

NATURAL RESOURCES CONSERVATION SERVICE CONSERVATION PRACTICE STANDARD

WASTE TREATMENT LAGOON

(no.)
CODE 359

DEFINITION

A waste treatment impoundment made by constructing an embankment and/or excavating a pit or dugout.

PURPOSE

To biologically treat waste, such as manure and wastewater, and thereby reduce pollution potential by serving as a treatment component of a waste management system.

CONDITIONS WHERE PRACTICE APPLIES

- Where the lagoon is a component of a planned agricultural waste management system.
- Where treatment is needed for organic wastes generated by agricultural production or processing.
- On any site where the lagoon can be constructed, operated and maintained without polluting air or water resources.
- To lagoons 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 country roads.

CRITERIA

General Criteria for All Lagoons

Laws and Regulations. All Federal, state, and local laws, rules, and regulations governing the construction and use of waste treatment lagoons must be followed.

Location. To minimize the potential for contamination of streams, lagoons 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 25-year flood event, or larger if required by laws, rules, and regulations. Lagoons shall be located so the potential impacts from breach of embankment, accidental release, and liner failure are minimized; and a minimum of 300 feet from a neighboring residence or public area such that prevailing winds and landscape elements such as building arrangement, landforms, and vegetation minimize odors and protect aesthetic values.

Lagoons should be located a minimum of 100 feet downstream from any domestic well.

Lagoons should be located so they have as little drainage area as possible. If a lagoon has a drainage area, the volume of normal runoff during the treatment period and 25-year, 24-hour storm event runoff shall be included in the required volume of the lagoon.

Soils and foundation. The lagoon shall be located in soils with an acceptable permeability that meets all applicable regulations, or the lagoon shall be lined. A copy of the soils investigation report shall be made a part of the design document. Information and guidance on controlling seepage from waste impoundments can be found in the Agricultural Waste Management Field Handbook (AWMFH), Appendix 10D.

The lagoon shall have a bottom elevation that is a minimum of 2 feet above the seasonal high

water table unless special design features are incorporated that address buoyant forces, lagoon seepage rates, and non-encroachment of the water table by contaminants. The water table may be lowered by use of perimeter drains to meet this requirement.

Flexible membranes. Flexible membrane liners shall meet or exceed the requirements of flexible membrane linings specified in NRCS Practice Standard 521, Pond Sealing or Lining, Flexible Membrane Lining.

Required volume. The lagoon shall have the capability of storing the following volumes:

- Volume of accumulated sludge for the period between sludge removal events;
- Minimum treatment volume (anaerobic lagoons only);
- Volume of manure, wastewater, and other wastes accumulated during the treatment period;
- Depth of normal precipitation and runoff, less evaporation on the surface area (at the required volume level) of the lagoon during the treatment period;
- Depth of the 25-year, 24-hour storm precipitation and runoff on the surface area (at the required volume level) of the lagoon.

Treatment period. The treatment period is the detention time between drawdown events. It shall be the greater of either 60 days; or the time required to provide the storage that allows environmentally safe utilization of waste considering the climate, crops, soil, and equipment requirements; or as required by local, state, and Federal regulations.

Waste loading. Daily waste loading shall be based on the maximum daily loading considering all waste sources that will be treated by the lagoon. Reliable local information or laboratory test data should be used if available. If local information is not available, Chapter 4 of the AWMFH may be used for estimating waste loading.

Embankments. The minimum elevation of the top of the settled embankment shall be 1 foot above the lagoon'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, and neither slope shall be steeper than 2 horizontal to 1 vertical unless provisions are made to provide stability.

Table 1 – Minimum Top Widths

Total Embankment Height, ft.	Top Width, ft.
15 or less	8
15 – 20	10
20 – 25	12
25 – 30	14
30 – 35	15

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

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 have a minimum diameter of 6 inches and a minimum slope of 1 percent. Inlets 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.

Outlet. Outlets from the required volume shall be designed to resist corrosion and plugging. No outlet shall automatically discharge from the required volume of the lagoon.

Facility for drawdown. Measures that facilitate safe drawdown of the liquid level in the lagoon shall be provided. Access areas and ramps used to withdraw waste shall have slopes

that facilitate a safe operating environment. Docks, wells, pumping platforms, retaining walls, etc. shall permit drawdown without causing erosion or damage to liners.

Sludge removal. Provision shall be made for periodic removal of accumulated sludge to preserve the treatment capacity of the lagoon.

Erosion Protection. Embankments and disturbed areas surrounding the lagoon shall be treated to control erosion. This includes the inside slopes of the lagoon as needed to protect the integrity of the liner.

Safety. Design shall include appropriate safety features to minimize the hazards of the lagoon. If needed, the lagoon shall be fenced around the perimeter and warning signs posted to prevent children and others from using it for other than its intended purpose.

Additional Criteria for Anaerobic Lagoons

Loading rate. Anaerobic lagoons shall be designed to have a minimum treatment volume based on Volatile Solids (VS) loading per unit of volume. The maximum loading rate shall be as indicated in AWMFH Figure 10-22 or according to state regulatory requirements, whichever is more stringent.

Operating levels. The maximum operating level shall be the lagoon level that provides the required volume less the 25-year, 24-hour storm event precipitation on the surface of the lagoon. The maximum drawdown level shall be the lagoon level that provides volume for the required minimum treatment volume plus the volume of accumulated sludge between sludge removal events. Permanent markers shall be installed at these elevations. The proper operating range of the lagoon is above the maximum drawdown level and below the maximum operating level. These markers shall be referenced and described in the O&M plan.

Depth Requirements. The minimum depth at maximum drawdown shall be 6 feet. If subsurface conditions prevent practicable construction to accommodate the minimum depth at maximum drawdown, a lesser depth may be used, if the volume requirements are met.

Additional Criteria for Naturally Aerobic Lagoons

Loading rate. Naturally aerobic lagoons shall be designed to have a minimum treatment surface area as determined on the basis of daily BOD₅ loading per unit of lagoon surface. The required minimum treatment surface area shall be the surface area at maximum drawdown. The maximum loading rate shall be as indicated by AWMFH Figure 10-25 or according to state regulatory requirements, whichever is more stringent.

Operating levels. The maximum operating level shall be the lagoon level that provides the required volume less the 25-year, 24-hour storm event on the lagoon surface. The maximum drawdown level shall be the lagoon level that provides volume for the volume of manure, wastewater, and clean water accumulated during the treatment period plus the volume of accumulated sludge between sludge removal events. Permanent markers shall be installed at these elevations. The proper operating range of the lagoon is above the maximum drawdown level and below the maximum operating level. These markers shall be referenced and described in the O&M plan.

Depth requirements. The minimum depth at maximum drawdown shall be 2 feet. The maximum liquid level shall be 5 feet.

Additional Criteria for Mechanically Aerated Lagoons

Loading rate. Mechanically aerated waste treatment lagoons' treatment function shall be

designed on the basis of daily BOD₅ loading and aeration equipment manufacturer's performance data for oxygen transfer and mixing. Aeration equipment shall provide a minimum of 1 pound of oxygen for each pound of daily BOD₅ loading.

Operating levels. The maximum operating level shall be the lagoon level that provides the required lagoon volume less the 25-year, 24-hour storm event precipitation and shall not exceed the site and aeration equipment limitations. A permanent marker or recorder shall be installed at this elevation. The proper operating range of the lagoon is below this elevation and above the minimum treatment elevation established by the manufacturer of the aeration equipment. This marker shall be referenced and described in the O&M plan.

Table 2- 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

CONSIDERATIONS

General

Lagoons should be located as close to the source of waste as possible.

Solid/liquid separation treatment should be considered between the waste source and the lagoon to reduce loading.

The configuration of the lagoon should be based

on the method of sludge removal and method of sealing.

Due consideration should be given to economics, 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

Features, safeguards, and/or management measures to minimize the risk of embankment 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 2 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 2 may be significantly affected:

- An auxiliary (emergency) spillway
- Additional freeboard
- Storage volume for the wet year rather than normal year precipitation
- Reinforced embankment -- such as, additional top width, flattened and/or armored downstream side slopes
- Secondary containment
- Water 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 2 may be significantly 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 lagoon liner seepage

Consideration should be given to providing an additional measure of safety from lagoon seepage when any of the potential impact categories listed in Table 3 may be affected.

Should any of the potential impact categories listed in Table 3 be affected, consideration should be given to the following:

- 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.
- A flexible membrane liner
- A geosynthetic clay liner (GCL) flexible membrane liner
- A concrete liner designed in accordance with slabs on grade criteria in NRCS Practice Standard 313, Waste Storage Facility, for fabricated structures requiring water tightness.

Considerations for minimizing the impact of odors

For sites located where odors are a concern, the following should be considered:

- Reduce loading rates of anaerobic lagoons to at least one half the values of AWMFH Figure 10-22.
- Covering the lagoon with a suitable cover.
- Using naturally aerated or mechanically aerated lagoons.
- Using composting in conjunction with a solid waste system rather than a liquid or slurry system.
- Using an anaerobic digester and biogas capture system.

RENOVATION OF WASTE TREATMENT LAGOON

Where required minimum storage volume has

been compromised due to a buildup of solids and waste treatment lagoon cannot be maintained and operated in accordance with the operation and maintenance plan. A Renovation Plan shall be developed.

Renovation Plan shall be developed using criteria for Closure of Waste Impoundments, Code 360, Nutrient Management, Code 590, Waste Utilization, Code 633 and Manure Transfer, Code 634. Planner should make sure that the facility has adequate storage and/or treatment volume. Plan should include an emptying component and provisions for periodic removal of solids to preserve storage and treatment capacity. The plan should include an estimated cost for renovation of the waste treatment system.

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.

OPERATION AND MAINTENANCE

An operation and maintenance plan shall be developed that is consistent with the purposes of the practice, its intended life, safety requirements, and the criteria for design. The plan shall contain the operational requirements for drawdown and the role of permanent markers. This shall include the requirement that waste be removed from the lagoon and utilized at locations, times, rates, and volume in accordance with the overall waste management system plan. In addition, the plan shall include a strategy for removal and disposition of waste with least environmental damage during the normal treatment period to the extent necessary to insure the lagoon's safe operation. This strategy shall also include the removal of unusual storm events.

Table 3 - Potential Impact Categories for Liner Seepage

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 carbonate rock (limestone or dolomite)

Development of an emergency action plan should be considered for lagoons 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.

CONSTRUCTION SPECIFICATION WASTE TREATMENT LAGOON

1. Scope

Work shall consist of constructing the waste treatment lagoon including the embankment, inlet pipes, pipe supports, concrete chutes, and needed fence to the lines and grades as shown on the drawings or as staked in the field. The location of the waste treatment lagoon shall be as shown on the furnished drawings or as staked in the field.

2. Site Preparation

All trees, brush, vegetation, and debris to include old fence, stumps, building materials, and barnyard waste products shall be removed from the area to be occupied by the lagoon and embankment. All brush, wastes, and other debris shall be removed from the lagoon area and disposed of by burning, burying, or removal from the area.

3. Earthfill

Earthfill materials shall be obtained from the lagoon bottom or an adjacent or near by borrow area and shall be free from objectionable materials such as brush, roots, rock, or debris that would prevent construction of a relatively

impermeable embankment. Topsoil should be stockpiled and spread over the embankment surface and borrow areas to facilitate revegetation. Any rock, sand, or other permeable material exposed in the excavated lagoon surface shall be undercut by at least 12 inches and backfilled with compacted clay material. Fill shall be placed against slopes no steeper than 2:1 and in lifts no greater than 9 inches thick. 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 one tread track of the equipment or as specified in the construction details. The embankment, borrow areas, and lagoon surface shall be finished to a smoothness so the surface can readily be traveled upon by farm type equipment. One or more of the lagoon corners may be rounded to facilitate lagoon agitation and pumpout equipment. Final construction shall be considered satisfactory when:

- Excavation elevations are within + 0.2 foot of design grade or modified grade,
- Fill elevations are not less than design height plus settlement, and
- Slopes are at design slopes or are flatter than designed. Slopes will be uniform throughout their length (Allowance for anticipated slope settlement may be considered when calculating side slopes for construction check).

Select backfill material shall be placed around the pipe and concrete chute structure.

Preparation of a shaped bed with one-inch of moist, loose soil supporting about one-third of pipe circumference will help insure the pipe to soil contact. Minimum cover over the pipe shall be 1 foot.

4. Construction Materials

Pipe conduit shall be PVC material meeting the appropriate ASTM specifications. It shall be free of defects and shall be assembled with watertight connections and be placed on a continuous positive grade. Concrete used in

construction of chutes, curbs, or gutters shall have a minimum of 5 bags of cement per cubic yard and a maximum of 6 gallons of water per bag of cement. Concrete shall be evenly distributed in the forms and spaded or mechanically vibrated to assure consolidation. Concrete shall be finished smooth for delivery of wastes to the lagoon.

CLOSURE PLAN

All new applications for a liquid animal waste disposal permit shall include a closure plan. The plan shall be developed in accordance with Closure of Waste Impoundments Conservation Practice Standard, Code 360.