

## U.S. Army Corps of Engineers Institute for Water Resources

On the Web:  
<http://www.iwr.usace.army.mil>

For More Information:  
+1 (703) 428-9090

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### Advancing Technology on Levee Breaching Modeling: HEC Collaborative Workshop

ALEXANDRIA, VIRGINIA. Hurricane Katrina intensified our Nation's interest in levee overtopping and failure consequences. The Institute for Water Resources' (IWR) Risk Management Center (RMC) has developed standardized risk assessment methods for dams and is actively applying a similar framework to levees. Hydrology and Hydraulic modeling software developed at IWR's Hydrologic Engineering Center (HEC) also play important roles in contemporary dam and levee consequence analyses. The current version of HEC-RAS includes dam and levee failure capabilities. Computed breach growth rates are based on regression equations or user input relationships between velocity breach growth rates. However, levee breaching algorithms, the actual equations used to determine the size and rate of the breach, are highly empirical. These empirical equations have been largely inherited from *dam* failure practice, based on data from a few actual dam failures, but several processes make levee failures distinct, including tailwater controls and sloping water surfaces.

An interagency working group monitored the development of physically based dam breach models for over a decade. The models include the USDA-ARS WinDAM, HR Wallingford's HRBreach, and Dr Weiming Wu's DLBreach. It is still an open question whether these physically based models (which include empirical parameters that can vary by five orders of magnitude) give better results than the empirical methods. However, USACE engineers are applying them not only to dams but also to levees in ingenious but time intensive iterative work flows, passing results between these breaching models and HEC-RAS. Coupling one or more of these models to HEC-RAS, or adding the breaching algorithms directly to HEC-RAS, would streamline these analyses significantly.



Levee breach simulated in a HEC-RAS model

On June 30 and July 1 the RMC held a workshop at HEC to reassemble the dam and levee breaching working group, bring new focus and momentum to the Corps assessment of physical levee breach technology, provide input on ERDC's levee breaching research work units, and set a path forward for including a physically based breaching model in HEC-RAS. Representatives of all three breaching models presented their latest capabilities. The USACE's Engineer and Research Development Center (ERDC) presented their laboratory and field research on estimating erodibility parameters, the most difficult and sensitive parameter in physical breaching models. HEC presented current HEC-RAS capabilities, including the new simplified breaching capabilities which give users the option to apply their own non-linear levee incision and widening functions.

RMC and HEC emerged with a three year plan to test the stand alone breaching models, which were all developed for and tested against dam breach data, with some levee breach data sets. Then HEC, RMC and ERDC will select one or more of these breaching models and incorporate the breach algorithm into HEC-RAS. The workshop participants also discussed opportunities to leverage HEC-RAS capabilities to push the technology farther, like coupling the breach model with the physically based lateral erosion model recently coupled with HEC-RAS, the USDA-ARS Bank Stability and Toe Erosion Model (BSTEM), to improve the lateral levee breach rate over the current empirical assumptions. POC: Stanford Gibson PhD, CEIWR-HEC.

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