concrete, or geosynthetic lining eroded, perforated, or nonexistent.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

* Animal waste storage conforms to the requirements of the current Pennsylvania Technical Guide, Section IV, standard 313 and specification 313S, Natural Resource Conservation Service, Harrisburg, PA.

** Animal waste storage conforms to the requirements of the current Pennsylvania Technical Guide, Section IV, standard 313 and specification 313P, Natural Resource Conservation Service, Harrisburg, PA.

The operator of the animal waste storage facilities monitors and maintains them according to the site-specific operation and maintenance plan that meets the requirements of the current Pennsylvania Technical Guide, Section IV, standard 313, Natural Resources Conservation Service, Harrisburg, PA.

4 Best	3 Good	2 Fair	1 Poor	RANK (up to 3 sites)
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WASTE STORAGE FACILITY (continued)					Site Identification		
					#1	#2	#3
3. Stacked in livestock yard or on stacking pad	Paved with curbs, clean water diverted, and runoff collected in liquid-tight animal waste storage. Designed and installed according to accepted engineering standards and specifications.* Properly maintained.#	Paved with curbs. Run-off directed to grass filter area. Designed and installed according to accepted engineering standards and specifications.* Properly maintained.#	Stabilized earthen surface with medium- or fine-textured soils (silt, loam, clay loam, silty clay). Water table or fractured bedrock deeper than 2 feet. More than 200 feet from stream, pond, or lake.	Earthen surface with coarse-textured soils (sands, sandy loam). Water table or fractured bedrock shallower than 2 feet. No runoff controls or curbing. Less than 200 feet from stream, pond, or lake.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Stacked under roof	Paved floor. Protected from surface water runoff. Adequate bedding provided. Properly maintained.	Earthen or concrete floor on medium- or fine-textured soils (silt loam, loam, clay loam, silty clay), protected from surface water runoff. Water table or fractured bedrock deeper than 2 feet.	Earthen floor on medium- or fine-textured soils (silt loam, loam, clay loam, silty clay), subject to surface water runoff. Water table or fractured bedrock shallower than 2 feet.	Earthen floor on coarse-textured soils (sands, sandy loam), subject to surface runoff. Water table or fractured bedrock shallower than 2 feet.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Temporary in-field stacking	—	Solid waste. Earthen surface on moderately well- or well-drained, medium- or fine-textured soils (silt loam, loam, clay loam, silty clay), protected from surface water runoff. Water table or fractured bedrock deeper than 2 feet.	Earthen surface on medium- or fine-textured soils (silt loam, loam, clay loam, silty clay), subject to surface water runoff. Water table or fractured bedrock shallower than 2 feet.	Earthen surface on coarse-textured soils (sands, sandy loam), subject to surface water runoff. Water table or fractured bedrock shallower than 2 feet.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

* Livestock yard conforms to the requirements of the current Pennsylvania Technical Guide, Section IV, Standards 357 (Barnyard Runoff Control) and 561 (Heavy Use Area Protection) and stacking area conforms to the requirements of the current Pennsylvania Technical Guide, Section IV, Standards 317A (Waste Stacking and Handling Pad), Natural Resource Conservation Service, Harrisburg, PA.

The operator of the animal waste storage facilities monitors and maintains them according to the requirements of the current Pennsylvania Technical Guide, Section IV, Standard 357 or 317A, Natural Resources Conservation Service, Harrisburg, PA.

4 Best	3 Good	2 Fair	1 Poor	RANK (up to 3 sites)
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LOCATION					Site Identification		
					#1	#2	#3
6. Location of animal waste storage in relation to drinking water well or surface water	Down or across slope more than 100 feet if less than 1.5 million gallons; more than 200 feet if greater than 1.5 million gallons or has a slope greater than 8%.+	Upslope more than 100 feet if less than 1.5 million gallons; more than 200 feet if greater than 1.5 million gallons or has a slope greater than 8%.	—	Less than 100 feet if less than 1.5 million gallons; less than 200 feet if greater than 1.5 million gallons or has a slope greater than 8%.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	4 Best	3 Good	2 Fair	1 Poor	RANK (up to 3 sites)
LOCATION (CONTINUED)					Site Identification #1 #2 #3
7. Location of animal waste storage on floodplains	Not within floodplain.	Consistent with local ordinances. [#] Sides protected from erosion and scouring by 25-year flood.	—	Local ordinances not consulted. Subject to erosion, scouring, overtopping, or uplift pressures from a 25-year flood.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

⁺ Location complies with Pennsylvania Code Title 25, Chapter 105, Appendix I.105-249, unless other state or federal laws or regulations require a greater distance for public water sources.

[#] Under Pennsylvania Flood Plain Management Act 32, Subsection 679.101-601.

					Site Identification #1 #2 #3
STORAGE CAPACITY AND MANAGEMENT					
8. Storage capacity	Adequate capacity to meet nutrient management plan for growing season application.	—	Adequate capacity to meet nutrient management plan for spring and fall application.	Volume is inadequate for application based on crop needs and efficient nutrient use. Frequent applications when crops are not growing.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
9. Storage status at time of unloading (liquid, semi-solid manure)	When full, capacity to handle 25-year, 24-hour storm event is still available, plus more than 6 inches freeboard for structures and 1 foot for earthen ponds remain.	When full, capacity to handle 25-year, 24-hour storm event is still available or more than 6 inches freeboard for structures and 1 foot for earthen ponds remain (whichever is greater).	Occasionally less than 6 inches freeboard for structures and 1 foot for earthen ponds remain when full.	Often less than 6 inches freeboard for structures and 1 foot for earthen ponds remain when full.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
10. Reception and transfer system	Designed and installed according to accepted engineering standards and specifications. No potential backflow from storage. Properly maintained.	—	Not designed to engineering standards, or design criteria unknown. No potential backflow from storage. No sign of leaks, cracks, or structural problems.	Not designed to engineering standards, or design criteria unknown. Signs of leaks, overflow, cracks, or structural problems.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
11. Water diversion around animal waste storage facilities	All clean runoff and roof water directed away from the storage area.	Most clean runoff and roof water directed away from storage facilities, or storage designed to accommodate the runoff volume.	No clean runoff or roof water redirected before it reaches the animal waste storage facility. Water may flow through the facility during heavy storms.	Water regularly runs freely through the animal waste storage facilities or causes loss of storage capacity or overtopping.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
12. Animal waste storage and handling facilities inspections	All animal waste storage and handling facilities routinely (at least once a month and after storms) observed for leaks, spills, or overflows. Repairs made as needed.	Animal waste storage and handling facilities occasionally (at least once every six months and after storms) observed for leaks, spills, or overflows. Repairs made as needed.	Animal waste storage and handling facilities repaired only when signs of leaks, spills, or overflows are noticed.	Animal waste storage and handling facilities generally ignored and not observed for leaks, spills, or overflows.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

	4 Best	3 Good	2 Fair	1 Poor	RANK (up to 3 sites)
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SPILLS					Site Identification		
					#1	#2	#3
13. Unloading and handling	Spills cleaned up immediately and disposed of properly. Liquid or semi-solid storage outlets protected by check valves or shutoffs.	Spills cleaned up within a few days. Liquid and semi-solid storage outlets protected by check valves or shutoffs.	—	Spills and loading area not cleaned. Liquid or semi-solid storage outlets not protected by check valves or shutoffs.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

EMERGENCY					Site Identification		
					#1	#2	#3
14. Emergency Action Plan	Site-specific contingency plan developed for leaks or spills posted or readily available in case of an emergency. ⁺ Adequate equipment and supplies available for plan implementation.	—	Site-specific contingency plan developed for manure leaks or spills, but not readily available or resources for implementation not available. ⁺	No plan for manure leaks or spills.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

⁺ In accordance with the current Pennsylvania Technical Guide, Section IV, standard 313, Natural Resources Conservation Service, Harrisburg, PA.

DEAD ANIMAL DISPOSAL					Site Identification		
					#1	#2	#3
15. Dead animal disposal	Dead animals properly disposed of within 48 hours by composting, ⁺ incineration, or pickup by rendering company, where available.	Dead animals disposed of by covering them with at least 3 inches of quick lime and 24 inches of soil. More than 100 feet from well, spring, or surface water. Not subject to overflow from ponds or streams. Water table deeper than 4 feet.*	Dead animals disposed of by covering them with less than 24 inches of soil or placing them less than 100 feet from a well or water source. Subject to surface runoff or water table than 4 feet.	Dead animals allowed to decompose in the open.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

⁺ In accordance with the current Pennsylvania Technical Guide, Section IV, standard 318, Natural Resources Conservation Service, Harrisburg, PA.

*Specified by the Pennsylvania Department of Agriculture, Act No. 317, Sections 17 and 20.

TOTAL
Use this total to calculate overall performance ranking.

HOW TO USE THESE RANKINGS

Step 1: Now that each feature has been ranked, add all these rankings together and put that value in the “Total” box at the end of the worksheet. Transfer that number to the box below.

Step 2: Divide the value in the “Total” box by the number of features ranked.

Step 3: Repeat for the remaining sites. Calculate the average ranking for all sites combined.

_____ divided by _____ equals _____ (total of rankings) (# of features ranked) (average ranking)* *carry your answer out to one decimal place

Step 4: Evaluate the overall management practices and site conditions.

3.6–4.0 = best management

2.6–3.5 = good management

1.6–2.5 = fair management

1.0–1.5 = poor management

This ranking gives an idea of how animal waste storage practices as a whole might affect water quality. This ranking should serve only as a very general guide, not a precise diagnosis. Since it represents an averaging of many individual rankings, it can mask any individual rankings (such as 1s and 2s) that should be of concern.

Step 5: Look over the rankings for individual features of each site:

Best (4s): the current ideal; should be the goal despite cost and effort

Good (3s): provides reasonable surface water and groundwater protection

Fair (2s): inadequate protection in many circumstances

Poor (1s): poses a high risk of polluting surface water and/or groundwater and causing human or animal health problems

Regardless of the overall ranking, any individual rankings of “1” should receive immediate attention. Some concerns can be taken care of right away; others could be major or costly projects, requiring planning and prioritizing before taking action.

Step 6: Consider how to modify farmstead management practices or site conditions to better protect water quality. Contact your local **conservation district**, **Cooperative Extension office**, or the **USDA Natural Resources Conservation Service** for ideas, suggestions, or guidance.

GLOSSARY

Animal waste: A combination of manure, bedding, feed, dirt, and water.

Cast-in-place concrete storage: A type of liquid-tight animal waste storage structure. Located on a concrete pad, it consists of poured concrete reinforced with steel. It may be located above ground or partially or totally in ground.

Collection and transfer system: Small volume pits receiving animal waste directly from animals by gravity flow or scraping before it is moved through channels or pipes to the animal waste storage facility.

Compost: Organic residues such as animal waste and animal mortalities that have been collected and allowed to decompose with aeration until they are stable.

Composting: A controlled process of decomposing organic matter by microorganisms in aerobic conditions. The end product is usually used as a nutrient source or soil conditioner.

Decompose: The aerobic (well-aerated) or anaerobic (poorly aerated) breakdown of organic materials primarily by microbial activity.

Earthen storage pond: An in-ground animal waste storage facility constructed according to specific engineering standards. Not simply an excavation. Must be built in compacted clay soils or have a compacted clay, geotextile, or other impermeable liner in order to reduce the potential for leakage.

Engineering standards: Planning and design criteria available from conservation districts or the Natural Resources Conservation Service (NRCS). These standards are part of the *Pennsylvania Soil and Water Technical Guide (Pennsylvania Technical Guide)*.

Filter area: A sloping grass area used to filter runoff from the livestock yard and some types of solid manure storage systems. Influent waste is distributed uniformly across the high end of the strip and allowed to flow downslope and infiltrate into the soil. Nutrients and suspended material remaining in the runoff water are filtered through the grass, absorbed by the soil, and ultimately taken up by plants. Filter areas must be designed and sized to match the characteristics of the livestock yard or storage facility. Vegetation should be removed periodically to prevent any buildup of nitrogen in the soil that may contaminate surface and groundwater.

Geosynthetic liner: A single layer of synthetic geomembrane material or a multiple-layer geocomposite specifically manufactured to be a fluid barrier in an earthen impoundment, and to meet applicable engineering specifications.

Glass-lined steel storage: A type of liquid-tight, above ground animal waste storage structure. Located on a concrete

pad, it consists of sealed steel panels bolted together and coated inside and outside with glass to provide corrosion protection.

Liquid waste: Waste with low solids content that flows and can be easily pumped or transferred through pipes.

Pennsylvania Code Title 25: Pennsylvania regulation developed under the authority of various legislation defining and providing for the prevention of watercourse pollution and dam safety including the installation, operation, modification, and maintenance of certain agricultural activities that encroach into streams and their floodways (P.L. 704, No. 294, June 14, 1923). Agricultural waste storage facilities are included in the provisions of the regulation. Enforcement is the responsibility of the Department of Environmental Protection (DEP).

Pennsylvania Technical Guide, Section IV: Publication of the USDA Natural Resource Conservation Service (NRCS). Purpose of the publication is to establish minimum acceptable requirements for planning, designing, constructing, and operating and maintaining waste storage facilities, including waste storage structures, ponds, and stacking facilities. The Pennsylvania Department of Environmental Protection requires that the criteria specified be followed for all liquid and semi-solid animal waste storage facilities.

Pre-cast concrete storage: A type of liquid-tight animal waste storage structure. Located on a concrete pad, it consists of concrete panels bound together with cable, rods, or bolts and sealed between panels. May be partially or totally below ground.

Semi-solid waste: Waste that is difficult to pump yet impossible to handle with a fork. It will flow, not stack, and discharges liquids.

Solid waste: Waste material that can be transferred with a fork and handled with a conventional manure-spreader. It will stack and not discharge liquids when protected from rain.

Stacking pad: A stabilized surface used for storage and handling of solid animal waste. A waste stacking and handling pad provides an all weather working surface for storage and/or composting of manure, equipment operation, and a method for controlling or excluding surface water flow onto and off the pad.

Water table depth: Depth to free water in soil, geologic material, or bedrock. There are two types of water tables: (1) the water table typically noted in a well log as an indication of usable water supply; and (2) the seasonal high water table. The seasonal high water table is the most important for animal waste storage facilities because it may present facility design, construction, and operation problems.

ACKNOWLEDGMENTS

The Pennsylvania Farm•A•Syst package contains the following Worksheets:

- Introduction
- Farmstead Map
- Preliminary Screening Quiz
- Worksheet #1—Water Well Condition and Construction
- Worksheet #2—Pesticides and Fertilizer Storage and Handling
- Worksheet #3—Household Waste Treatment
- Worksheet #4—Barnyard Management
- Worksheet #5—Milkhouse Waste Management
- Worksheet #6—Stream and Drainageway Management
- Worksheet #7—Petroleum Storage Management
- Worksheet #8—Silage Storage Management
- Worksheet #9—Animal Waste Storage Management
- Overall Farmstead Ranking

Material for the Pennsylvania Farm•A•Syst package was developed by revision of Farm•A•Syst material from the University of Wisconsin Cooperative Extension Service, University of Nebraska Cooperative Extension, Delaware Cooperative Extension System, and the National Farm•A•Syst/Home•A•Syst Program. Additional format and style features for the Pennsylvania package were adapted from the Ontario Environmental Farm Plan published by Ontario Farm Environmental Coalition, Ontario, Canada.

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