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EC97-781 Livestock Systems Environmental Assessment

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Livestock Systems Environmental Assessment

A Component of Nebraska's Farm*A*Syst Program

Introduction

The goal of this assessment package is to help a livestock producer confidentially evaluate their stewardship of water and air resources. Protecting both the groundwater that supplies your drinking water and the surface waters that provide recreational opportunities is in the interests of every livestock producer. The following worksheets will:

- Assist you in estimating the quantity of nutrients in the manure from your livestock;
- Guide you through a step-by-step evaluation of your livestock system for possible impacts on water and air quality;
- Help you identify your operation's environmental strengths and weaknesses.

Why should I be concerned?

Because manure can be a either a valuable crop nutrient resource or a environmental pollutant, the choices a producer makes relative to management of manure determines the balance between these two possibilities. Contaminated clean-up water and silage leachate also incur certain risks to the environment when not managed correctly. Good stewardship of soil, air and water resources begins by identifying risky livestock management practices and situations.

Manure, contaminated clean-up water and silage leachate can contribute to high nitrate levels in drinking water. Levels higher than 10 ppm (parts per million) NO_3-N (nitrate-nitrogen) can pose health problems for infants under 6 months of age. This condition, Methemoglobinemia, is common known as blue baby syndrome. NO_3-N can also affect adults, but the evidence is less certain. Excess nitrogen and phosphorus levels can also diminish recreational value of our ponds, streams and lakes resulting from excess algae growth, lower water oxygen levels and reduced fish populations. Ammonia can also be toxic to fish.

Fecal bacteria in livestock manure can contaminate surface and groundwater and cause infectious diseases such as dysentery, typhoid and hepatitis. Surface water used for drinking or swimming is at greatest risk. Typical water purification practices, including chlorination, are not effective in controlling some pathogens found in livestock manure.

Organic matter in manure, contaminated clean-up water and silage leachate all degrade rapidly and consume considerable oxygen. Fish kills are often caused in part by the depletion of the oxygen supply in water due to manure degradation. Manure, silage leachate and waste milk are extremely high in degradable organic matter (50 to 250 times more concentrated than raw municipal sewage).

How do I proceed?

1. Estimate the quantity of nutrients available from your livestock herd for crop production with the "Nutrients in Manure" worksheet (page 3).
2. Evaluate your farm's stewardship by completing any or all of the following worksheets:
   ____ Manure Storage
   ____ Livestock Yards
   ____ Land Application of Manure
   ____ Silage Storage
   ____ Milking Center Effluent
   ____ Odor Control
3. When completing a worksheet, read all possible answers and circle the statement that describes conditions on your farm. (Leave blank any categories which do not apply.)
4. List your high-risk activities in the Environmental Farm Planning Guide on page 19. Use this guide to identify strengths and weaknesses of your operation, future manure management goals and planned actions for addressing high-risk concerns. *Note italicized responses. Besides representing high-risk situations, these situations also violate Nebraska law.*

Farm*A*Syst

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Some worksheets are a part of the Nebraska Farm*A*Syst program and were adapted for Nebraska from the Wisconsin Farm*A*Syst program, University of Wisconsin.

Nutrients in Manure

Table 1. Total manure nutrients produced by livestock. Nitrogen, P_2O_5 and K_2O production can be calculated by entering livestock operation's information into columns 2 and 3 for the appropriate animal species and multiplying by the relevant factors in columns 5, 7 and 9.

1. Livestock or poultry species	2. Number of animals (average capacity)	3. Average weight (lb.)	4. Total animal weight (Column 2 x Column 3)	5. Lb. of N per lb. of animal weight per year	6. Lb. N/yr (Column 4 x Column 5)	7. Lb. of P_2O_5 per lb. of animal weight per year	8. Lb. of P_2O_5/yr. (Column 4 x Column 7)	9. Lb. of K_2O per lb. of animal weight per year	10. Lb. K_2O/yr (Column 4 x Column 9)
Example : Swine...Finish	2,000	150	300,000	0.15	45,000	0.13	39,000	0.10	30,000
Swine Nursery				0.22		0.21		0.15	
Grow				0.15		0.13		0.10	
Finish				0.15		0.13		0.10	
Sows & Litter				0.17		0.12		0.13	
Sows (Gestation)				0.07		0.05		0.05	
Gilts				0.09		0.07		0.06	
Boars				0.055		0.042		0.044	
Beef 450-750 lb.				0.11		0.083		0.088	
Feeder (high energy diet)				0.11		0.078		0.092	
Feeder (high forage diet)				0.11		0.091		0.11	
Cow				0.12		0.10		0.11	
Dairy Cow...50 lb./d				0.18		0.087		0.100	
Dairy Cow...70 lb./d				0.22		0.096		0.110	
Dairy Cow...100 lb./d				0.27		0.110		0.130	
Dry Cow				0.11		0.074		0.079	
Heifer/Calves				0.11		0.033		0.11	
Poultry Layer				0.30		0.26		0.15	
Pullet				0.23		0.20		0.11	
Broiler				0.40		0.28		0.20	
Turkey				0.27		0.23		0.12	
TOTAL: If more than one manure storage or treatment system is used for different groups of animals, separate the groupings of animals and their nutrient excretion totals for each manure system.			System 1:						
			System 2:						

Source: NRCS Agricultural Waste Management Handbook, 4/92 with exception of dairy lactating and dry cows. Dairy estimates are from H.H. Van Horn. 1991. Achieving environmental balance of nutrient flow through animal production systems. The Professional Animal Scientist. 7:3:22-33.

Table 2. Nutrients available (annually) after losses from open lot, storage or lagoon. Enter the total manure nutrients produced (from Table 1) in second row and multiply by the relevant multiplication factor describing your manure management system. Multiplication factor is portion of nutrients retained in the manure after losses. Remaining nutrients volatilize into air, settles to lagoon bottom as solids or is lost as runoff.

	Nitrogen			P_2O_5			K_2O		
1. Manure Storage/Treatment System	2. N produced (Table 1)	3. Multipli-cation factor	4. Available N after losses (Col. 2 X Col. 3)	5. P_2O_5 produced (Table 1)	6. Multipli-cation factor	7. Available P_2O_5 after losses (Col. 5 X Col. 6)	8. K_2O produced (Table 1)	9. Multipli-cation factor	10. Available K_2O after losses (Col. 2 X Col. 3)
Example: Storage (liquid manure, top loaded storage)	45,000	X 0.70 =	31,500	39,000	X 1.0 =	39,000	30,000	X 1.0 =	30,000
Open lot or feedlot		X 0.5 =			X 0.95 =			X 0.7 =	
Manure and bedding pack under roof		X 0.70 =			X 1.0 =			X 1.0 =	
Storage (slurry manure, bottom-loade storage)[1]		X 0.85 =			X 1.0 =			X 1.0 =	
Storage (liquid manure, top-loaded storage)		X 0.70 =			X 1.0 =			X 1.0 =	
Storage (pit beneath slatted floor)		X 0.75 =			X 1.0 =			X 1.0 =	
Poultry manure stored in pit beneath slatted floor		X 0.85 =			X 1.0 =			X 1.0 =	
Poultry manure on shavings or sawdust held in housing		X 0.50 =			X 1.0 =			X 1.0 =	
Compost		X 0.70 =			X 1.0 =			X 1.0 =	
One-cell anaerobic treatment lagoon		X 0.20 =			X 0.35 =			X 0.65 =	
Multi-cell anaerobic treatment lagoon[1]		X 0.10 =			X 0.35 =			X 0.65 =	

Table 3. Economic value of manure nutrients if valued at commercial fertilizer prices.

Nitrogen			P_2O_5			K_2O		
1. Available N after losses (Table 2)	2. Price per pound of fertilizer N	3. Value of N (Col. 2 X Col. 3)	4. Available P_2O_5 after losses (Table 2)	5. Price per pound of fertilizer P_2O_5	6. Value of P_2O_5 (Col. 4 X Col. 5)	7. Available K_2O after losses (Table 2)	8. Price per pound of fertilizer K_2O	9. Value of K_2O (Col. 7 X Col. 8)
Example: 31,500	X $0.25/lb =	$7,875	39,000	X $0.18/lb =	$9,750	30,000	Don't Purchase	$0

Table 4. Phosphorus retained as settled solids by an anaerobic treatment lagoon[1]. Enter total phosphorus estimate from Table 1, interval (years) between when settled solids are removed and complete calculation.

1. Nutrient	2. Total pounds produced annually from Table 1	One-cell and multiple cell treatment lagoon		
		3. Years between solids removal	4. Portion retained in lagoon	5. Total P_2O_5 in settled solids (Col. 2 X Col. 3 X Col. 4)
Phosphate		X	X 0.65 =	

[1]Applies to an anaerobic treatment lagoon with a permanent liquid pool and no agitation at time of effluent removal.

Table 5. Average manure nutrient application rate for crop land. Enter total pounds of nutrient from Tables 2 or 4, crop acres to which manure is applied in any one year and complete calculations.

1. Nutrient	2. Total pounds from Table B or C	Nutrient application rate on currently used crop land	
		3. Land area receiving manure in any one year (acres)	4. Nutrient application rate (Col. 2 ÷ Col. 3)
Example	*31,500 lb. of N*	*140 ac.*	*31,500 - 140 ÷ 225 lb. manure N / acre*
Nitrogen (Table 2)[1]			
P_2O_5 (Table 2)			
K_2O (Table 2)			
Settled Solids P_2O_5 (Table 4)			

[1]Not all manure nitrogen is crop available. See "Determining Crop Available Nutrients From Manure," NebGuide G97-1335.

Manure storage and runoff holding pond: ground and surface water risk

	High risk (risk 4)	High-moderate risk (risk 3)	Moderate-low risk (risk 2)	Low risk (risk 1)
Nebraska DEQ Permit or letter of exemption.	*No*	*Yes, but animal numbers are greater than listed on permit.*		Yes
Liquid or slurry manure storage, holding pond or lagoon: evaluate only the method you are using.				
Location (earthen only)	Constructed in coarse-textured soils[1]; AND Fractured bedrock or high water table less than 2 feet below storage bottom or depth is unknown; OR Evidence of seepage observed during construction; OR Construction site was not evaluated for evidence of seepage.	Constructed in medium- or fine-textured[1] soils; AND Fractured bedrock or high water table less than 2 feet below storage bottom or depth is unknown; OR Evidence of seepage or coarse material during construction; OR Construction site was not evaluated for evidence of seepage or coarse material.	Constructed in medium- or fine-textured[1] soils; AND Construction site evaluation reveals no evidence of seepage or coarse material; AND Fractured bedrock or high water table is likely to be more than 2 feet below storage bottom.	Constructed in medium- or fine-textured[1] soils; AND Soil core samples are taken at mid-points of each of four storage sides to 2 feet below storage bottom. No indication of coarse material, high water table or fractured bedrock observed; OR Laboratory tested percolation rate of completed liner is less than 1/28" per day (prior to filling with manure).
Location (concrete or steel storage tank only)	Constructed in coarse-textured soils[1]; AND Fractured bedrock or high water table less than 2 feet below storage bottom or depth is unknown.	Constructed in medium- or fine-textured[1] soils; AND Fractured bedrock or high water table less than 2 feet below storage bottom or depth is unknown.		Constructed in medium- or fine-textured[1] soils; AND Fractured bedrock or high water table are more than 2 feet below storage bottom.
Design (earthen, concrete, or steel)	Not designed to engineering standards[2].	Designed according to engineering standards[2].	Designed according to engineering standards[2]. Plans signed/sealed by licensed engineer.	Designed according to engineering standards[2]. Plans signed/sealed by licensed engineer. Construction monitored by designer.
Construction (earthen only)	Earthen structure installed without any compaction of earthen liner (i.e. construction by power shovel).	Earthen structure installed using track-mounted or rubber-tired construction equipment. No specific efforts made to compact all bottom and bank surfaces.	Earthen structure installed using heavily-weighted, rubber-tired construction equipment. Specific efforts made to compact all inner surfaces of bottom and banks.	Earthen structure installed using vibrating or sheepsfoot roller or equivalent compaction equipment for compacting all inner surfaces of bottom and banks.
Management (earthen only)	Weeds are not controlled; AND Signs of earthen liner erosion are observed.	Weeds are not controlled; OR Signs of earthen liner erosion are observed.	Embankments have established grass growth and weeds are regularly mowed; AND No erosion of liner is observed.	Embankments have established grass growth and weeds are regularly mowed; AND No erosion of liner observed; AND Emergency plan is available.

Italics type: Besides representing a higher risk choice, this practice also violates Nebraska law.

1. Coarse textured soils: gravels, sands and sandy loams. Medium or fine-textured soils: silt loam, loam, clay loams and silty clay.
2. ASAE Standard Engineering Practices including EP393.2 (Manure Storages), EP403.2 (Design of Anaerobic Lagoons for Animal Waste Management), EP 470 (Manure Storage Safety) and EP340.2 (Installation of Flexible Membrane Linings) or comparable standards set by the Natural Resource Conservation Service or the University of Nebraska.

Manure storage and runoff holding pond: ground and surface water risk (continued)

	High risk (risk 4)	High-moderate risk (risk 3)	Moderate-low risk (risk 2)	Low risk (risk 1)
Semi-solid or solid storage: evaluate only the method(s) you are using.				
Stacked in field (on soil base)	Stacked for more than 30 days OR Stacked on coarse-textured soils[1]. Fractured bedrock or water table shallower than 20 feet OR Upslope surface water not diverted.	Stacked for less than 30 days; Medium- or fine- textured soils[1]. Water table is deeper than 20 feet AND Upslope surface water diverted around pile.	Stacked for less than 30 days; Medium- or fine- textured soils[1]; Water table is deeper than 20 feet; AND Upslope surface water diverted around pile; AND New location for pile each year.	Never stacked on field or bare soil
Stacked in feedyard[2] • Groundwater contamination	Earthen yard with coarse-textured soils[1]. Fractured bedrock or water table shallower than 20 feet.	Earthen yard with medium- or fine-textured soils[1]. Water table deeper than 20 feet. Lot is without animals for several months at a time.	Earthen yard with medium- or fine-textured soils[1] and filled almost continuously with livestock. Water table deeper than 20 feet.	Well-maintained concrete yard.
Stacked in feedyard[2] • Surface water contamination	*Feedlot with no surface runoff containment and upslope clean water not diverted.*	*Feedlot with surface runoff only partially contained and upslope clean water only partially diverted.*	All feedlot surface runoff is directed to settling basin and grass filter strip. All clean water is diverted[3].	All feedlot surface runoff is contained in appropriate size storage. All clean water is diverted.
Stacked on concrete	*No roof AND Liquid runoff is allowed to enter farm drainage, road ditch, intermittent or continuous stream or natural wetlands.*	*No roof AND Liquid runoff from storage is diverted to pasture or crop land.*	No roof AND Liquid runoff from storage is diverted to properly designed grass filter strip for handling storage runoff[3].	Roofed storage: No liquid exits storage. Upslope clean water is diverted; OR No roof: Liquid runoff is collected in separate storage. Upslope clean water is diverted.
Stored in animal housing[2] on:	Earthen floor of coarse-textured soils[1] and subject to surface water runoff. Water table or fractured bedrock shallower than 20 feet.	Concrete floor or compacted earthen floor of medium- or fine-textured soils[1] and subject to surface water runoff. Water table or fractured bedrock shallower than 20 feet.	Concrete floor or compacted earthen floor of medium- or fine-textured soils[1] and protected from surface water runoff. Water table or fractured bedrock deeper than 20 feet.	Building has concrete floor, protected from surface water runoff.

Italics type: Besides representing a higher risk choice, this practice also violates Nebraska law.

1. Coarse textured soils: gravels, sands and sandy loams. Medium or fine-textured soils: silt loam, loam, clay loams and silty clay.
2. Access of dairy cows to stored manure is in violation of Nebraska Department of Agriculture dairy permit requirements and the Federal Pasteurized Milk Ordinance.
3. Permitted under Nebraska law in limited situations as determined by Nebraska Department of Environmental Quality.

Manure storage and runoff holding pond: ground and surface water risk (continued)

	High risk (risk 4)	High-moderate risk (risk 3)	Moderate-low risk (risk 2)	Low risk (risk 1)
Location and other factors				
Distance from livestock manure storage to nearest surface water source.	Less than 100 feet	100 to 199 feet	200 to 500 feet	Greater than 500 feet
Location of livestock manure storage in relation to drinking water well	*Well is within 100 feet.*[1]	Well is 100 to 250 feet AND Down slope or at grade.	Well is more than 250 feet AND Downslope or at grade.	Well is more than 100 feet AND Upslope.
Storage capacity (see Livestock Yard Worksheet #8 for capacity of runoff holding ponds)	*Less than four months (before 1996)* *Less than six months (1996 or later)*		At least six months for storages emptied by irrigation system.	At least nine months for storages emptied by irrigation system. At least six months for storages emptied by all other systems
Storage is emptied when:	Often less than 1 foot of freeboard remains when emptied.	Occasionally less than 1 foot of freeboard remains when emptied.		When capacity to handle 25 year 24 hour storm event is still available; OR More than 1 foot of freeboard remains (whichever is greater).
Total (count number of circled responses):				

Italics type: Besides representing a higher risk choice, this practice also violates Nebraska law.

[1]Illegal for new well construction. Existing wells must meet separation requirements in effect at time of construction.

Livestock yards management: ground and surface water risk

	High risk (risk 4)	High-moderate risk (risk 3)	Moderate-low risk (risk 2)	Low risk (risk 1)
Nebraska Department of Environmental Quality Permit or letter of exemption exists for open lot?	*I do not have a Nebraska DEQ operating permit for my outdoor feedlot.*	*I have a Nebraska DEQ operating permit for my outdoor feedlot but it may not be current due to feedlot expansion.*		I have a current Nebraska DEQ operating permit for all outdoor feedlot facilities or a written letter of exemption from DEQ.
Location				
Distance from yard to drinking water well	*Well is within 100 feet.*[1]	Well is 100 to 250 feet AND Down slope or at grade.	Well is more than 250 feet AND Downslope or at grade.	Well is more than 100 feet AND Upslope.
Flow distance from yard to nearest surface water source (runoff is contained)	Less than 100 ft.	100 to 199 feet	200 to 500 feet	More than 500 feet
Flow distance from yard to nearest surface water source *(runoff is not contained)*	*Stream or drainage to stream flows through yard or along border of yard*	*Less than 2,000 feet (These guidelines may not be acceptable to Nebraska DEQ)*	*2,000 to 5,000 feet (These guidelines may not be acceptable to Nebraska DEQ)*	*Greater than 5,000 feet (These guidelines may not be acceptable to Nebraska DEQ)*
Site characteristics				
Soil depth and permeability (groundwater protection)	Excessively well-drained coarse-textured soils[2] to gravel or poorly drained soils. Very shallow (less than 20 inches).	Moderately well-drained coarse-textured[2]. Shallow (20-30 inches).	Well-drained or moderately well-drained medium- or fine-textured soils[2]. 30-40 inches deep.	Well-drained medium- or fine-textured soils[2]. More than 40 inches deep.
Design and management				
Yard surface	Earthen yard experiences periods of several months with no animal traffic.	Earthen yard has constant animal traffic but extended periods of low animal density. Some areas are overtaken by weeds.	Earthen surface with almost continuous animal traffic.	Concrete
Surface water diversion	Roof and upslope surface water runs through the yard.	Some surface water diverted. Some roof water diverted.	Most upslope surface and roof water diverted.	All upslope and roof water diverted.
Yard runoff control system	*Yard runoff uncontrolled.*	*Most of yard runoff collected. Solids settled out. No filter strip for released liquids.*	All runoff collected. Solids settled out. Released water directed onto filter strip.	All runoff collected and held in holding pond.

Italics type: Besides representing a higher-risk choice, this practice also violates Nebraska law.

[1]Illegal for new well construction. Existing wells must meet separation requirements in effect at time of construction.

[2]Coarse textured soils: gravels, sands and sandy loams. Medium or fine-textured soils: silt loam, loam, clay loams and silty clay.

Livestock yards management: ground and surface water risk (continued)

	High risk (risk 4)	High-moderate risk (risk 3)	Moderate-low risk (risk 2)	Low risk (risk 1)
Design and Management (continued)				
Runoff holding pond capacity	*Design capacity of holding pond is unknown; OR Capacity is insufficient to handle runoff from 25 year, 24 hour storm (5.5" rain for eastern Nebraska to 4" rain for western Nebraska) plus month of June due to feedlot expansion or inadequate original design.*	Solid accumulation in holding pond has not been removed in recent years and holding capacity is diminished.		Capacity to handle precipitation on storage and runoff from 25 year, 24 hour storm (5.5" rain for eastern Nebraska to 4" rain for western Nebraska) plus month of June.
Runoff containment overflow	None	Emergency spillway directs flow across cropland	Emergency spillway directs flow across permanent vegetation (pasture, alfalfa or grass)	Emergency spillway directs flow across grass filter strip designed to distribute flow across surface
Abandoned Livestock Yards Management	No cleanup of yard occurs following removal of animals; OR Yard is tilled but no vegetative cover is established.	Manure was collected and land applied following removal of animals.	Manure and top 6 to 12 inches of soil were collected following removal of animals.	Manure and some soil were collected following removal of animals; AND A viable vegetative cover (alfalfa or grass) is established.
Total (count number of circled responses):				

Italics type: Besides representing a higher-risk choice, this practice also violates Nebraska law.

Land application of manure: ground and surface water risk

	High risk (risk 4)	High-moderate risk (risk 3)	Moderate-low risk (risk 2)	Low risk (risk 1)
Does sufficient land base exist for land applying nutrients in manure? (see Worksheet 1, Nutrients in Manure, Table 4)	Manure nutrient production is unknown; OR *Insufficient crop acres are available to safely utilize manure nutrients.*		Total manure nutrient production is known and sufficient crop acres are available to safely use manure **nitrogen** only.	Total manure nutrient production is known and sufficient crop acres are available to safely use manure **nitrogen** and **phosphorus.**
Is manure applied as a nutrient resource?				
Value given to manure nutrients for crop production?	Commercial fertilizer applications are not reduced to reflect manure application.	Only phosphorus application is reduced or eliminated to reflect manure application.	Phosphorus application is reduced or eliminated. Some commercial nitrogen reduction has occurred.	Commercial fertilizer added to address only any deficit in nitrogen or phosphorus following manure nutrient crediting.
Location of application?	Manure is regularly applied to: frozen or snow covered land; OR unharvested areas such as pasture or grassed waterways; OR fields that flood with some regularity.	Manure is applied regularly to crop land nearest the livestock housing without consideration of crop nutrient requirements.	Manure is distributed relatively evenly over most cropland on the farm.	Manure is distributed to crop land at rates based upon nitrogen or phosphorus needs of individual crops with preference given to non-legume crops.
Uniformity of application?	Fields receiving manure are not covered uniformly	Some effort is made to cover field uniformly with manure.	All fields receiving manure are covered as evenly as practical.	All fields receiving manure are covered as evenly as practical; AND Spreader distribution pattern is known and operator compensates for variation.
Information available to credit crop available nutrients from manure				
Are nutrient concentrations in manure known?	No manure analysis or book value estimate of nutrient value is used.	Book value for estimating nutrients is used.	Manure analysis is done once per year.	Manure analysis is done prior to each primary period of land application.
Manure application rate?	Spreader application rates are not known.	A rough estimate of manure application rate is available.	A good estimate of manure application rate is known.	Calibrated manure application equipment within past three years.
Manure application records?	Records of manure application are not kept.	Record of individual field manure applications for past year is available.	Record of individual field manure applications for past three years is available.	Permanent record of individual field manure applications is maintained.
Soil testing:				
• Basic soil test?	No soil testing	Infrequent	Every four to five years	Every one to three years
• 2 to 3 foot soil test for nitrates?	Infrequent or no soil testing.	Every three to five years	Every other year	Annual soil testing of all fields

Italics type: Besides representing a higher-risk choice, this practice also violates Nebraska law.

Land application of manure: ground and surface water risk (continued)

	High risk (risk 4)	High-moderate risk (risk 3)	Moderate-low risk (risk 2)	Low risk (risk 1)
Information available to credit crop available nutrients from manure (continued)				
Nutrient management plan?	No end of the year summation of nutrient application (including manure) is completed; OR No advanced plan of manure allocation to individual fields is completed.		An end of the year summation of nutrient applications from all sources (including manure) is completed.	An end of the year summation of nutrient applications from all sources (including manure) is completed; AND A plan for allocating manure to individual fields is completed for next year.
Nutrient management plan gives credit to nutrients including:	No nutrient application plan.	Commercial fertilizer only.	Commercial fertilizer and soil residual nutrients	Commercial fertilizer, soil residual nutrients, irrigation water nitrates, legumes and manure.
Land application site characteristics: groundwater risks				
Some sites have a depth to water table of:	Less than 20 feet.	Between 20 and 50 feet.	Between 50 and 100 feet.	Over 100 feet.
Some sites have a soil depth and permeability of:	Coarse-textured soils (sandy, sandy loam) to gravel. Very shallow (less than 20 inches)	Moderately well-drained coarse textured soils (sands, sandy loam). Shallow (20-30 inches)	Moderately well-drained medium- or fine-textured soils (loam, silt loam, clay loams, clays), 30-40 inches deep.	Well-drained medium or fine-textured soils (loam, silt loam, clay loams, clays) More than 40 inches deep.
If manure or lagoon effluent is applied by irrigation, it is:	Applied on saturated soils or soils prone to flooding where leaching of nitrates is likely.	Applied outside of the growing season of the crop under irrigation.	Applied only during the crop growing season.	Applied as light applications (less than soil moisture deficit) during crop growing season.
Land application site characteristics: surface water risks				
Slope of some sites for:				
• Annual crops?	10% +	6 to 10%	1 to 5%	Flat to 1%
• Perennial crop?	15% +	9 to 15%	4 to 8%	Flat to 3%
Surface water location with respect to some land sites?	No buffer[1], moderate slope.	20 foot or less buffer[1], moderate slope.	20 to 50 foot buffer[1], slight slope.	Greater than 50 foot buffer[1], slight or no slope.
Frequency of flooding for some sites?	Frequently	Occasionally	Rarely	Never
Conditions of application?	Manure is applied under winter conditions to snow covered or frozen fields from which runoff is common.	Manure is applied under winter conditions to snow covered or frozen fields with minimum slope and limited runoff potential.	Winter application is avoided. Manure is applied in late summer or fall on land to be planted to spring crops.	Manure is applied primarily to growing crops or within several weeks prior to planting.
Total (count number of circled responses):				

[1]Crop land, grass or wooded buffer receiving NO manure application.

Silage storage: ground and surface water risk

	High risk (risk 4)	High-moderate risk (risk 3)	Moderate-low risk (risk 2)	Low risk (risk 1)
Distance from well to concrete or glass-lined storage.		Well is within 100 feet.		Well is more than 100 feet away.
Distance from well to earthen trench or plastic tubes.	Well is within 100 feet.	Well is 100 to 250 feet AND Down slope or at grade.	Well is more than 250 feet AND Downslope or at grade.	Well is more than 100 feet AND Upslope.
Distance from silage storage to nearest surface water source.	Less than 100 feet; OR Leachate drains into road ditch or surface water	100 to 500 feet	Greater than 500 feet	Silage effluent is collected and stored for field application
Leachate collection system	No system in place. Leachate collects in low area or moves to ditch, surface water or wetlands	No system in place. Leachate moves to crop land or pasture area without ponding in single location.	Designed system in place and seepage is distributed over grassed filter area.	Designed system in place and seepage is land applied.
Total (count number of circled responses):				

Milking center wastewater treatment: ground and surface water risk

	High risk (risk 4)	High-moderate risk (risk 3)	Moderate-low risk (risk 2)	Low risk (risk 1)
Milking center effluent directed to manure storage				
All effluent directed to manure storage or feedlot runoff pond storage	If using this practice, do not complete the rest of this worksheet. Complete risk assessment results for Manure storage (page 6) and Land application of manure (page 11) to determine potential risks.			
Milking center waste reduction				
Manure addition to milking center effluent	Most manure, excess feed and other solids from parlor and holding pen manure is added to milking center effluent.	Some manure, excess feed and other solids from parlor and holding pen manure is added to milking center effluent.	Most manure, excess feed and other solids are scraped from parlor before clean-up. Holding pen manure and clean-up water are not added to milking center effluent.	All manure, excess feed and other solids are scraped from parlor before clean-up. Holding pen manure and clean-up water are not added to milking center effluent.
Milk addition to milking center effluent	Waste milk and first rinse of pipeline and bulk tank is added to milking center effluent.	Waste milk is collected for feeding to animals but first rinse of pipeline and bulk tank is added to milking center effluent.	Most waste milk and first rinse of pipeline and bulk tank is collected for feeding to other animals or adding to manure.	All waste milk and first rinse of pipeline and bulk tank is collected for feeding to other animals or adding to manure.
Pretreatment (before discharge to soil absorption bed/field)				
Storage/settling tank liner	No liner to prevent seepage.	Cracked or porous liner.		Concrete, clay or plastic lined.
Solids cleanout from settling tank	Tank never cleaned.	Annual cleaning.	Tank cleaned every six months.	Tank cleaned as needed or every three to four months.
If final disposition of milking center effluent is (select one of following five systems that best matches farm's disposal of effluent):				
Field application by irrigation	Applied to permanent vegetation at more than 54,000 gallons per acre per week (2 inch rainfall equivalent). Vegetation not removed.	Applied to cropped or grazed land at 27,000-54,000 gallons (1-2 inch rainfall equivalent) per acre per week.	Applied to permanent vegetation at less than 27,000 gallons (1 inch rainfall equivalent) per acre per week. Vegetation not removed.	Applied to cropped or grazed field at 27,000 gallons (1 inch rainfall equivalent) per acre or less per week.
Surface flow	Discharged to ditch, drainage or stream; OR Applied in sheet to highly or moderately permeable soil. Vegetation not removed.	Applied in sheet to slowly permeable soil. Vegetation not removed.	Applied in sheet to slowly permeable soil. Vegetation sometimes removed.	Applied in sheet to slowly permeable soil. Vegetation regularly removed.

Milking center wastewater treatment: ground and surface water risk (continued)

	High risk (risk 4)	High-moderate risk (risk 3)	Moderate-low risk (risk 2)	Low risk (risk 1)
If final disposition of milking center effluent is : (continued)				
Slow surface infiltration	No pretreatment. 1 foot of medium- or fine-textured soil[1] above bedrock or high water table. Vegetation not removed.	Some pretreatment. Medium- or fine-textured soil[1] more than 2 to 3 feet over bedrock or high water table. Vegetation not removed.	Combined with high-level pretreatment. Medium- or fine-textured soil[1] more than 3 feet to water table or bedrock. Extended rest period between loadings. Vegetation removed.	Combined with high-level pretreatment. Medium- or fine-textured soil[1] more than 10 feet to water table or bedrock. Extended rest period between loadings. Vegetation removed.
Subsurface absorption field	Located on medium or coarse-textured soil (silt loam, loam, sands, sandy loam) less than 5 feet to water table or creviced bedrock. No air allowed to enter subsoil.	Located in deep medium-textured soils (silt loam, loam). Soil dries every few weeks.	No medium to low risk options. System has at least a moderate risk of nitrate pollution. This is not a recommended practice.	
Rapid surface infiltration.	No pretreatment. Sandy loam or loamy sand soil less than 5 feet thick. Vegetation not removed.	Combined with high-level pretreatment. Sandy loam or loamy sand soil 5 or more feet thick. Vegetation removed regularly.	No medium to low risk options. System has at least a moderate risk of nitrate pollution. This is not a recommended practice.	
Location of discharge, absorption field, or infiltration area				
Distance from drinking water well	*Well is within 100 feet.*[2]	Well is 100 to 250 feet AND Down slope or at grade.	Well is more than 250 feet AND Downslope or at grade.	Well is more than 100 feet AND Upslope.
Distance from nearest surface water source.	Less than 100 ft.	100 to 199 feet	200 to 500 feet	Greater than 500 feet
Total (count number of circled responses):				

Italics type: Besides representing a higher-risk choice, this practice also violates Nebraska law.

[1]Coarse textured soils: gravels, sands and sandy loams. Medium or fine-textured soils: silt loam, loam, clay loams and silty clay.

[2]Illegal for new well installation. Existing wells must meet separation requirements in effect at time of construction.

Odor management and control

Potential odor risk:	High risk (risk 4)	High-moderate risk (risk 3)	Moderate-low risk (risk 2)	Low risk (risk 1)
Neighbors				
Do neighbors complain?	Several complaints within last year.	Several complaints within recent years.	Occasional complaints in recent years.	Never
Have neighbors been asked about odor?	No	Some neighbors have been approached about odors.	Higher risk neighbors have been approached about odors.	All neighbors have been approached about odor.
Are neighbors notified of planned land application?	No	Occasionally		Always
Nearby land use? (all distances should be doubled for larger than average livestock facilities)	Several residences, school or recreational area are within 1,000 feet of manure storage or animal housing; OR Neighbors are located in valley below farm.	Several residences are within 1,000 to 2,500 feet of manure storage or concentrated animal housing; OR A school, sub-division, or recreational area is within 1 mile.	One to three residences are within 1,000 to 2,500 feet of manure storage or concentrated animal housing; AND No schools, sub-division or recreational areas are within 1 mile.	No neighbors within 2,500 feet of manure storage or concentrated animal facility; AND No schools, communities or recreational areas are within 1 mile.
Animal Housing				
Is manure and runoff water controlled?	Manure can run off into areas where it is not regularly collected.			All manure/runoff are contained within housing, outdoor lot or runoff control pond.
Frequency of manure and waste feed removal from indoor confinement facilities	Less than one per week.	Manure is removed every two to seven days	Manure is flushed or mechanically scraped from facility once a day, OR Animals are heavily bedded to maintain dry conditions.	Manure is flushed or mechanically scraped from facility more than once a day.
Dust minimization in confined facilities	Few efforts have been made to control dust.	Some housing facilities employ some "Low risk" dust control practices.	Most housing facilities employ at least two of the "Low risk" dust control practices.	Three or more of following are implemented: • Diet contains 2 1/2% (50 lb. /ton or more added fat; • Liquid feeding systems; • Drop tubes used on all augers; • Floors/animals are sprayed with vegetable oil daily.
Are outdoor lots dry?	Part or all of lots remain wet much of year due to inadequate slope, off-site drainage or limited lot maintenance.	Part or all of lot remains wet for more than a week after precipitation.	Most, but not all, "Low risk" practices encouraging rapid lot drying are in practice	Outdoor lots dry quickly due to: • sufficient slope; • diversion of off-site drainage; • good lot maintenance.

Odor management and control (continued)

Potential odor risk:	High risk (risk 4)	High-moderate risk (risk 3)	Moderate-low risk (risk 2)	Low risk (risk 1)
Storage or treatment lagoon				
How is manure stored (storage with no permanent pool)	Manure is stored as a liquid in an open storage tank and does not form a crust; OR Liquid manure storage crust is broken by aggressive agitation during emptying.	Stored liquid manure forms thick crust which is partially disturbed by top loading of storage; OR Liquid manure is stored under animal housing floor.	Manure contains substantial bedding and stored as a solid; OR Stored manure forms thick crust not disturbed during loading (bottom loaded); OR Manure is stored less than one week and emptied completely.	Manure is not stored but instead is spread daily; OR Manure is held in enclosed manure storage tank or storage covered with crop residue, plastic membrane or other type of cover.
How is manure stored (treatment lagoon with permanent pool)?	Manure is stored in an inadequately sized lagoon; OR Manure volume exceeds original lagoon design.	Manure is stored in an adequately sized lagoon but lagoon does not turn purple or is purple only during the summer and fall.		Manure is not stored but instead is spread daily; OR Manure is held in covered lagoon; OR Manure is stored in a properly sized lagoon that turns purple when not frozen over.
Land Application				
When is manure applied? • Time of day?	Time of day, weekends and holidays are seldom considered in selecting application time.	Manure is sometimes applied in mid- to late-afternoons and on weekends or holidays.	Manure is normally applied before before 2 p.m. Weekends and holidays are often avoided.	Manure is always applied before 2 p.m. and weekends and holidays are avoided.
• Conditions?	Wind direction and weather conditions are not generally considered in selecting timing of applications.	Manure is sometimes applied on still, humid days and wind direction and lower elevation neighbors are rarely considered.	Manure is usually applied on dry windy days. Sometimes wind direction and lower elevation neighbors are considered.	Manure is applied only on dry, windy days and, where practical, wind direction and lower elevation neighbors are considered.

Odor management and control (continued)

Potential odor risk:	High risk (risk 4)	High-moderate risk (risk 3)	Moderate-low risk (risk 2)	Low risk (risk 1)
Land Application (continued)				
Land application of:				
• Stored manure?	Spread onto land by spray irrigation system.	Spread on land with liquid or slurry tank spreaders and no incorporation.	Incorporated by afternoon of the same day as applied; OR Applied with equipment that minimizes mixing of air and manure (i.e. drop hose).	Incorporated during or immediately following application.
• Manure stored less than five days from time of animal excretion?		Surface applied as a liquid.	Surface applied as a solid.	Incorporated same day as applied.
• Lagoon effluent?	Effluent from inadequately sized lagoon is spread onto land by sprinkler irrigation system.	Inadequately sized lagoon effluent is surface applied with no incorporation using liquid or slurry tank spreaders.	Incorporated by afternoon of the same day as applied; OR Applied with equipment that minimizes mixing of air and manure (i.e. drop hose or flood irrigation); OR Properly sized lagoon effluent is surface applied.	Incorporated during or immediately following application.
Have other odor control measures been adopted?			Independently documented odor control additive. OR Anaerobic lagoon sized for odor control. OR Purple lagoon	Anaerobic digestion or aerobic treatment.
Total (count number of circled responses):				

Environmental farm planning guide

Strengths and weaknesses: After completing appropriate worksheets, identify the strengths and weakness of your system.

1. Strengths of system	2. Weaknesses of system
a.	a.
b.	b.
c.	c.
d.	d.
e.	e.
f.	f.

Environmental goals: Use the worksheet below to begin planning changes to address higher-risk activities.

	Estimate of resource requirements (capital and operating costs, labor, management, etc.) High Medium Low $	Completion Date:
I. Manure management goal:		
a. Long-term activities (completion requires more than six months)		
1._____	1 2 3 4 5 $_____	_____
2._____	1 2 3 4 5 $_____	_____
3._____	1 2 3 4 5 $_____	_____
b. Short-term activities (completion requires less than six months)		
1._____	1 2 3 4 5 $_____	_____
2._____	1 2 3 4 5 $_____	_____
3._____	1 2 3 4 5 $_____	_____
II. Manure management goal:		
a. Long-term activities (completion requires more than six months)		
1._____	1 2 3 4 5 $_____	_____
2._____	1 2 3 4 5 $_____	_____
3._____	1 2 3 4 5 $_____	_____
b. Short-term activities (completion requires less than six months)		
1._____	1 2 3 4 5 $_____	_____
2._____	1 2 3 4 5 $_____	_____
3._____	1 2 3 4 5 $_____	_____

Glossary Of Terms

Below-ground absorption field: A wastewater treatment system that applies septic tank effluent to the soil through a trench, bed or pit.

Cast-in-place concrete storage: A type of manure storage structure. Located on a concrete pad, it consists of a cast-in-place, concrete structure reinforced with steel. May be on or below grade level.

Concrete stave storage: A type of animal manure 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 on or below grade.

Earthen basin or pit: A manure storage facility constructed according to specific engineering standards, not simply an excavation. Must be built in compacted clay soils or have a compacted clay liner, plastic liner, or other impermeable liner.

Engineering standards: Design and construction standards as contained in Natural Resources Conservation Service (NRCS) technical guides, state regulations or land grant university engineering handbooks.

Field application: Application of wastewater or manure to croplands and pastures by irrigation equipment or a liquid manure spreader.

Filter strip: A gently sloping grass plot used to filter runoff from the livestock yard and some types of solid manure storage systems. Influent is distributed uniformly across the high end of the strip and allowed to infiltrate into the soil. Nutrients and suspended material in the runoff water are filtered through the grass, absorbed by the soil, and ultimately taken up by plants. Filter strips must be designed and sized to match the characteristics of the livestock yard or storage system.

Flow distance: Distance traveled by runoff following normal drainage paths. This may not be the same as the closest distance between two points (i.e. livestock yard and stream).

Glass-lined steel storage: A type of above-ground storage structure. Located on a concrete pad, it consists of steel panels bolted together. A glass layer is fused to the surface to provide corrosion protection.

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

Leachate: Water-soluble materials that move down through the soil with water.

Percolation: The downward movement of water through the soil.

Rapid surface infiltration: Application of wastewater to coarse-textured soils to encourage rapid percolation of water into the soil. Treated effluent drains rapidly to surface water or groundwater. A much greater portion of the applied wastewater percolates to groundwater than in other discharge methods.

Runoff control system: A combination of systems designed 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.

Runoff holding pond: A structure, usually an earthen basin, designed to collect and hold livestock yard runoff.

Slow surface infiltration: Application of wastewater at one end of a gently sloping grass filter strip or terrace, so it is treated as it slowly flows through the plant-soil system. A portion of the flow percolates to groundwater and some is used by vegetation.

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, which only permit slow water movement. Moderately or highly permeable soils have coarse-textured materials, like sands, which 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."

Surface (overland) flow: The process of allowing wastewater to run slowly in a uniform layer over a grass-covered slope and relatively impervious clay soil. There is little percolation into the soil with this method because of the impervious soil. Water eventually flows into runoff collection ditches (for subsequent discharge).

25-year, 24-hour storm: The amount of precipitation occurring within a 24 hour period expected to happen, on average, ever 25 years. This varies from 6" in southeast Nebraska to 3.5" in the Panhandle of Nebraska.

Upslope surface water: Water not contaminated with manure originating from cropland, pasture or a farmstead that would normally flow through the livestock yard.

Water table depth: Depth to the top of groundwater. This depth is sometimes indicated in the county soil survey, but varies widely. This information may be available from your well construction report or from hydrogeological reports and groundwater flow maps of your area. A local well driller, county University of Nebraska Cooperative Extension educator or NRCS specialist may also be able to help you gather this information. There are two types of water table: (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 most important in regard to construction of livestock manure storage facilities, because it can help determine if construction problems may result.

CONTACTS AND REFERENCES

Who to call about...

Permits for runoff control needs, manure storage and manure application through irrigation systems
Appropriate permits may be required for above activities. Livestock owner or owners are responsible for contacting the Nebraska Department of Environmental Quality to determine appropriate permit requirements. Department of Environmental Quality, Permits and Compliance Section, Suite 400, 1200 N Street, The Atrium, Lincoln, NE 68509-8922, (402) 471-4239 can provide information on installation guidelines and permit process.

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
University of Nebraska Cooperative Extension offices, Natural Resources Conservation Service offices, Natural Resources District Offices or the Nebraska Department of Environmental Quality can give you more information regarding livestock manure management and water quality.

Manure testing
Commercial laboratories are available. Contact the closest University of Nebraska Cooperative Extension educator or Nebraska Cattlemen's office at (402) 475-2333. Nebraska DEQ (see above address) can also provide 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. EC 90-2502. $2. (1)
Nitrate Nitrogen in Drinking Water. G 763. (1)
Understanding Groundwater. NebGuide G93-1128. (1)
Testing for Bacterial Safety of Drinking Water. NebGuide G90-989 (1).
Water Testing Laboratories. NebGuide G89-907. (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 G 79-467. (1)
Perspectives on Nitrates. EC 90-2502. $2. (1)

Planning and design of livestock manure storage facilities
Lagoons for Management of Livestock Manure. EC96-799. (1)
Livestock Waste Facilities Handbook. MWPS-18 (2)
Concrete Manure Storage Handbook. MWPS-36 (2)

Management of livestock yards
Manure Management for Open Lot Livestock Production. (5)
Feedlot Abandonment. NebGuide G96-1293. (1)
Mound Design for Feedlots. NebGuide G73-66. (1)
Locating a New Feedlot. NebGuide G73-65. (1)
Beef Housing and Equipment Handbook. MWPS-6. (2)

Land application of livestock manure
Livestock Waste Facilities Handbook. MWPS-18. $8. (2)
Liquid Manure Application Systems: Design, Management, and Environmental Assessment. NRAES-79. $20. (4)
Manure Applicator Calibration. NebGuide G95-1267 (1).
Environmental Considerations for Manure Application System Selection. NebGuide G95-1266 (1).
Estimating Manure Nutrients from Livestock and Poultry NebGuide G97-1334. (1)
Estimating Crop Available Nutrients from Manure. NebGuide G97-1335. (1)

Silage management
Dairy Feeding System. NRAES-38. $25. (2)
Silage Production from Seed to Animal. NRAES-67. $25. (2)
Silage and Hay Preservation. NRAES-5. $8. (2)

Milking center effluent
Dairy Housing and Equipment Handbook. MWPS-7. (2)
Alternative Methods for Treating Milking Center Wastes in Milking Center Design conference proceedings. NRAES-66. (4)

Odor control
Managing Livestock Odors: Principles, Farm Assessment and Planning. EC95-745 (1).
New Knowledge in Livestock Odor. International Livestock Odor Conference '95. (6)
A Review of the Literature on the Nature and Control of Odors from Pork Production Facilities. $15. (7)

Livestock management
Dairy Housing and Equipment Handbook. Midwest Plan Service. MWPS-7. $20. (2)
Beef Housing and Equipment Handbook. Midwest Plan Service. MWPS-6. $7. (2)
Sheep Housing and Equipment Handbook. Midwest Plan Service. MWPS-3. (3)
Swine Housing and Equipment Handbook. Midwest Plan Service. MWPS-8. (3)

Publications available from...

1. Your local extension office or IANR Communications and Information Technology, University of Nebraska-Lincoln, 105 Ag Communications Building, P.O. Box 830918, Lincoln, Nebraska 68583-0918, (402) 472-7912.
2. Midwest Plan Service publications are available through your local extension office or Agricultural Engineering Plan Service, University of Nebraska-Lincoln, 219A LW Chase Hall, P.O. Box 830727, Lincoln, Nebraska 68583-0727 (402) 472-1646.
3. Nebraska Cattlemen, 1335 H Street, Suite 101, Lincoln, Nebraska 68508, (402) 475-2333.
4. NRAES, Riley Robb Hall, Cornell University, Ithaca, NY 14853, (607) 255-7654.
5. USDA Natural Resources Conservation Service. Federal Bldg., 100 Centennial Mall N., Lincoln, NE 68508.
6. Iowa State University, College of Agriculture, 304 Curtiss Hall, Ames, IA 50011.
7. National Pork Producers Council, Ordering Department, P. O. Box 10383, Des Moines, IA 50306.