Environmental Compliance for Kentucky Beef Operations

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Environmental compliance is typically a sensitive subject among livestock producers. The fear of adapting to environmental regulation is often a result of perceived costs, expectations that production will be limited, resistance to change, and a general lack of information. Environmental compliance topics are often addressed through simple production practices. Practices such as rotational grazing have been highlighted for production benefits, although there is an equal amount of environmental benefit. Practices that accomplish both production and environmental benefits are called best management practices (BMPs). BMPs can no longer be ignored. Some are required by law, although adoption rates are generally low. Research shows that voluntary compliance leads to less environmental regulation, so it is best to achieve compliance now in order to maintain flexibility. Regulators are not the only ones concerned about how the farm is managed—consumers have become equally influential in the way food is grown or raised. Most producers desire to manage their cattle operations in a manner that prevents soil erosion and sustains water quality. This chapter of the beef book is for producers who want to preserve their farm, achieve their production potential, and obtain a market advantage.

What are You Required to Do?

In Kentucky, beef cattle producers are required by law to have an Agriculture Water Quality Plan (AWQP) (https://www.uky.edu/bae/sites/www.uky.edu.bae/files/KAWQ_Plan.pdf). An AWQP is a list of planned and implemented best management practices (BMPs) that covers six areas of the operation: farmsteads, crops, livestock, pesticides and fertilizers, streams and other water bodies, and forestry. To help complete the plan, an online or hardcopy workbook asks a series of questions to help identify where BMPs may be needed and then offers a list of suggested BMPs. Producers may offset the cost of implementing BMPs by using local, state, or federal cost share programs. The tool to help producers develop an AWQP can be accessed at: https://www.uky.edu/bae/sites/www.uky.edu.bae/files/awqp.pdf. Contact the local Cooperative Extension office or Conservation District for more information or for assistance completing the plan.

As part of the AWQP, livestock producers are also required by law to have a nutrient management plan. There are several options for developing nutrient management plans. A Comprehensive Nutrient Management Plan (CNMP) is required for producers requesting cost share or technical assistance from Conservation Districts or the Natural Resources Conservation Service (NRCS) for manure handling systems. A CNMP must be completed by a Technical Service Provider (TSP) certified by the NRCS. Cost share is available to offset the cost of developing a CNMP. Producers not needing a CNMP must implement a Kentucky Nutrient Management Plan (KyNMP), outlined in the University of Kentucky Cooperative Extension (UKCES) publication ID-211: *Kentucky Nutrient Management Planning Guidelines* (http://www2.ca.uky.edu/agcomm/pubs/id/id211/id211.pdf). In some cases, a TSP may be willing to write a KyNMP for a nominal fee. Your local Conservation District or Cooperative Extension agent may be able to assist with the completion of a KyNMP. Producers can also write their own plan by reading ID-211: *Kentucky Nutrient Management Planning Guidelines* and using the resources provided at https://www.uky.edu/bae/awqp-nmp.

What You Should Do

Simply having an Agriculture Water Quality Plan (AWQP) does not ensure compliance, as the operation may still be contaminating water resources. The goal is to prevent contamination—not just have a piece of paper. The AWQP workbook is intended to help producers choose a suite of best management practices (BMPs) that collectively prevent nutrient and soil laden runoff from leaving the farm. It is up to the producer to choose and implement which BMPs work for their operation to achieve this goal. Since it may not be feasible to implement all the necessary BMPs at once, the planned BMP component of the AWQP shows an inspector that the producer is aware of the issues and has a long-term plan for mitigating them. In other words, there is a lot of flexibility and forgiveness with the AWQP; however, if voluntary compliance is not improved, then more BMPs will likely become required. Essentially, an AWQP is a farm planning tool to get the producer to start thinking holistically about the operation. Therefore, producers should carefully complete the AWQP workbook and consult with technical professionals to choose which BMPs are right for their operation and develop an action plan for implementing the BMPs.

Best Management Practices for Beef Operations

From an environmental perspective, best management practices (BMPs) are designed to prevent soil, nutrients, pathogens, and other water quality contaminants from leaving the farm. From a production perspective, the goals of BMPs are to effectively manage mud, manure, and runoff. The following BMPs are organized by their intended focus of managing mud, manure, or runoff; many of them help manage all three. Use the

following as a guide for choosing which suite of BMPs work for a given operation.

Managing Mud

Some producers may think that mud is an inevitable part of livestock production. Mud can limit production potential by decreasing performance. Livestock that walk through and lay in mud expend more energy and thus require more feed to reach a desired weight. In addition, if livestock must walk through mud to obtain feed or water, they will not eat as often because of the increased walking effort. In a muddy lot, livestock tend to stand because there is not a dry place to lie. Standing requires more energy than lying, and mud accumulation on the hair can affect production by increasing the amount of energy needed to regulate body temperature. Mud and manure in the hair coat can also lower sale prices. Mud can increase animal stress and lead to a variety of health problems and even death. Feeding in muddy areas, such as in a typical winter feeding area, also results in wasted feed. The bottom line is mud costs producers money. Below are several BMPs that help prevent mud and provide many other production benefits.

Planned Grazing System

Rotational grazing and stockpiling forages are planned grazing systems. Rotational grazing is an excellent practice for controlling mud, but it also benefits producers during a drought. Planned grazing reduces mud by dividing larger pastures into smaller pastures that can be alternately rested and grazed, as this helps maintain optimal vegetative cover. A well planned grazing system also provides strategically located water, minimizes damage to trees and stream banks, provides shade and windbreaks, and minimizes lanes (discussed later). Rotational grazing provides a multitude of other production benefits such as reduced supplemental feeding and pasture waste, improved forage composition, and increased stocking densities compared to continuously grazed systems. Stockpiling forages rests a pasture during the end of the growing season until it can be incrementally grazed in the fall or winter. Providing livestock access to the stockpiled pasture incrementally prevents spot grazing and soiled forage. This BMP is relevant to producers who have overgrazed pastures, pastures with suboptimal forage quality, and pastures with excess mud from high stocking rates. To learn about the other benefits of rotational grazing and how to develop a rotational grazing plan, see the UKCES publication ID-143: *Rotational Grazing* (http://www2.ca.uky.edu/agcomm/pubs/id/id143/id143.pdf) and AGR-162: *Stockpiling for Fall and Winter Pasture* (http://www2.ca.uky.edu/agcomm/pubs/agr/agr162/agr162.pdf).

Stocking Density

Whether using a rotational or a continuous grazing system, an appropriate stocking density is necessary to maintain adequate vegetative forage, which helps prevent the creation of mud and erosion and reduces stored feed needs. In order to maintain an appropriate level of cover, stocking densities may need to be reduced. A publication has been developed to assist producers in estimating the carrying capacity and proper stocking density of their cool-season pastures in Kentucky through the use of Web Soil Survey, available at http://www2.ca.uky.edu/agcomm/pubs/AGR/AGR222/AGR222.pdf. The overstocking of pastures may temporarily support an increased herd, but soil loss can lead to reduced plant persistence and subsequent soil loss, which can increase labor and fuel costs. Overstocked pastures can also become a compliance concern because denuded (i.e. no vegetation) lots act as an impervious surface and generate nutrient rich runoff. If stocking densities cannot be reduced or if it is not feasible to rehabilitate a denuded lot, the operation should consider switching to confinement or installing an all-weather surface in the lot surrounded with vegetative buffers to avoid compliance violations. An all-weather surface would facilitate manure collection, thus reducing the potential for runoff and contamination of nearby water resources.

Alternative Water Sources with All-weather Surfaces

Watering points are a critical component of any grazing system since water intake encourages feed intake and watering point locations determine grazing efficiency as well as manure and urine distribution. However, providing water alone is not sufficient—water quality is equally important as water quantity. Although natural water sources are an inexpensive alternative to other watering systems, when they become contaminated they can limit production and lead to multiple health problems. Over the last few years, blue-green algae blooms have become more prevalent in lakes and ponds. These potentially harmful algae blooms have shut down public water supplies and killed cattle. Producers should not assume that their ponds or creeks are free of blue-green algae or other contaminants. Research has shown that beef cattle production can be significantly increased when livestock have access to clean water. Because of this, livestock should be excluded from contaminated surface waters and provided with an alternative water source surrounded with an all-weather surface. To learn how to site and construct an all-weather surface for an alternative water source, see the UKCES publication ID-229: *All-weather Surfaces for Cattle Watering Facilities* (http://www2.ca.uky.edu/agcomm/pubs/ID/ID229/ID229.pdf). An alternative water source is a water supply other than natural water bodies with unlimited access. Alternative water sources may include water harvested from roofs, a developed spring, pipeline and tank, a gravity-fed tank below an excluded pond, or an automatic watering fountain supplied with city water. Figure 3-1 shows how a pond can be fenced off and still provide clean drinking water to a gravity-fed stock tank.

The vegetated area surrounding the pond serves as a filter strip can also be flash-grazed periodically. Frequent use of the alternative water source and loitering creates surface depressions filled with mud, manure, and urine, which expose pipelines to freezing temperatures and can cause a variety of livestock health issues (Figure 3-2). An all-weather surface prevents surface depressions and protects livestock health. Consider installing alternative water sources in lanes or in a layout such as in Figure 3-3, so it can be used to service multiple pastures in conjunction with a rotational grazing system. Additional information related to providing alternative water sources in beef cattle production systems is available for download at http://www2.ca.uky.edu/agcomm/pubs/ID/ID236/ID236.pdf.

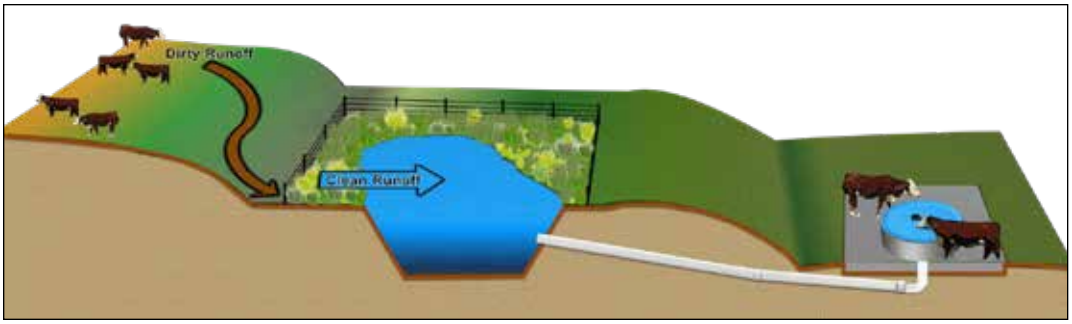

Figure 3-1. With a gravity-fed system, livestock can be excluded from ponds to prevent contamination and still be provided with clean water. Figure by Donnie Stamper

All-weather Surfaces

Watering points are just one of several heavy-use areas on the farm that are prone to mud and erosion, even with an appropriate stocking density. The foot pressure of standing cattle is approximately 69 percent greater than a 50-ton bulldozer. Other typical heavy-use areas include feeding lanes, winter feeding areas, and gate entrances. These areas should be reinforced with an all-weather surface such as concrete or geotextile fabric and rock. Consider turning sacrifice lots into dry lots, which are much more versatile, by installing an all-weather surface. To prevent runoff contamination, manure should be routinely collected from all-weather surfaces. However, scraping can remove rock, so it will need to be replaced periodically. If an area is to be routinely scraped, then concrete should be considered.

Figure 3-2. Without an all-weather surface, the heavy use area has eroded to the point where the watering facility is almost inaccessible and is no longer frost-proof. The depression also poses a threat to livestock health because livestock have to stand in mud and excrement to drink. Note the diameter of the bare soil area (18′). Photo by Jeff Lehmkuhler

Hardening heavily used livestock areas can decrease the creation of mud, create an area that is easier to maintain, reduce the amount of feed wasted and required by livestock, and save time and money by increasing work efficiency. Feeding and heavy-use areas should be protected with an all-weather surface such as concrete or geotextile fabric and rock. Figure 3-4 shows an all-weather surface used for fence-line feeding with roll bales, demonstrating how all-weather surfaces can be used in conjunction with certain management styles. To learn about all-weather surface options and how to install them, see the UKCES publication AEN-115: *All-Weather Surfaces for Livestock* that is available for download at (http://www2.ca.uky.edu/agcomm/pubs/aen/aen115/aen115.pdf).

Stream Crossings

Drainages or streams that have flowing water for more than 30 days per year (total) should be excluded from livestock. If livestock have access to flowing drainages, there is an increased chance of a water quality violation, and as previously mentioned, this water is likely hindering cattle performance. When planning a grazing system, livestock should be excluded

Figure 3-3. Alternative water sources can be constructed to service multiple pastures in conjunction with a rotational grazing system, such as in this layout. Figure by Donnie Stamper

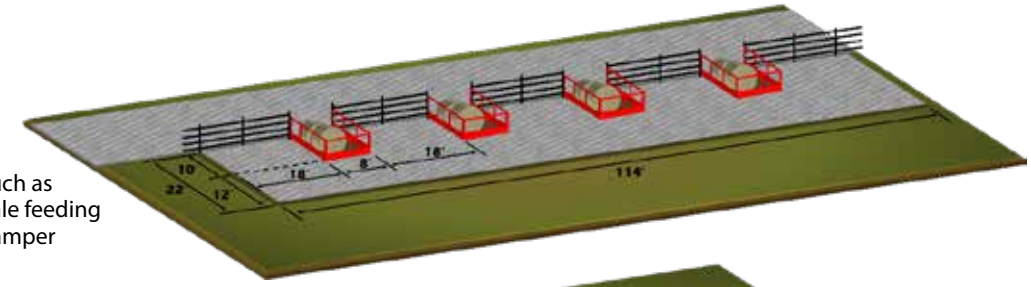

Figure 3-4. All-weather surfaces can be used to fit any management style, such as with this fence line, roll bale feeding lane. Figure by Donnie Stamper

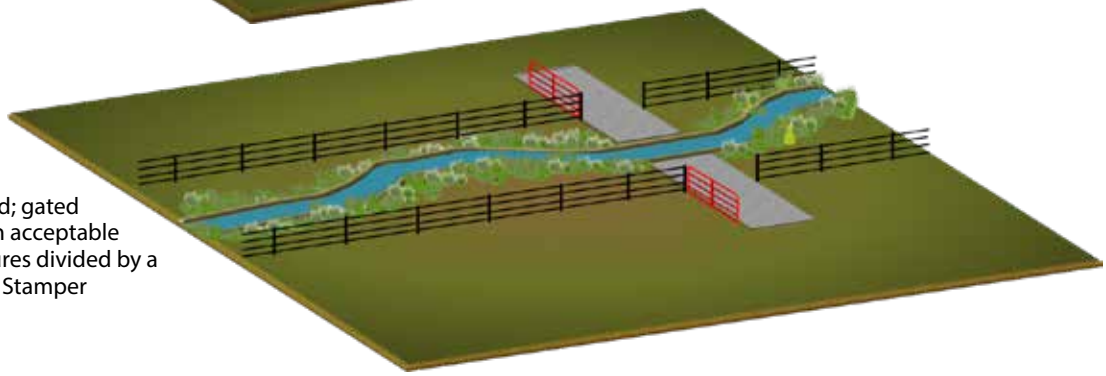

Figure 3-5. Livestock should be excluded from drainages and a vegetated buffer should be established; gated stream crossings provide an acceptable method for accessing pastures divided by a drainage. Figure by Donnie Stamper

from drainages. If a drainage (e.g. stream) must be crossed to access other pastures, stream crossings should be installed. A stream crossing is an acceptable method for moving livestock to pastures separated by water, whereas unrestricted stream access is unacceptable. Stream crossings should consist of a reinforced surface to prevent erosion and gates on each side of the stream to restrict access when the crossing is not being used (Figure 3-5). To learn how to site and install a stream crossing, see the UKCES publication AEN-101: *Stream Crossings for Cattle* (http://www2.ca.uky.edu/agcomm/pubs/aen/aen101/aen101.pdf).

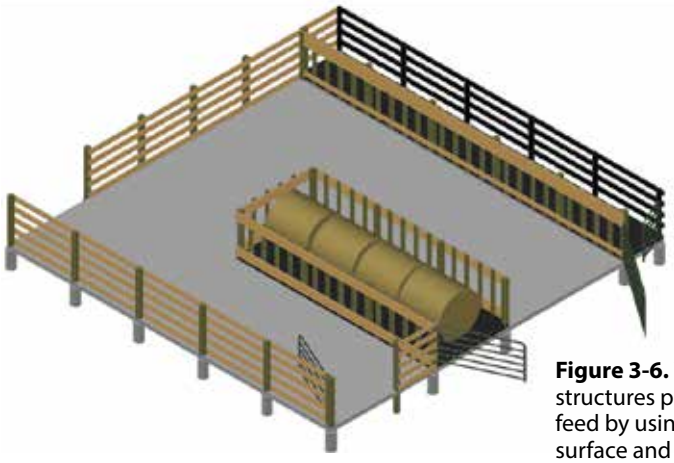

Figure 3-6. Winter feeding structures prevent mud and save feed by using an all-weather surface and an elevated feed rack. Figure by Donnie Stamper

Winter-feeding Structures

A winter feeding structure is an area with an all-weather surface that includes geotextile fabric and rock and/or concrete surfaces. Figure 3-6 shows a winter feeding structure that is ideal for winter feeding cattle within a rotational grazing system rotational grazing. This system should be installed using a holistic approach where beef feeding and handling are centered on this structure. An ideal situation uses lanes, multiple pastures, and pens with the structure being centrally located and near hay storage. Water sources should be located at least 150 feet from the structure to reduce the volume of manure that needs to be handled. This practice allows limit feeding in which cattle come to the structure for feeding during the winter or during wet weather and then return to a vegetated pasture for water. Additional areas or pens can be set up to facilitate creep feeding or creep grazing. Several cattle herds can be managed at once using this type of system. The system is designed to elevate hay and feed and keep cattle from wasting hay. This structure protects pastures, decreases livestock energy expenditures (as opposed to walking through mud), facilitates manure collection, and reduces labor, expenses, and wasted feed. For more information on winter feeding structures, see the UKCES publication ID-188: *Strategic Winter Feeding of Cattle using a Rotational Grazing Structure* (http://www2.ca.uky.edu/agcomm/pubs/id/id188/id188.pdf).

An additional winter feeding system has been developed through the fence-line feeder project at Eden Shale Farm. Details on how to build and incorporate a fence-line feeding system into your operation can be found at: http://www2.ca.uky.edu/agcomm/pubs/AEN/AEN134/AEN134.pdf.

Managing Manure

Manure plays an essential role in farm production as an on-farm source of nutrients and organic matter. In order for manure to be an effective fertilizer and soil amendment to lower input costs, it must be properly collected, stored, and managed. Improperly collecting and storing manure could lead to nutrient losses. Nutrient losses increase spending, decreased yields, and increase wasted time and money by applying a low nutrient value product. Conversely, some producers may be over applying manures

to fields. Proper collection and utilization of manures and deceased animals also prevents pathogens from entering water resources and thus protects overall herd health. The following best management practices (BMPs) discuss how to properly collect and utilize manure and handle animal mortalities.

Manure Management System

With today's regulatory climate, it is critical that producers have a manure management system. A manure management system is a combination of BMPs used to collect and store manure and a plan for how nutrients will be utilized without degrading water resources. Components of a manure management system include, but are not limited to: manure storage structures, manure handling, and a nutrient management plan.

Ideally, a beef producer should limit the concentration of animals to reduce the labor involved with manure buildup and cleanup. This is why rotational grazing is such a good management tool; it allows the cattle to distribute manure evenly over a field. However, winter feeding necessitates the concentration of animals. In the past, there have been cost-share opportunities to build covered manure stack pads and adjacent feeding structures. Obtaining a manure stack pad through state or federal cost-share today requires a Comprehensive Nutrient Management Plan (CNMP).

In some cases, there have been dairies that have switched over to beef production. These farms may have a manure storage pond or lagoon, which would require a Kentucky No Discharge Operational Permit (KNDOP) from the Kentucky Division of Water and may need to close out their structure. For more information on closing out a liquid manure holding structure see the UKCES publication AEN-125: *Closing a Liquid Manure Storage Structure,* which is available as a free download from http://www2.ca.uky.edu/agcomm/pubs/AEN/AEN125/AEN125.pdf.

Manure Storage Structure

If manure is exposed to precipitation, sunlight, or wind, the amount of plant available nitrogen will decrease due to volatilization, leaching, and runoff, making the manure less valuable as a fertilizer. To minimize nutrient loss and comply with state law, manure should be collected from impervious surfaces and stored in a manure storage structure. A manure storage structure, also known as a stack pad, is a roofed structure that is used for storing solid manure. Managing manure as a solid, as opposed to a liquid, has many benefits:

- A manure storage structure allows it to dry out and compost.
- A manure storage structure can be used for dead animal composting.
- Solid manure is cheaper to haul off-site.
- Solid manure retains higher nutrient content, requiring a reduced application rate.
- Solid manure is less likely to be transported with runoff after land application.
- A manure storage structure is less problematic and requires less management than liquid manures.
- Running equipment for scraping and land-applying is cheaper than running equipment for pumping and injecting.

Nutrient Management Planning (NMP)

This BMP involves managing all sources of nutrients on the farm, such as manure, mortalities, inorganic fertilizer, crop residues, and legume crops. From a compliance and production standpoint, it is likely the most important BMP to implement.

Nutrient management planning is an extensive topic, but below are some key components of proper nutrient management:

- Manure should be applied to soils based on existing soil fertility and realistic yield goals. The primary soil nutrient that should be monitored is the soil test phosphorus (STP) concentration. Producers will not get a yield benefit by applying manure to soils above 45 pounds of STP per acre.
- Collect manure from impervious surfaces and store in a proper storage structure.
- Prevent manure deposited on pastures or holding areas from entering water resources.
- Collect soil and manure samples prior to land application and use a NMP to determine application rates.
- Only apply manure to actively growing plants or just before planting.
- Never apply manure to frozen ground. Manure applied in winter is likely to be washed into streams instead of being absorbed in the soil.
- Never apply manure within 24 hours of a rainfall event, as this too can result in nutrients leaving the application area.
- When possible, incorporate manure in the soil immediately after application.
- Never apply manure near environmentally and socially sensitive areas such as surface waters (streams, ponds, wetlands, etc.), sinkholes, or roads.

Disposal and Composting of Animal Mortalities

Acceptable methods for dead animal disposal in Kentucky are incineration, burial, removal by a licensed rendering company, disposal in an approved landfill, and composting. Composting is the easiest and most cost-effective option; however, if a pickup service is available at minimal or no cost, it may be used instead. Whichever acceptable method (by law) is used, it must be accomplished within 48 hours of the animal's death.

A mortality composting facility should be located near animal housing. The composting area should not be built in a floodplain, within 300 feet of a water well, stream, sinkhole, pond, property line, or public road, or within 1,500 feet of churches, schools, businesses, or any other public use area. When choosing a site, consider that any runoff lost from the compost pile should be diverted to an existing manure storage structure or to a vegetated filter strip. The leading edge of the filter strip and the low edge of the composting pad must be level, and the filter strip must be at least 30 feet long. The filter strip vegetation must be maintained as specified in the NRCS filter strip standard. In addition, if the composting structure is located within a pasture, fencing is required to exclude livestock from both the composting pad and the filter strip.

The type of composting structure used should be based on the type and size of the animal operation. Ideally, the structure should have a concrete pad, sides to facilitate loading and turning, and a roof to block precipitation. A roof and sides are not required, but for operations with more than 100 animal units, the pad flooring shall be constructed

using a "High Traffic Area" surface such as concrete, soil cement, sound bedrock, compacted clay, or heavy traffic pads using rock and geotextile fabric. All of these surface treatments prevent mud creation and reduce sediment in runoff. For more information about soil cement, see UK Cooperative Extension publication ID-176: *Using Soil-Cement on Horse and Livestock Farms* (http://www2.ca.uky.edu/agcomm/pubs/id/id176/id176.pdf). To construct a heavy traffic pad as a composting surface, refer to UK Cooperative Extension publication ID-164: *High Traffic Area Pads for Horses* (http://www2.ca.uky.edu/agcomm/pubs/id/id164/id164.pdf). For operations with less than 100 animal units, composting can be conducted directly on the soil as long as the composting site is alternated with a crop rotation. You can use traditional composting facilities like stack pads, bins, windrows, and vessels; however, a windrow system, using an uncovered stack pad made with a High Traffic Area surface is by far the easiest structure to manage and the cheapest to construct for composting large animals.

To learn more about how to compost animal mortalities, see the UKCES publication ID-166: *On-farm Composting of Animal Mortalities* (http://www2.ca.uky.edu/agcomm/pubs/id/id166/id166.pdf).

Managing Runoff

Managing runoff is about keeping clean water clean and collecting or filtering contaminated water. From a production perspective, these BMPs prevent mud and erosion. Stormwater can also be harvested to provide the operation with a free source of water. For example, stormwater could be directed toward a farm pond that gravity feeds an alternative water source or could be collected from facility roofs and stored in tanks to directly water livestock. If the operation uses a liquid manure storage pond, managing stormwater can effectively add capacity to the pond by diverting clean water away from the liquid manure handling structure. Properly collecting or treating contaminated runoff can also help protect livestock health by minimizing the risk of consumption and prevent compliance violations.

Stormwater Diversion

Stormwater diversion is the practice of diverting uncontaminated rainfall away from production areas so it does not encounter manure, soil particles, fertilizers, pesticides, or other water quality contaminants. Areas that typically have clean stormwater on farming operations are properly stocked pastures, facility roofs, roads, or other surfaces that do not contain a high concentration of contaminants. Clean stormwater should be diverted away from contaminants to designated drainages with gutters, pipes, grassed waterways, or ditches to reduce the amount of contaminated water that needs to be managed. Once stormwater encounters water quality contaminants, it needs to be properly collected or naturally filtered depending on the level of contamination. Frequent manure collection from impervious surfaces such as feeding lanes and confinement areas will also help minimize the amount of water that needs to be managed. Stormwater BMPs must be considered on a site-specific basis. The following are a few examples of stormwater BMPs:

Gutters. If a facility has a roof that drains onto a production area, consider installing gutters with downspouts. Placing gutters on buildings diverts clean rainwater away from animal handling and holding areas and prevents the contamination of this otherwise clean and usable water. Downspouts should be directed to diversion ditches, and guttered water should be carried away from animal containment areas.

Headwater diversion. Over time, topography can be altered with road creation, structure remodeling, and facility additions, causing runoff to flow through the production area. To keep clean runoff clean, diversion practices should be implemented if water enters the production facility from upland sources, such as drainages or overland flow. Headwater diversion entails installation of structures such as levees, dikes, drainage swales, berms, and diversion ditches to carry the water away from the production area and to a natural drainage way.

Gully erosion structures. One way to fix gully erosion is with a grade stabilization structure or other hardened structures (e.g. rock chutes, check dams, etc.). Hardened structures such as these use large rock-lined ditches, posts, fabric, and fence panels to slow flowing water and prevent erosion. To learn how to install a grade stabilization structure, see the UKCES publication AEN-100: *Building a Grade Stabilization Structure to Control Erosion*, which is available for download at http://www2.ca.uky.edu/agcomm/pubs/aen/aen100/aen100.pdf. Ways to prevent gully erosion include: controlling stocking density, regulating time in a field, and by fencing off drainages.

Culverts. Culverts are an essential component of stormwater diversion, as they help quickly transport runoff away from the operation. If a culvert that is too small for the drainage area is installed, water may flood on the upstream side of the culvert and severe erosion can occur on the downstream side. Consult a technical service provider to ensure culverts are properly sized. Installing a culvert, in some cases, may require a floodplain construction permit from the Division of Water (http://water.ky.gov/floodplain/Pages/FloodplainConstruction.aspx).

Vegetative Buffers

Vegetative buffers are a set of practices that utilize vegetation to filter and trap sediment, pathogens, and other water quality contaminants. In some cases, contaminated runoff can be sufficiently treated with vegetative buffers, such as a riparian buffer, filter strip, or grassed waterway to avoid regulatory issues and nuisance driven complaints. The key to a successful vegetative buffer is to maintain sufficient forage growth to slow, trap, and filter runoff before it leaves the farm. The size of a vegetative buffer depends on the volume of runoff and level of contamination, but aim for the maximum size possible to ensure water quality compliance. The following are a few examples of vegetative buffer BMPs.

Riparian buffer. Riparian buffers, also called streamside buffers, can be created passively (naturally) or actively. Passively creating a riparian buffer is as simple as establishing a no-mow zone around a stream or pond and allowing vegetation to reestablish itself naturally. This method is an easy and inexpensive way to create a riparian buffer, but may require maintenance to prevent the growth of unwanted invasive plants. A typical rule of thumb

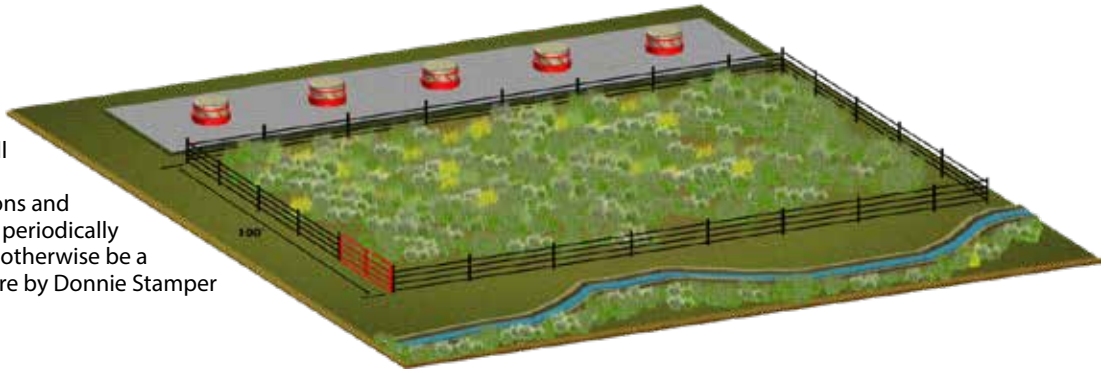

Figure 3-7. Filter strips can be used on the downhill side of production areas to prevent compliance violations and provide an area that can be periodically flash-grazed in what would otherwise be a denuded, muddy area. Figure by Donnie Stamper

is to create a buffer that is three times the width of the creek. If the floodplain is known, then the buffer should extend outside of this area. Creating a buffer does not necessarily mean that the area is lost to production. Many areas can be flash-grazed during dry periods. These corridors can be used to move cattle from one pasture to another to facilitate rotational grazing. For more information on riparian buffers, see the UKCES publication ID-175: *Riparian Buffers: A Livestock Best Management Practice for Protecting Water Quality*, which is available for download at http://www2.ca.uky.edu/agcomm/pubs/id/id175/id175.pdf.

Filter strips. Filter strips should be placed on the downhill side of production areas to provide a buffer for filtering runoff and preventing erosion. The filter can be established by installing a fence around a 100-foot wide filter strip that is the length of the production area. The filter strip in Figure 3-7 can be periodically flash-grazed, and the filter strip in Figure 3-8 can be used as a creep feeding pasture for calves. Depending on its use, filter strips should be planted with dense grass sod consisting of forages designed to be actively growing during times when cattle are confined to the feeding area. Novel endophyte tall fescue makes an excellent filter strip in Kentucky because of its superb growth, adaptability, nutrient uptake, and safety for livestock. Filter strips should also be managed so that vegetation is periodically removed or flash-grazed to continue nutrient removal, prevent unwanted brush growth, and keep the soil test phosphorus levels from becoming too high. To learn more about filter strips, see the UKCES publication ID-189: *Enhanced Vegetative Strips for Livestock Facilities*, which is available at: https://www.uky.edu/bae/sites/www.uky.edu.bae/files/id189.pdf.

Grassed waterways. Grassed waterways are gently sloped stormwater diversion ditches that are lined in grass or other suitable vegetation. Grassed waterways help convey, slow, and filter stormwater. Grassed waterways should only convey clean water, as their main purpose is to prevent erosion. If vegetation is not maintained, head-cutting or gully erosion may occur.

Shade Structures and Windbreaks

Shade structures and windbreaks can reduce cattle energy expenditures by protecting them from the hot summer sun and brutal winter winds. The concept behind providing shade for livestock is to lure them away from drainages, streams, and other areas where tree canopies typically provide shade. Livestock tend to loaf in these areas, consequently creating mud and nutrient buildup.

Producers should consider using portable shade sleds to provide shade without creating mud and environmental problems. Shade structures can be constructed so they can easily be moved within and among pastures as part of a planned grazing system. The ability to move these structures facilitates manure cleanup and reduces soil compaction and mud. A permanent shade structure with an all-weather surface could also be used. An ideal shade structure for cattle provides 20 square feet of shade per animal. A 70 percent or greater occluded shade cloth can be used as the shade material. This same material can be used to drape the southern or western sides to provide additional shade and act as a windbreak for southern prevailing winds. To learn more about shade structures, see the UKCES publication AEN-99: *Shade Options for Grazing Cattle* (http://www2.ca.uky.edu/agcomm/pubs/aen/aen99/aen99.pdf).

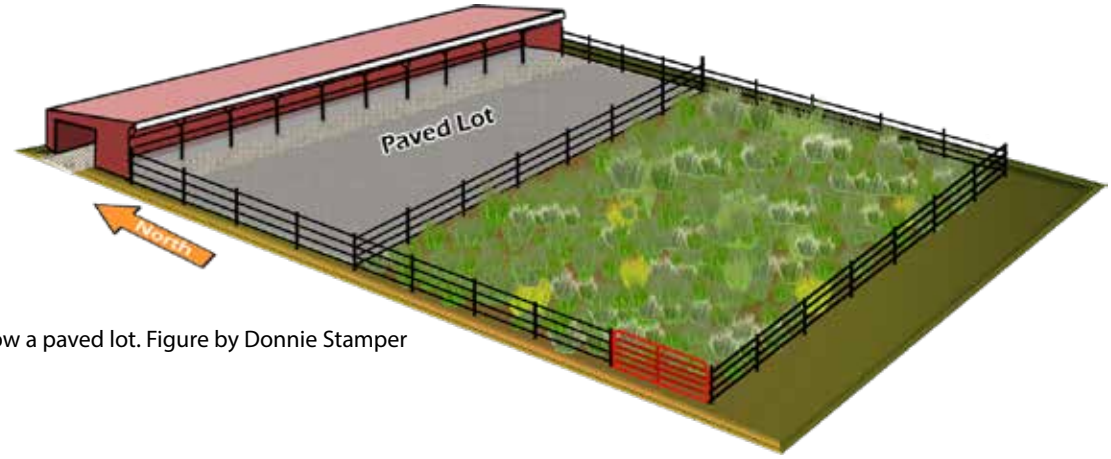

Figure 3-8. Filter strips below a paved lot. Figure by Donnie Stamper

Windbreaks can be provided by vegetation or materials on the farm that cannot be destroyed by the animal. The height of the windbreak only needs to be as tall as the animal. The windbreak should be oriented along the east-west axis and set away from fence lines to allow livestock to have access to each side of the windbreak. Some common farm materials that can be used to create a windbreak include trees, shrubs, plywood, metal siding, and round bales.

Summary

Best management practices (BMPs) are research-proven methods for farm management that provide numerous production benefits to the producer while helping to protect natural resources. Production benefits include: increased weight gains and work efficiency, improved marketability and animal well-being, and reduced spending on fertilizer, feed, fuel, water, and labor. Although many innovative BMPs have been developed that incorporate recent findings and technology, the majority of BMPs advocated today have been advocated since the 1930s, yet there is still a lack of voluntary adoption and thus a depletion of natural resources. To prevent a continued depletion, regulations now require that certain BMPs be implemented. Cost-share and technical assistance is available to assist producers with implementing their Agriculture Water Quality Plan through the Natural Resources Conservation Service, their local Conservation District, or the University of Kentucky Cooperative Extension Service. Producers should take advantage of these free services to maintain compliance with state law and realize the operation's production potential.

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