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CENTER FOR MULTIDISCIPLINARY RESEARCH IN TRANSPORTATION

Project Summary Report 0-2104-S

Project 0-2104

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PROJECT SUMMARY REPORT

Climatic Adjustments of Natural Resource Conservation Service (NRCS) Runoff Curve Numbers: Findings and Recommendations

Summary: For the purposes of this project, the term *observed curve number* (and CN_{obs}) refers to the estimate of effective curve number for a watershed that is derived for paired observations of rainfall depth and runoff depth. Similarly, the term *predicted curve number* (also CN_{pred}) refers to the standard estimate of the curve number for a watershed for the average antecedent moisture condition (AMC II). The standard curve number (CN_{pred}) is derived from soil association (hydrologic soil group) and land use/land cover through a table look-up procedure.

What We Did…

The objectives of this research were: 1) to determine if the standard curve number is representative of rainfall-runoff processes for Texas watersheds; 2) if not, to develop a method to adjust the NRCS curve number for use on Texas watersheds; and 3) to compare the deviations generated from the project and observed data to a curve number adjustment procedure developed by Hailey and McGill (1983).

What We Found…

Based on review of measured rainfall-runoff data from about 100 watersheds and approximately 1600 events, CN_{pred} is greater than CN_{obs} for much of the state of Texas. That is, an adjustment of CN_{pred} is required to avoid inflating the runoff volume associated with a particular design rainfall depth at a particular recurrence interval. Therefore, differences between CN_{obs} and CN_{pred} were computed and used as the basis for a simple adjustment procedure. Basically, the adjustment amounts to a subtractive amount between 0 and 20 points.

This procedure was compared with the procedure developed earlier by Hailey and McGill (1983). In general, the curve numbers produced by the project procedure are less than those produced by the Hailey and McGill method. That is, estimates of runoff produced using curve numbers adjusted according to the project method will be less than or equal to estimates of runoff produced using the Hailey and McGill approach.

The Researchers Recommend...

1) It is the recommendation of the investigators that the study approach be adopted for testing by TxDOT. The design tool and a suggested procedure are appended to Research Report 0-2104-2.

2) GIS technology is appropriate for computation of CN_{pred}. Although not a product of this research study, the scripts that were used and the databases are readily available to TxDOT

analysts. The issue then is obtaining appropriate training for TxDOT designers.

3) Finally, in the process of executing this research project, it became clear to the investigators that hydrologic measurements of watershed behavior on small watersheds basically ceased in Texas about 20 years ago. The development and assessment of hydrologic methods depends on the availability of such data. Large areas of Texas have had no small watershed studies executed in those regions. Therefore, it is difficult to measure the effectiveness of methods like the NRCS curve number procedure for hydrologic modeling in those areas. Clearly, then, it is in the interest of TxDOT that such data be collected. It is the recommendation of the investigators that avenues to encourage such a data collection program be opened and executed.

Application of the tool is straightforward. For areas for which adjustment factors are defined (see Figure 1), the analyst should:

1. Determine CN_{pred} using the normal NRCS procedure.

2. Find the location of the watershed on the design aid (Figure 1). Determine an adjustment factor from the design aid and adjust the curve number.

3. Examine Figure 1 and find the location of the watershed. Use the location of the watershed to determine nearby study watersheds. Then refer to Figure 1 and determine the difference between CN_{pred} and CN_{obs} for study watersheds near the site in question, if any are near the watershed in question.

4. Compare the adjusted curve number with local values of CN_{obs}.

5. The result should be a range of values that are reasonable for the particular site. As a comparison, the adjusted curve number from Hailey and McGill (Figure 2) can be used.

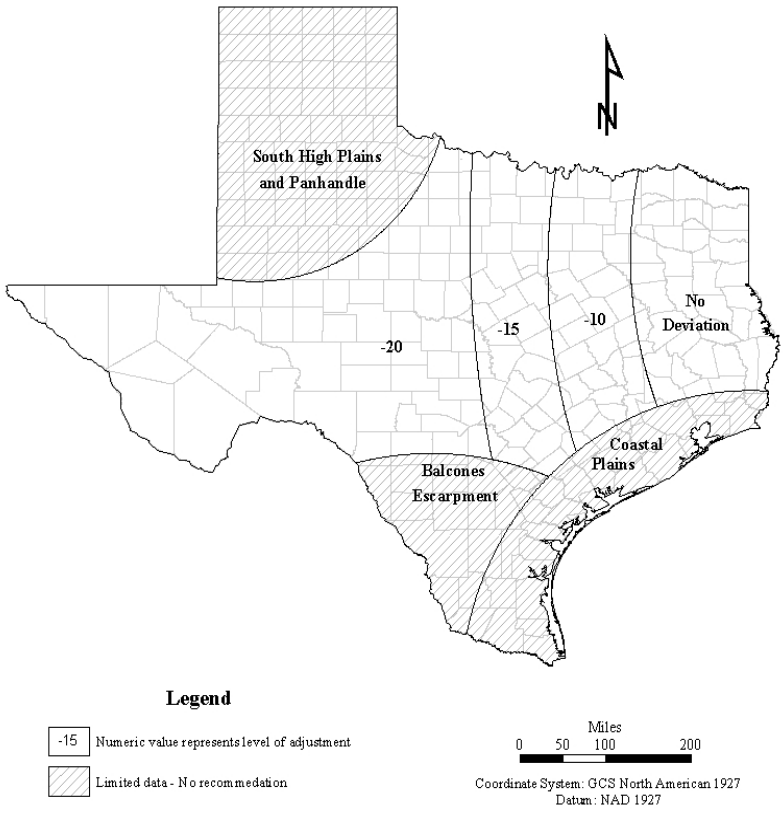

Figure 1. Suggested design aid based on difference between CN_{obs} and CN_{pred}

A lower bound equivalent to the curve number for AMC I, or a curve number of 60, whichever is greater, should be considered.

Judgment is required for application of any hydrologic tool. The adjustments presented in Figure 1 are no exception. A lower limit of AMC I (dry antecedent conditions) may be used to prevent an overadjustment downward. For areas that have few study watersheds, the Hailey and McGill approach should provide some guidance for the amount of reduction to CN_{pred} that is appropriate, if any.

Furthermore, application of the tool is not meant to be used to adjust the risk associated with a particular event. It is intended to provide a more realistic estimate of the curve number, and hence an estimate of the peak discharge, expected at a particular site. The risk of exceedence is defined by the choice of return interval for the design.

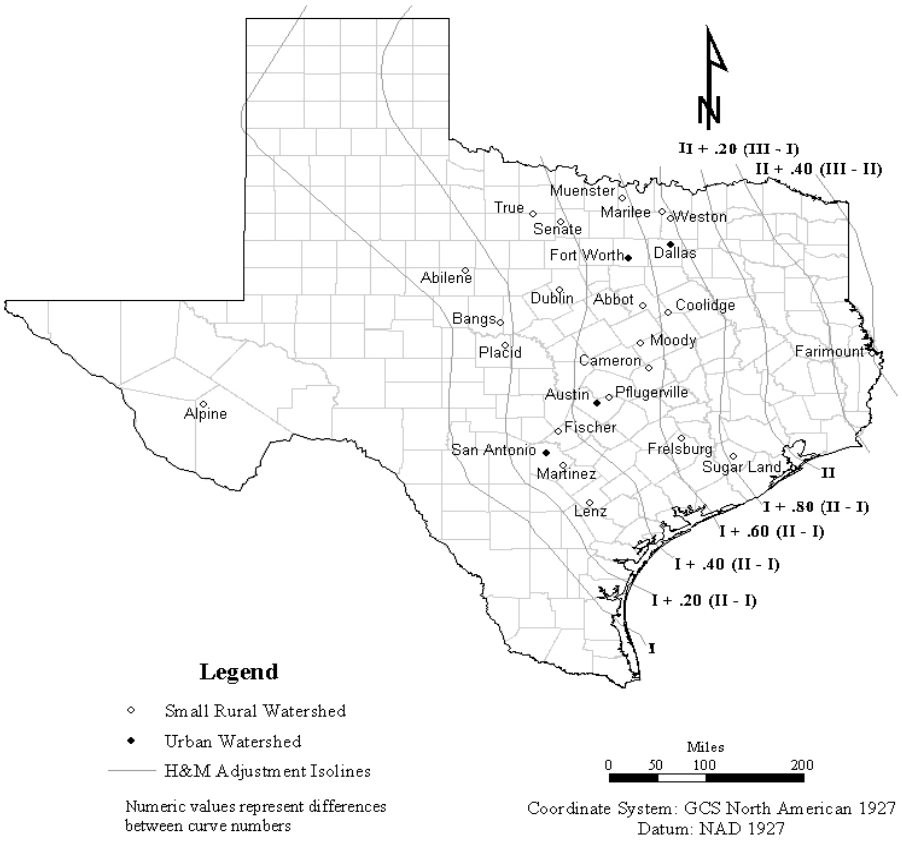

Figure 2. The Hailey and McGill (1983) map for adjustment of NRCS curve number.

For More Details…

The research is documented in the following reports:

Report No. 0-2104 - Climatic Adjustments of Natural Resource Conservation Service (NRCS) Runoff Curve Numbers

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TXDOT IMPLEMENTATION STATUS
RMC 3, August 2004…

The research developed an improved methodology to predict rainfall depth and runoff depth statewide for use in hydraulic design. The application of the new hydraulic design tool is straightforward and easy to use. The new hydraulic methodology will be implemented statewide by the TxDOT Bridge Division by future incorporation into the online TxDOT Hydraulic Design Manual.

For more information, contact; Sharon Barta, P.E., RTI Resarch Engineer, at (512) 465-7403 or email sbarta@dot.state.tx.us.

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