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Guidance Document

for

Performance Demonstration for an Alternate Cover Design Using the HELP Modeling Program Under the New Mexico Solid Waste Management Regulations (20 NMAC 9.1)

and

Performance Demonstration for an Alternate Liner Design Using the HELP Modeling Program Under the New Mexico Solid Waste Management Regulations (20 NMAC 9.1)

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Permit Section
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Performance Demonstration for an Alternative Cover Design Using the HELP Modeling Program Under the New Mexico Solid Waste Management Regulations (20 NMAC 9.1)

1. Existing Solid Waste Landfills without a Liner System:

A prescriptive landfill cover system must, in accordance with Section 502.A.1, consist of an infiltration layer comprised of a minimum of 18 inches of earthen material with the required hydraulic conductivity (K) and a minimum of 6 inches of soil that is capable of sustaining native plant growth as an erosion layer (Figure 1). The cover component of 18 inches of earthen material must be equivalent to the least hydraulically conductive natural subsoils or a saturated hydraulic conductivity of no greater than 1×10^{-5} cm/sec. For example, if the hydraulic conductivity of the natural subsoils is 1×10^{-6} cm/sec, then the K of the infiltration layer material must be equivalent to these soils. If the hydraulic conductivity of the natural subsoils is greater than 1×10^{-5} cm/sec (e.g., 1×10^{-4} cm/sec), the K of the infiltration layer material must equate to the 1×10^{-5} cm/sec requirement.

If the infiltration layer meets the minimum hydraulic conductivity of 1×10^{-5} cm/sec or that of the natural subsoils and the minimum 18 inch condition then a HELP Model simulation is not required. If an alternative cover design is proposed, it must achieve an equivalent reduction in infiltration as the infiltration layer specified in Section 502.A.1.a. Therefore, a HELP Model simulation is required to demonstrate that the design of such a cover provides equivalent reduction in infiltration as the prescriptive cover design. If the natural subsoils have a hydraulic conductivity of less than 1×10^{-5} cm/sec (e.g., 1×10^{-6} cm/sec), then the cover must achieve equivalent reduction in infiltration as that of the prescriptive cover but with an 18 inch infiltration layer with a hydraulic conductivity of 1×10^{-6} cm/sec.

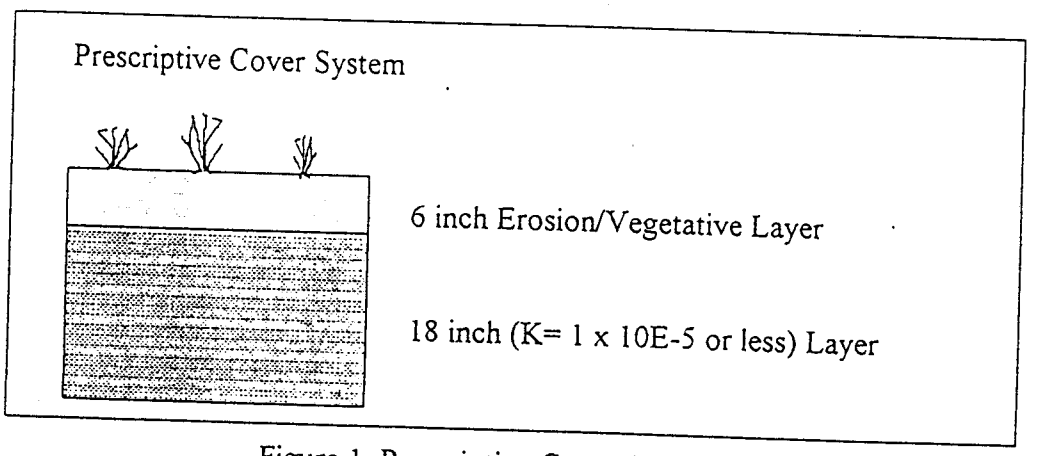

Figure 1. Prescriptive Cover System

A demonstration of equivalent reduction in infiltration is determined by using the EPA HELP Model. The HELP Model simulations must compare the prescriptive cover and the alternative cover design (Figure 2). The simulation for the prescriptive cover must include the erosion, infiltration and intermediate layers. The alternative cover design simulation includes the intermediate and alternative cover layers. The two designs are to be simulated for years 1 through 5 with vegetation during the

post-closure care period to demonstrate equivalency. Precipitation, evapotranspiration, temperature, and solar radiation data must be site specific and identical for both alternative and prescriptive cover designs simulations. Provide justification for all input parameters in the model utilizing the attached forms. Indicate characteristics of on-site or other sources of soil proposed for the construction of the cover and the parameter values in the model. It is anticipated that the entire area of the landfill or cell will be modeled.

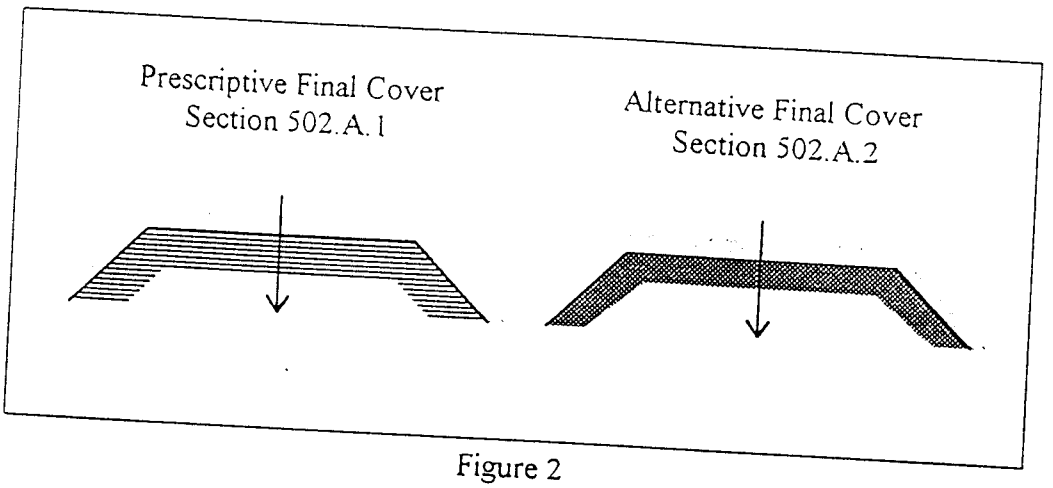

Figure 2

For example, comparing the prescriptive cover of:

1) 6 inches of topsoil
2) 18 inches of compacted soil ($K = 5 \times 10^{-6}$; to meet natural subsoils $K = 5 \times 10^{-6}$)
3) Intermediate layer (Optional: if an intermediate layer is used it must also be simulated in the proposed alternative cover.)

with a proposed alternative cover system of:

1) 6 inches of topsoil
2) 30 inches of compacted ($K = 1 \times 10^{-5}$)
3) Intermediate layer (Optional: if an intermediate layer is used it must also be simulated in the prescriptive cover.)

2. New Solid Waste Landfills:

As in the above case, the cover for the proposed landfill with a prescriptive or alternative liner must achieve an equivalent protection as the liner. If an alternative final cover is proposed for the landfill, then a demonstration must be submitted to the Bureau for approval pursuant to Section 502.A. It must be determined by this demonstration that the proposed final cover design includes an infiltration layer that achieves an equivalent reduction in infiltration as the bottom liner (Figure 3). A HELP Model simulation comparison is acceptable for this demonstration for a 5 year period with vegetation. Precipitation, evapotranspiration, temperature, and solar radiation data must be site specific and identical for both liner and cover design simulations. Provide justification for all input parameters in the model utilizing the attached forms. Demonstrate the relationship of the characteristics of on-site or other sources of soil proposed for the construction of the cover or liner and the parameter values in the model. It is anticipated that the entire area of the landfill or cell will be modeled.

For example, the comparison must include a HELP Model simulation for the liner and the proposed final cover systems as below.

The simulation for an alternative liner system* could include:

1) the drainage/protective layer of the liner with leachate collection system,
2) the 60-mil HDPE FML,
3) the 0.2 inch ($K = 2 \times 10^{-9}$) GCL (geosynthetic clay liner),
4) the 6 inches of compacted in situ soil used as the prepared subgrade, and
5) with the solid waste cell open and no runoff.

*Any alternative liner system must meet the demonstration as described in the "Performance Demonstration For An Alternative Liner Design Using The HELP Modeling Program Under the New Mexico Solid Waste Management Regulations (20 NMAC 9.1)."

A liner system is compared with a HELP Model simulation for a proposed final cover:

1) 18 inches uncompacted material (6 inches of topsoil with poor grass and 12 inches of uncompacted soil),
2) the 0.2 inch GCL ($K = 2 \times 10^{-9}$),
3) 12 inches of intermediate cover (6 inches of compacted soil and 6 inches of uncompacted soil), and
4) with the solid waste cell closed and final placement of the cover to include runoff.

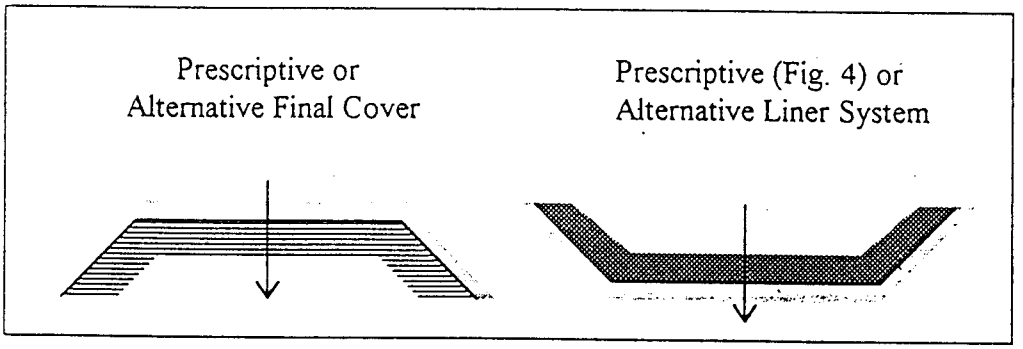

Figure 3

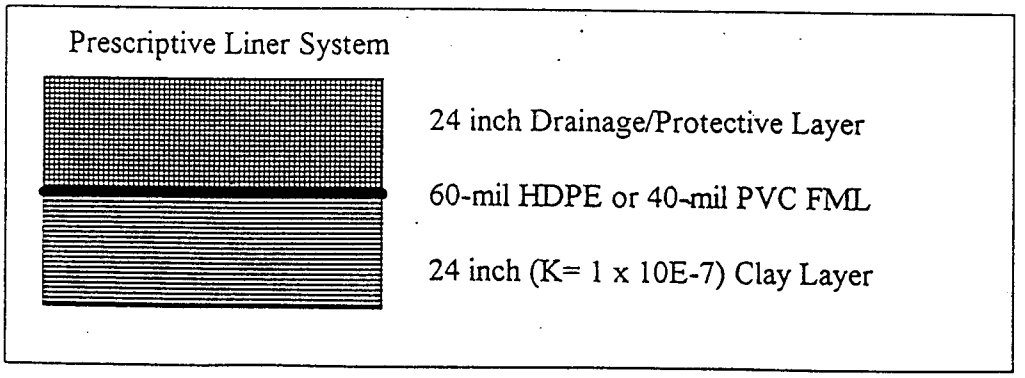

Figure 4

Performance Demonstration for an Alternate Liner Design Using the HELP Modeling Program Under the New Mexico Solid Waste Management Regulations (20 NMAC 9.1)

1. Permit applicants proposing an alternate liner in accordance with Section 306.A.2 must demonstrate the liner "... provides equivalent protection as the composite liner ... and ensures concentration values listed in Section 1110 will not be exceeded in the uppermost aquifer ... ". This requires that a two tier demonstration be made:

1 - the alternate liner provides equivalent protection, and

2 - the alternate liner ensures the uppermost aquifer will be protected.

The first tier of this demonstration may be satisfied through mathematical modeling using the EPA developed HELP model. Two computer modeling analyses must be performed - (1) an analysis of the composite liner as specified in Section 306.A.1 and analysis of the proposed alternate liner as specified in Section 306.A.2. Each of these analyses must be performed under identical hydrologic and climatologic loading conditions with at least five years of no solid waste in the landfill. This time period is necessary to adequately evaluate the performance of the two liners. A successful demonstration of equivalent protection has been made when the analyses show equivalent percolation/leakage through the bottom layer of the proposed alternate liner to the percolation/leakage through the bottom layer of the Section 306.A.1 composite liner (Figure 5).

The second tier of the demonstration must include HELP modeling of the actual design conditions and the entire operational development of the landfill as closely as possible by doing a succession of model simulations which consider the factors in Section 306.A.2.a. To aid in accomplishing this, each successive computer simulation must use the previous simulation's moisture content output as the input for the following simulation (Figure 6). The modeling design method must be fully described. If no leakage is indicated after the second simulation [3(2)b] and subsequent simulations [3(2)c & 3(2)d], then a successful demonstration has been made that the uppermost aquifer will be protected as required by Section 306.A.2 and it will not be necessary to perform fate and transport modeling.

2. Justification for all input parameters in the HELP modeling must be provided utilizing the attached forms. Demonstrate the relationship of the characteristics of the soil proposed for the construction and operation of the landfill and the parameter values used in the model. Show justification for the soil and waste moisture content parameters as well as geomembrane liner data and storm water runoff fractions. The initial moisture content of the soil should be initialized by the user in the HELP model. The Department recommends initializing the soil moisture content to be at least the value of the wilting point plus 25% of the difference between the wilting point and the field capacity. Other values deviating from this range may be used but must be fully justified.

(field capacity - wilting point) 25% + wilting point

① = 5 consecutive . . test years using Climate data
② = use corresponding Climate data
③ = use synthetic generated data for Solar Radiation

3(1) First Tier of the Demonstration

Two simulations must be made, one of the Section A.1 specified liner and one of the proposed alternate liner, both using the same precipitation①, temperature②, and other climate data, solar radiation③, and evapotranspiration data. Current historic NOAA weather data from the nearest representative weather station as published by the National Climatic Data Center in Asheville, North Carolina must be used for the precipitation and temperature files. Both simulations must be made for the landfill in the open condition with no run-off and a Leaf Area Index of zero.

3(1)a A simulation for the specified liner design must be performed using a 24 inch protective layer, a lateral drainage layer (which may be integral with the protective layer), an FML, and a 24 inch barrier layer of soil with a saturated hydraulic conductivity of 1×10^{-7} cm/sec. This simulation must be performed using no solid waste and for a five year period.

3(1)b A simulation for the proposed alternate liner design must be performed using a 24 inch protective layer, a lateral drainage layer (which may be integral with the protective layer), and the other proposed liner layer (the bottom layer must be modeled as a barrier layer). This simulation must be performed using no solid waste and for a five year period.

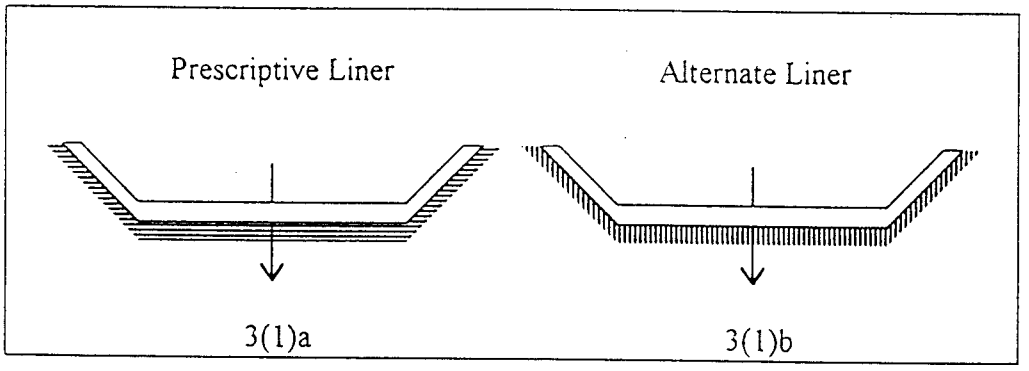

Figure 5

Compare the average annual leakage from the bottom layer of the two simulations. If the leakages are equivalent, a successful demonstration has been made for the first tier.

3(2) Second Tier of the Demonstration

Four simulations encompassing the entire life cycle of the facility to model actual design conditions and operational development as closely as possible must be performed. This is accomplished through a succession of four model simulations: one simulation of the open landfill, a second with the landfill partially filled with solid waste, a third with the landfill in the closed condition with bare ground, and a fourth with the landfill in the closed condition with poor vegetation.

3(2)a The initial simulation must model the open landfill at start-up when the landfill contains no solid waste. The time period should extend for the anticipated duration of this condition, a minimum of one year and probable maximum of two years.

3(2)b A succeeding simulation to model conditions of the partially filled landfill for a five year period. This would incorporate daily and intermediate covers.

3(2)c Model the landfill in the closed condition with bare ground for a two year time period.

3(2)d Finally, perform a simulation to model the landfill in the closed condition with poor vegetation for remainder of the post-closure care period.

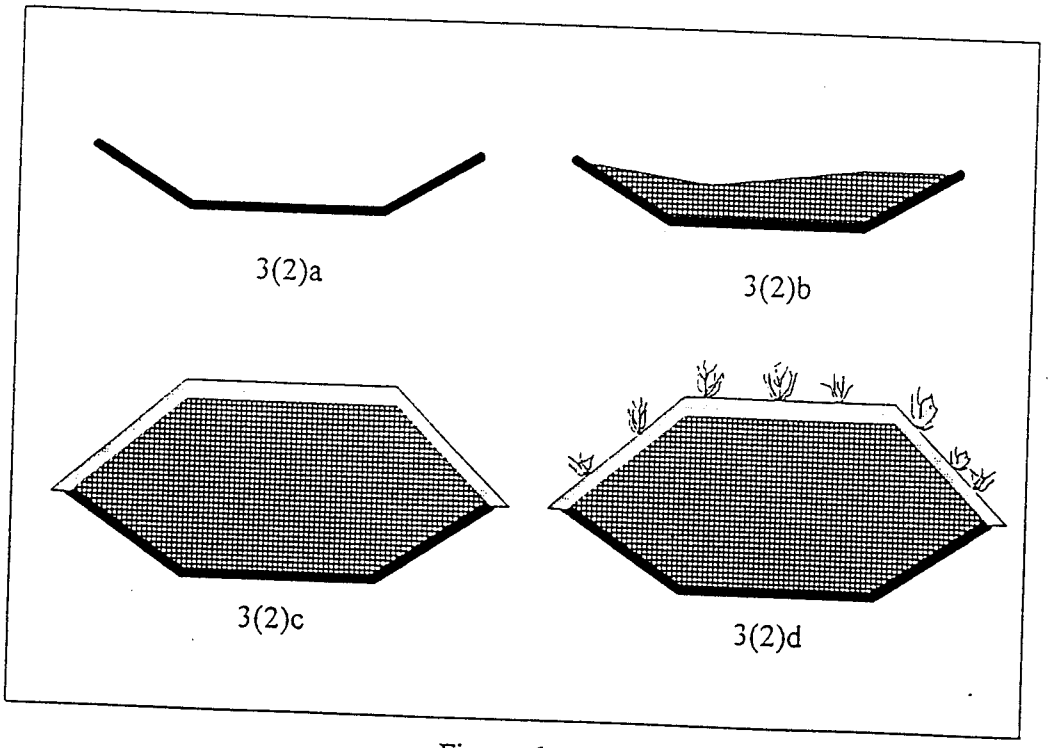

Figure 6

If the simulations indicate no leakage after the second simulation [3(2)b] and subsequent simulations [3(2)c & 3(2)d], then the simulations have served to demonstrate the concentration values delineated in Section 1110 of the Regulations will not be exceeded in the uppermost aquifer at the relative point of compliance. Therefore, a successful demonstration has been made for the second tier.

Landfill Alternative Liner or Cover Design Modeling Input Parameters (11/23/94) SHEET 1 (rev. 2 7/10/96)

Project: _____ **Date:** _____

INPUT PARAMETER	VALUE	JUSTIFICATION
WEATHER DATA:		
City/State		
Latitude		
Evaporative zone depth		
Maximum leaf area index		
Growing season start & end day		
Avg. wind speed		
Relative humidity & source of data		
Precipitation & source of data (default, synthetic or user specified)		
Temperature & source of data (synthetic or user specified)		
Solar radiation & source of data (synthetic or user specified)		
LANDFILL COVER DATA:		
Type of vegetation		
SCS runoff curve number		
% of area where runoff is possible		
Surface area		
SOIL AND DESIGN DATA:		
Source of soil charactersitics		
Number of layers		

NOTES:

Landfill Alternative Liner or Cover Design Modeling Input Parameters (11/23/94) SHEET 2 (rev. 2 7/10/96)

Project: _____ **Date:** _____

INPUT PARAMETER	VALUE	JUSTIFICATION
LAYER NUMBER:		
Thickness		
Layer type		
Soil texture		
Total porosity		
Field capacitiy		
Wilting point		
Moisture content		
Saturated hydraulic conductivity		
If lateral drainage layer:		
Slope		
Drainage length (maximum horizontal distance)		
If geosynthetic:		
Geomembrane pinhole density (#/acre)		
Geomembrane installation defects (#/acre)		
Liner installation quality (if geomembrane)		
Geotextile transmissivity		

NOTES:

(make additional copies for each layer as required)