Project Summary – RES2013-38
10/21/16

Problem

Planners and engineers require reliable estimates of the magnitude and frequency of floods to design bridges, culverts, and other structures near unregulated streams and rivers. In order to estimate the magnitude and frequency of floods at ungaged sites reliably, prediction methods must be updated periodically to include recent streamflow data, incorporate improvements to flood-frequency computations at gaged sites, and reflect technological improvements in the ability to accurately calculate basin characteristics that affect hydrologic response in streams. In 2003, the U.S. Geological Survey (USGS) published a computer program for estimating flood frequency at ungaged sites in Tennessee (Law and Tasker, 2003). This computer program included estimates from standard regional multivariable regression equations and a new Region-of-Influence (ROI) method. In the ROI method, multivariable regression equations for each recurrence-interval peak flow are developed by using explanatory data from a unique group of gaging stations with basin characteristics similar to the ungaged site of interest (Law and Tasker, 2003). Since the development of the original flood-frequency ROI program for unregulated streams in Tennessee, we have obtained 13 additional years of streamflow record for many of the gages used to develop the prediction methods. During this period, specifically during the major floods of 2010 and 2011, historic maximum flood peaks at many USGS gages throughout Middle and West Tennessee were exceeded. Standardized methods for determining flood-frequency at gaged sites have improved since the publication of the original ROI program, and those improvements are being included in the update of prediction methods. Additionally, Geographic Information System (GIS) techniques can now be used to examine the influence and automate the calculation of basin characteristics, allowing for more accurate, thorough, and consistent basin-characteristic calculation than was possible when the original ROI program was published.

The USGS, in cooperation with the Tennessee Department of Transportation (TDOT), is updating the ROI methods for predicting flood magnitude and frequency for unregulated streams in Tennessee using recent peak-flow data and basin characteristics derived from GIS techniques. Data for 454 gaging stations, including 443 of the 453 stations used in the original study (Law and Tasker, 2003), were compiled into a computer application that automates the complex calculations required for flood magnitude and frequency predictions. Methods from the computer program also will be incorporated into a web application such as Tennessee StreamStats (Ladd and Law, 2007) to further automate the process of predicting flood magnitude and frequency.

Purpose and Scope

The purpose of the project is to update the original ROI methods for predicting flood frequency and magnitude for unregulated streams in Tennessee using GIS-derived basin characteristics for gaging stations and 13 additional years of annual-peak flow record at existing stations. The ROI methods include the determination of flood magnitudes that have annual exceedance probabilities (AEP) of 50, 20, 10, 4, 2, 1, and 0.2 (the 2-, 5-, 10-, 25-, 50-, 100-, and 500-year floods, respectively).

The ROI methods for predicting flood frequency and magnitude are applicable in the State of Tennessee. Peak-flow records and GIS-derived basin characteristics from 454 gages located in rural and lightly-developed areas of Tennessee, Georgia, North Carolina, Virginia,

Alabama, Kentucky, and Mississippi are being used to update the ROI flood-frequency prediction methods.

Current Status

A draft version of the updated ROI computer program has been provided to TDOT. The accompanying manuscript should be ready for review within the next few weeks, at which time a review copy will be provided to TDOT. Ongoing discussions have taken place with the National StreamStats team concerning implementation of the updated ROI methods in StreamStats. The National StreamStats team is currently working on implementation of the original ROI peak-flow methods, and the updated model will be provided to the team after approval.

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References

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