DWR-NPDES-SOP-14- WW Design Criteria Chapter 9-06012025
Design Criteria for Review of Sewage Works Construction Plans and Documents
Chapter 9

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Revision History Table

Revision	Date	Brief Summary of Change
0	07/28/2014	Initial issue
1	06/01/2025	Overall update to Chapter 9

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9.1 General

The criteria contained in this chapter are applicable to all new, expanded, and/or modified ponds, impoundments, and lagoons that contain wastes or wastewater associated with activities under operational permits issued by the Division of Water Resources. These wastes and wastewaters include, but are not necessarily limited to:

- Municipal Sewage
- Industrial wastewater and Non-hazardous Industrial sludge
- Food Processing wastewater and solids
- Concentrated Animal Feeding Operation (CAFO) wastewater and solids
- Stormwater
- Municipal waste activated sludge (WAS), water treatment plant sludge, wastewater treatment plant sludge, and biosolids

These criteria apply to units independent of whether the unit is part of the treatment process (includes equalization) or is used for storage.

This chapter describes the requirements for impoundments, including the following biological treatment processes:

a. Stabilization ponds

b. Aerated lagoons

Additionally, this chapter describes the requirements for use of hydraulic control release lagoons for effluent disposal.

In the case of impoundments/ponds related to coal combustion residuals (CCRs), the applicable federal requirements will not be or are not superseded by these guidelines.

9.1.1 Applicability

In general, impoundments, ponds, and aerated lagoons are most applicable to small and/or rural communities where land is available at a low cost and minimum secondary treatment requirements are acceptable. Additionally, these units are being used in decentralized wastewater treatment systems, such as surface spray irrigation and subsurface drip dispersal. Advantages include potentially lower capital costs, simple operation, and low Operation and Maintenance (O&M) costs.

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9.1.2 Definitions

"**Aerated Lagoon**" means a wastewater treatment system where a pond is artificially aerated to promote biological oxidation of wastewater.

"**Director**" means the Director of the Division of Water Resources, Tennessee Department of Environment and Conservation.

"**Division**" means the Division of Water Resources, Tennessee Department of Environment and Conservation.

"**Fault**" means a fracture or a zone of fractures in any material along which strata on one side have been displaced with respect to that on the other side.

"**Floodplain**" means the lowlands and relatively flat areas adjoining inland waters, including flood-prone areas, which are inundated by a flood. The "100-year floodplain" refers to a floodplain that is subject to a one percent or greater chance of flooding in any given year from any source.

"**Impoundment**" means a structure, often a pond or basin, designed to store or treat wastewater.

"**Karst**" means a specific type of topography that is formed by dissolving or solution of carbonate formations, such as limestone or dolomite; it is characterized by closed contour depressions or sinkholes, caves, sinking and reappearing streams, and/or underground conduit drainage flow.

"**Seismic impact zone**" means an area with a ten percent or greater probability that the maximum horizontal acceleration in lithified earth materials, expressed as a fraction of the earth's gravitational pull will exceed 0.10g in 250 years.

"**Stabilization Pond**" also known as an oxidation pond or lagoon, is a large, shallow basin used for biological wastewater treatment. These ponds utilize physical and biological processes, including the interaction of sunlight, algae, and bacteria, to remove pollutants, organic matter, and pathogens from wastewater.

"**Surface impoundment**" means a facility or part of a facility which is a natural topographic depression, man-made excavation, or diked area formed primarily of earthen materials (although it may be lined with man-made materials), which is designed to hold an accumulation of liquid wastes, or wastes containing free liquids, and which is not an

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injection well. Examples of surface impoundments are holding, storage, settling and aeration pits, ponds, and lagoons. Surface impoundments will be referred to as "impoundments" in this chapter.

"**Unstable area**" means a location that is susceptible to natural or human-induced events or forces capable of impairing the integrity of some or all of the impoundment's structural components responsible for preventing releases from the impoundment. Unstable areas can include poor foundation conditions, areas susceptible to mass movements, and Karst terrains.

Engineering Report

In addition to the requirements in Chapter 1, the engineering report (ER) should include an assessment of the hydrogeological and geotechnical characteristics of the site that meets the requirements of these design criteria. The ER should include geotechnical analyses for the dikes and impoundment, including slope stability, seepage, and settlement analyses. These should be performed by a qualified licensed engineer. The ER should be submitted prior to submission of the final construction plans and specifications. The hydrogeological portion of the engineering report should:

1. Be prepared, sealed, signed, and dated by a qualified geologist or a qualified engineer who is licensed or professionally registered with the State of Tennessee as required for such persons at Tennessee Code Annotated section 62-36-102.
2. Be based on an analysis of existing data (e.g., well drillers' logs) and site-specific soil borings and drillers' logs or other subsurface investigations. The soil borings performed should be of such number, locations, and depths to sufficiently provide a complete and accurate description of relevant subsurface conditions.
3. Include a subsurface investigation using generally accepted geophysical methods to investigate potential karst conditions, such as Electrical Resistivity Tomography, Frequency-Domain Electromagnetic, and Seismic Refraction Method (in accordance with American Society of Testing Material (ASTM) D-5777-00). Multiple methods are available and used depending on the site conditions and the purpose of the investigation.
4. Include the following information:

    (i) A description of the soil sampling and analytical procedures used, including a characterization of the soils underlying the site, providing, at a minimum:

(a) Unified soil classifications;

(b) The saturated hydraulic conductivities of undisturbed samples of soils underlying the site that is to be used in meeting soil buffer requirements;

(c) The saturated hydraulic conductivity of remolded samples of soils taken from the site which are to be used in meeting liner and cover requirements; and a description of the soil sampling and analytical procedures used;

(ii) A tabulation of water table elevations (if encountered within the limits of drillings) measured at the time borings were performed. Groundwater observation wells or piezometers should be installed for monitoring groundwater levels. If an estimation of the seasonal high-water table cannot be made utilizing these data and other existing information, then the Division may require water table elevations to be measured over a period of up to one year.

(iii) A boundary plat locating soil borings with accurate horizontal and vertical controls which are tied to a permanent on-site bench-mark (reference elevation may be site-specific). The plat should include the boundary of the proposed fill areas;

(iv) A potentiometric map of the uppermost aquifer (if such can be determined by information obtained within the limits of drilling) based on stabilized water elevations;

(v) A description of local groundwater recharge and discharge features in the vicinity of the proposed impoundment and, if the Division deems appropriate, a description of the regional groundwater regime;

(vi) The locations of any springs and existing and abandoned wells within a one-mile radius;

(vii) The locations of public water supply system intakes and wells within a two-mile radius; and

(viii) A narrative summary and analysis of geological and hydrological evaluations performed as they relate to the suitability of the site for an impoundment.

(ix) The location of the 100-year floodplain near the site.

5. Undisturbed soil samples for hydraulic conductivity should be collected in thin-

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walled Shelby tubes per ASTM D-1587. The hydraulic conductivity should be determined in accordance with ASTM D-5084.

6. Remolded soil samples for hydraulic conductivity should be re-compacted in accordance with ASTM D-698 [Note: ASTM D-698 (Standard Proctor) is typically used for dikes, dams, and soil liners as opposed to ASTM D-1557 (Modified Proctor)]. The hydraulic conductivity should be determined in accordance with ASTM D-5084.

7. The report should include a comprehensive environmental site assessment that includes an evaluation of the quality of groundwater beneath the proposed impoundment.

9.2 Stabilization Ponds

Stabilization ponds are facultative and are not artificially mixed or aerated. Mixing and aeration are provided by natural processes. Oxygen is supplied mainly by wind and algae.

9.2.1 Depth

The primary (first in a series) pond depth should not exceed six feet. Greater depths will be considered for polishing ponds and the last ponds in a series of four or more.

9.2.2 Influent Structures and Pipelines

a. Manholes
A manhole should be installed at the terminus of the influent interceptor line or force main and should be located as close to the dike as topography permits; its invert should be at least six inches above the maximum operating level of the pond to provide sufficient hydraulic head without surcharging the manhole.

b. Influent Pipelines

A minimum self-cleaning velocity of two feet per second under normal flow conditions will permit self-cleaning of the pipeline in most circumstances. The influent pipeline can be placed at zero grade if provisions to clean or flush are included.

c. Inlets and Outlets

Influent and effluent piping should be located to minimize short-circuiting and stagnation within the pond and maximize the use of the entire pond area. There should be a concrete pad for submerged inlets to prevent erosion. The pad should be square with sides equal to three times the pipe diameter.

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d. Discharge Apron

Provisions should be made to prevent erosion at the point of discharge to the pond.

9.2.3 Interconnecting Piping and Outlet Structures

Interconnecting piping for pond installations should be valved or provided with other arrangements to regulate flow between structures and permit variable depth control. Anti-seep collars should be considered.

The outlet structure can be placed on the horizontal pond floor adjacent to the inner toe of the dike embankment. A permanent walkway from the top of the dike to the top of the outlet structure should be provided for access.

The outlet structure should consist of a well or box equipped with multiple-valved pond draw off lines. An adjustable draw off device is also acceptable. The outlet structure should be designed so that the liquid level of the pond can be varied from a three to five-foot depth in increments of 0.5 feet or less.

The lowest draw off lines should be 12 inches above the bottom of the lagoon to control eroding velocities and avoid pickup of bottom deposits. The structure should also have provisions for draining the pond. A locking device should be provided to prevent unauthorized access to level control facilities. An unvalved overflow placed six inches above the maximum water level should be provided.

The pond overflow pipes should be sized for the peak design flow to prevent overtopping of the dikes. Other emergency overflow designs may also be acceptable such as an emergency overflow spillway.

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9.2.4 Number of Ponds

Three ponds in series should be designed (or baffling provided for a single cell lagoon design configuration) to provide good hydraulic and kinetic design. The objective of the design is to eliminate short-circuiting and provide full treatment.

9.2.5 Parallel/Series Operation

The hydraulic design should allow for equal distribution of flows to all ponds in either parallel or series mode of operation.

9.2.6 Design Loading

Design loading should not exceed 30 pounds biochemical oxygen demand (BOD) per acre per day on a total pond area basis and 50 pounds BOD per acre per day to any single pond.

9.3 <u>Aerated Lagoons</u>

9.3.1 Depth

Depths can range from 6 to 20 feet. However, the optimal depth can vary depending on the type of aeration system used and the specific treatment goals. In choosing a depth, aerator erosion protection and allowances for ice cover and solids accumulation should be considered.

The minimum operating depth should be sufficient to prevent the growth of aquatic plants and damage to the dikes, bottom, control structures, aeration equipment, and other appurtenances.

Detention times in the settling basin or portion of a basin used for settling of solids should be limited to two days to limit algae growth. The design of inlet and outlet structures should receive careful attention.

9.3.2 Influent Structures and Pipelines

The same requirements apply as described for facultative systems, except that the discharge locations should be coordinated with the aeration equipment design.

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9.3.3 Interconnecting Piping and Outlet Structures

a. Interconnecting Piping

The same requirements apply as described for facultative systems.

b. Outlet Structure

The same requirements apply as described for facultative systems, except for variable depth requirements and arrangement of the outlet to withdraw effluent from a point at or near the surface. The outlet should be preceded by an underflow baffle.

9.3.4 Number of Lagoons

No fewer than three basins should be used and be arranged for both parallel and series operation. A settling pond should follow the aerated cells, or an equivalent of the final aerated cell and should be free of turbulence to allow the settling of suspended solids.

Alternative designs may be submitted to the Division for consideration.

9.3.5 Aeration Equipment

The purpose of wastewater aeration is twofold: to supply the required oxygen to the metabolizing microorganisms; and to provide mixing so that the microorganisms come into contact with the dissolved and suspended organic matter.

A minimum of two mechanical aerators or blowers should be used to provide the horsepower required. At least three anchor points should be provided for each aerator. Access to aerators should be provided for routine maintenance which does not affect mixing in the lagoon. Timers will be required.

The design of aerated lagoons for BOD removal is based on first-order kinetics and the complete mix hydraulics model. Minimum aeration requirements to satisfy oxygen needs, assuming that nitrification is not required, can be determined as follows:

$$Ce = Co / [1 + (KT)(t)/n]^n$$

where: Ce = effluent BOD

Co = influent BOD

K_T = temperature dependent rate constant

K_{20} = rate constant at 20 C

K_{20} = 0.276 d^{-1} at 20 C

= temperature coefficient (1.036)

$K_T = K_{20}\ ^{(T-20)}$

T = temperature of water

t = total detention time in system

n = number of equal sized cells in system

(Reference: EPA Fact Sheet, September 2002)

If a lagoon basin treating a domestic wastewater is fitted with mechanical surface aerators that provide a power intensity of at least 30 horsepower (HP) per million gallons. A minimum of 1 HP per million gallons is needed for algae control; however, a mixing level equivalent to 5 HP per million gallons is generally recommended for all lagoon basins, including those used for sedimentation

The horsepower requirements for mixing and oxygen should be compared, and the greater value should be used for the design of the given lagoon. In most cases, mixing requirements will control the aerator design in lagoons. However, in the first aerated lagoon, oxygen requirements may control the aerator design, depending on raw wastewater organic strength.

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9.4 Pond Features

9.4.1 Pond Shape

The shapes of all cells should be such that there are no narrow, L-Shaped, or elongated portions. Round or rectangular ponds are most desirable. Square or round ponds are considered most desirable for complete mix aerated lagoons. However, stabilization ponds should be rectangular with a length not exceeding three times the width or be baffled to ensure full utilization of the basin. Islands, peninsulas, or coves are to be avoided. Dikes should be rounded at corners to minimize accumulations of floating materials.

9.4.2 Flow Measurement

When required by the permit conditions, the design should include provisions to measure, total, and record the wastewater flows to meet permit requirements. Flow measurement is desirable for all facilities.

9.4.3 Level Gauges

Pond level gauges should be located on outfall structures or be attached to a stationary structure for each pond.

Some impoundments may need to have remote water level monitoring capable of providing a continuous, year-round record of impoundment levels accurate to within 0.125 inches. [Depends on the purpose, design, and permitting requirements].

9.4.4 Pond Dewatering

Sufficient pumps and appurtenances should be available to facilitate the draining of individual ponds in cases where multiple pond systems are constructed at the same elevation or for use if recirculation is desired.

9.4.5 Control Building

A control building for laboratory and maintenance equipment should be provided.

9.4.6 General Site Requirements

The pond area should be enclosed with an adequate fence to keep out livestock, wildlife, discourage trespassing, and be located so that travel along the top of the dike by maintenance vehicles is not obstructed. A vehicle access gate of a width sufficient to accommodate mowing equipment and maintenance vehicles should be provided. All-access gates should be provided with locks and appropriate warning signs are desirable.

9.4.7 Provision for Sludge Accumulation

Influent solids, bacteria, and algae that settle out in the lagoons will not completely decompose and a sludge-blanket will form. The design should include provisions for the removal and disposal of accumulated sludge, particularly in the cases of anaerobic stabilization ponds and aerated lagoons. The design should include an estimate of the rate of sludge accumulation, frequency, or sludge removal, methods of sludge removal, and ultimate sludge handling and disposal.

9.4.8 Risk Assessment

Ponds and lagoons should be assessed with respect to the degree of risk relative to hazards that may be posed in the event of accidental or catastrophic release. [Note: a **hazard** is something that can cause harm, e.g., electricity, chemicals, noise, etc. A **risk** is the chance, high **or** low, that any **hazard** will actually cause somebody harm]. These criteria focus on the operability and maintainability of a functioning system and are not geared or focused on preventing structural failures—that is the fiduciary responsibility of the design engineer.

9.5 Pond Construction

9.5.1 Pond Seal

Ponds should be sealed such that seepage loss through the seal is as low as practicably possible. To achieve an adequate seal in a pond/lagoon system using soil, native clay, bentonite-amended soil, geosynthetic clay liners, and geomembranes may be considered, provided the permeability, durability, and integrity of the proposed material can be

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satisfactorily demonstrated for all anticipated conditions. Results of a testing program that substantiates the adequacy of the proposed seal should be incorporated into and/or accompany the engineering report. Standard ASTM International procedures should be used for all tests. Methods or procedures not covered by ASTM should be approved in advance by the Division. The permeability or hydraulic conductivity (*k*) in centimeters per second specified for the seal should not exceed the value derived from the following expression:

$$\boldsymbol{k} = \mathbf{FL}$$

Where,

L = seal/liner thickness (cm), and

F = constant 2.6 x 10^{-9} sec^{-1}

(Reference: WEF-MOP-8)

For water balance calculations, note that permeability and seepage rates per unit area differ and that Darcy's seepage rate is not *k*, but it is a function of *k*. To calculate the seepage rate use Darcy's Law as follows:

$$\mathbf{Q} = \frac{\boldsymbol{k}\mathbf{A}\boldsymbol{h}}{\mathbf{L}}$$

Where,

k = permeability, cm/sec;

L = seal/liner thickness (cm);

Q = flow through the liner, cm^3/sec;

A = liner area, cm^2; and

h = hydraulic head over the liner, cm.

The design of the liner either clay, clay + geotechnical liner, or geotechnical liners should take into account the depth of water and the local conditions and provide a specification for the liner material and its placement and QC requirements.

[See Appendices 9-B and 9-C for hydraulic values and conversion factors]

9.5.2 Pond Erosion Control

To prevent erosion and desiccation of clay or bentonite liners, the interior slopes of the lagoon should have soil cover and riprap. Recommended minimums are 1.6 feet above and below the lagoon water level or twice the impinging wave height calculated for twice the maximum wind velocity anticipated. With surface aerators, consideration should be given to protect the basin directly below the aerators from the vortex or other scouring action. Concrete pads, anti-erosion plates on the aerator, or six inches of crushed rock provides

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adequate protection. Essentially, the walls should be protected from erosion; the bottom should be protected from damaging scour from inflow, outflow and/or a mechanical mixing or aeration or both. Additional recommendations of the geotechnical engineer should be the followed.

Emergency overflows with flow measurement and disinfection for overflows should be provided.

9.5.3 Pond Embankment

Embankment tops should be a minimum width of eight feet permit access of maintenance vehicles. The embankment's outer slopes should be no steeper than 3:1 to allow grass growth and tractor mowing.

9.5.4 Pond Inspections

Structural inspections by a registered geotechnical engineer should be conducted every five years at a minimum to ensure integrity, or more frequently if seepage, erosion, or cracks on the berm surface appear. Action should be taken in accordance with the recommendations made by the geotechnical engineer in the structural integrity evaluation. Sampling wells should be sampled, and water depths recorded as part of this integrity evaluation.

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APPENDIX 9-A

BIBLIOGRAPHY – CHAPTER 9

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8. Middlebrooks, E.J., et al. *Wastewater Stabilization Lagoon Design, Performance and Upgrading*, (McMillan Publishing Co., New York, NY) 1982.
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APPENDIX 9-B

Comparison of 10 States Standards and WEF MOP-8

FROM 10 STATES STANDARDS:

To achieve an adequate seal in a pond/lagoon system using soil, native clay, bentonite-amended soil, or other seal materials, the permeability or hydraulic conductivity (k) in centimeters per second specified for the seal should not exceed the value derived from the following expression:

$\boldsymbol{k}$ **= FL**

Where, $\boldsymbol{k}$ = hydraulic conductivity

L = seal/liner thickness (cm), and

F = constant 2.6×10^{-9} sec^{-1}

Therefore, at L = 30.48 cm (1 foot):

$k = 2.6 \times 10^{-9}\ sec^{-1} \times 30.48$ cm

$k = 79.25 \times 10^{-9}$ cm/sec

FROM WEF MOP-8:

Uses basically the same expression as 10 States Standard, except for F

$\boldsymbol{k}$ **= FL**

Where,

L = seal/liner thickness (cm), and

F = constant 3.0×10^{-9} sec^{-1}

Therefore, for L = 30.48 cm

$\boldsymbol{k} = 3 \times 10^{-9}\ sec^{-1} \times 30.48$ cm

$\boldsymbol{k} = 91.44 \times 10^{-9}$ cm/sec

For water balance calculations, note that permeability and seepage rates per unit area differ and that Darcy's seepage rate is not k, but it is a function of k. To calculate the seepage rate, use Darcy's Law as follows:

$$\mathbf{Q} = \frac{\boldsymbol{k}\mathbf{A}\boldsymbol{h}}{\mathbf{L}}$$

Where,

$\boldsymbol{k}$ **=** permeability, cm/sec;

L = seal/liner thickness (cm);

Q = flow through the liner, cm/sec;

A = liner area, cm^2 and

$\boldsymbol{h}$ = hydraulic head over the line, cm.

FROM WEF MOP-8:

$$\mathbf{Q} = \frac{\boldsymbol{k}\mathbf{A}\boldsymbol{h}}{\mathbf{L}}$$

For ***h*** = 6 feet:

$$Q = \frac{(79.25 \times 10^{-9}\ \text{cm/sec})(43{,}560\ \text{ft}^2/\text{ac})(6\ \text{ft})(7.48\ \text{gal/ft}^3)(1{,}440\ \text{min/day})(60\ \text{sec/min})}{1\ \text{ft}\ (30.48\ \text{cm/ft})}$$

Q = 439.18 GPD/acre (using F = 2.6 x 10^{-9} sec^{-1} per 10 States Standards)

If F = 3.0 x 10^{-9} sec^{-1}, per MOP-8, then:

Q = 507 GPD/acre

[Note: 10 States Standards says that Q should be less than 500 GPD/acre]

Seepage Rate =
(507 gal/ac-day)(ft^3/7.48 gal)(acre/43,560 ft^2)(12 in/ft)(2.54 cm/in)(day/1,440 min)(min/60 sec)

= 5.5 x 10^{-7} cm/sec

@439.18 GPD/acre, Seepage Rate = 4.8 x 10^{-7} cm/sec

APPENDIX 9-C

Hydraulic Values and Conversion Factors

0.2 gallons per day per square foot (GPD/SF) = 2.25 inches per week (in/wk)

0.18 GPD/SF = 2.00 inches/week

0.13 GPD/SF = 1.5 inches/week

0.11 GPD/SF = 1.25 inches/week

0.10 GPD/SF = 1.12 inches/week

Moderately Slowly Permeable = 0.2 – 0.6 inch/hour x 10% = 3.4 – 10.1 inches/week = 0.3 – 0.9 GPD/SF

Slowly Permeable = 0.06 – 0.2 inch/hour x 10% = 1.0 – 3.4 inch/week = 0.1 – 3.4 GPD/SF

0.25 GPD/SF = 2.81 inches/week = 0.4 inch/day = 10,840 GPD/ac

1.0 inch/week = 0.089 GPD/SF = 3,880 GPD/ac

500 GPD/ac = 0.128 inches/week

0.1 GPD/SF = 4.7 x 10^{-6} cm/sec

0.25 inch/day = 6,788 GPD/ac

The 10 States Standards (2014) maximum allowable seepage rate for liners is 0.0015 feet per day or 500 gallons per acre per day.

The following soil types, based upon the Unified Soil Classification System groups, have published (4) seepage rates greater than 0.0015 feet/day.

- CL (low to medium plasticity clays)
- GC (clayey gravels and poorly graded gravel-sand-clay mixtures)
- GM (silty gravel and poorly graded gravel/sand-silt mixtures)
- GP (poorly graded gravels and sandy gravel mixtures with little or no fines)
- GW (well-graded gravels and gravel-sand mixtures)
- ML (inorganic silts - very fine sands, silty, or clayey fine sands)
- SC (clayey sands, sand clay mixtures)
- SM (silty sand, sand silt mixtures)
- SP (poorly graded sands and gravelly sands with little or no fines)
- SW (well-graded sands and gravelly sands with little or no fines)

Therefore, these soils by themselves are often unacceptable without a synthetic liner or other construction modifications to reduce seepage. However, CH (high plasticity clays) with a listed seepage rate of 0.0003 feet per day would be acceptable.

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APPENDIX 9-D-1

ENGINEERING REPORT
IMPOUNDMENTS, PONDS, AND AERATED LAGOONS
REVIEW GUIDANCE – CHECKLIST

WPN: ________________ PROJECT:______________________________

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Acceptable	Item Number	DESCRIPTION	COMMENTS
	1	Geotechnical analyses for the dikes and impoundment, including slope stability, seepage, and settlement analyses	
	2	Provide a description of the soil sampling and analytical procedures used	
☐	**3**	Provide the locations of any springs and existing and abandoned wells within a one-mile radius.	
	4	Provide the locations of public water supply system intakes and wells within a two-mile radius	
	6	Show the location of the 100-year floodplain near the site	

APPENDIX 9-D-2

FINAL DESIGN SUBMISSION
FOR
IMPOUNDMENTS, PONDS, AND AERATED LAGOONS
REVIEW GUIDANCE – CHECKLIST

WPN: _________________ PROJECT:________________________________

Acceptable	Item Number	DESCRIPTION	COMMENTS
☐	**1**	Submittal form is accurate	
☐	**2**	Cover letter and/or plan signed by utility representative and/or letter provided by the utility stating they approve the design and will own, operate, and maintain the improvements.	
☐	**3**	Fees received for the correct amount	
☐	**4**	All plan sheets sealed by a professional engineer licensed in TN, signed by owner; legible when printed on an 11 x 17 sheet	
☐	**5**	Calculations including all information required by Section 9.2 sealed by a professional engineer licensed in TN	
☐	**6**	Other utilities shown on plan and profile sheets	
	7	A minimum of two mechanical aerators or blowers should be used to provide the horsepower required. At least three anchor points should be provided for each aerator	
	8	Minimum width of embankment tops is eight feet	

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