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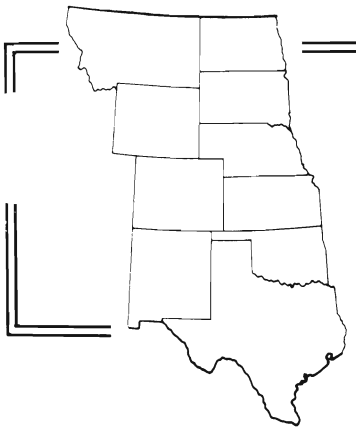

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Management Of Feedlot Runoff Control Systems

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During recent years, most open feedlot operators have found it desirable and, in some cases, necessary to install runoff control facilities. Even though the primary purpose of feedlot runoff control systems is the prevention of water pollution, many producers have found that good management of these systems also offers limited economic benefits in the form of fertilizer nutrients and supplemental irrigation water. Well managed runoff control systems also reduce weeds, odors, insects and muddy areas at or near feedlot edges. The runoff control system that has proved most satisfactory for all areas of the country is one consisting of clean water diversion, runoff collection, a solids settling facility (or debris basin), a runoff holding pond and pond dewatering equipment (Figure 1). Management consists of cleaning solids from the settling facility and pumping out the holding pond when necessary. The amount of labor required for proper management of runoff control systems is not excessive, but this type task usually has a low priority in a general farming situation and, therefore, is often not accomplished when it should be.

A lack of cattle lot maintenance can lead to undrained muddy areas and to nuisance conditions such as fly and odor problems. Such conditions have also been shown to decrease animal performance. If the settling basin is not cleaned when solids build-up reaches the design-full level, the outlet clogs and more solids carry through to the holding pond. Allowing solids to reach the holding pond reduces its capacity and shortens its useful life unless periodic sludge removal is practiced. Additionally, an excessive accumulation of solids and undrained liquids in the basin frequently results in odor and insect problems. Failure to pump out the holding pond on a timely basis may lead to overflows with dubsequent loss of crop nutrients, water pollution, and potentially to a lawsuit.

Clean Water Diversion

To minimize the amount of water which must be handled through a runoff-control system; diversion terraces, channels and roof gutters should be utilized and kept in good repair. Keeping clean water diverted away from feedlots decreases the quantity of liquids to be separated in the settling basin and subsequently stored in the holding pond. Control of clean water effectively reduces the required size of the holding pond or can increase the time between dewatering operations.

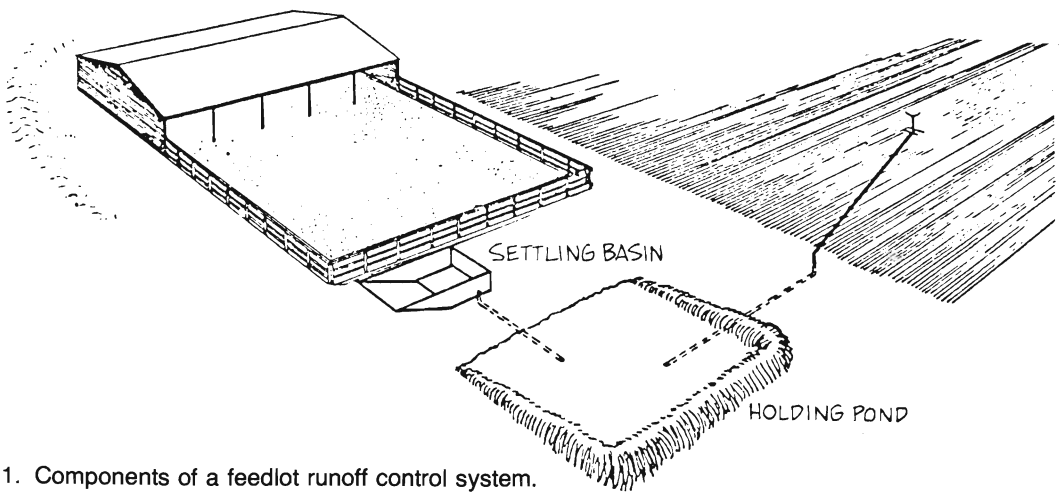

Figure 1. Components of a feedlot runoff control system.

In situations where clean water is to be collected for use as irrigation water, it should be diverted around the settling basin directly to the holding pond. Careful sizing and design of the holding pond is essential to ensure adequate capacity for storing both the diverted clean water and feedlot runoff.

Runoff can be collected from feedlot areas and diverted to settling basins and holding ponds by using curbs, channels, terraces, pipes or combinations of these. All parts of the runoff control facilities need to be kept free of obstructions such as weeds, tree limbs, and accumulations of solids. Obstructions in runoff collection devices may cause overflows with resultant pollution or nuisance conditions due to unconfined feedlot runoff. Obstructions can also cause solids to settle in areas where removal may be difficult, or impossible. Routine moving and clean-up supplemented with periodic grading and shaping of earthen runoff collection devices will effectively minimize the development of erosive or low, soggy areas.

Settling Basins

A settling basin is used to separate the liquids and larger solids in feedlot runoff. The runoff collects in the basin with a large portion of the solids settling and the liquid draining into a storage pond. The settling basin reduces the quantity of solids reaching the holding pond. Management of the settling basin is a major factor in maintaining a successful runoff control system. Keeping solids out of the holding pond increases effective liquid storage, helps minimize odors, and makes the liquid much easier to pump through irrigation or other dewatering equipment.

Many types of settling facilities can be used. Common designs include channels (Figure2) and boxes (Figure 3) made of earth or concrete. The required frequency of cleaning depends on the size of basin, type of lot surface and storm runoff characteristics. Cleaning may be necessary after each large storm but in any case, the settling facility should be cleaned when the depth of the trapped solids approaches 50 percent of the basin depth. Generally, cleaning a well-designed settling facility four to six times per year seems to be adequate.

If plans are to clean the settling facility with conventional semi-solid manure handling equipment, such as a tractor and loader, the basin must have a concrete bottom. Concrete sides are also beneficial to enhance loading. This type handling generally requires that the depth of solids accumulation be limited to 1 to 2 feet for improved drying and easier handling. If liquid manure handling equipment is available, it may be easier to handle the settled solids in the basin as a slurry or liquid.

Should an accumulation of solids occur in a debris basin with an unpaved, muddy bottom, two alternative methods of cleaning are available:

1. Utilize heavy equipment such as a backhoe or clamshell equipped dragline to dip solids out of the basin into trucks or open top spreaders for transport and cropland application.
2. Add sufficient water to produce a pumpable slurry and agitate or mix throughly. Pump the slurry into tank spreaders for transport and cropland application.

Cleaning the settling facility not only includes removal of solids but also includes cleaning the basin outlet. A commonly used basin outlet for box-type settling facilities consists of a galvanized-corrugated, asphalt-covered metal pipe or a heavy wall steel pipe having a diameter of at least 18 inches. These risers usually have vertical 1 inch × 4 to 6 inch slots spaced at 120° intervals around the pipe. The slots should be positioned to produce a vertical spiral pattern around the pipe with a vertical overlap of slots of at least two inches. When solids are removed from the basin these slots need to be cleaned by scraping or washing with high pressure water

The use of an expanded metal screen as illustrated in Figure 2 has proven successful in reducing clogging problems associated with outlet risers. The removable expanded metal screen provides a much larger area for the

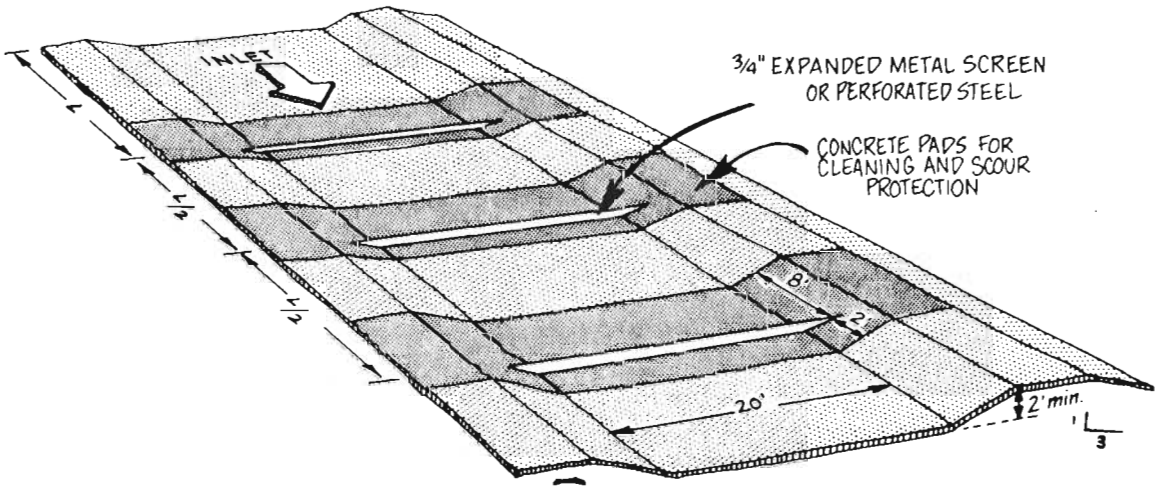

Figure 2. Settling channel and baffle for removing solids present in feedlot runoff.

separation of liquids and solids than does the pipe riser. Again, scraping or utilizing high pressure water are methods for cleaning the screen.

Other methods of separating the liquids from the solids such as concrete risers, slotted board dams and porous dams have been utilized with varying degrees of success. All require routine maintenance and cleaning in order to efficiently separate liquids and solids.

The amount of solids which enter the settling facility is greatly influenced by the frequency of lot cleaning. Solid manure should be scraped and removed from lots on a regular basis. If intervals of several months between lot cleanings are anticipated, the size of the settling facility should be increased 25 to 50 percent. Lot manure should never be scraped into or stored in the settling facility, but should be hauled away or scraped into a separate manure storage area where it will not interfere with the settling basin performance. When lots are scraped, care should be exercised to avoid causing low spots in the pen surface. If low spots or potholes do exist, fill soil should be added to return the lot surface to the original grade to ensure good drainage. (See GPE 7600, "Manure Management for Cattle Feedlots").

Runoff Holding Ponds

The purpose of a holding pond is to temporarily store runoff, before application on land. Runoff holding ponds should be differentiated from a similar structure, the anaerobic treatment lagoon. Holding ponds are designed to provide only temporary storage with land application providing the necessary treatment whereas lagoons are designed as a treatment process with bacteriological action being utilized to decompose solids which enter the lagoon.

In arid areas, evaporation from holding ponds during summer months may be adequate for dewatering. In such cases the holding pond should have sufficient capacity to store all runoff anticipated during the balance of the year. As a minimum, the runoff holding pond must be sized to control the 25 year-24 hour storm. In more humid areas, the ponds must be emptied by pumping. In general, holding ponds should be pumped out whenever land conditions permit an application without excessive runoff or damage to growing crops and when crops will benefit from the utilize the water and nutrients. Doing this helps provide adequate storage capacity to store lot runoff from the next percipitation event.

As a minimum, spring and fall dewatering of holding ponds is recommended. Generally, holding ponds contain the most crop nutrients in early spring, thus spring dewatering provides the largest crop nutrient benefit. Fall dewatering is recommended to provide capacity for winter and early spring runoff. An alternative to twice-per-year dewatering is to construct a holding pond designed for a full-year storage.

Holding ponds should be fenced to prevent direct access by livestock and for safety considerations. Bank slopes should normally be no steeper than 2.5 feet horizontal for each foot of rise. The banks should be seeded with a suitable vegetation to prevent erosion. Keeping the banks mowed will aid in reducing nuisance conditions from flies or mosquitoes and improve overall farmstead appearance.

Holding Pond Dewatering Equipment

Lot runoff stored in holding ponds is normally utilized by applying it on nearby cropland. While hauling by tank wagon is possible, pumping and irrigating di-

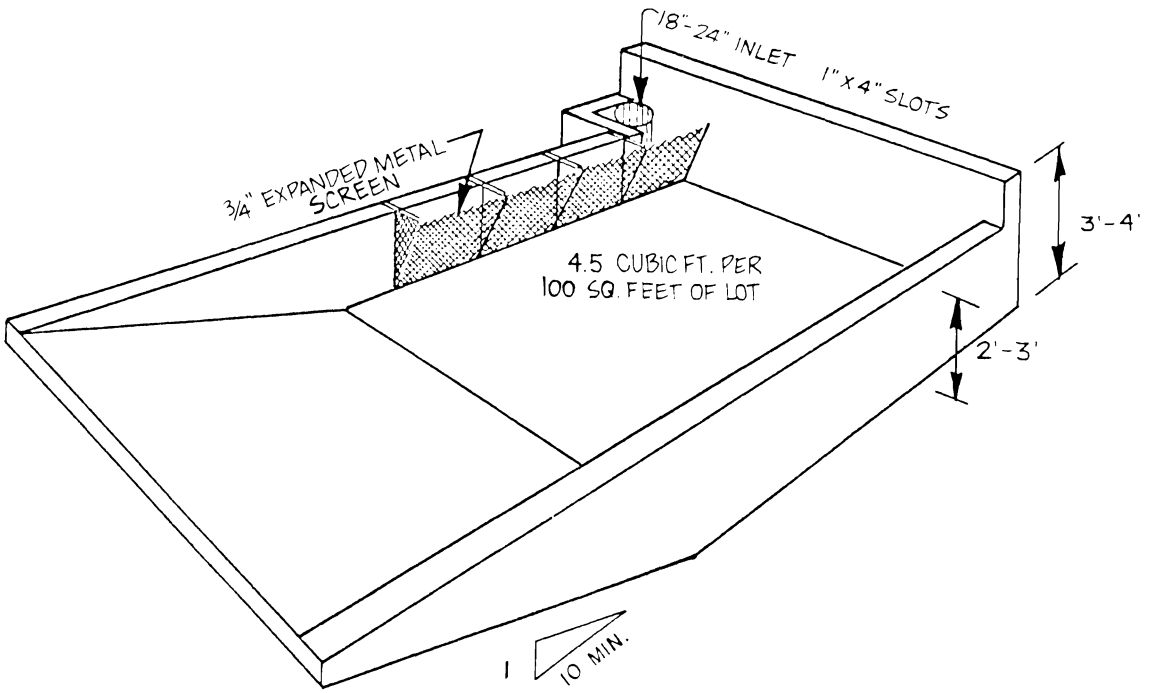

Figure 3. Box-type settling basin utilizing expanded metal screen for liquid-solids separation.

rectly to the land is usually the more economical dewatering method. Irrigation systems do not need to be elaborate. The main objective is to empty the pond within a reasonable length of time without exceeding the infiltration capacity of the soil or the nutrient utilization level of the crop.

Standard centrifugal pumps are usually satisfactory for pumping lot runoff from holding ponds through sprinkler systems or gated or perforated pipe. Power for the pump can be provided by electric motors, internal combustion units or tractor PTO's. Aluminum or plastic pipe may be used. With furrow irrigation of stored feedlot runoff, care must be exercised to prevent accumulations of solids at the top end of furrows, which could result in crop damage or provide insect breeding areas.

Solids Removal

Occasionally, holding ponds become overloaded with manure solids as a result of incomplete or poor solids settling in the debris basin or due to a lack of settling basin management. Solids in the holding pond reduce the storage capacity and usually create odors and other nuisance problems. In the event that solids need to be removed from a holding pond, several procedures are available:

1) If the holding pond is rectangular or circular shaped and small, whereby good circulation and mixing can be obtained, then agitation prior to the dewatering operating can successfully remove a small solids accumulation. Some pumps are equipped with agitator nozzles for mixing. In other situations, the pump discharge may simply be directed back into the storage. Before using this method of removing solids, the operator should insure that the dewatering pump and distribution equipment will handle the resuspended solids without clogging. When pumping accumulated solids, irrigation nozzles at least 7/8 inch in diameter should be used to minimize clogging. If the solids concentration exceeds six percent it may be necessary to utilize chopper pumps or similar equipment for removing the solids or to add addtional water to reduce the solids concentration prior to pumping.
2) Another alternative is to pump out as much water as possible and allow the remaining solids to dry out prior to subsequent removal. This process takes several months of low rainfall. It may be advantageous to use a dragline to remove some of the sludge and solids to hasten drying. After drying, scrapers, front-end loaders and other conventional manure handling equipment can be used for final soilds removal from holding ponds having firm bottoms.

Summary

Runoff control systems consisting of clean water diversion, runoff collection, a solids settling facility, holding pond and pond dewatering equipment have proven successful in reducing water pollution. All systems must be signed and installed to comply with local pollution control regulations. Following good design and careful installation, management of these systems is necessary to ensure that the system operates as designed and does not create additional pollution, odor or nuisance conditions.

Key management requirements are periodic cleaning of the settling basin and timely holding pond dewatering. Failure to clean the settling basin allows manure solids to enter the holding pond and creates odor and other nuisance conditions in both the pond and basin. Failure to pump out the holding pond can lead to overflow which produces pollution hazards and results in a loss of crop nutrients present in the feedlot runoff.

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