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GUIDE

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Lagoon Pumping and Irrigating Equipment

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Lagoons are an important part of many Missouri livestock waste management systems. In addition to providing relatively low-cost storage for wastes, lagoons biologically degrade and liquify manure for pumping and distribution onto pasture or crop land.

Lagoons definitely should *not* be considered final disposal impoundments for animal wastes. Pumping and distributing wastes onto the land is necessary for:

1. Preventing lagoon overflow and the resulting pollution potential. Although overflow may seem infrequent or of little consequence, the discharge of lagoon effluent from the owner's property may result in a violation of state or federal pollution laws.
2. Utilizing fertilizer nutrients in the lagoon effluent. Significant amounts of fertilizer nutrients are present in lagoon effluent. These plant nutrients can supplement or reduce requirements for commercial fertilizer.
3. Reducing the levels of salts and minerals that accumulate in the lagoon. In the bacterial breakdown of manure, salts and minerals are released as products of the biological activity. These salts and minerals can become concentrated, especially during periods of high evaporation and little rainfall, if they are not periodically removed from the lagoon.

Equipment Requirements

Although the equipment required for pumping and distributing lagoon effluent may be similar to conventional irrigation equipment, the smaller volume of water handled in lagoons generally allows the use of smaller and less costly systems. Table 1 gives average annual pumpdown volumes for lagoons receiving wastes from livestock. Note, the pumpdown volumes for lagoons are less than the volumes of water normally handled in conventional irrigation systems. Thus, the lesser volume of lagoon water requires smaller and less sophisticated irrigating equipment.

System Types

The types of systems suitable for distributing lagoon

Table I. Average Annual Pumpdown Volume for Lagoons.

Animal Type	Lagoon Pumpdown Volume Acre-Inches/Year
Beef, Total Confinement per 100 Head	5.0
Beef, Open Dirt Lot per 100 Head	19.0
Poultry, Total Confinement per 10,000 Layers	3.6
Swine, Total Confinement per 1,000 Finishing Hogs	16.0
Dairy, per 100 Cows	28.0

Figure 1. Plastic pipe with properly spaced holes may be suitable for small lagoons.

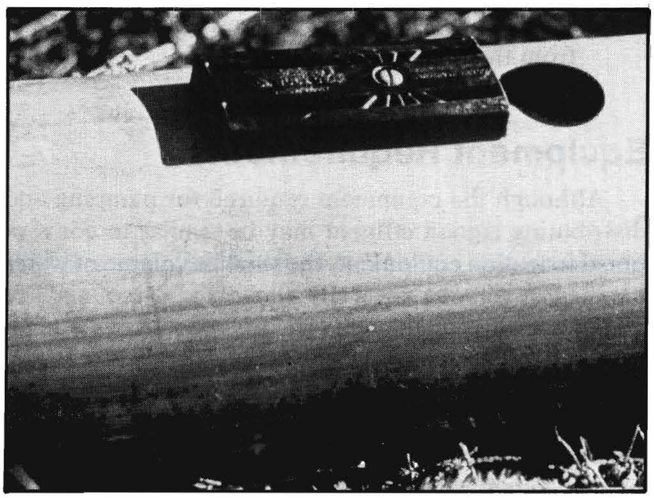

Figure 2. Commercial gated pipe with adjustable gates.

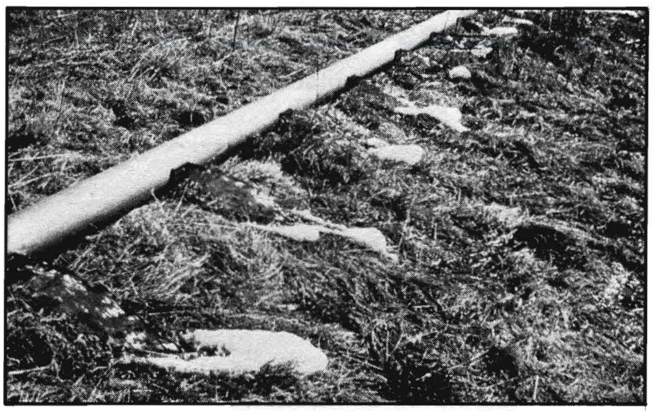

Figure 3. Gates should be adjusted to provide uniform flow from pipe.

effluent fall into two major categories—(1) gated pipe or surface irrigation systems and (2) sprinkler irrigation systems.

Gated pipe systems. These systems consist of a pump or gravity flow arrangement from the lagoon to a distribution pipe that has holes at intervals along its length. Lagoon effluent is discharged through the holes at a rate compatible with the land slope and soil infiltration capability. The gated distribution pipe usually is laid as level as possible across the upper end of a sloped soil-plant filter or waste receiving area. Gated pipe or surface irrigation systems are suitable for land slopes from 0.2-5.0 percent. Flatter slopes result in ponding of effluent at the discharge point of the gated pipe, while steeper slopes cause effluent runoff with little opportunity for infiltration into the soil.

The advantages of gated pipe systems are relatively low cost, low operating pressures, and even distribution of effluent if the holes in the pipe are properly located and sized. The disadvantages of gated pipe systems are high labor and management to insure the proper operation of the systems. Gated pipe systems do not perform well on uneven or steeply sloped land. Traditionally, gated pipe has been used to irrigate row crops. However, properly designed and managed gated pipe systems have been used successfully to distribute lagoon effluent onto grassed areas.

Simple, low-cost gated pipe systems can be made by drilling holes at 30- to 40-inch intervals in plastic pipe as shown in Figure 1. Such distribution systems would be limited to small lagoons because flow rates would be 50 gallons per minute or less with 2-inch plastic pipe.

Commercially manufactured aluminum gated pipes, 4-8 inches in diameter, will provide greater flow rates at increased cost. The gates on commercially manufactured pipe usually are adjustable (Figure 2) to provide even flow at the desired rate through each individual gate as shown in Figure 3. Gated pipe systems usually are *hand carried* from one point to another on the soil-plant filter area to assure full coverage. Pressure in gated pipe systems usually does not exceed 20-30 pounds per square inch.

Sprinkler Systems

Sprinkler systems are more suited to the rolling terrain found in many areas of Missouri. With sprinklers, the water application rate is near the infiltration capability of the soil. Hence, potential for runoff is reduced even on steeper slopes. Sprinkler systems generally include a pump at the lagoon, aluminum or buried plastic pipe to carry effluent to the soil-plant filter, and some type of sprinkler or sprinklers to distribute the effluent. In addition to their suitability for rolling or steeply sloped land, some sprinkler systems can be designed with considerably less labor than gated pipe systems. Sprinkler systems usually operate in the range of 40-120 pounds per per square inch pressure.

Hand-carry sprinkler systems. The simplest and least costly sprinkler systems are the hand carry or hand move types (Figure 4) that require labor input for setting up and moving the system. Such systems are usually 4-inch or 6-inch pipe with one or more sprinklers which *tee* off the main line at the appropriate intervals (Figure 5). Nozzle sizes for these systems are generally in the ½-1-inch range and typically cover ½-2 acres/sprinkler depending upon nozzle size and system operating pressure. Although some labor input is required, these systems are applicable because of their relatively low cost.

Stationary big gun. This system includes a pump and main line similar to the hand carry system, but with a single large volume gun sprinkler replacing hand move sprinklers. Advantages of the big gun system include larger flow rates and a larger wetted area so less labor is required in moving the sprinkler. Some big guns are wheel-mounted (Figure 6) to facilitate moving the unit. Stationary big guns typically have nozzle sizes ranging from 1-2 inches, and operate best at pressures of 80-120 pounds per square inch. Coverage areas from 2.5-6.0 acres can be obtained with proper selection of nozzle size and operating pressure. Although stationary big guns cost more than smaller hand carry systems, the reduced labor and higher flow rates may offset the higher cost.

The sprinkler systems already described require labor for movement from one *set* or location to another to insure that the soil does not become saturated.

Traveling gun. This self-propelled unit covers larger areas than stationary sprinklers of the same size. Traveling guns consist of a conventional gun sprinkler mounted on wheels. A water-driven winch on the traveling gun pulls the unit across the ground by a cable anchored at the end of the field. This winch also may be driven (on some models) by a small gasoline engine. Such an arrangement prevents the possibility of solids plugging the water turbine. However, plugging problems are minimal when pumping effluent from properly sized lagoons.

Figure 7 is an example of a typical water-driven traveling gun. Water is directed to the traveling gun through a flexible hose pulled behind the unit (Figure 8). The distance a traveling gun can move between sets is dictated by the length of the flexible hose. Hose lengths from 330-660 feet are common, and allow travel distances of 660-1320 feet (twice the length of the hose). Effluent usually is carried from the lagoon to the point of connection with the flexible hose by aluminum pipe.

Traveling guns require pressure ranging from 75-120 pounds per square inch. Flow rates are from 100-800 gallons per minute. Typical coverages are 4 acres per set for small traveling guns to 13 acres per set for large traveling guns.

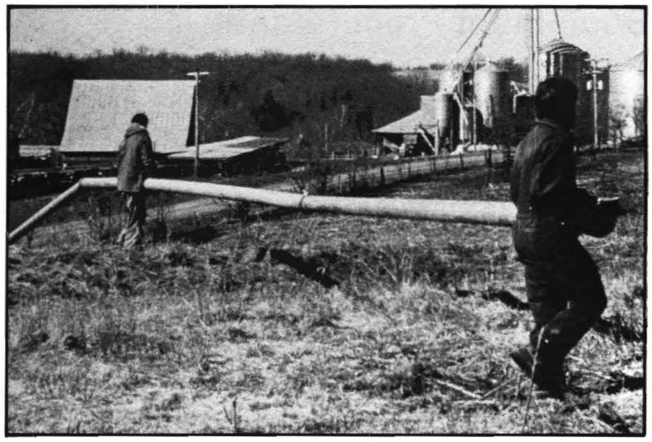

Figure 4. Simple systems require hand labor for setting up and moving.

Figure 5. Hand-set sprinklers are placed at proper intervals along the main line.

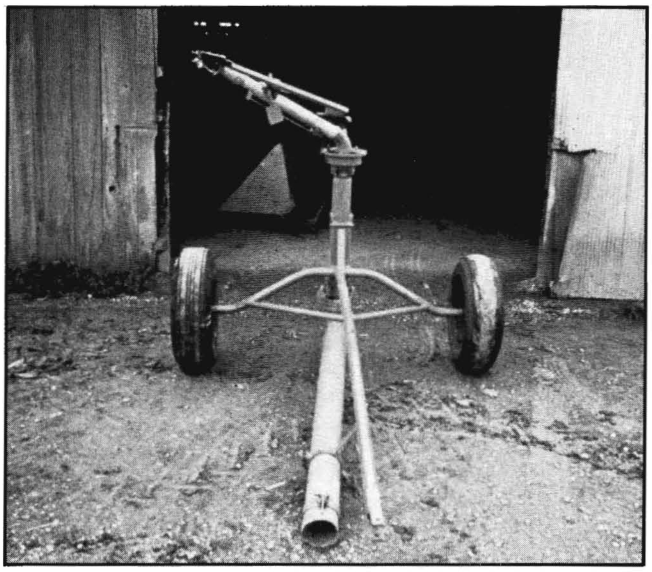

Figure 6. Some stationary big guns are mounted on wheels to make moving easier.

Large traveling guns (Figures 7 and 8), traditionally used for crop irrigation, are too costly to be used only for lagoon pumping. However, these units have been used successfully in dual-purpose applications for crop irrigation and lagoon pumping. Several manufacturers of irrigation equipment have small traveling gun systems which may be competitive in cost with the hand move or stationary big gun sprinklers. These units (Figure 8) are adaptable to the rolling terrain often encountered near lagoons and are easily transported.

Center pivot irrigation systems. Obviously, these systems must be used primarily for crop irrigation. However, limited experience indicates that lagoon effluent can be distributed successfully through center pivot systems. In some cases, the irrigation reservoir also serves as the lagoon receiving livestock wastes. In such cases, take care to insure that the reservoir does not overflow, or that the overflow does not violate pollution laws and regulations.

If a lagoon and irrigation reservoir are located close together, a properly designed pump intake system may allow simultaneous withdrawal of liquid from both the irrigation reservoir and the lagoon. If the irrigation reservoir and lagoon are some distance apart, a pump at the lagoon will probably be required to inject the lagoon effluent into the pipe downstream from the pump serving the center pivot system. Another alternative is to pump or drain the lagoon effluent into the irrigation reservoir provided there is sufficient volume available. Regardless of the scheme selected, the use of center pivot systems for distributing lagoon effluent requires careful planning.

Pumps

Most conventional irrigation pumps will handle lagoon effluent with little difficulty. Power-take-off pumps (Figure 10) are used most often for pumping lagoon effluent. Pumps with integral power units are usually too costly unless they have another application.

The pump intake should be floated 1-2 feet below the surface of the lagoon (Figure 11). This keeps the intake free of floating debris, and above the sludge layer at the bottom of the lagoon. Properly designed lagoons operate with a sludge layer (usually 6-18 inches thick) but do not require agitation prior to pumping.

Pumping Management

Lagoons should never be allowed to overflow, and should be in the *pumped down* condition going into the fall and winter months. This insures that maximum volume is available for waste and runoff accumulation during the winter and early spring. Lagoons should not be *pumped dry* because adequate levels of bacteria must remain in the lagoon to degrade incoming wastes after the lagoon is pumped down. Consult the designer of the lagoon or the UMC Extension Service for information on pumping your particular lagoon.

System Design

The proper design and equipment selection for irrigation systems requires detailed knowledge of terrain elevations, pipe friction losses, suction head, and performance specifications. Consult your local UMC Extension specialist, a qualified consulting engineer, or other qualified individuals for assistance in system design.

System flow rate, which depends upon the time available for pumping, is the criteria usually used to size systems. Table 2 gives the pumping time required for different flow rates for the average annual pumpdown volumes in Table 1.

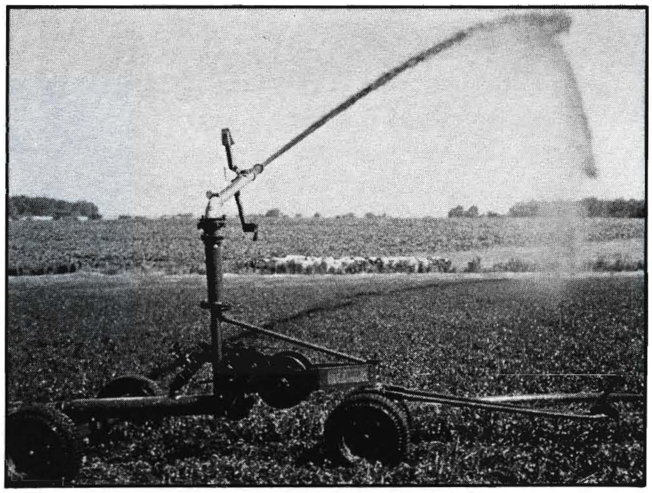

Figure 7. Conventional traveling guns provide excellent distribution of lagoon effluent.

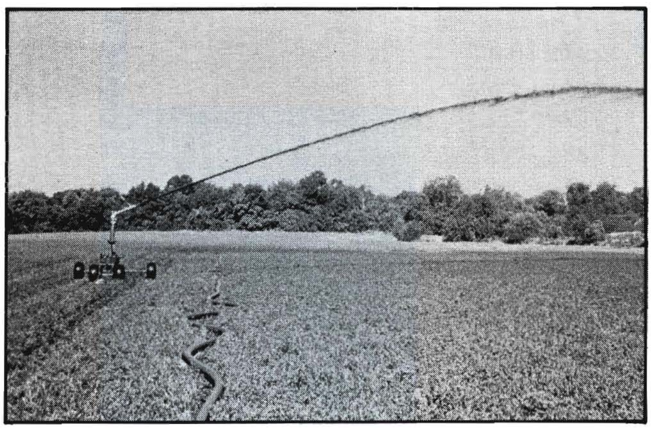

Figure 8. Traveling guns pull a flexible hose in a loop behind the gun.

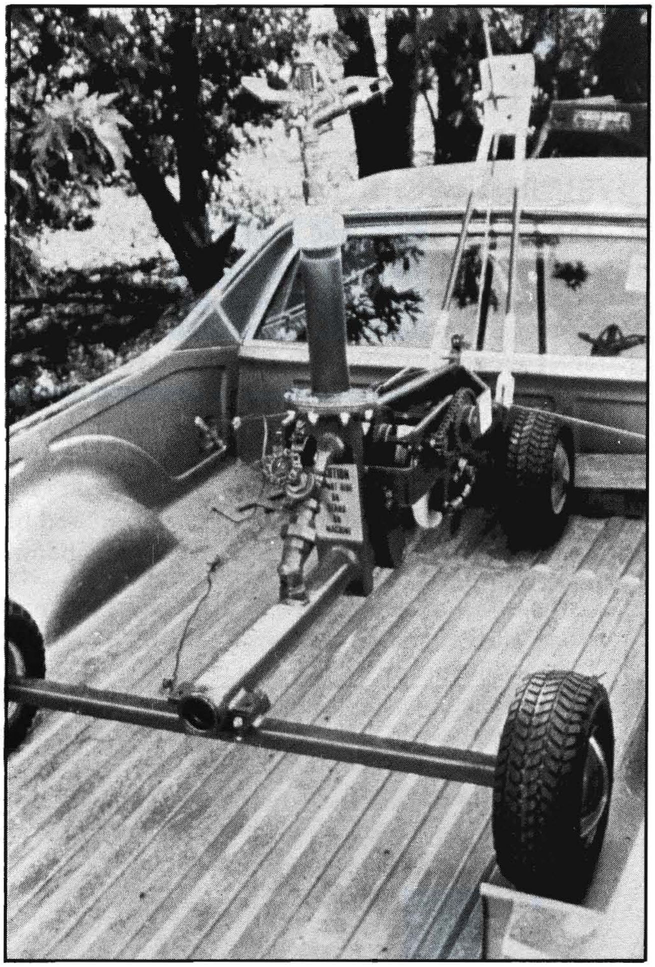

Figure 9. A small traveling gun may reduce labor requirements at a cost compatible with the production facility.

Figure 10. Tractor-powered PTO pumps are commonly used to pump lagoon effluent.

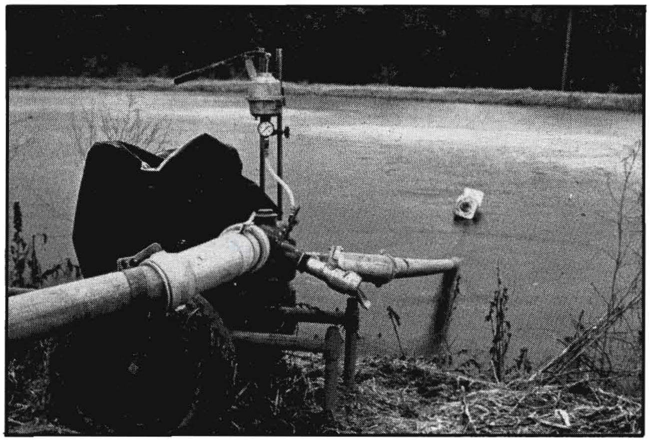

Figure 11. A pump intake floated 1-2 feet, below the surface will be least likely to plug.

Table 2. Pumping Time Required to Distribute the Annual Average Pumpdown Volume.

Animal Type	System Flow Rate, gpm.	Average Annual Pumping Time, Hours	Pipe Size (Aluminum), Inches
Beef, Total	100	22.5	3-4
Confinement, per	300	7.5	5
100 Head	500	4.5	6
Beef, Open	100	85.5	3-4
Dirt Lot,	300	28.5	5
per 100 Head	500	17.1	6
Poultry, Total	100	16.2	3-4
Confinement, per	300	5.4	5
10,000 Layers	500	3.2	6
Swine, Total	100	72.0	3-4
Confinement, per	300	24.0	5
1000 Finishing Hogs	500	14.4	6
Dairy,	100	126.0	3-4
per 100	300	42.0	5
Cows	500	25.2	6