ALABAMA A&M AND AUBURN UNIVERSITIES

ALABAMA COOPERATIVE Extension SYSTEM

ANR-954

Selecting, Planning, and Managing Dairy Waste Storage Ponds

To satisfy Alabama's agricultural "no discharge" water quality concept, dairy operators can choose from three predominant types of dairy waste management systems: daily scrape and haul, lagoon-gutter flush, and waste storage pond. These systems share some common activites, and when properly planned and managed, each allows for the necessary basic functions of waste collection, transfer, and land application.

Daily scrape and haul has the advantage of bypassing the treatment-storage option of the other methods. However, because of the high daily labor needed and the constraints of timing land applications, this method is most applicable to dairy herds of 100 cows or less. The other two systems—lagoon-gutter flush and waste storage pond—are applicable to dairy herds with more than 100 cows.

Deciding Which Dairy Waste Management System To Use

Before planning for one waste management system or another, operators should consider (1) waste nutrient value and required land application area and (2) waste handling, land application interval, and storage volume.

Waste Nutrient Value And Required Land Application Area

In a 24-hour confinement operation, the 100-cow herd generates about 62 pounds of nitrogen per day and more than 22,000 pounds per year. About 30 percent of this is lost in a waste storage pond, leaving around 15,000 pounds. This same dairy waste treated in a two-stage lagoon system would be reduced by anaerobic bacteria to about 5,500 pounds of nitrogen. At a land application rate of 200 pounds of nitrogen fertilizer per acre, more than two and one-half times as much cropland would be needed for a waste storage pond system compared to a two-stage lagoon system for the same number of cows. With a typical first year nitrogen availability factor using slurry-wastewater irrigation of 50 percent, this would be around 0.38 acre per cow needed with the storage pond system compared to 0.14 acre per cow for the lagoon system, a 24-acre difference with a 100-cow herd.

Treatment degradation of phosphorus and potassium is not so great with lagoons. Soils showing increasing accumulations of phosphorus may dictate land application based on phosphorus. This could double or even quadruple required land application area.

Waste Handling, Land Application Interval, And Storage Volume

Storage volume requirements are affected by the method of waste collection and transfer and the land application interval. Freestall lane flush with wastewater recycle is standard practice in the two-stage lagoon-flush system. Wastewater recycle flush systems are subject to salt buildup, predominately magnesium ammonium phosphate (struvite). For information on addressing this problem, see Extension Circular ANR-860, "Controlling Salt Buildup In Wastewater Recycling Systems."

Wastewater recycle flush is sometimes used in waste storage pond systems but is not recommended. It requires the addition of 50 gallons of freshwater per cow per flush during periods of low storage pond levels following waste pumpout until pond wastewater levels build up to allow recycle. A way of adding this freshwater to the flush system must be provided, and great care must be taken to prevent an accidental plumbing cross-connection that could contaminate the dairy water supply with recycle wastewater from the flush system. This additional freshwater need must be figured into total storage volume requirements to maintain desired storage period. This more complicated liquid management for flushing after pumpout is one of the factors that makes waste storage pond systems less desirable than lagoon-flush systems.

Full-time freestall lane flushing with freshwater is definitely not recommended due to increased freshwater needs and increased wastewater volumes generated. One alternative is to use a tractor to scrape dairy waste into the storage pond. This would require the construction of a reinforced

concrete ramp with equipment safety barriers. The storage pond would also need to be adjacent to the freestall barn.

Land application interval will greatly affect storage volume needed. This interval is determined primarily by the need to apply dairy waste to a growing crop at agronomic rates to reduce the chance of environmental pollution through runoff or deep percolation to ground water. In most of Alabama, the prospect of an actively growing crop needing fertilizer during the months of December through March is unlikely. This, and the need to give additional application flexibility, suggest that a land application interval or storage period of 180 days may be desirable from a water quality standpoint (See Extension Circular ANR-918, "Animal Waste Management Planning," for guidelines).

Planning A Dairy Waste Storage Pond

Further considerations in the planning of a dairy waste storage pond include:

- Site location and soils.
- Storage volume.
- Access ramps and pumps.

Site Location And Soils Investigation

Because earthen waste storage ponds are generally less expensive to build than above- or belowground concrete or aboveground metal storage tanks, most operators choose earthen pond construction. To minimize potential for surface and ground water contamination, storage ponds should be located at least 150 feet from any uphill well, 500 feet from other wells, and 50 feet from the milk house. For gravity transfer of collected dairy waste to storage pond and possible settling basin use, storage pond full level should be located 6 to 8 feet below the freestall barn apron.

An on-site subsurface soils investigation must take place to determine if the planned manure storage site has shallow soil over coarse sand and gravel, creviced limestone, or permeable bedrock. If any of these conditions exist, construction procedures and materials to prevent seepage to ground water, such as clay liners, geotextile or fabric liners, or concrete, must be used. Geologic conditions and treatments should be determined from county soil surveys and performance of other waste storage ponds in the area. A backhoe under the direction of an experienced engineer, geologist, or soil scientist is one of the best subsurface soil investigation tools available.

A waste storage pond should not be located in a flood plain nor should the bottom of the pond be constructed to a depth below the underground water table unless curtain drains or interception drains are installed around the perimeter of the pond at least 1 foot below the pond bottom.

As part of the animal waste management technical assistance program, Natural Resources Conservation Service (NRCS) currently offers on-site soils and geologic investigation assistance for animal waste management structures. NRCS should be contacted for assistance. Corrective treatments at some locations could be so costly that aboveground storage may be required or a waste management system at the site may be totally impractical. This could force moving an existing dairy to a more suitable location and should definitely be a significant part of the site investigation process for new dairy installations.

Storage Volume

Daily Dairy Waste Accumulation. Storage volume considerations should include daily dairy waste. A mature dairy cow can weigh 1,400 pounds and generate around 14 gallons (about 120 pounds or 1.9 cubic feet) of feces and urine each day with an average as-excreted solids content of around 12 percent. The total excrement for cows housed in freestall total confinement, along with milking wash wastes would bring the total to more than 2.5 cubic feet per cow per day. This is nearly 9 tons and more than 9 cubic yards of manure per day per 100 cows. For cows on pasture part-time, manure handling and storage needs would be less and in direct proportion to actual confinement time. A 100-cow herd on half-time pasture would accumulate nearly 6 cubic yards (5.5 tons) of manure per day in confinement, including milk wash wastes.

Milking Center Wastes. Depending on milking preparation procedures (such as automatic cow wash) and the use of milk center manure flush cleaning, daily milk center wastewater generated per cow can vary from 30 to 150 gallons. Typically dairy wastes from milking centers (milk house, parlor, and holding area) are very dilute. However, this additional wastewater does increase waste storage volume needed.

Additional Inputs. Storage pond volume must also include expected rainfall minus evaporation from the pond surface. In Alabama this is typically 12 to 14 inches annually but should be adjusted for the planned storage interval worst case and be based on local figures if possible. Volume must also include space for the 25-year–24-hour rainstorm event and any resulting watershed runoff into the pond. Roof and other rainfall runoff may or may not be included, depending on whether di-

lution water is needed for irrigation or not needed for tankwagon application of dairy waste. In addition to the above inputs, the volume of the storage pond should also include an allowance of at least 1 foot of freeboard above expected full level for overflow cushion protection and an allowance of at least 2 feet of depth on the bottom of the pond for materials not removed during the normal agitation-pumpout procedure. See the figure for cross section of a dairy waste storage pond. Note the upper pumpdown stake. Pumping should begin when water reaches this level.

Solids Accumulation. Dairy waste solids, particularly those from freestall housing bedding, can accumulate quickly in waste storage ponds. Solids accumulation requires longer, more thorough agitation at pumpout time to resuspend settled solids and special manure solids handling "chopper" pumps for transfer to tanker wagons or waste slurry irrigation systems. Solids can cause pumping problems, and over time can greatly reduce usable storage pond volume. *Serious consideration should be given to the installation of solids separation equipment between the freestall housing and waste storage pond.*

Properly designed gravity settling basins can remove up to 50 percent of the waste solids but must have a minimum of 4 to 6 feet elevation between the bottom of the barn collection channel and the maximum height of the storage pond liquid surface to work properly. They require periodic cleaning out with a tractor front end loader and work best when at least two are constructed side by side to allow alternating use and some manure solids drying out before cleaning.

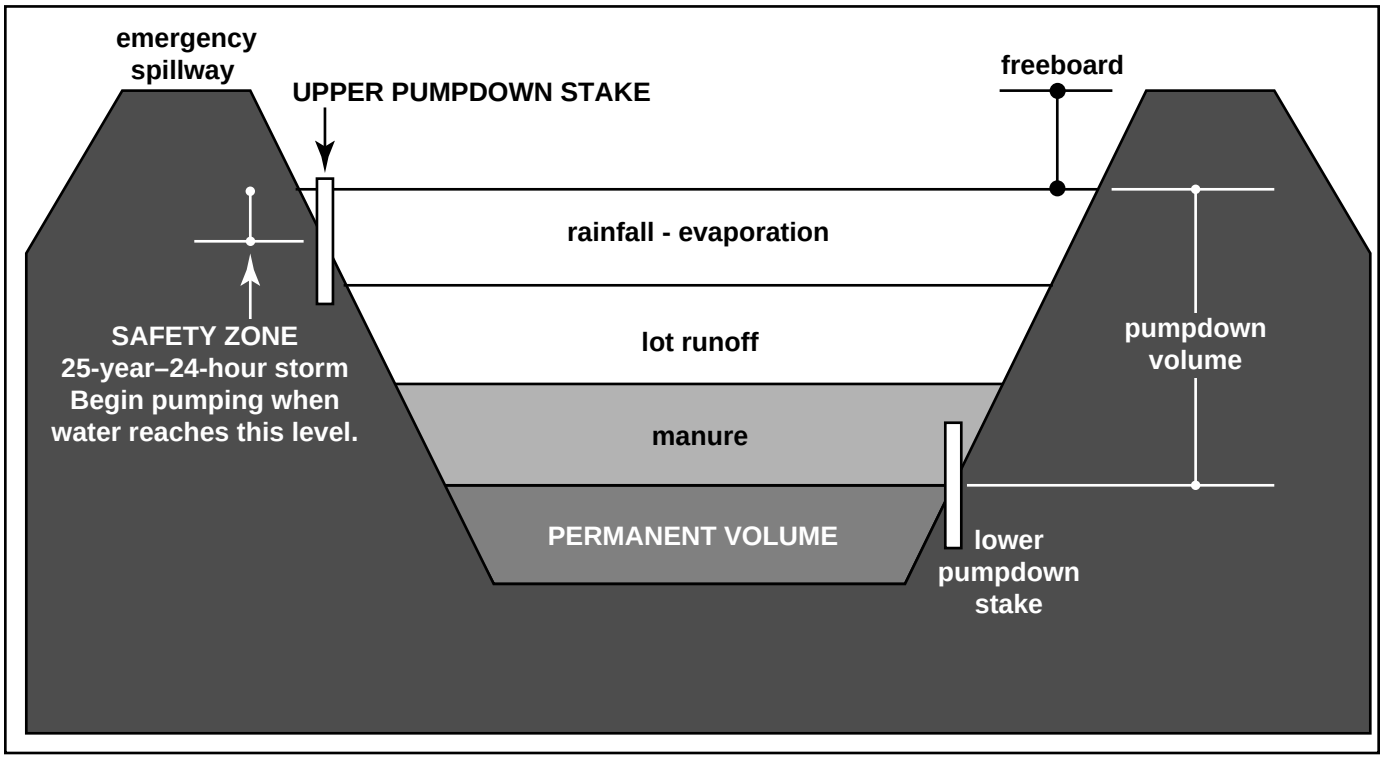
Mechanical separators are typically either rotating or stationary screens and generally remove 20 to 30 percent of the waste solids. These separators require little attention and produce manure solids that may be easily recycled as bedding or land applied off-farm with solid manure spreaders.

Access Ramps And Pump Platforms

Concrete access ramps and pumping-agitation platforms should be provided as needed to allow ease of access to the pond for agitating, pumping, or mechanically removing solids. Ramp slopes should be no steeper than 5:1 for tractor/agitator or tractor/pump access. To improve traction, grooves or ridges 1 inch or more across the ramp should be formed into the concrete before it sets. Concrete platforms built into the inside slope of the pond makes positioning of pumping and agitating equipment much easier and safer.

Managing A Dairy Waste Storage Pond

The dairy waste storage pond should be fenced and posted to keep young children, livestock, and other unauthorized visitors away. Pond banks should be seeded or sodded with a good grass



Cross section of a dairy waste storage pond.

cover to prevent soil erosion. This area should be mowed regularly to control grass and weed growth. If mosquitoes become a problem, contact your county Extension agent for control methods. Human waste should not be added to the dairy waste pond.

Storage pond pumpout must be carried out within the planned storage period. *Pumpout should be started in time to insure that space is available to hold the 25-year–24-hour rainstorm.* Waste irrigation equipment or tank wagons and specially designed pumps must be available, with tractors large enough to handle the horsepower requirements. Both agitation before pumpout and manure solids handling pumps matched to either the slurry irrigation system or "honey wagon" transfer tank are critical to successful waste storage pond pumpout. For more information on these subjects, see Extension Circular ANR-953, "Renovating Livestock Lagoons Using Irrigation."

Irrigating with dairy slurry or wastewater calls for special equipment designed to handle both the high solids content and high fertilizer content of the waste. Careful consideration must be given to matching irrigation application amount and nutrient content to crop soil tests. For more information on land applying dairy waste storage pond contents refer to Extension Circular ANR-925, "Calibrating Traveling Guns For Slurry Irrigation."

Owner Responsibility

Regardless from whom educational, technical, or financial assistance is sought, the owner or operator is ultimately responsible for the installation and proper management of a dairy waste management system.

Tips On Planning And Managing Dairy Waste Storage Ponds

• On-site soils and geological conditions should be investigated before a new dairy is installed. If soils or geological conditions are not suitable, existing dairies could have to move to a more practical location.

• Installation of solids separation equipment between the freestall housing and waste storage pond should be considered.

• Pumpout should be started in time to insure that space is available to hold the 25-year–24-hour rainstorm.

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Ted W. Tyson, *Extension Agricultural Engineer,* Associate Professor, Agricultural Engineering

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