EM 8649 • Reprinted May 1997
$1.75

Manure Management in Small Farm Livestock Operations

Protecting surface and groundwater

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Clean, safe water for consumption, recreation, irrigation, manufacturing, and fish and wildlife habitat is important to Oregonians. Nonpoint source pollution is the major cause of water quality degradation in Oregon.

Nonpoint source pollution is an accumulation of small pollution sources and single pollution events that, as a whole, cause significant degradation to water quality. For example, runoff water may carry small amounts of soil particles, pesticides, nutrients, or bacteria from several land areas (Figure 1).

When combined in a water source, these small amounts of pollution add up to a large problem. Proper management of these potential pollution sources is needed to maintain clean and usable water resources.

Many Oregonians own small acreages and raise a few livestock, for example, cattle, horses, pigs, sheep, goats, llamas, or chickens. These owners can enhance their farm's productivity by managing manure as a soil amendment. Manure is a source of nitrogen,

Figure 1.—Utilizing Best Management Practices allows small farms to protect surface and groundwater.

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phosphorus, potassium, and many micronutrients that can increase soil fertility. It also is a source of organic matter, which can improve soil water-holding capacity and tilth.

If not managed properly, however, manure can contribute significantly to pollution. Excess nutrients, disease-causing organisms, and organic matter from manure can contaminate surface and groundwater.

The following sections discuss manure as a pollution source, how its constituents can contaminate surface and groundwater, and what practices can help prevent pollution. Best management practices (BMPs) that can help you protect water quality and maintain your farm's productivity are outlined. Additional sources of information and assistance also are listed.

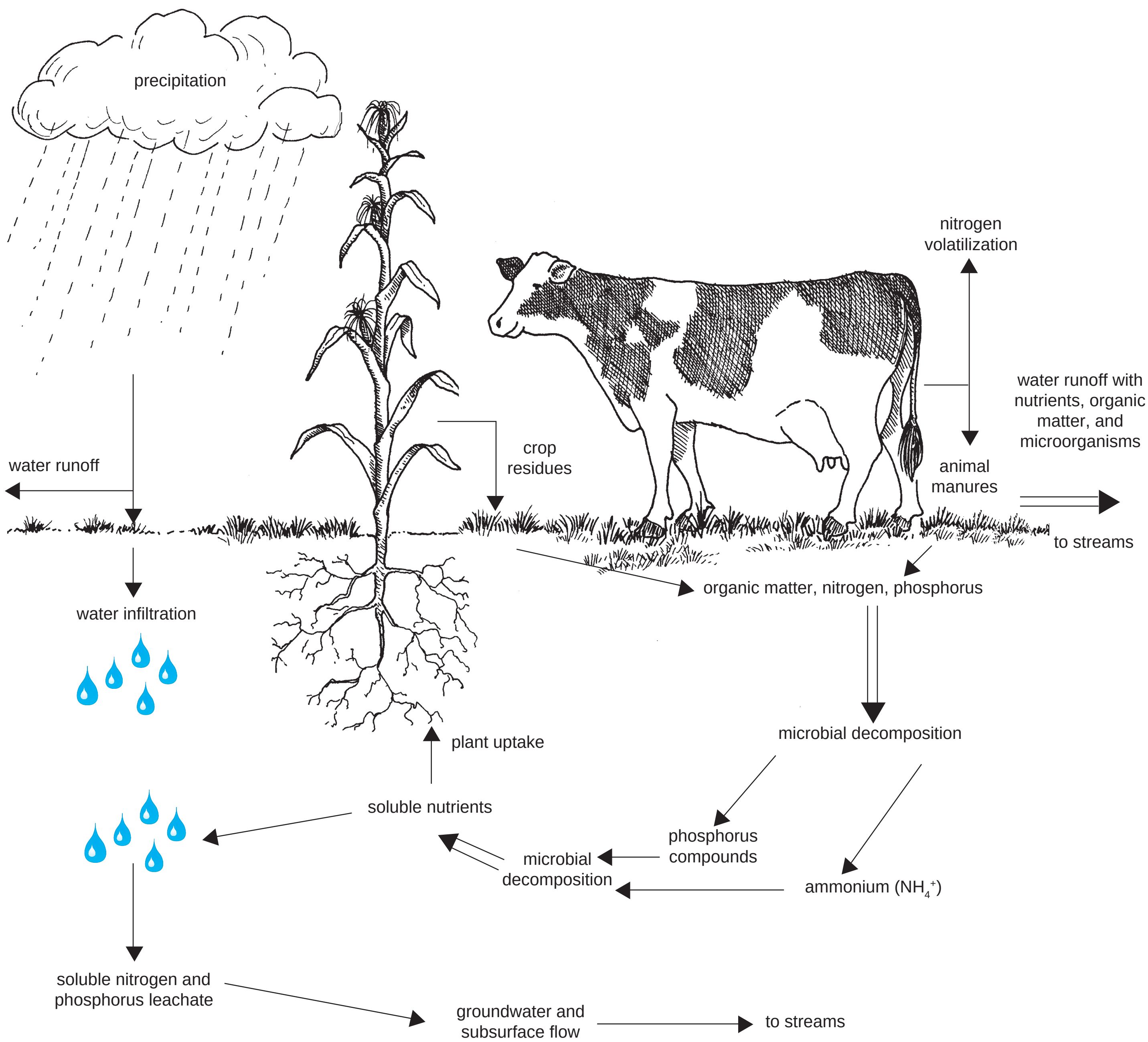

Figure 2.—Organic nitrogen and phosphorus in soil are converted through microbial decomposition to plant-available forms, which are taken up by growing plants. Nutrients also can be lost through volatilization, surface runoff, and leaching to groundwater.

Manure as a source of . . .

. . . Plant nutrients

The nitrogen in fresh manure is in the form of ammonia and organic nitrogen. The organic nitrogen is in particles such as hay and grain (organic matter).

In the soil, microorganisms convert the ammonia and organic nitrogen to nitrate (NO_3), which is readily available to plants (Figure 2). The conversion of ammonia to nitrate usually occurs quickly, providing an immediate nutrient source for plants. The conversion of organic nitrogen to nitrate occurs more slowly, providing a nutrient source over time.

Nitrate is water soluble and moves easily with water in the soil. It can move below the root zone to contaminate a water supply.

Most of the phosphorus in manure is in the form of large organic molecules. When you apply manure to soil, the organic phosphorus binds to soil particles and is immobilized. Once immobilized, it slowly becomes available to plants as phosphate (PO_4).

Phosphorus also can travel with eroded soil particles in runoff to surface waters, or can dissolve and leach to groundwater. In surface water, phosphorus stimulates the growth of algae. Excess algae growth can deplete dissolved oxygen, change the taste of the water, and cause discoloration.

. . . Microorganisms

Microorganisms abound in animal intestinal tracts, and many are excreted in manure. A few of these organisms can cause disease in humans and livestock.

These disease-causing organisms (pathogens) can live in and move with water. In surface waters, many settle into a stream's sediments, live there for extended periods of time, and are resuspended when the water is disturbed.

However, when pathogens are carried with water into the soil, they usually are filtered out and die. This natural filtering process protects groundwater.

. . . Organic matter

Manure contains organic matter, which serves as a food source for microorganisms. As microorganisms break down organic matter, they consume oxygen. When large amounts of organic matter are broken down in streams or ponds, the microorganisms use all the dissolved oxygen, and fish and other aquatic animals that need oxygen die.

Water pathways

The main concern is to keep manure out of water pathways so its constituents aren't carried to surface and groundwater. Livestock owners should pay attention to how water moves across their pasture and around buildings.

Water flows downhill over the surface toward the areas of lowest elevation, or it enters the soil and travels down toward the groundwater. Any low, wet areas or drainage-ways can be sources of both surface and groundwater.

Runoff occurs when rainfall or irrigation intensity exceeds the rate at which water can enter the soil (infiltration rate). Sandy soils have large soil particles and pore spaces and can accept water at a faster rate than clay soils (smaller particles and pore spaces).

Some areas around buildings, such as soils compacted by animal or machine traffic, have very low infiltration rates. These areas produce runoff under most storm conditions. Roofs and paved areas provide no infiltration. These areas produce runoff under all storm conditions, in turn increasing the amount and rate of water that runs off of nearby areas.

In the summer, when soils are drier, it may take several heavy rainfalls to cause surface runoff; however, in winter, when soils already are wet, a single small rain can cause runoff. The amount of rainfall necessary to cause runoff also depends on the surface slope. There is more runoff from steeper slopes.

Potential pollution problems and their Best Management Practices

Manure deposited in streams or on stream banks

Allow animal access to only small sections of streams.

You can use fences to limit access. Water gaps are fenced openings that allow animals to drink in a stream (Figure 3). However, in areas that experience high rainfall rates and flooding, such as the Oregon Coast, high maintenance demands limit the use of water gaps.

Provide alternate watering areas away from streams.

A water tank at an easily accessible location can greatly reduce the amount of time animals spend in a creek (Figure 4). Place the tank in or close to the animals' normal path toward the creek. Water can be pumped or gravity-fed to the tank.

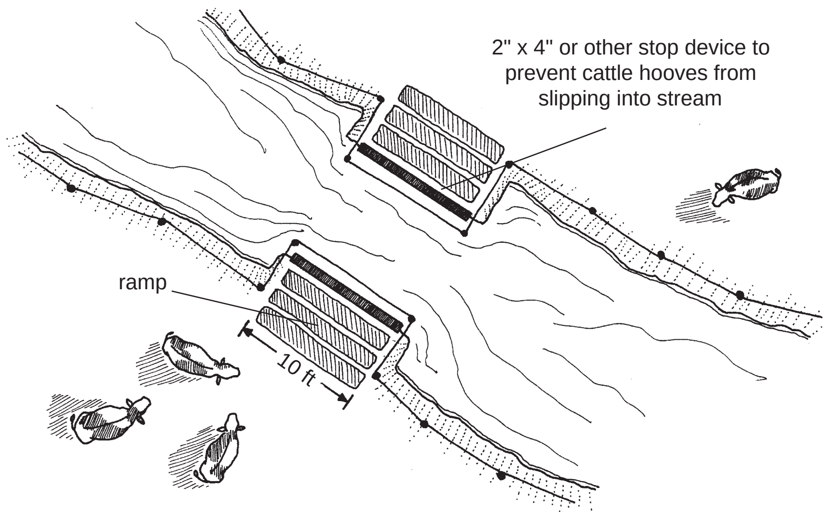

Figure 3.—Limit stream access to small areas for watering.

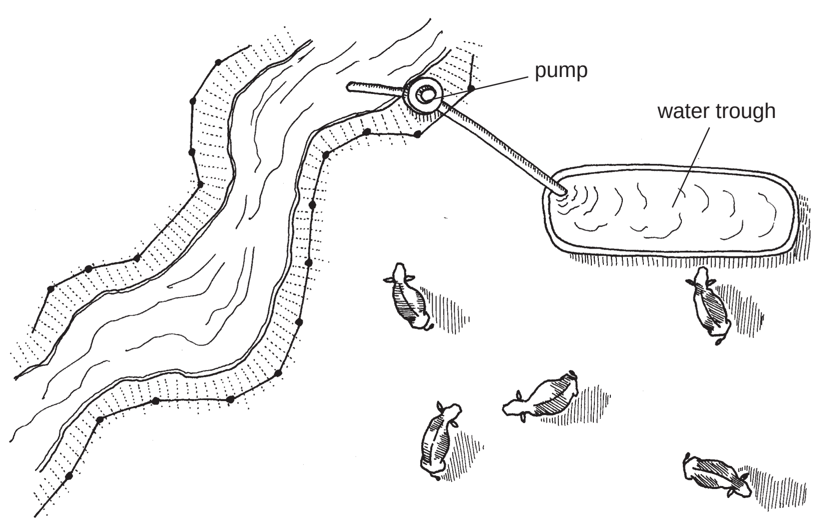

Figure 4.—Gravity flow or pumped water provides a drinking area away from the stream bank.

Overgrazing or high traffic areas next to water sources

Maintain healthy riparian vegetation and/or vegetated filter strips along streams.

The plants that grow in wet areas next to streams are called *riparian vegetation* (Figure 5). They provide shade, habitat, and food for fish and wildlife. *Vegetated filter strips* are protected areas planted to grass that are located next to creeks, winter turnout areas, impervious areas, and manure storage piles.

Riparian vegetation and vegetated strips slow runoff; increase infiltration; and filter microorganisms, nitrogen, phosphorus, organic matter, and sediment from small-volume surface runoff. When runoff volume is high, with flow depths of 2 to 3 inches, the ability to filter pollutants is greatly reduced.

Subdivide non-vegetated and impermeable areas greater than 1 acre with filter strips. The width needed for an effective filter strip varies with the size and slope of the area draining toward the strip. Recommended widths are:

- 25–50 feet for 0–3 percent slopes
- 50–100 feet for 3–8 percent slopes
- More than 100 feet for steeper slopes

The use of a vegetated earthen berm or diversion ditch greatly enhances the filtering ability of the strip. These should drain onto other vegetated areas for further filtering.

Protect all filter strips from excessive animal use, especially during wet seasons. You can mow filter strips, but don’t mow them real short.

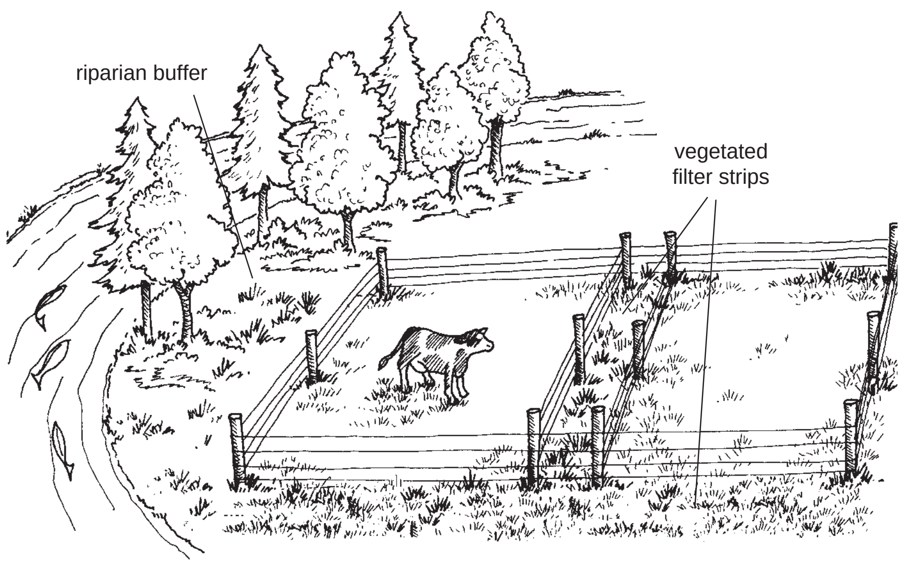

Figure 5.—Use vegetated filter strips to slow runoff, increase infiltration, and filter pollutants from runoff water.

Uncontained manure and mud in wet weather

Keep manure piles protected from rain and surface runoff.

Place the storage on high, well-drained ground away from surface water sources. Cover all manure and soiled bedding, and protect them from runoff (Figure 6). There are several ways to cover manure piles—from a simple pinned-down tarp, to a storage area with a roof and concrete floor.

Make sure your storage either contains the liquids or provides a drain to move runoff to soils and vegetation that can adequately filter leachate.

Calculate the amount of manure produced and bedding used during the storage period in order to design an adequate-size storage area. For help, refer to EC 1094, *Calculating the Fertilizer Value of Manure*. In Western Oregon, a storage length of 120 days usually is adequate to allow spreading the manure on unsaturated soil when the pasture is growing.

Keep clean runoff from flowing through livestock facilities and manure storage piles.

Reduce the amount of contaminated water to be handled by providing gutters and down spouts that move clean roof runoff away from buildings and storage areas. Create diversion ditches or earthen berms that move clean water away from livestock facilities.

Control grazing and keep livestock off pastures in the winter.

Overgrazed pastures are potential sources of surface runoff and groundwater contamination due to compacted soils and lack of filtering vegetation. Cross-fencing the pasture into smaller paddocks and controlling livestock grazing and movement can help maintain healthy, vigorous forage plants.

Because soils are wet and pasture growth is minimal during the winter, pastures will be overgrazed and physically torn up if livestock are left out. Keep livestock in small winter holding areas and collect their manure. In high rainfall areas, it is necessary to place material such as chips above the soil to keep animals out of the mud. You can use gravel, but it is difficult to keep rocks out of the pasture when you clean out the manure and haul it to your fields in the spring.

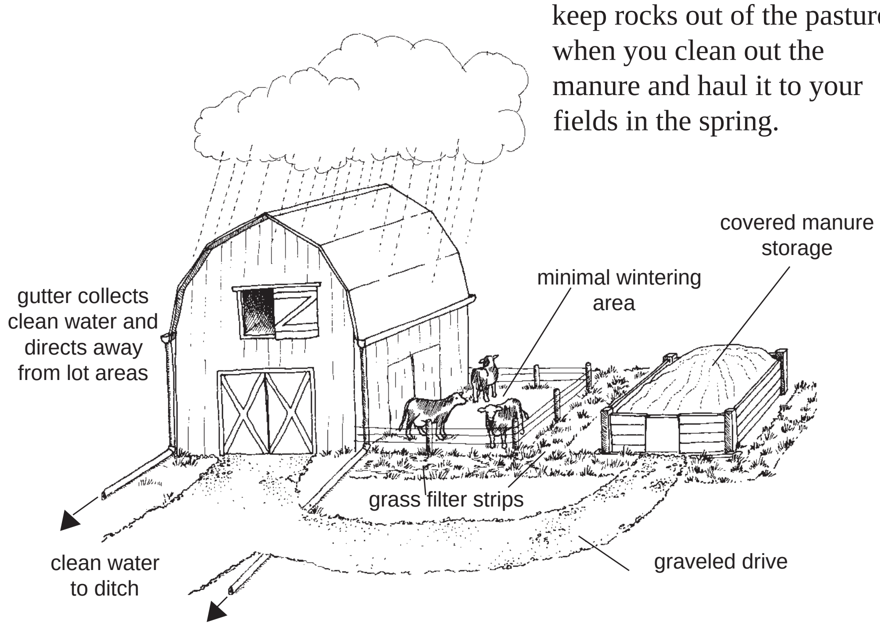

Figure 6.—Careful management of grazing, manure storage, and clean water runoff can protect surface and groundwater from contamination during wet weather.

Excessive nutrients on a pasture

Collect and store manure in winter, then spread it on pastures when plants are growing.

Spread the manure on pastures in the spring or early summer when there is little chance of runoff and growing plants can readily use nutrients.

Stored manure, with or without bedding, provides food and a place for bacteria to grow, thus making it a readily compostible material. Composting kills most disease-causing organisms, reduces the manure pile size, and provides a more stable nitrogen source that greatly reduces the possibility of leaching. Consult your county office of the OSU Extension Service for more information about composting.

Apply manure and fertilizer based on crop needs.

Spreading manure from one 1,000-lb cow, three 150-lb pigs, or twelve 100-lb sheep on 1 acre of pasture may provide the yearly phosphorus requirement for the plants (Table 1). If you apply manure based on pasture grass nitrogen needs only, you may apply excess phosphorus, which will be available for runoff and leaching. In this case, apply manure at the rate needed to supply P and purchase supplemental N fertilizer to meet crop nitrogen needs. Worksheets for calculating the fertilizer value of manure and land area required for application are available from the OSU Extension Service and other agencies.

Table 1.—Daily manure production and nutrient content of manure from various farm animals.

Animal	Animal size (lb)	Manure production (cu ft)	N (lb)	P (lb)
Dairy	150	0.19	0.06	0.011
	250	0.32	0.11	0.023
	500	0.66	0.22	0.047
	1,000	1.32	0.45	0.094
	1,400	1.85	0.59	0.131
Beef				
Cattle	500	0.50	0.17	0.051
	750	0.75	0.26	0.079
	1,000	1.0	0.34	0.109
	1,250	1.2	0.43	0.12
Cow		1.05	0.36	0.11
Swine				
Nursery pig	35	0.038	0.018	0.0052
Growing pig	65	0.070	0.034	0.0099
Finishing pig	150	0.16	0.078	0.023
	200	0.22	0.104	0.036
Gestate sow	275	0.15	0.069	0.023
Sow and litter	375	0.21	0.1	0.031
Boar	350	0.19	0.081	0.023
Sheep	100	0.062	0.045	0.0066
Poultry				
Layers	4	0.0035	0.0034	0.0012
Broilers	2	0.0024	0.0024	0.0006
Horse	1,000	0.75	0.31	0.072

The next step

Proper manure management starts with identifying existing and potential pollution problem areas. The next step is to plan and develop manure management techniques to reduce the impacts on surface and groundwater. The following agencies can help:

- Oregon State University Extension Service
- Natural Resource Conservation Service (NRCS)
- Farm Services Agency (FSA)
- Soil and Water Conservation District (SWCD)
- Oregon Department of Agriculture (ODA)

These agencies can help you select BMPs for your livestock operation. They also have information on pasture renovation and management, soil testing, and well-water testing. FSA also provides a Water Quality Incentives Program, which can offset part of the cost of these tests and improve overall farm management, as well as some cost-sharing opportunities for building livestock manure-handling facilities.

You make a difference

Proper management of livestock waste usually can be accomplished with minimum investment. Your efforts do make a difference.

For more information

OSU Extension publications

Assessing your Manure Management for Water Quality Risk, EM 8646, by M. Gamroth and J. Moore (Oregon State University, Corvallis, 1996). 75¢

Calculating the Fertilizer Value of Manure from Livestock Operations, EC 1094, by J. Moore and M. Gamroth (Oregon State University, Corvallis, reprinted 1993). $1.00

Dairy Manure as a Fertilizer Source, EM 8586, by J. Hart, M. Gangwer, M. Graham, and E. Marx (Oregon State University, Corvallis, reprinted 1996). 75¢

Livestock Manure Management Worksheet, EM 8596, by R. Miner (Oregon State University, Corvallis, 1995). $1.00

Livestock Manure Management Fact Sheet, EM 8597, by R. Miner (Oregon State University, Corvallis, 1995). $1.25

Manure Application Rates for Forage Production, EM 8585, by J. Hart, E. Marx, and M. Gangwer (Oregon State University, Corvallis, 1996). $1.00

Manure Management Practices to Reduce Water Pollution, FS 281, by J. Moore and T. Willrich (Oregon State University, Corvallis, reprinted 1993). No charge.

To order copies of the above publications, or additional copies of this publication, send the complete title and series number, along with a check or money order for the amount listed, to:

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Other publications

The Midwest Plan Service has a number of publications on livestock facilities, manure storage and treatment, etc. These publications can be purchased at OSU Extension county offices or from OSU's Bioresource Engineering Department in Corvallis.

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