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Uncertainties in design rainfall and flood peaks based on period of record, region and statistical distributions in northeastern Illinois

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Trend analysis of the annual flood peaks on twelve small urbanizing watersheds in Northeastern Illinois indicated that the peaks increased in the recent decades, which can be explained by intensive urbanization, and also increasing intensity and frequency of the heavy rainfall. It was demonstrated that significant increase in precipitation, and land-use change occurred between 1954 and 1996. Precipitation frequency analysis for different time periods was calculated based on L-moments; hydrologic parameters for different land-use categories were determined using Geographical Information System (GIS); and hydrologic analysis was performed using the HEC-HMS model. This study quantified the increase in design precipitation between 1954 and 1996; quantified the increase in flood peaks; identified the land-use changes in the watershed areas; identified the relative contributions of land cover change and climate change on increasing flood discharges; compared the published regulatory discharges with flood discharges computed for current conditions; and provided tools to analyze future land use and climate scenarios. The 100-year rainfall amounts at gaging sites in Northeastern Illinois were calculated and compared with those of TP-40, NOAA-14 and Bulletin 71. It was found that the precipitation values calculated in this study are on average slightly lower than those of Bulletin 71, within one percent of those given by NOAA-14, and 15.5% larger than the corresponding precipitation values given in TP-40. The 100-year discharges were compared with those certified by FEMA and USGS. On average, the flood peaks in this study are 13.5% higher than those of FEMA, and 12.9% larger than those published by the USGS in 2004.

This research indicated that design precipitation and design flood discharges are more

sensitive to the changes in the period of record than to the selection of region or choice of underlying statistical distribution. For example, the design precipitation for Aurora College station based on the period of 1951-2004 was approximately 200% larger than the corresponding value for the period of 1900-1950. Nevertheless, design precipitation based on different 2- and 3-parameter statistical distributions could differ by as much as 50%; and 1-station region could produce a design precipitation 20-25% larger than that of a 12-station region.