Iowa Beef Center
IOWA STATE UNIVERSITY

# Inexpensive Pumping Systems to Manage Small Feedlot Runoff

## A demonstration project summary

The results of a 2011 feedlot pumping demonstration project show that using small electric sewage pumps can be a cost effective way to reduce the risk of feedlot runoff from leaving farms. This system is applicable to feedlots that have less than 1,000 head and do not require NPDES permits.

**Costs and Benefits**

The installation cost of the systems has ranged from $2 to $18 per head for all components, approximately one third each for electric wiring, pump, and movable distribution/plumbing system. The operating electricity cost was less than $0.03 per head per year.

The high end of the cost range was an all-weather installation that worked automatically next to a highly visible location on a small feedlot. The more cattle that can be serviced with a single pump and movable distribution system the cheaper the fixed cost per head will be.

The primary benefit is the risk of runoff from the feedlot causing a water quality impact in a receiving stream is greatly reduced. A secondary benefit is the runoff water can benefit adjacent crop fields if managed properly.

The flexible transfer hose provides a means to change the location of the runoff distribution system so the soil is not overloaded with water or nutrients. In the 2011 crop year, every demonstration site showed a yield increase where the feedlot runoff water was applied. Management is required to move the hose to a new location after each large rain event to prevent overloading the soil.

**System Design**

The design of the system required the following components:

- Adequate runoff storage
- Pump and control system
- Plumbing and distribution system
- Management considerations

**Adequate Runoff Storage**

The engineers involved in this project recommend a minimum of ½ inch of runoff storage for this system. The storage can be in the settling structure or after the settling structure. Additional storage capacity will reduce the number of times the storage overflows when the pump cannot keep up with the incoming runoff. A ½ horsepower pump can distribute the water from most rainfall events from a one-acre feedlot over a 24 hour period if adequate storage is provided to hold the runoff (approximately three inches of runoff). Even when the system has inadequate storage or is overwhelmed by an extreme rainfall event, the pump would handle the first part of the runoff event, which presents the highest pollution potential.

The float should be set up to start when there is at least five minutes of pumping capacity (500 gallons) in the storage structure or enough pool in the settling structure to provide adequate solids separation. This provides enough capacity to ensure that the pump is not cycling too frequently which would reduce the life of the motor.

The runoff storage system should have enough capacity to hold at least ½ inch of runoff from the lot before it overflows. The location of the overflow should be grassed, to reduce the risk of erosion and provide infiltration in the big runoff events the pump can't handle. When possible, overflow should be directed to flat infiltration areas where it can soak into the ground and not reach a stream.

**Pump and Control System**

This project utilized commonly available sewage pumps with adequate lift and flow capacity to handle the desired feedlot runoff. Sewage pumps can handle some solids without plugging and have higher reliability than sump pumps**.**

If the distance from the electric source is long (more than 200 feet) a 220 volt pump may be a better choice than a 110 volt pump because of the reduced current and voltage drop. In our demonstrations, sewage pumps operated well even with voltage drops up to twice the generally recommended limits. In some cases, a second pump might be recommended to add system capacity and reliability while keeping the cost down.

Most sewage pumps provide less than 20 feet of lift capacity. If the topography to the field requires more elevation lift, make sure to select a pump that can deliver.

The control system includes a float switch that will turn on when the water is high and turn off before the pump runs dry. Often a coarse screen (½ to ¾ inch openings) is added to protect the pump and float from trash and weeds that will plug the pump or foul the float. A fused manual disconnect switch provides safety for maintenance and overload protection.

**Plumbing and Distribution System**

In this project 2 to 3 inch flexible lay flat hose was used to convey the water from the pump to the field. A 3-inch hose can handle around 5,000 gallons per hour while a 2-Inch hose can handle around 3,000 gallons per hour.

The hose should be laid along a fence or similar structure and out of the way for field work. While it can be driven over when empty, repeated traffic may puncture the hose. Buried PVC or PE pipe will eliminate traffic concerns and have longer life, but it is more expensive.

The distribution system we used was a 2 inch PVC pipe with ¾ inch holes on 60 inch centers. This allows for the runoff water to flow down every other (30-inch) corn row. A removable cap on the end of the distribution pipe allows flushing of sludge and scale that can accumulate in the pipe. Flexible lay flat hose may also work well as a distribution pipe.

**Management Considerations**
We recommend that the distribution system be moved after each significant pumping event (½ inch of runoff from the lot, or ¾ inch rain). The PVC pipe is light and can be moved to a new set of rows in less than 5 minutes. This prevents the same soil from being overloaded with feedlot runoff that may hurt the crop. Additional short segments of transfer hose with couplers can make relocating the distribution pipe easier.

There are typically fewer than 20 days a year that would require the system to be moved to a new location following the ½ inch of runoff guideline. Because the pumping/distribution system is a man-made device, discharges which reach a water of the U.S. may have implications for NPDES permit status. With each pumping event, check for runoff from the distribution system and make the necessary corrections to protect water quality.

**Summary**
This system provides additional runoff control and water quality protection at a low cost. When NPDES permit requirements do not require greater controls, a system of this type may allow small feedlots to better protect water resources while gaining crop benefits from feedlot runoff. Proper system design and careful system observation and management are required for optimum performance.

Contact your Iowa State University Extension Ag Engineer to discuss this system and how it might work on your farm.
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Prepared by Kris Kohl and Shawn Shouse, Extension agricultural engineering program specialists, and Sherry Hoyer, Iowa Beef Center.

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