STORM DURATION AND ANTECEDENT MOISTURE CONDITIONS FOR FLOOD DISCHARGE ESTIMATION

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By

Bruce M. McEnroe and Pablo Gonzalez, both of the University of Kansas

RESEARCH

Introduction

Structures such as culverts and bridges are designed for floods with specified recurrence intervals. In many situations, flood hydrograph computer simulation is the best method available for estimation of design flows. The major problem with this method is that the computed peak discharge depends strongly on the assumed storm duration, the assumed antecedent soil moisture condition and other factors.

Project Objective

The objectives of this project were (1) to determine which combinations of storm duration and antecedent moisture condition yield the best estimates of flood discharges under various conditions and (2) to develop specific guidelines for design-flow estimation by flood hydrograph simulation for possible inclusion in the KDOT Design Manual.

Project Description

Many different combinations of modeling procedures and inputs were tested in flood simulations for 66 primarily rural gaged watersheds under 50 km^2 in Kansas. The simulations were performed using the HEC-1 program. The key inputs were the duration of the hypothetical frequency-based storm and the antecedent moisture condition (AMC) in the NRCS loss model. Floods of varying recurrence intervals were simulated using four different storm durations, five antecedent moisture conditions and both the NRCS and the Snyder unit-hydrograph models. The results for watersheds in eastern and western Kansas were analyzed separately. We computed the bias and standard error of the simulated flows , relative to gage-based estimates, for each combination of inputs in each region. From these results, we identified combinations of storm duration and AMCs that yield unbiased discharge estimates for each set of conditions. Longer storm durations and/or higher AMCs are needed for higher recurrence intervals. The storm durations are shorter in the western region than in the eastern region.

Project Results

Flood hydrograph simulation with the recommended inputs is approximately as accurate as the USGS regression equations in eastern Kansas and more accurate than the USGS regression equations in western Kansas. The standard errors of the simulated flows are lower in the western region than in the eastern region. Simplified guidelines for flood hydrograph simulation specify the NRCS unit hydrograph model and a single combination of storm duration and AMC for each recurrence interval and region.

Report Information

For technical information on this report, please contact: Bruce M. McEnroe, Professor, Department of Civil, Environmental and Architectural Engineering, University of Kansas, Learned Hall, 1530 W. 15th Street, Lawrence, Kansas, 66045-7609; Phone: 785-864-2925; Fax: 785-864-5631; e-mail: mcenroe@ku.edu.

For a copy of the full report, please contact: William L. Jacobs, P.E., Technology Transfer Engineer, Kansas Department of Transportation, Bureau of Materials and Research, 2300 Southwest Van Buren Street, Topeka, Kansas 66611-1195; Phone: 785-291-3847; Fax: 785-296-2526; e-mail: Bill.Jacobs@ksdot.org.