TEXAS

ENGINEERING TECHNICAL NOTE

Subject : HYDROLOGY

No. : 210-18-TX8

Reference : GUIDE TO DETERMINE INSTANTANEOUS PEAK FLOW FOR FLATLAND AREAS

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Guide to Determine Instantaneous Peak Flow for Flatland Areas

This technical note is basically the same as EWP Technical Guide - 40 which was issued in 1971. The procedure was developed to provide a simple method to determine instantaneous peak flow in "flatland" areas. Design of channel improvements and drainage structures in "flatland" areas where discharge by frequency is required, should be based on the instantaneous peak discharge and its related stage rather than on the "removal" rate concept used in normal drainage ditch design. (See Figure 3.)

Studies have been made by the Agricultural Research Service to determine the ratio between the instantaneous peak flow and the maximum 24-hour average "removal" rate. (See attached Figure No. 1.) Further details of the ARS studies are contained in their publication ARS-41-95 "Using the Cypress Creek Formula to Estimate Runoff Rates in the Southern Coastal Plain and Adjacent Flatwoods Land Resource Areas" by Stephens and Mills.

The procedure developed by Stephens and Mills shall only be used in the "flatland" areas. Watersheds that have benches or geologic terraces or slopes that exceed .002 may be outside of the range of use for this Technical Note because of the possibility of under estimation of peak discharges. For these conditions other methods such as TR-20, TR-48 (DAMS2), Chapter 2 EFM, or statistical analysis of stream gage data should be the appropriate procedure to use for determination of peak discharges by frequency.

The following examples illustrate the use of the Technical Note

PROCEDURE TO DETERMINE INSTANTANEOUS PEAK FLOW FOR FLATLAND AREAS

Example No. 1

To determine the instantaneous 100-year peak discharge at a proposed location for a full-flow open structure. Given the following basic data:

a. The 100-year 24-hour rainfall is 12.0 inches

b. The runoff curve number is 80.

c. The 24-hour runoff (Re) is 9.45 inches.

d. The Cypress Creek "C" value, using the Stephens-Mills formula, gives:

$$C = 16.39 + 14.75(Re) = 16.39 + 14.75(9.45) = 155.8$$

Use C = 156

e. The total drainage area at the cross section is 1.75 square miles.

f. The "removal" rate discharge:

$$Q = CM^{5/6} = 156(1.75)^{5/6} = 249 \text{ cfs}$$

g. Using the attached Figure 1 to obtain the ratio of the instantaneous peak to the "removal" rate discharge at 1.75 square miles gives a factor of 1.90.

h. The instantaneous peak discharge q = 249 (1.90) = 473 cfs.

i. Use this peak to hydraulically proportion the full-flow open structure for total design capacity.

<u>Example No. 2</u>

Assume the preceding example is for a watershed in an urban area which has no developed system of storm sewers. In the event that 20 percent of the urban area in Example No. 1 were served by storm sewers, use Figure 2 to determine the increase in instantaneous discharge to design a channel to carry the 100-year peak discharge. For this condition, the discharge for Example No. 1 would need to be increased by 14 percent, resulting in an instantaneous 100-year peak of 539 cfs.

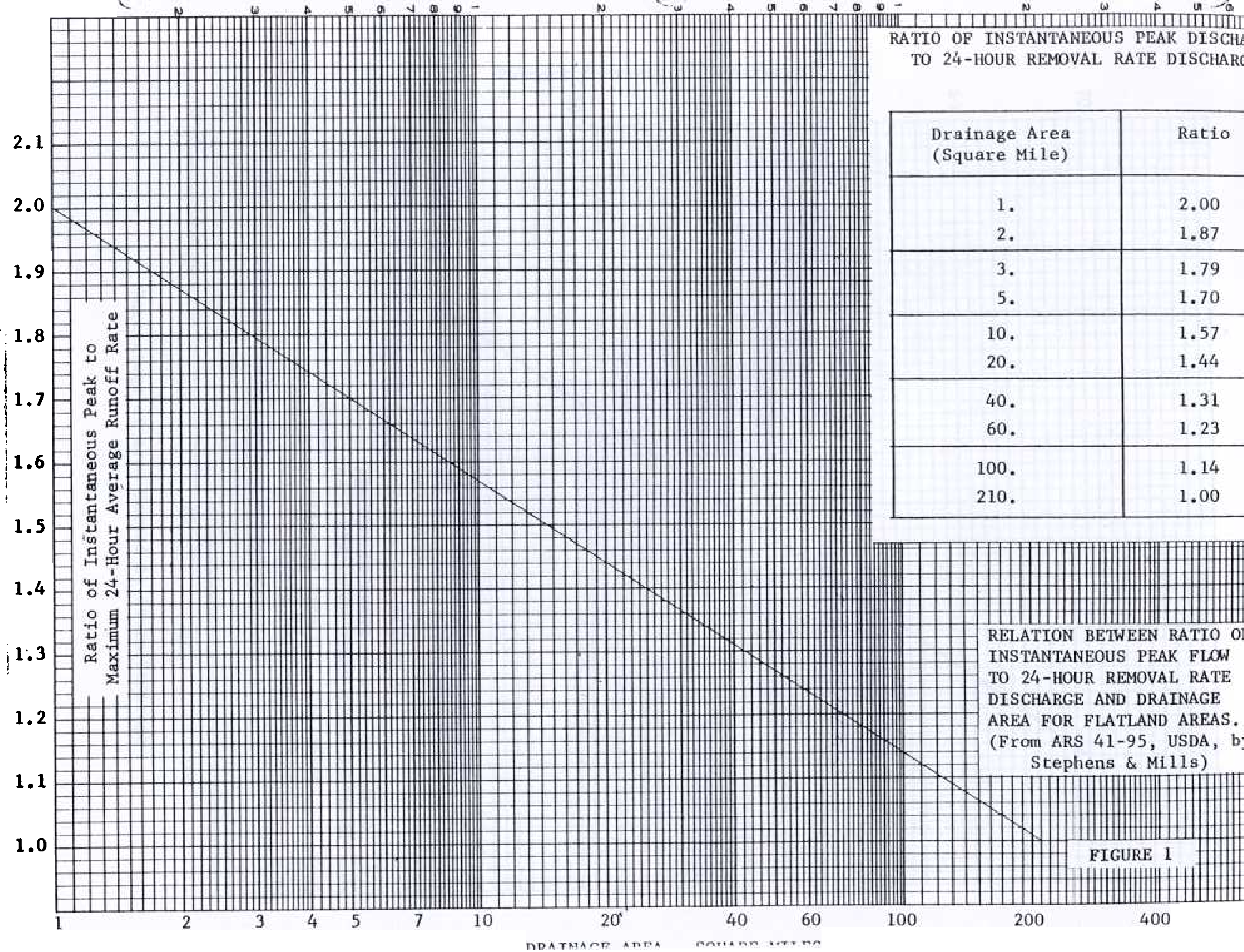
U.S. Geological Survey Circular 554, "Hydrology for Urban Land Planning - A Guidebook on the Hydrologic Effects of Urban Land Use," presents an excellent summary of the effects of urbanization on peak discharges. This bulletin shows the effect of two factors, i.e., (a) the percentage of area served by storm sewers, and (b) the effect of changes in percentage of area impervious. The attached Figure 2 was developed to show only the effect of storm sewerage, since the percent imperviousness will be reflected in the selection of the runoff curve number used in determining the Cypress Creek "C" value.

<u>Example No. 3</u>

To determine the 100-year peak discharge at a cross section where the total drainage consists of both urban and rural runoff contribution. In this situatiion, determine a composite runoff curve number for the drainage area and proceed as in Example No. 1.

RATIO OF INSTANTANEOUS PEAK DISCHAR
TO 24-HOUR REMOVAL RATE DISCHARG

Drainage Area (Square Mile)	Ratio
1.	2.00
2.	1.87
3.	1.79
5.	1.70
10.	1.57
20.	1.44
40.	1.31
60.	1.23
100.	1.14
210.	1.00



RELATION BETWEEN RATIO OF INSTANTANEOUS PEAK FLOW TO 24-HOUR REMOVAL RATE DISCHARGE AND DRAINAGE AREA FOR FLATLAND AREAS. (From ARS 41-95, USDA, by Stephens & Mills)

FIGURE 1

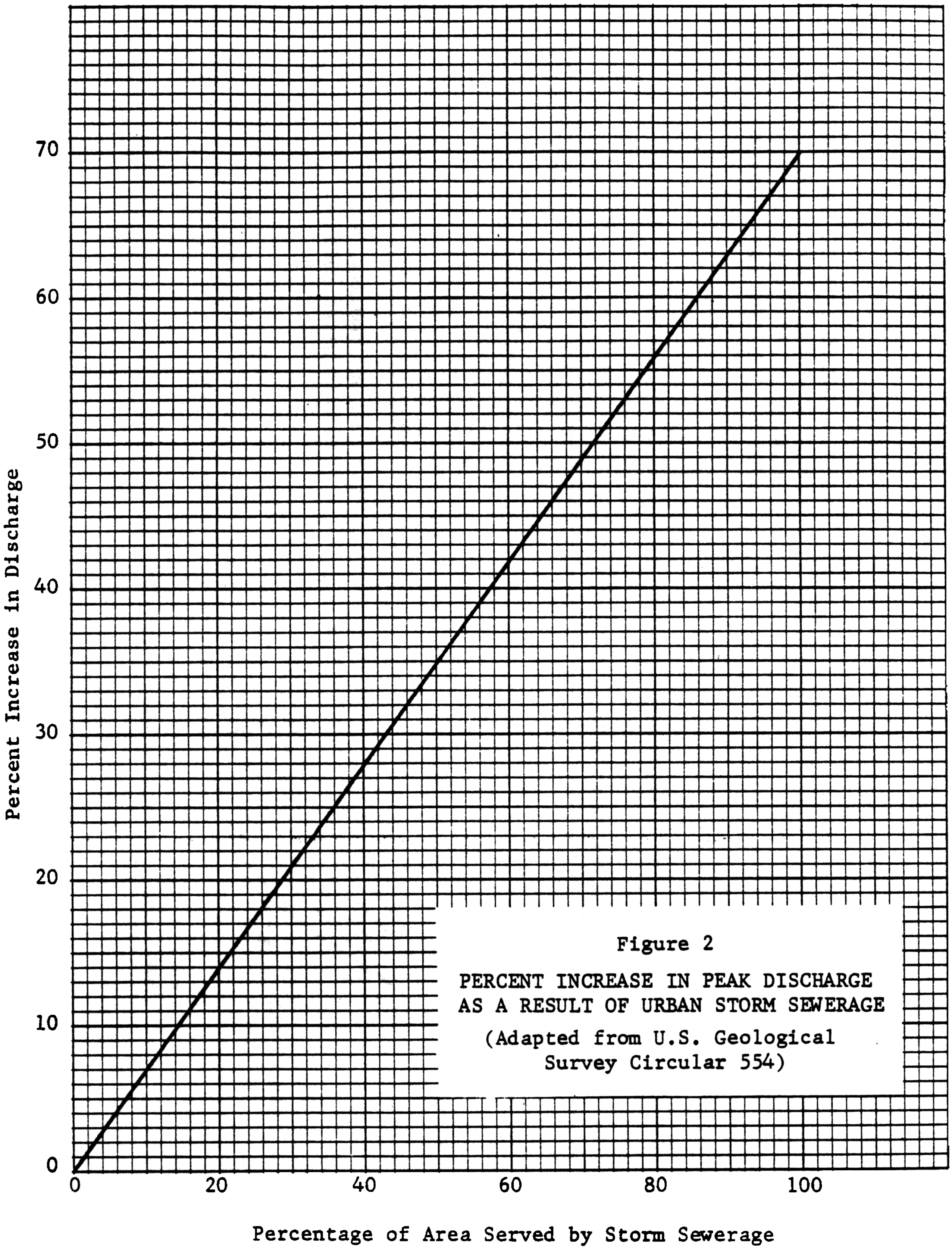


Figure 2

PERCENT INCREASE IN PEAK DISCHARGE AS A RESULT OF URBAN STORM SEWERAGE

(Adapted from U.S. Geological Survey Circular 554)

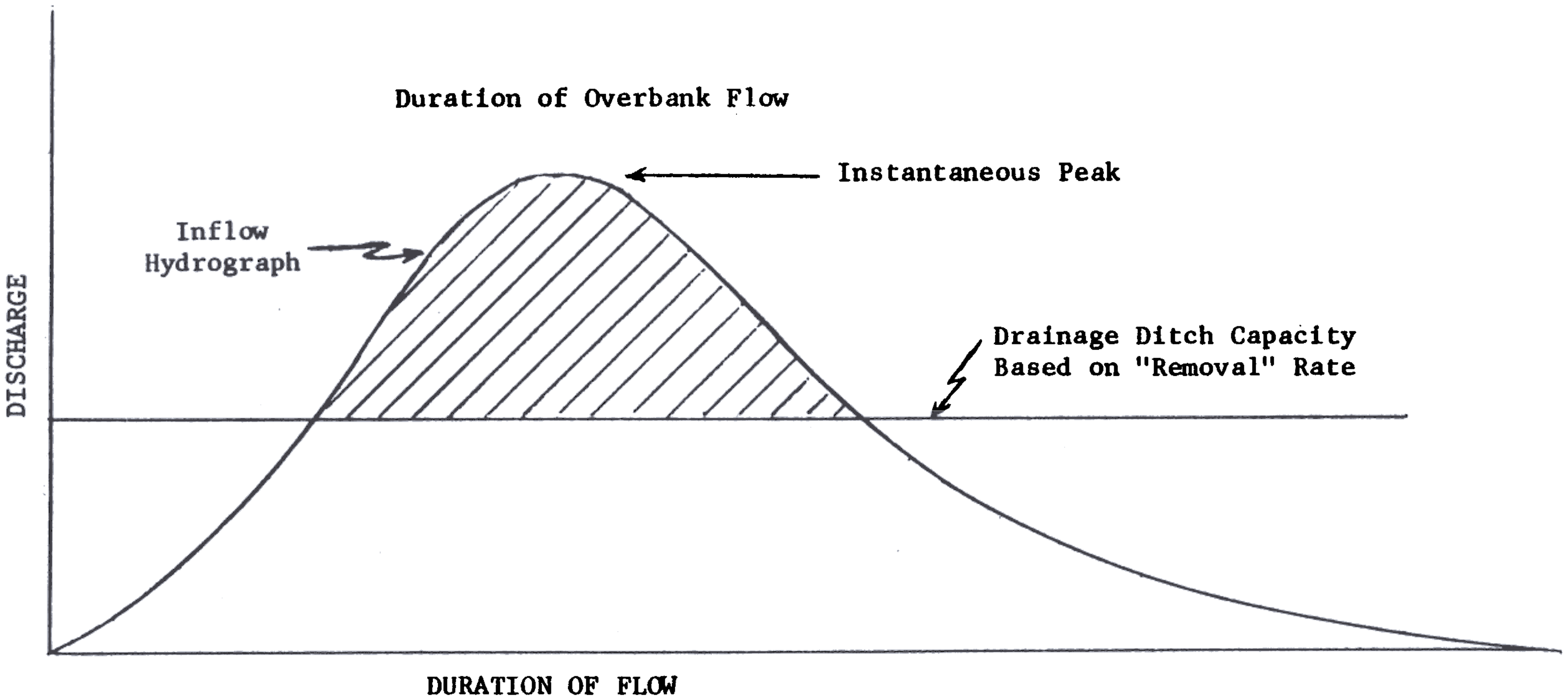


Figure 3

TYPICAL ILLUSTRATION - SHOWING RELATION BETWEEN DRAINAGE DITCH "REMOVAL" RATE CAPACITY AND INSTANTANEOUS PEAK OF THE INFLOW HYDROGRAPH