NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

WASTE STORAGE FACILITY

(No.)
Code 313

DEFINITION

A waste storage impoundment made by constructing an embankment and/or excavating a pit or dugout, or by fabricating a structure.

PURPOSE

To temporarily store wastes such as manure, wastewater, and contaminated runoff as a function of an agricultural waste management system.

CONDITIONS WHERE PRACTICE APPLIES

- Where the storage facility is a component of a planned agricultural waste management system.
- Where temporary storage is needed for organic wastes generated by agricultural production or processing.
- Where the storage facility can be constructed, operated and maintained without polluting air or water resources.
- Where soils, geology, and topography are suitable for construction of the facility.
- To facilities utilizing embankments with an effective height of 35 feet or less where damage resulting from failure would be limited to damage of farm buildings, agricultural land, or township and country roads.
- Where fabricated structures including tanks, stacking facilities, and pond appurtenances.

CRITERIA

General Criteria for Applicable To All Waste Storage Facilities.

Laws and regulations. Plan, design, and construct waste storage facility to comply with all Federal, state, and local laws, rules, and regulations. Waste management systems may need to be approved or permitted by the Florida Department of Environmental Protection. Refer to Chapter 62-620 Florida Administrative Code (F.A.C.) and Chapter 62-670 F.A.C. for permitting requirements.

Evaluate and avoid or minimize impact to cultural resources, wetlands and Federal and state protected species to the extent practicable during planning, design and implementation of this conservation practice in accordance with established National and Florida policy, General Manual (GM) Title 420-Part 401; Title 450-Part 401, Title 190-Parts 410.22 and 410.26, National Planning Procedures Handbook (NPPH) Florida Supplements to Parts 600.1 and 600.6, National Cultural Resources Procedures Handbook (NCRPH), National Food Security Act Manual (NFSAM), and the National Environmental Compliance Handbook (NECH).

Location. To minimize the potential for contamination of streams, locate waste storage facilities outside of floodplains. However, if site restrictions require location within a floodplain, waste storage facilities shall be protected from inundation or damage from a 25-year, 24-hour storm event, or a larger storm event if required

by laws, rules, and regulations. Locate waste storage facilities so the potential impacts from breach of embankment, accidental release, and liner failure are minimized; and separation distances are such that prevailing winds and landscape elements such as building arrangement, landforms, and vegetation minimize odors and protect aesthetic values.

Locate waste storage facilities as close to the source of waste and as far from neighboring dwellings or other areas of public use as practical.

Locate waste storage facilities to meet the minimum distance requirement from public or private facilities as shown in Table 1.

Table 1 - Minimum Distance Requirement for Waste Storage Facilities

Public or Private Use Facilities	Minimum Distance From Waste Storage Facility
Any public use area, church, picnic area, playground, etc.	300 feet
Residence or place of habitation other than owner or tenant	300 feet
Potable Wells, Private	100 feet
Potable Wells, Public	300 feet
Natural Water Courses	200 feet
Milking parlor	100 feet
Drainage Ditches (does not include internal field ditches that do not discharge off-site)	100 feet
Area specified by state or local ordinance	Greater of state or local distance or distance shown above

Storage period. The storage period is the maximum length of time anticipated between emptying events. Base the minimum storage period on the timing required for environmentally safe waste utilization considering the climate, crops, soil, equipment, management and local, state, and federal regulations. Design the storage period to be a minimum of seven (7) days.

Design storage volume. Design the minimum storage volume to be the greater of the volume required for (1) the storage period or (2) the volume based on a monthly waste and water budget analysis using the 30 year average monthly rainfall. Include in the storage volume the total of the following as appropriate:

a. Manure, wastewater, and other wastes accumulated during the storage period.

b. If the facility is uncovered, normal precipitation less evaporation on the surface area (at the required design storage volume level) of the facility during the storage period.

c. Normal runoff from the facility's drainage area during the storage period.

d. If the facility is uncovered, 25-year, 24-hour storm precipitation on the surface (at the required design storage volume level) of the facility.

e. 25-year, 24-hour storm runoff from the facility's drainage area.

f. Residual solids after liquids have been removed. Provide a minimum of 6 inches for tanks.

g. Additional storage as may be required to meet management goals or regulatory requirements.

Inlet. Design inlets in accordance with Florida conservation practice standard Manure Transfer, Code 634.

Emptying component. Provide some type of component for emptying storage facilities. It may be a component such as a gate, pipe, dock, wet well, pumping platform, retaining wall, or ramp. Incorporate features in the design to protect against erosion, tampering, and accidental release as necessary.

Design ramps used to empty liquids to have a slope of 4 horizontal to 1 vertical (4:1) or flatter. Design ramps used to empty slurry, semi-solid, or solid waste to have a slope of 10 horizontal to

1 vertical (10:1) or flatter. Use steeper slopes if special traction surfaces are provided.

Where agitators are used in ponds with liners, ensure the tip of the propeller to be a minimum of 3 feet from the liner surface or protect the liner by a concrete pad.

Make provision for periodic removal of accumulated solids to preserve storage capacity. Consider the anticipated method for periodic removal of accumulated solids during the planning process, particularly in determining the size and shape of the pond and type of seal, if any.

Utilize waste removed from storage facilities in accordance with Florida NRCS conservation practice standard Waste Utilization, Code 633 or Nutrient Management, Code 590, as appropriate.

Safety. Include in the design appropriate safety features to minimize the hazards of the facility.

Provide warning signs, fences, ladders, ropes, bars, rails, and other devices, as appropriate, to ensure the safety of humans and livestock.

Provide ventilation and warning signs for covered waste holding structures, as necessary, to prevent explosion, poisoning, or asphyxiation. Provide pipelines with a water-sealed trap and vent, or similar device, if there is a potential, based on design configuration, for gases to enter buildings or other confined spaces.

Fence ponds and uncovered fabricated structures for liquid or slurry waste with walls less than 5 feet above ground surface and post warning signs to prevent children and others from using them for other than their intended purpose.

Erosion protection. To control erosion, vegetate embankments and disturbed areas surrounding the facility according to Florida NRCS conservation practice standard Critical Area Planting, Code 342.

Staff Gauge. Place a staff gauge or other permanent marker to clearly indicate the maximum level of storage allowed to accumulate in the facility before emptying must occur. Indicate on the marker the level at which sufficient storage remains to contain the 25-year, 24-hour storm runoff and precipitation.

Liners. Design liners to meet or exceed the requirements of Florida NRCS conservation practice standard Pond Sealing or Lining, Code 521.

Additional Criteria for Waste Storage Ponds

Hazard classification. Evaluate the area downstream of the embankment to determine the impact from damage from a sudden breach of the proposed embankment on both structural and environmental features. Consider all improvements and those improvements that may reasonably be expected to be made during the useful life of the structure in this evaluation. The results of this examination provide for the proper hazard approval classification of the embankment. Only hazard class (a) embankments are to be designed under this standard. See National Engineering Manual Part 520.23 for guidance in documenting hazard classification.

Soils and foundation. Include a detailed soils investigation with special attention to the water table depth and seepage potential in each design. Evaluate soils to a depth no less than two feet below the final grade of any excavation during the soil investigations. In high-risk areas, follow the procedures outlined in the Agricultural Waste Management Field Handbook (AWMFH), page FL7-16a. Information and guidance on controlling seepage from waste storage ponds can be found in the AWMFH, Chapter 7.

Liners. Self-sealing ponds are not an acceptable means of containing waste, except as noted in the section "Waste storage ponds constructed in high water table soils". Design the subgrade to be a dense base regardless of liner method. Design the storage pond to have a bottom elevation that is a minimum of 2 feet above the seasonal high water table unless features of special design are incorporated that address buoyant forces and maintaining liner integrity. Seal the storage pond by one of the liners as described below.

1. Compacted Earth. Design earthen liners in accordance with AWMFH –Appendix 10D Geotechnical, Design, and Construction Guidelines for a maximum allowable specific discharge of 0.0028 ft/day (1 x 10^{-6} cm/sec).

   Test the soil to determine the compaction and moisture requirements in order to not exceed the maximum allowable specific discharge.

   Design and construct compacted earth liners to have a minimum thickness of 1 foot on

pond side slopes and bottom measured perpendicular to the finished surface. Determine the final liner thickness by using AWMFH – Appendix 10D. Place the liner material in layers not over 9 inches thick and compact to the required density to ensure the liner does not exceed the maximum allowable specific discharge. Ensure moisture content before compaction to be approximately 2 percent wet of optimum. Verify compaction requirements in accordance with ASTM D 698.

Design and construct compacted earth liners to have side slopes of 3 horizontal to 1 vertical (3:1) or flatter, except where compacted earth liners are part of (brought up with) an earthfill. Cover the compacted earth liner with not less than 1 foot of compacted on-site material measured perpendicular to the finished surface. Protect compacted earth liners from damage during initial filling operations.

2. Flexible Membrane. Design and construct a flexible membrane liner in accordance with the Florida NRCS conservation practice standard Pond Sealing and Lining - Flexible Membrane, Code 521A.

3. Bentonite. –Design and construct a bentonite liner in accordance with the Florida NRCS conservation practice standard Pond Sealing and Lining - Bentonite Sealant, Code 521C.

4. Concrete. – Design and contruct a concrete liner in accordance with NRCS Construction Specification 32, Concrete for Minor Structures, and the following criteria:

   For side slopes and bottoms that will not have any vehicular traffic, design the minimum thickness of the concrete slab to be 4 inches. No joints are required. Specify wire mesh or fiber reinforcement.

   For concrete lined areas such as approaches, ramps and bottoms that will have vehicular traffic of any kind, use a minimum concrete thickness of 5 inches placed over a minimum thickness of 4 inches of compacted sand. Specify joints and reinforcement as required by design analysis.

   Design and construct concrete lined side slopes to be 2 horizontal to 1 vertical (2:1) or flatter, except for concrete push-off ramps. Ensure concrete push-off ramp slopes to be 1 horizontal to 1 vertical (1:1) or flatter on cut slopes and 2 horizontal to 1 vertical (2:1) or flatter on embankment slopes.

5. Natural clay base. In-situ soils classified in permeability groups III or IV as defined in AWMFH – Appendix 10D are acceptable provided they have a minimum thickness of 2 feet below the deepest excavation limits and are at dry densities equivalent to at least 90 percent Standard Proctor (ASTM D 698). Determine the required minimum thickness of the natural clay base by using AWMFH – Appendix 10D. Take Special precautions if the soils contain high amounts of calcium. Subsurface investigations must demonstrate that suitable natural soil material exists for the minimum depth required below the design bottom elevation of the waste storage pond and that no highly unfavorable geologic conditions occur at the site.

   Design and construct natural clay based liners to have side slopes of 2 horizontal to 1 vertical (2:1) or flatter.

Maximum Operating Level. The maximum operating level for waste storage ponds shall be the pond level that provides for the required volume less the volume contribution of precipitation and runoff from the 25-year, 24-hour storm event plus the volume allowance for residual solids after liquids have been removed. Install a permanent marker or recorder at this maximum operating level to indicate when drawdown should begin. Reference and explain the marker or recorder in the O&M plan.

Outlet. Design all outlets in accordance with Florida NRCS conservation practice standard Manure Transfer, Code 634.

Embankments. Design and construct the minimum elevation of the top of the settled embankment to be 1 foot above the required storage volume for waste storage pond without auxiliary spillways, and 1 foot above the design depth of flow in the spillway for storage pond with spillways. Increase this height by the amount needed to ensure that the embankment top elevation will be maintained after settlement. Ensure this increase to be not less than 5 percent.

Design and construct the minimum embankment top width to be as shown in Table 2. If the embankment top is to be used as a road, construct the minimum width to be 16 feet for one-way traffic and 26 feet for two-way traffic.

Use guard rails or other safety measures where necessary. When the embankment top is used as a road, make provision for protecting the spillway from damage.

Table 2 - Embankment Top Width

Total Height of Embankment, Feet	Minimum Top Width, Feet
< 15	8
15 to 20	10
>20 to 25	12
>25 to 30	14
>30 to 35	15

Design and construct the combined side slopes of the settled embankment to be not less than 5 horizontal to 1 vertical (5:1) and neither slope to be steeper than 2 horizontal to 1 vertical (2:1). Design all slopes to be stable. Where embankments are to be mowed; 3 horizontal to 1 vertical (3:1) or flatter slopes are recommended.

Ensure compaction of the embankment fill material to be in accordance with the specified design requirements for compaction and moisture content. As a minimum ensure compaction to be equivalent to, or better than, the following:

Layers of fill shall not exceed 9 inches in thickness before compaction. Accomplish compaction by routing the hauling and spreading equipment over the fill in such a manner that every point on the surface of each layer of fill will be traversed by not less than two tread tracks of the loaded equipment traveling in a direction parallel to the main axis of the fill.

Compact clayey soils with a "sheepsfoot" or tamping roller. (AWFMH- Appendix 10D for guidance on compaction.)

Excavated ponds. Design and construct side slopes to be stable and not be steeper than 2 horizontal to 1 vertical (2:1). Construct a low embankment to prevent surface runoff from entering the pond. Design the embankment to meet the criteria contained in the section "Embankments", of this standard.

Auxiliary spillway. Provide an auxiliary spillway, combination of spillways, or additional storage to protect the waste storage pond from over topping when a 25-year, 24-hour storm event is exceeded and the design volume is filled. Locate the crest of the auxiliary spillway at or above the same elevation as the top of the 25-year, 24-hour storm storage. Design the auxiliary spillway to pass a 25-year, 24-hour storm without overtopping. Provide a minimum of 1 foot of freeboard above the designed depth of flow in the auxiliary spillway. Auxiliary spillway requirements, however, do not apply to waste storage ponds without drainage areas and with less than 3 feet of depth above natural ground.

Place the auxiliary spillway in undisturbed soil when possible. When it must be placed in fill material, take precautions to ensure the integrity of the structure.

Where a waste storage pond empties into another waste storage pond and the liquid level is positively controlled by an adequately sized overflow pipe, no auxiliary spillway is required for the primary waste storage pond.

Design pipe auxiliary spillways to have a minimum diameter of 6 inches and equipped with trash racks, antivortex devices, and antiseep collars as required in Florida NRCS conservation practice standard Pond, Code 378. Pipes may be steel, concrete, aluminum, HDPE, or PVC as required in Florida NRCS conservation practice standard Pond, Code 378.

Waste storage ponds constructed in high water table soils. Base waste storage ponds constructed in high water table soils on a detailed risk assessment. Include an analysis of the potential for ground water pollution considering the hydrogeology, ground water transmissivity, soil permeability, etc. in the risk assessment. Provide reasonable assurances that the facility will not cause surface or ground water pollution when decisions to install waste storage facilities in high water table soils without liners are made.

If during the risk assessment, it is determined that the site is a potential hazard to ground water pollution, design the waste storage pond with a liner to prevent contamination of ground water. Include methods to maintain the liner integrity in the design.

Calculate storage volume for waste storage ponds constructed in high water table soils to be the volume above the natural high water level elevation.

Additional Criteria for All Fabricated Structures

Service life and durability. Plan, design, and construct all fabricated structure to ensure that the structure is sound and of durable materials commensurate with the anticipated service life, initial and replacement costs, maintenance and operation costs, and safety and environmental considerations.

Guidance in evaluating the service life of various materials is given in Table 3. The materials indicated meet the requirements of this standard. If the material is not shown in Table 3, base the service life of the material on performance data.

Foundation. Design the foundations of fabricated waste storage facilities to be proportioned to safely support all superimposed loads without excessive movement or settlement.

Table 3 - Service Life of Various Materials

Service life	Material [1/]
Short (min. of 10 year)	Wood; masonry, including concrete staves; flexible membranes; glass/fiber reinforced plastics/resins; steel coated with zinc, epoxy, vinyl and asphalt; reinforced concrete.
Medium (min. of 20 year)	Reinforced concrete; glass fused steel.
Long (min. of 50 year)	Reinforced concrete; flexible membranes with earth covers.

[1/] The durability and estimated life of reinforced concrete is a function of the design criteria and the quality of the concrete. A key aspect affecting durability is corrosion of the reinforcement which is directly related to cracking (design stress) and the reinforcement cover. The quality levels of reinforced concrete are discussed under "Structural Design."

Where a non-uniform foundation cannot be avoided or applied loads may create highly variable foundation loads, calculate settlement from site specific soil test data. Index tests of site soil may allow correlation with similar soils for which test data is available. If no test data is available, obtain presumptive bearing strength values for assessing actual bearing pressures from Table 4 or another nationally recognized building code. In using presumptive bearing values, provide adequate detailing and articulation to avoid distressing movements in the structure.

Treat foundations consisting of bedrock with joints, fractures, or solution channels or provide a separation distance consisting of a minimum of 1 foot of impermeable soil between the floor slab and the bedrock or an alternative that will achieve equal protection.

Liquid tightness. Design and construct applications such as tanks that require liquid tightness in accordance with standard engineering and industry practice appropriate for the construction materials used to achieve this objective.

Structural loading. Design waste storage structures to withstand all anticipated loads including internal and external loads, hydrostatic uplift pressure, concentrated surface and impact loads, water pressure due to seasonal high water table, and frost or ice pressure and load combinations in compliance with this standard and applicable local building codes.

Table 4 - Presumptive Allowable Bearing Stress Values [1/]

Foundation Description	Allowable Stress
Crystalline Bedrock	12000 psf
Sedimentary Rock	6000 psf
Sandy Gravel or Gravel	5000 psf
Sand, Silty Sand, Clayey Sand, Silty Gravel, Clayey Gravel	3000 psf
Clay, Sandy Clay, Silty Clay, Clayey Silt	2000 psf

[1/] Basic Building Code, 12th Edition, 1993, Building Officials and Code Administrators, Inc. (BOCA)

Calculate the lateral earth pressures from soil strength values determined from the results of appropriate soil tests. Lateral earth pressures can be calculated using the procedures in Technical Release (TR) - 74. If soil strength tests are not available, use the presumptive lateral earth pressure values indicated in Table 5.

Assign lateral earth pressures based upon equivalent fluid assumptions according to the structural stiffness or wall yielding as follows:

- **Rigid frame or restrained-wall**. Use the values shown in Table 5 under the column “Frame Tanks", which gives pressures comparable to the at-rest condition.
- **Flexible or yielding wall**. Use the values shown in Table 5 under the column "Freestanding Wall”, which gives pressures comparable to the active condition. Walls in this category are designed on the basis of gravity for stability or are designed as a cantilever having a base wall thickness to height of backfill ratio not more than 0.085.

Use internal lateral pressure of 65 lb/ft^2 for design where the stored waste is not protected from precipitation. Use a value of 60 lb/ft^2 where the stored waste is protected from precipitation and will not become saturated. Use lesser values if supported by measurement of actual pressures of the waste to be stored. If heavy equipment will be operated near the wall, add an extra two feet of soil surcharge in the wall analysis.

Table 5 - Lateral earth pressure values [1/]

		Equivalent fluid pressure (lb/ft^2/ft of depth)			
Soil		Above seasonal high water table [2/]		Below seasonal high water table [3/]	
Description [4/]	Unified Classification [4/]	Free-standing walls	Frame tanks	Free-standing walls	Frame tanks
Clean gravel, sand or sand-gravel mixtures (maximum 5% fines) [5/]	GP, GW, SP, SW	30	50	80	90
Gravel, sand, silt and clay mixtures (less than 50% fines) Course sands with silt and/or clay (less than 50% fines)	All gravel/sand dual symbol classifications and GM, GC, SC, SM, SC-SM	35	60	80	100
Low-plasticity silts and clays with some sand and/or gravel (50% or more fines) Fine sands with silt and/or clay (less than 50% fines)	CL, ML, CL-ML, SC, SM, SC-SM	45	75	90	105
Low to medium plasticity silts and clays with little sand and/or gravel (50% or more fines)	CL, ML, CL-ML	65	85	95	110
High plasticity silts and clays (liquid limit more than 50) [6/]	CH, MH	-	-	-	-

[1/] For lightly compacted soils (85% to 90% maximum standard density.) Includes compaction by use of typical farm equipment.
[2/] Also below seasonal high water table if adequate drainage is provided.
[3/] Includes hydrostatic pressure.
[4/] AII definitions and procedures in accordance with ASTM D 2488 and D 653.
[5/] Generally, only washed materials are in this category.
[6/] Not recommended. Requires special design if used.

Design tank covers to withstand both dead and live loads. As a minimum, use the live load values for covers contained in ASAE EP378.3, Floor and Suspended Loads on Agricultural Structures Due to Use, and in ASAE EP393.2,

Manure Storages. Use the actual axle load for tank wagons having more than a 2,000 gallon capacity.

If the facility is to have a roof, wind loads shall be as specified in ASCE 7, Minimum Design Loads for Buildings and Other Structures. If the facility is to serve as part of a foundation or support for a building, the total load shall be considered in the structural design.

Structural design. Include in the structural design all items that will influence the performance of the structure, including loading assumptions, material properties and construction quality. Indicate design assumptions and construction requirements on standard plans.

Tanks may be designed with or without covers. Include covers, beams, or braces that are integral to structural performance on the construction drawings. Design the openings in covered tanks to accommodate equipment for loading, agitating, and emptying. Equip these openings with grills or secure covers for safety, and for odor and vector control.

Underlay all structures with free draining material or include a footing located below the anticipated frost depth. Design fabricated structures according to the criteria in the following references as appropriate:

- Steel: "Manual of Steel Construction", American Institute of Steel Construction.
- Timber: "National Design Specifications for Wood Construction", American Forest and Paper Association.
- Concrete: "Building Code Requirements for Reinforced Concrete, ACI 318", American Concrete Institute.
- Masonry: "Building Code Requirements for Masonry Structures, ACI 530", American Concrete Institute.

Slabs on grade. Include in the slab design the required performance and the critical applied loads along with both the subgrade material and material resistance of the concrete slab. Where applied point loads are minimal and liquid-tightness is not required, such as barnyard and feedlot slabs subject only to precipitation, and the subgrade is uniform and dense, design the minimum slab thickness to be 4 inches with a maximum joint spacing of 10 feet. Joint spacing can be increased if reinforcing steel is added based on subgrade drag theory.

For applications where liquid-tightness is required such as floor slabs of storage tanks, design the minimum thickness for uniform foundations to be 5 inches and shall contain distributed reinforcing steel. Base the required area of such reinforcing steel on subgrade drag theory as discussed in industry guidelines such as American Concrete Institute, ACI 360, "Design of Slabs-on-Grade".

When heavy equipment loads are to be resisted and/or where a non-uniform foundation cannot be avoided, use an appropriate design procedure incorporating a subgrade resistance parameter(s) such as ACI 360.

Additional Criteria - Stacking Facilities

Solids stacking implies that the manure has a consistency that does not flow, but remains in place even during the wettest time of the storage period. Do not design facilities receiving 100 percent of the manure production, with no provision for liquid separation, as stacking facilities.

Stacking facilities may be open or roofed and are used for wastes which behave primarily as a solid. The anticipated stacking angle of the manure must be considered in determining the wall height.

Construct stacking facilities of durable materials such as reinforced concrete, reinforced concrete block, or treated lumber. Design the stacking facilities with adequate safety factors to prevent failure due to internal or external pressures, including hydrostatic uplift pressure and imposed surface loads such as equipment which may be used within, on, or adjacent to the structure. Do not use lumber for walls which support moving stacking elevators or similar loads.

Structural design criteria for stacking facilities shall be in accordance with the criteria for the various materials listed in the section "Structural Design" of this standard.

Floor Slabs and Walls. Slope floors away from the entrance. Suggested grade of the floor is 0.2 or 0.3 percent.

Where concrete floors contact wood walls or posts, separate the concrete and wood by 1/2-inch preformed bituminous expansion joint material. The expansion joint material is not

required where wood walls rest on top of concrete and the resultant joint is horizontal.

Timber Walls. Specify all other timber to be pressure-treated in accordance with ASTM D1760. Design posts to have a minimum size of 6 inches by 6 inches and be placed in the ground from 3 to 6 feet deep, depending on the design analysis. Use treated lumber with a minimum thickness of 2 inches for side planking.

Seepage. Prevent effluent seepage in amounts that would pollute surface or ground water by watertight construction or collected and disposed of in a safe manner. Prevent influent seepage in amounts that would infringe on designed storage capacity by watertight construction or site drainage.

Internal Drainage. Make provisions for drainage of some liquids, including rainfall from the stacking area (especially those without a roof). This is best accomplished by use of a timber wall with the boards installed vertically, leaving 3/4-inch cracks. The timber wall drainage section may be included in a concrete or masonry block wall. Use the same design criteria for timber walls. Collect seepage in a tank or waste storage pond, or properly treated in a lagoon or infiltration strip.

Poultry litter stacking facilities. To prevent spontaneous combustion, ensure poultry litter in the stacking facility to be less than 40 percent moisture and do not layer moist litter with dry litter. In addition, design the height of the litter stack not to exceed 7 feet, with litter to wood contact limited to 5 feet.

CONSIDERATIONS

Consider constructing an auxiliary (emergency) spillway and/or increasing embankment height to protect the embankment. Evaluate factors such as drainage area, pond size, precipitation amounts, downstream hazards, and receiving waters in this consideration. Consider adding a minimum of 0.5 feet of freeboard for waste storage tanks.

Consider excluding non-polluted runoff from the waste storage facility to the fullest extent possible, except where its storage is advantageous to the operation of the agricultural waste management system.

Solids separation. To minimize frequency of solids removal from waste storage ponds, consider routing polluted runoff through vegetative filter strips, low-gradient channels, or debris basins to remove readily settleable solids. Settling facilities should have adequate capacity to store settled solids for a time period based on climate, equipment, clean out frequency, and method of disposal. If animal manure, such as from dairy cows, is flushed into a storage pond, consider providing a solids separator for removing fibrous solids to facilitate pumping and irrigation. Design solid separators, debris basins, etc., to prevent seepage to the groundwater. Design solids separation in accordance with Florida NRCS conservation practice standard Solids/Liquid Waste Separation Facility, Code 632.

Water quantity. Consider the waste storage facilities affect on the water budget. The affect will be dependent upon the size of the waste storage facility. The waste storage facility will cause an increase in evaporation and a decrease in downstream runoff where drainage is designed to the facility. The waste storage facility will not increase water demand at the site.

Water quality. The waste storage facility should have an overall positive impact on water quality by storing animal waste and polluted runoff until it can be safely applied to the land. Where ponds are used for waste storage, there can be a positive effect on water related wildlife habitat by providing open water bodies. Water quality can be adversely impacted during initial construction due to erosion of the site but will be minimal using proper construction pollution prevention measures.

Consider the economics, environmental concerns, the overall waste management system plan, and safety and health factors.

Considerations for minimizing the potential for and impacts of sudden breach of embankment or accidental release from the required volume.

Consider features, safeguards, and/or management measures to minimize the risk of failure or accidental release, or to minimize or mitigate impact of this type of failure when any of the categories listed in Table 6 might be significantly affected.

Consider the following either singly or in combination to minimize the potential of or the consequences of sudden breach of embankments when one or more of the potential impact categories listed in Table 6 may be significantly affected:

1. An auxiliary (emergency) spillway
2. Additional freeboard
3. Storage for wet year rather than normal year precipitation
4. Reinforced embankment such as, additional top width, flattened and/or armored downstream side slopes
5. Secondary containment

Table 6 - Potential Impact Categories from Breach of Embankment or Accidental Release

1. Surface water bodies -- perennial streams, lakes, wetlands, and estuaries.
2. Critical habitat for threatened and endangered species.
3. Riparian areas.
4. Farmstead, or other areas of habitation.
5. Off-farm property
6. Historical and/or archaeological sites or structures that meet the eligibility criteria for listing in the National Register of Historical Places

Consider the following options to minimize the potential for accidental release from the required volume through gravity outlets when one or more of the potential impact categories listed in Table 6 may be significantly affected:

1. Outlet gate locks or locked gate housing
2. Secondary containment
3. Alarm system
4. Another means of emptying the required volume

Considerations for minimizing the potential of waste storage pond liner failure.

Avoid sites with categories listed in Table 7 unless no reasonable alternative exists. Under those circumstances, give consideration to providing an additional measure of safety from pond seepage when any of the potential impact categories listed in Table 7 may be significantly affected.

Should any of the potential impact categories listed in Table 7 be affected, give consideration to the following:

1. A clay liner designed in accordance with procedures of AWMFH Appendix 10D with a thickness and coefficient of permeability so that specific discharge is less than 1×10^{-6} cm/sec
2. A flexible membrane liner over a clay liner
3. A geosynthetic clay liner (GCL) flexible membrane liner
4. A concrete liner designed in accordance with slabs on grade criteria for fabricated structures requiring water tightness

Table 7 - Potential Impact Categories for Liner Failure

1. Any underlying aquifer is at a shallow depth and not confined
2. The vadose zone is rock
3. The aquifer is a domestic water supply or ecologically vital water supply
4. The site is located in an area of solutionized bedrock such as limestone or gypsum.

Considerations for improving air quality.

To reduce emissions of greenhouse gases, ammonia, volatile organic compounds, and odor, consider adding other conservation practices such as Waste Treatment Lagoon, Code 359, Covered Anaerobic Digester, Code 365, and Composting Facility, Code 317 to the waste management system.

Adjusting pH below 7 may reduce ammonia emissions from the waste storage facility but may increase odor when waste is surface applied (see Florida NRCS conservation practice standard Waste Utilization, Code 633).

Some fabric covers have been shown to be effective in reducing odors.

PLANS AND SPECIFICATIONS

Prepare the plans and specifications in accordance with the criteria of this standard and describe the requirements for applying the practice to achieve its intended use. As a minimum, include in the engineering plans, specification and reports the following:

1. Plan view of system layout.
2. Type and number of animals the structure is designed to serve.
3. Storage period.

4. Structural details of all components, including reinforcing steel, type of materials, thickness, anchorage requirements, lift thickness, covering.
5. Locations, sizes, and type of pipelines and appurtenances.
6. Requirements for foundation and preparation and treatment.
7. References to components supplied by others (pumps, etc.).
8. Vegetative requirements.
9. Quantities.
10. Drainage/Grading plan if one is needed.
11. Soil and foundation findings, interpretations, and reports.
12. Safety features, roof covers, fencing ladders, and safety signs.
13. Temporary erosion control measures during construction.
14. Odor management or minimization requirement.
15. Location of utilities and notification requirements.

OPERATION AND MAINTENANCE

Develop an operation and maintenance plan that is consistent with the purposes of the practice, its intended life, safety requirements, and the criteria for its design. Inspect the waste storage facility periodically to ensure that all components are operating as planned. Records shall be kept of the amount of waste applied, location and acres where applied, and the date waste was applied.

Include in the O&M the operational requirements for emptying the storage facility, clean out intervals, maximum operating and other operating levels and reference to the staff gauge(s). Provide O&M requirements for all structural components (concrete, pumps, etc.).

Include in the O&M plan the requirement that waste shall be removed from storage and utilized at locations, times, rates, and volume in accordance with Florida NRCS conservation practice standard Waste Utilization, Code 633 and/or Nutrient Management, Code 590. In addition, include in the O&M plan for ponds the requirement that following storms, waste shall be removed at the earliest environmentally safe opportunity to ensure that sufficient capacity is available to accommodate subsequent storms.

Operate the waste storage facility so as to maintain the storage capacity for the 25-year, 24-hour storm.

The embankment and other vegetated areas shall be mowed and fertilized to maintain a protective vegetative cover.

Consider the development of an emergency action plan for waste storage facilities where there is a potential for significant impact from breach or accidental release. Include site-specific provisions for emergency actions that will minimize these impacts in the plan.

REFERENCES

ACI 318, 360, 530
ASABE Specifications: ASAE EP378.3, ASAE EP393.2
ASCE Standard: ASCE-7
ASTM D 653, D 698, D 1760, D 2488
AWMFH, Chapter 7
AWMFH, Appendix 10D
Basic Building Code, 12th Edition
Chapter 62-620 and 62-670 F.A.C.
Florida NRCS Conservation Practice Standards
- Covered Anaerobic Digester, Code 365
- Composting Facility, Code 317
- Critical Area Planting, Code 342
- Manure Transfer, Code 634
- Nutrient Management, Code 590
- Pond, Code 378
- Pond Sealing or Lining, Code 521
- Solids/Liquid Waste Separation Facility, Code 632
- Waste Utilization, Code 633
- Waste Treatment Lagoon, Code 359

General Manual (GM)
- Title 420-Part 401
- Title 450-Part 401
- Title 190-Parts 410.22 and 410.26

"Manual of Steel Construction", American Institute of Steel Construction.
National Cultural Resources Procedures Handbook
"National Design Specifications for Wood Construction", American Forest and Paper Association.
National Engineering Manual, Part 520
National Environmental Compliance Handbook
National Food Security Act Manual
National Planning Procedures Handbook
- Florida Supplements to Parts 600.1 and 600.6

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