UNITED STATES DEPARTMENT OF AGRICULTURE
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 storage function component 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 site conditions 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
- To fabricated structures including tanks, stacking facilities, and pond appurtenances

CRITERIA

General Criteria Applicable to All Waste Storage Facilities

Federal, State, and Local Laws. All planned activities shall comply with all federal, state, and local laws and regulations. The Alabama Department of Environmental Management (ADEM) Rules require owners/operators of animal feeding operations (AFO's) and associated waste management systems to fully implement and regularly maintain effective best management practices (BMP's) that meet or exceed NRCS technical standards and guidelines to prevent discharges and to ensure groundwater and surface water quality. AFO owners/operators who fail to implement BMP's or whose facilities discharge or have the significant potential to discharge to "waters of the state" can be required by ADEM or the Environmental Protection Agency (EPA) to implement effective corrective actions immediately. If preventive or effective actions are not fully implemented in a timely manner, civil penalties may be incurred by the owners/operators.

All construction activities must implement adequate stormwater management BMP's. In addition, to comply with the National Pollutant Discharge Elimination System (NPDES) Phase II Rule, all construction activities involving one acre or more of land disturbance shall have and follow a construction best management practices plan (CBMPP) until construction is complete and all disturbed areas are stabilized.

ADEM AFO rules require that operators retain records documenting that (1) all designs and plans for any structures were prepared and certified by a professional engineer registered in the State of Alabama (PE), (2) construction was supervised by a PE, (3) once construction was completed, a PE certified that the completed facility was constructed in accordance with the approved plans and met or exceeded good engineering practices and NRCS technical standards and guidelines, and (4) any modifications or repairs made to the structures were supervised and certified by a PE.

Location. To minimize the potential for contamination of streams, waste storage facilities should be located outside of floodplains. However,

if site restrictions require location within a floodplain, they shall be protected from inundation or damage from a 100-year flood event. Waste storage facilities shall be located 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.

Waste storage facilities shall be located to meet the minimum buffer distance requirements from water(s), wells, property lines, and public or private facilities as defined in the ADEM Administrative Code, Chapter 335-6-7, as amended.

Storage Period. The storage period is the maximum length of time anticipated between emptying events. The minimum storage period shall be determined so as to prevent surface or groundwater pollution and be based on the timing required for environmentally safe waste utilization considering the climate, crops, soil, equipment, management, and local, state, and federal regulations. The minimum storage period shall be thirty (30) days for all methods of disposal, except milk parlor waste that is conveyed with sprinkler irrigation shall have a minimum storage period of seven (7) days.

Required Storage Volume. The required storage volume shall consist of the total of the following as appropriate:

- Manure, wastewater, and other wastes accumulated during the storage period.
- If the facility is uncovered, normal precipitation less evaporation on the surface area (at the required storage volume level) of the facility during the storage period. For storage ponds, precipitation on the maximum collection area inside the top of the pond, less evaporation on the average pond surface area during the storage period.
- Normal runoff from the facility's drainage area during the storage period.
- If the facility is uncovered, the 25-year, 24-hour storm volume (the volume resulting from the rainfall from the 25-year, 24-hour storm on the maximum collection area inside the top of the facility plus the runoff from any contributing drainage area from the 25-year, 24-hour storm).

  In accordance with ADEM's and EPA's concentrated animal feeding operation (CAFO) rules, a new large CAFO facility for swine, veal, and poultry must contain the volume from the 100-year, 24-hour storm. Large CAFO's are defined as those confining the following number of animals or more:

  - 1,000 veal calves
  - 2,500 swine weighing ≥ 55 pounds
  - 10,000 swine each weighing < 55 pounds
  - 30,000 laying hens or broilers
- Residual solids after liquids have been removed. A minimum depth of 6 inches shall be provided for tanks.
- Additional storage as may be required to meet management goals or regulatory requirements.

For determining the portion of the required storage volume that involves precipitation and evaporation, the storage period during the year that will produce the largest volume shall be used, based on average monthly precipitation and evaporation tables.

Inlet. Inlets shall be of any permanent type designed to resist corrosion, plugging, freeze damage, and ultraviolet ray deterioration while incorporating erosion protection as necessary. Inlets shall be designed to carry the peak rate of waste flow to the storage facility without leakage or other soil contact by the wastes, unless a portion of the inlet incorporates a wastewater treatment strip as part of the overall design.

Emptying Component. Some type of component shall be provided for emptying storage facilities. It may be a gate, pipe, dock, wet well, pumping platform, retaining wall, or ramp. Features to protect against erosion, tampering, and accidental release shall be incorporated as necessary.

Accumulated Solids Removal. Provision shall be made for periodic removal of accumulated solids to preserve storage capacity. The anticipated method for doing this must be considered in planning, particularly in determining the configuration of the facility and type of liner, if any.

Safety. Design shall include appropriate safety features to minimize the hazards of the facility. Entrance ramps shall be designed for safe entrance based on the type of equipment used.

Ramps used to empty liquids shall have a slope of 4 horizontal to 1 vertical or flatter. Those used to empty slurry, semi-solid, or solid waste shall have a slope of 10 horizontal to 1 vertical or flatter unless special traction surfaces are provided.

Warning signs, fences, ladders, ropes, bars, rails, and other devices shall be provided, as appropriate, to ensure the safety of humans and livestock. Ventilation and warning signs must be provided for covered waste holding structures, as necessary, to prevent explosion, poisoning, or asphyxiation. Pipelines shall be provided 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. Ponds and uncovered fabricated structures for liquid or slurry waste with walls less than 5 feet above ground surface shall be fenced and warning signs posted to prevent children and others from using them for other than their intended purpose.

Fencing shall be according to Alabama NRCS conservation practice standard Fence, Code 382, with safety as the objective. This will require permanent fencing using 5 strands of barbed or high tensile wire or woven wire with 2 strands of barbed wire on top. Do not use temporary or electric fencing. Warning signs shall be posted to deter anyone from using the facility for anything other than its intended purpose. A warning sign (90 in^2 minimum) shall be placed on each straight section of fencing, not to exceed a spacing of 300 feet.

Erosion Protection. To control erosion, embankments and disturbed areas surrounding the facility shall be vegetated according to Alabama NRCS conservation practice standard Critical Area Planting, Code 342.

Flexible Membranes. Flexible membranes shall meet or exceed the requirements of flexible membrane linings as specified in Alabama NRCS conservation practice standard Pond Sealing or Lining (Flexible Membrane), Code 521A.

Liners. Liners shall be designed and constructed in accordance with the Alabama NRCS conservation practice standard, Waste Treatment Lagoon, Code 359.

Seepage. Effluent seepage in amounts that would pollute surface or ground water shall be prevented by watertight construction or a low permeability liner, or shall be collected and utilized in a safe manner. Influent seepage in amounts that would infringe on designed storage capacity or disrupt the proper operation of the facility shall be prevented by watertight construction, a low permeability liner, or by site drainage.

Foundations consisting of bedrock with joints, fractures, or solution channels shall be separated from the bottom of the floor slab or liner by a minimum of one foot of low permeability soil [type III or IV as described in the National Engineering Handbook (NEH), Part 651, Agricultural Waste Management Field Handbook (AWMFH), Chapter 7 and Appendix 10D] or by an alternative that will achieve equal protection.

Additional Criteria for Waste Storage Ponds

Hazard Classification. The area downstream of the embankment must be evaluated carefully to determine the impact a sudden breach of the proposed embankment would have on both structural and environmental features and to public safety (see the section "Considerations" of this standard). This evaluation must consider all improvements and those improvements that may reasonably be expected to be made during the useful life of the structure. The results of this examination provides for the proper hazard classification of the embankment. Only hazard class "a" embankments are to be designed under this standard. See National Engineering Manual (NEM), Part 520 for guidance concerning documentation of hazard class determination.

Soils and Foundation. The pond lining shall have a permeability of $1x10^{-7}$ cm/sec or less, or a maximum allowable operational specific discharge of no more than 0.0028 ft/day. (NOTE: These rates may be reduced one order of magnitude due to manure sealing). The pond shall be located in soils that shall not exceed these rates or shall be sealed by a low permeability liner. Where possible, avoid sites with gravelly soils and shallow soils over fractured or cavernous rock. A detailed soils investigation with special attention to the water table depth and seepage potential must be considered in each design. Soil investigations must evaluate soils to a depth no less than 2 feet below the final grade of any excavation. Subsurface investigation in soils underlain by the Demopolis or Mooreville Chalk formations of the Selma Chalk

group in the Blackland Prairie major land resource area may terminate at a depth of 1 foot below the surface of the chalk.

Information and guidance on controlling seepage from waste storage ponds can be found in the AWMFH, Chapter 7 and Appendix 10D.

Waste Storage Ponds Constructed in High Water Table Soils. Waste storage ponds constructed in high water table soils will be considered only as a last site alternative and shall be based on a detailed risk assessment. The risk assessment shall include an analysis of the potential for ground water pollution considering the hydrogeology, ground water transmissivity, soil permeability, etc. The pond shall 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, pond seepage rate and non-encroachment of the water table by contaminants. Decisions to install waste storage facilities in high water table soils without liners must provide reasonable assurances that the facility will not cause surface or ground water pollution. The water table may be lowered by use of perimeter drains, if feasible, to meet this requirement.

If during the risk assessment it is determined that the site is a potential hazard to ground water pollution, it shall be designed with a liner to prevent contamination of ground water. Methods to maintain the liner integrity shall be incorporated in the design.

The storage volume for waste storage ponds constructed in high water table soils shall be the volume above the natural high water level elevation unless perimeter drains are utilized to lower the ground water level.

Inlet. Inlets may be push-off ramps, paved slopes, or pipe inlets. Paved slopes shall be no flatter than 4 horizontal to 1 vertical (4:1) and will not be used when appreciable bedding materials are used.

Pipe inlets may be concrete, aluminum, or plastic as required in Alabama NRCS conservation practice standard Pond, Code 378.

All pipes shall be designed to carry the required flow and shall be installed on a slope of 1% or greater and preferably 1.5% or greater. Where solids are being conveyed, the pipe diameter shall be sized to prevent plugging. Minimum pipe diameter will be 6 inches. Wye or tee fittings shall be placed at a maximum spacing of 150 feet to facilitate cleanout of the pipe in case of blockage. The inlet pipe should extend a sufficient distance from the shoreline to ensure good distribution. Pipes shall be installed far enough below the ground surface to avoid freezing or be provided with other protective measures.

The slope of the pond and the liner at the pipe inlet shall be protected from erosion by paving, by extending the pipe to a point where the discharge will not fall on the slope, or by using a flexible down pipe at the pipe discharge during filling. Permanent measures shall be used to protect liners during initial filling and after periodic emptying. Pipes shall be supported on pilings of pressure treated wood, steel, concrete, or masonry and anchored to prevent dislodging or flotation. Piling installation shall maintain liner integrity.

Pumped inlets shall be sized to meet the requirements of the pumping equipment. Larger diameter gravity loading pipes for solids and liquids shall outlet at the bottom of the pond, and the effective head (vertical difference between the top of the drop inlet and the required storage volume elevation) shall be no less than 4 feet.

Maximum Operating Level. The maximum operating level for waste storage ponds shall be the pond level that provides for the required storage volume less the 25-year, 24-hour storm volume (the 100-year, 24-hour storm volume, if applicable).

Freeboard. Freeboard is the vertical distance between the settled top of dike of a waste storage pond and the designed liquid level in the pond with the auxiliary spillway or overflow structure operating at the design discharge. This distance shall be a minimum of 1 foot.

Embankments. The height of the embankment shall be increased during construction by the amount needed to ensure that the designed height will be maintained after settlement. This increase shall not be less than 5 percent. The combined side slopes of the settled embankment shall not be less than 5 horizontal to 1 vertical (5:1), and neither slope shall be steeper than 2 horizontal to 1 vertical (2:1) unless special provisions are made to provide stability. The top of the dike shall slope slightly

toward the outside dike slope in order to direct as much rainfall as possible from the waste storage pond. All slopes must be designed to be stable. Where embankments are to be mowed; 3 horizontal to 1 vertical (3:1) or flatter slopes are recommended.

The minimum embankment top width shall be as shown in Table 1. If the embankment top is to be used as a road, the minimum top width shall be 16 feet for one-way traffic and 26 feet for two-way traffic, and provisions shall be made for protecting the auxiliary spillway from damage. Guard rails or other safety measures shall be used where necessary.

Table 1. Embankment Top Width

Total Height of Embankment (ft.)	Minimum Top Width, (ft.)
<15	8
15 to <20	10
20 to <25	12
25 to <30	14
30 to 35	15

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

1. Layers of loose fill shall not exceed 9 inches in thickness before compaction. Compaction shall be accomplished 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 2 complete passes of the loaded equipment traveling in a direction parallel to the main axis of the fill.
2. If a minimum required density is specified, each layer of fill shall have the moisture adjusted and be compacted as necessary to obtain the density. Special equipment shall be used, if needed, to obtain the required moisture content and degree of compaction.

Excavations. Side slopes shall be stable and shall not be steeper than 2 horizontal to 1 vertical (2:1) unless provisions are made to provide stability.

Runoff Exclusion. A low embankment shall be constructed if needed to exclude uncontaminated surface runoff from the pond. The embankment shall meet the criteria contained in the section "Embankments" of this standard.

Outlet. No outlet shall automatically release stored material from a level below the surface elevation of the required storage volume. Outlets from the waste storage pond shall be designed to resist corrosion and plugging. Manually operated outlets shall be of a permanent type designed to resist corrosion and plugging.

Multiple cells. When multiple cells are used, the volume of the primary cell shall be the sum of the manure, wastewater, and other wastes accumulated during the storage period plus the planned solids accumulation between cleanout events, minimum. The remaining volumes shall be in the following cell(s), with normal precipitation, storm volumes, and freeboard being designed and maintained in the final cell. All cell(s) prior to the final cell shall have 1 foot minimum freeboard with the overflow structure passing the 25-year, 24-hour storm, but do not require an auxiliary spillway.

Embankment Waste Storage Pond and Spillway. Embankment waste storage ponds (those having a maximum operating level against the embankment of 3 feet or more above natural ground) shall be provided with an auxiliary spillway, overflow structure, or combination to protect the embankment from overtopping when the pond is at the maximum operating level and a 25-year, 24-hour storm volume (the 100-year, 24-hour storm volume, if applicable) is exceeded. The crest of the auxiliary spillway or overflow structure shall be located at or above an elevation that will contain the 25-year, 24-hour storm volume (the 100-year, 24-hour storm volume, if applicable). This elevation shall be a minimum of 1 foot above the maximum operating level. The auxiliary spillway, overflow structure, or combination shall be designed to pass the 25-year, 24-hour storm volume while maintaining the required minimum freeboard of one foot.

The auxiliary spillway shall be placed in undisturbed soil when possible. When it must be placed in fill material, precautions shall be taken to insure the integrity of the structure. When locating the auxiliary spillway, areas near the waste storage pond corners and the side containing the inlet shall be avoided, if possible.

Pipe auxiliary spillways shall be 6-inch minimum diameter and equipped with trash racks, antivortex devices, and antiseep collars and may be steel, concrete, aluminum, or plastic as required in Alabama NRCS conservation practice standard, Pond, Code 378.

Excavated Waste Storage Pond. Excavated waste storage ponds (those having a maximum operating level against the embankment of less than 3 feet above natural ground) do not require an auxiliary spillway, overflow structure, or freeboard unless they are in a series of multiple cells (see the section "Multiple Cells" in this standard) or have an outside drainage area (include overflow protection as for an embankment waste storage pond). The vertical distance from the maximum operating level to the settled top of the embankment shall provide storage for the 25-year, 24-hour storm volume (the 100-year, 24-hour storm volume, if applicable) or be a minimum of 1 foot, whichever is greater.

Emptying Facilities. Some type of facility shall be provided for emptying the waste storage pond (see the requirements in the section "Safety" of this standard).

Where agitators are used in ponds with liners, the tip of the propeller shall be a minimum of 3 feet from the liner surface or the liner shall be protected by a concrete pad. The agitator shall be positioned so that agitated flow will not cause scouring of an adjacent slope

Provision shall be made for periodic removal of accumulated solids to preserve storage capacity. The anticipated method for doing this must be considered in planning, particularly in determining the size and shape of the pond and type of liner.

Waste removed from storage facilities shall be utilized in accordance with Alabama NRCS conservation practice standard, Nutrient Management, Code 590.

Staff Gage. A staff gage shall be placed in the waste storage pond with a marker for the maximum operating level allowed and the level of the auxiliary spillway, if applicable. The staff gage will have incremental marks which will coincide with a stage-storage curve for the operator's use in monitoring waste volumes in the pond. The minimum drawdown level will also be marked on the staff gage. The markings and the stage-storage curve shall be referenced and described in the operation and maintenance (O&M) plan.

Additional Criteria for Fabricated Structures

Service Life and Durability. Planning, design, and construction shall ensure that the structure is sound and of durable materials commensurate with the anticipated service life, initial and replacement costs, (O&M) costs, and safety and environmental considerations.

Guidance in evaluating the service life of various materials is given in Table 2. The materials indicated meet the requirements of this standard. The service life of materials not shown shall be based on performance data.

Table 2. Service Life of Various Materials

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

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

Where a non-uniform foundation cannot be avoided or where applied loads may create highly variable foundation loads, settlement should be calculated 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, presumptive bearing strength values for assessing actual bearing pressures may be obtained from Table 3 or another nationally recognized building code. In using presumptive bearing values, adequate detailing and articulation shall be provided to avoid distressing movements in the structure.

Watertightness. Applications such as tanks that require watertightness shall be designed and constructed in accordance with standard engineering and industry practice appropriate for the construction materials used to achieve this objective.

Structure Loading. Waste storage structures shall be designed 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 3. Presumptive Allowable Bearing Stress Values [1/]

Foundation Description	Allowable Stress
Crystalline Bedrock	12,000 psf
Sedimentary Rock	6,000 psf
Sandy Gravel or Gravel	5,000 psf
Sand, Silty Sand, Clayey Sand, Silty Gravel, Clayey Gravel	3,000 psf
Clay, Sandy Clay, Silty Clay, Clayey Silt	2,000 psf

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

The lateral earth pressures should be calculated from soil strength values determined from the results of appropriate soil tests. Lateral earth pressures can be calculated using the procedures in NRCS Technical Release (TR) - 74. If soil strength tests are not available, the presumptive lateral earth pressure values indicated in Table 4 shall be used.

Lateral earth pressures based upon equivalent fluid assumptions shall be assigned according to the following conditions:

- **Rigid frame or restrained-wall.** Use the values shown in Table 4 under the columns "Frame Tanks", which give pressures comparable to the at-rest condition.
- **Flexible or yielding wall.** Use the values shown in Table 4 under the columns "Freestanding Walls", which give 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.

  Internal lateral pressure used for design shall be 65 lbs/ft^2 where the stored waste is not protected from precipitation. A value of 60 lbs/ft^2 may be used where the stored waste is protected from precipitation and will not become saturated. Lesser values may be used if supported by measurement of actual pressures of the waste to be stored. If heavy equipment will be operated near the wall, an additional two feet of soil surcharge shall be considered in the wall analysis.

If the facility is to have a roof, snow and wind loads shall be as specified in "Minimum Design Loads for Buildings and Other Structures," Standard No. 7-02, ASCE. 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. The structural design shall consider all items that will influence the performance of the structure, including loading assumptions, material properties, and construction quality. Design assumptions and construction requirements shall be indicated on the plans.

Fabricated structures shall be designed 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

Table 4. Lateral Earth Pressure Values [1/]

Soil		Equivalent fluid pressure ($lb/ft^2/ft$ of depth)			
		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/] All definitions and procedures in accordance with ASTM D2488 and D653.
[5/] Generally, only washed materials are in this category.
[6/] Not recommended. Requires special design if used.

Concrete Slabs on Grade. Slab design shall consider the required performance and the critical applied loads with both the subgrade material and material resistance of the concrete slab. Where applied point loads are minimal and watertightness is not required, such as barnyard and feedlot slabs subject only to precipitation, and the subgrade is uniform and dense, the minimum slab thickness shall be 4 inches with a minimum joint spacing of 10 feet. Joint spacing can be increased if steel reinforcing is added based on subgrade drag theory as discussed in industry guidelines such as "Design of Slabs-on-Grade," ACI 360.

For applications where watertightness is required, such as floor slabs of storage tanks, the minimum thickness for uniform foundations shall be 5 inches and shall contain distributed reinforcing steel. The required area of such reinforcing steel shall be based on subgrade drag theory.

When heavy equipment loads are to be resisted and/or where a non-uniform foundation cannot be avoided, an appropriate design procedure as described in ACI 360 shall be used.

Concrete Repair. Concrete that will not meet its intended purpose due to honeycombed areas,

voids, cracks, or other defects shall be replaced or repaired according to the "Concrete Repair Manual," 2nd Edition, ACI, or the "Guide to Concrete Repair," Bureau of Reclamation.

Quality Assurance for Concrete Structures. Quality assurance is essential during the installation of concrete structures to assure that the design expectations are met. For low or medium hazard structures that can be economically maintained and replaced, concrete design and construction shall be according to NEH Construction Specification 32, Structure Concrete. For high quality, complex, or critical structures, concrete design and construction shall be according to NEH Construction specification 31, Concrete for Major Structures.

Holding Tank. Holding tanks are used for liquid and slurry waste and may be open or covered, inside or outside of enclosed housing, or beneath slotted floors. Holding tanks shall be watertight or have their in-ground portion completely contained by a liner as described in the section "Liners" of this standard. As required by ADEM, a leak detection and groundwater monitoring system shall be installed under the facility, and secondary containment shall be provided for above-ground storage tanks.

Depending on the hazard involved to the environment, tanks shall be constructed of reinforced masonry, coated or glass-fused steel, or reinforced concrete. Tanks designed as buried structures shall have exterior drainage or a minimum safety factor of 1.3 against uplift, when empty.

Tanks may be designed with or without covers. Covers, beams, or braces that are integral to structural performance must be indicated on the construction drawings. The openings in covered holding tanks shall be designed to accommodate equipment for loading, agitating, and emptying, and shall have grills or secure covers for safety, odor, and vector control. Central loading from an elevation at or above the top of the sidewall of open holding tanks allows more complete and uniform filling, particularly with manure containing bedding. Steel and other corrodible materials shall be adequately protected with concrete, paint, or other protective coatings to prevent corrosion.
Tank covers shall be designed to withstand both dead and live loads. The live load values for covers contained in ASAE EP378, Floor and Suspended Loads on Agricultural Structure Due to Use, and in ASAE EP393, Manure Storages, shall be the minimum used. The actual axle load for tank wagons having more than a 2,000 gallon capacity shall be used.

All structures shall be underlain by free draining material or shall have a footing located below the anticipated frost depth.

A minimum of 6 inches of residual solids storage shall be provided for tanks.

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. Facilities receiving wet waste that will not stack to the designed height, with no provision for liquid separation, shall not be designed 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 manure must be considered in determining the wall height.

Stacking facilities shall be constructed of durable materials such as reinforced concrete, reinforced concrete block, or treated lumber. They shall be designed 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. Lumber shall not be used 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 . Floors shall slope downward slightly from the entrance into the stacking facility. Suggested grade of the floor is 0.2 to 0.3 percent.

Timber Walls. All posts and lumber in contact with soil, wastes, or exposed to moisture shall be pressure-treated in accordance with the American Wood-Preservers' Association (AWPA) Standard U1 (current version). Support and brace posts in ground contact shall be treated to meet Use Category UC4B Modified Exposure (Farm Use). Above ground lumber shall be treated to meet Use Category UC3B. Posts shall have a minimum size of 4 inch by 6 inch (nominal) and be placed in the ground from 3 to 6 feet deep, depending on the

design analysis. Posts for "mini-composters" shall have a minimum size of 4 inch by 4 inch (nominal). Side planking shall have a minimum thickness of 2 inches (nominal).

Due to the corrosive nature of chemical wood preservatives required after December 31, 2003, all bolts, washers, nuts, nails, and other hardware used in contact with treated wood shall be galvanized to meet ASTM Specifications A153 for fasteners and A653 Class G185 sheet metal for connectors, Type 304 or 316 (stainless) steel, or other type of material or coating as approved by the preservative manufacturer. Current information on specific fastener materials is available through links to the preservative manufacturers on the AWPA website at www.awpa.com. Aluminum should not be used in direct contact with treated wood.

Internal Drainage. Drainage of liquids, including rainfall from the stacking area (especially those without a roof), shall be collected in a tank or waste storage pond or be otherwise contained until final utilization. Collection may be 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. Design criteria shall be the same as for timber walls.

Poultry Litter Stacking Facilities. To prevent spontaneous combustion, poultry litter in the stacking facility should have less than 40 percent moisture, and dry litter and moist litter should not be layered. In addition, the height of the litter stack shall not exceed 5 to 7 feet, with litter to wood contact limited to 3 to 5 feet.

Design procedures for poultry litter stacking facilities are contained in the Alabama Poultry Waste Management - Waste Utilization and Facility Design Workbook.

Waste Storage-Livestock Feeding Facilities

Locate facility on a well drained upland site with a vegetated filter meeting the requirements of Alabama NRCS conservation practice standard Filter Strip, Code 393 between it and any down gradient environmentally sensitive areas (perennial or intermittent streams, ponds, lakes, springs, or sinkholes). The primary location will be on top of a ridge or hill. If the location must be on a slope it will be less than 150 feet from the crest of the ridge or hill with a runoff diverting feature meeting the requirements of Alabama NRCS conservation practice standard Diversion, Code 362 upslope of the facility.

Access for operation of the facility will be by an all-weather road meeting the requirements of Alabama NRCS conservation practice standard Access Road, Code 560.

Locate watering facilities and mineral supplements away from the waste storage-livestock feeding facility to minimize loitering of livestock around the facility and to improve animal waste distribution and forage usage. Livestock must not be confined to the feeding facility.

The livestock operation will implement Alabama NRCS conservation practice standard Prescribed Grazing, Code 528 on involved pastureland and environmentally sensitive areas such as riparian areas, streams, or stream buffers.

Provide adequate manure storage in the facility to scrape and stockpile manure accumulated during the winter feeding months. Implement a Comprehensive Nutrient Management Plan (CNMP) for the stored animal manure. The availability of adequate manure spreading equipment will be documented in the CNMP.

Use concrete under the roof to facilitate manure scraping and implement additional heavy use area protection to protect the area adjacent to the facility in accordance with Alabama NRCS conservation practice standard Heavy Use Area Protection, Code 561.

Only use facility during periods in which livestock are not actively grazing pastures. Typically this will be during periods when hay and supplemental feed are required to maintain the livestock. This period may run from November through March. Use the facility for animal feeding and manure storage only.

Facility use is limited to 60 head of cattle. Larger herds will require multiple facilities.

Establish all disturbed soils to permanent cover in accordance with Alabama NRCS conservation practice standard Critical Area Planting, Code 342. Maintain healthy stand of vegetation. Promptly repair any damaged areas.

Implement an emergency action plan to prevent waste from entering environmentally sensitive areas should wastes leak or overflow from the facility.

Control roof runoff according to Alabama NRCS conservation practice standard Roof Runoff Structure, Code 558.

CONSIDERATIONS

Location. Waste storage facilities should be located as close to the source of waste and polluted runoff as practicable. In addition, they should be located considering prevailing winds and landscape elements such as building arrangement, landform, and vegetation to minimize odors and visual resource problems.

It is highly recommended that waste storage facilities meet the minimum distance requirement from public or private facilities as shown in Table 5. These distances should be increased wherever possible in order to minimize any negative impacts of the storage facilities. In no case shall the facility siting distances be less than the minimum distance requirements as required by the ADEM Administrative Code Chapter 335-6-7, as amended. ADEM's regulatory minimum distances are summarized in the ADEM/NRCS Buffer Distance Summary for Animal Feeding Operations.

Table 5. Minimum Distance Requirement for Waste Storage Facilities

Public or Private Use Facilities	Minimum Distance from Waste Storage Facility
Any public use area or DCSHP [1/]	700 feet – liquid 330 feet – dry new 165 feet - dry expansion
Well, up-gradient	100 feet - dry 150 feet - liquid
Well, down-gradient	300 feet
Natural Water Courses and Lakes	200 feet
Milking Parlor	100 feet
Drainage Ditches	100 feet
Area specified by state or local ordinance	Greater of state or local distance or distance shown above

[1/] DCSHP: Non-owner existing occupied Dwelling, Church, School, Hospital, or Park

Solids Separation. To minimize frequency of solids removal from waste storage ponds, route wastes through a solid separator to remove solids. Separation facilities should have adequate capacity to store separated solids for a time period based on climate, equipment, clean out frequency, and method of disposal. Solid separators, settling basins, etc., shall be designed to prevent seepage to the groundwater.

Water Quantity. Waste storage facilities will have an 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 enter 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.

Other Considerations. Non-polluted runoff should be excluded 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.

Development of an emergency action plan should be considered for waste storage facilities where there is a potential for significant impact from breach or accidental release. Where there is potential for significant impact, the plan shall include site specific emergency action plan provisions for minimizing the impact.

Due consideration should be given to economics, the overall waste management system plan, safety and health factors.

Consider other low-cost animal waste management methods before constructing a waste storage-livestock feeding facility. Other methods include using heavy use areas for feeding when strategically located in pastures; using portable feeding devices that are moved to minimize damage to pastures and distribute animal wastes,

or even various grazing management techniques such as grazing stockpiled forages.
If erosion is encountered or expected from livestock trails then implement Alabama NRCS conservation practice standard Animal Trails and Walkways, Code 575.

Do not locate the waste storage-livestock feeding facility near other animal handling facilities.

Considerations for Minimizing the Potential for and Impacts of Sudden Failure of a Waste Storage Facility or Accidental Release from the Required Volume

Features, safeguards, and/or management measures to minimize the risk of waste storage facility failure or accidental release, or to minimize or mitigate impact of this type of failure should be considered when any of the categories listed in Table 6 may be affected.

Table 6. Potential Impact Categories from Failure of a Waste Storage Facility 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

The following should be considered either individually or in combination to minimize the potential of or the consequences of a sudden failure of a storage facility when one or more of the potential impact categories listed in Table 6 may be affected:

- An auxiliary spillway
- Additional freeboard
- Design storage volume for wet year rather than normal year precipitation
- Reinforced embankment - such as, additional top width, flattened and/or armored downstream side slopes
- Secondary containment
- Liquid level indicators or recorders

The following should be considered 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 affected:

- Outlet gate locks or locked gate housing
- Secondary containment
- Alarm system
- Another means of emptying the required volume

Considerations for Minimizing the Potential of Waste Storage Pond Liner Failure or Fabricated Structure and Tank Leakage

Sites with categories listed in Table 7 should be avoided unless no reasonable alternative exists. Under those circumstances, consideration should be given to providing an additional measure of safety from pond, fabricated structure, or tank seepage when any of the potential impact categories listed in Table 7 may be significantly affected.

Table 7. Potential Impact Categories for Liner Failure and Leakage
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

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

- A liner under the facility designed in accordance with procedures of AWMFH Appendix 10D with a thickness and coefficient of permeability so that final specific discharge is less than 0.0028 ft/day
- A flexible membrane liner over a clay liner
- A geosynthetic clay liner (GCL) flexible membrane liner

- A concrete liner designed in accordance with criteria for a watertight fabricated structure in this standard
- A leak detection and monitoring system installed under the facility to minimize the potential for undetected release of wastewater to groundwater

Considerations for Improving Air Quality

To reduce emissions of greenhouse gases, ammonia, volatile organic compounds, and odor:

- Use additional practices such as anaerobic digesters, covers, and composting facilities
- Use liquid/solid separation prior to discharge to storage ponds to reduce volatile solids (VS) loading and use composting of solids to further reduce gaseous emissions and odors
- Adjust pH below 7. This may reduce ammonia emissions from the storage pond but may increase odor when waste is surface applied

PLANS AND SPECIFICATIONS

Plans and specifications shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended use.

Engineering plans, specifications, and reports shall include the following as a minimum:

- Plan view of system layout
- Type and number of animals the structure is designed to serve
- Storage period
- Typical cross section(s) of waste storage pond and structures
- Structural details of components
- Construction specifications
- References to components supplied by others (pumps, etc.)
- Special safety requirements
- Vegetative requirements
- Quantities
- Drainage and grading plan
- CBMPP if one is needed
- Soil and foundation findings, interpretations, and reports
- O&M plan

OPERATION AND MAINTENANCE

An O&M plan shall be developed that is consistent with the purposes of the practice, its intended life, safety requirements, and the criteria for its design. The waste storage facility shall be inspected periodically to ensure that all components are operating as planned.

The O&M plan shall contain the operational requirements for emptying the storage facility. It shall include maximum operating levels of the waste storage facility, clean-out intervals, operation requirements of structural components, etc. The O&M plan shall include the requirement that waste shall be removed from storage and utilized in locations, times, rates, and volumes in accordance with the overall waste management system plan. Records shall be kept of all waste applications according to Alabama NRCS conservation practice standard Nutrient Management, Code 590.

The O&M plan for ponds shall include the requirement that following storms, waste shall be removed at the earliest environmentally safe opportunity to ensure that sufficient volume is available to contain the 25-year, 24-hour storm (the 100-year, 24-hour storm if applicable). The plan shall also include an explanation of the use of the staff gage and stage-storage curve to indicate the operating levels and volumes in the storage pond.

The O&M plan for stacking facilities shall require that the structure be inspected at least twice each year when the facility is empty. Any wooden parts, hardware, or other replaceable parts which are damaged or show excessive wear or decay shall be replaced. Roof structures should be examined for structural integrity. Walls of composters, dry stacks, and waste storage-livestock feeding facilities that are constructed with lumber may need replacing during the life of the structure.

The embankment and other vegetated areas shall be mowed and fertilized to maintain a protective vegetative cover. Trees can cause leaks and safety hazards. Trees and shrubs should not be allowed to grow within a potential distance of their root zones to the embankment.

REFERENCES

ACI 318, 360, 530
ADEM Administrative Code, Chapter 335-6-7, as amended
ADEM/NRCS Buffer Distance Summary for Animal Feeding Operations
Alabama Poultry Waste Management – WasteUtilization and Facilities Design Workbook
ASAE Specifications: EP378, EP393
ASTM Specifications: A153, A185, A615, A653, C143, C309, D653, D698, D2488
AWPA Standard U1 (current version)
"Basic Building Code,",12th Edition, Building Officials and Code Administrators, Inc.
"Concrete Repair Manual," 2nd Edition, ACI
EPA CAFO Final Rule, 40 CFR Parts 9, 122,123,412
"Guide to Concrete Repair," Bureau of Reclamation
"Manual of Steel Construction," American Institute of Steel Construction.
"Minimum Design Loads for Buildings and Other Structures," Standard 7-02, ASCE
"National Design Specifications for Wood Construction," American Forest and Paper Association.
NEM, Part 520, Streams and Channels
NEH, Part 642, Specifications for Construction Contracting:
Concrete for Major Structures (cs031)
Structure Concrete (cs032)
NEH, Part 651, Agricultural Waste Management Field Handbook (AWMFH), Chapters 7 and 10.
NPDES Phase II Rule
NRCS Technical Release - TR-74
"Standard Grading Rules for Southern Pine Lumber," Southern Pine Inspection Bureau
"Standard Specifications for Highway Construction," Alabama Highway Department (current version)