More Manure Storage? Consider Your Operation and Your Neighbor's Concerns

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Recycling dairy nutrients back to the land needs to be timely to preserve nitrogen and to avoid environmental losses. Manure storages are an integral part of the manure management system on the farm to make sure this is possible. Nutrients, particularly nitrogen, should be applied as close to the plant's use as possible to reduce the potential for emission, runoff and leaching losses. Fall, winter and wet weather manure spreading have the potential for significant losses to the environment. Manure storage until right before the growing season, with a premium on storage locations that allow quick and efficient spreading when the time is appropriate, should be part of every manure management system.

Additional storage either at the farmstead or convenient to fields needs to be evaluated carefully. Many farms already have some manure storage. The site selection needs to consider how the storage will be loaded and unloaded. Pumps and pipe systems add versatility to where manure storages can be located. Powerful pump systems are available that can increase the effective range in locations where manure storages can be placed on the farm or on neighboring farms. If manure is pumped, manure and bedding consistency, as well as potential treatment systems, need to be planned for and considered. Sand-laden dairy manure (SLDM) has an impact on pumped and gravity flow systems. Bedding amount and type influences how far and how high manure can be easily pumped. Solid liquid separation (SLS) systems may need to be considered as part of the system. Manure at less than 4 percent solids is much easier to pump than dairy manure as produced at 12 percent solids. Plans for additional treatment for nutrient concentration, energy production, and/or odor control may also be considered. Route any pipes so that they can be monitored during pumping. Locate pumps so they can be monitored if automatic safety equipment fails.

FIGURE 1

Satellite Manure Storage: pump loaded, located out of sight, convenient for spreading, sized for the cropland to receive the recycled nutrients, and built on appropriate soils.

The size of the storage should be determined with the help of your nutrient management planner and/or engineer. It should be sized to meet the production of the cows and the land base on which the nutrients will be utilized. Consider the possibility of increased manure production in the future. Satellite storages for more remote field complexes need to have enough storage for the manure to be spread, plus any precipitation for the storage period. If they will only be emptied once a year, the year's precipitation will need to be added.

Use the Natural Resources Conservation Service (NRCS) Standard for Waste Storage Facilities as a minimum for design. In general, a square (or round) and deep storage will have the most volume for the least construction cost. A shallow storage will collect more precipitation and have a larger perimeter. The design for the storage should include more than the average precipitation. During wet years additional storage is often needed. Extreme events need to be planned for so the potential for overtopping is reduced. Capacity for at least the 25-year event is often required. Preparations for a 100-year-event capacity will give additional peace of mind. Alternatively a floating cover may be considered to prevent additional precipitation from entering the storage. Covers should only be considered in conjunction with SLS. They also can mitigate for odors and trap greenhouse gases.

Safety concerns include limiting access and protecting from the potential of harmful gas concentrations. Fences and warning signs to prevent people, equipment and animals from accidentally entering the storage or confined spaces are needed. Protect against vandalism by limiting access to valves and pumps. Access

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road entrances should have enough sight distance to allow traffic to adjust to farm equipment and hardened enough to prevent mud from tracking into the roadway. Work with local authorities to take steps to protect high-traffic and frequent-turn areas.

Gravity out systems bring an additional safety concern as valve failures have allowed the release of large flows of manure. With the improvement and prevalence of pumps (and the need to homogenize the storage to get a uniform nutrient application), the usefulness of gravity flow for unloading has declined. Pumped loading to a higher storage has the same potential if the valves fail (unless there is a designed air gap in the system as it enters the storage). The stored manure can flow back down catastrophically. Locate the storage to provide room and/or facilities so that unintentional minor or major spills can be intercepted and mitigated before they enter a water course or a floodplain. Unloading areas should be graded back to the storage so that any spillage will not escape or contaminate the clean water drainage around the storage.

Storing solid or frozen manure requires access to the storage over the top, and this needs to be built into the design. Use of SLDM and other settling solids in the bedding (or even a large storage that agitators can't stir completely) need access to the bottom for solids removal. Ramps that will be traveled in and out of the storage by manure hauling equipment should be at least 8:1 and roughened for traction. Ramps that are used occasionally to move pumps, agitators or solid handling equipment should be at least 4:1 for safety. If the pumping and agitating equipment is just lowered down the sides, the hardened area can match the side slopes.

Test pits are needed to determine the soil characteristics and the presence of ground water or bedrock to properly design the storage. The test pits should go at least two feet deeper than the bottom of the storage. Bedrock should be two feet lower than the bottom of the storage and even deeper (or use an impermeable bottom) if the bedrock is fractured and has solution channels. Groundwater control is very important. If groundwater enters the storage, it will fill the storage prematurely, and will add to time and cost of hauling to fields. Groundwater movement through the banks of the storage can collapse the bank and make channels for manure water to leak out. Seepage layers need to be identified and a drainage system needs to be designed to keep the groundwater out.

Soil samples should be taken to test the soil for adequate impermeability. If the soils are too permeable, it may be possible to find suitable material nearby. If testing confirms, material for a borrow pit can be hauled to the site to construct an earthen liner. Some earth materials can be modified by adding a specific amount of bentonite to decrease the permeability. An impermeable high-density plastic liner can be placed at an additional cost if the existing or modified earth cannot be made impermeable enough. Plastic-lined storages will need concrete agitation areas or a concrete floor to remove solids. Concrete or metal structures will be needed if the site requires.

Select a site that is compatible with the community. Work with your nutrient management planner and engineer to find the best location. Follow all local zoning regulations. Avoid sensitive environmental areas. Keeping the storage out of sight goes a long way to reduce community objections. Use a long access road, locate it behind a view screen of trees or buildings, or have the berm or wall high enough to prevent the manure from sight of road or houses. Consider the prevailing winds. Locate the storage to get the greatest downwind distance from occupied structures that is practical. Adjusting the dimensions of the surface area to reduce the exposure to any odor receptor reduces odor potential. The surface area of the storage can be minimized by making it deeper. Air drainage needs to be considered as well. During low-wind conditions, heavier-than-air odorous gases can flow much like water, down from a storage to surround a low-lying area. This can be particularly unpleasant when it permeates residences.

Properly planned and designed manure storages will improve the efficiency of recycling manure back to the land for optimum nutrient benefit. Placing the manure storage where the neighbors can't see or smell it will help keep good neighbor relations. Determining the soil conditions that don't require extra modification or structural components can keep costs lower. Finding the right site is so important that some farmers might actually buy the land with these conditions so a satellite storage can be installed to benefit the dairy enterprise.

For information on funding assistance for the engineering of manure storages in New York State visit: prodairy.cals.cornell.edu/dairy-acceleration.

For more information on resources for construction of manure storages, contact your local Soil and Water Conservation office and USDA NRCS office or visit: agriculture.ny.gov/FAQ_manure_storage.pdf#_blank.

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