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PONDS 3.2 TECHNICAL MEMO

Date: October 5, 2007
Re: Evaluating Stability of Pond Berms

Modes of failure for a retention pond fill berm can include:

① Seepage through the berm resulting in wetting of the outboard slope followed by internal erosion (piping) and external erosion.

② Slope instability due to seepage forces if the outboard slope can become saturated

③ Overtopping the berm with resulting erosional failure, especially in ponds without positive outfalls.

The following discussion relates primarily to slope stability issues (Item ② above).

Although PONDS does not directly perform a stability analysis of a pond berm, it can be used to determine the seepage path through the berm in order to assess the likelihood of a seepage failure.

The general steps for doing this are as follows:

Step 1 Check to see if the seepage path wets the outboard part of the slope

Step 2a If the outboard slope becomes saturated, perform a simple infinite slope analysis with full seepage force (100% saturation)

Step 2b If the outboard slope does not saturate, then it is stable (assuming that the berm is stable under normal/dry conditions)

The PONDS software can be used to determine whether a retention pond fill berm is susceptible to seepage failure by plotting the ground water mound profile on top of the berm cross section, as illustrated in Exhibit 1. If the two intersect, then there is the potential for seepage failure, and an infinite slope stability analysis should be performed.

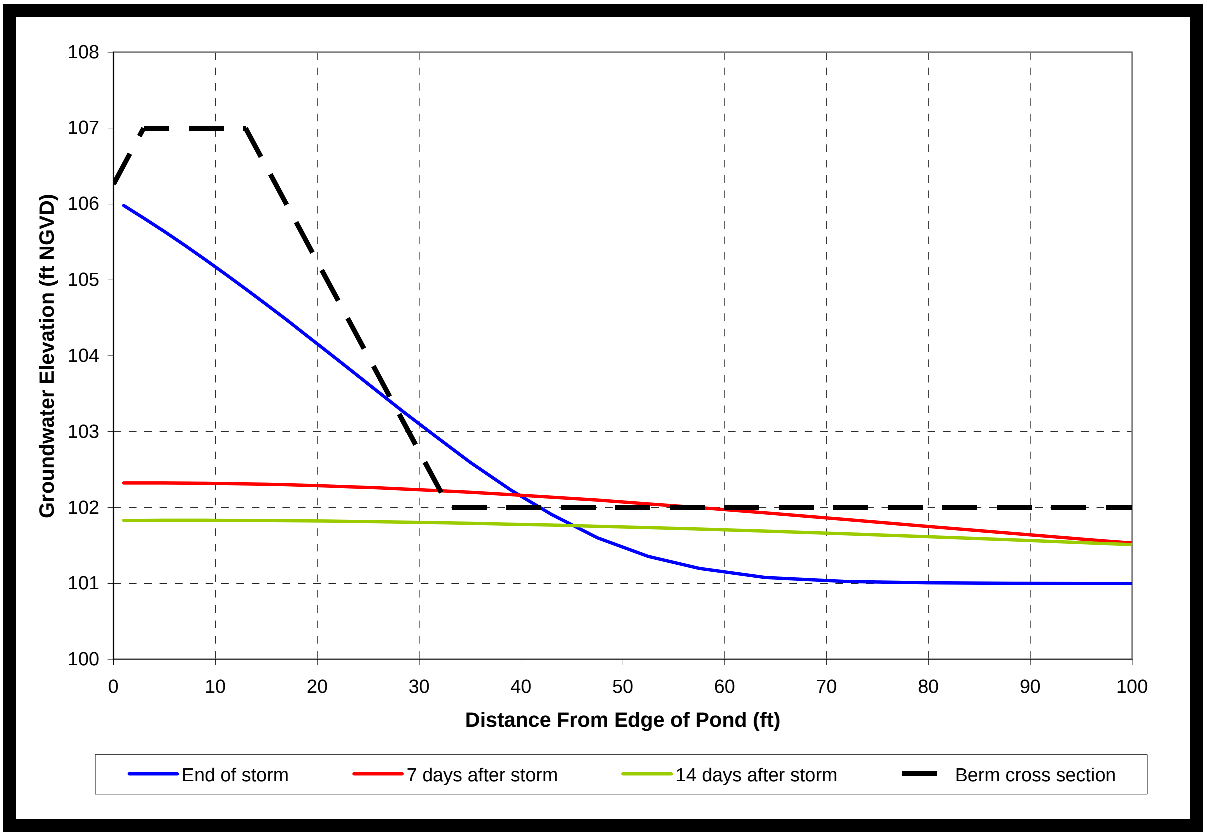
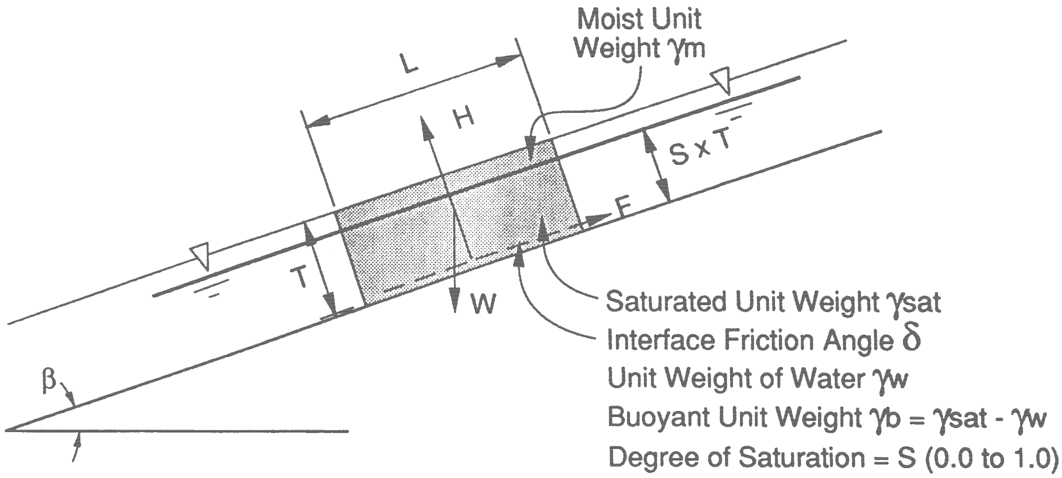


Exhibit 1. Berm Cross section with groundwater profile

An infinite slope stability analysis is performed using the following equation, using a degree of saturation of 100%.



Σ Forces parallel to slope

Resisting Force: $F = \{ \gamma m\ T\ (1\text{-}S)\ L\ + L\ \gamma b\ T\ S \}\ \tan\delta\ \cos\beta$

Seepage Force: $= \gamma w\ T\ S\ L\ \sin\beta$

Weight: $= \{ \gamma m\ T\ (1\text{-}S)\ L\ + L\ \gamma b\ T\ S \}\ \sin\beta$

$$\text{Factor of Safety} = \frac{\text{Resisiting Force}}{\text{Seepage Force + Weight}} = \frac{\tan\delta}{\tan\beta}\left\{ \frac{\gamma m\ (1\text{-}S) + \gamma b\ S}{\gamma w\ S + \gamma m(1\text{-}S)\ + \gamma b\ S} \right\}$$

Exhibit 2. Seepage forces for infinite slope stability analysis

These calculations have been programmed in an Excel spreadsheet titled *Infinite Slope Stability Analysis.xls* which is available for download from www.devoeng.com.