**NATURAL RESOURCES CONSERVATION SERVICE**
**CONSERVATION PRACTICE STANDARD**
**ARIZONA**

# 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

*This practice may be applied as part of an agricultural waste management system:*

- 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 fabricate structures including tanks, stacking facilities, and pond appurtenances.

## CRITERIA

*Waste storage facilities shall be designed on an individual basis to meet site conditions and functional requirements. They shall be part of an approved and overall engineering plan for irrigation, drainage, wildlife, recreation, channel improvement, or similar purposes.*

*Design and implementation of subsidiary components and/or structures shall meet all applicable Natural Resource Conservation Service (NRCS) standards. The criteria for the design of any components not specifically addressed in NRCS practice standards or specifications shall be consistent with sound engineering principles and/or manufacturer recommendations.*

### General Criteria Applicable to All Waste Storage Facilities

***Laws and Regulations****.* Waste storage facilities must be planned, designed and constructed to meet all federal, state, *Tribal* and local laws*, rules,* and regulations. *Laws and regulations of particular concern include those involving water rights, land use, pollution control, property easements, wetlands, preservation of cultural resources, and endangered species. State water quality standards for seepage loss shall be followed.*

*The owner is responsible for securing necessary permits and water rights, complying with all laws and regulations, and meeting legal requirements applicable to the installation, operation, and maintenance of this practice and associated structures.*

**Location**. To minimize the potential for contamination of streams, waste storage

facilities should be located outside of floodplains. This practice has been determined to have no effect on federally listed species if installed outside of the designated 100-year flood plain. However, if site restrictions require location within a floodplain, they shall be protected from inundation or damage from a 25-year flood event, or larger if required by laws, rules, and regulations. Additional determination of effect by NRCS and consultation with the Fish and Wildlife Service may also be required for installation within the 100-year floodplain. 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.

*New storage lagoons and expansion of existing storage lagoons and land application of wastes should not occur within 100 feet of any watercourse. A horizontal setback of 100 feet shall be maintained between storage facilities and private drinking water supply wells. Public drinking water supplies will require a setback of 200 feet.*

**Storage Period**. The storage period is the maximum length of time anticipated between emptying events. The minimum storage period shall be based on the timing required for environmentally safe waste utilization considering the climate, crops, soil, equipment, and local, *Tribal,* state, and federal regulations.

**Design Storage Volume**. The design storage volume equal to the required storage volume shall consist of the total of the following as appropriate:

(a) Manure, wastewater, and other wastes accumulated during the storage period
(b) Normal precipitation less evaporation on the surface area (at the 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) 25-year, 24-hour precipitation *(rainfall)* on the surface (at the required design storage volume level) of the facility
(e) 25-year, 24-hour runoff from the facility's drainage area
(f) Residual solids after liquids have been removed. A minimum of 6 inches shall be provided for tanks
(g) Additional storage as may be required to meet management goals or regulatory requirements

**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.

**Emptying Component**. Some type of component shall be provided for emptying storage facilities. It may be a facility such as 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 ponds and type of seal, if any.

**Safety**. Design shall include appropriate safety features to minimize the hazards of the facility. Ramps used to empty liquids shall have a slope of 4 horizontal to 1 vertical *(4H:1V)* or flatter. Those used to empty slurry, semi-solid, or solid waste shall have a slope of 10 horizontal to 1 vertical *(10H:1V)* 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.

**Erosion Protection**. Embankments and disturbed areas surrounding the facility shall be treated to control erosion.

**Liners**. Liners shall meet or exceed the criteria in *Conservation Practice Standard* 521, Pond Sealing or Lining.

*Unless otherwise specified by ADEQ regulations, the permeability of waste storage ponds installed without a synthetic flexible membrane liner shall not exceed $1x10^{-7}$ centimeters per second.*

**Additional Criteria for Waste Storage Ponds**

**Soil and foundation**. The pond shall be located in soils with an acceptable permeability that meets all applicable regulation, or the pond shall be lined. Information and guidance on controlling seepage from waste impoundments can be found in the Agricultural Waste Management Field Handbook (AWMFH), Appendix 10D.

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. The water table may be lowered by use of perimeter drains, if feasible, to meet this requirement.

*National Engineering Manual, Part 531, Geology, specifies geologic investigation requirements and soil transportation regulations.*

*Unless otherwise specified by ADEQ regulations, soil compaction shall be no less than 90% Standard Proctor Density. If the facility is classified as a regulatory dam, the compaction requirement for an embankment increases to 95% Standard Proctor Density.*

**Maximum Operating Level**. The maximum operating level for waste storage ponds shall be the pond level that provides for the required volume less *than* 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. A permanent marker or recorder shall be installed at this maximum operating level to indicate when drawdown should begin. The marker or recorder shall be referenced and explained in the O&M plan.

**Outlet**. No outlet shall automatically release storage from the required design volume. Manually operated outlets shall be of permanent type designed to resist corrosion and plugging.

**Embankments**. The minimum elevation of the top of the settled embankment shall be 1 foot above the waste storage pond's required volume. This height shall be increased by the amount needed to ensure that the top elevation will be maintained after settlement. This increase shall be not less than 5 percent. The minimum top widths are shown in Table 1. The combined side slopes of the settled embankment shall not be less than 5 horizontal to 1 vertical *(5H:1V)*, and neither slope shall be steeper than 2 horizontal to 1 vertical *(2H:1V)* unless provisions are made to provide

stability. *The inside slope of all waste storage ponds shall not be steeper than 3 horizontal to 1 vertical (3H:1V).*

Table 1 – Minimum Top Widths

| Total Embankment Height (feet) | Top Width (feet) |
|---|---|
| 15 or less | 8 |
| 15 – 20 | 10 |
| 20 – 25 | 12 |
| 25 – 30 | 14 |
| 30 – 35 | 15 |

*Unless otherwise specified by Arizona Department of Environmental Quality (ADEQ) regulations, all embankment waste storage facilities shall have a minimum 2 feet freeboard above the required design volume.*

**Excavations**. Unless supported by a soil investigation, excavated side slopes shall be no steeper than 2 horizontal to 1 vertical.

**Additional Criteria for Fabricated Structures**

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

Where a non-uniform foundation cannot be avoided or 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 2 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.

Foundations consisting of bedrock with joints, fractures, or solution channels shall be treated or a separation distance provided 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.

Table 2 – Presumptive Allowable Bearing Stress Values [1]

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

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

***Liquid Tightness**. Applications such as tanks, that require liquid tightness shall be designed and constructed in accordance with standard engineering and industry practice appropriate for the construction materials used to achieve this objective.*

**Structural Loadings**. 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.

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 TR-74. If soil strength tests are not available, the presumptive lateral earth pressure values indicated in Table 3 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 3 under the column "Frame tanks," which gives pressures comparable to the at-rest condition.
- Flexible or yielding wall. Use the values shown in Table 3 under the column "Free-standing walls," 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.

Internal lateral pressure used for design shall be 65 lb/ft$^2$ where the stored waste is not protected from precipitation. A value of 60 lb/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

Table 3 – 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 Classification4 | 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) Coarse sands with silt and 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 D 2488 and D 653.
[5] Generally, only washed materials are in this category
[6] Not recommended. Requires special design if used.

surcharge shall be considered in the wall analysis.

Tank covers shall be designed to withstand both dead and live loads. The live load values for covers contained in ASAE EP378.3, Floor and Suspended Loads on Agricultural Structures Due to Use, and in ASAE EP 393.2, 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.

If the facility is to have a roof, snow and wind loads shall be as specified in ASAE EP288.5, Agricultural Building Snow and Wind Loads. 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 standard plans.

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 tanks shall be designed to accommodate equipment for loading, agitating, and emptying. These openings shall be equipped with grills or secure covers for safety, and for odor and vector control.

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

**Slabs on Grade**. Slab design shall consider 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, the minimum slab thickness shall be 4 inches with a maximum joint spacing of 10 feet. Joint spacing can be increased if steel reinforcing is added based on subgrade drag theory.

For applications where liquid-tightness 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 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, an appropriate design procedure incorporating a subgrade resistance parameter(s) such as ACI 360 shall be used.

***Investigations, Surveys and Design Criteria.*** *Waste management systems include practice components required for the complete management of waste. Documentation requirements will be as outlined below, in additional to the*

*documentation requirements of the practice components used in the system.*

*Make a preliminary site assessment or investigation to determine the complexity of the problem, availability of land for utilizing the waste and water, and to select the type of waste management system component which will best meet the needs of the owner to operate the waste management system. Volume of waste that will be produced per day shall be recorded in terms of biochemical oxygen demand ($BOD_5$), raw manure, volatile solids (V.S.), nutrients or water use. Additional information may include:*

1. *Review of soil borings or geological site investigation, depending on existing site conditions or scope and complexity, to determine site feasibility, ground surface elevation of each hole or site, depth to ground water and seasonal high water table, description of each soil material (silty sand, lean clay, etc.), unified soil classification of each material (SM, CL, etc.), estimate of soil permeability of underlying materials (permeable, low permeability, etc.), and any soil limitations and/or whether the materials are oxidized or un-oxidized.*
2. *Determine if the waste management system is to be designed for phosphorous or nitrogen (limiting nutrient). Where soil survey data is available, it may be used for preliminary planning.*
3. *Inventory of system- method of operation, number of livestock, waste disposal methods, type of equipment, future expansion plans, crop rotations on planned areas, component locations, structure requirements, quantities and costs.*
4. *Verify appropriate state, Tribal or local laws for permitting and approval requirements and notify participant of their responsibilities.*
5. *Verification or certification of used materials (if any).*

*To adequately plan and layout this practice, a detailed topographic survey is required, that adequately details:*

1. *Site topography, as needed to show the physical features of the site, including existing features/practices, field elevations, location of any utilities or markers, etc.*
2. *Adequate topographic information/data at the proposed location of the waste storage facility in order to determine excavation and/or earthfill requirements. Obtain topographic data with the land disposal area to determine waste distribution system layout, pumping requirements and costs;*
3. *Topographic surveys of sufficient detail and extent to determine the drainage area around barns, high intensity areas (HIA), and pastures contributing runoff to the proposed facility. When possible, divert uncontaminated runoff, especially roof runoff.*
4. *Profiles along the centerline of proposed pipelines, ditches, diversions, etc.*
5. *Reference stakes, control elevations and locations of water levels, including impermeable or restrictive layers;*
6. *A permanent benchmark(s) shall be set and described. Preferably, the elevations and coordinates should be based on a local (assumed) or coordinate system (State or grid) and clearly stated on the plan. Datum may be in the form of Northing and Easting coordinates, or Longitude and Latitude.*

*Where applicable, USGS 7.5-minute topographic Quadrangles may be used, provided hydraulic analysis verifies minimum criteria are meet at all locations.*

*The design of a practice is the application of Field Office Technical Guide practice standards, NEH Part 651, AWMFH, using experience and judgment in the development of a solution to the problem or the objective. All computations and decisions made during the design of a practice are to be checked by another*

*qualified individual and appropriate notations made. Design computations, calculations or analysis shall meet the following criteria:*

1. *Complete soils investigation report as needed and construction recommendations. See NEH Part 651, Chapter 7, AWMFH;*
2. *Plot ground profiles at structure site(s) with the elevations of any drains and high intensity areas (HIAs) contributing waste, waste water and storm water runoff into the proposed facility;*
3. *Size the waste management system using the appropriate engineering practice standard and the NEH Part 651, AWMFH;*
4. *Hydrologic determinations – documentation may include printouts from EFM2 or TR-55 programs or software/spreadsheets used for AWMS design;*
5. *Hydraulic calculations or analysis, as required to determine capacities, sizes and proportion of facilities such as pipelines, diversions, etc.;*
6. *If site is within the 100 year floodplain, flood routing data from SITES or other approved software to evaluate pipe sizes for sediment basins;*
7. *Manure production/volume calculations (AWM, hand calculations or design spreadsheets for storage computation and documentation);*
8. *Structural design calculations;*
9. *Construction material estimates (material volume computations), includes estimates of earthwork, pipe, concrete, rock, vegetative components, geotextile and erosion control fabrics, or other appurtenances.*
10. *Subsidiary and applicable components shall be designed in accordance with applicable conservation practice standards (i.e., structures shall meet the requirements of Conservation Practice 587, Structure for Water Control, etc.).*

***Installation and Basis of Acceptance**. For construction that does not meet State, OSHA, or Tribal criteria or requirements where deficient construction materials were used, NRCS may consider a waiver request for approval of construction after it has received a signed and sealed construction and/or material exemption from a licensed engineer. Required exemption shall be for installation of materials that do not meet minimum quality criteria as found in applicable Standards, Specifications, ASTM's, AWWA standards, etc.*

*Contractors performing work under this practice shall abide by all Federal, State or Tribal laws or criteria, and must be licensed by the state board of technical registers where the work is being implemented.*

## CONSIDERATIONS

Waste storage facilities should be located as close to the source of waste and polluted runoff as practicable.

Non-polluted runoff should be excluded from the structure to the fullest extent possible except where its storage is advantageous to the operation of the agricultural waste management system.

Freeboard for waste storage tanks should be considered.

Solid/liquid separation of runoff or wastewater entering pond facilities should be considered to minimize the frequency of accumulated solids removal and to facilitate pumping and application of the stored waste.

Due consideration should be given to environmental *and ecological* concerns, *economics, the overall waste management system plan, acceptable level of risk, 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.***

*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 should be considered when any of the categories listed in Table 4 might be significantly affected.*

*The following should be considered 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 4 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 4 – 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 *and drainage*
6. Historical and/or archaeological sites or structures that meet the eligibility criteria for listing in the National Register of Historical Places

The following options 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 4 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**

Sites with categories listed in Table 5 should be avoided unless no reasonable alternative exists. Under those circumstances, consideration should be given to providing an additional measure of safety from pond seepage when any of the potential impact categories listed in Table 5 may be significantly affected.

Table 5 – 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

Should any of the potential impact categories listed in Table 5 be affected, consideration should be given 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 $1 \times 10^{-6}$ 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

**Considerations for Improving Air Quality *and/or minimizing the impact of odors***

To reduce emissions of greenhouse gases, ammonia, volatile organic compounds, and odor, other practices such as Anaerobic Digester – Ambient Temperature (365),

Anaerobic Digester – Controlled Temperature (366), Waste Facility Cover (367), and Composting Facility (317) can be added 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 Waste Utilization, 633).

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

*An anaerobic lagoon instead of a waste storage pond should be considered for sites located in rural areas where odors are a concern. This should be especially considered where odors would affect neighboring farms having enterprises that do not cause odors and/or neighbors. The recommended loading rate for anaerobic lagoons at sites where odors must be minimized is one-half the values given in AWMFH Figure 10-22.*

*For sites located near urban areas practices such as the following should be considered to reduce odor emissions:*

1. *Covering the storage facility with a suitable cover.*
2. *Using naturally aerated or mechanically aerated lagoons.*
3. *Using composting in conjunction with a solid waste system rather than a liquid or slurry system.*
4. *Using a methane digester and capture system.*

## PLANS AND SPECIFICATIONS

*Use Arizona standard drawings to the extent possible. These may be supplemented by additional drawings or specification notes on the drawings to provide full installation instructions.*

*Construction plans shall include all components needed for the safe operation of the proposed improvements such as railing, fencing, or warning signs as appropriate. The plans shall address operations near existing utilities, trench excavations and any other items related to construction of the structure that may pose a safety risk to those involved.*

*Development of* plans and specifications *for waste storage facilities will be guided by the National Engineering Handbook, Part 650, the Engineering Field Handbook, Chapter 5, and shall be in accordance with the National Engineering Manual, Parts 541 and 542, shall be prepared for specific field site,* 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. *Plans and specifications shall include such drawings, specifications, material requirements, quantities, construction requirements, equipment requirements, and other documents as are necessary to describe the work to be done. As a minimum, the plans and specifications shall provide the following:*

- *Project location map, including section, township and range, North arrow, owner/cooperator/landowner acknowledgement and certification signature blocks, engineering job class (cover sheet);*
- *References that the owner/cooperator are responsible for all permits, rights-of-way, easements and the contact, coordination and location determination of any existing utilities or clearances (buried utility disclaimer);*
- *If applicable, a map showing the location of the practice(s) or system in reference to a known or established benchmark or reference point with the location, description and elevation clearly shown. Topographical features and/or controls shall be shown, showing tie in with existing or other planned practices;*
- *Field surveys and notes, soil investigations or geologic soil boring locations and soil classifications, earthwork or material estimates/quantities (foundation or subgrade preparation and requirements);*

- *Overall system or plan view (i.e., complete waste system layout, waste distribution system, facility plan layout; structural alignment, sizes, stationing, elevations, reference points, cultural features, and other details of the facility; types of materials, thickness, anchorage requirements, lift thickness, covering; profiles showing intended grades, elevations, stationing, pipes and similar structures; cross sections, as needed, to show all pertinent details such as side slopes, berms, bottom widths, and elevation; layout of the containment structure, collection points, water transfer locations or pipelines, and topography of the site; special foundation or subgrade preparation requirements and details, safety features, roof covers, ladders; quality control testing; vegetative, fence and signage requirements, if required; construction/installation criteria, State and Federal [OSHA] safety requirements, etc.), type, quality and quantity as necessary;*
- *Sufficient sectional, dimension or detail views of all system components and appurtenances (i.e., structural details, including dimensional plan views, sectional views to clearly show all necessary details for construction; reinforced concrete requires separate sectional or detail views; location, type, size of construction joints, expansion-contraction joints or special joints for fabricated structures; etc.) as required, for proper system functionality;*
- *Construction notes to clarify a component and furnish directions for installation by supplementing standard or general specifications as needed.*
- *Use Arizona Construction and Material Specifications for each item of work and material, as applicable and available. Additional specifications may need to be written to provide full material and installation instructions. Fill in blanks and add or delete items from the specifications to make them fit the job as needed.*

*All designs completed by non-NRCS personal shall meet minimum State licensing board requirements and NRCS requirements and criteria as outlined in the General Manual, the National Engineering Manual (including Arizona Supplements), and the National Engineering Handbook.*

*ONCE ALL PARTIES HAVE ACCEPTED AND SIGNED THE PLANS AND SPECIFICATIONS, NO CHANGES SHALL BE MADE TO THE DRAWINGS OR SPECIFICATIONS WITHOUT PRIOR APPROVAL OF NRCS.*

**OPERATION AND MAINTENANCE**

An operation and maintenance *(O&M)* plan*, specific to each site,* shall be developed *and reviewed with the landowner, cooperator or individual responsible for operation and maintenance and shall be commensurate with the size and complexity of the project. The plan shall be* consistent with the purposes of the practice, its intended life, safety requirements and the criteria for its design. *It shall document needed actions, including reference to periodic inspections and the prompt repair or replacement of damaged components, and should provide specific instructions for operating and maintaining facilities to ensure they function properly. This includes, but is not limited to:*

- The plan shall contain the operational requirements for emptying the storage facility. This shall include the requirement that waste shall be removed from storage and utilized at locations, times, rates, and volume in accordance with the overall waste management system plan.
- In addition, for ponds, the plan shall include an explanation of the permanent marker or recorder installed to indicate the maximum operating level *or design capacity*.
- The plan shall include a strategy for removal and disposition of waste with the least environmental damage during the normal storage period to the extent necessary to insure the pond's safe operation. This strategy is for the removal of the contribution of unusual storm events

that may cause the pond to fill to capacity prematurely with subsequent design inflow and usual precipitation prior to the end of the normal storage period.

- 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. The plan shall include site-specific provisions for emergency actions that will minimize these impacts.
- *Do not allow human entry to any enclosed structure without safety equipment that includes ladders and breathing apparatus.*
- *Maintain all pumps, agitators, piping, valves, and all other electrical and mechanical equipment in good operating condition by following manufacturer's recommendations.*
- *Appurtenances such as trash racks, outlet structures, and valves shall be kept free of trash, debris, foreign materials or blockage and replaced when needed to prevent clogging of outlet and overflow pipes*
- *Repair spalls, cracks, and weathered areas in concrete surfaces and repair or replace rusted or damaged metal and paint.*
- *Eradicate or otherwise remove all rodents or burrowing animals that have or may potentially damage any part of the delivery or application facilities. Immediately repair any damage caused by their activity.*
- *Apply insecticides, as needed, for insect control per manufacturer's recommendations and precautions.*
- *The practice should be inspected periodically and especially after storm events to determine whether it is functioning properly or if repairs are needed.*
- *Immediately repair any damage resulting from vandalism, vehicles, or livestock and do not allow the operation of any vehicular equipment near the structure that may cause damage.*
- *All fences, railings, and/or warning signs shall be maintained to prevent unauthorized human or livestock entry.*

***REFERENCES***


- *ASAE, 1984. D384 – Manure Production and Characteristics. ASAE. St. Joseph, MI.*
- *Midwest Plan Service. 1985. Livestock Waste Facilities Handbook. MWPS, Department of Agricultural and Bio-systems Engineering, Iowa State University, Ames, IA.*
- *Midwest Plan Service. 1985. Livestock Waste Management Systems. Department of Agricultural and Bio-systems Engineering, Iowa State University, Ames, IA.*
- *Quality Assurance and Quality Control for Waste Containment Facilities, EPA/1600/R-93/182, September 1993.*
- *NRCS, "Agricultural Waste Management Field Handbook", National Engineering Handbook, Part 651.*
- *National Engineering Handbook - Part 650, Engineering Field Handbook, Chapter 1 – Engineering Surveys; Chapter 3 – Hydraulics; Chapter 4 – Elementary Soils Engineering; Chapter 5 – Preparation of Engineering Plans; Chapter 6 – Structures; Chapter 10 – Agricultural Waste, and Chapter 17 – Construction & Construction Materials*
- *National Engineering Manual, Part 531 Geology 531.31, USDA, Natural Resources Conservation Service*
- *USDA-NRCS, TR-62 Engineering Layout, Notes, Staking and Calculations;*
- *General Manual, Title 420-Part 401, Title 450-Part 401, Title 190-Parts 410.22 and 410.26*
- *National Environmental Compliance Handbook*
- *National Planning Procedures Handbook*
- *USDA NRCS, Engineering Design Standards – Far West States*
- *National Cultural Resources Handbook*