STATE OF ARKANSAS

ARKANSAS GEOLOGICAL COMMISSION

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WATER RESOURCES SUMMARY NUMBER 12

GRAPHS FOR DETERMINING THE APPROXIMATE ELEVATION OF THE

50-YEAR FLOOD IN ARKANSAS

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ILLUSTRATIONS

GRAPHS FOR DETERMINING THE APPROXIMATE ELEVATION OF THE
50-YEAR FLOOD IN ARKANSAS

By Marion S. Hines

INTRODUCTION

Recognition of flood-prone areas is necessary for the orderly
development and growth of Arkansas. Serious economic loss may result
from improper development and use of flood plains. As an aid to flood-
plain management, this report describes a method by which the elevation
of the 50-year flood may be estimated for sites where virtually natural
flooding conditions exist.

DATA AND ANALYSIS

Streamflow records at 58 sites in Arkansas where the floodflow
conditions are virtually natural were used to determine the difference
in water-surface elevation between the 50-year flood and the 50-percent
duration (median) flows. These values were then used to define graphically
the regional average elevation difference as a function of drainage-area
size. Because of the variations in topography, three data plots were
necessary. One plot represent average conditions in the delta, areas of
slight relief north and east of the Arkansas River in the Coastal Plain,
and including the main stem of the Black River (fig. 1); another plot
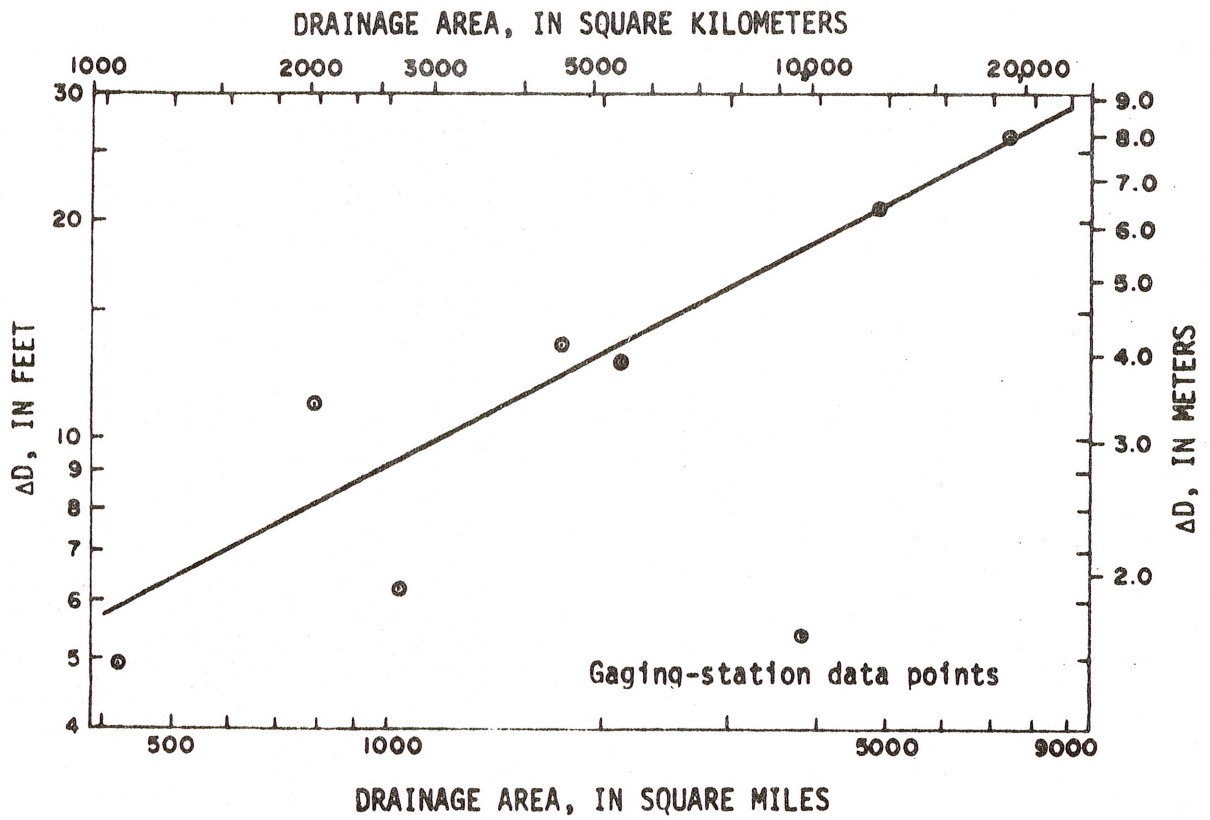represents average conditions in the hills south and west of the Arkansas

Figure 1.— Elevation of 50-year floodflow minus elevation of 50-percent
duration flow (ΔD) versus drainage area for the delta and the Black
River main stem.

River in the Coastal Plain, but also includes the Cossatot River, Spring
River, Eleven Point River, Big Creek, Bayou Bartholomew, and the St.
Francis River main stem (fig. 2); and the other plot represents average
conditions in the mountains, but also includes the Tyronza River main
stem (fig. 3).

The magnitude of the 50-year floodflow was taken from Patterson
(1971) and the magnitude of the 50-percent duration flow was taken from
Hines (1975). Elevations for the 50-year floodflow and the 50-percent
duration flow were determined from the most recent stage-discharge
relationship tables or curves as defined for each gaging station. The
elevation of the 50-percent duration flow was subtracted from the eleva-
tion of the 50-year floodflow, resulting in a difference in elevation
between the 50-year flood and the 50-percent duration (median) flow; this
value is shown as ΔD on the data plots. Drainage area at the gaging site
was the other parameter used. Some scatter of the data points may be
attributed to shift in the controls that is normally experienced at gaging
stations that have natural controls.

USE AND ACCURACY OF GRAPHS

The accompanying three graphs (figs. 1, 2, and 3) may be used to
determine the approximate elevation of the 50-year flood at a site or
along a reach of stream. Figure 4 shows the geographic areas corre-
sponding to those on the graphs and the locations of sites where data were
collected. This figure may be used to select the graph corresponding to
the geographic location of the stream for which flood elevations are
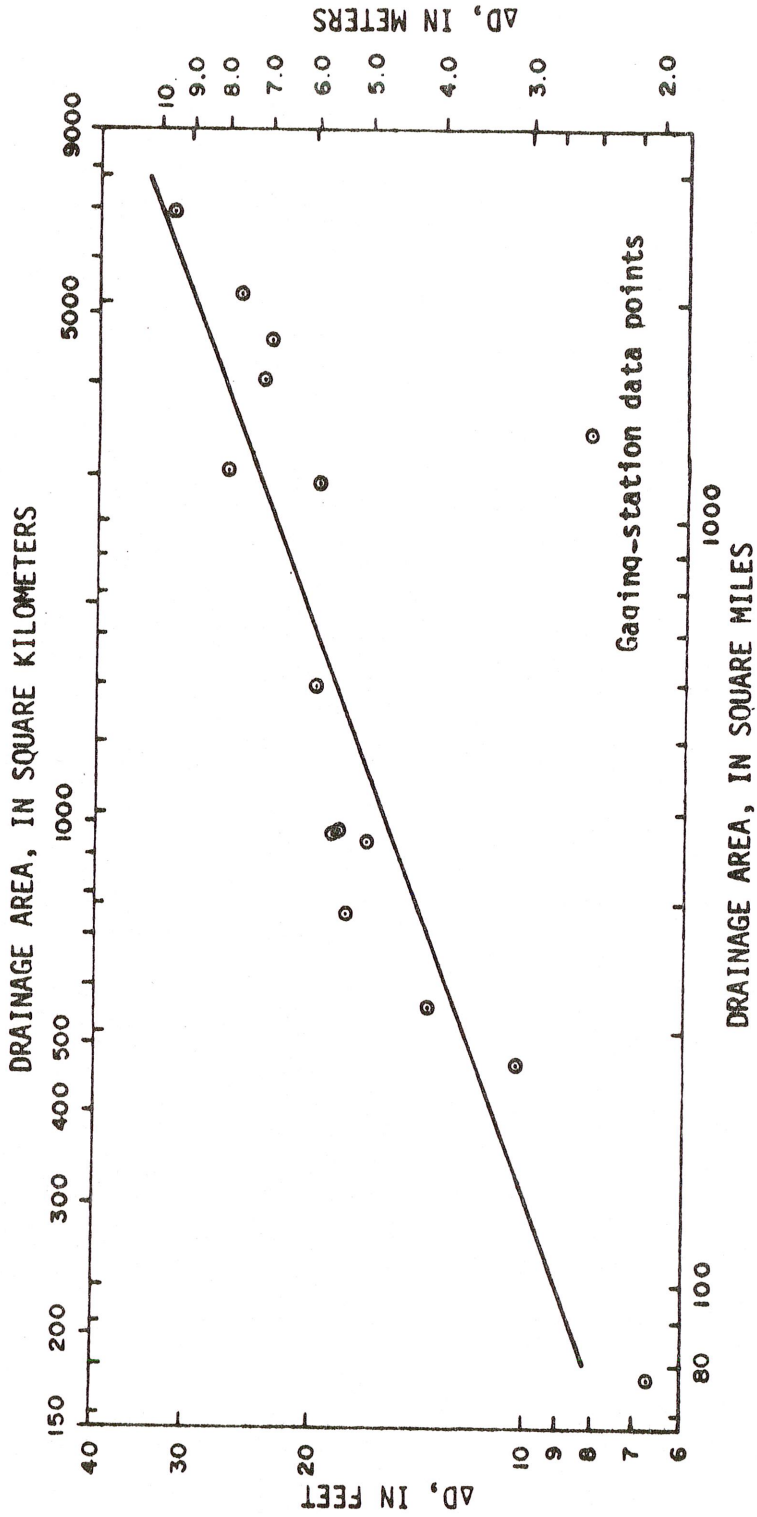desired. To use the graphs, it is necessary first to determine the

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Figure 2.—Elevation of 50-year floodflow minus elevation of 50-percent duration flow (ΔD) versus drainage area for the hills, Cossatot River, Spring River, Eleven Point River, Big Creek, Bayou Bartholomew, and the St. Francis River main stem.
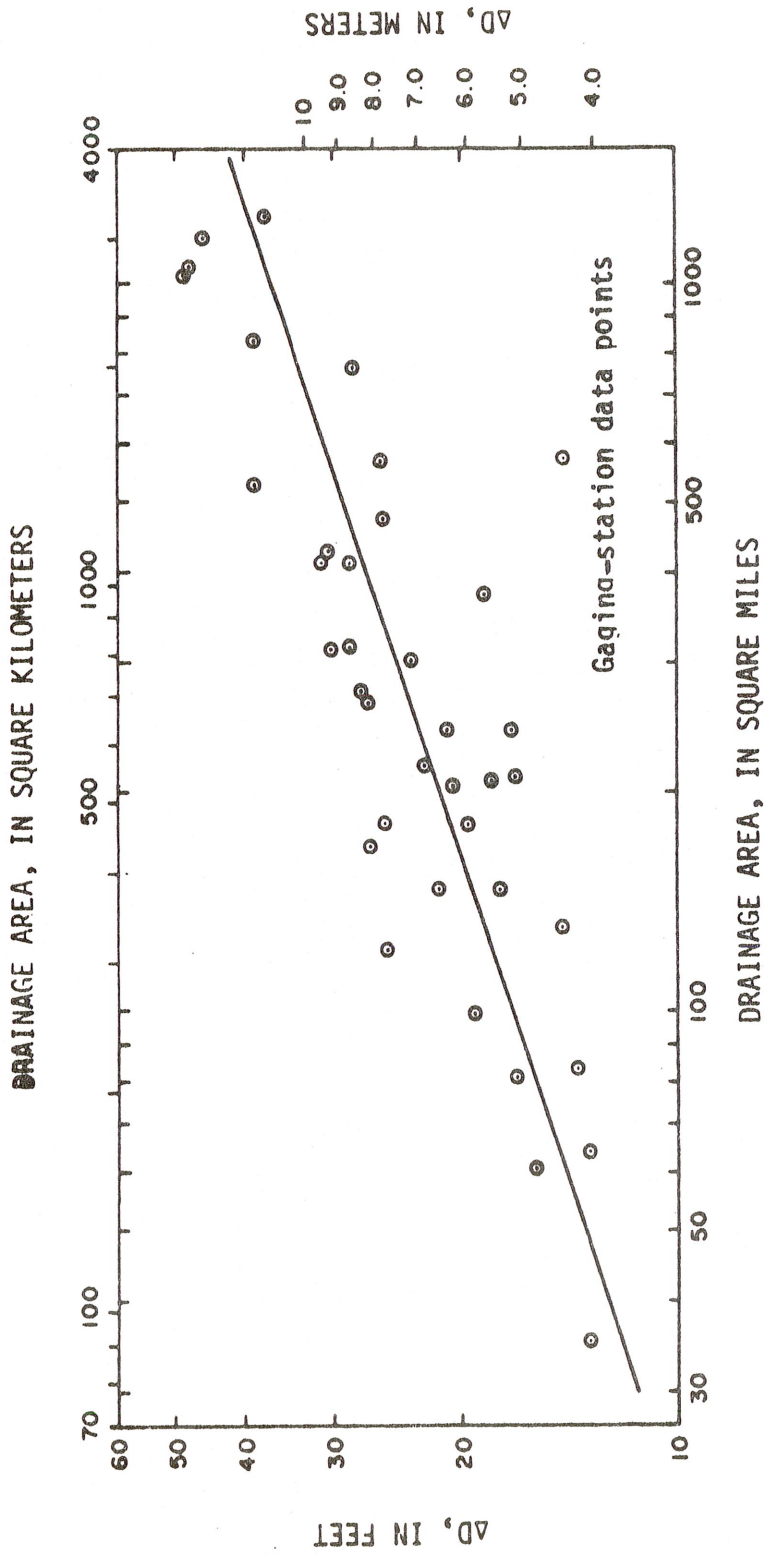
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Figure 3.— Elevation of 50-year floodflow minus elevation of 50-percent duration flow (ΔD) versus drainage area for the mountains and the Tyronza River main stem.
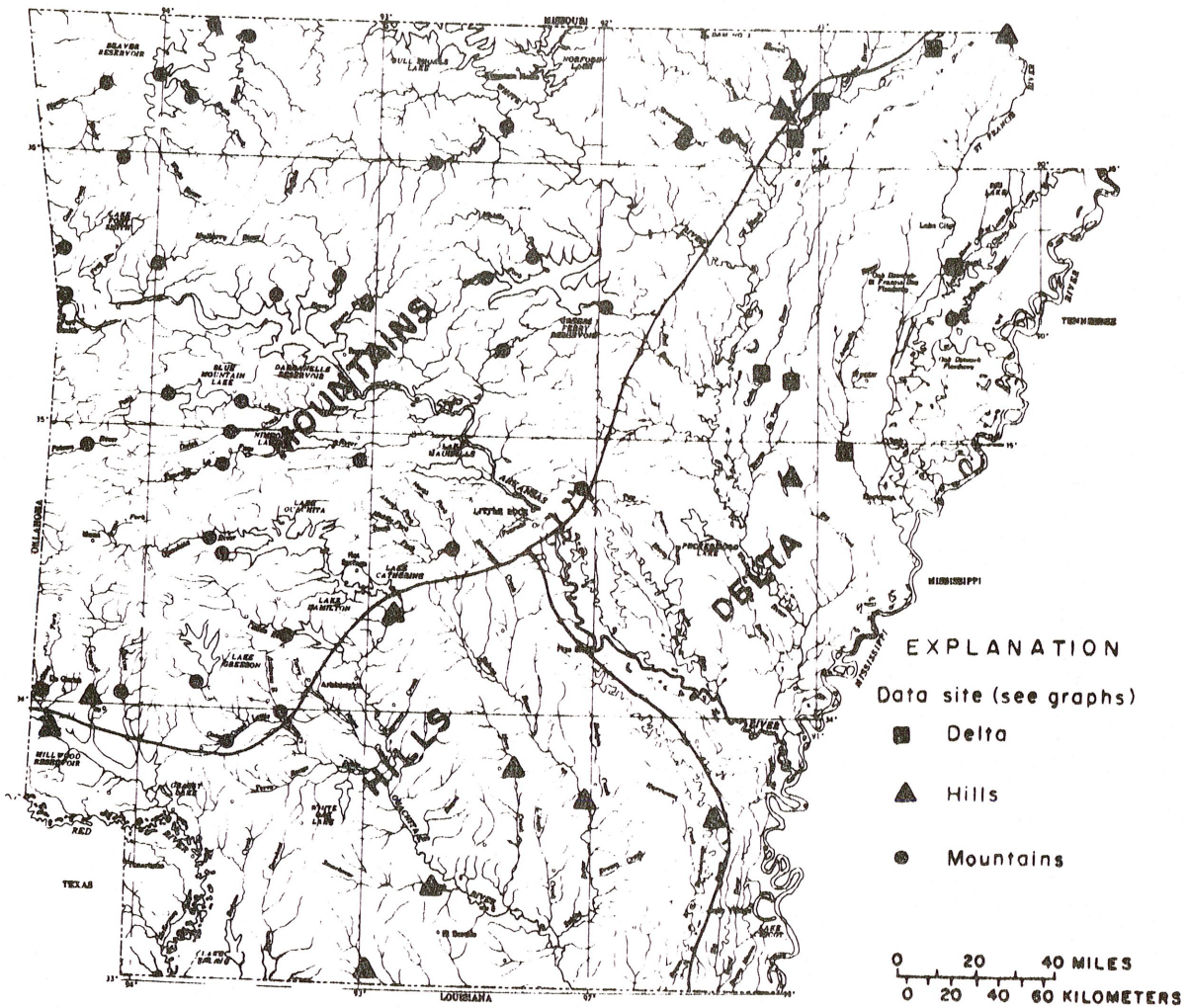
Figure 4.—Geographic divisions of Arkansas for use with figures 1-3, inclusive.

elevation of the 50-percent duration (median) flow, either from a topo-graphic map or from field observations, and second to add the ΔD value from the graph to that elevation. A reasonable assumption is that the contour "turnbacks" on streams (where the contour lines cross the stream) are at the elevation of median flow. Streams are more likely to experi-ence median flow when vegetation is dormant in late fall and winter, which often coincides with the time when the aerial photographs were taken for constructing the topographic maps.

There are, or have been, one or more gaging stations on many streams in Arkansas. Hines (1975) analyzed records for 107 continuous-record gaging stations (stage and discharge). These records provided the 50-percent duration (median) flow for this report. There are many additional sites where stage readings only have been collected and more than 100 sites where stage and peak flow have been collected. All of the records mentioned should be reviewed for applicability to flood studies. The accompanying graphs are intended for use in the absence, or in support, of other stream-flow data. Methods requiring extensive field surveys are available to accurately determine the elevation and peak flow of design floods and should be used if the additional accuracy is required. An experienced hydrologist should be consulted in the use of these graphs or in the use of the more accurate computational procedures.

If all data points plotted on the curves of figures 1-3, the graphs would still only be applicable at the data sites. However, the graphs are considered equally representative of other sites because the curve is drawn as an average experience of many sites. The graphs represent virtually natural conditions, and the effects of any alternation to streamflow must be evaluated and appropriate adjustments made to values of ΔD. The

following table is intended to assist in an evaluation of the accuracy
of the graphs.

Graph	Graphical standard error (percent)
Figure 1	33
Figure 2	21
Figure 3	20

The accompanying graphs were originally intended for use in estimating
the elevation of the 50-year flood at a site or along a reach of stream,
not so much to determine how high the water will be but rather the area
that would be subject to flooding. It is very difficult to determine the
size of the flooded area in the delta. In the hills and mountains, however,
the pronounced change in relief at the edge of the flood plain allows a
reasonably accurate representation of the flooded area, even though there
may be an error in the estimated elevation of the 50-year flood.

Flood-prone-area maps depicting the 50-year flood were prepared in
the following manner:

1. Mileage along the stream was measured from some feature
    identifiable on a topographic map.

2. A median-flow (50-percent duration) profile was plotted using
    elevation of topographic contour "turnbacks" and river
    mileage (miles versus elevation).

3. The drainage area at selected points along the stream was
    obtained, and mileage at these points was noted.

4. From the graph selected for the particular area, ΔD was
    listed for each drainage-area point.

5. ΔD values were added to elevation of median-flow profile at the approximate mileage points corresponding to drainage-area points (miles versus elevation of "turnback," plus ΔD). A line connecting these points is an approximate 50-year flood profile.

6. The intersection of the 50-year flood profile and the ground surface was located as defined by contour lines.

The flood-prone maps for areas in Arkansas may be obtained from:

> U.S. Geological Survey
> 2301 Federal Office Building
> Little Rock, Arkansas 72201
>
> or
>
> Arkansas Geological Commission
> 3815 West Roosevelt Road
> Little Rock, Arkansas 72204

REFERENCES

Edelen, G. W., Jr., 1973, Guidelines for preparation, transmittal, and distribution of flood-prone area maps and pamphlets: U.S. Geol. Survey open-file report, 30 p.

Gann, E. E., 1968, Flood height-frequency relations for the plains area in Missouri: U.S. Geol. Survey Prof. Paper 600-D, p. 52-53.

Hines, M. S., 1975, Flow-duration and low-flow frequency determinations of selected Arkansas streams: Arkansas Geol. Comm. Water Resources Circ. 12, 75 p.

Patterson, J. L., 1971, Floods in Arkansas, magnitude and frequency characteristics through 1968: Arkansas Geol. Comm. Water Resources Circ. 11, 21 p.