Table 1. Regional, State, and National Pond Liner Design Requirements

Central Valley Water Board	**Pond Liner Design Requirements**
Waste Discharge Requirements General Order No. ____	**Tier 1 or Tier 2 option:** Tier 1: A pond designed to consist of a double liner constructed with 60-mil high density polyethylene or material of equivalent durability with a leachate collection and removal system (constructed in accordance with Section 20340 of Title 27) between the two liners will be acceptable without a demonstration that the pond design is protective of groundwater quality. Tier 2: A pond designed in accordance with California Natural Resource Conservation Service (NRCS) Conservation Practice Standard 313 or equivalent and which the Discharger can demonstrate through submittal of technical reports that the alternative design is protective of groundwater quality as required in General Specification B. 8 of the General Order.
Central Valley Counties	**Pond Liner Design Requirements**
Kings County	The specific discharge (seepage rate) of process water through the soils lining the bottom and sides of the manure separation pits and lagoons shall not be greater than 1×10^{-6} centimeters per second (cm/sec).
Merced County	Liner shall be designed and constructed with a seepage rate of 1×10^{-6} cm/sec or less (with no credit for manure sealing) and a minimum thickness of one foot.
Solano County	Large dairies (700 or more mature dairy cows): Liner placed atop bedrock or foundation materials comprised of (from bottom to top): (1) Two feet of compacted clay with permeability less than or equal to 1×10^{-7} cm/sec, (2) 60 mil high-density polyethylene geomembrane with a permeability less than or equal to 1×10^{-13} cm/sec, (3) Geomembrane filter fabric, and (4) 24-inch thick soil operations layer. Medium sized dairies (200 to 699 mature dairy cows): Liner of compacted clay that is a minimum of one foot thick, with maximum permeability of 1×10^{-6} cm/sec. Small dairies (14 to 199 mature dairy cows): No pond liner requirements.

Table 1. Regional, State, and National Pond Liner Design Requirements

Top 10 Milk Producing States (in order of highest to lowest milk production)	Pond Liner Design Requirements
California	Title 27 of the California Code of Regulations: 10% clay and no greater than 10% gravel.
Wisconsin	Wisconsin Natural Resources Conservation Service (NRCS) Practice Standard 313: In-place soils (more than 50 percent fines and three feet thick), clay (maximum permeability of 1×10^{-7} cm/sec), geomembrane (60 mil high density polyethylene or 60 mil linear low density polyethylene), geosynthetic clay liner, or concrete .
New York	No pond liner design requirements.
Pennsylvania	Pennsylvania NRCS Conservation Practice Standard 313: In place soils with acceptable permeability (see Appendix 10D below) or lined (soil liner with maximum seepage rate of 1×10^{-5} cm/sec, flexible membrane, bentonite, soil dispersant, or concrete)
Minnesota	Any material that meets maximum seepage rate of 500 gallons per acre per day (5.0×10^{-7} cm/sec).
Idaho	NRCS Agricultural Waste Management Field Handbook Appendix 10D (see below).
New Mexico	Case-by-case but compacted clay or synthetic is standard, maximum permeability of 1×10^{-7} cm/sec
Michigan	Michigan NRCS Conservation Practice Standard 313: In soils with acceptable permeability (per Appendix 10D (see below) or lined (with one foot compacted earth with maximum seepage rate of 1×10^{-5} cm/sec and a minimum one foot compacted operations layer, flexible membrane, bentonite, or concrete).
Washington	Washington NRCS Conservation Practice Standard 313: Maximum soil permeability of 1×10^{-6} cm/sec or a compacted clay liner, amended soil or synthetic liner required meeting requirements of NRCS Conservation Practice Standards 521A through 521D.
Texas	When no site specific assessment completed, one and a half foot of compacted clay with maximum permeability of 1×10^{-7} cm/sec. Otherwise, "designed and constructed in accordance with technical standards of NRCS, ASAE, ASCE, or ASTM that are in effect at time of construction."

Table 1. Regional, State, and National Pond Liner Design Requirements

Natural Resources Conservation Service (NRCS)	**Pond Liner Design Requirements**
NRCS Agricultural Waste Management Field Handbook Appendix 10D – Geotechnical, Design, and Construction Guidelines	In-place soils at least two feet thick and maximum permeability of 1×10^{-6} cm/sec. Consider liner if: aquifer is unconfined and shallow and/or aquifer is a vital water supply; site underlain by less than two feet soil over bedrock, coarse-grained soils with less than 20 percent low plasticity fines, or soils with flocculated clays or highly plastic clays with blocky structure. Acceptable liners: Compacted clay liner (allowable seepage rate of 1×10^{-6} cm/sec if manure sealing cannot be credited or 1×10^{-5} cm/sec if manure sealing can be credited, minimum thickness of one foot), concrete, geomembranes, or geosynthetic clay liners.
California NRCS Conservation Practice Standard 313	Target maximum seepage rate of 1×10^{-6} cm/sec for all vulnerability/risk categories, except that: (1) Synthetic liner required when aquifer vulnerability and risk are high (i.e., groundwater is within five to 20 feet of the pond bottom or coarse soils are present and the pond is within 600 feet from a domestic supply well), or (2) Other storage alternatives required when the aquifer vulnerability and risk are very high (i.e., groundwater is within five feet of the pond bottom or the pond is less than 600 feet from an improperly abandoned well and the pond is less than 1,500 feet from a public supply well or less than 100 feet from a domestic supply well).