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SUBJECT: Alternative Designs for Liners and Caps Incorporating Geosynthetic Clay Liners (GCLs) at Residual Solid Waste Landfills (RSW LFs)

GUIDANCE #: 0537

REFERENCE:

Municipal Solid Waste	Industrial Solid Waste	Residual Solid Waste
N/A	N/A	OAC 3745-30-07(C)

CROSS REFERENCES: #0141 - Considerations for the Use of Geosynthetic Clay Liners (GCLs) for Liner and Cap Systems Barrier Layer, dated August 19, 1994.

DATE: February 12, 1996

TOTAL # OF PAGES: 4

I. PURPOSE

The use of GCLs in the design of liner and cap systems in RSW LFs requires Ohio EPA approval as an alterative design. The purpose of this guidance document is to extend the standards for GCL use that are now incorporated into the rules for both municipal (OAC 3745-27) and industrial landfills (OAC 3745-29) to RSW LFs.

II. APPLICABILITY

This guidance applies to owners and operators of RSW LFs for their design of liners and cap system barrier layers.

III. BACKGROUND

The use of GCLs in the design of liner and cap systems is allowed in both the municipal and industrial solid waste rules. For RSW Lfs, the use of GCLs will still require Ohio EPA approval as an alternative design. As a starting point, the current design alternatives in the municipal and industrial rules would be acceptable for RSW LF applications. This document will provide guidance in applying these alternatives to the different liner and final cap requirements for the different classes of RSW Lfs. More general information on use of GCLs can be found in the guidance document "Considerations for the Use of Geosynthetic Clay Liners (GCLs) for Liner and Cap Systems Barrier Layers." Ohio EPA has incorporated the following use of GCLs for the design of recompacted soil liners in municipal and industrial solid waste landfills:

1. For recompacted soil liners (RSLs), a GCL is an acceptable replacement for a maximum of 2 feet of recompacted soil. Thus, the 5 foot recompacted soil liner can be replaced with a 3 foot recompacted soil liner and a GCL placed directly on top of the RSL.

2. In instances where less than 4 feet of recompacted soil are initially required for a RSL as per OAC 3745-27-08 Appendix I for municipal solid waste landfills due to good geology, a GCL is an acceptable replacement for one and one-half feet of recompacted soil. Thus, a 3 foot RSL can be replaced by an 18 inch RSL and a GCL placed directly on top of the RSL. Alternative designs will not be approved with less than 18 inches recompacted soil in the bottom liner because the quality of the first few inches of soil as barrier material are very dependent on the subgrade condition and construction practices. Less than an 18 inch thickness of recompacted soil could result in less than a 12 inch thickness of uniform and dense barrier layer. Other reasons that support the continued use of recompacted soil are the thickness, which reduces the concern of punctures or seam problems with GCLs alone, and the attenuation capacity for contaminants that may exist in leachate.

3. For final cap systems, the standard 2 feet of $1x10^{-7}$ cm/sec recompacted soil barrier layer can be replaced with a 18 inch $1x10^{-6}$ cm/sec recompacted soil barrier layer plus an FML or it can be replaced by a 12 inch thick engineered soil subgrade plus a GCL plus an FML. Because of the thinness and lack of tensile strength in GCL seams, the agency has not been willing to allow a GCL alone (i.e., without an FML).

   Specifications for the construction of an engineered subgrade should follow those written in the municipal and industrial rules, OAC 3745-27-08(C)(3)(e) and OAC 3745-29-08(C)(3)(e). Thus the engineered subgrade should:

   1. Have a thickness sufficient to achieve an evenly graded surface and shall be a minimum of twelve inches; and

   2. Be constructed of a soil:

      (i) With one hundred per cent of the particles having a maximum dimension not greater than two inches; and

      (ii) With not more than ten per cent of the particles, by weight, having a dimension greater than 0.75 inches; and

   3. Be compacted to at least ninety-five per cent of the maximum "Standard Proctor Density" using ASTM D-698 or at least ninety per cent of the maximum "Modified Proctor Density" using ASTM D-1557; and
   4. After being smooth-rolled, the surface shall not have sharp edged or protruding particles; and

5. The particle size and proctor density required by this paragraph shall be verified by tests performed on representative samples based on the variability and homogeneity of the material, but no less than a minimum of once every five thousand cubic yards of material used in the engineered subgrade; and

6. Field density testing shall be performed at a frequency not less than five tests per acre. Any penetrations in the subgrade as a result of the testing must be repaired using bentonite or a bentonite-soil mixture.

The use of GCLs in alternative designs for RSW LFs is complicated by the fact that there are four different classes with different liner requirements. Acceptable alternative designs for residual Class I and II follow the guidelines above for municipal and industrial facilities. The alternative design for Class III RSW LFs incorporates an exception from including an FML because DSIWM intends to maintain a consistent program and to provide flexibility yet not to disrupt the RSW program by increasing engineering standards. Class III RSW LF liner has 2 design options (1) 3 feet RSL at $1x10^{-7}$cm/s , and (2) 18 inches RSL at $1x10^{-7}$cm/s and FML. DSIWM has determined that for some sites, there is one equivalent design using GCLs: 18 inches RSL at $1x10^{-7}$cm/s and GCL. To follow the guidelines would result in a liner system equivalent to a Class II liner which is comprised of 18 inches RSL at $1x10^{-7}$cm/s and GCL and FML. Because the purpose of including the FML is to overcome the lack of tensile strength in the GCL seams, DSIWM has decided to allow the use of GCLs without the companion FML at those sites (or areas) where the lack of tensile strength in the seams is not problematic due to flat slopes.

The table below summarizes the alternative designs for RSW LF liner and cap systems:

RSW LF Classifications	**RSW LF Liner Requirements** **RSL=Recompacted Soil Liner** **FML=Flexible Membrane Liner**	**Alternative Designs**
Class I	5' RSL @ $1x10^{-7}$ cm/sec with an FML (no minimum FML thickness)	3' RSL @ $1x10^{-7}$ cm/sec + GCL + FML (no minimum FML thickness)
Class II	3' RSL @ $1x10^{-7}$ cm/sec with an FML (no minimum FML thickness)	18" RSL @ $1x10^{-7}$ cm/sec + GCL + FML (no minimum FML thickness)
Class III	3' RSL @ $1x10^{-7}$ cm/sec without an FML	for some sites, 18" RSL @ $1x10^{-7}$ cm/sec + GCL without an FML
	18" RSL @ $1x10^{-7}$ cm/sec with an FML (no minimum FML thickness)	
Class IV	No RSL, no FML	No alternatives

For the final cap system design at residual solid waste landfills, the two design alternatives in the municipal and industrial rules would be acceptable.

	Final Cap Requirements **RSL=Recompacted Soil Liner** **FML=Flexible Membrane Liner**	**Alternative Designs**
Class I through Class IV	2' RSL @ $1x10^{-7}$ cm/sec	18" RSL @ $1x10^{-6}$ cm/sec + FML (no minimum FML thickness)
		12" subgrade + GCL + FML (no minimum FML thickness)

IV. PROCEDURE

The use of GCLs in the design of liners and cap systems in RSW LFs requires Ohio EPA approval as an alternative design. Approval of the alternative design will either be through approval of a permit, or if a permit has already been issued then through approval of an alteration request. The designs given in this guidance indicate some alternatives that would be acceptable. Other designs beyond those given here are still possible and may be submitted for Ohio EPA evaluation on a case by case basis.

V. POINT OF CONTACT

Engineering Rules/Policy/Training Unit, Unit Supervisor: (614) 728-5373.