



US Army Corps  
of Engineers®

## Flood&Coastal Storm Damage Reduction R&D Program

# Unlined Spillway Erosion

### Description

Unlined spillway erosion is highly dependent on channel geometry (usually not well-characterized and variable in nature), geologic material, and uncertain flood discharge. To account for this uncertainty, the traditional unlined spillway erosion threshold line was expanded using multiple logistic regression into a series of threshold lines for a range of probabilities. This is similar to the procedure in earthquake engineering in advancing the relationship between normalized standard



**Tuttle Creek Spillway, Kansas, after 1993 flood**

penetration tests versus normalized cyclic stress ratio in liquefaction threshold lines. This initial binary assessment was then advanced using ordinal logistic regression on a database of spillway erosion case histories to develop a probabilistic model for estimating the amount of erosion that is sorted into qualitative levels of damage. The basis data set was derived from studies of spillway erosion case histories by the U.S. Department of Agriculture (USDA) and U.S. Army Corps of Engineers (USACE). The assessment is currently based on five parameters found to be the leading factors influencing spillway damages due to flood discharge: length of spillway channel, slope of the spillway floor, maximum flood discharge, duration of the flood, and the behavior of the geologic material in resisting erosion. The probability of spillway damage can be assessed using an ordinal logistic regression technique with five levels of spillway damage: no damage, lightly damaged, moderately damaged, severely damaged and breached. For a set of input data, consisting of these five spillway parameters, the probability of each damage level can then be estimated. Applying the procedure to several real case histories indicates consistent results verifying this as a useful procedure to enable spillway risk assessment procedures and prioritizing spillway channel remediation projects.

### Benefits

This technology can be used to evaluate and group unlined spillway in a consistent way to find a relative comparison among them. By multiplying the probability of spillway breach, with the consequence when the spillway breaches, the ranking can be used for prioritizing spillway channel remediation projects.

<b>Status</b>	The unlined spillway erosion toolbox and the manual have been developed and now are under evaluation by an Internal Technical Review (ITR) Team, and are expected to be released by spring 08.
<b>Distribution Source(s)</b>	Once the toolbox is approved by ITR, the toolbox will be available for the Corps or public agencies as needed.
<b>Available Documentation</b>	The toolbox is developed using Excel Spreadsheet. Both Excel Spreadsheet and the technical manual will be available upon the approval from ITR.
<b>Available Training</b>	A civil engineer or a geologist with geotechnical engineer knowledge will be able to use this method as it is a straightforward procedure.
<b>Available Support</b>	Application support can be obtained by contacting Johannes L. Wibowo ERDC-GSL.
<b>Application</b>	U.S. Army Corps of Engineers Dam Safety Group. This toolbox is plan to be used to evaluate the Corps' spillway system for Portfolio Risk Assessment
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<b>Partners</b>	In this project, ERDC-GSL worked closely with the U.S. Department of Agriculture (USDA) Agricultural Research Services in Stillwater, Oklahoma, who provide many Spillway Erosion Case Histories. During the development of the Excel Spreadsheet Toolbox, ERDC-GSL worked together with USACE, Louisville District.