



State of New Hampshire  
DEPARTMENT OF ENVIRONMENTAL SERVICES

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To: Affected Parties

From: Philip J. O'Brien, Ph.D., Director  
Waste Management Division  
Department of Environmental Services

Re: **Required Evaluation of Landfill Cap Designs - Regulatory Policy**

The following regulatory policy is being adopted by the New Hampshire Department of Environmental Services, Waste Management Division (Department) to enhance the slope stability at closed landfills with cap designs involving sand over geomembrane liner material. The purpose of this policy is to clarify the requirements for the analysis and design of landfill caps that incorporate flexible geomembrane liner as the impermeable layer. It has been observed that traditional designs (i.e. geomembrane with sand drainage layer on top and no other drainage provision) may be at risk of slope failure due to excessive pore water pressures built up during significant rainfall events. The effect also appears to be cumulative where landfill cap slopes have been weakened over time. In some cases, the sloughing resulted in exposure of the geomembrane and so necessitated repairs and improvements to the failed area.

The following are elements of the design analysis that will be utilized by the Department staff in reviewing all landfill closures involving a geomembrane in the cap profile:

- 1) It must be demonstrated that rainwater which has infiltrated the cap drainage layer (i.e sand and/or geonet) is removed from all "flat" areas of the cap before it is allowed to collect and travel down any of the landfill cap side slope drainage layers. A flat area is defined to be any slope gentler than 4:1. Therefore, an internal piping system (or some other equivalent means) must be incorporated into the cap design, which would typically ring the top portion of the landfill and would adequately remove water in a reliable hydraulic conveyance system.
- 2) A stability analysis must be performed for the steepest slope using any one of the many standard methods which accounts for the effects of pore water pressure within the sand drainage layer. To obtain the pore water pressure and a flow for infiltration routing, a drainage analysis using 10" of rainfall in 48 hours must be used in addition to other storm events analyzed. This can be done using the HELP model Version 3 with manually edited precipitation data.
- 3) A moisture retention layer ( $\sim 1 \times 10^{-5}$  cm/sec) under the vegetative layer is strongly recommended. These layers have typically been greater than 6 inches in depth. The moisture retention layer serves to limit the amount of rainfall infiltration to the drainage layer and

more importantly serves to promote excellent vegetative growth, further stabilizing the cap. The moisture retention layer may be substituted for 6" of drainage sand in the design (i.e. 18" of drainage sand can be reduced to 12" but the stability analysis in #2 above must still be acceptable at the full soil depth and fully endorsed by the professional engineer).

- 4) All drainage flow must be effectively removed from the toe of slope in a timely manner. This criteria usually necessitates the use of a toe drain and piping network. A hydraulic profile may be useful in some cases.

Questions regarding these requirements should be directed to the Department's Permits and Design Review Section at (603) 271-2935.