

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 township and 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 and/or damage from a 25-year flood event, or larger if required by laws, rules, and regulations. Top of dam shall be above 100-year flood event. Lagoons 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.

The lagoon shall be at least 100 feet from any source of potable water supply and preferably downhill from it.

Lagoons shall 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 the 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, evaluated using Agricultural Waste Management Field Handbook (AWMFH), Appendix 10D, or the lagoon shall be lined according to Appendix 10D or sealed according to Standard PA521, Pond Sealing or Lining.

The investigation and treatment of soils and foundations for lagoons shall meet all the criteria for soils and foundations in Standard PA313, Waste Storage Facility.

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.

Subsurface drainage systems that serve to intercept ground water and/or relieve hydrostatic pressure and/or lower ground water around or under lagoons shall meet all the criteria for subsurface drainage in Standard PA313, Waste Storage Facility.

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 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 on the surface area (at the required volume level) of the lagoon.
- Volume of runoff from net precipitation and the 25-year, 24-hour storm from any contributing drainage area that cannot be excluded from the lagoon.
- One foot of freeboard.

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 upon 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.

The lagoon treatment design shall follow the procedures in Chapter 10 of the AWMFH.

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 or provisions made to provide stability; excavated side slopes shall be no steeper than 2 horizontal to 1 vertical. The bottom of aerobic lagoons shall be approximately level.

Structures. Structures shall meet the requirements of CP313P Construction Specification.

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. Inlet components shall meet the requirements of Standard PA634, Manure Transfer.

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.

The inlet pipe shall terminate a sufficient distance from the lagoon side slopes to ensure good distribution.

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.

Where agitators or any other equipment are used in lagoons with liners, the tip of the propeller or equipment shall be a minimum of 3 feet from a geosynthetic liner surface or the liner shall be protected by a concrete pad. A clay liner shall be protected by a concrete pad.

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. Embankments and disturbed areas surrounding the lagoon shall be vegetated according to Standard PA342, Critical Area Planting.

Safety. Design shall include appropriate safety features to minimize the hazards of the lagoon. 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. Fencing shall meet the requirements of Standard PA382, Fence, and have a minimum height of 4 feet. Access points shall be gated and locked. Provide safety device when persons are within perimeter of fence such as rope, floatation device, or equal.

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.

If a high degree of odor control is necessary, loading rates shall be decreased.

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 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. The site and the equipment dictate the maximum depth for an anaerobic lagoon, but it shall not exceed 15 feet without a DEP permit.

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 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 depth at maximum operating level shall be no more than 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.

CONSIDERATIONS

General

Lagoons should be located as close to the source of waste and polluted runoff 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.

Vegetative screens or other methods should be used to shield the lagoon from public view and to improve visual conditions. No plantings shall be allowed on embankment or within 25' of top of inside slope.

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:

- 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 are required 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

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 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.

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)

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 over a clay liner
- A geosynthetic clay liner (GCL) flexible membrane liner
- A concrete liner designed in accordance with slabs on grade criteria in Standard PA313, 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.
- Use additional practices such as Anaerobic Digester (365 or 366), Waste Facility Cover (367), Composting Facilities (317), Waste Utilization (633), and Solid/Liquid Waste Separation Facility (632).
- Using naturally aerated or mechanically aerated lagoons.

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

A site specific operation and maintenance (O&M) plan shall be developed for and reviewed with the landowner as part of the design. The O&M plan shall be 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 Nutrient Management (PA590) plan and/or Waste Utilization (PA633) 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.

An emergency action plan is a required component of the O&M plan for all lagoons. The plan shall include site specific provisions for emergency actions that will minimize impacts on health, safety, and the environment.

The emergency action plan shall be available at the facility at all times. It shall include the phone number(s) for immediately notifying the Department of Environmental Protection of any spill, overtopping, leak or other discharge that would endanger downstream water users or would otherwise result in pollution or create a danger of pollution or would damage downstream property.

In the event the Landowner or Operator has the lagoon emptied by a custom applicator, it is the Landowner or Operator's responsibility to review the emergency action plan with the applicator prior to unloading of the lagoon.

When perimeter drains, foundation drains, and leak detection systems outlet closer than 50 feet to a water body, the operation and maintenance plan shall include the requirement for monthly inspection of the outlet. In the event of a suspected problem, the landowner shall take the following actions.

- Intercept the outlet with a sump and pump the water to a location where it cannot adversely effect the quality of the water body and,
- Take immediate action to draw down the level in the lagoon until the leak stops, and contact the designer for inspection.

The O & M Plan shall contain the following:

1. Pre-charge with a volume of water equal to one-half of the treatment volume before wastes are introduced.
2. Highly visible markers shall be installed to mark the maximum and minimum operating levels. Pumping shall be done as necessary to maintain the liquid level between these two markers.
3. Recommendations for inspection and maintenance of embankment, liners and other components.

4. Recommendations for inspection and maintenance of vegetation.
5. Information on sampling and testing of effluent.
6. After 5 years the waste treatment lagoon shall be checked for sludge accumulation annually. If sludge has encroached into the treatment volume, the sludge will be removed and applied at agronomic rates based on analysis of the sludge.
7. Others, as appropriate.

REFERENCES

Agricultural Waste Management Field Handbook
Chapter 4
Chapter 10 and Appendix 10D
Chapter 11
Conservation Practice Standards
Critical Area Planting, PA342
Fence, PA382
Nutrient Management, PA590
Pond Sealing and Lining, PA521
Waste Storage Facility, PA313
Waste Utilization, PA633