AEN-107

Paved Feeding Areas and the Kentucky Agriculture Water Quality Plan

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Kentucky's abundant forage makes it well suited for grazing livestock. Livestock producers can make additional profits by adding a few pounds before marketing calves; however, adding those pounds requires keeping calves during the winter months (October to February), when pasture forages are dormant and supplemental feed is required. The areas used to winter calves need to be conducive to feeding and need to avoid negatively impacting the environment, especially water quality.

Some livestock producers use a paved feeding area to limit mud, ease manure removal, and facilitate feeding and management. Typically, producers are interested in improving herd health, limiting expenses, and increasing profits, but environmental issues also need to be addressed to prevent degradation of natural resources and limit the possibility of nuisance complaints and notices of violation (NOVs).

Best management practices (BMPs) are particular management methods that consider the nutrients in manure; reduce runoff; and trap, filter, and control pollution. This publication is intended to provide an overview of the impacts associated with paved feeding areas and highlight the Kentucky Agriculture Water Quality Plan (KAWQP) and the BMPs it recommends for livestock producers.

Potential Environmental Problems

When densely stocked animals are fed concentrated diets and the area on which the animals are standing is impervious (no rainwater infiltration), the manure and dirty water that is produced will pollute runoff. It needs to be managed. The following sections describe the environmental impacts of paved feeding areas.

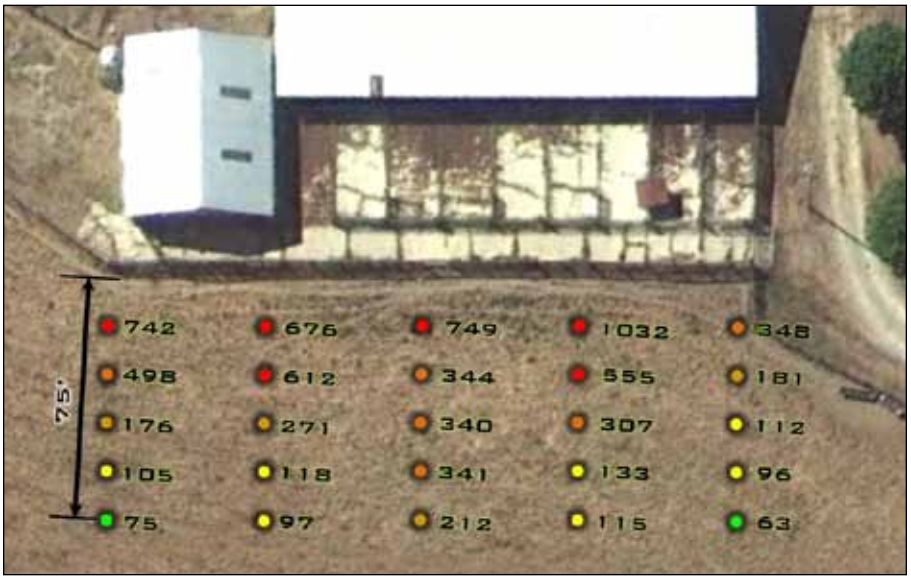

Figure 1. Aerial view of a paved feeding area with soil test phosphorus levels of adjacent land.

Animal Concentration

First consider a pasture system. One brood cow and her calf (a total mass of approximately 1,500 lb) require 2 acres, or about 5,800 sq ft for every 100 lb of animal. Conversely, a feeding area has a stocking density of approximately 40 sq ft for every 100 lb of animal, which means that a feeding floor has a stocking density that is approximately 150 times greater than that of a pasture system.

Now consider the manure generated. If a calf started at 400 lb and was marketed at 1,300 lb, the average animal weight is 850 lb. An 850-lb animal produces approximately 60 lb of nitrogen and 35 lb of phosphorus, and feedstuffs commonly used for winter feeding such as distiller's grains, corn gluten meal, and mineral supplements can contain high concentrations of phosphorus, which can increase the amount of phosphorus produced by wintering livestock. It is estimated that approximately 80% of the phosphorus consumed by an animal is excreted in the feces, and the majority of this phosphorus is contained in manure solids.

Assuming no nutrient losses during storage and application, that 850-lb animal produces enough nitrogen to fertilize about 1 acre of pasture and enough phosphorus to fertilize almost 6 acres.

If a producer applies the manure from a paved feeding area to a hayfield based on nitrogen requirements, about six times more phosphorus has been added than the crop needs. If the producer continues this practice year after year, the phosphorus fertility in the soil will increase exponentially. Once the soil particles are saturated with phosphorus, the phosphorus is free to move through the soil profile, possibly contaminating surface and groundwater. Because phosphorus and pathogens can become attached to soil particles, any erosion could also move those pollutants off site and pollute surface waters.

Impervious Area

Impervious area refers to concrete or other hardened surfaces on which animals are often fed. About 95% of the rain that falls on these areas runs off (runoff coefficient) and carries with it the nutrients and pathogens produced by the animals. If there is an adjoining barn that is used to provide shelter for the animals, it too can produce polluted runoff if the barn is not properly guttered. A roof is also impervious and has a runoff coefficient of 95%.

Free-flowing polluted runoff has the ability to move off site and increase soil test phosphorus, as shown in Figure 1, for which soil samples were collected along the side of a production area where runoff occurs. The soil test phosphorus data show high concentrations of phosphorus immediately adjacent to the production area and lower phosphorus levels farther from the production area. If this production area was placed near a stream, it would be fairly easy for phosphorus and possibly other pollutants to pollute the stream. Also consider the barn's roof. If it was not guttered and downspouts did not redirect clean water away from the production area, more water would pour onto the impervious surface and increase movement of pollutants off site.

The Kentucky Agriculture Water Quality Act

In order to protect water quality, the Kentucky Agriculture Water Quality Act (KRS 224.71-100 through 224.71-145) was passed in 1994. It was written as a guide for reducing water quality impacts associated with agriculture and silviculture activities. The main focus of the act is to protect surface and groundwater resources, primarily through the use of best management practices (BMPs). The Kentucky Agriculture Water Quality Plan (KAWQP) is a product of the act and is a statewide guide for developing individual water quality plans for use on individual farms. All agriculture or silviculture operations on 10 or more contiguous acres of land have been required to have a fully implemented water quality plan since 2001.

Table 1. Kentucky Agricultural Water Quality Plan paved feeding BMPs and recommended resources.

Paved Feeding BMP	KAWQP BMP Number	Resources for Implementation[1]
Manure Management Systems	Livestock #5	• *The Agronomics of Manure Use for Crop Production* (AGR-165) • *Managing Liquid Dairy Manure* (AEN-91) • *Sampling Animal Manure* (ID-148) • *Potential for Livestock and Poultry Manure to Provide the Nutrients Removed by Crops and Forages in Kentucky* (IP-57) • *Using Animal Manures as Nutrient Source* (AGR-146)
Manure Storage Ponds	Livestock #6	
Manure Storage Structures: Holding Tanks	Livestock #7	
Sediment or Solids Separation Basins	Livestock #9	
Manure Storage Structures: Stack Pads	Livestock #10	
Nutrient Management	Livestock #11	
Filter Strips	Livestock #13	• *Vegetative Filter Strips for Livestock Facilities* (ID-189)
Stormwater Diversion	Livestock #18	• *Stormwater BMPs for Confined Livestock Facilities* (AEN-103)

[1] All of these resources can be found at http://www.ca.uky.edu/agcomm/pubs.asp.

KAWQP Best Management Practices

Because the polluted runoff from paved feeding areas can be so significant, regulatory agencies require that the runoff be collected and stored until it can be land-applied and used as part of a nutrient management plan or comprehensive nutrient management plan. Examples of liquid and solid storage structures are described below. Other BMPs, such as stormwater diversion and filter strips, can help keep clean water clean and reduce the amount of pollution that makes it to surface water resources.

Livestock producers should implement at least one of the BMPs listed in Table 1 where paved feeding areas are used; however, trapping, controlling, and preventing pollution usually requires more than one. Producers also must consider site-specific conditions when choosing and implementing any BMP. Each of the BMPs listed in Table 1 can be used individually or in combination to protect the environment.

Livestock BMP #5: Manure Management Systems

A manure management system is a planned system for managing liquid and solid manure in which all necessary components are installed in a manner that does not degrade soil or water resources. Such systems are planned to preclude the discharge of pollutants to surface or groundwater and to recycle manure through soil and plants to the fullest extent possible. A system may consist of a single component, such as diversion, or may consist of several components as part of a planned system. Components of a complete manure management system may include, but are not limited to

- Debris basins
- Dikes
- Diversions
- Fencing
- Grassed waterways or outlets
- Irrigation systems
- Irrigation water conveyances
- Nutrient management
- Constructed wetlands
- Pond sealings or linings
- Subsurface drains
- Surface drains
- Manure storage facilities
- Manure treatment lagoons

The overall system should include sufficient land for proper use or disposal of manure at locations, times, rates, and volumes that maintain desirable water, soil, plant, and other environmental conditions. System components should be planned and installed in a sequence that ensures that each will function as intended without being hazardous to others or to the overall system. Appropriate handling equipment should be available for effective operation of the system, and safety features and devices should be included, as appropriate, to protect animals and humans from drowning, dangerous gases, and other hazards. Fencing should

be provided to prevent livestock and others from using the facilities for other purposes.

Livestock BMP #6: Manure Storage Ponds

A manure storage pond is a reservoir, pit, or pond made by excavation or earth fill for the temporary storage of liquid and/or solid livestock manures, wastewater, and/or other polluted runoff prior to land application. Construction and proper management of a storage pond for animal manure allows it to be used more effectively for fertilizer and reduces degradation of water resources. thereby increasing stream water quality and aquatic habitat. It also concentrates labor requirements and allows spreading to occur during more favorable weather and crop application conditions.

A manure storage pond should be located out of the floodplain area, and soils, rock depth, topography, and underlying geology should be investigated for site suitability. The pond should also be close to the manure source to reduce excess surface runoff water in the holding pond. Sufficient land must be available for a disposal area without overloading soils or exceeding crop requirements.

The size of a manure storage pond should accommodate projected liquid and solid manures and surface runoff water (from a 25-year, 24-hour storm plus six months of excess precipitation) and take into account the planned frequency of pumping the pond. Depth and shape are not critical as long as the design capacity is achieved. Also consider future livestock expansion as well as the present number of livestock when determining pond size. Manage the pond to avoid overflow, and adhere closely to the design and construction plan developed by a government or private engineer. A permit is required. Contact the county conservation district for local information.

Livestock BMP #7: Manure Storage Structures–Holding Tanks

A holding tank is an essentially watertight structure made of concrete, concrete block, steel, fiberglass, or similar materials to temporarily store livestock liquid and slurry manure. Holding tanks are an effective means of storing animal manure on site, reducing its access to streams, and decreasing organic material, thereby improving aquatic habitat and minimizing insect problems and manure odors. The manure can be hauled and applied in a slurry form when soil conditions permit and it is most needed for crop production.

A holding tank should be located out of the floodplain area, and soils, rock depth, topography, and underlying geology should be investigated for site suitability, especially when the tank is located underground. The tank should also be close to the manure source to reduce excess surface runoff water in the holding pond. Sufficient land must be available for a disposal area without overloading soils or exceeding crop requirements.

Estimate tank size according to the kind and number of livestock, the amount of flushing water for dilution, and the planned retention time. Allow a minimum 6-inch freeboard at the top of the tank and 6 inches at the bottom for accumulated wastes. Construct according to engineering design by a government or private engineer. A permit is required. Contact the county conservation district for local information.

Livestock BMP #9: Sediment or Solids Separation Basins

A separation basin is a structure that temporarily restrains runoff and permits liquids to drain gradually to a holding pond, lagoon, or infiltration area. Solids remain in the basin for drying and later removal for field application. Generally consisting of a shallow basin designed for low velocities and the accumulation of settled materials, a separation basin should be constructed between the manure source and manure storage or treatment facilities. An infiltration area may be used to further treat effluent. Locate the basin on soils of slow-to-moderate permeability or on soils that can seal through sedimentation and biological action. Avoid gravelly soils and shallow soils over fractured or cavernous rock. If self-sealing is not probable, the basin must be sealed by mechanical treatment or by the use of an impermeable membrane. Do not construct to an elevation below the seasonal high water table. The separation basin should also have adequate capacity to store settled solids for a reasonable period based on climate, equipment, and method of disposal.

Livestock BMP #10: Manure Storage Structures—Stack Pads

A stack pad is a stacking facility constructed of durable materials to temporarily store solid livestock manure or other agricultural waste until it can be removed and properly disposed of on land for fertilizer. Other management components such as manure storage ponds and filter strips may be used effectively with stack pads to reduce nutrient-rich runoff from reaching surface waters.

To minimize potential pollution, locate the stack pad close to the manure source to reduce scraping time and also away from residences, water supplies, and streams. Also, before locating the site and designing the structure, check soils, depth to rock, water table, and topography, and investigate local and state regulations that relate to site location and design. The structure's size depends on the type and number of animals, amount of bedding used, and proposed retention time. Fence as necessary to prevent livestock and people from using the facility for other purposes, and use vegetative screens or other methods as needed to shield structure from public view and/or improve visual conditions. Follow a design construction plan prepared by a government or private engineer. A permit may be required. Contact the county conservation district for local information.

Livestock BMP #11: Nutrient Management

Nutrient management involves carefully monitoring all aspects of soil fertility and making necessary adjustments so that crop needs are met while minimizing the loss of nutrients to surface or groundwater. It includes management of all plant nutrients associated with animal manure, commercial fertilizer, legume crops, crop residues, and other organic wastes. Nutrient management provides the crop with the correct amount of nutrients at the optimum time and location so they are used efficiently. It limits the amount of plant nutrients lost to leaching, runoff, and volatilization. Nutrient

management is one of the most important conservation practices protecting our natural resources. Tremendous benefits to water quality can be achieved, it is relatively easy to implement, and it can increase profits.

To implement nutrient management, an operation must comply with the USDA Natural Resources Conservation Service (NRCS) Kentucky Standards and Specification for Nutrient Management Practice Code 590. Elements included in the practice code include:

- Maintaining an adopted sequence of crop rotations to use nutrients
- Taking soil tests to determine the pH (buffer), pH (water), phosphorus, potassium, zinc, magnesium, and calcium needed to optimize plant production
- Analyzing animal manure for total nitrogen, phosphate, potash, calcium, and magnesium prior to land application to establish nutrient credits and to formulate application rates
- Managing animal manure in a manner that prevents degradation of water, soil, and air and protects public health and safety
- Making sufficient land available for a disposal area without overloading soils or exceeding crop requirements for nutrients
- Minimizing edge-of-field delivery of nutrients where no setbacks are required.

Livestock BMP #13: Filter Strips

A filter strip is a strip of close growing, dense vegetation that filters sediment, nutrients, and pathogens. Ideally, filter strips are established down slope of animal production areas to capture and treat runoff before it reaches environmentally sensitive areas. Potential sites for filter strips include areas directly below manure management systems and adjacent to perennial streams, farm ponds, and lakes.

To establish a filter strip, plant or maintain a dense grass sod in strips to help protect water quality by reducing soil movement. When there is little or no existing vegetation, follow pasture and hayland planting or forage and biomass best management practices. Leave existing natural vegetation along streams or lakes if it is effective in removing sediment and manure. Filter strips can also provide additional forage for hay production when needed if they are properly managed.

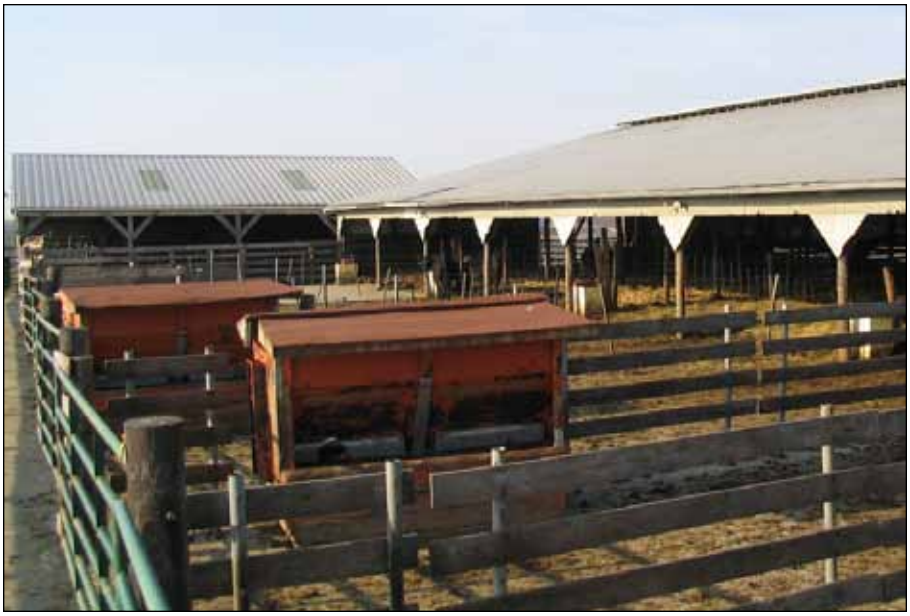

Figure 2. A typical paved feeding area with a guttered roof to redirect clean water away from the production area.

Livestock BMP #18: Stormwater Diversion

Stormwater diversion is the practice of diverting clean water to keep it clean and to reduce the volume of dirty water that must be managed. Appropriate practices include, but are not limited, to

- Guttered buildings that reduce the volume of water flowing onto open animal confinement areas where animals are held or fed (Figure 2)
- Vegetative filter strips or rock-lined channels that divert headwater away from production facilities, feeding areas, lagoons, and manure storage ponds
- Detention/retention structures that hold large amounts of stormwater generated from impervious areas
- Hardened structures, such as hardened ditches and check dams, that prevent soil erosion associated with high storm flows.

The purpose of these BMPs is to reduce issues associated with the "first flush," a high concentration of pollutants that washes away into surface water once a rainfall begins. In many cases, diverting clean water also reduces the amount of water that requires containment and management, creates a drier environment for the animals, and reduces odors.

Implementation of BMPs

BMPs that avoid, trap, or control possible pollution sources associated with a paved feeding area could be implemented for the production facility shown in Figures 1 and 2 by taking the following steps:

- Clean or scrape the open production area often or at least immediately before significant rainfall events to limit the chances of manure, nutrients, and pathogens moving off site in runoff. (Livestock BMP #5—Manure Management Systems).
- Place the manure in a covered shed for storage and hold until it can be land applied. (Livestock BMP #10–Manure Storage Structures: Stack Pads and Livestock BMP #5–Manure Management Systems).
- Land-apply manure solids away from the production area to soils that need phosphorus, such as those planted in grains, silage, or alfalfa. These crops remove large qualities of phosphorus per yield unit, which reduces the need for expensive fertilizers and decreases the chance of water pollution. (Livestock BMP #11—Nutrient Management and Livestock BMP #5—Manure Management Systems).

- Create a filter strip in order to use the fertility in the soils. Use the soil test data adjacent to the production area to determine the best location. Manage the area by interseeding cool-season grasses into warm-season grasses to trap and use nutrients year round. Fence off the filter strip with temporary electric fencing to allow flash grazing or to allow the area to grow up and be harvested. The point is to use some sort of adaptive management and a BMP, in this case an enhanced filter strip, to trap and use nutrients before they become a point or non-point source pollution source. (Livestock BMP #13–Filter Strips as well as Livestock BMP #5–Manure Management Systems, because it is being used as a wastewater filter strip).
- Gutter the area of the roof that drains onto the production area and use downspouts to redirect the water to keep clean water clean. (Livestock BMP #18—Stormwater Diversion).
- Bed the barn with an absorbent material such as wood shavings, sawdust, or straw to reduce odors. Although this BMP is not recommended by the Agricultural Water Quality Plan, it could reduce the generation of gases that often leads to nuisance complaints.

Cost-Share Assistance

Cost share assistance for the BMPs listed in the KAWQP may be available through the Natural Resources Conservation Service and/or the Kentucky Division of Conservation. For more information, contact the local offices of the U.S. Department of Agriculture Farm Service Agency (FSA) or the local conservation district.

References

Kentucky Agriculture Water Quality Authority. 2008. The Kentucky Agriculture Water Quality Plan. Available at: http://conservation.ky.gov/Pages/AgricultureWaterQuality.aspx

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