TECHNIQUE FOR ESTIMATING MAGNITUDE AND FREQUENCY OF FLOODS IN KENTUCKY

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations 76-62

Prepared in cooperation with

THE UNIVERSITY OF KENTUCKY
KENTUCKY GEOLOGICAL SURVEY
Wallace W. Hagan
Director and State Geologist

BIBLIOGRAPHIC DATA SHEET	1. Report No.	2.	3. Recipient's Accession No.

4. Title and Subtitle	5. Report Date
TECHNIQUE FOR ESTIMATING MAGNITUDE AND FREQUENCY OF FLOODS IN KENTUCKY	Issued November 1976
	6.
7. Author(s) Curtis H. Hannum	8. Performing Organization Rept. No. USGS/WRI-76-62
9. Performing Organization Name and Address U.S. Geological Survey Water Resources Division 600 Federal Place Louisville, Kentucky 40202	10. Project/Task/Work Unit No. 11. Contract/Grant No.
12. Sponsoring Organization Name and Address U.S. Geological Survey Water Resources Division 600 Federal Place Louisville, Kentucky 40202	13. Type of Report & Period Covered 14.

15. Supplementary Notes

Report prepared in cooperation with the Kentucky Geological Survey

16. Abstracts This report presents flood magnitude and frequency relations applicable to unregulated streams in Kentucky. The relations are based on flood data at 117 gaging stations in Kentucky and 14 in adjacent states having 10 or more years of record not significantly affected by man-made changes. Equations that relate flood magnitude and frequency to contributing drainage area in 16 geographic areas may be used to estimate magnitude of future floods with recurrence intervals of as much as 100 years on gaged and ungaged streams having drainage areas of 10 to 4,300 square miles (25.9 to 11,100 square kilometres). Estimating equations are also presented in graphical form for the convenience of the user. Additional graphs are presented to estimate flood magnitude for selected recurrence intervals along the Cumberland, Kentucky, and Ohio Rivers.

17. Key Words and Document Analysis. 17a. Descriptors

Technique for estimating, Magnitude and frequency, Equations, Kentucky, Natural flow, Streams

17b. Identifiers/Open-Ended Terms

Flood magnitude and frequency

17c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report)	21. No. of Pages
No restriction on distribution	UNCLASSIFIED	70
	20. Security Class (This Page) UNCLASSIFIED	22. Price

TECHNIQUE FOR ESTIMATING MAGNITUDE AND FREQUENCY OF FLOODS IN KENTUCKY

By Curtis H. Hannum

U. S. GEOLOGICAL SURVEY

Water-Resources Investigations 76-62

Prepared in cooperation with

THE UNIVERSITY OF KENTUCKY
KENTUCKY GEOLOGICAL SURVEY
Wallace W. Hagan
Director and State Geologist

November 1976

UNITED STATES DEPARTMENT OF THE INTERIOR

Thomas S. Kleppe, Secretary

GEOLOGICAL SURVEY

Vincent E. McKelvey, Director

For additional information write to:

U.S. Geological Survey
Room 572 Federal Building
Louisville, Kentucky 40202

CONTENTS

ILLUSTRATIONS

TABLES

FACTORS FOR CONVERTING ENGLISH UNITS TO METRIC UNITS

Multiply English units	By	To obtain Metric units
	LENGTH	
Feet (ft)	0.3048	Metres (m)
Miles (mi)	1.609	Kilometres (km)
	AREA	
Square miles (mi^2)	2.590	Square kilometres (km^2)
	FLOW	
Cubic feet per second (ft^3/s)	.02832	Cubic metres per second (m^3/s)

Metric units can not be used in the regression equations. To determine discharge in metric units for a given frequency, compute the discharge using English units and convert to metric units by multiplying by 0.02832.

Due to space limitations, metric equivalents are not shown in tables.

Technique for Estimating Magnitude and Frequency of Floods in Kentucky

By Curtis H. Hannum

ABSTRACT

This report presents flood magnitude and frequency relations applicable to unregulated streams in Kentucky. The relations are based on flood data at 117 gaging stations in Kentucky and 14 in adjacent states having 10 or more years of record not significantly affected by man-made changes. Equations that relate flood magnitude and frequency to contributing drainage area in 16 geographic areas may be used to estimate magnitude of future floods with recurrence intervals of as much as 100 years on gaged and ungaged streams having drainage areas of 10 to 4,300 square miles (25.9 to 11,100 square kilometres). Estimating equations are also presented in graphical form for the convenience of the user. Additional graphs are presented to estimate flood magnitude for selected recurrence intervals along the Cumberland, Kentucky, and Ohio Rivers.

INTRODUCTION

Flood magnitude and frequency are primary factors in the design of structures in the flood plains of streams. This report presents equations determined by flood-frequency analysis which can be used to estimate magnitude and frequency of floods for sites on most streams where flood discharges are not significantly affected by regulation or urbanization.

The evaluation of flood potential is necessary in the design of structures such as bridges, culverts, highways, sewage disposal plants, water-works, levees, and dams within the flood plain. The cost of flood proofing a structure should be balanced against the probable damage caused by flooding during the life of the structure. The selection of the magnitude of the flood to be considered in designing a structure is usually determined on the basis of some definite frequency of recurrence. For example, drainage structures on the Federal Interstate Highway System are usually designed to pass a flood of 50-year recurrence interval or the maximum known flood, whichever is greater, and checked for the 100-year flood.

A recurrence interval criterion in no way implies that once a flood of the magnitude of the 50-year flood, or greater, has occurred that it will not occur for another 50 years. During any given year there is a 2 percent chance (probability of 0.02) that the magnitude of a 50-year flood will be exceeded. The frequency or recurrence interval of floods is the average time in years between floods of a given magnitude over a long period of time based on past flood experience.

It is not possible to anticipate all sites where flood information might be needed, and it is not economically feasible to collect flood data at all potential sites. The purpose of this report is to provide methods for determining flood magnitude and frequency at ungaged sites as well as at existing gaging stations.

Log Pearson Type III flood-frequency curves were computed using annual peaks for each gaging station with 10 or more years of record not significantly affected by regulation or urbanization. Accuracy of individual station frequency curves is affected by time sampling errors, and by the assumption that the Log Pearson Type III fitting process is correct. Variation of coefficient of skew between adjacent gaging stations is an indication of the time-sampling errors. Map skews suggested by Hardison, 1974, were used in this report to partially overcome the variability of coefficient of skew. For further information see the section on Frequency Analysis at Gaging Stations and the reference to Hardison, 1974.

Individual gaging station flood-frequency data for 131 gaging stations including 14 in adjacent states were used in a regression analysis to relate flood frequency to basin parameters. These relations allow the user to estimate flood frequency at ungaged sites. The flood relationships are presented both mathematically and graphically and apply to all natural streams within designated areas in Kentucky. This study does not evaluate the effects of urbanization, flood-control reservoirs, or other activities in a drainage basin which might affect flood-peak discharges.

All information contained in this report is subject to revision upon the acquisition of additional data.

ESTIMATING TECHNIQUE

Flood magnitude for a given recurrence interval can usually be estimated more reliably at a stream-gaging station, and for a short distance upstream or downstream from a gage on the same stream, than from regression equations. Therefore, the first step in determining flood magnitude at a site should be to search Plate 1 and Table 4 for available gage information. Estimates for "assigned skew" in Table 4 can be used directly at gage sites.

When the site is located between two gages on the same stream determine the flood magnitude for the desired recurrence interval at the upstream and downstream gages using "assigned skew" values from Table 4 and estimate discharge at the site by interpolation on basis of contributing drainage area. If the drainage area at the downstream gage is more than three times that at the upstream gage, use one of the procedures described below.

Flood magnitudes having recurrence intervals of 2, 5, 10, 25, 50, and 100 years may be computed for ungaged, natural flow sites by using the appropriate values of contributing drainage area and geographical factor in equations shown in Table 2. Drainage area (A) in square miles, is the area contributing surface flow to the site. It is determined by planimetering along the drainage divide outlined on 7-1/2 minute topographic maps. Within areas of karst geology (see figure 1), some basins may contain closed areas which do not contribute to surface runoff because of sink holes. The total drainage area of such basins should be adjusted to contributing drainage area by subtracting non-contributing drainage areas determined from 7-1/2 minute topographic maps. As a simplified but less reliable estimate, Figure 2 may be used to approximate contributing drainage area in karst geology. Areal factor (R), is a dimensionless geographical factor which provides an index of the variations in flood peaks with geology and topography. The geographical areas and factors are shown on Plate 1. To simplify the users computations, Table 3 gives the results of (R) raised to the appropriate power for the frequency desired.

Graphical solution of the regression equations are presented for each area in Figures 3-18. Figures 19-21 present graphs to estimate flood magnitude for selected recurrence intervals on the Cumberland River upstream from Lake Cumberland, Kentucky River downstream from Heidelberg and Ohio River downstream from Huntington.

If the site is near a gaging station on the same stream, a weighted value of the ratio of the "assigned skew" magnitude to the regression value at the gage should be used to adjust regression estimate at the ungaged site. This method is not recommended for drainage areas more than twice or less than half the drainage area at the gage site. The weighted estimate of discharge is determined as follows:

$$Q' = K_S Q_R$$

Q' Weighted discharge.

K_S Weighted ratio of "assigned" flood magnitude to regression value at site.

Q_R Discharge estimated by regression equation.

The weighted ratio for the ungaged site is computed as follows:

$$K_S = (K_G - 1)\left(\frac{2A_G - A_S}{A_G}\right) + 1$$ For site downstream from gage

$$K_S = (K_G - 1)\left(\frac{2A_S - A_G}{A_G}\right) + 1$$ For site upstream from gage

K_S Weighted ratio of assigned flood magnitude to regression value at site.

K_G Weighted ratio of assigned flood magnitude to regression value at gage.

A_G Drainage area at gage.

A_S Drainage area at site.

When a stream crosses a regional boundary compute the discharge for the total drainage area for each geographical area and use the weighted discharge based on percent of drainage areas in each geographical area as the final discharge.

Table 4 lists all natural flow stream-gaging stations and high-flow partial-record stations with 10 or more years of record in Kentucky and some stations in surrounding states that were used in preparation of this report. Data presented for each station runs across two pages. Map number identifies the stream-gaging station on both pages of Table 4 and Plate 1. The first line for each station (Computed) shows skew and discharge for indicated frequencies from Log-Pearson Type III flood frequency computations using station data only. The second line (Assigned) shows the assigned skew (Hardison, 1974) used in the Log-Pearson computations and the corresponding discharges. The third line shows the estimate from the regression equations.

The results from the regression equations were used to plot graphical partial solutions of discharge equations shown in graphs, Figures 3-18. Data for Assigned skew was used to plot Figures 19, 20. Computed data was used to plot Figure 21.

In summary, the recommended procedure for estimating flood discharge for a desired frequency is outlined below.

1. Search for availability of stream-gaging information at the site using Plate 1 and Table 4. If gage data is available at the site use assigned skew values of discharge from Table 4 for the desired frequency.
2. When the site is on the same stream with one or more gaging stations transfer available gage information for Assigned skew, Table 4, upstream or downstream to the site using the appropriate procedure described above and observing the drainage area limitations.
3. Use regression estimates where no stream-gaging information is available, provided the site is within the limitations specified in the following paragraphs.

LIMITATIONS

Regression equations shown in Table 2 were defined from data at gaging stations on natural flow streams having drainage area between 10 mi^2 (25.9 km^2) and 4,300 mi^2 (11,100 km^2). The applicability of regression equations to sites with drainage area outside this range is unknown. The equations should not be used to make estimates of floodflows at sites on main-stem streams or streams affected by man-made changes that significantly alter floodflows upstream from the site.

The user is cautioned to look for man-made changes in the drainage basin upstream from the site that may alter floodflows, such as reservoirs, urban development, possibly strip mines; and interchange of flow between basins for storage, water supply, irrigtaion and hydro-plants. The regression equations and graphs are not applicable to sites where man-made changes significantly affect flood flow.

The main-stem streams for which equations in Table 2 can not be used are:

Cumberland River downstream from Harlan, Ky.

Kentucky River downstream from Heidelberg, Ky.

Ohio River downstream from Huntington, W. Va.

Table 1 lists Kentucky streams where peak discharge is affected more than 10 percent (Benson, 1962) by upstream reservoirs as of November 1, 1975. Table 1 also lists the agency to contact for information on flood magnitude and frequency.

TABLE 1.--LIST OF REGULATED STREAMS AND RESPONSIBLE AGENCIES

Stream name	Agency to contact for flood magnitude and frequency
Levisa Fork below Fishtrap Lake near Millard, Ky.	U.S. Army Corps of Engineers Huntington, W. Va.
Russell Fork downstream Va.-Ky. state line	...........do...............
Johns Creek below Dewey Lake near Van Lear, Ky.	...........do...............
Big Sandy River downstream from Louisa, Ky.	...........do...............
Little Sandy River below Grayson Lake near Leon, Ky.	...........do...............
Licking River below Cave Run Lake near Farmers, Ky.	U.S. Army Corps of Engineers, Louisville, Ky.
Middle Fork Kentucky River below Buckhorn Lake at Buckhorn, Ky.	...........do...............
North Fork Kentucky River below Middle Fork Kentucky River	...........do...............
Dix River below Herrington Lake near Burgin, Ky.	--
Green River below Green River Lake near Campbellsville, Ky.	U.S. Army Corps of Engineers, Louisville, Ky.
Nolin River below Nolin River Lake near Kyrock, Ky.	...........do...............
Barren River below Barren River Lake near Finney, Ky.	...........do...............
Rough River below Rough River Lake near Falls of Rough, Ky.	...........do...............
Cumberland River below Cumberland Lake near Jamestown, Ky.	U.S. Army Corps of Engineers, Nashville, Tenn.

TABLE 1.--LIST OF REGULATED STREAMS AND RESPONSIBLE AGENCIES--CONTINUED

Stream name	Agency to contact for flood magnitude and frequency
Cumberland River below Barkley Lake near Grand Rivers, Ky.	U.S. Army Corps of Engineers, Nashville, Tenn.
Tennessee River below Kentucky Lake at Gilbertsville, Ky.	Tennessee Valley Authority, Knoxville, Tenn.
Ohio River below mouth of Cumberland River	U.S. Army Corps of Engineers, Louisville, Ky.

ILLUSTRATIVE EXAMPLES

Example 1:

Assume the discharge is desired for a flood with a recurrence interval of 50 years for a site on an ungaged stream in the upper Kentucky River basin (Geographical Area 4) having a drainage area of 200 square miles.

The equation to use is:

$$Q_{50}=638A^{0.663}R^{1.040}$$

$A=200$ mi^2 By slide rule or calculator $(200)^{0.663}=33.54$

From Plate 1, R=1.271 for Area 4.

From Table 3, 1.271^b for the 50-year flood is 1.283.

Final equation is:

$$Q_{50} =638x33.54x1.283-27,500 \text{ ft}^3/\text{s}$$

or from Figure 6 for drainage area 200 mi^2

$$Q_{50}=27,500 \text{ ft}^3/\text{s}$$

Example 2:

Assume the discharge is desired for a flood with a recurrence interval of 50 years for a site on an ungaged stream in the Barren River basin having a drainage area of 50 square miles. The site is in the karst region, the drainage area must be corrected for noncontributing drainage area by using Figure 1. For a total drainage area of 50 square miles, the graph, Figure 2, gives a net drainage area of 41 square miles which is the "A" used in the equation for the 50-year flood.

The equation to use is:

$$Q_{50}=638A^{0.663}R^{1.040}$$

A=41 mi^2, By slide rule or calculator $(41)^{0.663}=11.73$

From Plate 1, R=1.351 for Geographical Area 11, and from Table 3, 1.351^b for the 50-year flood is 1.367.

Final equation is:

$$Q_{50}=638x11.73x1.367-10,200 \ ft^3/s$$

or from Figure 13 for contributing drainage area 41 mi^2

$$Q_{50}=10,200 \ ft^3/s$$

Example 3:

The discharge for a flood with a recurrence interval of 50 years is desired for a site on Craborchard Creek at State Highway 85. The site has a drainage area of 87 square miles. Craborchard Creek crosses from Geographical Area 11 to Geographical Area 13 at the mouth of Lynn Fork. The drainage area of Craborchard Creek, including Lynn Fork, is 25 square miles or 29 percent of the total drainage area at the site. Determine discharge for 50-year flood for Areas 11 and 13 for 87 square miles, by equation or from graphs Figures 13 and 15. The final discharge is a weighted average of discharge based on percent of drainage area in each area.

The equation to use is:

$Q_{50}=638A^{0.663}R^{1.040}$

$A=87^2mi$, By slide rule or calculator $(87)^{0.663}=19.32$

From Plate 1, R=1.351 for Geographical Area 11

and R=0.449 for Geographical Area 13

From Table 3 for 50-year recurrence interval for

Area 11 $R^b=1.367$

Area 13 $R^b=0.435$

Final equations adjusted for area in each region are:

For Area 11 $Q'_{50}=(638x19.32x1.367)x0.29$ = 4,900 ft^3/s

For Area 13 $Q'_{50}=(638x19.32x0.435)x0.71$ = 3,800 ft^3/s

Final Q'_{50} = 8,700 ft^3/s

Example 3--Continued:

By Figures 13 and 15 for drainage area 87 mi^2 the solution is:

From Figure 13 Q_{50}=16,800 ft^3/s for Geographical Area 11

From Figure 15 Q_{50}= 5,400 ft^3/s for Geographical Area 13

$$Q'_{50}=16,800 \times 0.29 = 4,900 \text{ ft}^3/\text{s}$$

$$Q'_{50}= 5,400 \times 0.71 = 3,800 \text{ ft}^3/\text{s}$$

$$\text{Final } Q''_{50} = 8,700 \text{ ft}^3/\text{s}$$

Example 4:

The discharge for a flood with a recurrence interval of 50 years is desired for a site on Triplett Creek downstream from the gaging station at Morehead. The site is in Geographical Area 2 and has a drainage area of 60 square miles.

The equation to use is:

$$Q_{50}=638A^{0.663}R^{1.040}$$

A=60 mi^2. By slide rule or calculator $(60)^{0.663}=15.10$

From Plate 1, R=1.773 for Geographical Area 2

From Table 3, 1.773^b for the 50-year flood is 1.814

Final equation is:

$$Q_{50}=638 \times 15.10 \times 1.814=17,500 \text{ ft}^3/\text{s}$$

Example 4--Continued:

Since the site is near the Triplett Creek at Morehead gaging station the discharge computed above should be adjusted by the ratio of the assigned discharge to the regression discharge from Table ~~3~~ 4 (see Map No. 22).

$$K_g = \frac{\text{Assigned Q}}{\text{Regression Q}} = \frac{22{,}500}{15{,}000} = 1.50 \text{ at gage, DA } 47.9 \text{ mi}^2.$$

The ratio K_s at the site is given by equation:

$$K_s = (K - 1)\left(\frac{2A_g - A_s}{A_g}\right) + 1 \text{ for site downstream from gage}$$

$$K_s = (1.50 - 1)\left(\frac{2 \times 47.9 - 60}{47.9}\right) + 1 = 1.37 \text{ at site}$$

Final discharge is:

$$Q'_{50} = 17{,}500 \times 1.37 = 24{,}000 \text{ ft}^3/\text{s}$$

TABLE 2.--SUMMARY OF REGRESSION EQUATIONS

Frequency of floods (years)	Magnitude of floods (ft^3/s)	Standard error of estimate (percent)
2	$Q_2 = 187A^{0.703}R^{0.965}$	31.8
5	$Q_5 = 318A^{0.685}R^{0.991}$	29.5
10	$Q_{10} = 412A^{0.677}R^{1.006}$	29.5
25	$Q_{25} = 540A^{0.668}R^{1.025}$	30.6
50	$Q_{50} = 638A^{0.663}R^{1.040}$	31.8
100	$Q_{100} = 740A^{0.659}R^{1.051}$	33.3

Q_2 - 2-year flood

A - Contributing drainage area

R - Geographical factor (from Plate 1)

TABLE 3.--R^b FOR GEOGRAPHICAL AREAS FOR INDICATED FREQUENCIES

	Frequency, in years					
	2	5	10	25	50	100
R \ b	0.965	0.991	1.006	1.025	1.040	1.051
0.449	.462	.452	.447	.440	.435	.431
.547	.559	.550	.545	.539	.534	.530
.619	.629	.622	.617	.612	.607	.604
.725	.733	.727	.724	.719	.716	.713
.782	.789	.784	.781	.777	.774	.772
.787	.794	.789	.786	.782	.779	.777
.805	.811	.807	.804	.801	.798	.796
.821	.827	.822	.820	.817	.815	.813
.858	.863	.859	.857	.855	.853	.851
.871	.875	.872	.870	.868	.866	.865
1.271	1.260	1.268	1.273	1.279	1.283	1.287
1.351	1.337	1.347	1.353	1.361	1.367	1.372
1.417	1.400	1.413	1.420	1.429	1.437	1.442
1.507	1.486	1.501	1.511	1.523	1.532	1.539
1.562	1.538	1.556	1.566	1.580	1.590	1.598
1.773	1.738	1.764	1.779	1.799	1.814	1.826

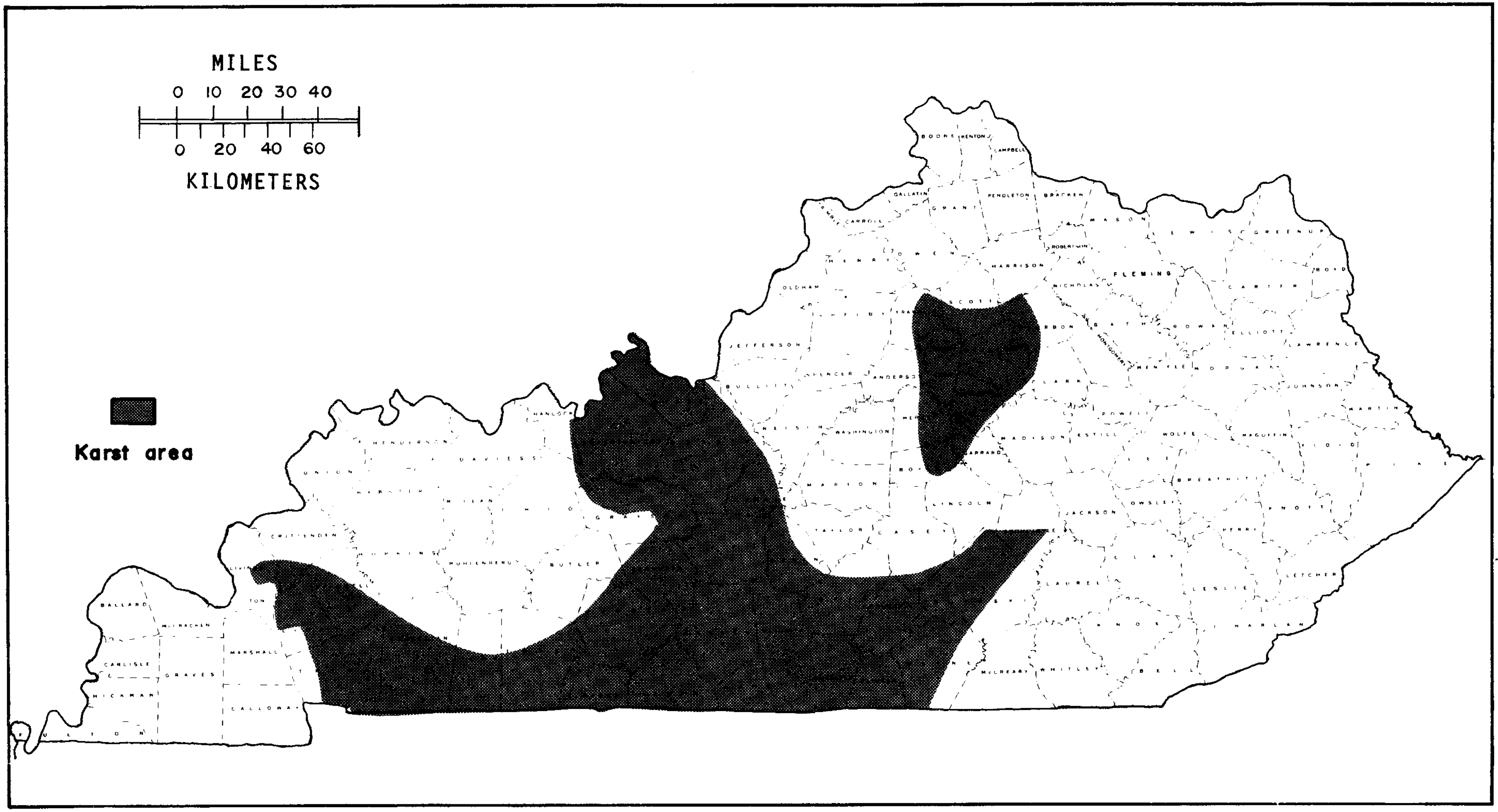

Figure 1.--Map of Kentucky showing approximate areas of karst geology.

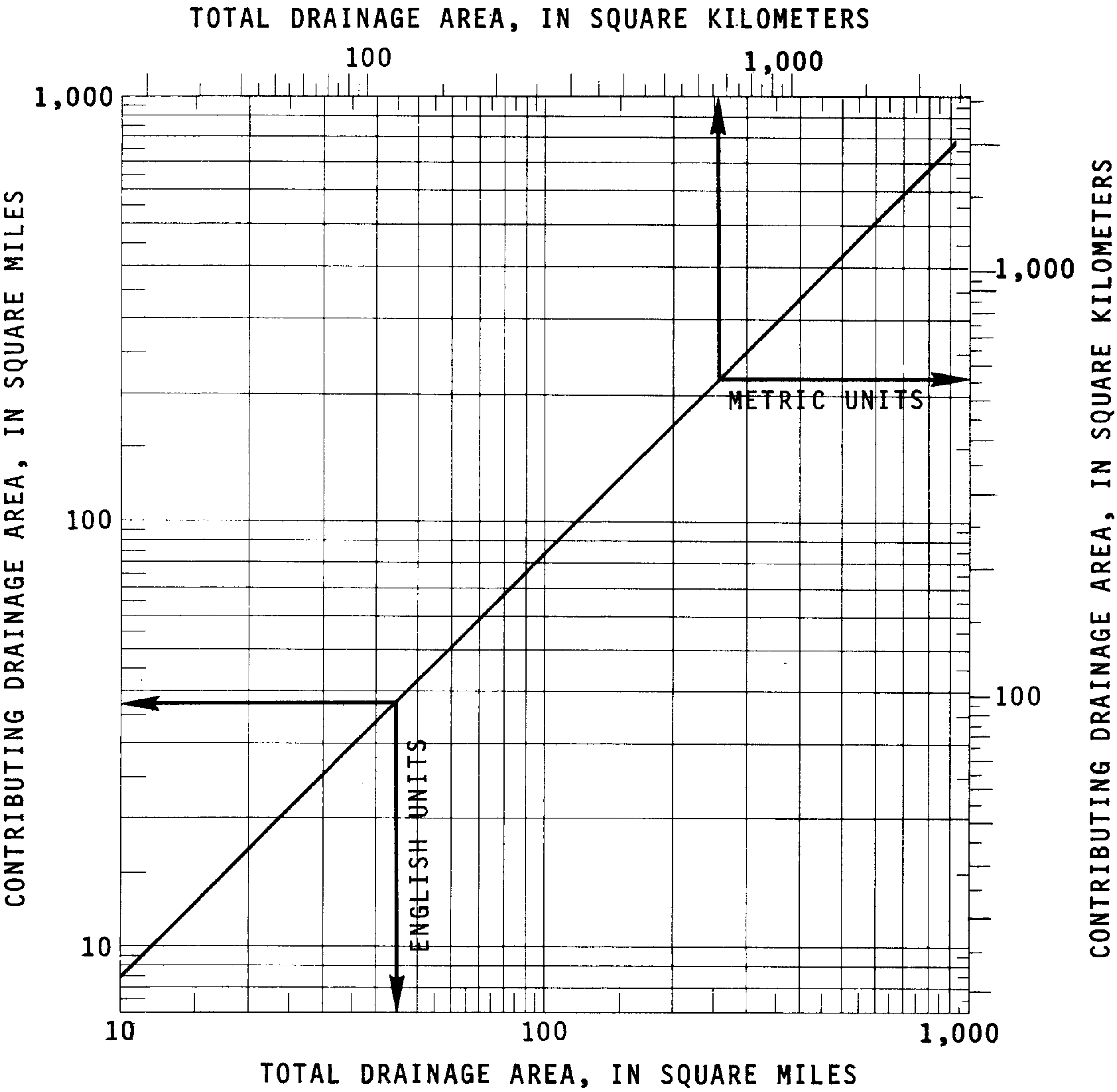

Figure 2.--Approximate contributing drainage area vs total drainage area in karst region.

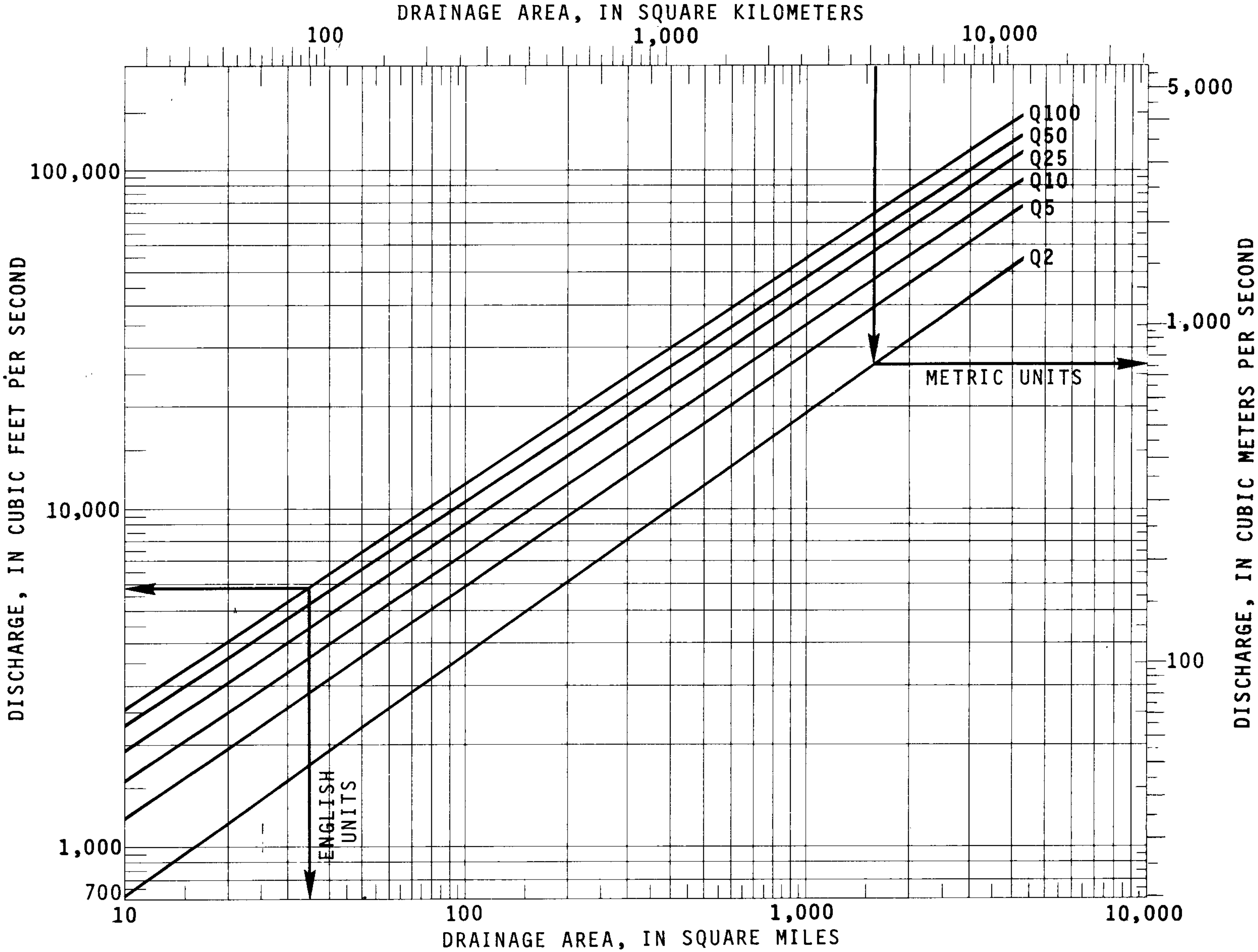

Figure 3.--Graphical solution of discharge equations, geographical area 1.

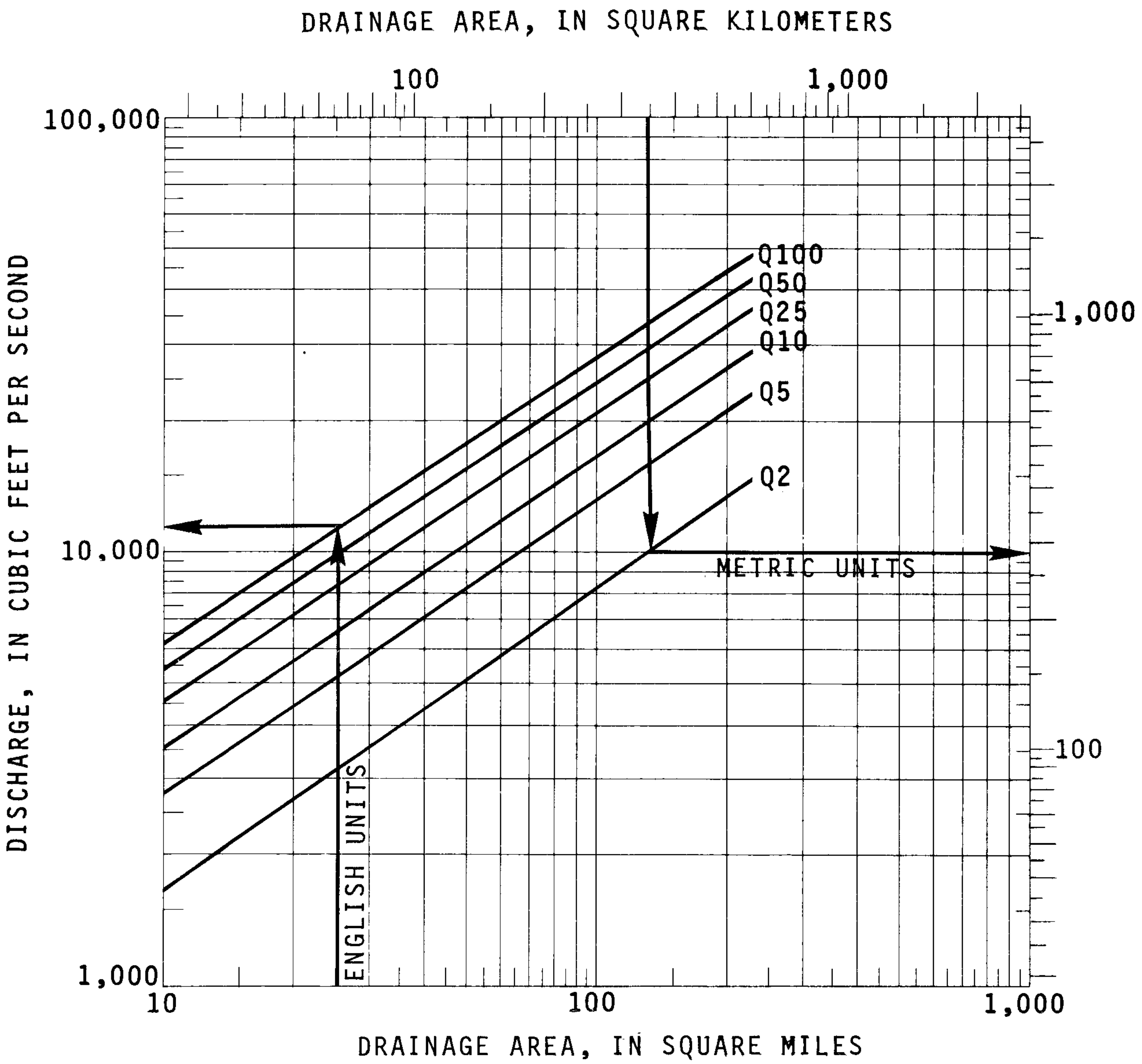

Figure 4.--Graphical solution of discharge equations, geographical area 2.

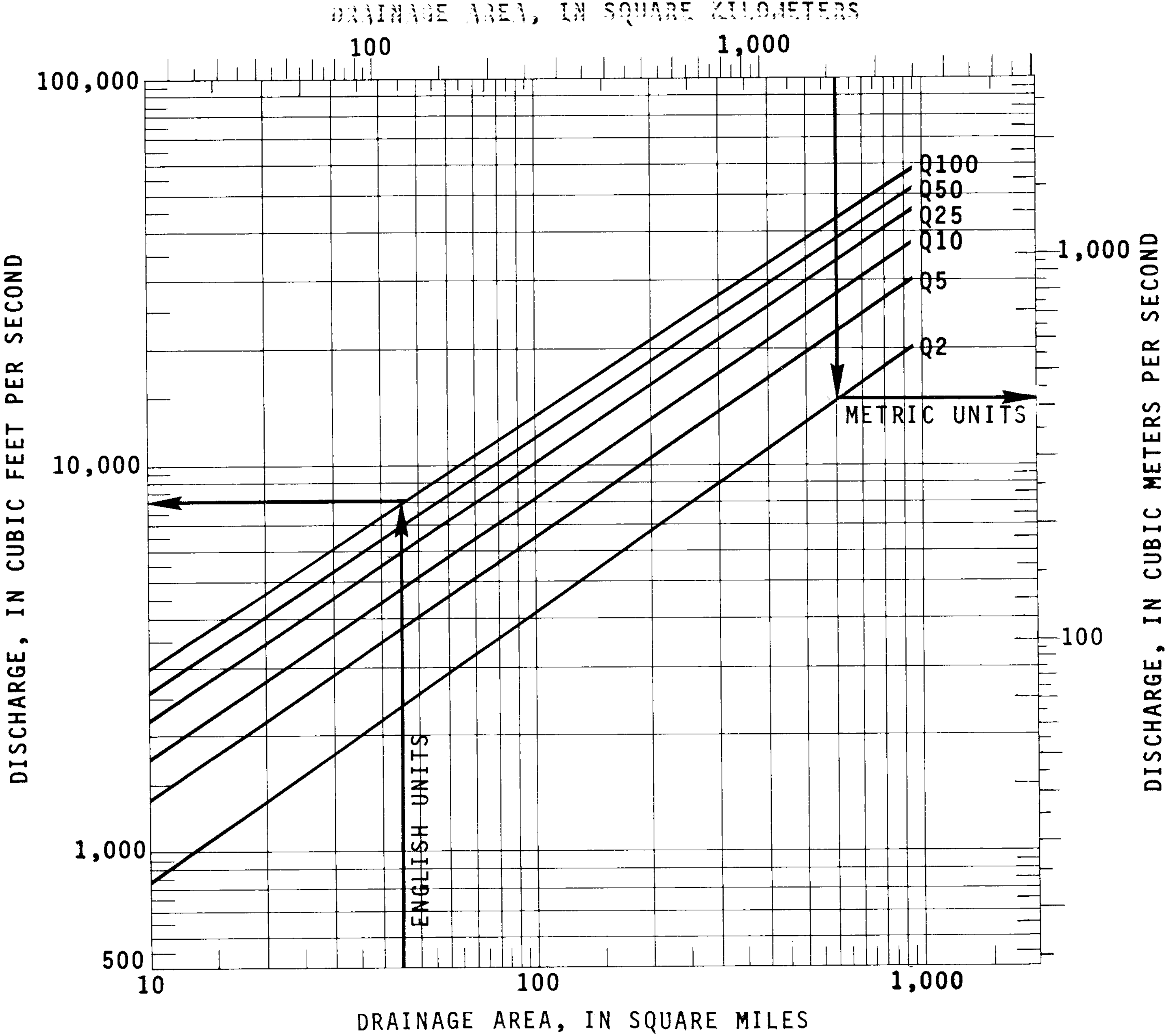

Figure 5.--Graphical solution of discharge equations, geographical area 3.

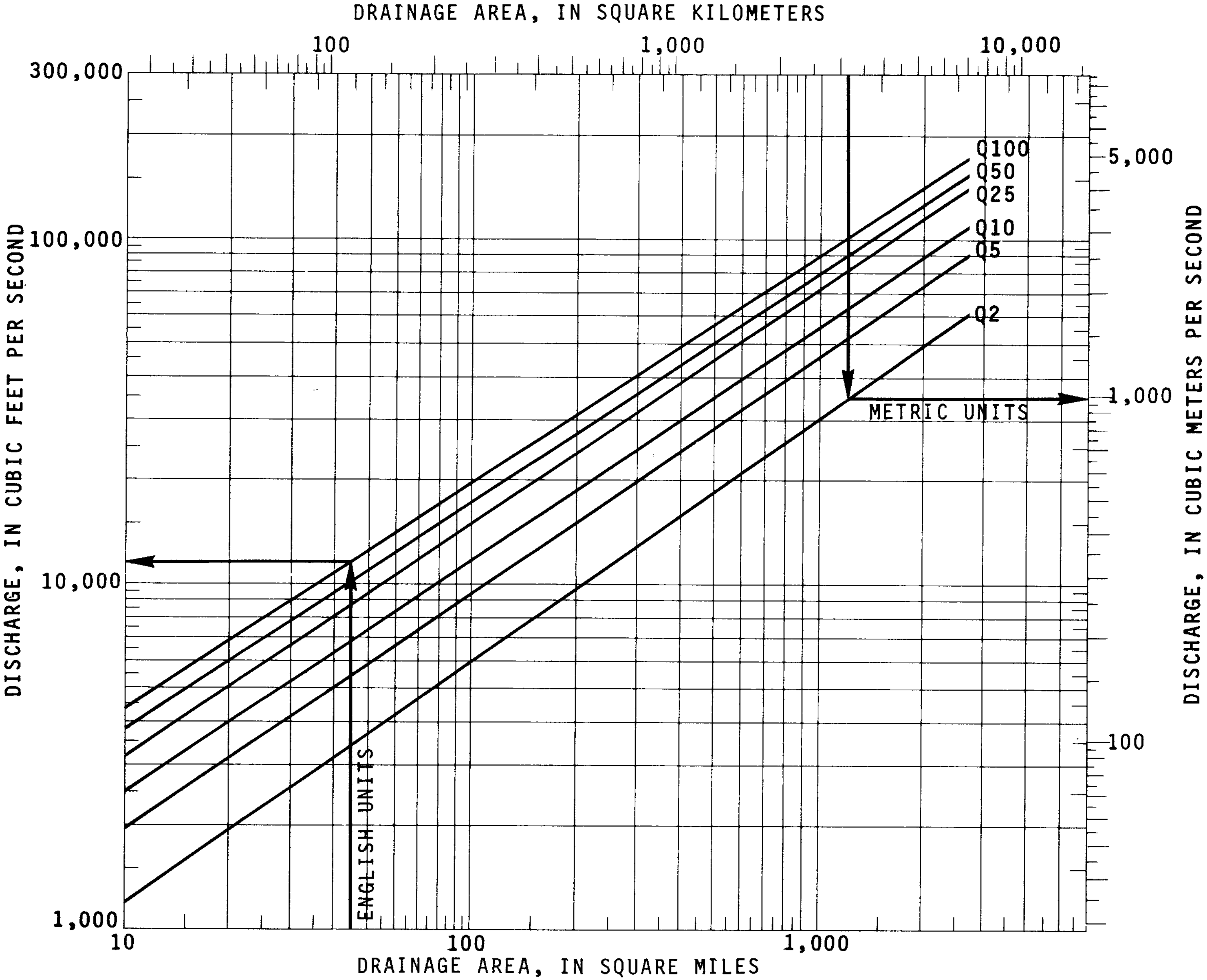

Figure 6.--Graphical solution of discharge equations, geographical area 4.

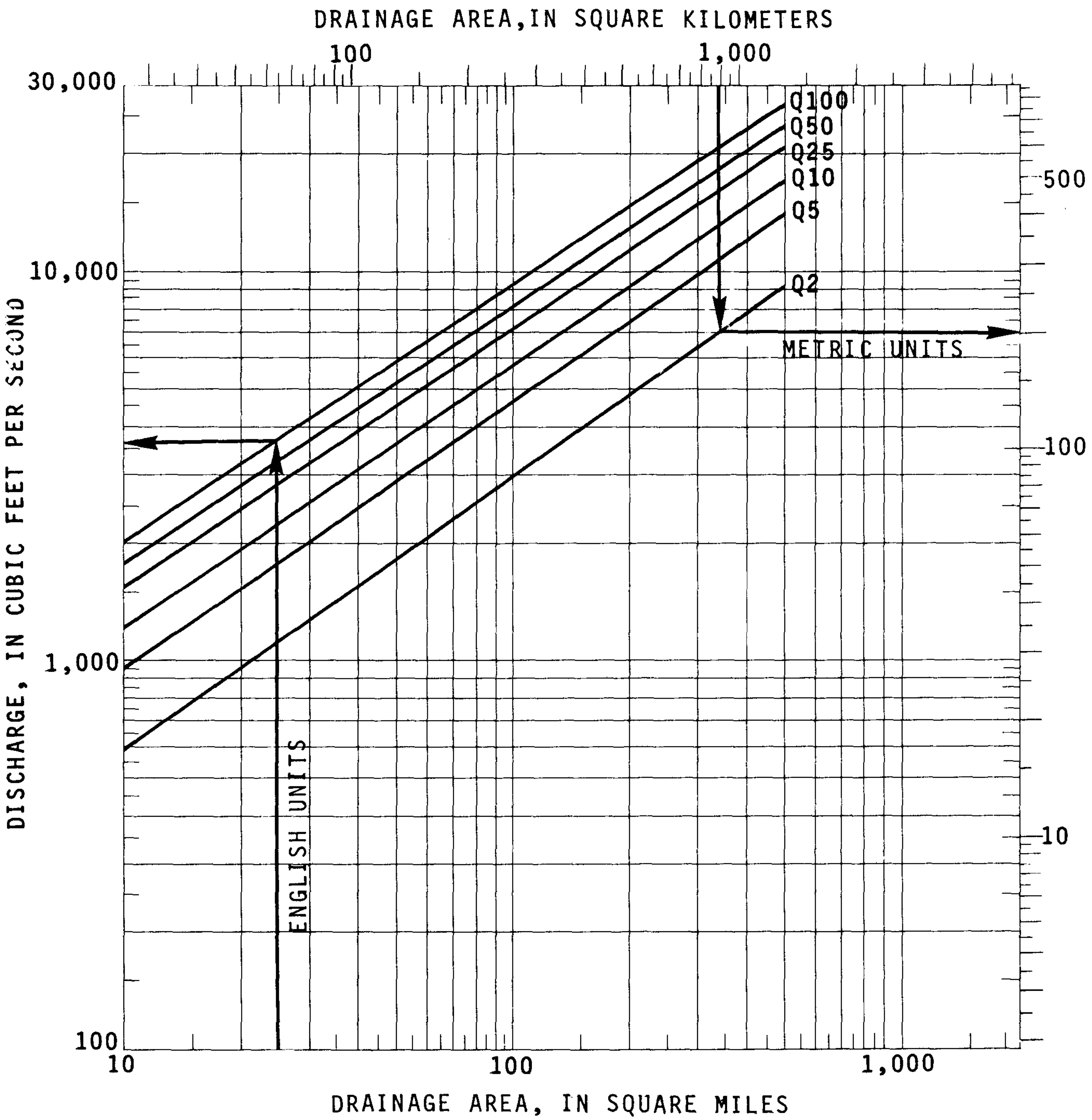

Figure 7.--Graphical solution of discharge equations, geographical area 5.

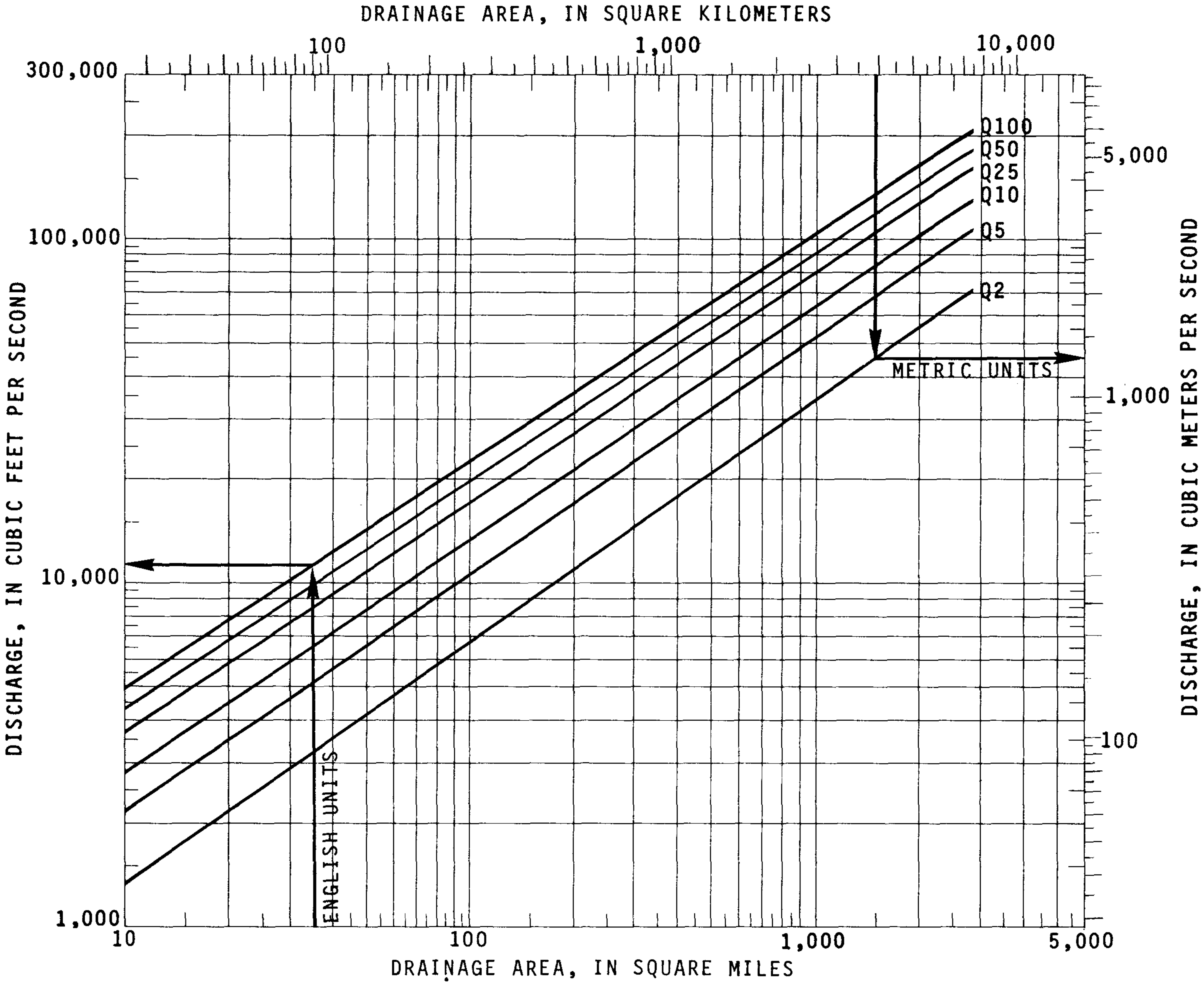

Figure 8.--Graphical solution of discharge equation, geographical area 6.

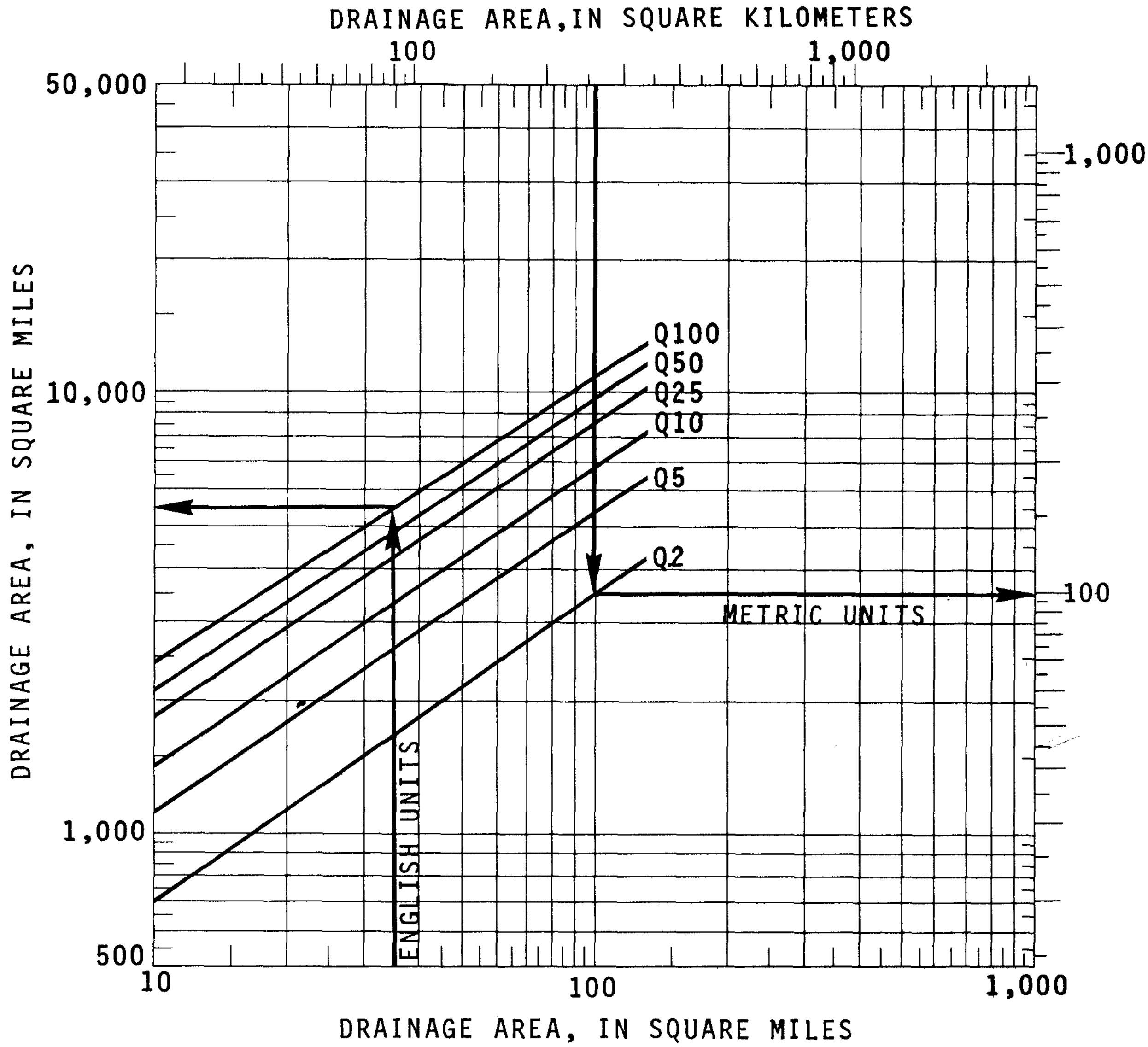

Figure 9.--Graphical solution of discharge equations, geographical area 7.

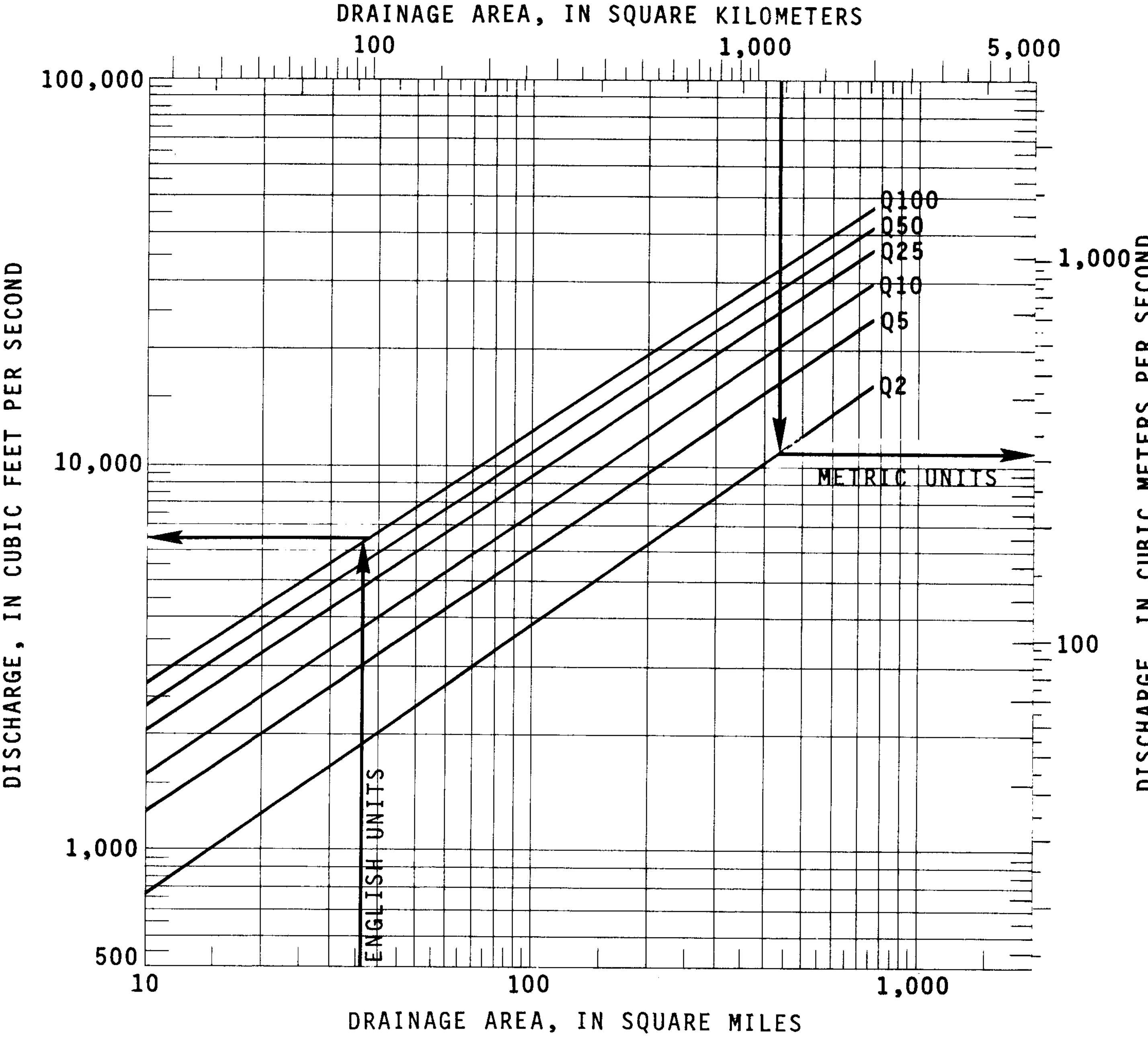

Figure 10.--Graphical solution of discharge equations, geographical area 8.

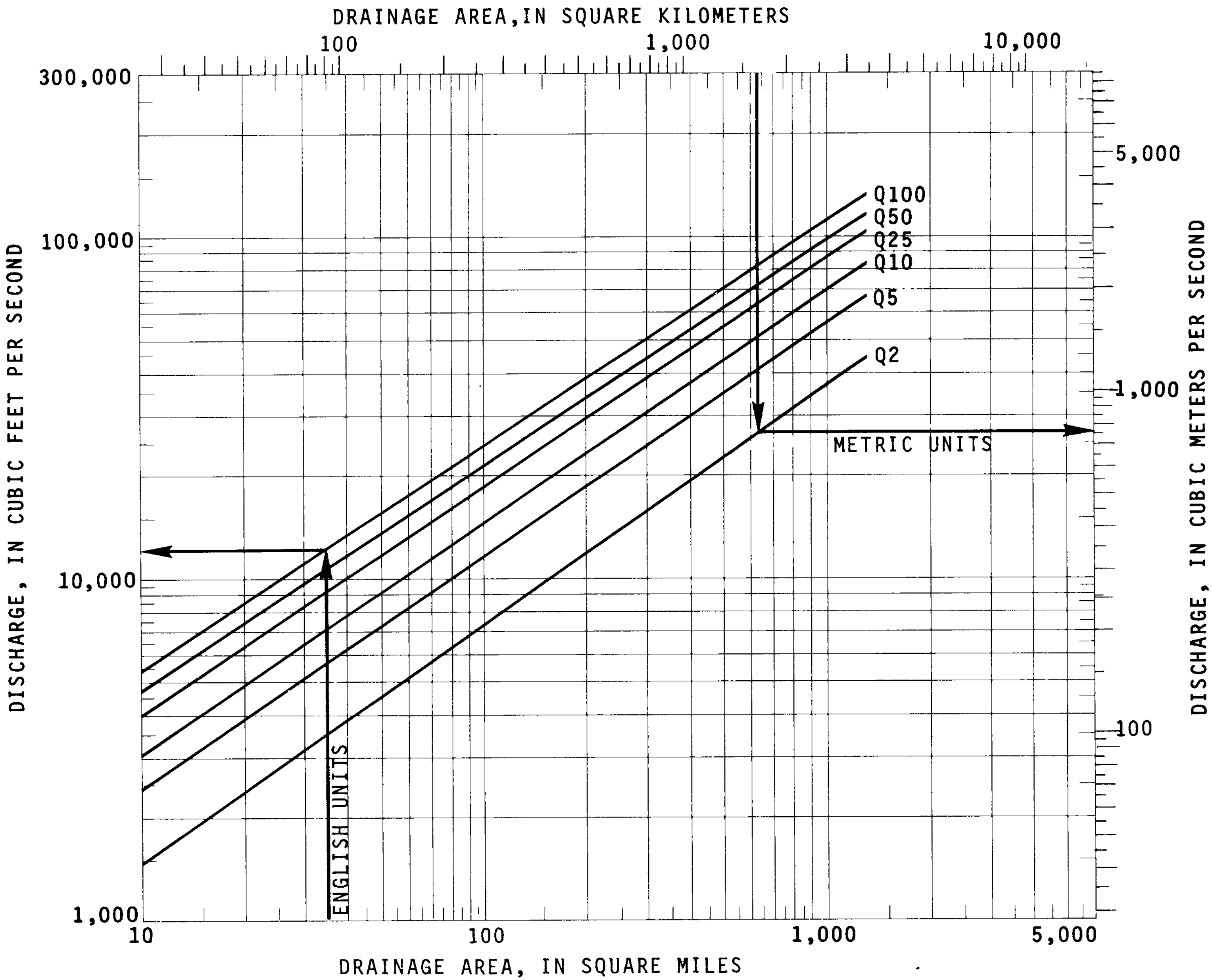

Figure 11.--Graphical solution of discharge equations, geographical area 9.

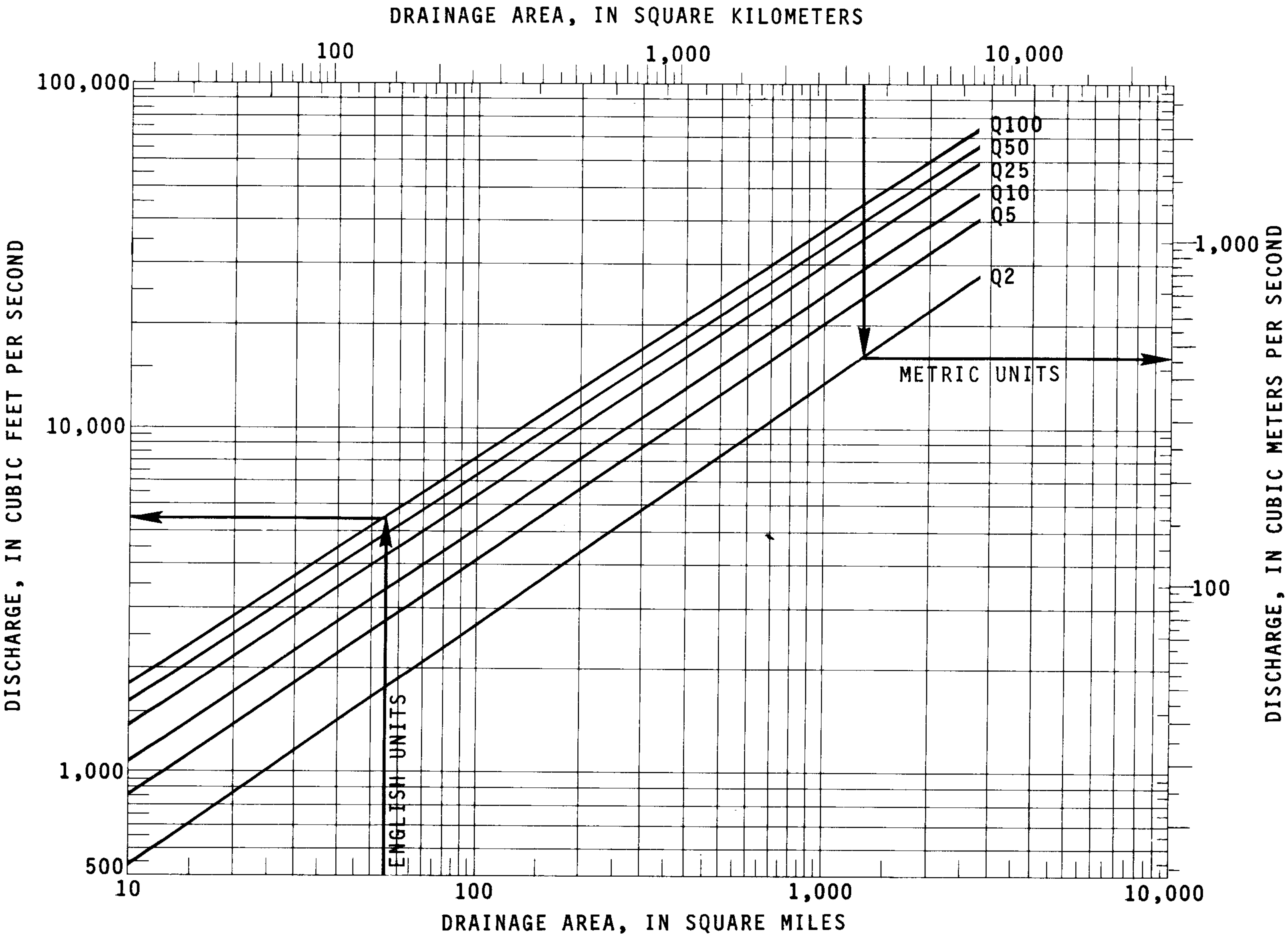

Figure 12.--Graphical solution of discharge equations, geographical area 10.

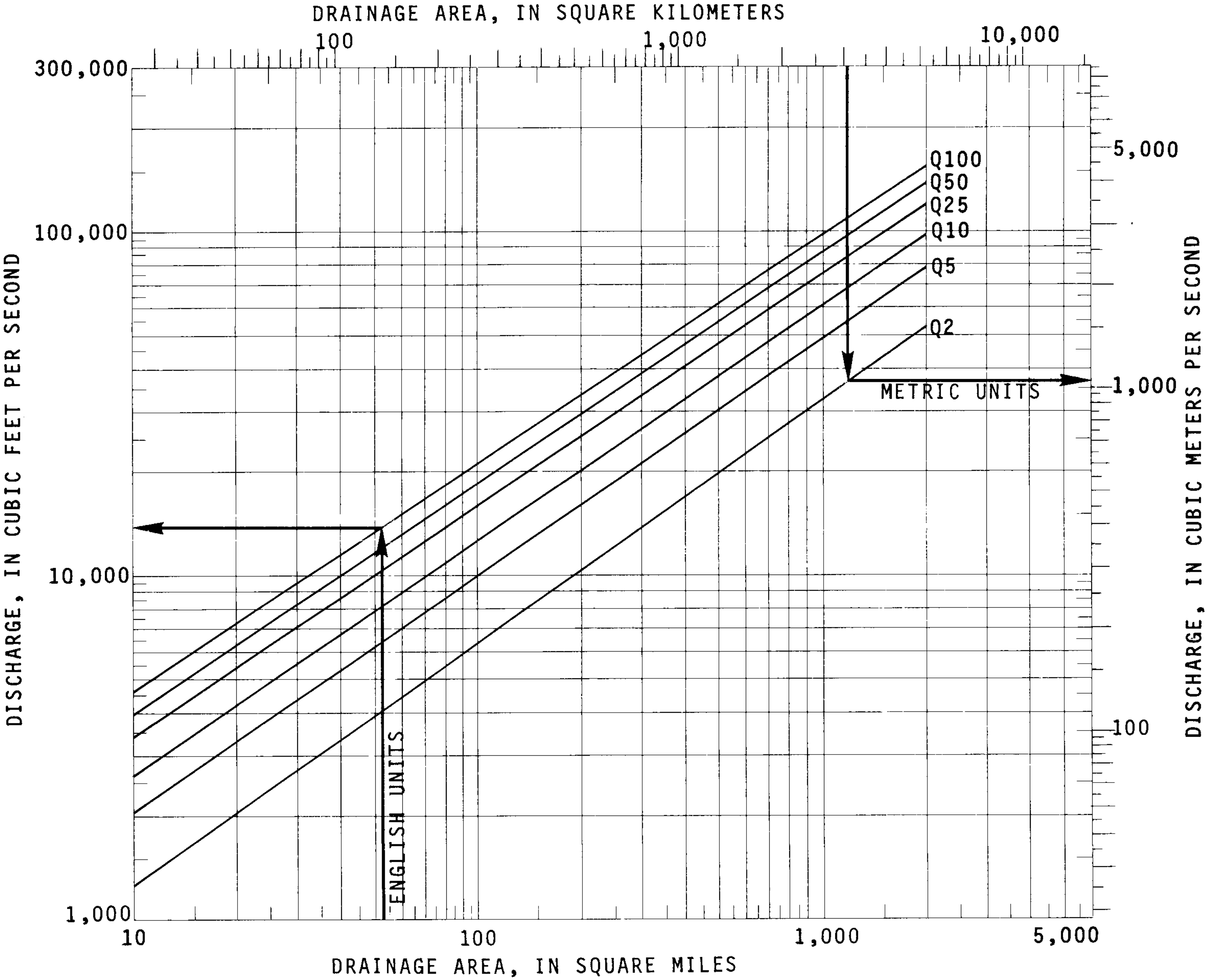

Figure 13.--Graphical solution of discharge equations, geographical area 11.

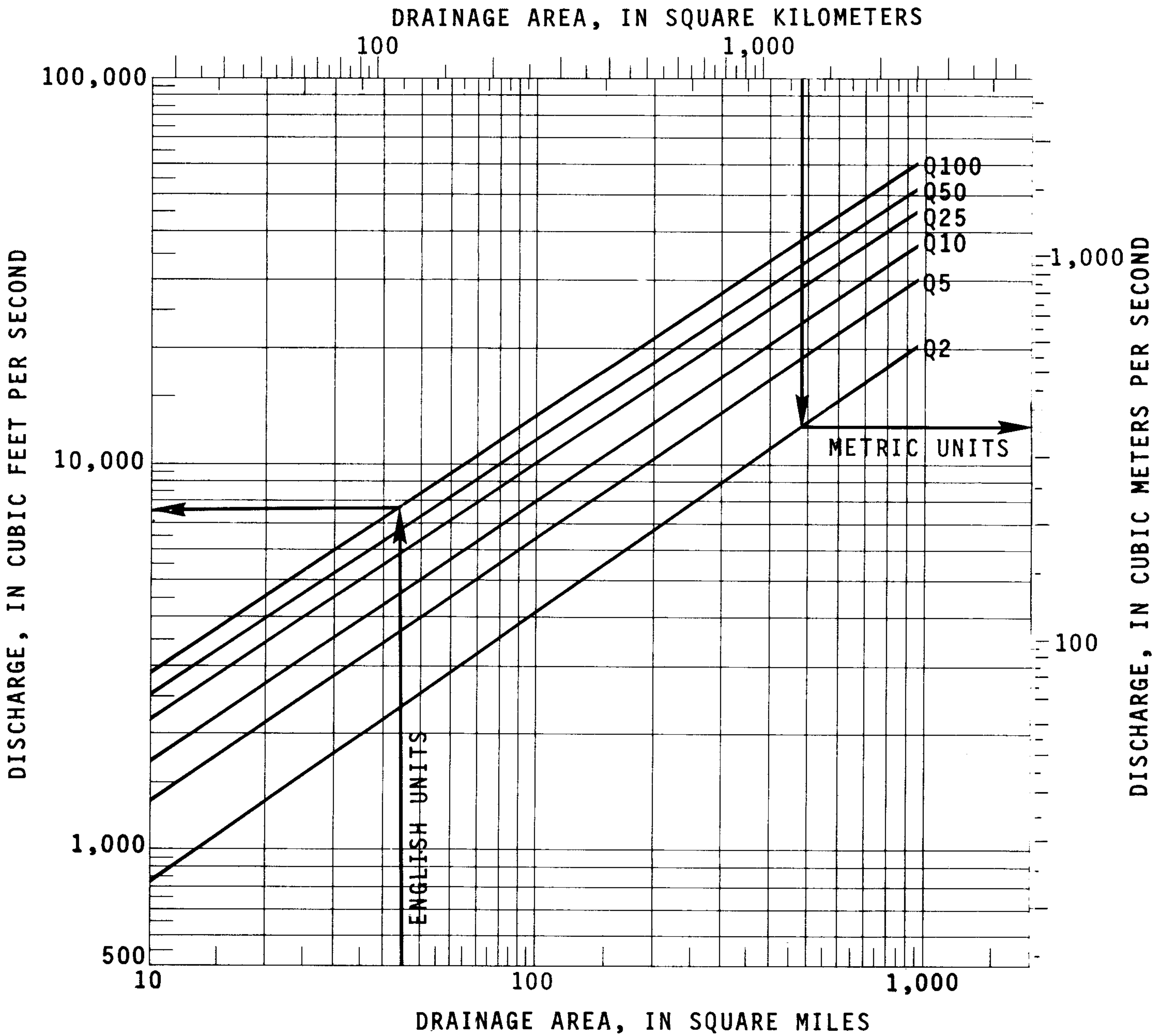

Figure 14.--Graphical solution of discharge equations, geographical area 12.

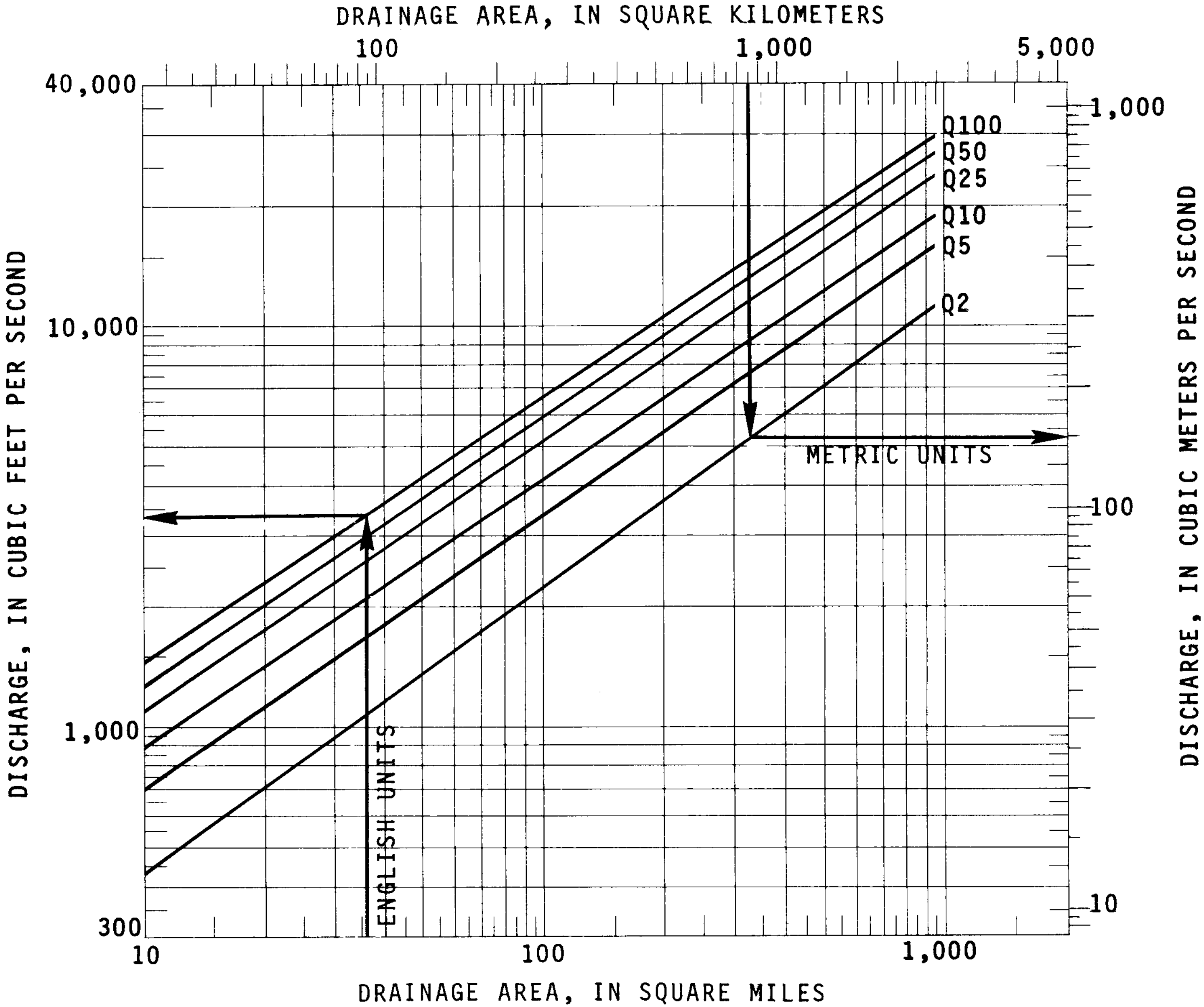

Figure 15.--Graphical solution of discharge equations, geographical area 13.

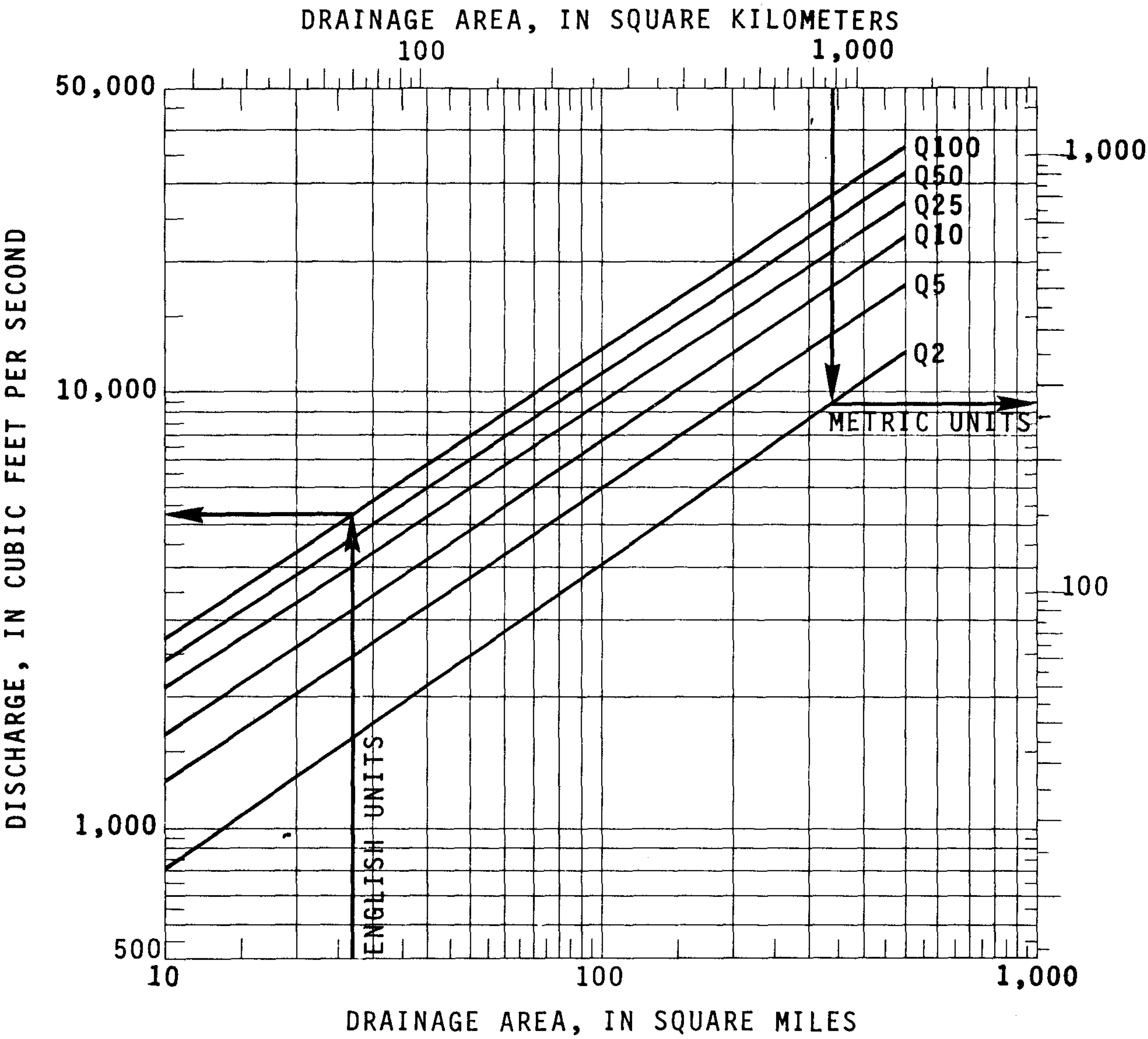

Figure 16.--Graphical solution of discharge equations, geographical area 14.

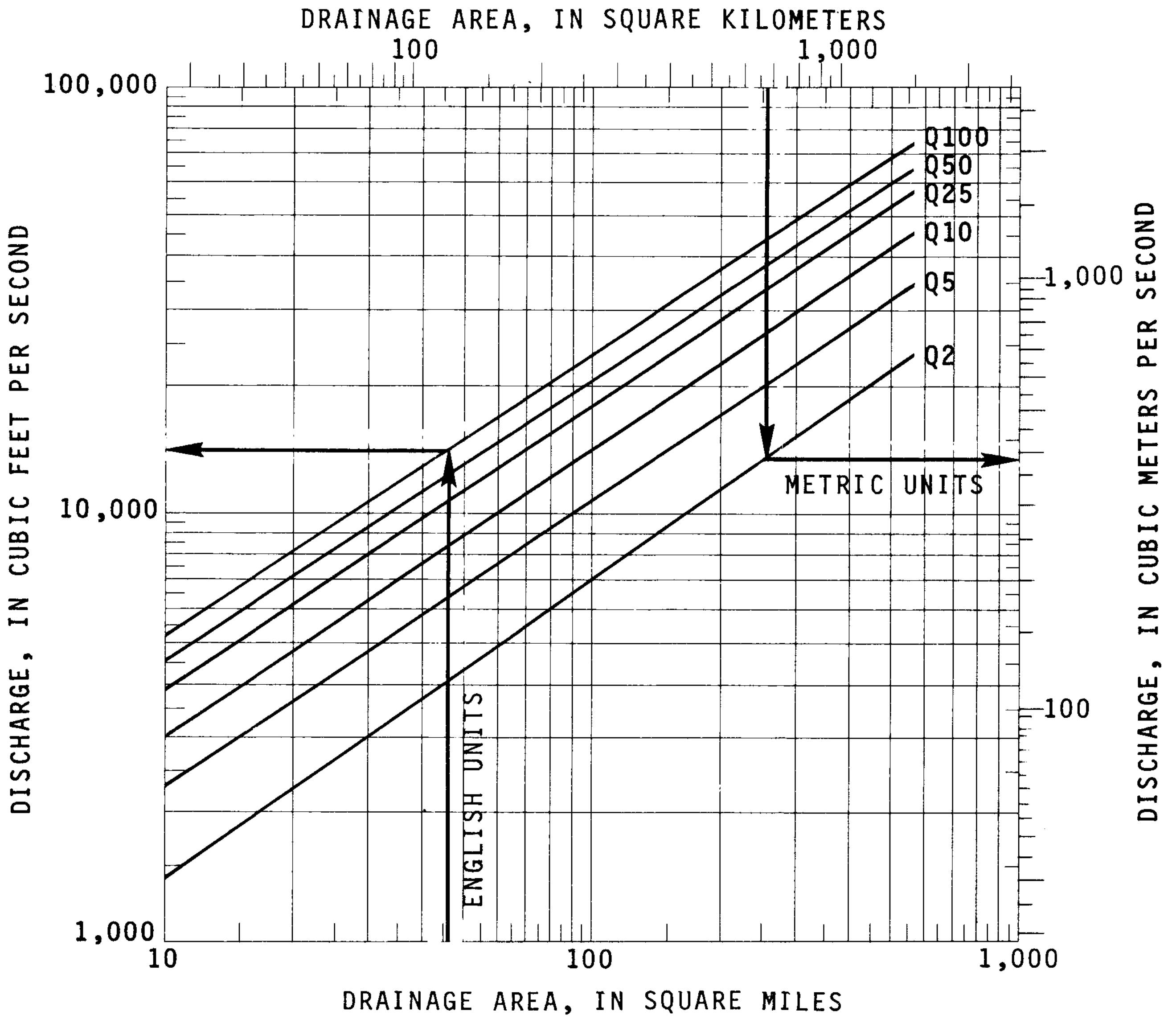

Figure 17.--Graphical solution of discharge equations, geographical area 15.

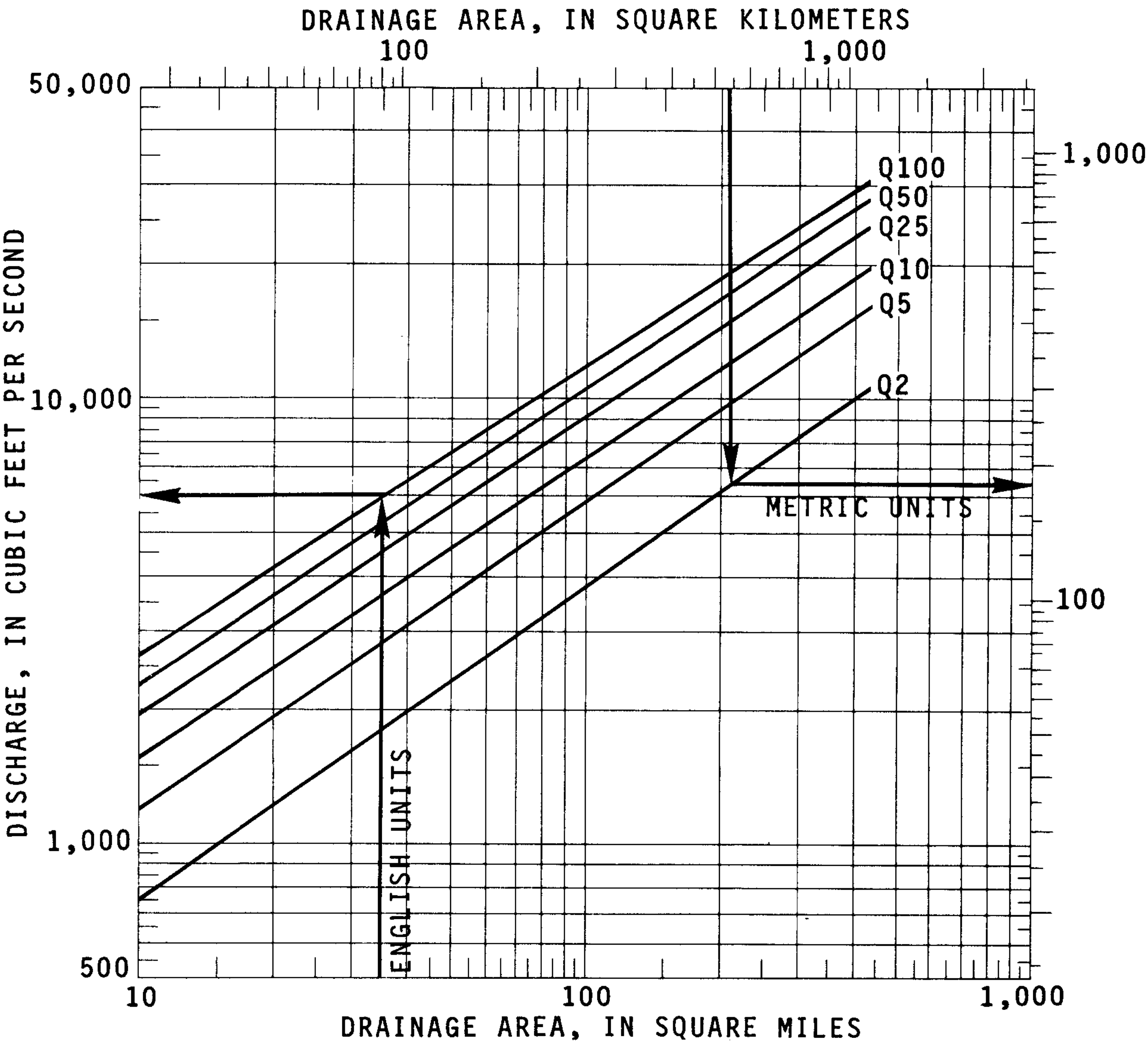

Figure 18.--Graphical solution of discharge equations, geographical area 16.

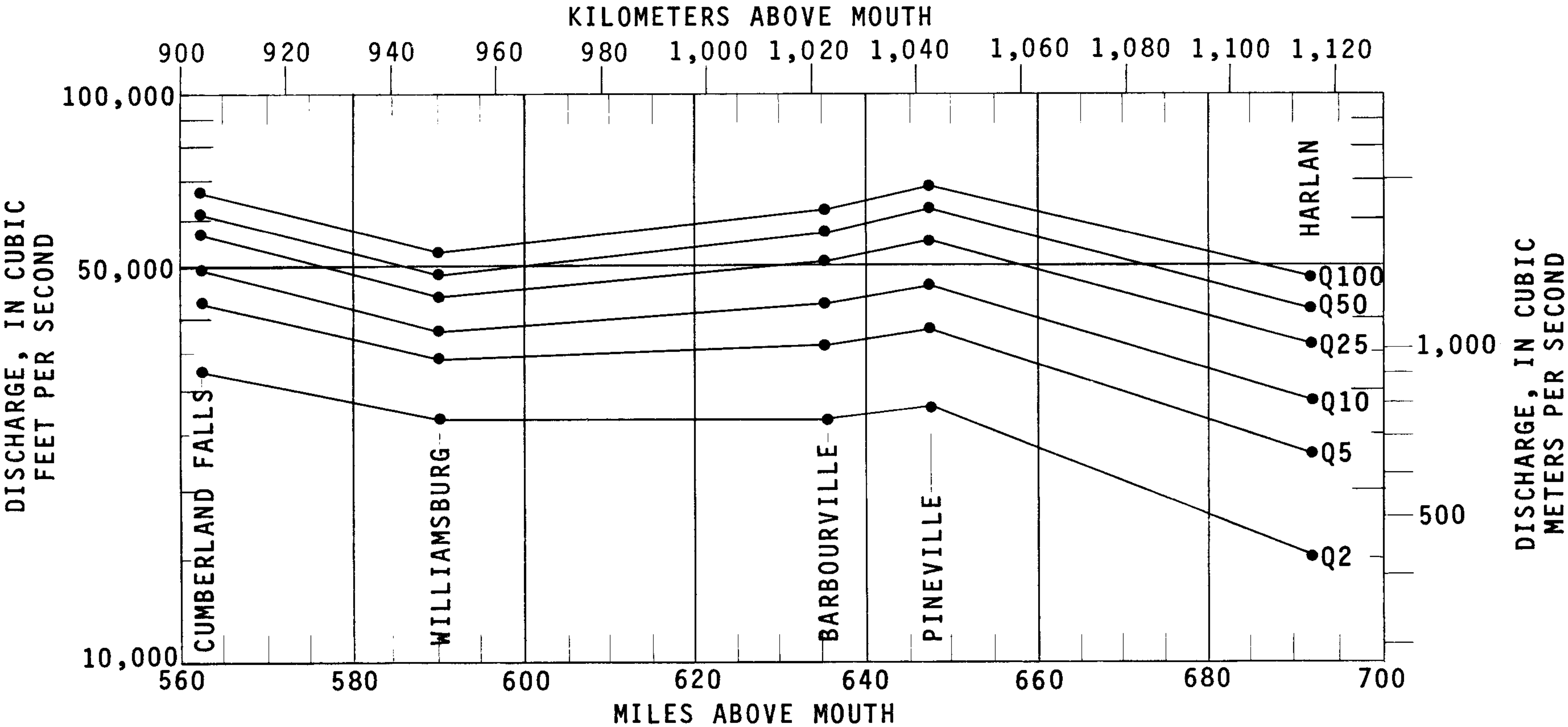

Figure 19.--Cumberland River, variation of magnitude for selected recurrence intervals with distance upstream from mouth.

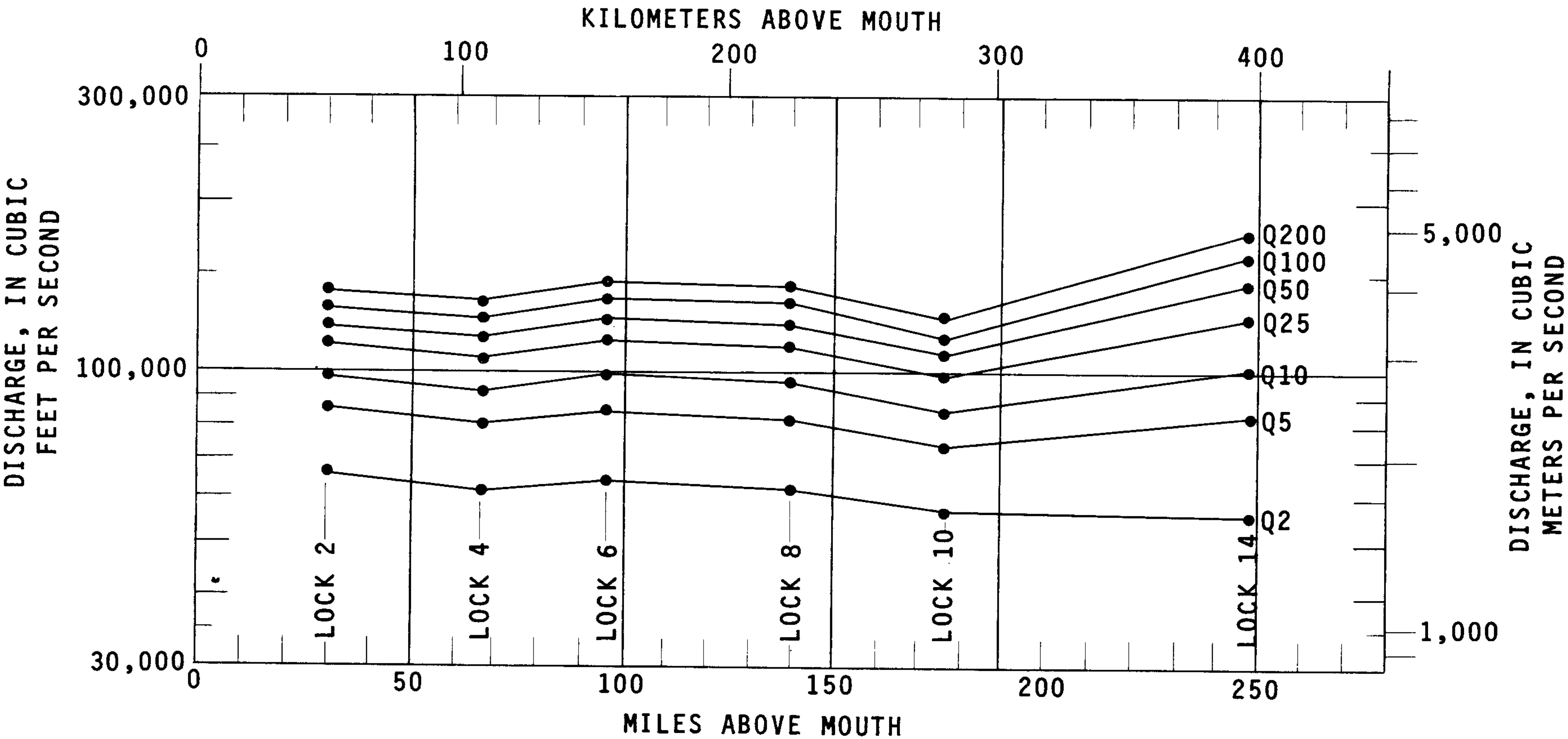

Figure 20.--Kentucky River, variation of magnitude for selected recurrence intervals with distance upstream from mouth.

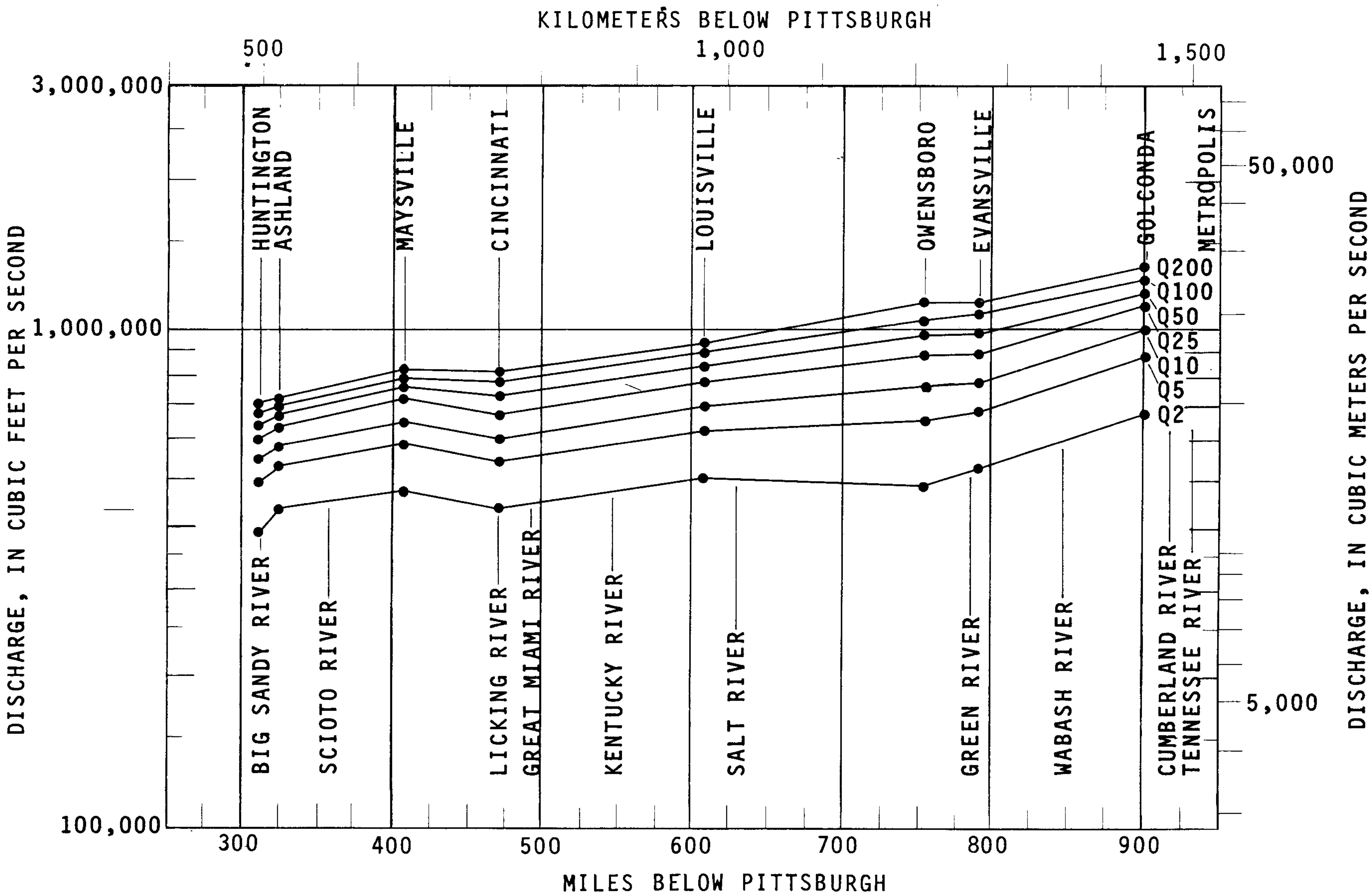

Figure 21.--Ohio River, variation of magnitude for selected recurrence intervals with miles downstream from Pittsburgh.

Table 4.--Comparison of discharge computed with station skew, assigned skew, and regression equation--Continued

Map No.	Station No.	Station Name	Drainage Area (square mile) Total	Contributing	Period of record
1	03026000	Ohio River at Huntington, W. Va.	55,900	55,900	1935-70
2	03207000	Twelvepole Creek at Wayne, W. Va.	291	291	1916-66
3	03207500	Levisa Fork near Grundy, Va.	235	235	1942-70
4	03208000	Levisa Fork below Fishtrap Dam near Millard, Ky.	386	386	1933-67
5	03208500	Russell Fork at Haysi, Va.	286	286	1927-70
6	03209000	Pound River near Haysi, Va.	221	221	1927-70
7	03209500	Levisa Fork at Pikeville, Ky.	1,237	1,237	1903-65
8	03210000	Johns Creek near Meta, Ky.	55.8	55.8	1942-70
9	03211500	Johns Creek near Van Lear, Ky.	206	206	1939-50
10	03212000	Paint Creek at Staffordsville, Ky.	103	103	1950-70
11	03212500	Levisa Fork at Paintsville, Ky.	2,143	2,143	1929-65
12	03214000	Tug Fork near Kermit, W. Va.	1,185	1,185	1935-67

Map No.		Skew	2-year discharge (ft^3/s)	5-year discharge (ft^3/s)	10-year discharge (ft^3/s)	25-year discharge (ft^3/s)	50-year discharge (ft^3/s)	100-year discharge (ft^3/s)
1	Computed	a-0.39	393,000	486,000	538,000	595,000	633,000	668,000
	Assigned	-	-	-	-	-	-	-
	Regression	-	-	-	-	-	-	-
2	Computed	.07	6,540	10,400	13,300	17,400	20,600	24,100
	Assigned	.07	6,540	10,400	13,300	17,400	20,600	24,100
	Regression	-	7,960	12,100	15,000	18,600	21,200	24,000
3	Computed	.50	10,200	16,600	20,800	25,900	29,500	33,000
	Assigned	.1	9,620	16,400	21,800	29,700	36,300	43,600
	Regression	-	6,850	10,500	13,000	16,100	18,400	20,900
4	Computed	-.13	12,400	18,400	22,500	27,800	31,800	35,800
	Assigned	.1	12,200	18,300	28,200	28,900	33,800	38,900
	Regression	-	9,710	14,700	18,100	22,400	25,600	28,900
5	Computed	-.74	14,300	23,200	28,700	34,800	38,900	42,500
	Assigned	0	13,200	23,000	30,700	41,900	51,100	61,100
	Regression	-	7,860	12,000	14,800	18,400	21,000	23,800
6	Computed	-.22	9,720	15,000	18,600	23,200	26,600	30,100
	Assigned	.1	9,450	14,900	18,900	24,600	29,200	34,100
	Regression	-	6,560	10,100	12,400	15,500	17,700	20,000
7	Computed	-.51	24,900	44,300	53,500	64,400	72,000	79,000
	Assigned	.1	27,800	43,800	55,800	72,500	86,000	101,000
	Regression	-	22,000	32,700	39,900	48,800	55,400	62,300
8	Computed	-.44	2,610	4,040	4,960	6,080	6,870	7,630
	Assigned	.1	2,480	3,990	5,150	6,780	8,110	9,550
	Regression	-	2,490	3,920	4,900	6,160	7,110	8,090
9	Computed	-1.02	4,360	6,880	8,260	9,650	10,500	11,200
	Assigned	0	3,900	6,840	9,170	12,500	15,300	18,400
	Regression	-	6,250	9,590	11,900	14,700	16,900	19,100
10	Computed	-.65	5,670	10,300	13,500	17,400	20,100	
	Assigned	-.1	5,270	10,200	14,400	20,500	25,700	31,500
	Regression	-	8,450	13,400	16,900	21,500	25,000	28,700
11	Computed	-.32	33,400	47,900	57,200	68,300	76,200	83,900
	Assigned	0	32,600	47,700	58,200	71,900	82,500	93,300
	Regression	-	32,400	47,700	57,900	70,500	79,800	89,500
12	Computed	-.03	23,200	37,200	47,600	61,900	73,200	85,200
	Assigned	0	23,100	37,200	47,700	62,200	73,800	86,200
	Regression	-	21,400	31,800	38,800	47,400	53,900	60,600

Table 4.--Comparison of discharge computed with station skew, assigned skew, and regression equation--Continued

Map No.	Station No.	Station Name	Drainage Area (square mile) Total	Contributing	Period of record
13	03215000	Big Sandy River at Louisa, Ky.	3,892	3,892	1939-70
14	03215500	Blaine Creek at Yatesville, Ky.	217	217	1916-70
15	03216000	Ohio River at Ashland, Ky.	60,750	60,750	1937-70
16	03216500	Little Sandy River at Grayson, Ky.	402	402	1937-67
17	03216800	Tygarts Creek at Olive Hill, Ky.	59.6	59.6	1958-70
18	03217000	Tygarts Creek near Greenup, Ky.	242	242	1941-70
19	03238000	Ohio River at Maysville, Ky.	70,130	70,130	1937-70
20	03248500	Licking River near Salyersville, Ky.	140	140	1939-70
21	03249500	Licking River at Farmers, Ky.	827	827	1938-70
22	03250000	Triplett Creek at Morehead, Ky.	47.9	47.9	1939-70
23	03250500	Licking River at Blue Lick Springs, Ky.	1,785	1,785	1938-70
24	03251000	North Fork Licking River near Lewisburg, Ky.	119	119	1938-70

Map No.		Skew	2-year discharge (ft^3/s)	5-year discharge (ft^3/s)	10-year discharge (ft^3/s)	25-year discharge (ft^3/s)	50-year discharge (ft^3/s)	100-year discharge (ft^3/s)
13	Computed	-0.50	48,800	70,400	83,500	98,600	109,000	118,000
	Assigned	0	47,000	69,900	86,100	107,000	124,000	141,000
	Regression	-	49,300	71,800	86,700	105,000	119,000	133,000
14	Computed	-.24	6,390	9,710	11,900	14,800	16,900	18,900
	Assigned	-.1	6,310	9,690	12,100	15,200	17,600	20,000
	Regression	-	6,480	9,940	12,300	15,300	17,500	19,800
15	Computed	a-.60	434,000	530,000	580,000	632,000	664,000	693,000
	Assigned	-	-	-	-	-	-	-
	Regression	-	-	-	-	-	-	-
16	Computed	-.48	10,100	14,500	17,100	20,200	22,400	24,300
	Assigned	-.1	9,770	14,400	17,600	21,600	24,700	27,800
	Regression	-	9,990	15,200	18,600	23,000	26,300	29,700
17	Computed	-.32	5,320	7,220	8,370			
	Assigned	-.1	5,240	7,200	8,460	10,000	11,200	12,300
	Regression	-	5,750	9,230	11,700	14,900	17,400	20,000
18	Computed	-1.14	7,240	9,990	11,300	12,500	13,200	13,700
	Assigned	-.1	6,670	9,990	12,300	15,300	17,500	19,800
	Regression	-	6,990	10,700	13,200	16,400	18,800	21,300
19	Computed	a-.64	464,000	582,000	644,000	710,000	751,000	786,000
	Assigned	-	-	-	-	-	-	-
	Regression	-	-	-	-	-	-	-
20	Computed	-.46	4,100	6,850	8,720	11,100	12,800	14,400
	Assigned	0	3,900	6,790	9,070	12,400	15,100	18,100
	Regression	-	4,760	7,360	9,130	11,400	13,100	14,800
21	Computed	-.65	12,100	16,400	18,700	21,300	22,900	24,400
	Assigned	-.1	11,600	16,300	19,300	23,200	26,000	28,800
	Regression	-	-	-	-	-	-	-
22	Computed	.72	5,900	10,500	14,800	22,100	29,200	38,100
	Assigned	-.1	6,430	10,900	14,200	18,800	22,500	26,400
	Regression	-	4,930	7,940	10,100	12,900	15,000	17,300
23	Computed	-1.32	21,100	25,800	27,800	29,400	30,200	30,800
	Assigned	-.2	19,900	25,900	29,600	33,900	36,900	39,800
	Regression	-	-	-	-	-	-	-
24	Computed	-.50	6,030	8,330	9,690	11,200	12,300	13,200
	Assigned	-.2	5,910	8,310	9,860	11,800	13,100	14,500
	Regression	-	4,710	7,320	9,110	11,400	13,100	14,900

Table 4.--Comparison of discharge computed with station skew, assigned skew, and regression equation--Continued

Map No.	Station No.	Station Name	Drainage Area (square mile) Total	Drainage Area (square mile) Contributing	Period of record
25	03251500	Licking River at McKinneysburg, Ky.	2,326	2,326	1925-70
26	03252000	Stoner Creek at Paris, Ky.	239	239	1954-70
27	03252500	South Fork Licking River at Cynthiana, Ky.	621	621	1918-70
28	03253500	Licking River at Catawba, Ky.	3,300	3,300	1854-1970
29	03255000	Ohio River at Cincinnati, Ohio	76,580	76,580	1873-1970
30	03277300	North Fork Kentucky River at Whitesburg, Ky.	66.4	66.4	1957-70
31	03277500	North Fork Kentucky River at Hazard, Ky.	466	466	1940-70
32	03278000	Bear Branch near Noble, Ky.	2.21	2.21	1955-70
33	03278500	Troublesome Creek at Noble, Ky.	177	177	1950-70
34	03280000	North Fork Kentucky River at Jackson, Ky.	1,101	1,101	1905-70
35	03280600	Middle Fork Kentucky River near Hyden, Ky.	202	202	1957-70
36	03280700	Cutshin Creek at Wooton, Ky.	61.3	61.3	1958-70

Map No.		Skew	2-year discharge (ft^3/s)	5-year discharge (ft^3/s)	10-year discharge (ft^3/s)	25-year discharge (ft^3/s)	50-year discharge (ft^3/s)	100-year discharge (ft^3/s)
25	Computed	-1.36	32,200	41,000	44,700	47,700	49,100	50,200
	Assigned	-.3	30,100	41,300	48,300	56,500	62,200	67,700
	Regression	-	-	-	-	-	-	-
26	Computed	-1.71	8,080	11,000	12,000	12,700		
	Assigned	-.2	7,070	11,200	14,200	18,000	20,900	23,900
	Regression	-	7,690	11,800	14,600	18,200	20,900	23,600
27	Computed	-1.34	18,500	24,500	27,000	29,200	30,300	31,000
	Assigned	-.3	17,100	24,700	29,500	35,300	39,500	43,600
	Regression	-	15,000	22,700	27,900	34,400	39,300	44,400
28	Computed	-.78	46,800	62,600	70,900	79,600	84,900	89,400
	Assigned	-.3	45,400	62,500	73,100	85,700	94,600	103,000
	Regression	-	-	-	-	-	-	-
29	Computed	a-.20	431,000	537,000	599,000	671,000	721,000	767,000
	Assigned	-	-	-	-	-	-	-
	Regression	-	-	-	-	-	-	-
30	Computed	.54	2,140	3,750	5,220	7,600		
	Assigned	.1	2,240	3,830	5,110	6,970	8,540	10,300
	Regression	-	2,820	4,410	5,510	6,920	7,970	9,070
31	Computed	-.70	18,400	27,900	33,400	39,700	43,700	47,400
	Assigned	0	17,200	27,600	35,300	46,000	54,500	63,500
	Regression	-	17,700	27,100	33,600	41,900	48,100	54,600
32	Computed	-.92	230	349	414	482		
	Assigned	0	210	346	450	594	711	835
	Regression	-	411	694	897	1,170	1,380	1,610
33	Computed	-.43	8,050	13,200	16,700	21,000	24,200	
	Assigned	0	7,690	13,100	17,300	23,200	28,100	33,400
	Regression	-	8,960	14,000	17,400	21,900	25,300	28,900
34	Computed	-.36	24,600	36,800	44,700	54,300	61,200	67,900
	Assigned	0	23,800	36,600	45,700	58,100	67,800	77,900
	Regression	-	32,400	48,900	60,100	74,300	85,100	96,200
35	Computed	.04	13,200	25,900	36,900	54,000		
	Assigned	0	13,200	25,900	36,800	53,500	68,100	84,700
	Regression	-	9,840	15,300	19,100	23,900	27,600	31,500
36	Computed	-.01	3,930	7,160	9,800			
	Assigned	0	3,920	7,160	9,810	13,700	17,000	20,700
	Regression	-	4,250	6,760	8,510	10,800	12,500	14,300

Table 4.--Comparison of discharge computed with station skew, assigned skew, and regression equation--Continued

Map No.	Station No.	Station Name	Drainage Area (square mile) Total	Contributing	Period of record
37	03281000	Middle Fork Kentucky River at Tallega, Ky.	537	537	1929-60
38	03281200	South Fork Kentucky River at Oneida, Ky.	486	486	1957-70
39	03281500	South Fork Kentucky River at Booneville, Ky.	722	722	1926-70
40	03282000	Kentucky River at lock 14, at Heidelberg, Ky.	2,657	2,657	1921-60
41	03282500	Red River near Hazel Green, Ky.	65.8	65.8	1955-70
42	03283000	Stillwater Creek at Stillwater, Ky.	24.0	24.0	1955-70
43	03283500	Red River at Clay City, Ky.	362	362	1931-70
44	03284000	Kentucky River at lock 10, near Winchester, Ky.	3,955	3,955	1908-70
45	03284500	Kentucky River at lock 8, near Camp Nelson, Ky.	4,414	4,414	1911-70
46	03285000	Dix River near Danville, Ky.	318	318	1943-70
47	03287000	Kentucky River at lock 6, near Salvisa, Ky.	5,102	5,002	1895-1970
48	03287500	Kentucky River at lock 4, at Frankfort, Ky.	5,412	5,292	1895-1970

Map No.		Skew	2-year discharge (ft^3/s)	5-year discharge (ft^3/s)	10-year discharge (ft^3/s)	25-year discharge (ft^3/s)	50-year discharge (ft^3/s)	100-year discharge (ft^3/s)
37	Computed	0.43	13,800	22,600	29,900	41,000	50,900	62,100
	Assigned	-.1	14,500	23,000	29,100	37,300	43,600	50,200
	Regression	-	19,600	29,900	37,000	46,000	52,800	60,000
38	Computed	-.20	21,400	34,500	43,700	55,900		
	Assigned	0	21,000	34,300	44,400	58,300	69,600	81,600
	Regression	-	18,200	27,900	34,600	43,000	49,500	56,100
39	Computed	-.04	23,200	37,200	47,500	61,500	72,700	84,400
	Assigned	-.1	23,400	37,200	47,300	60,700	71,300	82,100
	Regression	-	24,100	36,600	45,200	56,100	64,300	72,900
40	Computed	-.29	56,700	82,600	99,300	120,000	134,000	149,000
	Assigned	-.1	55,800	82,300	100,000	124,000	141,000	159,000
	Regression	-	60,200	89,400	109,000	134,000	153,000	172,000
41	Computed	.04	2,240	3,800	5,030	6,780		
	Assigned	-.1	2,270	3,820	4,980	6,570	7,850	9,190
	Regression	-	4,470	7,100	8,930	11,300	13,100	15,000
42	Computed	-.74	2,590	4,380	5,500	6,790		
	Assigned	-.1	2,400	4,340	5,880	8,080	9,900	11,900
	Regression	-	2,200	3,560	4,510	5,770	6,730	7,730
43	Computed	-.52	8,790	14,300	17,800	22,200	25,300	28,200
	Assigned	-.1	8,410	14,200	18,500	24,500	29,300	34,300
	Regression	-	10,300	15,700	19,300	24,000	27,500	31,100
44	Computed	-.89	59,200	74,700	82,300	89,700	94,000	97,600
	Assigned	-.2	57,000	74,600	85,300	98,000	107,000	115,000
	Regression	-	-	-	-	-	-	-
45	Computed	-1.04	65,400	82,800	91,000	98,600	103,000	106,000
	Assigned	-.2	62,300	82,800	95,500	111,000	121,000	132,000
	Regression	-	-	-	-	-	-	-
46	Computed	-.49	12,700	18,100	21,300	25,000	27,600	29,900
	Assigned	-.2	12,400	18,000	21,700	26,300	29,700	33,000
	Regression	-	15,000	23,300	28,900	36,200	41,800	47,600
47	Computed	-.81	66,800	85,600	95,100	105,000	110,000	115,000
	Assigned	-.2	64,500	85,400	98,200	114,000	124,000	135,000
	Regression	-	-	-	-	-	-	-
48	Computed	-1.02	64,100	80,900	88,800	96,200	100,000	104,000
	Assigned	-.3	61,600	81,000	92,500	106,000	115,000	124,000
	Regression	-	-	-	-	-	-	-

Table 4.--Comparison of discharge computed with station skew, assigned skew, and regression equation--Continued

Map No.	Station No.	Station Name	Drainage Area (square mile) Total	Contributing	Period of record
49	03288000	North Elkhorn Creek near Georgetown, Ky.	119	111	1957-70
50	03288500	Cave Creek near Fort Spring, Ky.	2.53	1.93	1953-70
51	03289000	South Elkhorn Creek at Fort Spring, Ky.	24.0	21.0	1951-70
52	03289500	Elkhorn Creek near Frankfort, Ky.	473	403	1916-70
53	03290000	Flat Creek near Frankfort, Ky.	5.63	5.63	1952-70
54	03290500	Kentucky River at lock 2, at Lockport, Ky.	6,180	5,980	1894-1970
55	03291000	Eagle Creek at Sadieville, Ky.	42.9	42.9	1941-70
56	03291500	Eagle Creek at Glencoe, Ky.	437	437	1915-70
57	03292500	South Fork Beargrass Creek at Louisville, Ky.	17.2	17.2	1940-70
58	03293000	Middle Fork Beargrass Creek at Louisville, Ky.	18.9	18.4	1945-70
59	03294500	Ohio River at Louisville, Ky.	91,170	91,170	1832-1970
60	03295000	Salt River near Harrodsburg, Ky.	41.4	39.4	1953-70

Map No.		Skew	2-year discharge (ft^3/s)	5-year discharge (ft^3/s)	10-year discharge (ft^3/s)	25-year discharge (ft^3/s)	50-year discharge (ft^3/s)	100-year discharge (ft^3/s)
49	Computed	-1.58	4,240	5,460	5,910	6,250		
	Assigned	-.3	3,880	5,540	6,590	7,870	8,780	9,650
	Regression	-	2,930	4,540	5,630	7,020	8,040	9,110
50	Computed	.56	85	150	209	305		
	Assigned	-.3	93	155	198	255	297	341
	Regression	-	198	329	420	542	634	729
51	Computed	.18	803	1,250	1,590	2,060	2,450	
	Assigned	-.3	836	1,260	1,540	1,890	2,150	2,400
	Regression	-	950	1,510	1,900	2,400	2,780	3,160
52	Computed	-.83	12,800	18,600	21,800	25,100	27,200	28,900
	Assigned	-.3	12,300	18,600	22,700	27,900	31,700	35,400
	Regression	-	7,750	11,700	14,300	17,600	20,100	22,600
53	Computed	-.28	2,140	3,310	4,110	5,110	5,850	
	Assigned	-.3	2,140	3,310	4,100	5,090	5,820	6,540
	Regression	-	882	1,470	1,880	2,450	2,880	3,330
54	Computed	-1.37	70,500	85,900	92,100	97,100	99,400	101,000
	Assigned	-.3	66,700	86,400	98,100	112,000	121,000	130,000
	Regression	-	-	-	-	-	-	-
55	Computed	.70	4,260	5,880	7,140	8,950	10,500	12,100
	Assigned	-.3	4,520	6,010	6,920	7,970	8,710	9,400
	Regression	-	3,680	5,900	7,450	9,510	11,100	12,700
56	Computed	-.46	22,600	31,500	36,900	43,000	47,200	51,100
	Assigned	-.3	22,300	31,500	37,200	44,200	49,100	53,800
	Regression		18,800	28,900	35,900	44,800	51,600	58,700
57	Computed	-.46	973	1,850	2,490	3,350	4,010	4,660
	Assigned	-.4	965	1,840	2,510	3,420	4,120	4,840
	Regression	-	1,010	1,620	2,050	2,600	3,010	3,440
58	Computed	1.06	1,220	1,990	2,720	3,970	5,200	6,760
	Assigned	-.4	1,380	2,100	2,560	3,130	3,530	3,920
	Regression	-	937	1,500	1,900	2,410	2,800	3,200
59	Computed	a-.22	495,000	617,000	689,000	771,000	828,000	881,000
	Assigned	-	-	-	-	-	-	-
	Regression	-	-	-	-	-	-	-
60	Computed	-.76	3,550	5,300	6,300	7,380	8,070	8,680
	Assigned	-.2	3,380	5,280	6,600	8,310	9,610	10,900
	Regression	-	3,100	5,000	6,330	8,090	9,440	10,800

Table 4.--Comparison of discharge computed with station skew, assigned skew, and regression equation--Continued

Map No.	Station No.	Station Name	Drainage Area (square mile) Total	Contributing	Period of record
61	03295500	Salt River near Van Buren, Ky.	196	192	1928-70
62	03298000	Floyds Fork at Fisherville, Ky.	138	138	1945-70
63	03298500	Salt River at Shepherdsville, Ky.	1,197	1,197	1939-70
64	03299000	Rolling Fork near Lebanon, Ky.	239	239	1939-70
65	03300000	Beech Fork near Springfield, Ky.	85.9	85.9	1953-70
66	03301000	Beech Fork at Bardstown, Ky.	669	669	1940-70
67	03301500	Rolling Fork near Boston, Ky.	1,299	1,299	1939-70
68	03302000	Pond Creek near Louisville, Ky.	64.0	64.0	1945-70
69	03303500	Ohio River at Owensboro, Ky.	97,200	97,200	1941-70
70	03304500	McGills Creek near McKinney, Ky.	2.14	2.14	1952-70
71	03305000	Green River near McKinney, Ky.	22.4	22.4	1952-70
72	03305500	Green River near Mt. Salem, Ky.	36.3	36.3	1954-70

Map No.		Skew	2-year discharge (ft^3/s)	5-year discharge (ft^3/s)	10-year discharge (ft^3/s)	25-year discharge (ft^3/s)	50-year discharge (ft^3/s)	100-year discharge (ft^3/s)
61	Computed	-0.91	9,040	12,100	13,700	15,300	16,200	16,900
	Assigned	-.3	8,670	12,100	14,300	16,900	18,700	20,400
	Regression	-	9,280	14,500	18,200	22,900	26,500	30,200
62	Computed	1.13	9,210	13,500	17,400	23,600	29,300	36,200
	Assigned	b	9,210	15,000	18,000	23,500	27,500	30,500
	Regression	-	8,360	13,100	16,400	20,700	24,000	27,400
63	Computed	.25	27,800	38,900	46,800	57,500	66,000	74,800
	Assigned	0	28,200	39,100	46,400	55,700	62,600	69,600
	Regression	-	38,200	57,700	71,000	87,800	101,000	114,000
64	Computed	.31	12,900	20,200	26,000	34,300	41,300	49,100
	Assigned	0	13,300	20,400	25,600	32,600	38,000	43,700
	Regression	-	12,300	19,100	23,800	29,900	34,600	39,400
65	Computed	-.18	5,690	7,810	9,160	10,800		
	Assigned	c-.18	5,690	7,810	9,160	10,800	12,000	13,100
	Regression	-	5,990	9,490	11,900	15,100	17,600	20,100
66	Computed	-.86	19,700	26,400	29,800	33,300	35,300	37,100
	Assigned	-.3	19,000	26,400	30,900	36,400	40,200	43,900
	Regression	-	25,400	38,700	47,900	59,600	68,500	77,700
67	Computed	-.92	27,300	36,800	41,700	49,500	49,300	51,600
	Assigned	-.3	26,100	36,800	43,600	51,700	57,400	62,900
	Regression	-	40,400	61,000	75,000	92,800	106,000	120,000
68	Computed	.04	2,350	3,740	4,770	6,210	7,360	8,580
	Assigned	c.04	2,350	3,740	4,770	6,210	7,360	8,580
	Regression	-	2,550	3,990	4,980	6,250	7,200	8,180
69	Computed	a-.3	476,000	646,000	750,000	871,000	955,000	1,030,000
	Assigned	-	-	-	-	-	-	-
	Regression	-	-	-	-	-	-	-
70	Computed	-.66	387	759	1,020	1,360	1,600	
	Assigned	-.2	361	754	1,090	1,590	2,020	2,500
	Regression	-	447	756	979	1,280	1,520	1,760
71	Computed	-.15	3,220	6,680	9,650	14,100	18,000	
	Assigned	-.2	3,250	6,690	9,600	13,900	17,600	21,700
	Regression	-	2,330	3,780	4,800	6,160	7,200	8,280
72	Computed	-.32	4,360	7,660	10,100	13,300		
	Assigned	-.2	4,300	7,640	10,200	13,700	16,500	19,400
	Regression	-	3,270	5,260	6,660	8,500	9,920	11,400

Table 4.--Comparison of discharge computed with station skew, assigned skew, and regression equation--Continued

Map No.	Station No.	Station Name	Drainage Area (square mile) Total	Contributing	Period of record
73	03306500	Green River at Greensburg, Ky.	736	736	1940-68
74	03307000	Russell Creek near Columbia, Ky.	188	173	1940-70
75	03307500	South Fork Little Barren River at Edmonton, Ky.	18.3	18.3	1942-70
76	03308500	Green River at Munfordville, Ky.	1,673	1,493	1913-68
77	03309000	Green River at Mammoth Cave, Ky.	1,983	1,539	1935-50
78	03309500	McDougal Creek near Hodgenville, Ky.	5.34	5.34	1954-70
79	03310000	North Fork Nolin River at Hodgenville, Ky.	36.4	35.6	1942-70
80	03310300	Nolin River at White Mills, Ky.	357	237	1960-70
81	03310400	Bacon Creek near Priceville, Ky.	85.4	54.4	1960-70
82	03310500	Nolin River at Wax, Ky.	600	380	1937-62
83	03311000	Nolin River at Kyrock, Ky.	707	484	1931-62
84	03311500	Green River at lock 6, at Brownsville, Ky.	2,762	2,072	1907-62

Map No.		Skew	2-year discharge (ft^3/s)	5-year discharge (ft^3/s)	10-year discharge (ft^3/s)	25-year discharge (ft^3/s)	50-year discharge (ft^3/s)	100-year discharge (ft^3/s)
73	Computed	0.69	18,000	27,400	35,200	47,100	57,600	69,800
	Assigned	-.2	18,200	27,400	33,700	41,600	47,600	53,500
	Regression	-	-	-	-	-	-	-
74	Computed	-.34	7,220	10,300	12,300	14,600	16,200	17,800
	Assigned	-.2	7,140	10,300	12,400	14,900	16,800	18,700
	Regression	-	5,210	8,050	9,980	12,500	14,300	16,200
75	Computed	-.02	1,680	2,130	2,420	2,750	3,000	3,230
	Assigned	-.2	1,700	2,140	2,400	2,710	2,920	3,120
	Regression	-	1,170	1,880	2,370	3,020	3,500	4,000
76	Computed	.11	28,000	39,500	47,300	57,500	65,300	105,000
	Assigned	d-.1	28,300	39,600	47,000	56,200	63,100	84,400
	Regression	-	-	-	-	-	-	-
77	Computed	.29	29,100	44,900	57,000	74,400	88,800	~~1,050,000~~ 105,000
	Assigned	-.3	30,600	45,500	55,200	67,200	75,900	84,400
	Regression	-	-	-	-	-	-	-
78	Computed	.28	844	1,540	2,110	2,970		
	Assigned	-.3	877	1,550	2,060	2,730	3,260	3,790
	Regression	-	850	1,420	1,820	2,360	2,780	3,220
79	Computed	-.88	4,190	6,720	8,180	9,750	10,700	11,600
	Assigned	-.3	3,940	6,710	8,700	11,300	13,300	15,400
	Regression	-	2,830	4,580	5,800	7,420	8,660	9,950
80	Computed	.83	6,340	10,600	14,500			
	Assigned	-.3	7,040	11,100	13,800	17,300	19,800	22,400
	Regression	-	5,640	8,520	10,500	12,900	14,700	16,500
81	Computed	-.60	1,250	2,080	2,630			
	Assigned	-.3	1,210	2,080	2,710	3,540	4,180	4,830
	Regression	-	2,060	3,200	3,970	4,950	5,680	6,420
82	Computed	-.44	9,270	13,100	15,400	18,000	19,900	21,600
	Assigned	-.3	9,170	13,000	15,500	18,400	20,500	22,600
	Regression	-	8,140	12,200	14,900	18,200	20,700	23,200
83	Computed	-.60	10,000	14,300	16,800	19,600	21,500	23,200
	Assigned	-.3	9,780	14,300	17,200	20,700	23,200	25,700
	Regression	-	9,130	13,600	16,600	20,300	23,100	25,900
84	Computed	.27	36,200	52,400	64,200	80,500	93,600	107,000
	Assigned	e0	36,900	52,700	63,500	77,500	88,200	99,000
	Regression	-	-	-	-	-	-	-

Table 4.--Comparison of discharge computed with station skew, assigned skew, and regression equation--Continued

Map No.	Station No.	Station Name	Drainage Area (square mile) Total	Contributing	Period of record
85	03312000	Bear Creek near Leitchfield, Ky.	30.8	30.8	1950-70
86	03312500	Barren River near Pageville, Ky.	531	512	1940-63
87	03313000	Barren River near Finney, Ky.	940	863	1942-50
88	03313500	West Bays Fork at Scottsville, Ky.	7.47	7.47	1951-70
89	03313800	Lick Creek near Franklin, Ky.	21.1	7.8	1959-70
90	03314000	Drakes Creek near Alvaton, Ky.	478	358	1937-70
91	03314500	Barren River at Bowling Green, Ky.	1,848	1,358	1938-63
92	03315500	Green River at lock 4, at Woodbury, Ky.	5,403	4,043	1937-63
93	03316000	Mud River near Lewisburg, Ky.	90.5	81.5	1940-70
94	03316500	Green River at Paradise, Ky.	6,182	4,802	1940-63
95	03317000	Rough River near Madrid, Ky.	225	158	1937-59
96	03317500	North Fork Rough River near Westview, Ky.	42.0	23.0	1955-70

Map No.		Skew	2-year discharge (ft^3/s)	5-year discharge (ft^3/s)	10-year discharge (ft^3/s)	25-year discharge (ft^3/s)	50-year discharge (ft^3/s)	100-year discharge (ft^3/s)
85	Computed	0.07	4,420	5,750	6,610	7,680	8,470	
	Assigned	-.3	4,500	5,780	6,520	7,380	7,960	8,510
	Regression	-	2,780	4,480	5,670	7,250	8,460	9,720
86	Computed	.35	18,700	32,900	45,200	64,500	82,000	
	Assigned	-.3	20,000	33,600	43,300	55,900	65,600	75,300
	Regression	-	17,800	27,400	34,000	42,400	48,800	55,500
87	Computed	-.26	28,900	49,200	63,900			
	Assigned	-.3	29,100	49,300	63,700	82,800	97,400	112,000
	Regression	-	26,700	40,600	50,100	62,200	71,400	80,900
88	Computed	1.94	1,350	2,010	2,720	4,030	5,430	
	Assigned	-.3	1,570	2,230	2,640	3,140	3,500	3,850
	Regression	-	1,030	1,700	2,170	2,820	3,310	3,820
89	Computed	1.31	1,770	2,810	3,830			
	Assigned	-.3	2,020	3,010	3,650	4,450	5,030	5,590
	Regression	-	1,850	3,010	3,830	4,920	5,750	6,620
90	Computed	.68	16,100	27,400	37,700	54,500	70,500	89,900
	Assigned	-.3	17,700	28,400	35,800	45,200	52,300	59,300
	Regression	-	16,600	25,500	31,600	39,500	45,500	51,800
91	Computed	.46	29,300	46,200	60,000	80,800	98,900	119,000
	Assigned	-.3	31,200	47,200	57,700	70,800	80,400	89,700
	Regression	-	42,900	64,500	79,200	97,700	112,000	126,000
92	Computed	.58	58,600	88,800	113,000	150,000	182,000	218,000
	Assigned	d0	61,300	90,400	111,000	138,000	158,000	180,000
	Regression	-	-	-	-	-	-	-
93	Computed	-.89	5,330	7,780	9,100	10,500	11,300	12,000
	Assigned	-.4	5,110	7,780	9,510	11,600	13,100	14,600
	Regression	-	5,140	8,150	10,200	13,000	15,100	17,300
94	Computed	-.38	53,700	73,700	85,800	100,000	110,000	119,000
	Assigned	-.4	53,700	73,700	85,700	99,600	109,000	118,000
	Regression	-	-	-	-	-	-	-
95	Computed	-1.82	9,620	12,400	13,300	13,900	14,100	
	Assigned	-.4	8,640	12,800	15,400	18,500	20,700	22,800
	Regression	-	6,310	9,730	12,100	15,000	17,300	19,600
96	Computed	-.04	1,940	2,770	3,320	4,030		
	Assigned	-.4	1,990	2,780	3,260	3,810	4,200	4,560
	Regression	-	1,930	3,070	3,860	4,890	5,660	6,460

Table 4.--Comparison of discharge computed with station skew, assigned skew, and regression equation--Continued

Map No.	Station No.	Station Name	Drainage Area (square mile) Total	Contributing	Period of record
97	03318000	Rough River near Falls of Rough, Ky.	454	345	1940-56
98	03318200	Rock Lick Creek near Glen Dean, Ky.	20.1	20.1	1957-70
99	03318500	Rough River at Falls of Rough, Ky.	504	394	1949-70
100	03318800	Caney Creek near Horse Branch, Ky.	124	124	1957-70
101	03319000	Rough River near Dundee, Ky.	757	637	1940-70
102	03320000	Green River at lock 2, at Calhoun, Ky.	7,564	6,024	1931-61
103	03320500	East Fork Pond River near Apex, Ky.	194	194	1940-70
104	03322000	Ohio River at Evansville, Ind.	107,000	107,000	1832-1970
105	03383000	Tradewater River at Olney, Ky.	255	246	1940-70
106	03384000	Rose Creek at Nebo, Ky.	2.10	2.10	1952-70
107	03384500	Ohio River at Golconda, Ill.	143,900	143,900	1937-70
108	03400500	Poor Fork at Cumberland, Ky.	82.3	82.3	1940-70

Map No.		Skew	2-year discharge (ft^3/s)	5-year discharge (ft^3/s)	10-year discharge (ft^3/s)	25-year discharge (ft^3/s)	50-year discharge (ft^3/s)	100-year discharge (ft^3/s)
97	Computed	-1.67	9,050	12,200	13,400	14,300		
	Assigned	-.4	8,120	12,500	15,400	19,000	21,500	24,000
	Regression	-	10,300	15,700	19,300	24,000	27,400	32,000
98	Computed	.70	2,820	4,590	6,140	8,640		
	Assigned	-.4	3,110	4,750	5,810	7,110	8,040	8,930
	Regression	-	1,330	2,130	2,690	3,430	3,980	4,550
99	Computed	-1.47	9,140	11,900	13,100	14,000	14,400	
	Assigned	-.4	8,470	12,100	14,300	17,000	18,800	20,600
	Regression	-	11,100	16,900	20,800	25,700	29,400	33,200
100	Computed	.47	5,170	7,160	8,630	10,700		
	Assigned	-.4	5,450	7,270	8,350	9,580	10,400	11,200
	Regression	-	4,780	7,420	9,230	11,600	13,300	15,100
101	Computed	-.83	10,400	14,600	16,800	19,100	20,500	21,800
	Assigned	-.4	10,100	14,600	17,400	20,700	23,000	25,200
	Regression	-	14,800	22,300	27,400	33,800	38,600	43,500
102	Computed	.84	53,000	75,300	93,300	120,000	144,000	171,000
	Assigned	d.1	55,600	77,000	91,700	111,000	125,000	140,000
	Regression	-	-	-	-	-	-	-
103	Computed	-.27	7,210	11,800	15,100	19,400	22,700	25,900
	Assigned	-.4	7,310	11,900	15,000	18,800	21,700	24,400
	Regression	-	10,100	15,800	19,700	24,800	28,700	32,700
104	Computed	.07	521,000	669,000	763,000	879,000	964,000	1,050,000
	Assigned	-	-	-	-	-	-	-
	Regression	-	-	-	-	-	-	-
105	Computed	.23	3,800	5,780	7,270	9,360	11,100	12,900
	Assigned	-.4	4,000	5,860	7,020	8,410	9,390	10,300
	Regression	-	3,680	5,570	6,830	8,400	9,550	10,700
106	Computed	-.15	629	874	1,030	1,230	1,370	
	Assigned	-.5	643	877	1,010	1,170	1,270	1,360
	Regression	-	421	712	921	1,210	1,430	1,660
107	Computed	a-.59	672,000	870,000	978,000	1,100,000	1,170,000	1,240,000
	Assigned	-	-	-	-	-	-	-
	Regression	-	-	-	-	-	-	-
108	Computed	-.46	4,000	6,250	7,720	9,500	10,800	12,000
	Assigned	0	3,820	6,200	8,000	10,500	12,500	14,600
	Regression	-	5,230	8,270	10,400	13,100	15,200	17,400

Table 4.--Comparison of discharge computed with station skew, assigned skew, and regression equation--Continued

Map No.	Station No.	Station Name	Drainage Area (square mile) Total	Drainage Area (square mile) Contributing	Period of record
109	03400700	Clover Fork at Evarts, Ky.	82.4	82.4	1960-70
110	03401000	Cumberland River near Harlan, Ky.	374	374	1941-70
111	03401500	Yellow Creek Bypass at Middlesboro, Ky.	35.3	35.3	1941-70
112	03402000	Yellow Creek near Middlesboro, Ky.	58.2	58.2	1941-70
113	03403000	Cumberland River near Pineville, Ky.	809	809	1929-70
114	03403500	Cumberland River at Barbourville, Ky.	960	960	1923-70
115	03404000	Cumberland River at Williamsburg, Ky.	1,607	1,607	1951-70
116	03404500	Cumberland River at Cumberland Falls, Ky.	1,977	1,977	1916-70
117	03404900	Lynn Camp Creek at Corbin, Ky.	53.8	53.8	1957-70
118	03405000	Laurel River at Corbin, Ky.	201	201	1923-70
119	03406000	Wood Creek near London, Ky.	3.89	3.89	1954-70
120	03406500	Rockcastle River at Billows, Ky.	604	604	1937-70

Map No.		Skew	2-year discharge (ft^3/s)	5-year discharge (ft^3/s)	10-year discharge (ft^3/s)	25-year discharge (ft^3/s)	50-year discharge (ft^3/s)	100-year discharge (ft^3/s)
109	Computed	-0.53	6,310	10,500	13,300			
	Assigned	0	5,960	10,400	13,900	18,900	23,100	27,700
	Regression	-	5,240	8,280	10,400	13,200	15,300	17,400
110	Computed	-.22	17,800	27,000	33,200	41,000	46,800	52,600
	Assigned	0	17,500	26,900	33,600	42,700	49,800	57,200
	Regression	-	15,200	23,300	28,900	36,100	41,600	47,200
111	Computed	.34	3,010	4,880	6,380	8,630	10,600	12,700
	Assigned	0	3,110	4,930	6,280	8,120	9,590	11,100
	Regression	-	2,890	4,630	5,860	7,470	8,690	9,970
112	Computed	.75	3,460	5,190	6,620	8,830	10,800	13,100
	Assigned	0	3,660	5,320	6,470	7,970	9,120	10,300
	Regression	-	4,100	6,520	8,210	10,400	12,100	13,900
113	Computed	-.11	28,200	39,000	46,000	54,700	61,100	67,400
	Assigned	0	28,000	38,900	46,200	55,500	62,600	69,600
	Regression	-	-	-	-	-	-	-
114	Computed	-.06	26,600	36,300	42,700	50,500	56,300	62,100
	Assigned	0	26,500	36,300	42,800	50,900	57,000	63,100
	Regression	-	-	-	-	-	-	-
115	Computed	.20	26,400	34,000	39,000	45,300	50,000	
	Assigned	0	26,700	34,100	38,700	44,400	48,400	52,400
	Regression	-	-	-	-	-	-	-
116	Computed	.01	33,000	43,200	49,700	57,700	63,600	69,400
	Assigned	-0.1	33,200	43,300	49,500	57,000	62,400	67,700
	Regression	-	-	-	-	-	-	-
117	Computed	.18	2,380	4,230	5,790	8,140		
	Assigned	-.1	2,460	4,280	5,680	7,640	9,240	10,900
	Regression	-	2,500	3,930	4,920	6,200	7,150	8,140
118	Computed	-.05	6,580	10,500	13,400	17,200	20,300	23,500
	Assigned	-.1	6,610	10,500	13,300	17,100	20,000	23,000
	Regression	-	6,310	9,700	12,000	14,900	17,100	19,400
119	Computed	-.72	276	441	541	654		
	Assigned	-.1	258	438	573	761	912	1,070
	Regression	-	394	651	831	1,070	1,250	1,440
120	Computed	-.46	20,800	30,200	36,100	42,900	47,700	52,100
	Assigned	-.1	20,200	30,100	36,900	45,800	52,500	59,300
	Regression	-	23,600	36,100	44,700	55,600	64,000	72,600

Table 4.--Comparison of discharge computed with station skew, assigned skew, and regression equation--Continued

Map No.	Station No.	Station Name	Drainage Area (square mile) Total	Contributing	Period of record
121	03407100	Cane Branch near Parkers Lake, Ky.	0.67	0.67	1957-70
122	03407200	West Fork Cane Branch near Parkers Lake, Ky.	.26	.26	1957-70
123	03407300	Helton Branch at Greenwood, Ky.	.85	.85	1956-70
124	03407500	Buck Creek near Shopville, Ky.	165	165	1953-70
125	03408000	New River near New River, Tenn.	314	314	1923-34
126	03408500	New River at New River, Tenn.	382	382	1935-67
127	03409500	Clear Fork near Robbins, Tenn.	272	272	1931-67
128	03410500	South Fork Cumberland River near Stearns, Ky.	954	954	1943-70
129	03411000	South Fork Cumberland River at Nevelsville, Ky.	1,271	1,271	1916-50
130	03411500	Cumberland River at Burnside, Ky.	4,865	4,865	1885-1950
131	03412500	Pitman Creek at Somerset, Ky.	31.3	31.3	1954-70
132	03414000	Cumberland River near Rowena, Ky.	5,790	5,790	1940-50

Map No.		Skew	2-year discharge (ft^3/s)	5-year discharge (ft^3/s)	10-year discharge (ft^3/s)	25-year discharge (ft^3/s)	50-year discharge (ft^3/s)	100-year discharge (ft^3/s)
121	Computed	-0.07	73	149	215	318		
	Assigned	-.1	73	149	215	315	402	499
	Regression	-	114	195	253	331	390	452
122	Computed	.66	32	56	77	113		
	Assigned	-.1	35	58	75	98	116	136
	Regression	-	59	102	133	176	208	242
123	Computed	-.29	54	107	150	211		
	Assigned	-.1	53	107	153	224	285	354
	Regression	-	135	230	297	388	457	529
124	Computed	-.33	8,100	12,700	15,800	19,600		
	Assigned	-.1	7,930	12,600	16,000	20,600	24,100	27,800
	Regression	-	9,480	14,800	18,600	23,400	27,100	30,900
125	Computed	1.80	17,300	27,300	38,100			
	Assigned	0	19,900	30,100	37,500	47,200	54,900	62,800
	Regression	-	16,400	25,400	31,600	39,700	45,900	52,300
126	Computed	-.28	24,600	31,700	35,900	40,700	44,000	47,100
	Assigned	0	24,300	31,600	36,300	42,000	46,200	50,300
	Regression	-	18,800	29,100	36,100	45,300	52,300	59,500
127	Computed	-.18	13,800	20,200	24,400	29,800	33,800	37,800
	Assigned	0	13,600	20,100	24,700	30,700	35,300	40,100
	Regression	-	14,800	23,000	28,700	36,100	41,700	47,600
128	Computed	-.17	44,500	59,100	68,200	79,100	86,800	94,300
	Assigned	-.1	44,400	59,100	68,400	79,700	87,900	96,000
	Regression	-	35,800	54,400	67,100	83,400	95,900	109,000
129	Computed	-.11	50,300	72,300	87,000	106,000	120,000	133,000
	Assigned	-.1	50,200	72,300	87,100	106,000	120,000	134,000
	Regression	-	43,800	66,200	81,500	101,000	116,000	131,000
130	Computed	-.54	107,000	142,000	162,000	183,000	197,000	210,000
	Assigned	-.1	104,000	141,000	165,000	195,000	216,000	237,000
	Regression	-	-	-	-	-	-	-
131	Computed	-.75	1,940	2,640	3,010	3,400		
	Assigned	-.1	1,860	2,620	3,130	3,770	4,250	4,720
	Regression	-	1,710	2,710	3,410	4,320	4,990	5,700
132	Computed	-.07	97,100	136,000	161,000			
	Assigned	c-.07	97,100	136,000	161,000	193,000	217,000	240,000
	Regression	-	-	-	-	-	-	-

Table 4.--Comparison of discharge computed with station skew, assigned skew, and regression equation--Continued

Map No.	Station No.	Station Name	Drainage area (square mile) Total	Contributing	Period of record
133	03414500	East Fork Obey River near Jamestown, Tenn.	202	196	1944-67
134	03415000	West Fork Obey River near Alpine, Tenn.	115	81	1943-67
135	03416000	Wolf River near Byrdstown, Tenn.	106	106	1944-67
136	03417500	Cumberland River at Celina, Tenn.	7,320	7,320	1923-50
137	03435500	Red River near Adams, Tenn.	709	309	1921-67
138	03436000	Sulphur Fork Red River near Adams, Tenn.	186	165	1940-67
139	03437500	South Fork Little River at Hopkinsville, Ky.	46.5	35.5	1950-70
140	03438000	Little River near Cadiz, Ky.	244	150	1940-70
141	03610000	Clarks River at Murray, Ky.	89.7	89.7	1952-70
142	03610500	Clarks River near Benton, Ky.	227	227	1939-70
143	03611500	Ohio River at Metropolis, Ill.	203,000	203,000	1930-70
144	07022500	Perry Creek near Mayfield, Ky.	1.72	1.72	1953-70

Map No.		Skew	2-year discharge (ft^3/s)	5-year discharge (ft^3/s)	10-year discharge (ft^3/s)	25-year discharge (ft^3/s)	50-year discharge (ft^3/s)	100-year discharge (ft^3/s)
133	Computed	-0.21	15,800	22,200	26,200	31,200	34,800	38,300
	Assigned	-.1	15,700	22,100	26,400	31,700	35,700	39,600
	Regression	-	10,500	16,500	20,700	26,200	30,300	34,600
134	Computed	-.18	6,920	10,000	12,000	14,600	16,500	18,300
	Assigned	-.1	6,880	9,990	12,100	14,800	16,800	18,800
	Regression	-	7,070	11,200	14,100	17,900	20,800	23,800
135	Computed	-.46	7,550	12,200	15,300	19,100	21,800	24,400
	Assigned	-.1	7,270	12,100	15,800	20,700	24,700	28,900
	Regression	-	7,630	12,100	15,200	19,200	22,300	25,600
136	Computed	a-.12	88,000	113,000	128,000	146,000	158,000	171,000
	Assigned	-	-	-	-	-	-	-
	Regression	-	-	-	-	-	-	-
137	Computed	-.42	14,000	20,300	24,300	29,000	32,200	35,300
	Assigned	-.3	13,800	20,300	24,500	29,600	33,300	36,900
	Regression	-	13,500	20,300	24,900	30,800	35,100	39,600
138	Computed	.08	6,320	9,300	11,400	14,300	16,500	18,800
	Assigned	-.3	6,510	9,370	11,200	13,400	15,000	16,500
	Regression	-	5,340	8,240	10,200	12,800	14,700	16,600
139	Computed	.61	2,390	3,790	4,970	6,800	8,430	
	Assigned	-.4	2,600	3,900	4,730	5,730	6,430	7,110
	Regression	-	1,990	3,150	3,960	5,000	5,790	6,600
140	Computed	.22	6,240	9,110	11,200	14,100	16,400	18,800
	Assigned	-.4	6,520	9,210	10,900	12,800	14,100	15,400
	Regression	-	6,390	9,820	12,200	15,100	17,400	19,700
141	Computed	.77	6,290	12,000	17,700	28,100	38,700	
	Assigned	b	7,000	12,600	16,800	22,600	27,300	32,200
	Regression	-	6,560	10,400	13,100	16,600	19,300	22,000
142	Computed	-.85	9,840	16,700	20,900	25,600	28,600	31,200
	Assigned	-.5	9,430	16,700	21,800	28,300	33,100	37,800
	Regression	-	12,600	19,600	24,500	30,800	35,700	40,700
143	Computed	a-.69	899,000	1,120,000	1,230,000	1,350,000	1,420,000	1,480,000
	Assigned	-	-	-	-	-	-	-
	Regression	-	-	-	-	-	-	-
144	Computed	.11	584	895	1,130	1,440		
	Assigned	-.5	614	905	1,080	1,290	1,440	1,570
	Regression	-	217	364	467	607	712	822

Table 4.--Comparison of discharge computed with station skew, assigned skew, and regression equation--Continued

Map No.	Station No.	Station Name	Drainage area (square mile) Total	Contributing	Period of record
145	07023000	Mayfield Creek near Lovelaceville, Ky.	212	212	1939-70
146	07023500	Obion Creek at Pryorsburg, Ky.	36.8	36.8	1952-70
147	07024000	Bayou de Chien near Clinton, Ky.	68.7	68.7	1940-70
148	07025500	North Fork Obion River near Union City, Tenn.	480	480	1930-67

a Main-stem station, station skew used.
b From graphical plot.
c Station skew used.
d Weighted skew.
e Mean skew.

Map No.		Skew	2-year discharge (ft^3/s)	5-year discharge (ft^3/s)	10-year discharge (ft^3/s)	25-year discharge (ft^3/s)	50-year discharge (ft^3/s)	100-year discharge (ft^3/s)
145	Computed	-0.15	6,490	8,960	10,500	12,500	13,900	15,300
	Assigned	-.5	6,640	8,990	10,300	11,900	12,900	13,800
	Regression	-	6,410	9,840	12,200	15,100	17,300	19,600
146	Computed	-.08	3,330	4,340	4,970	5,730	6,280	
	Assigned	-.5	3,400	4,360	4,880	5,460	5,840	6,180
	Regression	-	1,870	2,970	3,720	4,690	5,430	6,190
147	Computed	-.13	3,110	4,760	5,910	7,400	8,530	9,690
	Assigned	-.5	3,210	4,780	5,750	6,890	7,680	8,410
	Regression	-	2,900	4,550	5,670	7,120	8,210	9,340
148	Computed	0	9,450	17,300	23,700	33,300	41,400	50,300
	Assigned	-.5	10,000	17,500	22,600	29,100	33,900	38,500
	Regression	-	11,400	17,200	21,200	26,100	29,800	33,600

METHODS OF ANALYSIS

Methods of flood-frequency analysis used in this report are explained in detail in reports by Benson, 1962; Hardison, 1974; Thomas and Benson, 1970; and U.S. Water Resources Council, 1967; and are explained only briefly here.

The analysis had two steps:

1. Determine magnitude and frequency of floods based on annual flood peaks at individual stream-gaging stations throughout the State and a few in surrounding states.

2. Develop a method for estimating flood-frequency data at ungaged sites from flood characteristics at gaging stations.

Flood peaks and drainage area for 131 gaging stations having 10 or more years of record listed in Table 4 were used in this flood-frequency analysis. Three of these stations are in West Virginia, three in Virginia and eight in Tennessee.

Except for gaging stations on the Ohio River, the drainage area for most gages varies between 10 square miles (25.9 square kilometres), and 4,300 square miles (11,100 square kilometres).

Frequency Analysis at Gaging Stations

The magnitude and frequency relation for a gaging station can be determined mathematically, or graphically by fitting a curve to plotted points. The mathematical solution using log-Pearson Type III method recommended by the U.S. Water Resources Council (1967) was used in preparing this report. Computations were made with a digital computer and the results printed in both tabular and graphical form. In this method the peak discharge for selected recurrence intervals is computed by equation

$$\log Q = M+KS$$

where Q is the peak discharge for a selected recurrence interval, M is the mean of the logarithms of the annual peaks, K is Pearson Type III coordinates expressed in number of standard deviations from the mean for the selected recurrence interval, and S is the standard deviation of the logarithms of the annual peaks. Values of K may be selected from tables for desired recurrence interval using the computed coefficient of skew of the logarithms of skew of annual peaks, or assigned coefficients of skew.

Frequency curves computed by log-Pearson Type III method were compared to a graphical plot of the annual peaks. Plotting positions of the annual peaks were computed from the equation

$$T = (n+1)/m$$

where T is recurrence interval in years, n the number of years of record, and m the peak's numerical rank with the largest peak being 1. The log-Pearson Type III frequency curves using assigned skew

(Hardison, 1974) were in general agreement with graphical plots in most cases. Where they were not in agreement, extreme high and low annual peaks were examined. Low annual peaks which were considered to be "outliers", nonrepresentative annual peaks for the period of record, were eliminated (U.S. Water Resources Council, 1967). In all but two cases the log-Pearson plot agreed closely with the graphical plot. The graphical plot was used for these two stations; see Table 4, Map Nos. 62 and 141.

Historical peaks were plotted individually with appropriate plotting positions in years. For example, the flood of January 1937 along the Ohio River is the highest known flood in at least 200 years. The plotting position for the 1937 flood is at 200 years on the frequency curves for the Ohio River. This plotting of historical floods agreed with the computed curves in all cases which were used in this report.

When the computed coefficient of skew was within 0.05 of the assigned coefficient of skew, the computed value was used in the computations. Small differences in coefficient of skew makes little difference in computed discharge. Computed coefficient of skew was used for frequency analysis for stations on the Ohio River. Computed skews were weighted with Hardison's generalized skews to determine the assigned skew to use for three main-stem stations on the Green River. The two skews were averaged for another station on the Green River.

"Assigned skew" frequency values in Table 4 should be used to find the peak discharge for a desired frequency at a gaging station except along the Ohio River when the computed skew is used.

Regional Analysis

Relationships developed herein were determined by the step-backward multiple regression technique. Streamflow characteristics for 2-, 5-, 10-, 25-, 50-, and 100-year flood were related to basin characteristics. The regression model used to define these relationships has the general form

$$Q_p = aA^{b_1}B_1^{b_2}B_2^{b_3}\ldots$$

where Q_p is the flood peak, a is the regression constant, A and B are basin characteristics, and b_1 and b_2 are regression coefficients. The analysis determines the regression constant and coefficients, evaluates the statistical significance of each basin characteristic, and provides a standard error of estimate.

Seven basin parameters related to the 10-year flood were used in a report by Beaber, 1970. Four of these parameters, main channel slope, main channel length, mean basin elevation and percent forest cover are time-consuming and difficult for the user to determine. Non-contributing drainage area is removed from total drainage to give contributing drainage area for use in the regression equations in this report. Mean annual precipitation can be taken from graphs in National Weather Service reports. Several simple methods were tried to estimate main channel length and slope to use in the regression analysis. The results were very poor. It was decided to try another approach using only contributing drainage area.

A preliminary regression equation for 10-year peaks was computed using only contributing drainage area and flood peaks for 131 gaging stations in Kentucky and three surrounding states. Residuals, ratios of observed values of 10-year peaks to those computed with the preliminary equation, were plotted on a map "Streams of Kentucky" to investigate areal variations. Regional boundaries were drawn giving consideration to residual patterns, drainage basin boundaries, and physiographic divisions determined from over 500 geologic quadrangle maps and "Soil Conservation Service's General Soils Map-Draft" (for Kentucky). The State was divided into 16 regions or areas in this way. The weighted average of the residuals, based on length of record, was computed for each of the 16 areas and is shown as geographical area factor R under the geographical area number on Plate 1.

A multiple regression was run using contributing drainage area and geographical factor R as parameters. The results are the equations and standard errors shown in Table 2. Use of the equations are explained in the section Estimating Technique.

The following reaches of stream were treated as main-stem stations and the gaging stations on these streams were not used in the regression analysis:

Licking River below Cave Run Lake
Kentucky River below Heidelberg, Ky.
Green River below Campbellsville Lake
Cumberland River below Harlan, Ky.
Ohio River below Huntington, W. Va.

Figures 19-21 show the relation of peak discharge for selected recurrence intervals to river miles for Cumberland River upstream from Lake Cumberland, Kentucky River downstream from Lock 14 at Heidelberg, and Ohio River downstream from Huntington, W. Va., respectively.

The main stems of the Licking River and Green River are regulated by reservoirs, therefore no curves are shown.

The records for the Ohio River upstream from Golconda, Illinois, and the Kentucky River downstream from Heidelberg are homogeneous for the period of record. Total usable storage upstream from each station on these two streams are well below the criteria set by Benson, 1962, pertaining to regulation. High flow volumetric plots were made for the Cumberland, Kentucky and Ohio Rivers to confirm the shape of the curves shown in Figures 19-21.

SELECTED REFERENCES

Beaber, Howard C., 1970, A proposed streamflow data program for Kentucky: U.S. Geol. Survey open-file rept., 70 p.

Benson, M. A., 1962, Factors influencing the occurrence of floods in a humid region of diverse terrain: U.S. Geol. Survey Water-Supply Paper 1580-B, 64 p.

Hardison, C. A., 1974, Generalized skew coefficients of annual floods in the United States and their application: Water Resources Research Vol. 10, No. 4 August 1974 p. 745-752.

McCabe, John A., 1962, Floods in Kentucky - magnitude and frequency: Kentucky Geol. Survey Information Circular 9, Series X.

Speer, P. R., and Gamble, C. R., 1964, Magnitude and frequency of floods in the United States, Part 3-B, Cumberland and Tennessee River basin: U.S. Geol. Survey Water-Supply Paper 1676, 340 p.

_____1965, Magnitude and frequency of floods in the United States, Part 3-A, except Cumberland and Tennessee River basins: U.S. Geol. Survey Water-Supply Paper 1675, 630 p.

Thomas, D. M., and Benson, M. A., 1970, Generalization of streamflow characteristics from drainage-basin characteristics: U.S. Geol. Survey Water-Supply Paper 1975, 55 p.

U.S. Water Resources Council, 1967, A uniform technique for determining flood-flow frequencies: U.S. Water Resources Council Bull. 15, 15 p.

☆USGPO: 1976 — 758-112/04 Region 5-11