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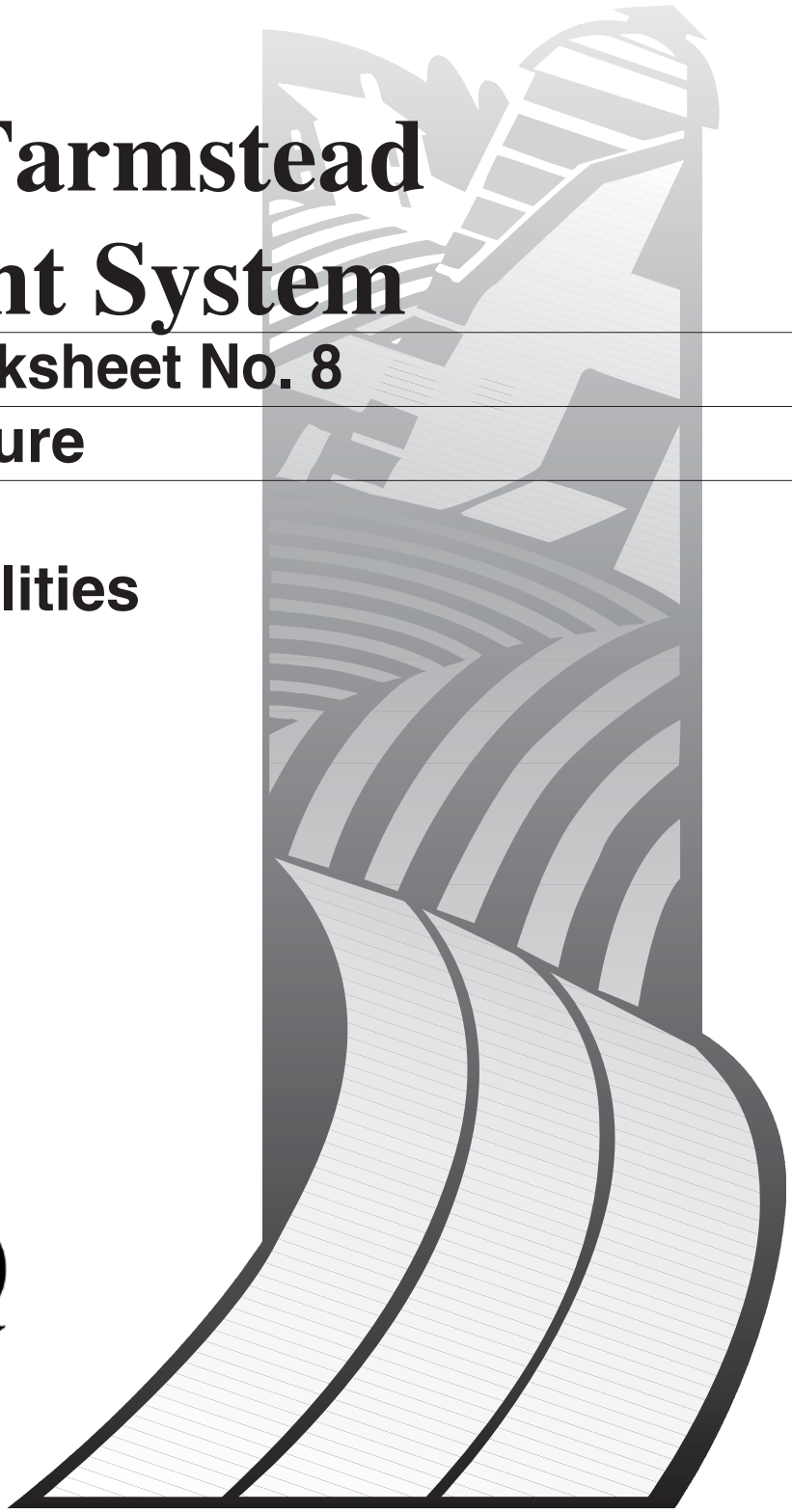
VIRGINIA FARM*A*SYST

Virginia Farmstead Assessment System

Fact Sheet/Worksheet No. 8

Livestock Manure Storage and Treatment Facilities



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INTRODUCTION TO THE VIRGINIA FARMSTEAD ASSESSMENT SYSTEM

Water wells and springs are the most common sources of private household water for rural homesites and farmsteads in Virginia. However, activities related to these environments may contribute to contamination of the groundwater which so many rural residents depend upon for household water. For example, farm facilities such as chemical and fuel storage tanks, livestock and poultry holding areas, irrigation systems, and septic systems are sometimes located near the farmstead well or spring. Retail agribusinesses and enterprises such as nurseries, greenhouses and direct farm markets are unique operations that may have production, storage, and sales areas close to a water well which may be also exposed to the general public. Inadequate maintenance of well-head and farmstead facilities and/or poor farmstead management practices can contribute to contamination of groundwater and drinking water supplies. Rural residents need to be aware of threats to water quality and of measures that will reduce or eliminate contamination of household water supplies.

To meet these challenges, as a part of a nationwide effort, the Virginia Farmstead Assessment System (Virginia Farm *A* Syst) was developed. This voluntary, educational/technical program is mainly a preventive program designed to: (1) provide safe, drinking water and thereby protect the health of Virginia's rural residents; (2) reduce potential land owner liability due to groundwater contamination which may result from farmstead or retail agribusiness activities; and (3) maintain or enhance farm property values throughout Virginia.

The Farm *A* Syst program is designed to guide an individual through a step-by-step evaluation of factors such as soils and geologic properties of the site, well-head or spring condition, and farmstead management practices that may impact the quality of his/her groundwater/drinking water supply. The program participant can identify potential pollution sources, and make an assessment of pollution risks to existing water supplies. Based on identified risks, corrective measures and/or management practices can be selected to reduce the likelihood of contamination.

This assessment is conducted by using a series of fact sheets and worksheets. A fact sheet /worksheet set deals with a specific pollution factor or source such as household wastewater, chemical storage, etc. Fact sheets are explanatory materials that contain background information on factors that affect groundwater quality, and legal requirements which address water quality and environmental protection. Worksheets are provided to determine ranking of potential pollution risks for each problem described in the fact sheets.

Each worksheet consists of a series of questions related to a specific farmstead feature or management practice such as well-head condition, fertilizer/chemical use, soils and geology of the site, etc. Based on the response to each question, a numerical ranking which indicates relative groundwater pollution risks is calculated. These rankings can then be used as a guideline to identify and prioritize corrective measures that will reduce or eliminate the potential for groundwater/drinking water pollution.

Users of this package need only to select those fact sheets/worksheets which are applicable to his/her activities or specific situations. For example, those evaluating rural, non-farm, homesite water supplies may select Fact Sheets/ Worksheets No. I -No. 5. Fact sheets/worksheets that will be important to many agribusinesses are No. 1 - No. 7. Some farming operations may relate to all worksheets. It is strongly recommended that the fact sheet corresponding to each worksheet be reviewed before using the worksheet itself. After developing a good understanding of each fact sheet, it will take about 15-30 minutes to complete each worksheet except for Worksheet No. 1 (Soils and Geology). To accomplish the task one needs only a pencil and a simple calculator. Each worksheet provides directions for completing the task. In addition, all users will need Worksheet No. 13 (Overall Risk Assessment). Fact Sheet/Worksheet No. 14 (Management of Irrigation Systems) was developed as an addendum chapter to the original Virginia Farm *A* Syst package and can be used in a stand alone manner or incorporated into the Overall Risk Assessment (Worksheet No. 13) as part of a complete farm assessment.

The Virginia Farm * A * Syst package contains the following Fact Sheets and Worksheets:

Fact Sheet/Worksheet No. 1 - Site Evaluation: Groundwater, Soils & Geology

Fact Sheet/Worksheet No. 2 - Well and Spring Management

Fact Sheet/Worksheet No. 3 - Household Wastewater Treatment and Septic Systems

Fact Sheet/Worksheet No. 4 - Hazardous Waste Management

Fact Sheet/Worksheet No. 5 - Petroleum Products Storage

Fact Sheet/Worksheet No. 6 - Fertilizer Storage, Handling, and Management

Fact Sheet/Worksheet No. 7 - Pesticide Storage, Handling, and Management

Fact Sheet/Worksheet No. 8 - Livestock and Poultry Yard Management

Fact Sheet/Worksheet No. 9 - Livestock Manure Storage and Treatment Facilities

Fact Sheet/Worksheet No. 10 - Poultry Litter Management and Carcass Disposal

Fact Sheet/Worksheet No.11- Milking Center Wastewater Treatment and Management

Fact Sheet/Worksheet No. 12 - Silage Storage and Management

Worksheet No. 13 - Overall Risk Assessment

Fact Sheet/Worksheet No. 14 - Management of Irrigation Systems

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Livestock and Poultry Yard Management

Fact Sheet and Worksheet No. 8 were modified by Eldridge Collins (Biological Systems Engineering Department, Virginia Tech).

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Livestock and poultry yards, such as barnyards, holding areas and feedlots, and areas around production buildings are areas of concentrated animal 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/poultry yard, 2) drain surface water away from wells or springs, or 3) 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 and poultry operations to affect groundwater is greatest if the facility or area of animal concentration is located on karst terrain or over sandy-textured permeable soils, or when the water table is at or near the surface, bedrock is within a few feet of the surface, or polluted runoff is discharged to permeable soils and bedrock.

The federal and state standard for nitrate in drinking water is 10 milligrams per liter [mg/l; equivalent to parts to million (ppm) for water measure] nitrate-nitrogen. Nitrate levels above this standard can pose health problems for infants under 6 months of age, including the condition known as blue baby syndrome (methemog-lobinemia). Fecal bacteria in livestock and poultry wastes can contaminate groundwater if waste seeps into nearby wells or springs, partially leading to such infectious diseases as dysentery, typhoid, and hepatitis.

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 mg/l) of nitrate-nitrogen from feed sources.

Other good reasons for improving management practices include improved herd and flock health, ease of maintenance, odor and fly control, and improved quality milk or meat production.

I. DISTANCE FROM WELL/SPRING

Wells and springs should be located upslope from the livestock and poultry feed yard and buildings so that runoff will drain away from the water source. The Virginia water well code requires a minimum separation of 150 feet between existing yards and new wells. With good farmstead planning, livestock and poultry facilities should be at least 300-400 feet away from the house. In this case, since the well is often near the house, it is likely that there would be at least 200 feet between the well and the feed yard or open lot surface. 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 meet current regulations whenever possible.

II. SITE CHARACTERISTICS

Groundwater protection should be a major consideration in siting feed yards, holding pens, or production buildings. Factors to consider include topography, soils and geology. Important soil characteristics include surface and subsoil texture, depth, and permeability. A very poor site has shallow soil, 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 Fact Sheet/Worksheet No. 1, "Site Evaluation: Groundwater, Soils, and Geology".

For existing feed yards on poor sites, the best options for protecting groundwater might be replacement with total confinement buildings with concrete floors for the livestock or poultry, or providing paved yards and liquid-tight basins (e.g. clay-lined or artificial liner) to store open yard runoff. The lot slope should be 3-4% (uniform grade) to allow rapid water drainage into the designed basin.

III. DESIGN AND MANAGEMENT

A. CLEAN WATER DIVERSION

One way of reducing water pollution from livestock feed yards is to reduce the amount of clean water entering the open lot. In all cases, the following structures need to be in place and maintained:

- Waterways, small terraces and roof gutters to direct water away from livestock and poultry pens and buildings.

- An earthen ridge or diversion terrace constructed across the slope upgrade to prevent runoff from entering the yard.

- In some areas, if a diversion terrace is not practical, a catch basin with a pipe outlet could be installed above the yard.

B. RUNOFF CONTROL SYSTEM

An open lot without a runoff control system typically has an earthen surface compacted by animal traffic. This surface needs to be shaped to a uniform grade for water drainage so it will remain relatively dry except during and immediately after rainfall. Manure typically accumulates on the surface and is mixed into the soil by animal traffic, thereby sealing the surface and reducing infiltration.

Water that runs off concrete pads, such as those located near barn doors, loading docks and material handling areas, and clean water that drains from roofs and upslope areas can wash manure from the open lot surface and create mudholes. Planning for such runoff is necessary.

Uniform drainage of the open lot surface is necessary, and the absence of runoff controls may lead to surface water quality problems. Contaminated runoff that accumulates in areas adjacent to an active feedlot may seep through the soil and threaten groundwater quality. This risk is greatest with soils of high infiltration capacity, such as sands and other soils with moderate to rapid internal drainage.

Runoff control systems can remedy such problem situations. Producers should collect runoff for storage and later land application (See Fact Sheet No.9, Section V). For frequently used livestock pens, these systems collect feedlot runoff, settle out manure solids, and direct the remaining runoff water through filter strips, and away from streams, ditches, waterways and areas of permeable soils and fractured bedrock. Figure 1 shows a typical livestock feedlot runoff control system for an open lot surface.

C. FEEDLOT CLEANING OR SCRAPING

Clean feedlot and pen surfaces regularly. The amount of manure on a feedlot surface depends on the animal density (square feet per head), hours per day animals spend on the open lot, animal size, and type of feed ration. Cleaning or scraping at least once per week is preferable. Concrete surfaces are easier to clean than earthen lots. Earthen yards are not recommended in Virginia, but may be cleaned when dry, which will result in less frequent removal of solids.

IV. CONCENTRATION OF ANIMALS AND TYPE OF YARD SURFACE

The area needed per animal to minimize 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 the resting area provided for animals. Too small an area will result in animals having difficulty moving about under wet conditions in pens, while too large an area is an extra expense and generates more runoff. For dairy operations, the best protection for groundwater is to confine animals to a freestall barn or roofed feeding barn. Where a yard is desired, 75 square feet of concrete per cow is recommended (400 square feet of earthen surface) and, if it will be used, about 2000 square feet of exercise area.

Where earthen lots will be used, maintenance of a compacted manure layer on the earthen open lot surface may help retard infiltration and reduce the amount of nitrate. Curbs will keep runoff from flowing off the edges of the concrete lot onto earthen areas.

The type of lot surface used also affects management. Earthen yards, for example, might be cleaned only once or twice per year. If a porous condition such as fractured bedrock is close to the surface where your livestock yard is located, it is advisable to pave the surface.

The "Dairy Loafing Lot Rotational Management System" has been approved as a cost-shared Best Management Practice (BMP) under the Virginia Department of Conservation and Recreation-Division of Soil and Water Conservation. This practice provides three grass loafing paddocks (about 33 cows/acre each) and one "sacrifice" paddock for use by a typical dairy herd outside the barn. Cows are allowed to rest on a paddock until surface conditions dictate rotation to one of the other paddocks. During wet periods, or when grass sod is likely to be damaged or destroyed, cows are placed in the "sacrifice" lot or confined to the barn until paddock conditions improve. The sacrifice paddock is typically protected from generating direct runoff to streams by location of the grassed paddocks. Figure 2 shows a schematic diagram of a dairy loafing lot rotational management system.

V. ABANDONED LIVESTOCK YARDS AND POULTRY HOUSES

In active feedlots and yards, the manure/soil mixture over compacted soil forms a barrier through which water moves very slowly. Therefore, rapid leaching of nitrate and bacteria through the surface seal and compacted layers is not likely. However, if this manure/soil layer is removed, or if open lot runoff is discharged to permeable soils, sinkholes, or bedrock, leaching to groundwater may occur.

Abandoned poultry houses or old earthen poultry house foundations can be threats to farmstead water sources. Similarly, abandoned feedyards and barn-lots also pose groundwater contamination risks. If you have such a lot or structure, collect all manure or litter, and spread it on crop fields according to recommended nutrient management practices. In the case of earthen floor facilities, soil to a depth of one foot should be removed and spread with the manure or litter. The remaining hole should be filled and leveled. Litter packs remaining from demolished poultry houses should also be removed and properly land applied or stored. The soil area under the litter pack should be sampled and tested for nitrogen, phosphorus, potassium, sodium-chloride, nitrates, and sulfates.

If you have a permanently abandoned feedlot or corral, collect all the manure, spread the manure and soil mixture on fields following appropriate procedures, and refill the former feedlot surface with other soil material. Then till and plant to a high-nitrogen-using crop. Manure should also be removed from a feedlot that is not being used for an extended period. Otherwise, cracks developing in the surface may allow leaching of nitrate and bacteria.

CONTACTS AND REFERENCES

For additional information, consult the Virginia Farm*A*Syst Resource Directory.For assistance in sampling, interpreting results, and dealing with remaining problems, contact your Cooperative Extension or Natural Resources Conservation Service office.

For additional information, you may contact your local Virginia Cooperative Extension or Natural Resources Conservation Service office, or the Virginia Department of Conservation and Recreation Division of Soil and Water Conservation Office.

GLOSSARY

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 and waste water flow of the livestock yard. A typical practice is to provide a filter strip area about equal to 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, upslope diversions, 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."

WORKSHEET NO. 8 LIVESTOCK AND POULTRY YARD MANAGEMENT

Read Fact Sheet No. 8, " Livestock and Poultry Yard Management," before completing this worksheet.

How will this worksheet help you protect your drinking water?

- It will take you step by step through your drinking water well or spring condition and management practices.
- It will rank your activities according to how they might affect the groundwater that provides your drinking water.
- It will provide you with easy-to-understand rankings that will help you analyze the "relative risk" to your drinking water well or spring.
- 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.

Follow the directions below.

Note: You will probably want to make a print-out of this worksheet to complete it.

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.)

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 rank.

LOCATION					
Distance live-stock /poultry facility from drinking water well or spring.	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	RISK NUMBER
	More than 200 feet	150-200 feet	100-150 feet	Less than 100 feet	

SITE CHARACTERISTICS					
	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	RISK NUMBER
Soil depth and permeability	Well-drained medium- or fine-textured soils (loam, silt loam, clay loam, clay) and/or low permeability. More than 40 in. deep.	Well-drained medium- or fine-textured soils (loam, silt loam, clay loam, clay) and/or low permeability. More than 40 in. deep. Well-drained or moderately well-drained medium- or fine-textured soils (loam, silt loam, clay loam, clay). 30-40 in. deep and/or moderate permeability.	Moderately well-drained coarse-textured soils (sand, sandy loam), 20-30 in. deep and/or high permeability.	Excessively well-drained coarse-textured soils (sand, sandy loam) to gravel, and/ or somewhat poorly drained soil to poorly drained soils. Very shallow (less than 20 in.) and/or very high permeability.	

DESIGN AND MANAGEMENT					
	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	RISK NUMBER
Surface water diversion	All upslope surface and roof water diverted.	Most upslope surface and roof water diverted.	No surface water diverted. Some roof water diverted.	All water (surface and roof water) runs through the yard.	
Lot runoff control system	No yard runoff produced (either barn or roofed area).	All runoff collected from open lots and routed through solids settling basins. Soils separated. Water directed through filter strip.	Most of lot runoff collected. Some solids removed. No filter strip.	Lot runoff uncontrolled.	
Feedlot cleaning and scraping practices.	Feedlot cleaning and scraping practices.	Once or twice per month leaving undisturbed manure layer.	Once or twice per year without maintaining manure layer for seal.	Rarely.	

CONCENTRATION OF LIVESTOCK [square feet per head (sf/hd)]					
	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	RISK NUMBER
Dairy cows	No yard. Confined to barn or roofed area, or on vegetated pasture.	75 sf/hd or more on fenced, curbed concrete pad and/ or 400 sf/hd on graded earthen surface. More than 1800 sf/hd in exercise area.	50 sf/hd or more on concrete and/ or 200-300 sf/hd on earthen surface. More than 1200 sf/hd in exercise area.	Some concrete (less than 50 sf/ hd) and earthen surface (less than 100 sf/hd).	
Dairy replacements	No yard. Confined to barn or roofed area, or on vegetated pasture.	More than 40 sf/ hd on fenced, curbed concrete pad and/or 150-200 sf/hd on earthen surface.	More than 20 sf/ hd on concrete and/or more than 75 sf/hd on earthen surface.	Less than 75 sf/ hd on earthen surface.	
Beef feeders	No yard. Confined to barn with slotted floor.	Barn and/or paved lot and more than 50 sf/ hd. Earthen lot with mound and more than 300 sf/hd, or without mound and more than 500 sf/hd.	No shelter and paved lot with 40-50 sf/hd. Earthen lot with mound and more than 150 sf/hd or earthen without mound and less than 250 sf/hd.	Paved lot less than 30 sf/hd, or earthen not less than 150 sf/hd.	
Beef cows/heifers	Barn or roofed lot, or on vegetated pasture.	Barn with paved lot more than 60 sf/hd. Earthen lot with mound and more than 400 sf/ hd. Earthen lot without mound and more than 600 sf/hd.	Paved lot more than 30 sf/hd. Earthen lot with mound and more than 200 sf/hd. Earthen lot without mound and more than 300 sf/ hd.	Earthen lot without mound and less than 200 sf/ hd.	
Sheep/ewes	No yard. Confined to barn or roofed yard, or on vegetated pasture.	Barn and paved lot more than 20 sf/hd. Earthen lot more than 40 sf/ hd.	Barn with paved lot and less than 15 sf/hd. Earthen lot and less than 25 sf/hd.	Earthen lot and less than 10 sf/hd.	
Feeder lambs	No yard. Confined to barn.	Barn with paved lot and more than 10 sf/hd. Earthen lot and more than 25 sf/hd.	Barn with paved lot and more than 5 sf/hd. Earthen lot and more than 10 sf/hd.	Earthen lot and less than 10 sf/hd.	
Hogs/sows	No yard. Confined to barn.	Shed with paved lot and more than 30 sf/hd.	Shed with earthen lot and less than 15 sf/hd.	Shed with earthen lot and less than 10 sf/hd.	
Pigs: growing / finishing	No yard. Confined to barn.	Shed with paved lot and more than 15 sf/hd.	Shed with earthen lot and more than 15 sf/hd.	Shed with earthen lot and less than 10 sf/hd.	
Shed with earthen lot and less than 10 sf/hd.	No yard. Confined to barn or on pasture.	Earthen lot and more than 2500 sf/hd. No pasture.	Earthen lot and more than 1500 sf/hd. No pasture.	Earthen lot and less than 1000 sf/ hd. No pasture.	

CONCENTRATION OF BIRDS ON YARD [square feet per bird (sf/bird)]					
	LOW RISK (rank 4)	LOW-MOD RISK (rank 3)	MOD-HIGH RISK (rank 2)	HIGH RISK (rank 1)	RISK NUMBER
Chickens (Broilers)	No lot. In building with watering system in good working order. Runoff diversion.	No lot. In building with watering system in good working order. Inadequate runoff diversion.	Earthen lot with 2 sf/bird or more, on medium-textured soils (silt loam, loam). Water table deeper than 20 feet.	Earthen lot and 2 sf/bird or more on coarse-textured soils (sand, sandy loam). Water table less than 20 feet.	
Chickens (Layers)	No lot. In building with watering system in good working order. Runoff diversion.	No lot. In building with watering system in good working order. Inadequate runoff diversion.	Earthen lot with 4 sf/bird or more, on medium-textured soils (silt loam, loam). Water table deeper than 20 feet.	Earthen lot with 4 sf/bird or more on coarse-textured soils (sand, sandy loam). Water table less than 20 feet.	
Turkeys	No lot. In building with watering system in good working order. Runoff diversion.	No lot. In building with watering system in good working order. Inadequate runoff diversion.	Earthen lot with 8 sf/bird or more, on medium-textured soils (silt loam, loam). Water table deeper than 20 feet.	Earthen lot with 8 sf/bird or more on coarse-textured soils (sands, sandy loam). Water table less than 20 feet.	
Ducks	No lot. In building with watering system in good working order. Runoff diversion.	No lot. In building with watering system in good working order. Inadequate runoff diversion.	Earthen lot with 4 sf/bird or more, on medium-textured soils (silt loam, loam). Water table deeper than 20 feet.	Earthen lot with 4 sf/bird or more on coarse-textured soils (sand, sandy loam). Water table less than 20 feet.	
		Use this total to calculate risk rank:		Rank Number Total:	

CALCULATE RISK RANK

Step 1:

Sum up the rankings for the categories you completed and divide by the total number of categories ranked. Carry your answer out to one decimal point.

Rank Number Total _____ ÷ No. of categories ranked _____ = Risk Rank _____

Risk Categories

3.6-4.0 = low risk
2.6-3.5 = low to moderate risk
1.6-2.5 = moderate to high risk
1.0-1.5 = high risk

This ranking gives you an idea of how your well or spring management practices as a whole might be affecting your drinking water. Later you will combine this risk ranking with other farmstead management rankings in Worksheet No. 13, "Overall Risk Assessment." This ranking should serve only as a very general guide, not a definitive indicator of contamination. 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.).

Step 2:

Look over your ranking for each category:

- 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.

Any individual rankings of "1" require immediate attention. Some concerns you can take care of right away; others could be a major-or costly-project, requiring planning and prioritizing before you take action. Note the activities that you identified as 1's to be listed later under "High-Risk Activities" in Worksheet No. 13.