

## Levee Breach Consequence Model

Validated by Case Study in Joso, Japan

Paul Risher, PE, Hydraulic Engineer, Risk Management Center (RMC), US Army Corps of Engineers (USACE); Cameron Ackerman, PE, D.WRE, Senior Hydraulic Engineer, Hydrologic Engineering Center (HEC), USACE; Jesse Morrill-Winter, Regional Economist, Sacramento District, USACE; Woodrow Fields, Hydraulic Engineer, HEC, USACE; and Jason T. Needham, PE, Senior Consequence Specialist, RMC, USACE

**Abstract--** In September 2015, extreme rainfall from two tropical cyclones caused the Kinugawa River levee to overtop and breach in three locations near the city of Joso, Japan. Citizens, government agencies, and television news observed the breaches and resultant flood damages. The well-documented disaster provides a unique opportunity to validate levee breach progression, flooding, evacuation, and lifeloss estimations generated by the suite of models used by USACE and others to support levee safety risk assessments.

In this paper, we describe how data from social media augmented official sources to create a complete and accurate data set. Specifically, we scoured multiple online sources to describe the breach erosion progression at a level of detail rarely available outside of a controlled environment. We then describe the multi-step modeling process of: 1) setting up the HEC-RAS river hydraulics model, with the required boundary conditions and breach parameters; 2) calibrating the HEC-RAS model to observed breach flow velocities, flood depths, and inundation extents in the leveed area; and 3) using the HEC-RAS results and the available information on warnings and evacuation to validate the estimates of life loss from HEC-LifeSim.