



#8 *Fact Sheet: Reducing the Risk of Groundwater Contamination by* **Improving Livestock Yards Management**

Besides addressing the potential of livestock yards to pollute groundwater, other good reasons for improving management practices include improved herd health, ease of maintenance and quality milk or meat production.

1. Distance from well

Wells should be located in an elevated area upslope of the livestock yard, so that runoff will not drain into the vicinity of the well. The recommended minimum separation between existing livestock yards and new wells is 50 feet. With good farmstead planning, livestock facilities would be 300-400 feet from the house. Since the well is often near the house, it is likely that there would be more than 200 feet between the well and the livestock yard.

Minimum separation distances regulate new well installations, as well as the distance from existing wells to new sources of contamination. 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 requirements, and strive to meet current regulations whenever possible.

2. Site characteristics

If groundwater protection is a major consideration in siting a livestock yard, soil characteristics are the most important factor. Important soil characteristics include surface and subsoil texture, soil depth, permeability and drainage class. The best site has a deep, well-drained silt loam/clay loam soil with low permeability. A very poor site has shallow soil, or a high water table, or a very sandy/gravelly soil with excessive drainage and high permeability. (For more assistance in assessing your site's vulnerability to groundwater contamination, see Worksheet #11, *Site Evaluation*.)

For existing livestock yards on poor sites, the best options for protecting groundwater might be eliminating the yard and using total confinement for the livestock or providing paved yards and liquid-tight basins to store yard runoff.

3. Clean water diversion

One way of reducing water pollution from livestock yards is to reduce the amount of clean water entering the yard. In all cases, these structures need to be maintained.

- * Waterways, small terraces and roof gutters direct water away from livestock yards.
- * An earthen ridge or terrace can be constructed across the slope upgrade from a livestock yard to prevent runoff from entering the yard.
- * In some areas, if a diversion terrace is not practical, a catch basin with a tile outlet could be installed above the livestock yard.

*For glossary,
see page 2 of
Worksheet #8.*

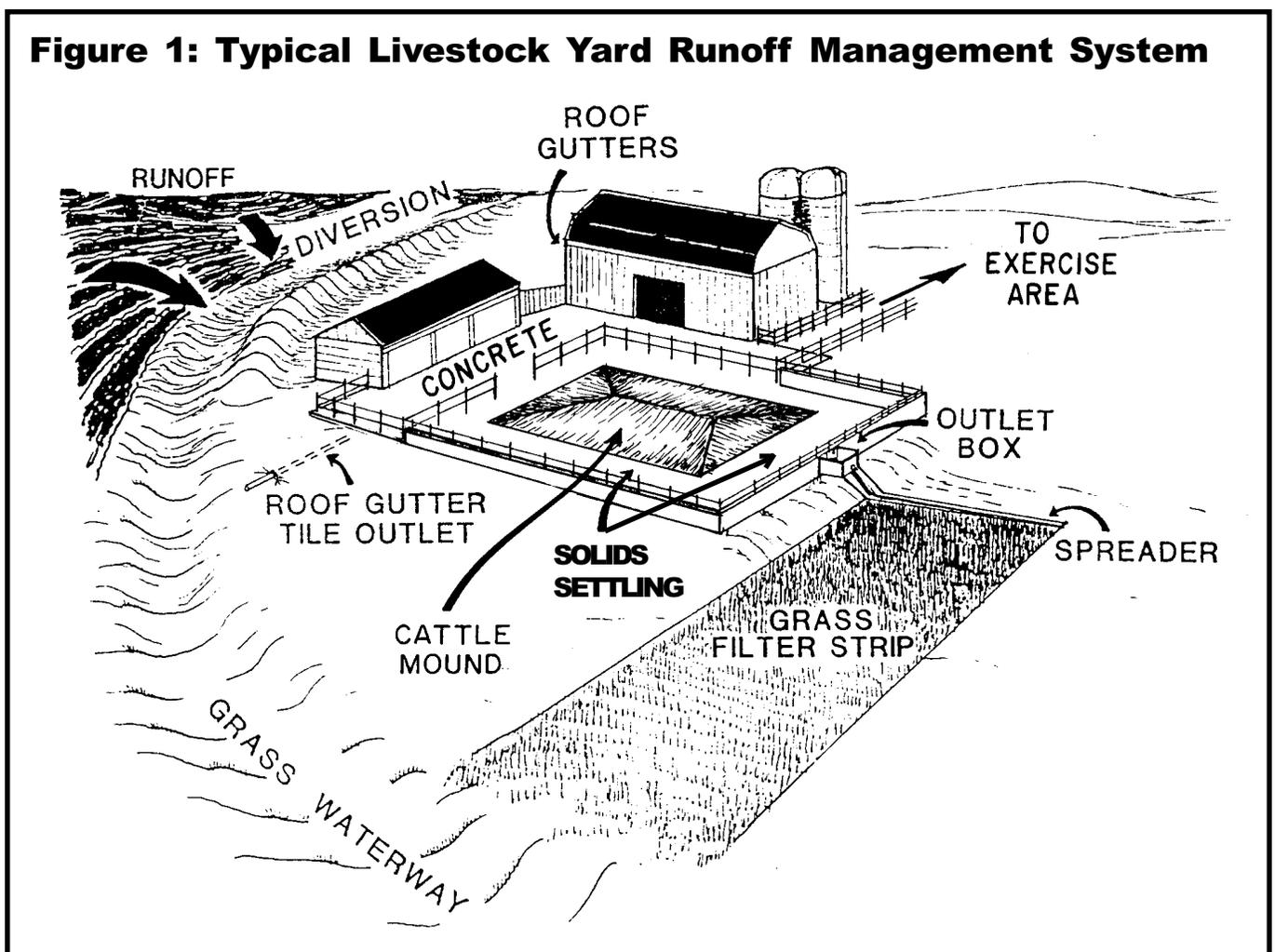
4. Runoff control systems

A livestock yard without a runoff control system typically has an earthen surface compacted by animal traffic. This surface is not shaped for water drainage, so it is sometimes dry and sometimes muddy. Manure typically accumulates on the surface, and decaying manure is mixed into the soil by animal traffic.

Water running off concrete pads located near barn doors and clean water from roofs and upslope areas can flush manure from the yard and create mudholes.

Such a yard is difficult to manage, and the absence of runoff controls may lead to water quality problems. Contaminated runoff from an active feedlot that accumulates in areas adjacent to the lot may flow through the soil and threaten groundwater quality. This risk is particularly high on sites with high infiltration and percolation rates, such as sandy soils and other soils with good to moderate drainage.

Runoff control systems can remedy such problem situations. These systems collect livestock yard runoff, settle out manure solids, and direct the remaining water to open fields or filter strips, away from streams, ditches, waterways and areas of permeable soils and creviced bedrock. Another option is to collect and store runoff for later land application. Figure 1 shows a typical livestock yard runoff control system.



Adapted from Barnyard Runoff Management, Wisconsin Department of Natural Resources and Department of Agriculture, Trade and Consumer Protection, 1987. Adapted by Leonard Massie, with graphic assistance by Andy Hopfensperger, University of Wisconsin-Madison Department of Agricultural Engineering.

5. Yard cleaning or scraping

Clean livestock yards regularly. The amount of manure on a livestock yard depends on the number of animals and the hours per day animals spend on the lot. Cleaning and scraping at least once per week is preferable. Heavy concentrations of animals may require solids removal more often. Concrete surfaces are easier to clean than earthen lots. Earthen yards are cleaned when dry, so solids may be removed less frequently.

6. Concentration of animals and type of yard surface

The area needed per animal for minimizing the risk of groundwater contamination depends on the type of lot surface. The amount of concrete surface area needed is much less than that required for an earthen lot.

The concrete area needed is a balance between traffic on the lot and resting area provided for animals. Too large an area results in manure freezing to the surface for long periods, while too small an area will result in animals having difficulty moving about.

For dairy operations, the best protection for groundwater is to confine animals to a free-stall barn or roofed yard. Where a yard is needed, 75 square feet of fenced concrete per cow is recommended (400 square feet of earthen surface) and roughly 2000 square feet of exercise area, if one is used. Direct runoff water carefully from the concrete onto the earthen area. Curbs will keep runoff from flowing off the edges of the concrete lot.

Yard management involves considerations other than surface and groundwater protection. A combination of yard surfaces can offer the most flexibility in adapting to weather conditions. Livestock location can be chosen based on the amount of mud in the yard: on concrete in sloppy conditions, on an earthen surface in dry weather, and on a mound in intermediate conditions.

The type of surface also affects management. Earthen yards, for example, might be cleaned only once or twice per year.

If bedrock is close to the surface where your livestock yard is located, pave the surface with concrete, or totally confine livestock.

7. Livestock storage and waste utilization

In addition to the condition of your livestock yards, your farm animal waste management should consider waste storage and utilization. (Worksheet and Fact Sheet #7, *Livestock Waste Storage*, provide guidelines for minimizing impact on groundwater.)

Ranging should be part of a crop rotation. Crop production on rangelands is designed to remove accumulated nutrients. High nutrient concentrations that are possible from poultry make this especially important.

Animal waste can be a valuable fertilizer and soil conditioner. When managed properly, the nutrients in manure can be substituted for commercial fertilizers, saving money and protecting groundwater and surface water. Matching nutrient applications to crop nutrient needs is critical.

8. Abandoned livestock yards

With active feedlots or yards, the layer of organic matter mixed with soil at the surface lies over compacted subsurface soil, forming a layer through which water moves very slowly. Therefore, leaching of nitrate and bacteria through the surface seal and compacted layers is not likely within the livestock yard. If livestock yard runoff is discharged to permeable soils or bedrock, leaching may occur. Studies have found little nitrate in the soil of active feedlots.

Nevertheless, abandoned yards can pose a particular groundwater contamination risk. As the manure pack breaks up from lack of use, water can leach through and reach the groundwater.

If you have a permanently abandoned yard, dig it up, spread the manure and soil combination on fields, and refill the former yard with other material. Another option is to till and plant the yard to a high-nitrogen-using crop, which will use the nitrogen released by soil and the manure decomposition process. Remove manure from a feedlot that will not be used for an extended period. Otherwise, cracks developing in the surface may allow leaching of nitrates.

CONTACTS AND REFERENCES

Who to call about...

Design assistance and technical standards for runoff control systems

Your Natural Resources Conservation Service office or Extension office.

Financial and technical assistance in remedying a risky situation

Your Natural Resources Conservation Service office or Extension office.

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.)

Nitrate contamination of groundwater

Bacterial Contamination of Drinking Water. Wisconsin Department of Natural Resources. PUBL-WS-003.86REV. (2)

Nitrate in Drinking Water. Wisconsin Department of Natural Resources. PUBL-WS-001.86REV. (2)

Health effects of nitrate in groundwater

Nitrate, Groundwater and Livestock Health. University of Wisconsin-Extension. G3217. (1)

Nitrates and Groundwater: A Public Health Concern. 1988. Freshwater Foundation. (4)

Management of livestock yards

Barnyard Runoff Management. 1987. Wisconsin Department of Natural Resources and Department of Agriculture, Trade and Consumer Protection. (2)

Design criteria and general information

Beef Housing and Equipment Handbook. Midwest Plan Service. MWPS-6 (3)

Sheep Housing and Equipment Handbook. Midwest Plan Service. MWPS-3. (3)

Swine Housing and Equipment Handbook. Midwest Plan Service. MWPS-8. (3)

Dairy Housing and Equipment Handbook. Midwest Plan Service. MWPS-7. (3)

Livestock Waste Facilities Handbook. Midwest Plan Service. MWPS-18. (3)

Publications available from...

1. Agricultural Bulletin, Room 245, 30 N. Murray Street, Madison, Wisconsin 53715, (608) 262-3346. There may be charges for publications, postage and sales tax.
2. Wisconsin Department of Natural Resources, Bureau of Water Supply, P.O. Box 7921, Madison, Wisconsin 53707, (608) 266-0821.
3. The Midwest Plan Service Secretary, Agricultural Engineering Department, 460 Henry Mall, University of Wisconsin, Madison, Wisconsin 53706, (608) 262-3310.
4. Freshwater Foundation at Spring Hill Center, 725 County Road 6, Wayzata, Minnesota 55391, (612) 449-0092.



The New Jersey Farmstead Assessment System is a cooperative project of the USDA Natural Resources Conservation Service, Rutgers Cooperative Extension, and New Jersey Department of Environmental Protection.

New Jersey Farm•A•Syst team members: **Susan Lance Scibilia**, Program Associate in Water Quality, Rutgers Cooperative Extension and **Fred Kelly**, Resource Conservationist, USDA Natural Resources Conservation Service.

Written by Leonard Massie, Department of Agricultural Engineering, University of Wisconsin-Madison, and University of Wisconsin-Extension, Cooperative Extension.

Materials adapted for New Jersey use from the Wisconsin-Minnesota Farm-A-Syst Program by Susan Lance, Program Associate in Water Quality, Rutgers Cooperative Extension; Fred Kelly, Resource Conservationist, USDA Natural Resources Conservation Service; Theodore B. Shelton, Extension Specialist in Water Resources Management.

Technical review provided by Fred Kelly, Resource Conservationist, USDA Natural Resources Conservation Service.

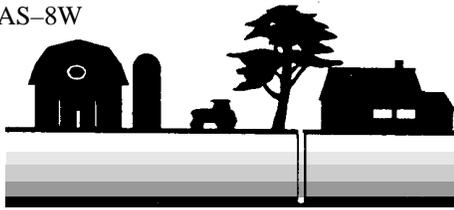
While technical reviewers provided guidance in copy revisions and assisted in assuring accuracy of content, the views expressed in this publication are those of the author and do not necessarily reflect the views of either the technical reviewers or the agencies they represent.

This publication is available from your New Jersey county Extension office or from the Publications-Distribution Center, Cook College, Rutgers University, PO Box 231, New Brunswick, NJ 08903, (732) 932-9762.

Distributed in cooperation with U.S. Department of Agriculture in furtherance of the Acts of Congress of May 8 and June 3, 1914. Cooperative Extension work in agriculture, home economics, and 4-H, Zane R. Helsel, director of Extension. Rutgers Cooperative Extension provides information and education services to all people without regard to sex, race, color, national origin, disability or handicap, or age. Rutgers Cooperative Extension is an Equal Opportunity Employer.

The United States Department of Agriculture (USDA) prohibits discrimination in its programs on the basis of race, color, national origin, sex, religion, age, disability, political beliefs and marital or familial status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (braille, large print, audiotape, etc.) should contact the USDA Office of Communications at (202) 720-5881 (voice) or (202) 720-7808 (TDD). To file a complaint, write the Secretary of Agriculture, U.S. Department of Agriculture, Washington, D.C., 20250, or call (202) 720-7327 (voice) or (202) 690-1538 (TDD). USDA is an Equal Opportunity Employer.





NEW JERSEY FARM-A-SYST

A FARMSTEAD WATER QUALITY ASSESSMENT SYSTEM

#8 *Worksheet: Assessing the Risk of Groundwater Contamination from Livestock Yards Management*

Why should I be concerned?

Livestock yards, such as barnyards, holding areas and feedlots, are areas of concentrated livestock wastes. They can be a source of nitrate and bacteria contamination of groundwater. This is especially true if there is no system to 1) divert clean water flow from the livestock yard or 2) collect polluted runoff from the yard for diversion to an area where its effect on surface water or groundwater is minimal. The potential for livestock yards to affect groundwater is greatest if the yard is located over coarse-textured permeable soils, if the water table is at or near the surface, if bedrock is within a few feet of the surface, or when polluted runoff is discharged to permeable soils and bedrock.

Nitrate levels in drinking water above federal and state drinking water standards of 10 milligrams per liter (mg/l; equivalent to parts per million for water measure) nitrate-nitrogen can pose health problems for infants under 6 months of age, including the condition known as methemoglobinemia (blue baby syndrome). Nitrate can also affect adults, but the evidence is much less certain.

Young livestock are also susceptible to health problems from high nitrate-nitrogen levels. Levels of 20-40 mg/l in the water supply may prove harmful, especially in combination with high levels (1,000 ppm) of nitrate-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 lend an undesirable taste and odor to drinking water, are not known to be dangerous to health, but their presence does suggest that other contaminants are flowing directly into groundwater.

The goal of Farm•A•Syst is to help you protect the groundwater that supplies your drinking water.

How will this worksheet help me protect my drinking water?

- It will take you step by step through your livestock yards management practices.
- It will rank your activities according to how they might affect the groundwater that provides your drinking water supplies.
- It will provide you with easy-to-understand rankings that will help you analyze the “risk level” of your livestock yards management practices.
- It will help you determine which of your practices are reasonably safe and effective, and which practices might require modification to better protect your drinking water.

How do I complete the worksheet?

Follow the directions at the top of the chart on the next page. It should take you about 15-30 minutes to complete this worksheet and figure out your ranking.

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.

Glossary

Livestock Yards Management

These terms may help you make more accurate assessments when completing Worksheet #8. They may also help clarify some of the terms used in Fact Sheet #8.

Filter strip: A gently sloping grass plot used to filter runoff from the livestock yard. Influent waste is distributed uniformly across the high end of the strip and allowed to flow down the slope. Nutrients and suspended material remaining in the runoff water are filtered through the grass, absorbed by the soil and ultimately taken up by the plants. Filter strips must be designed and sized to match the characteristics of the livestock yard.

Infiltration: The downward entry of water through the soil surface.

Percolation: The downward movement of water through the soil.

Runoff control system: A combination of management practices that can be used together to prevent water pollution from livestock yard runoff. Practices may include diversion of runoff from the yard, roof runoff systems, yard shaping, settling basins, and filter strips or buffer areas.

Soil drainage class: The conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soils, as opposed to human-altered drainage. Different classes are described by such terms as excessively drained, well-drained, and poorly drained.

Soil permeability: The quality that enables the soil to transmit water or air. Slowly permeable soils have fine-textured materials, like clays, that permit only slow water movement. Moderately or highly permeable soils have coarse-textured materials, like sands, that permit rapid water movement.

Soil texture: The relative proportions of the various soil separates (clay, sand, silt) in a soil. Described by such terms as sandy loam and silty clay.

Livestock Yards Assessment: Assessing Drinking Water Contamination Risk

1. Use a pencil. You may want to make changes.
2. For each category listed on the left that is appropriate to your farmstead, read across to the right and circle the statement that **best** describes conditions on your farmstead. (Skip and leave blank any categories that don't apply to your farmstead.)
3. Then look above the description you circled to find your "rank number" (4, 3, 2 or 1) and enter that number in the blank under "your rank."
4. Directions on overall scoring appear at the end of the worksheet.
5. Allow about 15-30 minutes to complete the worksheet and figure out your risk ranking for livestock yards management.

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
LOCATION					
Distance from drinking water well	More than 200 feet.	100-200 feet.	50-100 feet.	Less than 50 feet.	_____
SITE CHARACTERISTICS					
Soil depth and permeability	Well-drained medium- or fine-textured soils (loam, silt loam, clay loams, clays). With low permeability (silt and clay). More than 40 inches deep with low permeability (silt and clay).	Well-drained or moderately well-drained medium- or fine-textured soils (loam, silt loam, clay loams, clays). 30-40 inches deep with moderate permeability (loamy).	Moderately well-drained coarse-textured soils (sands, sandy loam). Shallow (20-30 inches) and/or high permeability (sandy).	Excessively well-drained coarse-textured soils (sands, sandy loam) to gravel, and/or somewhat poorly drained soil to poorly drained soils. Very shallow (less than 20 inches) and/or very high permeability (coarse sand).	_____
DESIGN AND MANAGEMENT					
Surface water diversion	All upslope and roof water diverted.	Most upslope surface and roof water diverted.	No surface water diverted. Some roof water collected and redirected.	All water (surface and roof water) runs through the yard.	_____
Lot runoff control system	No yard runoff (either barn or roofed area).	All runoff collected from curbed lot. Solids separated. Water directed onto filter strip.	Most of lot runoff collected. Some solids removed. No filter strip.	Lot runoff uncontrolled.	_____
Yard cleaning and scraping practice	No yard (animals confined).	Once per week.	Once per month.	Rarely.	_____

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
CONCENTRATION OF ANIMALS ON YARD [square feet per animal (sf/a)]*					
Dairy cows	No yard. Confined to barn or roofed yard.	75 sf/a or more on fenced, curbed concrete pad and/or 400 sf/a on graded earthen surface. More than 1800 sf/a in exercise area.	50 sf/a or more on concrete and/or 200-300 sf/a on earthen surface. More than 1200 sf/a in exercise area.	Some concrete (less than 50 sf/a) and earth (less than 100 sf/a).	_____
Dairy replacements	No yard. Confined to barn or roofed yard.	More than 40 sf/a on fenced, curbed concrete pad and/or 150-200 sf/a on earthen yard.	More than 20 sf/a on concrete and/or more than 75 sf/a on earthen surface.	Less than 75 sf/a on earth.	_____
Beef feeders	No yard. Confined to barn with slotted floor.	Barn and/or paved lot more than 50 sf/a. Earthen lot with mound more than 300 sf/a, or without mound more than 500 sf/a.	No shelter and paved lot 40-50 sf/a. Earthen with mound more than 150 sf/a or earthen without mound less than 250 sf/a.	Paved less than 30 sf/a, or earthen less than 150 sf/a.	_____
Beef cows/heifers	Barn or roofed lot.	Barn with paved lot more than 60 sf/a. Earthen with mound more than 400 sf/a. Earthen without mound more than 600 sf/a.	Paved lot more than 30 sf/a. Earthen with mound more than 200 sf/a. Earthen without mound more than 300 sf/a.	Earthen without mound less than 200 sf/a.	_____
Sheep/ewes	No yard. Confined to barn or roofed yard.	Barn and paved lot more than 20 sf/a. Earthen more than 40 sf/a.	Barn and paved lot less than 15 sf/a. Earthen less than 25 sf/a.	Earthen less than 10 sf/a.	_____
Feeder lambs	No yard. Confined to barn.	Barn and paved lot more than 10 sf/a. Earthen more than 25 sf/a.	Barn and paved lot more than 5 sf/a. Earthen more than 10 sf/a.	Earthen less than 10 sf/a.	_____

*Animal concentrations derived from Midwest Plan Service publications and other sources.

	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	YOUR RANK
CONCENTRATION OF ANIMALS ON YARD [square feet per animal (sf/a)]*					
Hogs/sows	No yard. Confined to barn.	Shed and paved lot more than 30 sf/a.	Shed and earthen lot less than 15 sf/a.	Shed and earthen lot less than 10 sf/a.	_____
Pigs: growing/finishing	No yard. Confined to barn.	Shed and paved lot more than 15 sf/a.	Shed and earthen lot more than 15 sf/a.	Shed and earthen lot less than 10 sf/a.	_____
Horses	No yard. Confined to barn or on pasture.	Earthen exercise lot more than 2500 sf/a. No pasture.	Earthen lot more than 1500 sf/a. No pasture.	Earthen lot less than 1000 sf/a. No pasture.	_____
Chickens:					
Broilers	No lot. In building with watering system in good working order. Runoff protected.	No lot. In building with watering system in good working order. Inadequate runoff protection.	Earthen lot of 2 sf/a or more, on medium-textured soils (silt loam, loam). Water table deeper than 20 feet.	Earthen lot of 2 sf/a or more, on coarse-textured soils (sands, sandy loam). Water table shallower than 20 feet.	_____
Layers	No lot. In building with watering system in good working order. Runoff protected.	No lot. In building with watering system in good working order. Inadequate runoff protection.	Earthen lot of 4 sf/a or more, on medium-textured soils (silt loam, loam). Water table deeper than 20 feet.	Earthen lot of 4 sf/a or more, on coarse-textured soils (sands, sandy loam). Water table shallower than 20 feet.	_____
Turkeys	No lot. In building with watering system in good working order. Runoff protected.	No lot. In building with watering system in good working order. Inadequate runoff protection.	Earthen lot of 8 sf/a or more, on medium-textured soils (silt loam, loam). Water table deeper than 20 feet.	Earthen lot of 8 sf/a or more, on coarse-textured soils (sands, sandy loam). Water table shallower than 20 feet.	_____
Ducks	No lot. In building with watering system in good working order. Runoff protected.	No lot. In building with watering system in good working order. Inadequate runoff protection.	Earthen lot of 4 sf/a or more, on medium-textured soils (silt loam, loam). Water table deeper than 20 feet.	Earthen lot of 4 sf/a or more, on coarse-textured soils (sands, sandy loam). Water table shallower than 20 feet.	_____

*Animal concentrations derived from Midwest Plan Service publications and other sources.

TOTAL

Use this total to calculate risk ranking on back page of worksheet.

What do I do with these rankings?

Step 1: Begin by determining your overall livestock yards risk ranking. Total the rankings for the categories you completed and divide by the number of categories you ranked:

$$\frac{\text{total of rankings}}{\text{\# of categories ranked}} \text{ divided by } \frac{\text{\# of categories ranked}}{\text{\# of categories ranked}} \text{ equals } \boxed{\text{risk ranking}}^*$$

*Carry your answer out to one decimal place.

3.6–4=low risk, 2.6–3.5=low to moderate risk, 1.6–2.5=moderate to high risk, 1–1.5=high risk

This ranking gives you an idea of how your livestock yards management practices **as a whole** might be affecting your drinking water. This ranking should serve only as a **very general guide, not a precise diagnosis**. Because it represents an **averaging** of many individual rankings, it can mask any **individual** rankings (such as 1's or 2's) that should be of concern. (See Step 2.)

Enter your boxed livestock yards management risk ranking on page 1 of Worksheet #12. Later you will compare this risk ranking with other farmstead management rankings. Worksheet #11 will help you identify your farmstead's site conditions (soil type, soil depth and bedrock characteristics). Worksheet #12 will show you how these site conditions affect your risk rankings.

Step 2: Look over your rankings for individual activities:

- Low-risk** practices (4's): ideal; should be your goal despite cost and effort
- Low-to-moderate-risk** practices (3's): provide reasonable groundwater protection
- Moderate-to-high-risk** practices (2's): inadequate protection in many circumstances
- High-risk** practices (1's): inadequate; pose a high risk of polluting groundwater

Regardless of your overall risk ranking, any individual rankings of "1" require immediate attention. Some concerns you can take care of right away; others could be major—or costly—projects, requiring planning and prioritizing before you take action.

Find any activities that you identified as 1's and list them under "High-Risk Activities" on pages 6-7 of Worksheet #12.

Step 3: Read Fact Sheet #8, *Improving Livestock Yards Management*, and consider how you might modify your farmstead practices to better protect your drinking water.



The New Jersey Farmstead Assessment System is a cooperative project of the USDA Natural Resources Conservation Service, Rutgers Cooperative Extension, and New Jersey Department of Environmental Protection.

New Jersey Farm•A•Syst team members: **Susan Lance Scibilia**, Program Associate in Water Quality, Rutgers Cooperative Extension and **Fred Kelly**, Resource Conservationist, USDA Natural Resources Conservation Service.

Written by **Leonard Massie**, Department of Agricultural Engineering, University of Wisconsin-Madison, and **University of Wisconsin-Extension, Cooperative Extension**.

Materials adapted for New Jersey use from the Wisconsin-Minnesota Farm-A-Syst Program by Susan Lance, Program Associate in Water Quality, Rutgers Cooperative Extension; Fred Kelly, Resource Conservationist, USDA Natural Resources Conservation Service; Theodore B. Shelton, Extension Specialist in Water Resources Management.

Technical review provided by Fred Kelly, Resource Conservationist, USDA Natural Resources Conservation Service.

While technical reviewers provided guidance in copy revisions and assisted in assuring accuracy of content, the views expressed in this publication are those of the author and do not necessarily reflect the views of either the technical reviewers or the agencies they represent.

This publication is available from your New Jersey county Extension office or from the Publications-Distribution Center, Cook College, Rutgers University, PO Box 231, New Brunswick, NJ 08903, (732) 932-9762.

Distributed in cooperation with U.S. Department of Agriculture in furtherance of the Acts of Congress of May 8 and June 3, 1914. Cooperative Extension work in agriculture, home economics, and 4-H, Zane R. Helsel, director of Extension. Rutgers Cooperative Extension provides information and education services to all people without regard to sex, race, color, national origin, disability or handicap, or age. Rutgers Cooperative Extension is an Equal Opportunity Employer.

The United States Department of Agriculture (USDA) prohibits discrimination in its programs on the basis of race, color, national origin, sex, religion, age, disability, political beliefs and marital or familial status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (braille, large print, audiotape, etc.) should contact the USDA Office of Communications at (202) 720-5881 (voice) or (202) 720-7808 (TDD). To file a complaint, write the Secretary of Agriculture, U.S. Department of Agriculture, Washington, D.C., 20250, or call (202) 720-7327 (voice) or (202) 690-1538 (TDD). USDA is an Equal Opportunity Employer.

