Form 9-014

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WASHINGTON, D. C. 20242

[Reports-Open file series]

not M
em
VTW___

EQUATION FOR ESTIMATING

REGIONAL FLOOD DEPTH - FREQUENCY RELATION

FOR VIRGINIA

By

E. M. Miller

1977

Open-File Report 77-396

UNITED STATES

DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

EQUATION FOR ESTIMATING REGIONAL FLOOD DEPTH - FREQUENCY

RELATION FOR VIRGINIA

arly ˅ cᴛ ᴸ ᶜ

By E. M. Miller

Open-File Report 77-396

Richmond, Virginia

March 1977

CONTENTS

ILLUSTRATION

EQUATION FOR ESTIMATING REGIONAL FLOOD DEPTH - FREQUENCY RELATION FOR VIRGINIA

By E. M. Miller

ABSTRACT

A regional relation is defined for estimating the depth of flooding on natural-flow streams in Virginia having a recurrence interval of 100-years. Drainage area is the only independent variable required.

1

PURPOSE AND SCOPE

The purpose of this report is to make available the results of a flood-depth-frequency study for Virginia. The drainage basin size was found to be the most significant of all parameters used.

The equation is given for computation of flood depths for the 100-year flood.

DETERMINATION OF FLOOD-DEPTH RELATION

Streamflow and stage records were used for 163 gaging stations on streams draining basins of 1.5 to 7,300 square miles (3.9 to 18,900 square kilometers) with natural channels and rural development.

Discharges for the 2-year and 100-year floods were obtained from individual station frequency curves. The U.S. Water Resources Council (1976) guidelines for determining flood-flow frequency were used to compute these curves. Gage heights for the 2-year and 100-year discharges were taken from defined station ratings or from ratings extended by straight-line log plot. The gage-heights for the 2-year flood were substracted from the 100-year flood gage heights to define the 100-year flood depths.

Bankfull stage is the stage above which extensive overflow occurs on one or both banks of the stream. Minor flooding of low areas adjacent to the stream is not

considered in arriving at a figure for bankfull stage. Bankfull stage has been determined and published for 149 of the 163 stations used. The bankfull stage is the same as the 2-year flood gage height for 32 stations; 92 stations are within $\pm$ 1 foot; and 111 stations are within $\pm$ 2 feet of the 2-year flood gage height. Bankfull stage can be determined in the field or from topographic maps.

The 100-year flood height above bankfull stage was regressed against the following areal parameters for 163 stations:

A   Drainage area, in square miles.

S   Main channel slope, in feet per mile.

L   Main channel length, in miles.

F   Forested area, in percentage of drainage area.

The step-backward regression program used allows analysis of significance of the independent parameters. A plot of residuals did not indicate any regional bias. It was determined that the 100-year flood depths related principally to a 0.2 power of the drainage area as follows:

$$D_{100} = 3.2 \ A^{0.2},$$

where D_{100} is the 100-year flood depth, in feet.

A is the drainage area, in square miles.

The standard error of the flood-depth relation is 37 percent. The relation is applicable to natural

channels on unregulated streams in Virginia. It does
not apply to tide-affected reaches.

The 100-year-flood-depth relationship has been used
to delineate flood-prone areas of streams in Virginia.
The user is cautioned, however, not to work backward
with this relationship to obtain 100-year flood discharges.
The possible variety of channel shapes may make the error
several times that determined in this relationship. A
plot of the relationship is shown in figure 1.

SELECTED REFERENCES

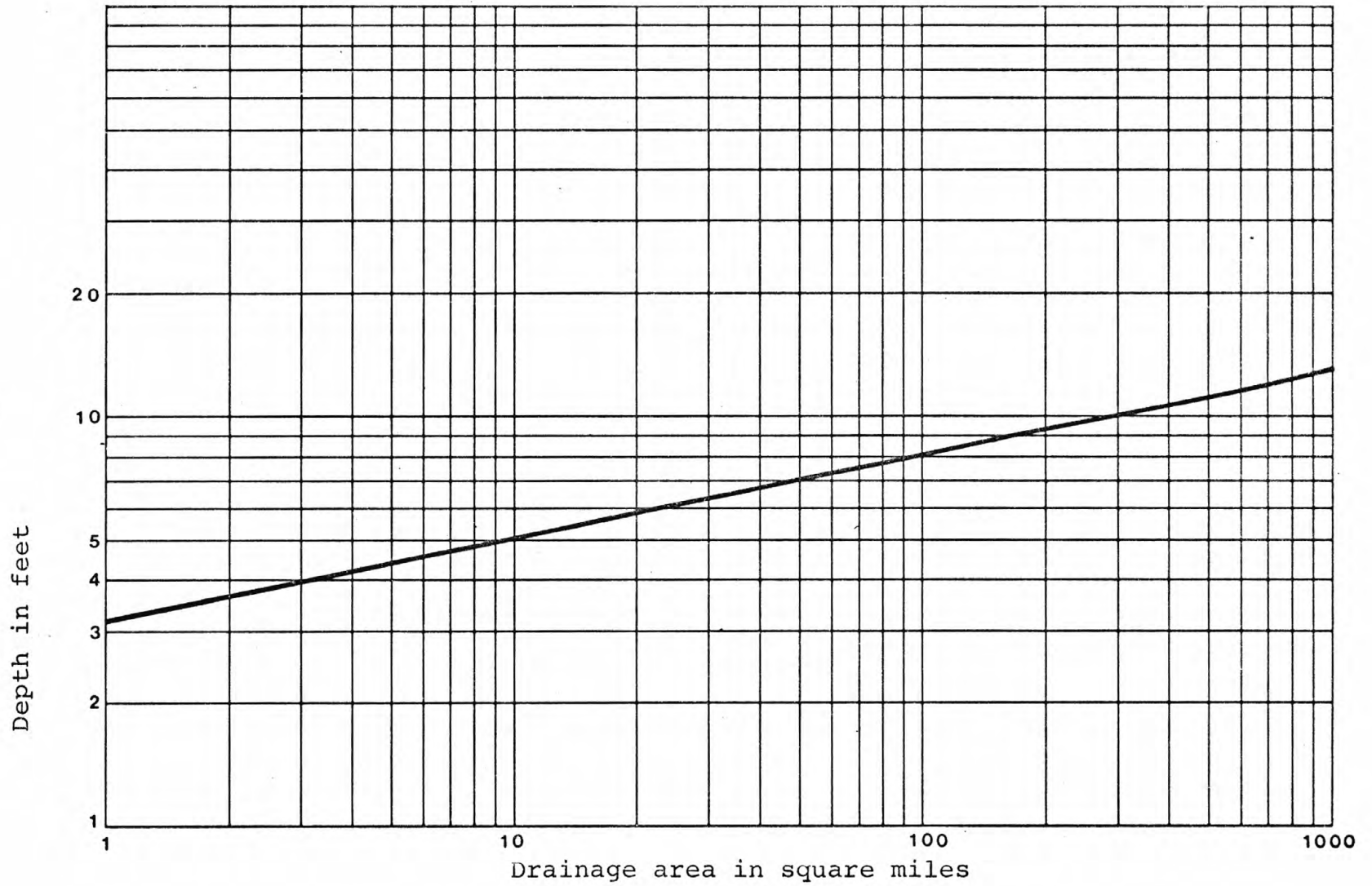Water Resources Council, 1976, Guidelines for determining flood-flow frequency: Bull. 17, 26 p.

Figure 1.--Relationship of 100-year flood depth to size of drainage area.