U. S. DEPARTMENT OF COMMERCE

SINCLAIR WEEKS, *Secretary*

WEATHER BUREAU

F. W. REICHELDERFER, *Chief*

TECHNICAL PAPER NO. 29

Rainfall Intensity-Frequency Regime

Part 1—The Ohio Valley

(Rainfall intensity-duration-area-frequency regime, with other storm characteristics, for durations of 20 minutes to 24 hours, area from point to 400 square miles, frequency for return periods from 1 to 100 years, for the quadrangle bounded by longitudes 80° and 90° W. and latitudes 35° and 40° N.)

Prepared by

COOPERATIVE STUDIES SECTION

HYDROLOGIC SERVICES DIVISION

U. S. WEATHER BUREAU

for

ENGINEERING DIVISION

SOIL CONSERVATION SERVICE

U. S. DEPARTMENT OF AGRICULTURE

WASHINGTON, D. C.

JUNE 1957

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. - Price 30 cents

U. S. DEPARTMENT OF COMMERCE

WEATHER BUREAU

TECHNICAL PAPER NO. 29

Rainfall Intensity-Frequency Regime

Part I--The Ohio Valley

Errata

Items 3, 4, 5, 7, 8, and 9 in Table 1-2 of Figures 1-1 and 2-1 should refer to Figures 2-2, 2-3, 2-4, 2-5, 2-6, and 2-7, respectively, instead of Figures 5 through 10.

USCOMM-WB-DC

CONTENTS

TABLES PAGE

SECTION I.

SECTION II.

FIGURES

SECTION I.

SECTION II.

Rainfall Intensity-Frequency Regime

Part I: The Ohio Valley

Rainfall intensity-duration-area-frequency regime, with other storm characteristics, for durations of 20 minutes to 24 hours, area from point to 400 square miles, frequency for return periods from 1 to 100 years, for the quadrangle bounded by longitude 80°W and 90°W and latitude 35°N and 40°N.

INTRODUCTION

1. Authority. This report is the first of a series being prepared on a regional basis for the Soil Conservation Service, Department of Agriculture, to provide material for use in developing planning and design criteria for the Watershed Protection and Flood Prevention program (P. L. 566).

2. Background. Heretofore, economic and engineering design requiring rainfall intensity-frequency analysis has been based largely on "Rainfall Intensity-Frequency Data"[1], by David L. Yarnell, which was first printed about 20 years ago. Since that time, besides the additional years of record, the number of recording gages has increased fifteen-fold, and ways have been found for effective use of data from cooperative observers who make observations of daily rainfall. It is, therefore, appropriate now to use maps with a more refined scale, portraying more regional variation than was possible 20 years ago. Instead of burdening the report with many maps, it has seemed expedient to use a small number of maps for significant durations and return periods, and to use diagrams with continuous variables for generalizing and interpolating among these few maps.

3. Approach to the problem. The point-rainfall analysis is based largely on routine application of the theory of extreme values, with empirical transformation to include consideration of the high values that are excluded from the annual series. Analysis of areal rainfall is a relatively new feature in frequency analysis and is based on the few dense networks that have several years of record and meet other important requirements. Consideration of other storm charactistics includes the portrayal of the seasonal variation in the intensity-frequency regime. The main reason for concern with seasonal variation may be illustrated by the fact that the 100-year 1-hour rain may be a typical summer thunderstorm, with considerable infiltration, whereas the 100-year flood may come from a lesser storm occurring on frozen or snow-covered ground in the late winter or early spring.

4. Separation of "Analysis" and "Applications". For convenience in practical application of the results of the work reported in this Technical Paper it is divided into two major sections. The first section, entitled "Analysis", describes what was done with the data, gives reasons for the way some things were done, and evaluates the results. The second section, entitled "Applications", gives step-by-step examples for use of the diagrams and maps in solving certain types of hydrologic problems.

5. Acknowledgements. This investigation was directed by D. M. Hershfield, project leader, in the Cooperative Studies Section (W. T. Wilson, Chief), of Hydrologic Services Division (W. E. Hiatt, Chief). Technical assistance was furnished by L. L. Weiss, collection and processing of data were performed by W. H. Bartlett, R. B. Holleman, Mrs. E. C. I'Anson, J. Keefer, S. P. Kerr III, Mrs. L. L. Langdon, Miss E. E. Marlowe, W. E. Miller, T. P. O'Connell, S. Otlin, H. J. Owens, Jr., J. G. Wangler, Jr., and A. J. Weinstein; typing was by S. P. Kerr III, and drafting by C. W. Gardner. Coordination with the Soil Conservation Service, Department of Agriculture, was maintained through H. O. Ogrosky, Staff Hydrologist of the Engineering Division. M. A. Kohler, Chief Research Hydrologist, and A. L. Shands, Assistant Chief, Hydrologic Services Division, acted as consultants. Mrs. L. K. Rubin of the Hydrometeorological Section edited the text.

SECTION I. ANALYSIS

Climate

6. The region covered in this study is bounded by longitudes 80° and 90° W. and latitudes 35° and 45° N. This region experiences wide variations in climatic conditions because of its broad areal extent, its location within the paths of various storm tracks, and wide range of elevation. The mean annual precipitation varies from about 80 inches near the tops of several high peaks on the Tennessee-North Carolina line to less than 40 inches in the northern part of the region. In the southern part, precipitation is greatest in the winter and slightly smaller in the summer. This seasonal trend is reversed to the north, with the maximum monthly amounts occurring during the summer, while some stations experience both a spring and summer maximum.

7. Storms and moisture source. Most of the summer precipitation is of the short-duration, thunderstorm type with high-intensity, small-area centers. The moisture for these storms is transported from the Gulf of Mexico by the prevailing southerly winds. Winter precipitation in the northern part of the region is partly in the form of snow, but in the southern part all large daily amounts are in the form of rain. This rain is, however, occasionally interspersed with snow and is the result of well-developed frontal systems.

8. Regional variation. Marked differences in precipitation occur among individual stations in orographic regions such as eastern Tennessee. Rainfall is considerably heavier on the Cumberland Plateau and on the Smoky Mountains than in the valleys of eastern Tennessee because a large percentage of the air reaching these valleys must first pass over the mountains on either side, thus losing much of its moisture before reaching the enclosed area. Heavy rains in western North Carolina are sometimes the result of orographic lifting of moist air from hurricanes. Such storms occasionally produce depths of more than 10 inches of rain per day.

9. Storms combined into one distribution. It has seemed worthwhile to question whether the statistical distribution of extreme rainfall is a function of storm type. In other words, does the same frequency distribution apply to thunderstorm, hurricane, and frontal rainfall? While this question is of less importance in the region of interest than in regions to the east and south, it is being investigated. Thus far no well-defined dichotomy has been found between hurricane rainfall and rainfall having other initial causes. A small amount of data indicates, at least tentatively, that once a rain-producing mechanism has been established (consisting of convergence, vertical motion and cooling, condensation and precipitation), the frequency distribution of its extreme values is not influenced much by the manner in which it got started or what source of energy maintains it.

Point Rainfall

Basic data

10. Station data. The sources of data used in this study are indicated in table 1-1. In order to generalize, and to insure proper relationships, it was necessary to examine data from outside the region of interest. For example, of the 200 first-order stations used (listed in table 1-1), only 17 are in this region. Long records were analysed from only a few stations (less than 300) to define the frequency relationships, and relatively short portions of the record from about 900 additional stations were analysed to define the regional pattern.

11. Station exposures. In refined analysis of mean annual and mean seasonal rainfall data it is necessary to evaluate station exposures by methods such as double-mass curve analysis. Such methods do not apply to extreme values. Except for some subjective selection (particularly for longer records) of stations that have had consistent exposures, no attempt has been made to adjust rainfall values to a standard exposure. The effects of varying exposure are implicitly included in the areal sampling error and are averaged out, if not evaluated, in the process of smoothing the isopluvial lines.

12. Time increments. Some of the hourly data are clock-hour, and some are maximum 60-minute data; correspondingly, some of the 24-hour data are for the maximum 1440 minutes, whereas others are for a calendar day. Examination of sufficient data has resulted in reliable empirical conversion factors so that the results refer to maximum n-minute data for all durations.

13. Rain or snow. The term precipitation has been used in reference to the 24-hour data because snow as well as rain is included in some of the smaller 24-hour amounts. This is particularly true for high-elevation stations. Comparison of arrays of all ranking precipitation events with those known to have only rain has shown trivial differences in the frequency relations for several high-elevation stations tested. For the rarer 24-hour frequencies, and for all short-duration frequencies, the precipitation is composed entirely of rain.

Table 1-1

SOURCES OF POINT RAINFALL DATA

Duration	No. of Stations	Av. Length of Rec. (yrs)	Source §
20 min - 24 hr	200 first - order	40	2,3
hourly	276 hydrologic	10	4,5
6 - hour	276 hydrologic	10	4,5
daily	276 hydrologic	10	4,5
daily	910 cooperative	12	4,6
daily	62 cooperative	55	4,6

§ These numbers indicate references listed on p. 17.

Duration analysis

14. Duration interpolation diagrams. The result of the duration analysis is portrayed in diagrams A and B of figure 1-1 in which the rainfall rate or depth can be computed for any duration, from 20 minutes to 24 hours, provided the values for 1, 6, and 24 hours for a particular return period are given. This convenient generalization was obtained empirically from data from 200 first-order Weather Bureau stations and is the same relation shown as diagrams A and B of figure 1 of Weather Bureau Technical Paper No. 28.[7] For example, the 3-hour rainfall depth may be obtained if the 1-hour and 6-hour depths are given, and the 12-hour depth is a simple function of the 6-hour and 24-hour depths. The degree to which estimated and observed values of 3-hour and 12-hour depths correspond is shown in figures 1-2 and 1-3, respectively. The values are obtained merely by laying a straightedge across the two given values (1 and 6, or 6 and 24 hours) and reading the value for the desired duration. The points on figures 1-2 and 1-3 were chosen at random from stations throughout the United States. Since no regional variation is evident in this duration-depth or duration-intensity relationship, it may be used for any locality in the United States.

15. The 1-, 6-, and 24-hour values for use in figure 1-1 were obtained from isopluvial maps which will be described later. A large copy of figure 1-1 is furnished in the pocket inside the back cover of this report with a detailed description of its use, with examples.

Frequency analysis

16. Return-period interpolation diagram. Extreme values of rainfall depths or intensities form a frequency distribution which may be defined in terms of its moments. Investigations of hundreds of rainfall distributions have confirmed the view of most authorities that the record length (rarely more than 50 years) is too short to measure beyond the first and second moments. The distribution must therefore be regarded as a function of the first two moments. The 2-year value is a measure of the first moment - the central tendency of the distribution. The relationship of the 2-year to the 100-year value is a measure of the second moment - the dispersion of the distribution. Diagram C of figure 1-1 illustrates the use of these two parameters, 2-year and 100-year rainfall, for estimating values for other return periods.

Diagram A, INTENSITY OR DEPTH OF RAINFALL FOR DURATIONS LESS THAN 6 HOURS

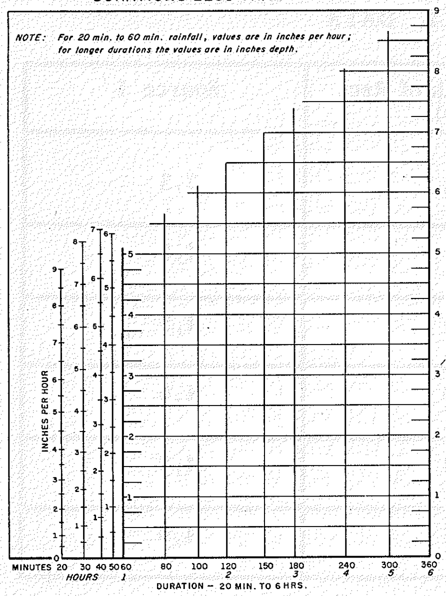


Diagram B, DEPTH OF RAINFALL FOR DURATIONS OF 6 TO 24 HOURS

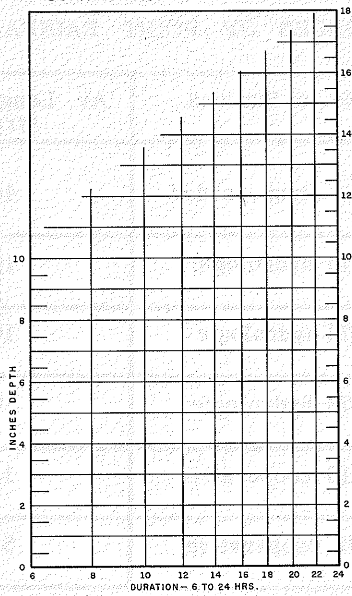
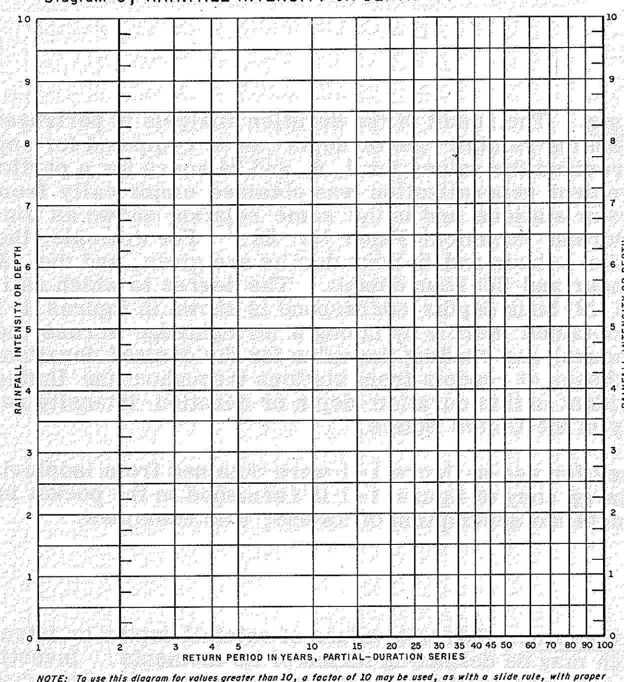


Table 1-2, with three examples, outlines the steps in the order they should be carried through in solving for the required rainfall intensities or depths.

Table 1-2

1. Location	36°00' N 82°00' W	39°00' N 84°00' W	37°00' N 89°00' W
2. Required Intensity (Depth)-Dur-Freq-Area	25-Yr 3-Hr Rainfall (In) for 100 sq. miles	50-Yr 12-Hr Rainfall (In) for 400 sq. miles	15-Yr 30-Min Int (In/Hr) for 50 sq. miles
3. 2-Year 1-Hour Rainfall. Fig. 5	1.4 In.	——	1.6 In.
4. 2-Year 6-Hour Rainfall. Fig. 6	2.2 In.	2.1 In.	2.5 In.
5. 2-Year 24-Hour Precip. Fig. 7	——	3.0 In.	——
6. Straightedge connecting (3) and (4) or (4) and (5) intersects required, duration. Diagrams A or B	(2-Yr 3-Hr) 1.9 In.	(2-Yr 12-Hr) 2.5 In.	(2-Yr 30-Min) 2.5 In/Hr.
7. 100-Yr 1-Hr Rainfall / 2-Yr 1-Hr Rainfall Fig. 8	2.1	——	1.9
8. 100-Yr 6-Hr Rainfall / 2-Yr 6-Hr Rainfall Fig. 9	2.3	2.0	2.1
9. 100-Yr 24-Hr Precip. / 2-Yr 24-Hr Precip. Fig. 10	——	2.0	——
10. (7) x (3)	(100-Yr 1-Hr) 2.9 In.	——	(100-Yr 1-Hr) 3.1 In.
11. (8) x (4)	(100-Yr 6-Hr) 5.1 In.	(100-Yr 6-Hr) 4.2 In.	(100-Yr 6-Hr) 5.3 In.
12. (9) x (5)	——	(100-Yr 24-Hr) 6.0 In.	——
13. Straightedge connecting (10) and (11) or (11) and (12) intersects required duration. Diagrams A or B	(100-Yr 3-Hr) 4.1 In.	(100-Yr 12-Hr) 5.1 In.	(100-Yr 30-Min) 4.6 In/Hr.
14. Straightedge connecting (6) and (13) gives required return period. Diagram C	3.3 In.	4.6 In.	3.5 In/Hr.
15. Percent of Point Rainfall Diagram D	85	87	69
16. (15) x (14) gives (2)	2.8 In.	4.0 In.	2.4 In/Hr.

Diagram C, RAINFALL INTENSITY OR DEPTH VS. RETURN PERIOD



NOTE: To use this diagram for values greater than 10, a factor of 10 may be used, as with a slide rule, with proper attention to the decimal point. If more convenient, other factors such as 2 or 5 may be used.

DIAGRAM D, AREA – DEPTH CURVES

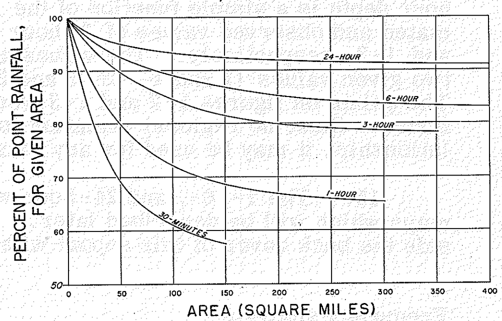


FIGURE I-1. DURATION, FREQUENCY, AREA-DEPTH DIAGRAMS, AND EXAMPLES OF COMPUTATION FOR WEATHER BUREAU TECHNICAL PAPER NO. 29, PART I. (PREPARED MARCH, 1957)

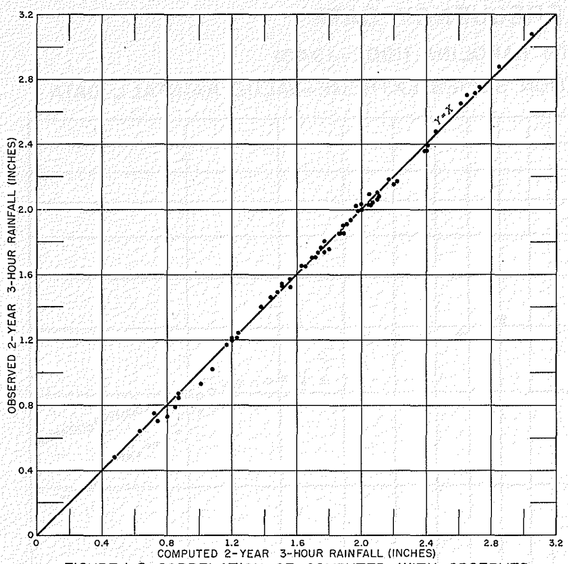


FIGURE 1-2. CORRELATION OF COMPUTED WITH OBSERVED 2-YEAR 3-HOUR RAINFALL.

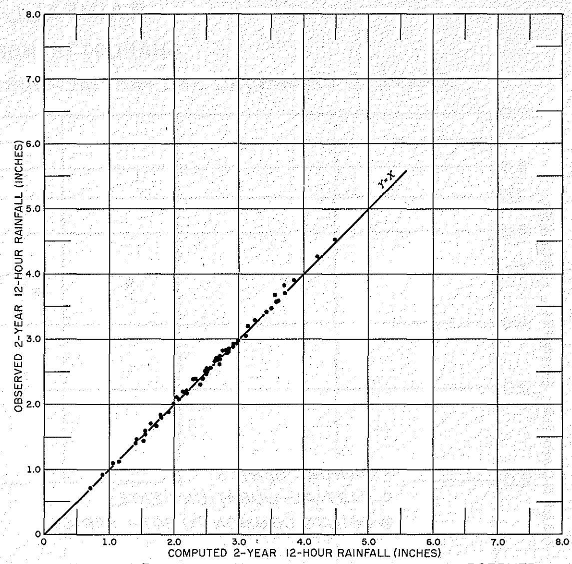


FIGURE 1-3. CORRELATION OF COMPUTED WITH OBSERVED 2-YEAR 12-HOUR RAINFALL.

17. Two types of series. The shape of the diagram - that is, the position of the other ordinates - is partly empirical and partly theoretical. This discussion requires consideration of two methods of selecting and analysing intense rainfall data. The partial-duration series includes all the high values, and the annual series consists of the highest value for each year. The highest value of record, of course, is the top value of each series, but at lower frequency levels (shorter return periods) the two series diverge, as shown in figure 1-4. The partial-duration series, having the highest values regardless of the year in which they occur, recognizes that the second highest of some year ordinarily exceeds the highest of some other year. The processing of partial-duration data is very laborious, and there is no theoretical basis for extrapolating it beyond the length of record, or even for good definition beyond about the 10-year return period, where there are only 40 or so years of record.

18. Construction of diagram. The return-period diagram C of figure 1-1 is based on data from the long-record Weather Bureau stations and is identical with the return-period diagram in Technical Paper No. 28. From one to 10 years it is entirely empirical, based on free-hand curves drawn through "California"[8] method plottings of partial-duration series data. For the 20-year and longer return periods, reliance was placed on Gumbel[9] analysis of annual series data. The transition was smoothed subjectively between 10- and 20-year return periods. If values between 2 and 100 years are taken from the return-period diagram, then converted to annual-series values and plotted on either Gumbel or log-normal paper, the points will very nearly define a straight line.

19. Conversion factors for two series. Table 1-3, based on a sample of nearly 50 widely scattered U. S. stations, gives the empirical factors for converting the partial-duration series to the annual series.

Table 1-3

EMPIRICAL FACTORS
FOR CONVERTING PARTIAL - DURATION SERIES TO ANNUAL SERIES

2-year return period	0.88
5-year return period	0.96
10-year return period	0.99

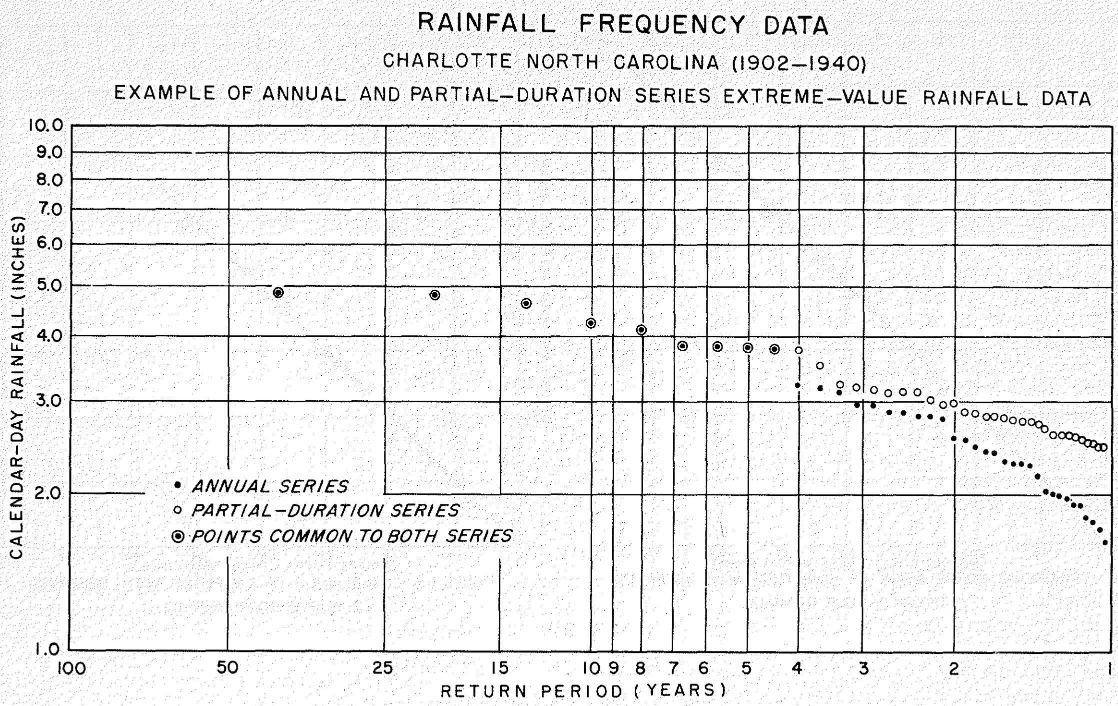


Figure 1-4

For example, if the 2-, 5-, and 10-year partial-duration series values estimated from the return-period diagram are 3.00, 3.75, and 4.21 inches, respectively, the annual series values are 2.64, 3.60, and 4.17 inches after multiplying by the conversion factors in table 1-3.

20. Use of diagram. The two intercepts needed for the frequency relation in diagram C of figure 1-1 are the 2-year values obtained from the 2-year maps, and the 100-year values obtained by multiplying the 2-year values by those given on the 100-year to 2-year ratio maps. Thus, given the rainfall values for both 2- and 100-year return periods, values for other return periods are functionally related and may be determined from diagram C which is entered with the 2- and 100-year values. The 100-year values for the first-order stations were taken from Gumbel analysis of the annual series (Technical Paper No. 25).[10]

21. General applicability of diagram. Diagram C is independent of the units used, as long as the same units (inches, tenths of inches, or anything else) are used for any given problem. Tests have shown that within the range of the data and the purpose of this report the diagram is also independent of duration. In other words, for one hour, or 24 hours, or any other duration within the scope of this report, the 2-year and 100-year values define the values for other return periods in a consistent manner. Studies have disclosed no regional pattern that would improve diagram C, which thus far appears to have application over the entire region of interest and perhaps the entire United States.

22. Questions on sub-sample size. In frequency analysis one of the postulates of extreme-value theory is the size of the sub-sample: each value in the annual series is the maximum of 365 events in the case of 24-hour rainfall, but in the case of shorter durations the sub-sample is obviously much larger - apparently being 24 times as large for hourly rainfall. Does the fact that some stations have more days of rain than others affect the sub-sample size appreciably? Should days of rain be regarded as the limiting number of possible rain events, or should a day of rain be regarded merely as an advanced stage of a process involving moisture content of the atmosphere, vertical motion, condensation, and other components - some of which have continuous values throughout each year?

23. These and related questions may remain unanswered for a long time; during their investigation there is some security in the knowledge that the traditional methods give results that are consistent within the range of the data and the range of present applications and that the results can be evaluated.

24. The use of short-record data introduces the question of possible secular trend and biased sample. Routine tests with data of different periods of record showed no significant trend, indicating that the direct use of the relatively recent short-record data was legitimate.

Isopluvial maps

25. For generalization over the region of interest three maps have been prepared which show rainfall depths for one, 6, and 24 hours for return periods of two years. Three additional maps show, for the same durations, the ratio of 100-year to 2-year rainfall. This set of six maps appears as figures 2-2 to 2-7 in section II of this report. For interpolation among the durations given on these maps, and for return periods other than 2 years the diagrams of figure 2-1 are used. In general, the isopluvials were drawn in a straightforward and fairly objective manner. The 2-year 24-hour map is based on about 1300 stations. While the 2-year value is well defined even for short records, there was a tendency in drawing the isopluvial lines to give more weight to the longer-record data. The 2-year 1-hour and 2-year 6-hour maps are each based on more than 300 stations. Experience in situations where it has been necessary to estimate short-duration data from daily observations has demonstrated that the ratio of 1-hour or 6-hour values to corresponding 24-hour values for the same return period does not vary greatly over a region. This knowledge served as a useful guide in smoothing the 1-hour and 6-hour isopluvials.

26. Reason for ratio maps. The decision to use maps of the ratio of the 100-year to 2-year values, instead of 100-year maps, was based largely on the fact that the ratio produces a flatter map and greatly reduces errors that might arise from the practical limitations of correct registration in the printing process and of interpolation in using the maps. If 100-year (or even 10-year) maps had been used, ratio maps would have been required for one of the consistency tests while preparing this report. One of the reasons for using the 100-year instead of 10-year or other short return-period ratios was to make the use of diagram C less subject to error. Although the ratio maps require an additional slide rule or other mulitipling operation, actual tests with alternate methods established the superiority of the ratio maps.

27. Examination of physiographic parameters. Work with mean annual and mean seasonal rainfall has resulted in the derivation and effective use of objective and empirically defined parameters relating rainfall data to the physiography of a region. Elevation, slope, orientation, distance from moisture source, and other parameters have been useful in drawing isopluvial maps of mean rainfall. These and many other parameters were examined in an effort to refine the maps presented here. However, tests showed that the use of these parameters would result in no improvement in the isopluvial pattern because of the high density of stations in this region and the sampling and other error inherent in values obtained for each station.

Reliability of results

28. The reliability of results is influenced by sampling error both in time and space, and by the manner in which the maps were constructed. Sampling error in space is a result of the chance occurrence of a storm at one station but not at a nearby station. Where stations are less closely spaced than in the dense networks studied for this project, stations may receive storms that are non-representative of their vicinity, or may completely miss storms that are representative. Similarly, sampling error in time is a product of storms not occurring according to their average regime during a brief record. A brief period of record may include some non-representative large storms, or may miss some important storms that occurred before or after the period of record at a given station. In evaluating the effects of areal and time sampling errors, it is pertinent to look for and to evaluate bias and dispersion. This is discussed in the two following paragraphs.

29. Areal sampling error. In developing the area-depth relations, which will be described later, it was necessary to examine data from several dense networks. Some of these dense networks were from regions where there could be no conceivable effect of physiography on the rainfall regime. Examination of some of these data showed, for example, that the standard deviation of point rainfall for the 2-year return period for a flat area of 300 square miles is about 20% of the mean value. With no assignable causes for this dispersion, it must be regarded as a residual error in sampling the relatively small amount of extreme-value data available for each station.

30. Sampling error in time. Daily data from 158 long-record stations were analysed for 10- and 45-year records to determine the reliability or level of confidence that should be placed on the results from the short-record data. No bias was found. The average differences without regard to sign in the results for selected return periods are given in table 1-4.

Table 1-4

AVERAGE DIFFERENCE OF VARIOUS RETURN - PERIOD AMOUNTS FOR 10- AND 45- YEAR RECORDS

Return Period (yrs)	2	5	10	25	50	100
Average Difference (%)	9	12	15	17	19	20

31. Smoothing of isopluvial lines. The reliability of the isopluvial maps is determined partly by the manner in which they are constructed and partly by any limitations in their use. The manner of construction involves the question of how much to smooth the data, and an understanding of the problem of data smoothing is necessary to their most effective use. The drawing of isopluvial lines through a field of data is analogous in some important respects to drawing regression lines through the data of a scatter diagram. Just as isolines can be drawn so as to fit every point on the map, an irregular regression line can be drawn to pass through every point; but the complicated pattern in each case would be unrealistic in most instances. In each case the correlation coefficient could be made 1.00, but too many degrees of freedom would be sacrificed. The maps were deliberately drawn so that the standard error of estimate (the inherent error of interpolation) was commensurate with the sampling and other error in the data and methods of analysis.

32. Evaluation. In general, the standard error of estimate ranges from a minimum of about 20%, where a point value can be used directly as taken from a flat part of one of the 2-year maps, to at least 50%, where a 100-year value of short-duration rainfall must be estimated for an appreciable area in a more rugged portion of the region. Even though the confidence band is wide, some significant 2-year estimates have undoubtedly been masked as a result of smoothing - as for instance, in mountainous areas where large local variations have been obscured. For example, Mt. Mitchell and North Fork No. 1, North Carolina, are about 10 miles apart at elevations of 6635 and 2765 feet, respectively, yet their 2-year 1-hour values of 1.21 and 1.61 inches have been practically merged through smoothing.

33. Tables of station data. In order to make unsmoothed data available to the user, all the observed 2-year 1-, 6-, and 24-hour values are given in table 2-1. The 100-year values for long-record first-order and cooperative observer data are presented in table 2-2. The station names and locations shown in these two tables are those listed in the climatological publications for the latest year of record used in this study.

Areal Rainfall

Basic data

34. Criteria for selection of data. A survey was made of all available dense networks and seven were selected on the basis of the criteria cited below:

1) The networks had to be composed entirely of recorders. The use of nonrecorders would have greatly increased the number and density of the networks but would also involve the construction of mass curves and therefore too much subjectivity.

2) The minimum length of record considered was seven years in order to insure an estimate of the 2-year areal rainfall within reasonable limits.

3) Gage locations had to remain the same during the period of record analysed.

4) A minimum of four gages for 400 or fewer square miles had to be available to estimate the areal depth.

35. The location, number of gages, and length of record for the networks used in this study are shown in figure 1-5.

Area-depth relationships

36. Determining average depth. The estimation of areal rainfall with sufficient volume of data to derive general regional duration and frequency relationships could become so laborious as to defeat its purpose.

With no precedent for this work, it was necessary to test methods for processing the data. It was found that the drawing of isohyets had no practical advantage over the faster and more objective method of taking the arithmetic mean of sufficient station values to estimate areal depth.

37. Shape factor. No attempt was made to evaluate effects of shape of area, though it can be said that there was no apparent difference among the areas studied, which varied in shape from essentially "square" to twice as long as wide. There were too few dense networks to evaluate the effects of orientation of the axis of a long drainage area.

38. Areal variation of storm rainfall. Ideally the study of areal rainfall patterns for given periods would show two things. One would be the degree of variability: some measure of the extreme range of rainfall depth from place to place within the given area and period. The other would be some indication of where the high and low centers are. The study, to date, of this aspect of storm characteristics has been rather limited. Except in regions of rugged terrain it is believed that the location of high and low centers of rainfall over small areas and short durations is random. Accordingly, it may suffice for the present to express merely the degree of variability. A convenient measure of variability is the standard deviation. For plain areas of two or three hundred square miles the standard deviation of hourly rainfall is about 40% of the mean depth, and for 24-hour rainfall the standard deviation is about 30% of the mean depth. For rugged areas the variability is greater than for plain areas - the more rugged the more variable. In a 200 square mile area in the vicinity of Asheville, North Carolina, the standard deviation was about twice the values given above for hourly and 24-hour rainfall.

Table 1-5

EXAMPLE OF COMPUTATIONAL PROCEDURE FOR DETERMINING THE AREA/POINT RATIO

Yearly Maximum 1-hour Point and Areal Rainfall (inches)

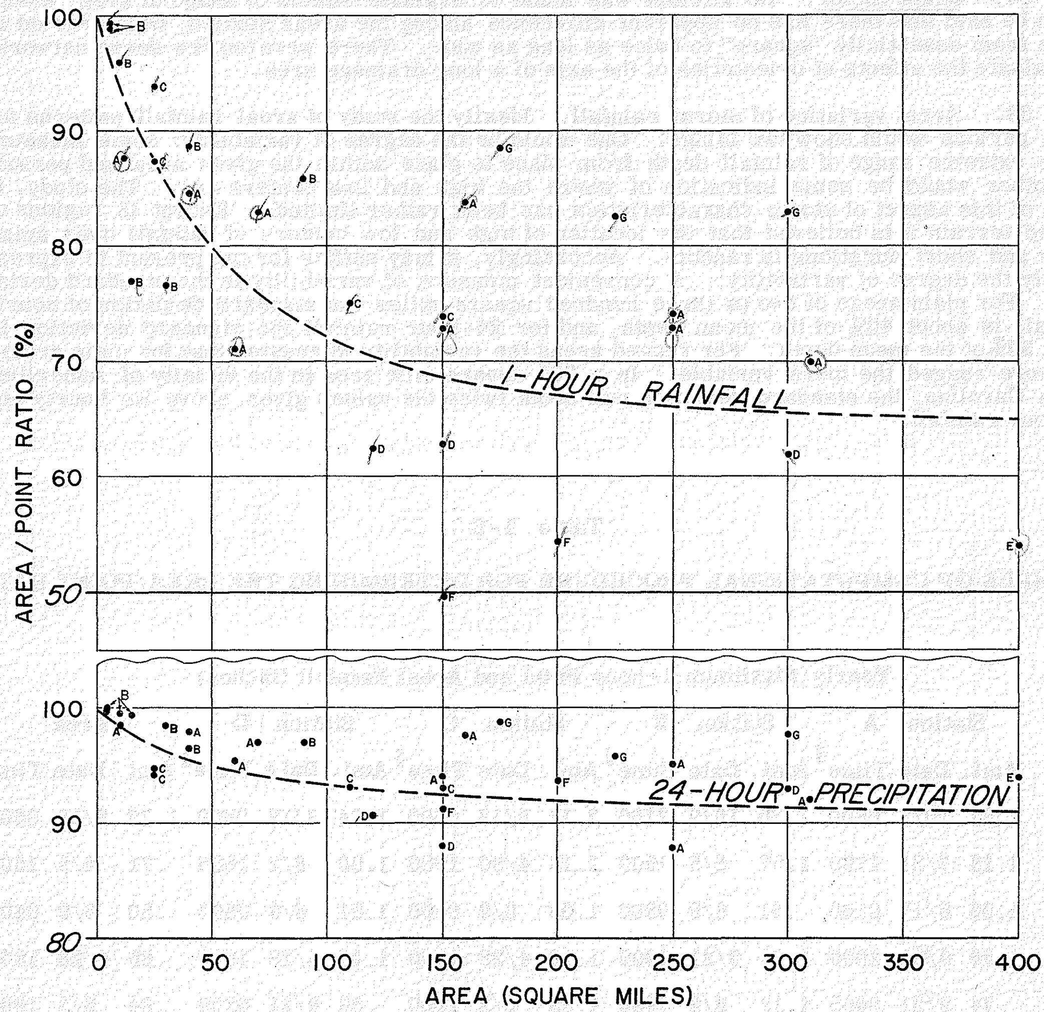
Year	Station A			Station B			Station C			Station D			Area		
	Amt.	Date	Time§	Amt.	Date	Time§	Amt.	Date	Time§	Amt.	Date	Time§	Amt.	Date	Time§
1954	1.87	10/3	0800	1.70	10/9	2100	2.11	8/18	0600	1.74	8/18	0600	1.79	8/18	0600
1953	1.13	7/21	1700	1.57	6/5	1500	1.13	4/30	1900	1.00	8/2	1600	.71	6/5	1500
1952	1.06	6/17	0100	.61	8/9	0300	1.08	8/9	0400	1.01	8/9	0500	.50	8/9	0400
1951	1.56	9/21	2000	1.05	9/21	0800	1.10	4/28	1900	1.40	4/28	1800	.65	4/28	1800
1950	.74	9/21	0600	1.12	6/2	1900	1.33	6/2	1900	.88	9/21	0700	.84	6/2	1900
1949	1.27	5/19	1200	.98	3/30	2400	.68	6/14	2300	.72	6/14	1900	.64	6/14	2300
1948	1.15	4/7	1800	.82	7/21	0700	1.15	7/21	0600	1.19	7/21	0700	.73	7/21	0700
Sum	8.78			7.85			8.58			7.94			5.86		
Years of record	7			7			7			7			7		
Mean	1.25			1.12			1.23			1.13			.84		

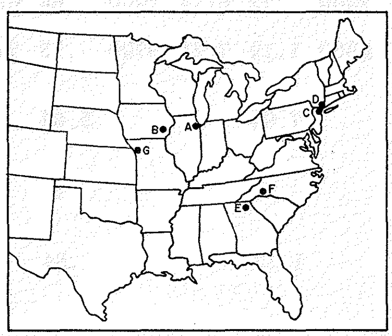
§ Hour ending

$$\text{Four-station mean point rainfall} = \frac{1.25 + 1.12 + 1.23 + 1.13}{4} = 1.18 \text{ inches}$$

$$\text{Ratio} \left(\frac{\text{Area}}{\text{Point}}\right) = \frac{.84}{1.18} = 71.2\ \%$$

RATIO OF MEAN MAXIMUM ANNUAL AREAL DEPTH TO MEAN MAXIMUM ANNUAL POINT RAINFALL (PRECIPITATION) FOR VARIOUS SIZE AREAS





DENSE NETWORK	TOTAL AREA	TOTAL NO. OF GAGES	NO. OF SUB-NETWORKS	LENGTH OF RECORD (YRS.)
A	310	13	8	9
B	90	9	6	15
C	150	6	3	15
D	300	5	2	14
E	400	4	0	11
F	200	5	1	7
G	300	5	2	14
TOTAL			22	

FIGURE I-5

Computations

39. Area-depth computations. As a practical device for saving labor, the data and curves shown in figure 1-5, for the relationship of depth to area for 1- and 24-hour durations, are for the mean of the annual series, which is the 2.3-year return period rather than the 2.0-year return period. The 2.0-year value is almost exactly 6% less than the series mean value. The ordinate of the lower curve of figure 1-5 is conveniently expressed as a fraction whose numerator is, for instance, the 2-year 24-hour rainfall over an area, and whose denominator is the average of the 2-year 24-hour points in the area. The numerator is obtained from an annual series of values, each of which is the maximum average depth for a given area during the year - the times of beginning and ending of the 24-hour duration, for example, being the same for each station in the area. The denominator is the mean of the individual station values - each being the 2-year 24-hour rainfall obtained from the annual series of point values without regard to when the 24-hour period occurs among the stations. The element of simultaneity in the numerator restricts the magnitude of the areal depths to values equal to or less than the average of the point rainfall depths. Table 1-5 shows the mechanics of this procedure applied to one of the sub-networks in the Chicago area.

40. The mean point values 1.25, 1.12, 1.23, and 1.13 inches obtained in these series are slightly larger than the 2-year values. It is therefore necessary to subtract 6% to obtain the 2-year values which are plotted on the isopluvial maps. This assignment of frequency may be unimportant if future work substantiates the indications that storm depth is insignificant in shaping the area-depth curves.

41. The foregoing discussion of area-depth computation may be expressed in mathematical symbols.

YEARLY MAXIMUM SHORT-DURATION RAINFALL

YEAR	POINT							AREA
1	P_{11}	P_{12}	P_{13}	.	.	.	P_{1n}	A_1
2	P_{21}	P_{22}	P_{23}	.	.	.	P_{2n}	A_2
3	P_{31}	P_{32}	P_{33}	.	.	.	P_{3n}	A_3
	.	.	.	P_{ij}	.	.	.	A_i
r	P_{r1}	P_{r2}	P_{r3}	.	.	.	P_{rn}	A_r
	$\overline{P}_{.1}$	$\overline{P}_{.2}$	$\overline{P}_{.3}$	$\overline{P}_{.j}$	.	.	$\overline{P}_{.n}$	$\overline{A}$

r is the number of years of record

n is the number of stations in the network

P_{ij} is the value taken from the j^{th} station for the i^{th} year, where i goes from 1 to r and j from 1 to n

A_i is the maximum areal rainfall for each year

$\overline{A}$ denotes the mean of r values of areal rainfall, therefore $\overline{A} = \sum_{i=1}^{r} \frac{A_i}{r}$

$\overline{P}_{.n}$ denotes the mean of r values from the n^{th} station, therefore $\overline{P}_{.n} = \sum_{i=1}^{r} \frac{P_{in}}{r}$

This value minus 6% (2-year value) is plotted on the 2-year maps

$$\text{Ratio (Area/Point)} = \frac{\sum_{i=1}^{r} \frac{A_i}{r}}{\frac{1}{nr} \sum_{i=1}^{r} \sum_{j=1}^{n} P_{ij}} = \frac{n \sum_{i=1}^{r} A_i}{\sum_{i=1}^{r} \sum_{j=1}^{n} P_{ij}}$$

42. Determination of area of network. It is fairly easy to determine the area of a watershed and estimate the average depth of rainfall over it from a dense network of gages. It is not so easy, however, to start with a dense network of gages and say to what size or shape of area the mean depth applies. The area "covered" by n gages was about equal to n circles having diameters equal to the average station spacing. The networks chosen involved compromise among density of the network, length of record, and nearness to the region of interest. The areas for most of the dense networks studied were rounded off to the nearest hundred square miles. Most of the area-depth curves are so flat and the scatter of points is so great, as shown in figure 1-5, that precise determination of area would not be worth the effort.

43. The larger-area networks were subdivided to provide additional points for help in defining the position of the curves for the smaller areas. The 1- and 24-hour curves were fitted by eye and represent a compromise between optimum fit for the larger areas and a well established feature of storm rainfall: the average intensity over an area in relation to the maximum point rainfall in that area is some inverse function of the size of that area.

Limitations

44. Discussion of imperfect relationships. The large scatter in figure 1-5 which exhibits no systematic regional pattern can partly be ascribed to the imperfect area-depth estimates. Reliable estimates would require:

1) synchronized readings of the rain gages, particularly for the shorter durations.

2) gages suitably located in sufficient number over the area.

3) the period having the maximum continuous rainfall rather than clock-interval rainfall because the areal rainfall, particularly for short periods, is underestimated. This is believed compensated for to some extent because clock-hour and calendar-day rainfall are used for both areal and point rainfall determinations.

45. Duration as a major parameter. From detailed studies of the seven dense networks and from tests performed on many others, it was found that the area-depth relationship varies with duration, as shown in figure 1-5. The area-depth relationship seems, however, to be independent of geographic location, time of year, and other circumstances.

46. Depth or return period not a parameter. None of the dense networks has sufficient length of record to evaluate the effect of magnitude (or return period) on the area-depth relationship. An approach to this problem included examination of published area-depth curves from "Storm Rainfall."[11] These curves required transformation to make them comparable with curves such as those of figure 1-5. The data for "Storm Rainfall" is storm centered, whereas the networks used in this report are geographically fixed. "Storm Rainfall" data represents profiles of discrete storms, whereas the dense network data are statistical averages in which the point values very seldom, if ever, correspond to areal values of the same storm each year; in fact, the point values for each year are usually from several storms. The area-depth curves taken from "Storm Rainfall", after transformation to make them comparable with the generalized curves of the dense networks for the 2.3-year return period, showed no significant differences from the curves for lesser storms. Accordingly, it is tentatively accepted that for areas of less than 400 square miles, storm magnitude is not a parameter in the area-depth relationship.

Seasonal Variation

47. Introduction. Short duration rainfall in the Ohio Valley is more intense in summertime than in winter. Of the rain from a heavy 1-hour storm in July, with normal vegetation and soil condition for that time of year, a certain portion is absorbed by the soil and the rest runs off and may contribute to a flood. But a greater flood may come from a lesser rain occurring in the wintertime when the soil may be frozen or snow-covered. With seasonal and other variations in the rainfall-runoff relationship, it was desirable to investigate the seasonal variation in the rainfall intensity-frequency regime.

48. Monthly vs. annual series. The frequency analysis so far has followed the conventional procedures of using only the annual maxima or the n-maximum events for n-years of record. Obviously, some months contribute more events to these series than others and, in fact, some months might not contribute at all to these two series. The purpose of the following analysis is to show how often these rainfall events occur during a specific month.

49. Data used. To develop the seasonal variation relationship, 13 first-order stations were chosen so as to sample a large part of the rainfall regime of the region of interest. The 13 stations and the length of record for the data are shown in table 1-6.

Table 1-6

STATIONS USED TO DEVELOP SEASONAL VARIATION RELATIONSHIP

Station	Length of Rec. (yrs)	Station	Length of Rec. (yrs)
Cairo, Ill.	43	Cincinnati, Ohio	51
Springfield, Ill.	39	Columbus, Ohio	43
Evansville, Ind.	41	Chattanooga, Tenn.	40
Indianapolis, Ind.	49	Knoxville, Tenn.	43
Lexington, Ky.	42	Lynchburg, Va.	37
Louisville, Ky.	44	Elkins, W. Va.	41
Charlotte, N. C.	39		

50. Computation of monthly probabilities. For each of three durations (1, 6, and 24 hours) all the events which make up the partial-duration series - the maximum n events for n-years of record - were classified according to month of occurrence, and magnitude on the return-period scale. After the data for each station were summarized, the frequencies were computed for each month by determining the ratio, expressed as a percentage, of the number of occurrences equal to or greater than the magnitude of a particular event to the total possible number of occurrences (years of record). The magnitude of any rainfall event is approximately related to the probability of its occurring in any year. Cases of non-occurrence as well as occurrence of rainfall events were considered in order to arrive at numerical probabilities. The results were then plotted as a function of return period and season.

51. Construction of seasonal probability diagrams. Some variation exists from station to station, suggesting a slight regional pattern, but no attempt was made to define it because there is no conclusive method of determining whether this pattern is a climatic fact or an accident of sampling. Duration seems to be the only parameter having significant effect on the shape of the seasonal probability relationships. The data from all 13 stations were combined, giving 550 station-years of record, and smoothed isopleths of frequency were drawn for each significant duration: 1, 6, and 24 hours. These isopleths appear as figures 2-8 to 2-10 in section II of this report. As a check on the consistency of these diagrams, the probability lines were carefully examined to make sure the aggregate probabilities agreed with the definition of return period; e. g., the 2-year value occurs on the average about 50% of the time.

52. Seasonal distribution of short-duration precipitation. Upon examination of figure 2-10, it will be noted that there is only a small chance of getting an amount as large as the 1-year event during the winter months. From a seasonal point of view large 24-hour precipitations are most likely during March and July with a slightly smaller chance in September. Figures 2-8 and 2-9 exhibit a very great range of frequency (and precipitation) with season, with practically all the larger events occurring during the summer months. This observation, together with the fact that monthly thunderstorm incidence is very nearly in phase with the frequency of short-duration rainfall events, indicates that only small areas are affected by these intense summer rainfalls.

53. Application to areal rainfall. To test the applicability of these diagrams for the range of area in this report, a limited amount of areal data was analysed in the same manner as the point data. The results exhibited no substantial difference from those of the point data, which lends some confidence for using these diagrams as a guide for small areas.

Time Distribution of Precipitation

54. Introduction. The variability of precipitation in time has a marked effect on the resulting runoff. If a three-inch rain is spread uniformly over a 24-hour period, the resulting streamflow, particularly the peak rate, will be much less than if the rain occurs during one hour of the 24-hour period. It is pertinent to ask what proportion of a 24-hour rain usually does fall in one hour, or in six hours. It is also pertinent to ask if this proportion is different for rains of different magnitude.

55. Selection of data. To develop the time distribution relationship, 696 storms with precipitation amounts equal to or greater than 2.0 inches in a continuous 24-hour period were analysed. The number of storms for each station is shown in table 1-7.

Table 1-7

STATIONS USED TO DEVELOP TIME-DISTRIBUTION RELATIONSHIP

Station	No. of Storms	Station	No. of Storms
Cairo, Ill.	100	Dayton, Ohio	26
Evansville, Ind.	98	Chattanooga, Tenn.	142
Louisville, Ky.	92	Knoxville, Tenn.	105
Cincinnati, Ohio	64	Elkins, W. Va.	39
Columbus, Ohio	30		

56. Preparation of depth-duration curves. In most instances the maximum continuous 24-hour precipitation extracted from the storm period was only a part of the total storm precipitation. The amounts used for smaller time increments were the maximum clock-hour, 2-hour, 3-hour, etc., all beginning and ending on the hour and all occurring within the 24-hour period. The empirical factor, 1.13, was used to bring clock-hour amounts up to the maximum continuous 60-minute rainfall. Similarly, empirical factors were used to adjust the 2-, 3-, 6-, 12-, and 24-hour amounts. The data were then stratified by 1-inch (per 24 hours) increments and averaged. The resulting smoothed depth-duration curves are shown in figure 1-6.

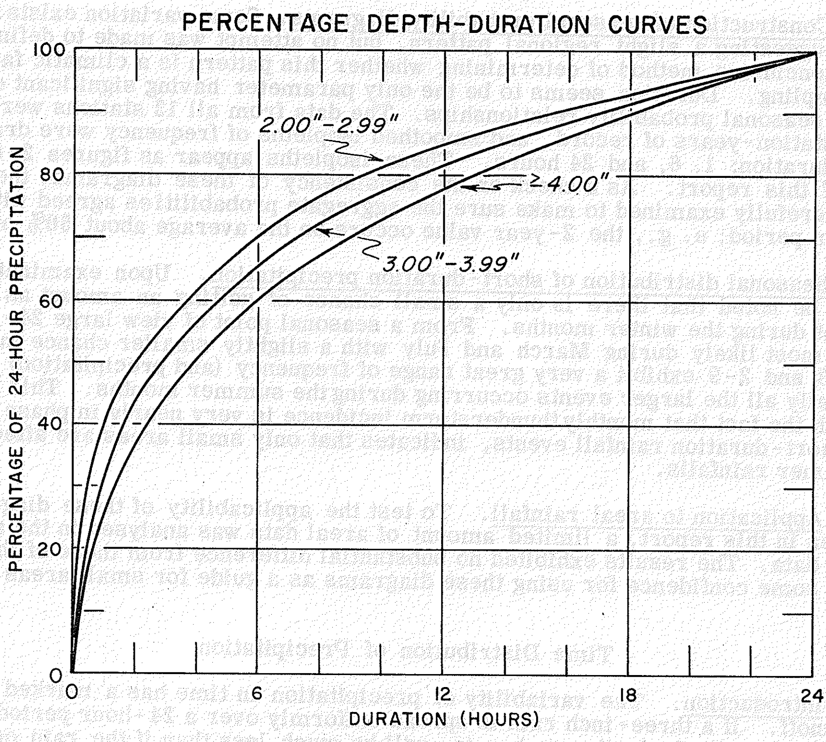


Figure 1-6

57. Probable sequence of 24-hour rainfall. These average curves, however, do not indicate which hour or quarter of a day during the 24-hour period is likely to have the largest rainfall or what the magnitude of the rainfall might be. Average sequences are summarized in table 1-8. The data were further analysed to give the frequency of occurrence in percent of the maximum 6-hour (quarter of a day) and 1-hour increments plus the average 6- to 24- and 1- to 6-hour ratios for each quarter of a day.

Table 1-8

AVERAGE TIME-DISTRIBUTION RELATIONS

	1st Quarter Day	2nd Quarter Day	3rd Quarter Day	4th Quarter Day
Frequency of Occurrence (%) of Max. Quarter Day Rainfall	42	22	20	16
Frequency of Occurrence (%) of Max. 1-hour Rainfall	40	21	21	18
Ratio of Max. Quarter Day Rainfall to 24-hour Rainfall	67	53	51	55
Ratio of Max. 1-hour Rainfall to Quarter Day Rainfall	50	49	51	52

58. Contrast with non-sequential relations. The curves of figure 1-6 should not be considered to have the same depth-duration relations as the curves in Technical Paper No. 25. In that paper the maximum data for each duration did not necessarily come from the same storm, whereas the relations shown in figure 1-6 are based on increments of rainfall which did come from the same 24-hour period. Consequently, the 1- to 24-hour and 6- to 24-hour ratios, etc., are slightly lower for the curves in this paper.

SECTION II. APPLICATIONS

59. Introduction. This Technical Paper has the primary purpose of presenting rainfall data in a manner convenient for hydrologic analysis and design criteria. It is no longer adequate for a field engineer to interpolate among a set of maps of point rainfall. The presently available degree of detail, and the introduction of areal and seasonal influences, have complicated his work so that in many instances he must use a combination of maps and diagrams in a rather long series of operations. After having read how these aids were prepared he is ready to use them, and by having them together in one section of the report he can easily find them for future use, without having to look through the entire report each time he needs to refer to the maps or diagrams. Hypothetical examples of a few representative problems are included with the maps and diagrams in this section of the Technical Paper.

60. Use of tabulated data with the maps. The tabulated data may be used in conjunction with the isopluvial maps in obtaining the best possible registration of the map with the stations and drainage areas themselves. Where there are steep gradients or complicated patterns in the isopluvials and in the contours of a region, the tabulated station data serve as identifying bench marks. The station can be located on the ground and tied in with the station as shown on the map. If there are errors of printing registration, or of interpolation in the isopluvial pattern, adjustments can thus be made.

61. Need for judgment. Whether to use the smoothed values from the isopluvial maps, or whether to use the individual station data, or some combination of the two, depends largely upon local physiography. In a plain region there is little question but that the smoothed isopluvials give a better estimate, than single station data, of the rainfall regime of a locality. In a rugged region, while sampling error exists, much of the variation among nearby stations may be properly ascribed to orographic influences. The assessment of how much of the variation can be ascribed to physical influences may have to be done by a person familiar with local conditions who has more information of storm patterns, and who has observed orographic influences. He may even be able to transfer a local topographic relation from a mountain slope where there are good data to a nearby but similar slope which lacks data.

62. The curves of figure 1-5, and similar curves for additional durations, are shown in diagram D of figure 1-1. The 30-minute curve is based on short record data from the Muskingum, Ohio network.[12] The points for defining the 3- and 6-hour curves were interpolated between the 1- and 24-hour curves. The three examples shown in figure 1-1 include reductions for area. If the particular area of interest is large enough and the isopluvial pattern is complicated enough, it may be questioned what point in the area should be taken as representative. The point value to which the area-reduction factor should be applied is the average point value in the area. For practical purposes the average point value can be determined adequately by inspection of the isopluvial map or maps.

63. Examples illustrating the use of the seasonal probability diagrams.

Example 1.

The 1-year 1-hour value of 1.3 inches for Nashville was estimated from a combination of figures 2-2, 2-5, and 2-1. From figure 2-8, the empirical probability that the 1-year 1-hour rainfall will be equalled or exceeded in July of any one year is 30% or 30 chances out of a hundred. Similarly, the probability that Nashville's 2-year 1-hour value of 1.5 inches will be equalied or exceeded in any one July is 14% by interpolation. The difference (30% — 14% = 16%) is the probability of occurrence in any one July of a 1-hour rainfall within the range 1.3 — 1.5 inches inclusive.

Example 2.

Assume the snowmelt season to be February through March and determine the probability of getting a rainfall of 1.0 inches or more in one hour during this season, at a point near Asheville, North Carolina. For a first approximation, determine from the isopluvial map the 2-year 1-hour value near Asheville to be about 1.4 inches. Referring to the seasonal probability chart for one hour for the 2-year return period, it may be seen that for February and March there is about a 1% chance of getting 1.4 inches or more per hour (corresponding to the 2-year 1-hour return period) in each of these months, or a 2% chance of getting 1.4 inches or more per hour during the two-month snowmelt season. Since the chances of equalling or exceeding 1.0 inches is obviously greater than for 1.4 inches, use the return-period diagram C for a second approximation, to get a rainfall value for the 1-year return period. At the point of interest near Asheville, (referring to the map of figure 2-5) we find that the ratio of 100-year to 2-year rainfall is about 2.0. Multiplying 1.4 inches by the ratio, 2.0, to get the 100-year value, we then enter diagram C with the 2-year value, 1.4, and the 100-year value, 2.8, and obtain a 1-year value of 1.2 inches. Referring again to the seasonal probability chart for one hour, the probability for February at the 1-year return period is a little less than 1% and for March about 3% — a probability for the two-month period of about 4% equalling or exceeding 1.2 inches. The probability for 1.4 inches or more is 2%, for 1.2 inches it is 4%, and one can safely extrapolate to the conclusion that the probability of 1.0 inches is 5%. In other words, the probability of 1.0 inches or more of rain per hour during this hypothetical snowmelt season is 5%; this rate of rainfall will be equalled or exceeded in one season out of twenty.

Example 3.

Consider the problem of what infiltration and other loss is necessary in the three summer months for the runoff to equal that in the three winter months, assuming 100% runoff in the winter, with a 10-year 6-hour rainfall. From the maps and diagrams it is determined that the 10-year 6-hour rainfall for this watershed is 3.0 inches. For June, July, and August, in the 6-hour seasonal probability chart, at the 10-year return-period level, the percentage values are about 1, 4, and 3, respectively, giving a total of 8% probability of 3.0 inches being equalled or exceeded during the three-month summer season of any one year. For equal probability in the three-month winter season, in the 1-year return period, the seasonal probability chart for December, January, and February gives values of 3%, 1%, and 2%, respectively, which is a little low compared with the total of 8% for summer. However, this is at the limit of the chart. Using diagram C, with 3.0 inches at the 10-year level and the hypothetical value of 1.8 inches (from the isopluvial map) for the 2-year value, read 1.4 inches for the 1-year value. Since there is only a 6% chance of this value being equalled or exceeded in wintertime and the 8% value is a little smaller, it can be inferred that the infiltration and other loss must be at least the difference between 3.0 and 1.4 inches, or 1.6 inches.

Example 4.

As an example where interpolation between durations is necessary, consider example 1, table 1-2 (of figure 2-1) where the 25-year 3-hour rainfall is estimated to be 3.3 inches. If the probability of occurrence for July is required, 1.3 and 0.8% are estimated from the 1- and 6- hour seasonal probability charts, respectively. The 3-hour probability is then interpolated to be 1.0% or one chance in a hundred of equalling or exceeding a 3-hour rainfall of 3.3 inches in July of a particular year.

REFERENCES

1. United States Department of Agriculture, Miscellaneous Publication No. 204, 1935.
2. United States Weather Bureau, Climatological Record Book, 1890-1951.
3. United States Weather Bureau, Form 1017, 1890-1950.
4. United States Weather Bureau, Climatological Data, 1897-1954.
5. United States Weather Bureau, Hydrologic Bulletin, 1940-1948.
6. Tennessee Valley Authority, "Precipitation in the Tennessee River Basin", 1938-1955.
7. United States Weather Bureau, "Rainfall Intensities for Local Drainage Design in Western United States", Technical Paper No. 28, November 1956.
8. California Department of Public Works, Bulletin No. 5, "Flow in California Streams", 1923.
9. E. J. Gumbel, "The Return Periods of Flood Flows", The Annals of Mathematical Statistics, Volume XII, June 1941, pp. 163-190.
10. United States Weather Bureau, "Rainfall Intensity-Duration-Frequency Curves for Selected Stations in the United States, Alaska, Hawaiian Islands, and Puerto Rico", Technical Paper No. 25, December 1955.
11. Corps of Engineers, United States Army, "Storm Rainfall in the United States", February, 1954.
12. United States Soil Conservation Service, "Precipitation in the Muskingum River Watershed", by 30 Minute Periods, Muskingum Climatic Research Center, New Philadelphia, Ohio, July 1938-June 1939.

Diagram A, INTENSITY OR DEPTH OF RAINFALL FOR DURATIONS LESS THAN 6 HOURS

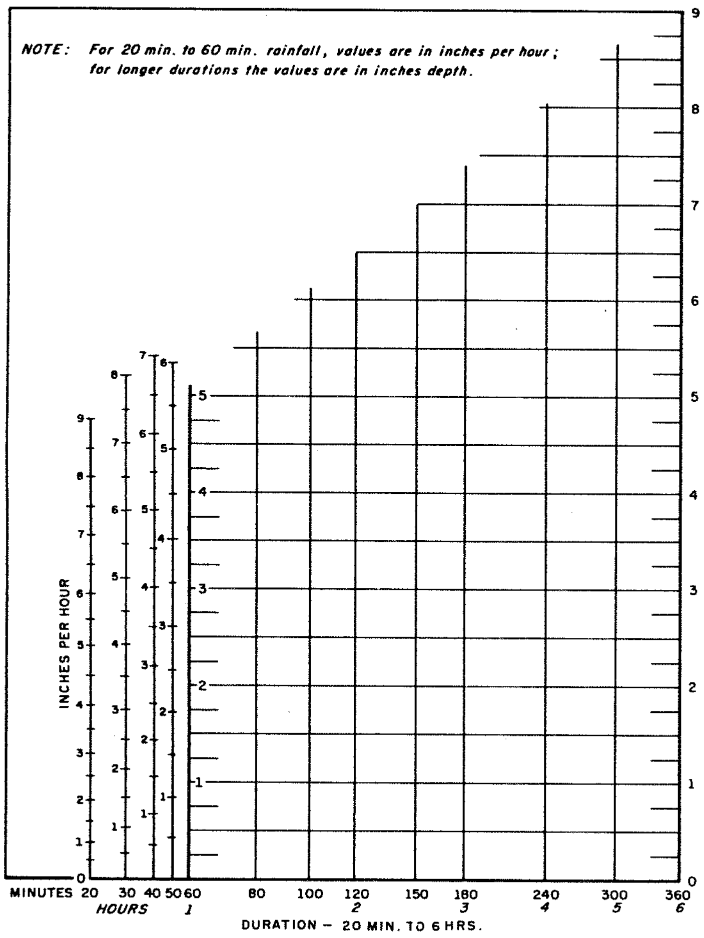


Diagram B, DEPTH OF RAINFALL FOR DURATIONS OF 6 TO 24 HOURS

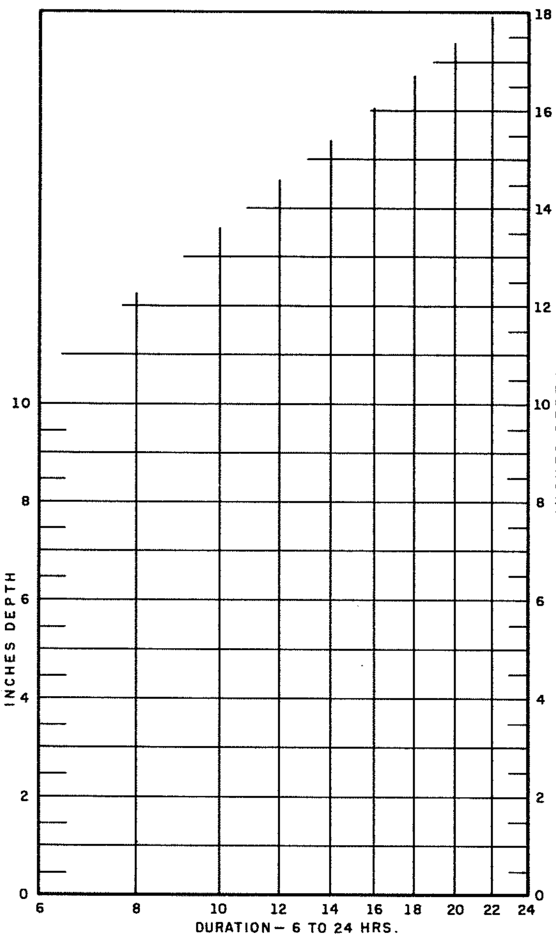
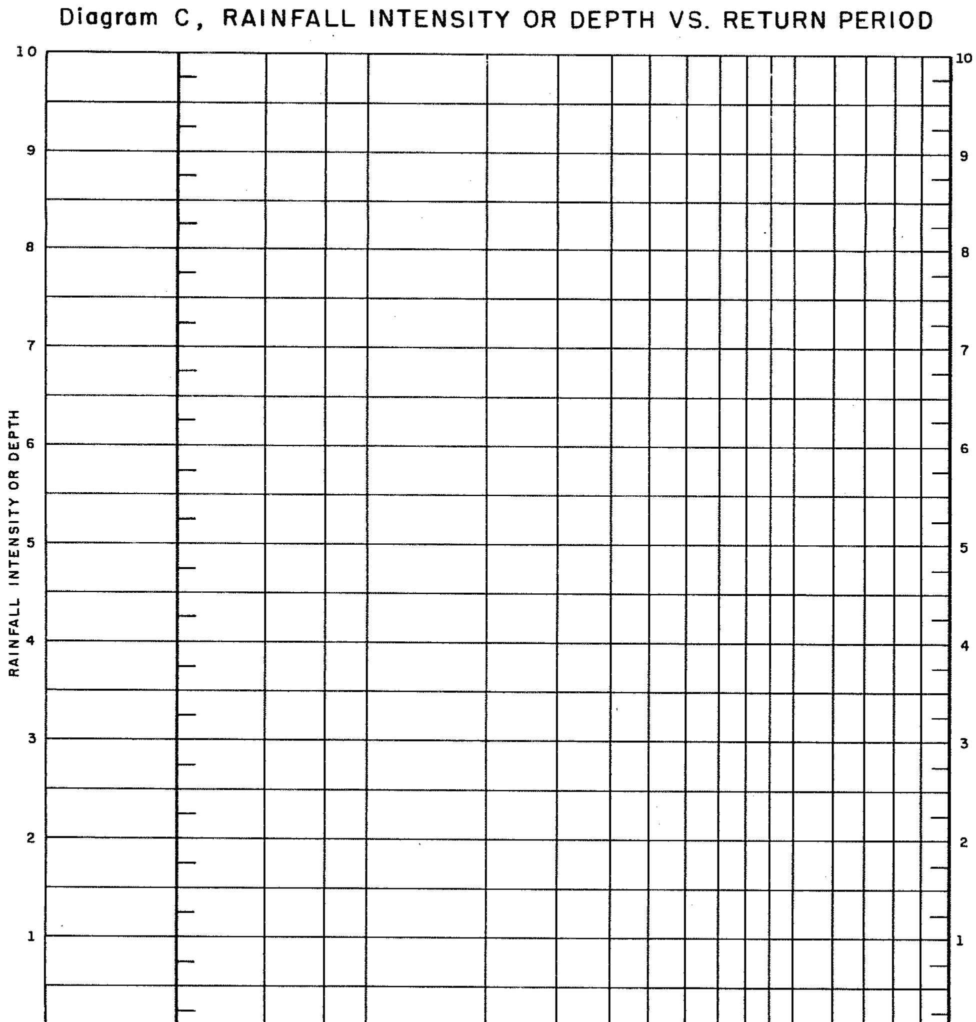


Table 1-2, with three examples, outlines the steps in the order they should be carried through in solving for the required rainfall intensities or depths.

Table 1-2

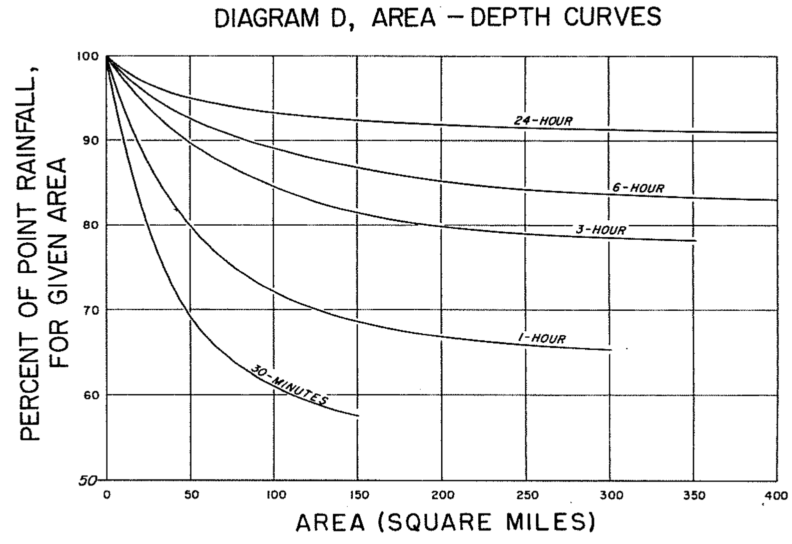
1. Location	36°00' N 82°00' W	39°00' N 84°00' W	37°00' N 89°00' W
2. Required Intensity (Depth)-Dur-Freq-Area	25-Yr 3-Hr Rainfall (In) for 100 sq. miles	50-Yr 12-Hr Rainfall (In) for 400 sq. miles	15-Yr 30-Min Int (In/Hr) for 50 sq. miles
3. 2-Year 1-Hour Rainfall. Fig. 5	1.4 In.	——	1.6 In.
4. 2-Year 6-Hour Rainfall. Fig. 6	2.2 In.	2.1 In.	2.5 In.
5. 2-Year 24-Hour Precip. Fig. 7	——	3.0 In.	——
6. Straightedge connecting (3) and (4) or (4) and (5) intersects required duration. Diagrams A or B	(2-Yr 3-Hr) 1.9 In.	(2-Yr 12-Hr) 2.5 In.	(2-Yr 30-Min) 2.5 In/Hr.
7. 100-Yr 1-Hr Rainfall / 2-Yr 1-Hr Rainfall Fig. 8	2.1	——	1.9
8. 100-Yr 6-Hr Rainfall / 2-Yr 6-Hr Rainfall Fig. 9	2.3	2.0	2.1
9. 100-Yr 24-Hr Precip. / 2-Yr 24-Hr Precip. Fig. 10	——	2.0	——
10. (7) x (3)	(100-Yr 1-Hr) 2.9 In.	——	(100-Yr 1-Hr) 3.1 In.
11. (8) x (4)	(100-Yr 6-Hr) 5.1 In.	(100-Yr 6-Hr) 4.2 In.	(100-Yr 6-Hr) 5.3 In.
12. (9) x (5)	——	(100-Yr 24-Hr) 6.0 In.	——
13. Straightedge connecting (10) and (11) or (11) and (12) intersects required duration. Diagrams A or B	(100-Yr 3-Hr) 4.1 In.	(100-Yr 12-Hr) 5.1 In.	(100-Yr 30-Min) 4.6 In/Hr.
14. Straightedge connecting (6) and (13) gives required return period. Diagram C	3.3 In.	4.6 In.	3.5 In/Hr.
15. Percent of Point Rainfall Diagram D	85	87	69
16. (15) x (14) gives (2)	2.8 In.	4.0 In.	2.4 In/Hr.

Diagram C, RAINFALL INTENSITY OR DEPTH VS. RETURN PERIOD



NOTE: To use this diagram for values greater than 10, a factor of 10 may be used, as with a slide rule, with proper attention to the decimal point. If more convenient, other factors such as 2 or 5 may be used.

DIAGRAM D, AREA – DEPTH CURVES



428981 O -57 (In Pocket)

FIGURE 2-1. DURATION, FREQUENCY, AREA-DEPTH DIAGRAMS, AND EXAMPLES OF COMPUTATION FOR WEATHER BUREAU TECHNICAL PAPER NO. 29, PART I. (PREPARED MARCH, 1957)

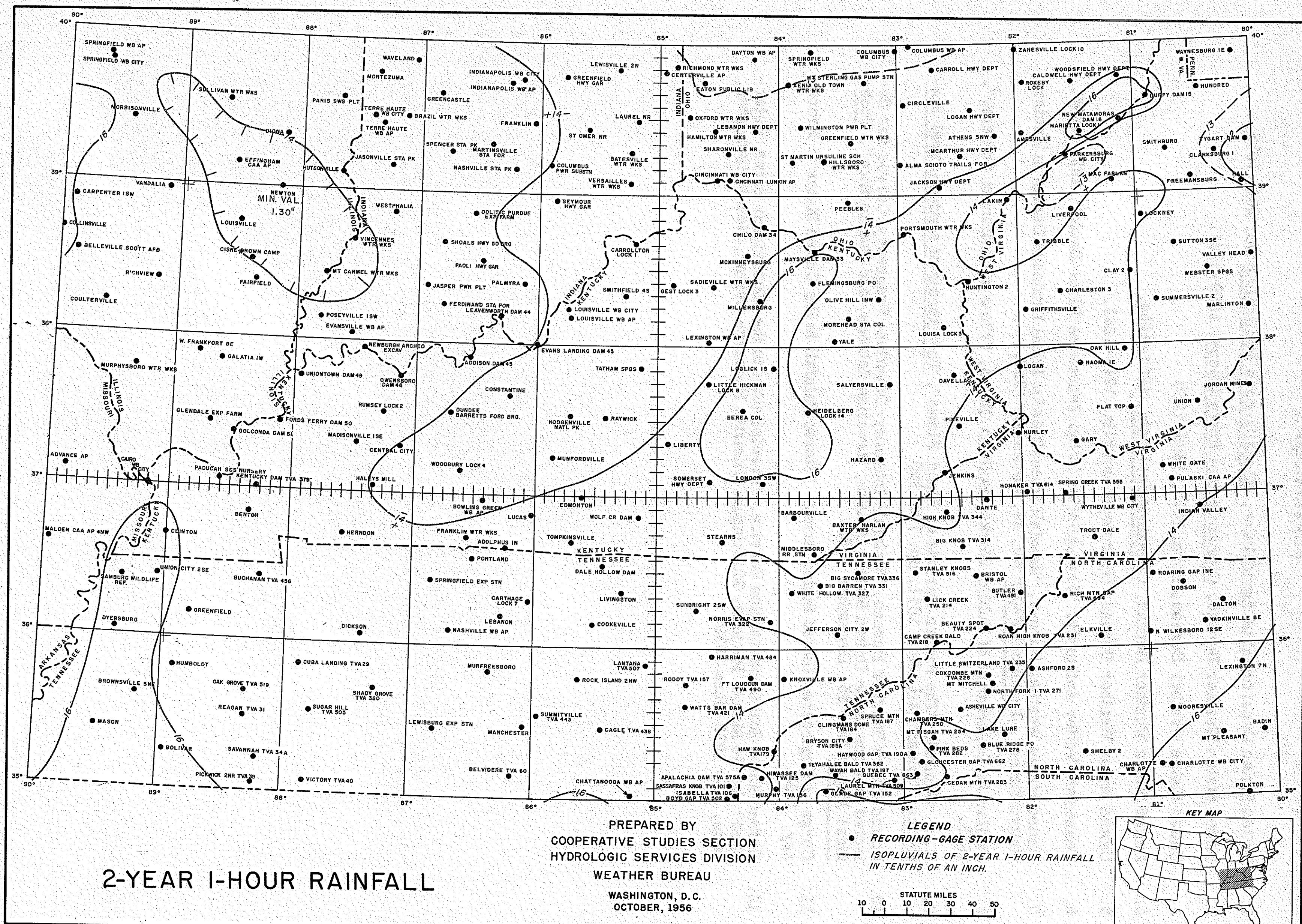

2-YEAR 1-HOUR RAINFALL
PREPARED BY
COOPERATIVE STUDIES SECTION
HYDROLOGIC SERVICES DIVISION
WEATHER BUREAU
WASHINGTON, D. C.
OCTOBER, 1956
LEGEND
RECORDING-GAGE STATION
ISOPLUVIALS OF 2-YEAR 1-HOUR RAINFALL IN TENTHS OF AN INCH.
STATUTE MILES
10 0 10 20 30 40 50
KEY MAP
MIN. VAL.
1.30"

Figure 2-2.

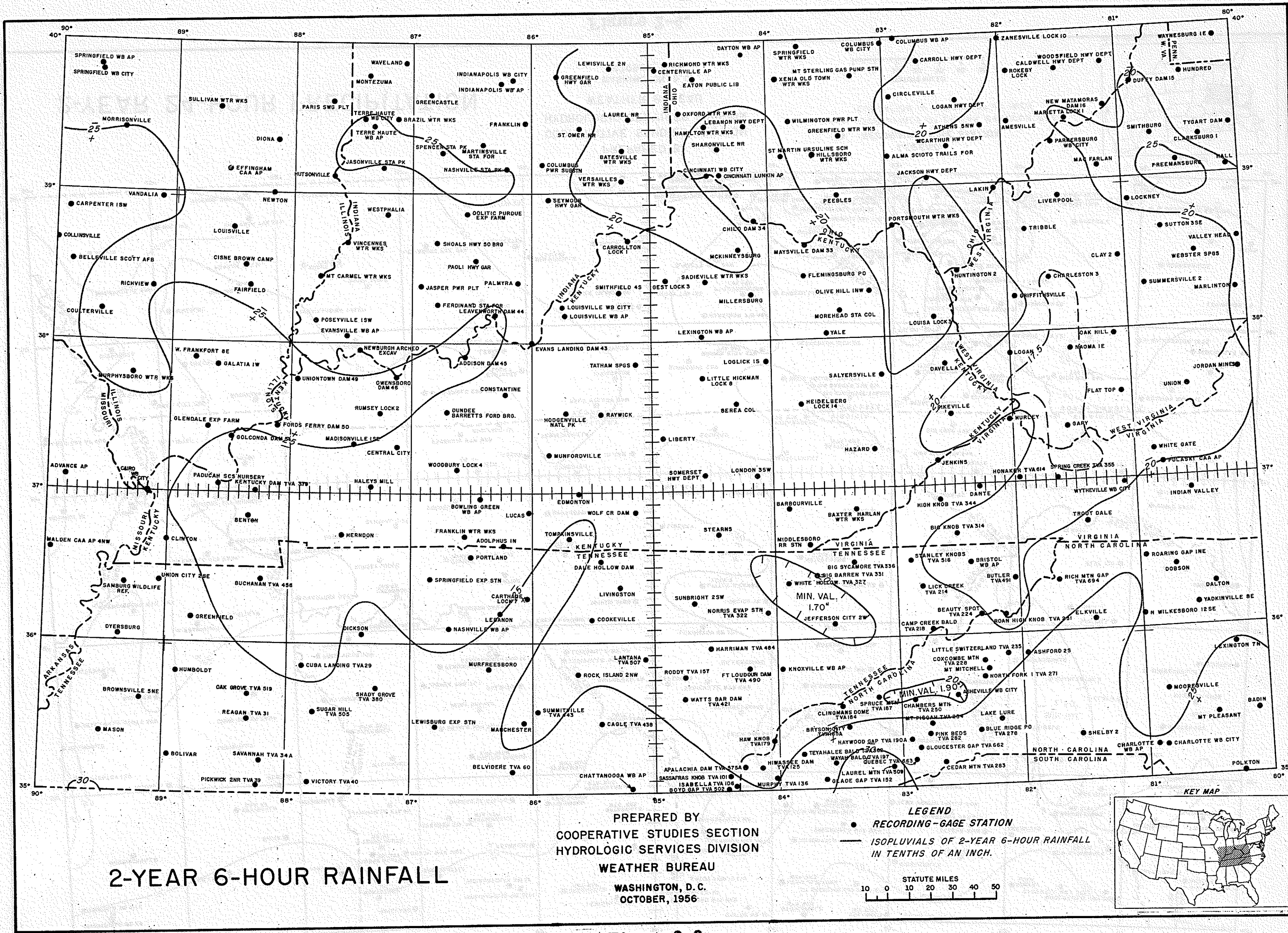

2-YEAR 6-HOUR RAINFALL
PREPARED BY
COOPERATIVE STUDIES SECTION
HYDROLOGIC SERVICES DIVISION
WEATHER BUREAU
WASHINGTON, D. C.
OCTOBER, 1956
LEGEND
RECORDING-GAGE STATION
ISOPLUVIALS OF 2-YEAR 6-HOUR RAINFALL IN TENTHS OF AN INCH.
STATUTE MILES
10 0 10 20 30 40 50
KEY MAP
MIN. VAL. 1.70"
MIN. VAL. 1.90"
INDIANA
OHIO
ILLINOIS
KENTUCKY
MISSOURI
WEST VIRGINIA
VIRGINIA
TENNESSEE
NORTH CAROLINA
SOUTH CAROLINA
ARKANSAS
PENN
W. VA.

Figure 2-3.

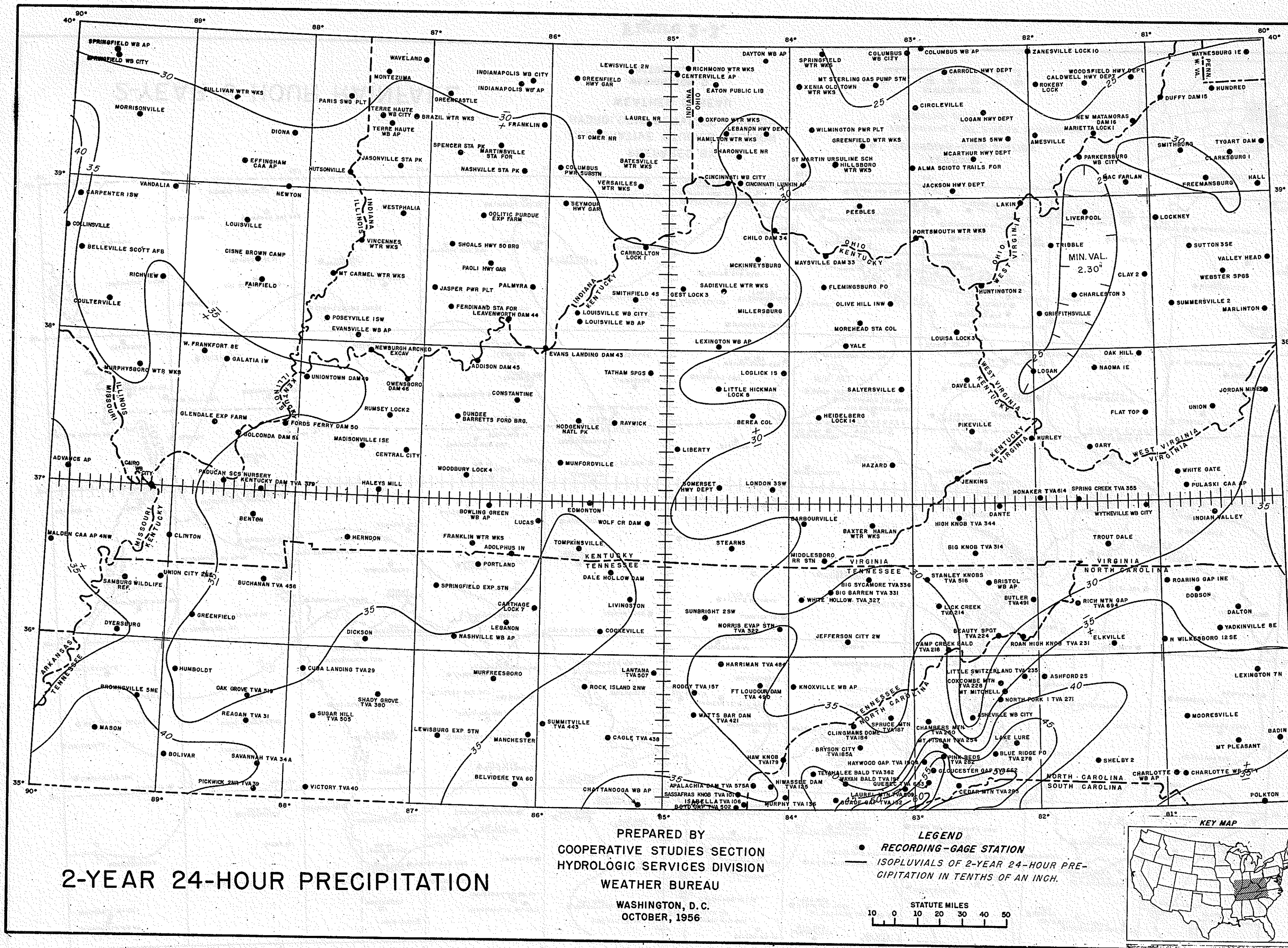

2-YEAR 24-HOUR PRECIPITATION
PREPARED BY
COOPERATIVE STUDIES SECTION
HYDROLOGIC SERVICES DIVISION
WEATHER BUREAU
WASHINGTON, D. C.
OCTOBER, 1956
LEGEND
RECORDING-GAGE STATION
ISOPLUVIALS OF 2-YEAR 24-HOUR PRECIPITATION IN TENTHS OF AN INCH.
STATUTE MILES
10 0 10 20 30 40 50
KEY MAP
MIN. VAL.
2.30"

Figure 2-4.

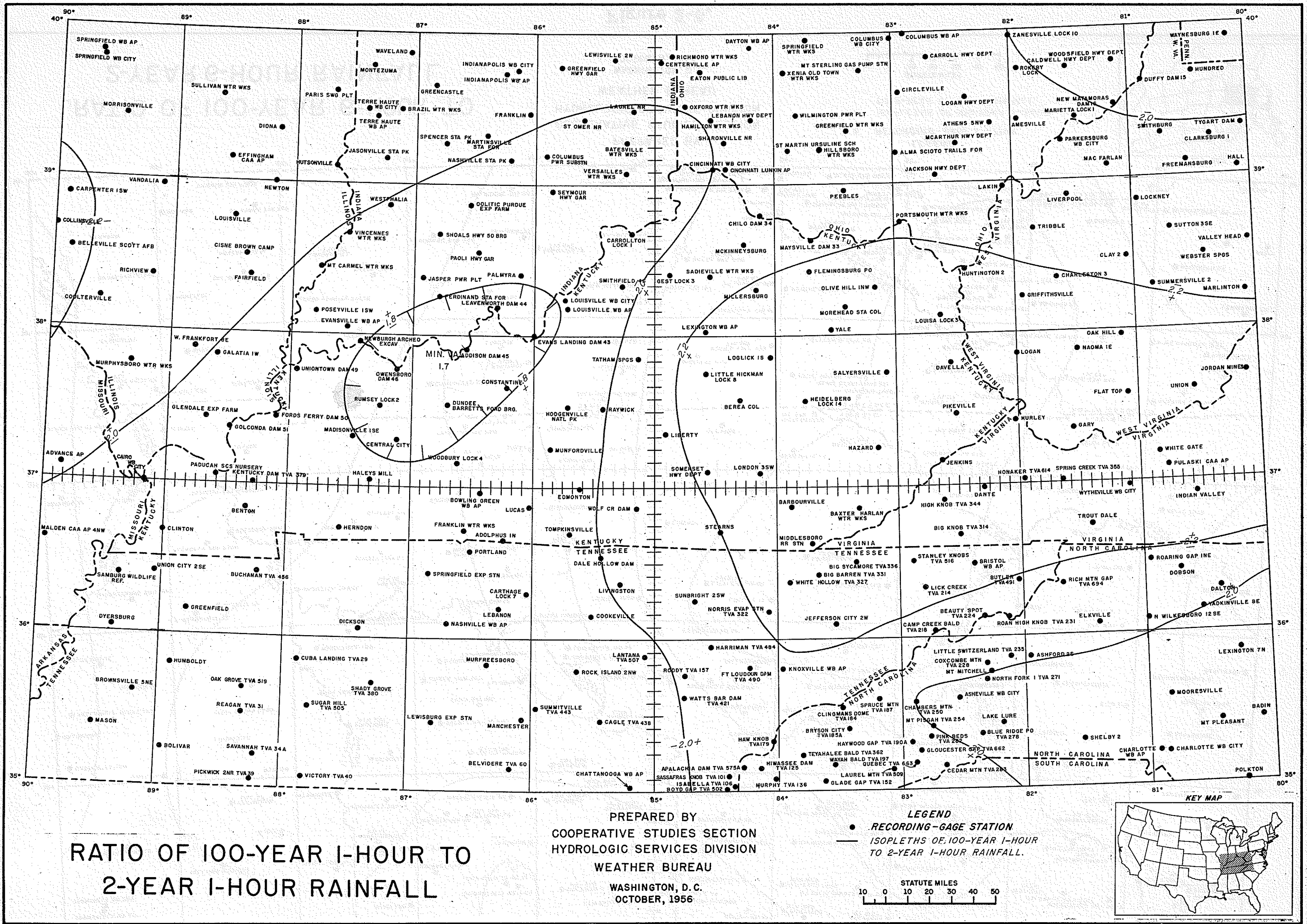

RATIO OF 100-YEAR 1-HOUR TO
2-YEAR 1-HOUR RAINFALL
PREPARED BY
COOPERATIVE STUDIES SECTION
HYDROLOGIC SERVICES DIVISION
WEATHER BUREAU
WASHINGTON, D. C.
OCTOBER, 1956
LEGEND
RECORDING-GAGE STATION
ISOPLETHS OF 100-YEAR 1-HOUR TO 2-YEAR 1-HOUR RAINFALL.
STATUTE MILES
10 0 10 20 30 40 50
KEY MAP

Figure 2-5.

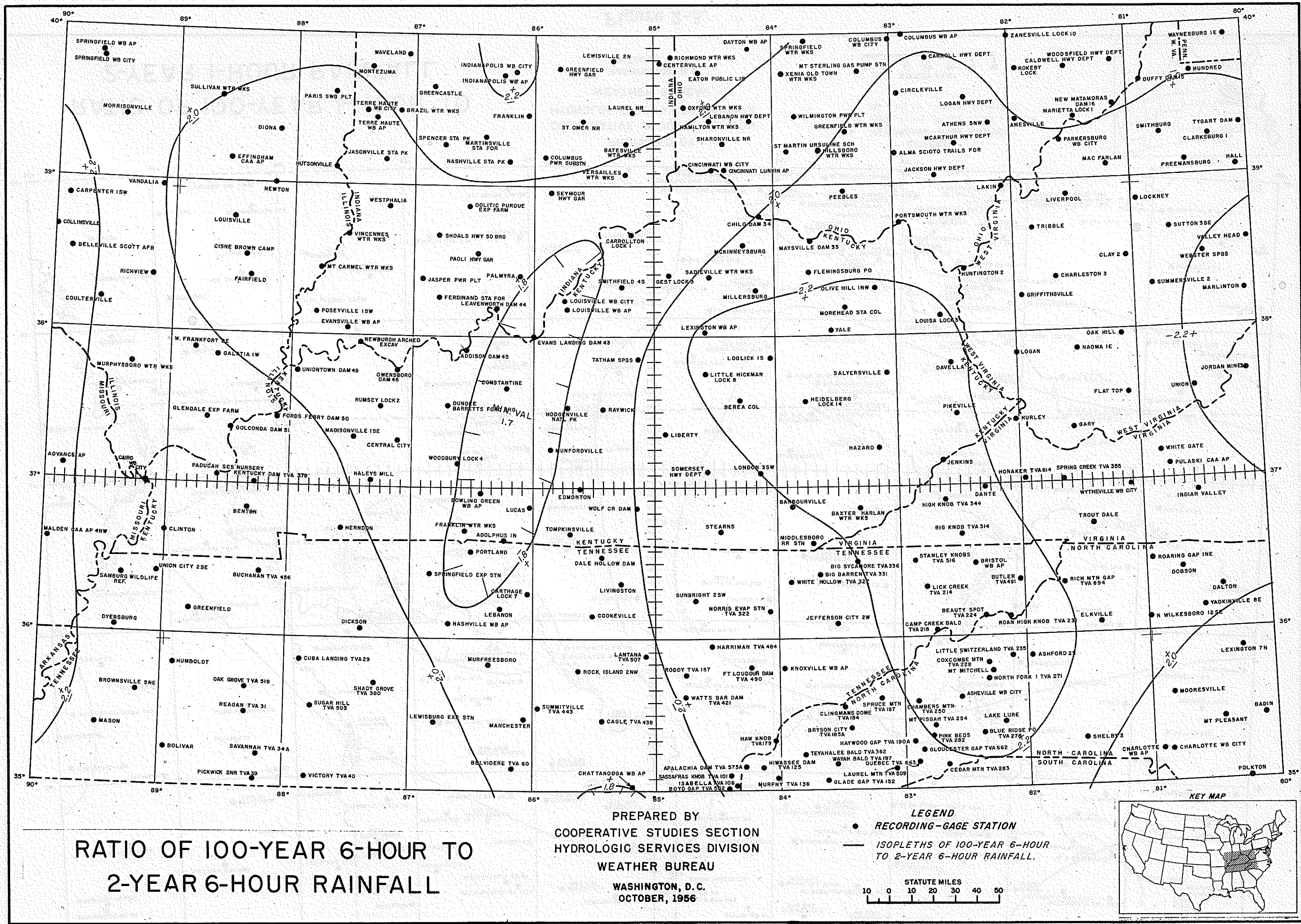
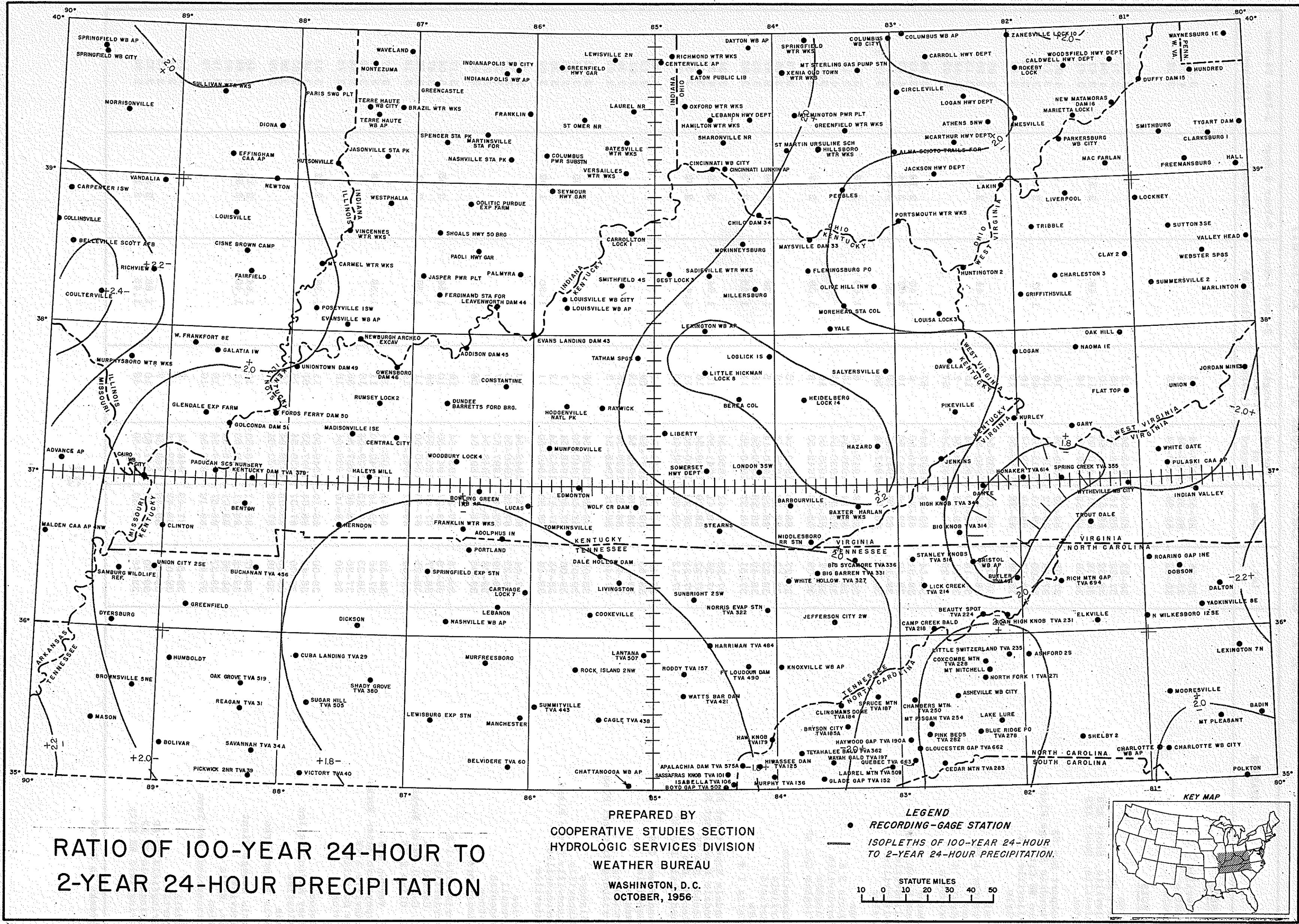

RATIO OF 100-YEAR 6-HOUR TO
2-YEAR 6-HOUR RAINFALL
PREPARED BY
COOPERATIVE STUDIES SECTION
HYDROLOGIC SERVICES DIVISION
WEATHER BUREAU
WASHINGTON, D.C.
OCTOBER, 1956
LEGEND
RECORDING-GAGE STATION
ISOPLETHS OF 100-YEAR 6-HOUR TO 2-YEAR 6-HOUR RAINFALL.
STATUTE MILES
10 0 10 20 30 40 50
KEY MAP

Figure 2-6.



RATIO OF 100-YEAR 24-HOUR TO 2-YEAR 24-HOUR PRECIPITATION

PREPARED BY
COOPERATIVE STUDIES SECTION
HYDROLOGIC SERVICES DIVISION
WEATHER BUREAU
WASHINGTON, D. C.
OCTOBER, 1956

Figure 2-7.

Table 2-1. Station Data (2-Year 1-, 6-, and 24-Hour)

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour (inches)	2-Year 6-Hour (inches)	2-Year 24-Hour (inches)
ARKANSAS							
Blytheville	35-56	89-55	1939-54	16			3.29
Burdette	35-49	89-57	1943-54	12			4.07
Osceola	35-43	89-58	1939-54	16			3.32
ILLINOIS							
Albion	38-22	88-03	1943-54	12			3.37
Anna 1 NW	37-28	89-15	1939-54	16			3.71
Belleville, Scott AFB	38-32	89-51	1945-54	10			4.04
Belleville, Scott AFB	38-32	89-51	1940-50	11	1.48	2.71	3.47
Benton	38-00	88-55	1939-54	16			3.41
Brookport Dam 52	37-08	88-39	1939-54	16			4.03
Carbondale Sewage Plant	37-44	89-12	1939-54	16			3.11
Cairo WB City	37-00	89-10	1903-51	49	1.57	2.58	3.72
Carlinville 4 E	39-17	89-49	1939-54	16			3.25
Carlyle	38-36	89-22	1940-54	15			3.56
Carmi	38-06	88-10	1939-54	16			2.92
Carpenter 1 SW	38-53	89-54	1940-50	11	1.44	2.78	3.90
Casey	39-18	88-00	1939-54	16			3.13
Centralia 4 W	38-31	89-12	1948-54	7			3.48
Charleston	39-29	88-10	1897-54*	57			3.02
Chester	37-54	89-49	1897-54*	57			3.38
Cisne Brown Camp	38-31	88-24	1945-50	6	1.40	2.18	3.43
Collinsville	38-40	89-59	1941-50	10	2.02	3.34	4.33
Coulterville	38-11	89-36	1941-50	10	1.31	2.09	3.19
Decatur	39-51	88-58	1897-54	58			3.00
Diona	39-22	88-08	1945-50	6	1.63	2.28	3.20
DuQuoin 2 S	38-00	89-14	1939-54	16			3.12
Edwardsville	38-49	89-58	1939-54	16			4.24
Effingham	39-07	88-33	1939-54	16			3.12
Effingham CAA AP	39-09	88-32	1942-50	9	1.38	2.27	3.62
Elizabethtown	37-27	88-18	1942-54	13			3.78
Fairfield	38-23	88-22	1939-54	16			3.06
Fairfield	38-23	88-22	1940-44	5	1.36	1.99	2.87
Flora	38-40	88-28	1939-54	16			3.02
Galatia 1 W	37-51	88-37	1940-50	11	1.55	2.73	3.82
Glendale Experiment Farm	37-26	88-41	1950-54	5			3.24
Glendale Experiment Farm	37-26	88-41	1941-50	10	1.64	3.10	4.39
Golconda Dam 51	37-22	88-29	1939-54	16			3.40
Golconda Dam 51	37-22	88-29	1940-50	11	1.44	2.82	3.58
Grand Chain Dam 53	37-12	89-02	1939-48	10			4.08
Grand Tower 2 N	37-40	89-30	1941-54	14			4.32
Greenville	38-53	89-24	1897-54	58			3.13
Greenup	39-15	88-09	1942-54	13			3.01
Harrisburg	37-44	88-32	1939-54	16			3.38
Harrisburg Disposal Plant	37-44	88-31	1948-54	7			2.65
Hillsboro	39-09	89-29	1939-54	16			3.22
Hutsonville	39-07	87-40	1940-50	11	1.45	2.46	3.25
Hutsonville Power Plant	39-06	87-40	1948-54	7			2.96
Lawrenceville	38-44	87-41	1943-54	12			3.36
Louisville	38-46	88-30	1940-50	11	1.30	1.92	3.02
Marion	37-44	88-55	1942-54	13			3.67
Marshall	39-23	87-42	1940-54	15			3.05
Mascoutah	38-29	89-48	1897-53	57			3.36
Mattoon	39-28	88-21	1948-54	7			3.23
McLeansboro	38-05	88-32	1897-54	58			3.44
Morrisville 1 E	39-25	89-26	1939-54	16			3.17
Morrisville	39-25	89-27	1941-50	10	1.54	2.55	3.04
Mt. Carmel 3 N	38-27	87-46	1898-54*	56			3.47
Mt. Carmel Water Works	38-25	87-45	1940-50	11	1.36	2.21	3.32
Mt. Olive 2 NE	39-04	89-42	1941-54	14			3.18
Mt. Vernon 4 N	38-22	88-55	1939-54	16			3.07
Murphysboro Water Works	37-46	89-19	1940-50	11	1.58	2.48	3.49
Nashville 3 NW	38-23	89-25	1939-54	16			3.49
New Burnside	37-35	88-46	1897-54	58			3.68
Newton	39-00	88-10	1939-54	16			2.75
Newton	39-00	88-10	1940-50	11	1.36	2.12	3.03
Olney Radio Station	38-43	88-04	1897-53	57			3.26
Palestine	39-00	87-37	1939-54	16			2.93
Pana	39-23	89-05	1939-54	16			3.26
Paris Water Works	39-38	87-42	1939-54	16			2.99
Paris Sewage Plant	39-37	87-41	1940-50*	10	1.44	2.11	2.48
Richview	38-22	89-11	1940-50	11	1.46	2.54	3.88
Ste. Marie	38-56	88-01	1948-54	7			2.96
Salem	38-37	88-57	1939-54	16			3.19
Shawneetown, New Town	37-43	88-10	1939-54	16			3.78
Sidell	39-55	87-49	1948-54	7			3.14
Sparta	38-08	89-42	1939-54	16			2.98
Springfield WB AP	39-50	89-40	1948-54	7			2.75
Springfield WB AP	39-50	89-40	1941-50	10	1.86	2.59	3.32
Springfield WB City	39-48	89-39	1903-50	48	1.45	2.17	2.98

*Breaks in Record

Table 2-1, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour (inches)	2-Year 6-Hour (inches)	2-Year 24-Hour (inches)
ILLINOIS (continued)							
Sullivan Water Works	39-34	88-37	1940-50	11	1.58	2.28	3.00
Taylorville	39-33	89-18	1941-54	14			2.87
Tuscola	39-48	88-17	1939-54	16			2.94
Vandalia CAA AP	38-59	89-10	1939-54	16			3.22
Vandalia	38-58	89-07	1940-50	11	1.56	2.55	3.30
Virden	39-30	89-46	1941-54	14			3.25
Waverly	39-41	89-57	1939-45	7			3.34
Wayne City	38-21	88-35	1948-54	7			3.26
W. Frankfort 8 E	37-52	88-48	1941-49	9	1.68	2.71	4.01
Wilcox	38-38	88-18	1948-54	7			3.32
Windsor	39-26	88-36	1939-54	16			3.12
INDIANA							
Batesville Water Works	39-18	85-15	1945-50	6	1.21	2.35	3.37
Bedford	38-51	86-30	1939-54	16			3.19
Bedford 4 SW	38-50	86-32	1945-54	10			3.10
Bloomington, Indiana University	39-10	86-30	1939-54	16			3.17
Boonville 2 E	38-02	87-15	1939-54*	13			3.24
Bowling Green	39-23	87-01	1948-54	7			2.87
Brazil Water Works	39-31	87-08	1945-50	6	1.48	2.44	3.50
Brookville 1 S	39-25	85-01	1939-54	16			2.88
Cambridge City	39-49	85-11	1939-54	16			2.98
Centerville AP	39-49	84-58	1941-46	6	1.48	1.95	2.60
Columbus	39-12	85-55	1939-54	16			3.58
Columbus Power Substation	39-12	85-55	1940-50*	10	1.06	2.01	3.07
Crane Naval Depot	38-52	86-50	1945-54	10			3.80
Cypress Dam 48	37-50	87-40	1939-54	16			3.35
Edwardsport Power Plant	38-48	87-14	1939-54	16			3.30
Elliston	39-02	86-58	1939-54	16			3.52
Evans Landing Dam 43	38-00	86-00	1939-54	16			2.80
Evans Landing Dam 43	38-00	86-00	1940-50	11	1.38	2.21	3.08
Evansville WB AP	38-02	87-32	1903-51	49	1.54	2.36	3.34
Farmersburg 3 SW	39-14	87-25	1939-51	13			3.22
Ferdinand State Forest	38-15	86-47	1940-50	11	1.60	2.10	3.08
Franklin	39-29	86-03	1939-54	16			2.84
Franklin	39-29	86-03	1942-50	9	1.51	2.37	3.32
Greencastle 1 E	39-39	86-51	1939-54	16			3.67
Greencastle	39-39	86-51	1940-48	9	1.33	1.95	2.86
Greenfield	39-47	85-46	1939-54*	15			2.62
Greenfield Highway Garage	39-46	85-47	1940-50	11	1.20	1.97	2.50
Greensburg 3 SW	39-20	85-33	1939-54	16			2.78
Hazelton Gravel Plant	38-30	87-32	1939-48	10			2.88
Henryville State Forest	38-33	85-46	1939-54	16			2.92
Huntingburg AP	38-16	86-57	1939-54	16			3.17
Indianapolis Monument Circle	39-46	86-10	1939-54	16			2.94
Indianapolis WB City	39-46	86-10	1903-51	49	1.47	2.30	2.87
Indianapolis WB AP	39-44	86-16	1939-54	16			2.64
Indianapolis WB AP	39-44	86-16	1941-50	10	1.31	2.10	2.66
Jasonville State Park	39-11	87-15	1942-50	9	1.60	2.43	3.28
Jasper Power Plant	38-23	86-55	1945-50	6	1.50	2.55	3.19
Jeffersonville	38-16	85-45	1897-54	58			3.08
Johnson Experiment Farm	38-16	87-45	1939-54	16			2.99
Knightstown Water Works	39-47	85-32	1948-54	7			2.75
Laurel (nr)	39-30	85-11	1940-48	9	1.13	1.72	2.56
Leavenworth Dam 44	38-11	86-20	1939-54	16			3.73
Leavenworth Dam 44	38-12	86-20	1940-50	11	1.48	2.67	3.65
Lewisville 2 N	39-50	85-21	1945-50	6	1.25	2.05	3.23
Madison	38-44	85-23	1897-54	58			3.17
Marengo	38-23	86-21	1939-44	6			2.68
Markland Dam 39	38-47	84-58	1948-54	7			2.72
Martinsville City Hall	39-25	86-26	1939-54	16			2.90
Martinsville State Forest	39-20	86-25	1940-50	11	1.52	2.39	3.02
Mauzy	39-37	85-20	1939-48	10			2.64
Montezuma	39-47	87-22	1942-50	9	1.37	2.16	2.80
Moores Hill	39-07	85-06	1902-54	53			3.14
Mount Vernon	37-56	87-54	1897-54	58			3.38
Nashville State Park	39-10	86-13	1945-53	9			3.68
Nashville State Park	39-09	86-13	1941-50	10	1.78	2.52	3.36
Newberry Highway St. Bridge	38-56	87-01	1948-54	7			3.07
Newburgh Archeological Excavation	37-57	87-27	1945-50	6	1.79	2.68	3.95
Newburgh Dam 47	37-57	87-24	1939-54	16			3.10
New Castle	39-56	85-22	1950-54	5			2.71
New Harmony	38-08	87-56	1939-54	16			2.93
North Vernon	39-01	85-37	1939-54	16			3.35
Oaklandon Geist Reservoir	39-54	85-59	1948-54	7			2.81
Oolitic Purdue Experiment Farm	38-53	86-32	1941-50	10	1.40	2.03	2.79
Palmyra	38-24	86-07	1940-50	11	1.54	2.29	3.38
Paoli	38-34	86-28	1898-54	57			3.34
Paoli Highway Garage	38-34	86-29	1940-50*	10	1.28	2.21	3.00
Pendleton Reformatory	39-59	85-45	1945-54	10			3.92

*Breaks in Record

Table 2-1, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour (inches)	2-Year 6-Hour (inches)	2-Year 24-Hour (inches)
INDIANA (continued)							
Petersburg 61 Bridge	38-31	87-17	1939-54	16			3.88
Poseyville 1 SW	38-10	87-48	1942-49	8	1.57	2.19	3.25
Princeton 1 W	38-21	87-35	1897-54	58			3.24
Richmond AP	39-46	84-50	1948-54	7			2.92
Richmond Water Works	39-51	84-51	1939-54	16			2.72
Richmond Water Works	39-50	84-51	1940-50	11	1.46	2.06	2.96
Rockville	39-46	87-14	1939-54	16			3.31
Rushville Sewage Plant	39-36	85-27	1949-54	6			2.62
Salem	38-37	86-06	1897-54	58			3.17
St. Omer (nr)	39-26	85-36	1940-48	9	1.49	2.11	2.69
Scottsburg	38-42	85-47	1897-54	58			3.26
Seymour 2 N	38-59	85-54	1939-54	16			2.96
Seymour Highway Garage	38-58	85-53	1940-50	11	1.17	2.13	3.07
Shelbyville Power Plant	39-32	85-46	1939-54	16			2.87
Shoals Highway 50 Bridge	38-40	86-48	1939-54	16			3.05
Shoals Highway 50 Bridge	38-40	86-48	1942-50	9	1.52	2.10	3.23
Spencer	39-17	86-46	1948-54	7			3.25
Spencer State Park	39-16	86-43	1940-50	11	1.38	2.61	3.06
Tell City Power Plant	37-57	86-46	1939-54	16			3.40
Terre Haute WB AP	39-27	87-18	1912-51	40	1.58	2.63	3.47
Terre Haute WB City	39-29	87-24	1940-46	7	1.72	2.60	3.15
Versailles Water Works	39-05	85-13	1940-50	11	1.33	1.88	2.85
Vevay Dam 39	38-44	85-05	1939-47	9			2.74
Vincennes	38-41	87-33	1939-54	16			3.26
Vincennes Water Works	38-42	87-31	1940-50	11	1.33	2.42	3.23
Washington	38-40	87-11	1939-54	16			3.34
Waveland	39-52	87-03	1945-50	6	1.30	2.02	2.63
W. Baden Springs College	38-34	86-37	1947-54	8			2.90
Westphalia	38-51	87-13	1940-46	7	1.31	2.45	2.95
Williams Power Plant	38-48	86-39	1939-54	16			3.18
KENTUCKY							
Addison Dam 45	37-55	86-34	1939-54	16			3.28
Addison Dam 45	37-55	86-34	1940-50	11	1.68	2.59	3.43
Adolphus 1 N	36-39	86-16	1940-50	11	1.44	2.42	3.23
Allen	37-35	82-43	1949-54	6			2.60
Anchorage	38-16	85-33	1901-54	54			3.41
Ashcamp	37-16	82-26	1949-54	6			2.47
Ashland Dam 29	38-27	82-36	1939-54	16			2.50
Barbourville	36-52	83-53	1942-50	9	1.61	2.32	3.07
Bardstown SJ Preparatory School	37-48	85-28	1949-54	6			3.55
Baxter Harlan Water Works	36-51	83-20	1940-50	11	1.19	2.20	2.95
Beaver Dam	37-25	86-52	1939-54	16			3.20
Benham	36-58	82-57	1946-54	9			3.19
Benton	36-51	88-21	1944-50	7	1.44	2.30	3.16
Berea College	37-34	84-18	1901-54	54			3.23
Berea College	37-34	84-18	1942-50	9	1.76	2.55	3.43
Berea Water Works	37-33	84-15	1948-54	7			3.22
Bowling Green	37-00	86-26	1940-54*	13			3.34
Bowling Green CAA AP	36-58	86-58	1939-54	16			3.44
Bowling Green Substation	37-01	86-26	1944-54	11			3.60
Bowling Green WB AP	36-58	86-26	1941-50*	8	1.68	2.25	3.08
Brent Dam 36	39-03	84-25	1944-54	11			2.74
Brownsville Lock 6	37-12	86-16	1939-54	16			3.26
Burnside	36-59	84-37	1939-52	14			3.07
Cadiz Lock E	36-46	87-58	1949-54	6			3.80
Campbellsville	37-20	85-21	1945-54	10			3.14
Carrollton Lock 1	38-41	85-11	1939-54	16			2.88
Carrollton Lock 1	38-41	85-11	1941-50	10	1.27	2.05	3.25
Central City	37-19	87-07	1942-50*	8	1.46	2.03	3.02
Clermont 1 SSE	37-55	85-40	1940-54*	9			3.20
Clinton	36-41	89-00	1942-50	9	1.66	3.05	4.15
College Hill Lock 11	37-47	84-06	1939-54	16			2.98
Cold Spring Dam 36	39-01	84-22	1939-43	5			2.53
Columbia	37-06	85-18	1949-54	6			3.53
Constantine	37-40	86-14	1940-50	11	1.37	2.40	3.05
Corbin CAA AP	36-58	84-08	1945-54	10			2.96
Covington WB AP	39-04	84-40	1948-54	7			3.14
Cynthiana	38-23	84-18	1939-54	16			3.22
Danville	37-39	84-46	1939-54	16			3.07
Davella	37-48	82-32	1940-50	11	1.50	2.17	2.81
Delphia 1 E	37-02	83-07	1949-54	6			2.47
Dema	37-25	82-48	1949-54	6			2.57
Dix Dam	37-48	84-43	1939-54	16			2.81
Dundee Barretts Ford Bridge	37-33	86-43	1950-54	5			3.25
Dundee Barretts Ford Bridge	37-33	86-43	1941-50	10	1.36	2.13	2.87
Dunmor	37-05	87-00	1949-54	6			4.25
Dunnville	37-13	84-58	1949-54	6			3.53
Eadsville	36-54	84-53	1939-46	8			3.35
Earlington	37-17	87-30	1939-48	10			2.86
Eddyville Lock F	37-03	88-05	1948-54	7			3.49
Edmonton	37-00	85-37	1941-50	10	1.54	2.24	3.27

*Breaks in Record

Table 2-1, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour (inches)	2-Year 6-Hour (inches)	2-Year 24-Hour (inches)
<u>KENTUCKY</u> (continued)							
Falmouth	38-40	84-20	1897-54	58			2.96
Farmers	38-09	83-33	1939-54	16			2.70
Flemingsburg	38-25	83-43	1939-54	16			3.13
Flemingsburg Post Office	38-25	83-44	1943-50	8	1.42	2.05	3.01
Ford Lock 10	37-54	84-16	1939-54	16			3.04
Fords Ferry Dam 50	37-28	88-06	1939-54	16			3.20
Fords Ferry Dam 50	37-28	88-06	1940-50	11	1.46	2.59	3.41
Frankfort Lock 4	38-13	84-52	1939-54	16			3.11
Franklin Water Works	36-43	86-34	1949-54	6			2.94
Franklin Water Works	36-43	86-34	1941-50	10	1.63	2.41	3.61
Frenchburg	37-57	83-39	1950-54	5			2.70
Georgetown Water Works	38-12	84-33	1949-54	6			2.98
Gest Lock 3	38-25	84-53	1939-54	16			3.25
Gest Lock 3	38-25	84-53	1941-50	10	1.48	2.18	3.32
Glasgow	37-00	85-55	1939-54*	11			3.35
Grant Dam 38	38-59	84-50	1939-54	16			2.68
Grayson	38-19	82-57	1939-54*	12			2.59
Greensburg	37-15	85-30	1939-54	16			3.02
Greensburg Highway 61 Bridge	37-15	85-30	1948-54	7			3.42
Greenup Dam 30	38-37	82-51	1939-54	16			3.01
Greenville 2 W	37-12	87-12	1939-54	16			3.34
Haleys Mill	37-03	87-20	1941-50	10	1.31	2.26	3.27
Hartford 6 NW	37-32	86-54	1939-54	16			3.30
Hazard	37-15	83-12	1940-50	11	1.44	2.10	2.74
Hazard Water Works	37-15	83-11	1939-51	13			2.87
Heidelberg Lock 14	37-33	83-46	1939-54	16			2.74
Heidelberg Lock 14	37-33	83-46	1940-50	11	1.60	2.02	2.80
Henderson 4 SW	37-47	87-37	1939-54	16			3.70
Herndon	36-44	87-34	1943-50	8	1.51	2.39	3.62
Hicksville	36-48	88-30	1949-54	6			4.12
High Bridge Lock 7	37-49	84-43	1939-54	16			2.94
Hindman Settlement School	37-20	82-59	1948-54	7			2.75
Hodgenville National Park	37-32	85-44	1945-50	6	1.68	2.70	3.77
Hopkinsville	36-51	87-30	1897-54	58			3.90
Hyden	37-10	83-22	1949-54	6			2.77
Irvington	37-53	86-17	1939-54	16			3.00
Jackson	37-33	83-23	1939-54*	15			3.00
Jenkins	37-12	82-36	1939-51*	9			2.62
Jenkins	37-10	82-38	1940-50	11	1.40	2.01	2.84
Jeremiah	37-10	82-56	1949-54	6			2.44
Keene 2 N	37-58	84-38	1949-54	6			3.42
Kentucky Dam TVA 379	37-01	88-16	1945-54	10			3.34
Kentucky Dam TVA 379	37-01	88-16	1944-50	7	1.28	2.01	3.05
La Grange	38-24	85-23	1939-46	8			3.24
Lancaster	37-37	84-35	1939-54	16			3.26
Laura	37-45	82-26	1948-54	7			2.44
Leitchfield	37-29	86-18	1897-54	58			3.34
Lexington WB AP	38-02	84-36	1903-53*	40	1.32	2.24	3.11
Liberty	37-21	84-55	1949-54	6			3.35
Liberty	37-21	84-55	1940-50	11	1.42	2.31	3.30
Little Hickman Lock 8	37-45	84-35	1939-54	16			2.81
Little Hickman Lock 8	37-45	84-35	1940-50	11	1.48	2.37	2.88
Lockport Lock 2	38-26	84-58	1939-54	16			2.92
Loglick 1 S	37-51	84-02	1941-50	10	1.57	2.38	2.84
London 3 SW	37-06	84-08	1940-50*	10	1.54	2.29	2.71
Louisa 2	38-07	82-37	1939-54*	15			3.30
Louisa Lock 3	38-07	82-37	1941-50	10	1.15	1.89	2.68
Louisville WB AP	38-11	85-44	1941-50	10	1.30	2.21	3.30
Louisville WB City	38-15	85-46	1903-51	49	1.36	2.10	3.28
Louisville, Bowman Field	38-13	85-40	1939-54	16			3.08
Louisville Upper Gage	38-17	85-48	1948-54	7			3.23
Lovelaceville	36-58	88-50	1939-54*	15			3.26
Lucas	36-53	86-02	1945-50	6	1.50	2.30	3.20
Madisonville 1 SE	37-19	87-29	1949-54	6			3.23
Madisonville 1 SE	37-19	87-29	1943-50	8	1.56	2.18	3.10
Mammoth Cave Park	37-11	86-06	1939-54	16			3.77
Manchester 4 SE	37-06	83-43	1949-54	6			3.38
Mayfield 2 S	36-42	88-38	1939-54	16			3.54
Mayfield Substation	36-44	88-39	1944-54	11			3.70
Maysville Dam 33	38-38	83-42	1939-54	16			2.90
Maysville Dam 33	38-38	83-42	1940-50	11	1.63	2.21	2.89
McKinneysburg	38-36	84-16	1940-50	11	1.32	1.97	3.09
Middlesboro	36-37	83-43	1939-54*	14			3.38
Middlesboro Railroad Station	36-37	83-43	1940-50	11	1.49	2.03	2.71
Midway	38-09	84-41	1948-54	7			3.37
Millersburg	38-18	84-09	1941-50	10	1.73	2.55	3.10
Millerstown	37-27	86-03	1948-54	7			3.49
Monticello	36-50	84-50	1939-54	16			3.00
Morehead State College	38-11	83-26	1946-50	5	1.88	2.60	3.53
Mount Sterling	38-04	83-56	1897-54*	56			3.11

*Breaks in Record

Table 2-1, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour (inches)	2-Year 6-Hour (inches)	2-Year 24-Hour (inches)
KENTUCKY (continued)							
Munfordville	37-16	85-53	1939-54*	14			3.34
Munfordville	37-16	85-53	1940-50	11	1.30	2.41	3.42
Murray	36-36	88-20	1939-54	16			3.72
Olive Hill 1 NW	38-18	83-11	1942-50	9	1.52	2.28	3.25
Olney	37-14	87-47	1949-54	6			3.00
Oneonta Dam 35	38-58	84-18	1939-54	16			2.58
Owensboro 2 W	37-46	87-09	1897-54	58			3.24
Owensboro Dam 46	37-47	87-08	1939-54	16			3.08
Owensboro Dam 46	37-47	87-08	1940-50	11	1.51	2.72	3.51
Paducah	37-06	88-37	1939-54	16			3.98
Paducah CAA AP	37-04	88-46	1950-54	5			3.89
Paducah SCS Nursery	37-04	88-35	1940-50	11	1.55	2.44	3.40
Paintsville	37-49	82-48	1939-54	16			2.74
Pikeville	37-29	82-31	1939-54*	15			2.56
Pikeville	37-29	82-31	1940-50	11	1.19	1.79	2.45
Pineville	36-45	83-42	1949-54	6			2.90
Pippapass	37-19	82-52	1939-46	8			3.29
Princeton	37-06	87-53	1939-54	16			3.67
Quicksand	37-32	83-21	1939-48	10			3.29
Ravenna Lock 12	37-40	83-57	1939-54	16			3.04
Raywick	37-33	85-26	1941-48	8	1.51	2.29	3.18
Richmond	37-44	84-18	1939-54*	14			2.84
Rumsey Lock 2	37-32	87-16	1939-54	16			3.23
Rumsey Lock 2	37-32	87-16	1940-50	11	1.61	2.62	3.39
Russellville	36-51	86-53	1939-54	16			3.49
Russellville Substation	36-50	86-54	1948-54	7			4.44
Sadieville Water Works	38-23	84-32	1943-50	8	1.20	2.08	2.81
St. John Bethlehem Academy	37-42	85-59	1939-54	16			3.08
Salvisa Lock 6	37-56	84-49	1939-54	16			3.12
Salyersville	37-45	83-04	1940-50	11	1.42	1.95	2.89
Science Hill	37-11	84-39	1943-49	7			3.11
Scottsville	36-45	86-12	1947-54	8			3.46
Sebree	37-36	87-32	1949-54	6			3.60
Shelbyville 2 W	38-13	85-16	1897-54	58			3.28
Shepherdsville	38-00	85-44	1939-54*	7			2.89
Smithfield 4 S	38-20	85-16	1942-50	9	1.40	2.28	3.42
Smiths Grove	37-03	86-11	1939-44	6			3.07
Somerset Highway Department	37-07	84-35	1942-50	9	1.44	2.12	2.88
Springfield	37-41	85-14	1947-54	8			3.72
Stearns	36-43	84-29	1939-54*	12			3.05
Stearns	36-42	84-29	1940-50	11	1.38	2.26	3.06
Summer Shade	36-53	85-43	1949-54	6			4.16
Summer Shade Substation	36-53	85-40	1948-54	7			3.65
Tatham Springs	37-52	85-09	1940-50	11	1.22	1.97	2.78
Taylorsville	38-02	85-21	1939-54*	10			3.59
Tompkinsville	36-42	85-41	1941-50	10	2.02	2.88	3.89
Tompkinsville 2	36-42	85-41	1947-54*	6			3.66
Turkey Creek School	36-45	88-05	1948-54	7			4.09
Tyrone Lock 5	38-02	84-51	1939-54	16			3.14
Uniontown Dam 49	37-46	87-57	1939-54	16			3.42
Uniontown Dam 49	37-46	87-57	1940-50	11	1.50	2.83	3.86
Valley View Lock 9	37-51	84-26	1939-54	16			2.92
Vanceburg Dam 32	38-39	83-21	1939-54	16			2.52
Waynesburg 6 E	37-22	84-34	1947-54	8			3.48
West Liberty Water Works	37-55	83-15	1948-54	7			3.24
Williamsburg	36-44	84-10	1897-54	58			3.10
Williamstown 5 WSW	38-38	84-38	1939-54	16			2.90
Willow Lock 13	37-36	83-50	1939-54	16			2.90
Winchester	37-55	84-16	1939-44	6			3.07
Wolf Creek Dam	36-52	85-09	1947-54	8			3.11
Wolf Creek Dam	36-53	85-08	1942-50	9	1.28	2.04	3.08
Woodbury Lock 4	37-11	86-38	1939-54	16			3.20
Woodbury Lock 4	37-11	86-38	1940-50	11	1.36	2.16	3.02
Yale	38-03	83-30	1940-45	6	1.44	2.19	3.18
MISSOURI							
Advance 5 ESE	37-06	89-50	1939-54	16			3.31
Advance AP	37-06	89-55	1942-49	8	1.63	2.58	3.79
Bernie	36-40	89-58	1944-54	11			3.31
Bloomfield	36-53	89-56	1945-54	10			3.88
Bragg City	36-17	89-55	1939-43	5			2.69
Cape Girardeau	37-18	89-32	1939-54	16			3.68
Cape Girardeau Missouri State College	37-18	89-32	1946-54	9			3.42
Caruthersville	36-11	89-39	1939-54	16			3.19
Deering	36-12	89-53	1941-54	14			3.47
Dexter	36-47	89-58	1939-54	16			3.74
Jackson	37-23	89-40	1899-54	56			3.78
Malden CAA AP	36-36	89-59	1949-53	5			4.48
Malden CAA AP 4 NW	36-36	89-58	1941-50	10	1.46	2.56	3.43
Marble Hill	37-18	89-58	1897-54*	57			3.50
Morehouse	36-51	89-42	1939-54	16			4.00

*Breaks in Record

Table 2-1, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour (inches)	2-Year 6-Hour (inches)	2-Year 24-Hour (inches)
MISSOURI (continued)							
New Madrid	36-35	89-31	1939-54	16			3.67
Parma	36-37	89-48	1939-54	16			3.55
Perryville	39-43	89-52	1941-54	14			3.13
Sikeston	36-53	89-35	1939-54	16			4.25
Zalma 5 E	37-10	89-59	1939-54	16			3.78
NORTH CAROLINA							
Albemarle	35-21	80-12	1939-54	16			4.06
Altapass	35-54	82-01	1939-54*	15			3.18
Andrews 2 E	35-12	83-48	1939-54	16			3.67
Andrews Dam	35-04	83-56	1939-54	16			2.78
Asheville CAA AP	35-26	82-29	1939-54	16			3.55
Asheville WB City	35-36	82-32	1903-51	49	1.34	1.97	2.93
Ashford 2 S	35-52	81-58	1942-50	9	1.58	2.55	3.48
Badin	35-25	80-07	1940-50	11	1.63	2.37	3.05
Bakersville	36-01	82-10	1939-54	16			2.60
Balsam	35-25	83-05	1943-54	12			3.33
Banner Elk	36-10	81-52	1939-54	16			3.67
Barnardsville	35-46	82-26	1939-54	16			2.77
Beaverdam Creek	35-13	84-06	1939-54	16			3.94
Beetree Dam 2	35-38	82-24	1948-54	7			2.95
Bent Creek	35-30	82-36	1949-54	6			3.24
Big East Fork Pigeon	35-22	82-49	1943-49	7			5.44
Big Pine	35-47	82-49	1939-44	6			3.16
Black Mountain	35-37	82-19	1950-54	5			3.32
Blowing Rock	36-08	81-41	1944-51	8			3.05
Blue Ridge Post Office	35-21	82-22	1939-54*	5			4.67
Blue Ridge Post Office TVA 278	35-21	82-22	1943-50	8	1.37	2.42	3.94
Bluff	36-24	81-13	1949-54	6			4.73
Boone	36-13	81-41	1939-54	16			4.15
Brevard	35-14	82-44	1902-54*	48			4.36
Bridgewater Hydro. Plant	35-44	81-50	1949-54	6			3.79
Bryson City TVA 185	35-26	83-27	1939-49	11			3.20
Bryson City TVA 185A	35-25	83-27	1944-50	7	1.44	2.03	3.30
Cane River	35-55	82-24	1939-54	16			2.62
Canton 1 SW	35-32	82-52	1939-54	16			2.90
Caroleen	35-15	81-47	1939-54	16			4.01
Cartoogechaye Creek	35-09	83-29	1942-54	13			4.00
Cataloochee	35-38	83-05	1945-54	10			2.87
Cataloochee Ranch	35-33	83-06	1939-54	16			3.28
Catawba	35-43	81-05	1946-54	9			2.72
Catawba Lookout Shoals	35-44	81-04	1949-54	6			2.92
Cedar Mountain TVA 283	35-09	82-39	1943-50	8	1.85	3.21	5.21
Celo 2 S	35-50	82-11	1943-54	12			3.94
Celo TVA	35-52	82-12	1939-54	16			3.86
Chambers Mountain TVA 250	35-34	82-54	1940-50	11	1.63	2.27	3.43
Charlotte WB AP	35-14	80-56	1940-50	11	1.68	2.66	3.64
Charlotte WB City	35-13	80-51	1903-51	49	1.67	2.58	3.54
Chatuge Dam	35-01	83-47	1943-54	12			2.83
Cheoah Dam	35-27	83-56	1939-54	16			3.30
Cherokee	35-29	83-19	1941-54*	13			2.66
Clingmans Dome TVA 184	35-33	83-30	1940-50	11	1.61	3.08	4.86
Cody Store	35-55	82-36	1939-54	16			3.10
Concord	35-25	80-35	1939-54	16			3.59
Conover Oxford Shoals	35-50	81-09	1949-54	6			3.49
Cove Creek	35-38	83-00	1939-44	6			2.96
Coweeta	35-04	83-26	1949-54	6			5.46
Coweeta 8	35-02	83-28	1950-54	5			6.95
Coweeta Experiment Station	35-02	83-26	1949-54	6			5.06
Coxcombe Mountain TVA 228	35-49	82-21	1940-50	11	1.15	2.15	3.25
Crossnore	36-01	81-56	1939-54	16			4.58
Cullowhee	35-19	83-11	1939-54	16			3.02
Dalton	36-17	80-24	1940-50	11	1.45	2.45	3.26
Danbury	36-25	80-12	1947-54	8			3.14
Daybook	35-59	82-18	1939-54	16			2.54
Dix Creek	35-27	82-52	1939-54	16			3.54
Dobson	36-23	80-43	1940-50	11	1.58	2.51	3.47
Doggett Gap 2	35-43	82-50	1939-54	16			2.99
Eaglenest Mountain	35-29	83-03	1939-54	16			3.28
Ela	35-27	83-22	1943-54	12			3.11
Elkin	36-15	80-51	1939-54	16			3.84
Elkville	36-04	81-24	1940-50	11	1.40	2.57	4.21
Enka	35-33	82-39	1939-54	16			2.72
Erastus	35-11	83-11	1939-44	6			4.37
Flat Top Mountain	36-02	82-24	1939-54	16			3.08
Fontana Dam	35-27	83-48	1945-54*	9			3.61
Forney Creek	35-30	83-34	1950-54	5			3.59
Franklin	35-13	83-22	1939-54	16			3.86
Franklin 1 SSW	35-11	83-23	1939-54	16			3.76
Franklin TVA	35-11	83-23	1939-54*	7			3.54
Garren Creek	35-31	82-20	1939-54	16			4.55
Gastonia	35-16	81-12	1939-54	16			3.79

*Breaks in Record

Table 2-1, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour (inches)	2-Year 6-Hour (inches)	2-Year 24-Hour (inches)
<u>NORTH CAROLINA</u> (continued)							
Glade Gap TVA 152	35-04	83-38	1940-50	11	1.62	2.59	4.38
Glendale Springs	36-21	81-23	1946-54*	8			3.52
Glenville Dam	35-12	83-09	1941-52	12			4.04
Glenville Power House	35-14	83-08	1942-54	13			3.54
Gloucester Gap TVA 662	35-16	82-50	1945-50	6	1.62	2.62	4.64
Hayesville	35-05	83-50	1939-44	6			2.99
Haywood Gap TVA 190A	35-18	82-55	1943-50	8	1.12	2.35	4.74
Helton	36-33	81-29	1946-54	9			2.06
Hendersonville	35-20	82-28	1898-54	57			4.08
Hendersonville TVA	35-19	82-29	1948-54	7			4.10
Hickory	35-45	81-21	1939-54	16			4.10
Hickory CAA AP	35-44	81-23	1949-54	6			3.65
Highlands	35-03	83-12	1942-54	13			5.84
Highlands 2 S	35-01	83-12	1897-54*	48			5.35
High Point	35-57	80-00	1939-54*	15			4.14
Hiwassee Dam 2	35-09	84-11	1941-54	14			3.71
Hiwassee Dam TVA 125	35-09	84-11	1940-50	11	1.57	2.05	3.33
Horseshoe	35-22	82-35	1939-50	12			3.95
Hot Springs	35-54	82-49	1939-54	16			2.65
Hot Springs 2	35-53	82-50	1941-54	14			2.47
Hyatt Creek	35-12	83-57	1939-54	16			4.10
Idlewild	36-18	81-27	1946-54	9			3.73
Ivy	35-49	82-30	1939-54	16			2.60
Jack Cove	35-24	83-17	1939-54	16			3.01
Jefferson	36-25	81-29	1939-54	16			3.64
Lake Lure	35-26	82-12	1941-50	10	1.42	2.80	4.63
Laurel Mountain TVA 509	35-09	83-05	1943-50	8	1.08	2.39	4.73
Leicester	35-39	82-42	1939-54	16			2.96
Lenoir	35-55	81-32	1897-54*	56			3.71
Letitia	35-03	84-09	1939-54	16			3.54
Lexington	35-49	80-16	1939-54	16			3.85
Lexington 7 N	35-52	80-15	1941-50	10	1.55	2.69	3.75
Little Switzerland TVA 235	35-51	82-06	1943-50	8	1.31	2.41	4.41
Marion	35-41	82-01	1897-54*	55			4.25
Marshall 2 NE	35-48	82-41	1939-54	16			2.42
Mast	36-15	81-48	1942-54	13			2.27
McKinney Gap	35-57	82-28	1939-54	16			3.12
Mocksville	35-53	80-34	1939-54	16			3.49
Monroe 4 SE	34-57	80-31	1939-54	16			3.86
Montreat	35-39	82-19	1939-47*	7			3.97
Mooresville	35-35	80-49	1940-50	11	1.52	2.34	3.10
Morganton	35-45	81-41	1897-54*	56			4.14
Mortimer	35-59	81-47	1948-54	7			3.68
Mt. Airy	36-30	80-36	1897-54	58			3.41
Mt. Gilead 4 W	35-12	80-04	1941-54*	13			3.79
Mt. Holly 4 NE	35-19	80-59	1949-54	6			3.71
Mt. Mitchell	35-46	82-16	1944-50	7	1.21	3.37	6.87
Mt. Mitchell 2 SSW	35-44	82-17	1939-54	16			5.81
Mt. Pisgah TVA 254	35-25	82-45	1943-50	8	1.19	2.89	5.29
Mt. Pleasant	35-24	80-26	1940-50	11	1.56	2.59	3.43
Mt. Sterling	35-43	83-05	1939-54	16			3.08
Murphy	35-05	84-02	1897-54*	54			3.19
Murphy TVA 136	35-05	84-02	1943-50	8	1.19	1.94	3.54
Nantahala	35-11	83-39	1939-54	16			3.62
Nantahala Dam	35-12	83-39	1943-54	12			3.91
Needmore	35-20	83-32	1939-54	16			3.42
Noland Creek	35-29	83-31	1939-49	11			3.30
North Fork	35-42	82-20	1948-54	7			3.58
North Fork 1 TVA 271	35-42	82-20	1940-50	11	1.61	2.65	4.69
North Fork 2	35-40	82-21	1943-54	12			3.39
North Wilkesboro	36-10	81-09	1939-54	16			4.21
North Wilkesboro 12 SE	36-05	81-00	1940-50	11	1.70	2.67	3.96
Old Fort	35-37	82-11	1948-54	7			4.04
Otto	35-05	83-20	1939-54	16			4.09
Owens Gap	35-12	82-58	1939-54	16			5.53
Parker 1 E	36-27	81-40	1939-54	16			2.40
Parker Gap	35-12	82-57	1941-47	7			3.67
Patterson	36-00	81-34	1946-54	9			3.60
Peachtree Creek	35-07	83-54	1939-45	7			3.04
Pink Beds TVA 282	35-21	82-46	1940-50	11	1.44	2.87	5.51
Pisgah Forest 1 N	35-16	82-42	1940-54	15			4.12
Plumtree	36-02	82-00	1939-54	16			3.19
Point Lookout	35-38	82-15	1940-51	12			4.25
Polkton	35-00	80-13	1941-50*	9	1.58	2.51	3.48
Poplar	36-04	82-21	1945-54	10			2.69
Pores Knob 4 SSE	36-03	81-06	1949-54	6			3.16
Proctor	35-28	83-43	1939-54	16			3.50
Quebec TVA 663	35-11	82-54	1946-50	5	1.54	2.71	5.64
Ranger	35-02	84-07	1939-45	7			3.10
Ravensford	35-31	83-18	1939-54	16			3.48

*Breaks in Record

Table 2-1, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour (inches)	2-Year 6-Hour (inches)	2-Year 24-Hour (inches)
NORTH CAROLINA (continued)							
Reese	36-20	81-50	1939-54	16			2.44
Rhodhiss Hydro. Plant	35-46	81-26	1948-54	7			3.86
Rich Mountain Gap TVA 694	36-20	81-43	1941-50*	9	1.10	2.14	3.20
Roaring Gap 1 NE	36-28	80-58	1943-50	8	1.94	3.25	4.93
Rock House	35-00	83-06	1939-54	16			5.35
Rockyface Mountain	35-35	82-48	1939-54	16			3.07
Rosman	35-08	82-50	1939-54	16			5.23
Rural Hall	36-14	80-18	1949-54	6			3.71
Rush Mountain	35-14	82-28	1939-54	16			5.50
Salisbury	35-40	80-29	1897-54	58			3.53
Sams Gap	35-57	82-34	1947-53	7			2.33
Santeetlah Dam	35-23	83-53	1939-54	16			3.65
Santeetlah Gap	35-21	83-54	1941-54	14			3.84
Settle	36-01	80-46	1939-54*	10			3.96
Shelby	35-18	81-32	1939-54	16			3.79
Shelby 2	35-18	81-33	1941-50*	8	1.91	2.61	3.60
Shooting Creek	35-01	83-41	1939-45	7			2.80
Smoky Gap	36-07	81-56	1939-54	16			2.80
Snow Creek	35-58	82-09	1939-54	16			3.13
Sparta	36-30	81-07	1946-54	9			3.48
Spruce Mountain TVA 187	35-37	83-11	1941-50	10	1.32	1.99	3.37
Spruce Pine	35-54	82-04	1943-54	12			3.30
Statesville 2 W	35-47	80-56	1939-54	16			3.54
Stecoah	35-22	83-41	1939-54	16			3.23
Swannanoa	35-36	82-24	1939-54	16			2.92
Tapoco	35-27	83-56	1939-54	16			3.31
Teyahalee Bald TVA 362	35-15	83-48	1941-50	10	1.39	2.60	4.02
Tipton Hill	36-02	82-16	1939-44	6			2.88
Tomotla	35-08	83-59	1939-54	16			3.53
Transou	36-24	81-18	1946-54	9			4.09
Tryon	35-13	82-14	1939-54	16			5.03
Tuckaseigee 2 S	35-14	83-08	1946-54	9			3.54
Twentymile	35-28	83-53	1949-54	6			4.14
Wadesboro	34-57	80-04	1941-54	14			3.90
Waterville	35-46	83-06	1939-54	16			2.66
Wayah Bald TVA 197	35-11	83-34	1944-50	7	1.37	2.41	4.27
Waynesville 1 E	35-29	82-58	1939-54*	15			3.06
Weaverville	35-42	82-34	1946-54	9			2.05
Wilbar 2 NW	36-15	81-18	1946-54	9			3.56
Wilkesboro	36-09	81-09	1948-54	7			3.72
Winston-Salem WB AP	36-07	80-12	1939-54	16			3.79
Yadkinville 8 E	36-08	80-33	1940-50	11	1.34	2.33	3.26
OHIO							
Alma Scioto Trails Forest	39-13	82-58	1940-49	10	1.08	1.54	2.36
Amesville	39-24	81-57	1940-45	6	1.26	1.57	2.32
Athens 5 NW	39-23	82-11	1950-54	5			2.30
Athens 5 NW	39-23	82-11	1940-50	11	1.28	1.91	2.69
Athens	39-20	82-06	1939-54	16			2.78
Barnsville Water Works	39-58	81-10	1948-54	7			2.45
Batavia 4 N	39-07	84-10	1939-50	12			2.80
Beverly Lock 4	39-33	81-39	1939-52	14			2.50
Caldwell 4 W	39-44	81-35	1939-54	16			2.86
Caldwell Highway Department	39-45	81-31	1940-50	11	1.02	1.53	2.24
Carroll Highway Department	39-48	82-42	1940-48	9	1.56	2.25	2.95
Cherry Fork	38-50	83-34	1940-46	7			2.89
Chesapeake Huntington CAA AP	38-25	82-30	1943-54	12			2.80
Chillicothe	39-20	82-58	1939-54	16			2.70
Chilo Dam 34	38-47	84-08	1939-54	16			2.89
Chilo Dam 34	38-47	84-08	1940-50	11	1.31	2.04	2.97
Circleville	39-36	82-57	1897-54	58			2.72
Circleville	39-36	82-57	1940-50	11	1.48	2.20	3.08
Cincinnati Ault Park	39-08	84-25	1943-54	12			2.77
Cincinnati Lunken AP	39-06	84-25	1941-50	10	1.14	2.07	2.68
Cincinnati WB City	39-06	84-30	1903-51	49	1.33	2.17	2.99
Clarington Lock 14	39-45	80-53	1939-54	16			2.56
Columbus Ohio State University	40-00	83-01	1939-54	16			2.56
Columbus WB AP	40-00	82-53	1941-50	10	1.37	1.99	2.62
Columbus WB City	39-58	83-00	1903-51	49	1.21	1.76	2.39
Columbus Valley Cross	39-56	82-57	1939-54	16			2.53
Dayton	39-45	84-10	1939-54	16			2.58
Dayton WB AP	39-54	84-12	1912-51*	38	1.29	1.90	2.27
Demos 4 SE	39-59	80-59	1939-47	9			2.48
Duffy Dam 15	39-38	80-53	1940-50	11	1.49	2.12	2.75
Eaton	39-45	84-38	1939-54*	11			2.88
Eaton Public Library	39-45	84-38	1941-50	10	1.14	1.67	2.65
Enterprise	39-35	82-29	1947-54	8			2.65
Fernbank Dam 37	39-07	84-42	1939-54	16			2.75
Franklin	39-33	84-18	1939-54*	11			3.13
Gallipolis 5 W	38-50	82-17	1939-54	16			2.71
Germantown 3 NE	39-40	84-20	1939-52	14			2.56

*Breaks in Record

Table 2-1, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour (inches)	2-Year 6-Hour (inches)	2-Year 24-Hour (inches)
OHIO (continued)							
Greenfield Water Works	39-21	83-23	1940-50	11	1.24	1.65	2.68
Hamilton	39-24	84-34	1939-54	16			2.72
Hamilton Water Works	39-25	84-33	1939-54	16			2.88
Hamilton Water Works	39-25	84-33	1940-50	11	1.46	2.17	3.03
Higginsport	38-47	83-48	1947-54	8			2.54
Hillsboro	39-12	83-37	1897-54*	50			3.01
Hillsboro Water Works	39-14	83-37	1941-50	10	1.39	1.90	2.70
Ironton	38-32	82-40	1939-54	16			2.89
Jackson	39-03	82-38	1939-54	16			2.89
Jackson Highway Department	39-03	82-39	1940-50*	10	1.58	2.15	2.69
Kings Mills	39-21	84-16	1939-54	16			2.82
Lancaster Power Substation	39-43	82-36	1939-54	16			2.86
Lebanon Highway Department	39-26	84-12	1940-50	11	1.56	2.27	3.18
Logan Highway Department	39-33	82-23	1940-50*	9	1.16	2.03	2.94
London 4 W	39-54	83-31	1939-54	16			2.75
Lowell Lock 3	39-32	81-31	1939-52	14			2.86
Marietta Lock 1	39-25	81-27	1949-54	6			2.86
Marietta Lock 1	39-25	81-27	1940-50	11	1.68	2.08	2.85
Marietta Water Works	39-25	81-27	1939-54*	14			2.51
McArthur	39-15	82-29	1939-44	6			2.92
McArthur Highway Department	39-15	82-28	1940-50	11	1.19	1.88	2.47
McConnelsville Lock 7	39-39	81-51	1939-54	16			2.81
Miamisburg 2 E	39-39	84-15	1939-54	16			2.65
Middletown	39-31	84-24	1939-54	16			3.11
Mt. Healthy Experiment Farm	39-17	84-34	1939-54*	11			2.52
Mt. Sterling Gas Pump Station	39-44	83-16	1945-50	6	1.49	1.94	2.55
New Carlisle	39-56	84-02	1939-54	16			2.40
New Lexington 2 NW	39-44	82-13	1943-54	12			2.78
New Matamoras Dam 16	39-29	81-07	1940-50	11	1.38	1.98	2.73
North Kenova Dam 28	38-25	82-30	1948-54	7			2.83
Norwich	39-58	81-48	1948-54	7			2.63
Oxford Water Works	39-31	84-44	1940-50	11	1.18	1.86	2.91
Peebles 1 S	38-56	83-25	1939-54	16			2.93
Peebles	38-57	83-25	1940-50	11	1.37	1.97	2.63
Philo	39-52	81-54	1897-54	58			2.53
Philo 3 SW	39-50	81-55	1939-54	16			2.40
Piketon	39-04	83-00	1943-54	12			2.74
Portland Dam 21	39-01	81-46	1948-54	7			2.29
Portsmouth	38-43	82-59	1897-54	58			2.92
Portsmouth U. S. Grant Bridge	38-44	83-00	1939-54	16			3.22
Portsmouth Water Works	38-45	82-55	1940-50	11	1.48	1.88	2.80
Racine Dam 23	38-53	81-52	1939-54	16			2.70
Rokeby Lock	39-44	81-55	1940-47	8	1.28	1.56	2.33
St. Martin Ursuline School	39-13	83-53	1940-50	11	1.34	2.39	3.43
Sedalia	39-45	83-29	1948-54	7			2.78
Senecaville Dam	39-55	81-26	1943-54	12			2.27
Sharonville (nr)	39-17	84-26	1940-46	7	1.54	1.83	2.73
Springfield	39-55	83-49	1939-54*	11			2.47
Springfield Water Works	39-57	83-45	1940-50	11	1.32	1.87	2.51
Springfield Elmwood Avenue	39-55	83-47	1939-50	12			2.45
Summerfield 3 NE	39-49	81-17	1948-54	7			2.82
Thornville	39-54	82-25	1948-54	7			3.22
Tipp City	39-58	84-11	1939-54	16			2.47
Washington Court House	39-32	83-25	1939-54	16			2.66
Waverly	39-08	82-59	1897-54*	55			2.58
West Manchester 3 SW	39-53	84-38	1939-54	16			2.68
Wilmington	39-27	83-50	1939-54	16			2.84
Wilmington Power Plant	39-27	83-49	1941-50	10	1.49	1.87	2.64
Woodsfield Highway Department	39-46	81-07	1940-50	11	1.66	1.94	2.62
Xenia 4 SSW	39-38	83-54	1939-54	16			2.62
Xenia Oldtown Water Works	39-44	83-56	1941-50	10	1.42	2.24	2.87
Zanesville CAA AP	39-57	81-54	1948-54	7			2.52
Zanesville Lock 10	39-56	82-00	1939-54*	15			2.30
Zanesville Lock 10	39-56	82-00	1940-50	11	1.34	1.77	2.38
PENNSYLVANIA							
Rices Landing Lock 6	39-57	80-00	1943-54	12			2.52
Waynesburg 1 E	39-54	80-10	1938-50	13	1.44	1.83	2.59
Waynesburg 1 E	39-54	80-10	1948-54	7			2.68
Waynesburg 2 W	39-54	80-13	1939-47	9			2.48
SOUTH CAROLINA							
Caesars Head	35-07	82-38	1939-54	16			5.94
Cherokee	35-05	81-50	1939-46	8			4.00
Cleveland 2 WNW	35-05	82-32	1943-54	12			4.08
Fort Mill 4 NW	35-00	81-00	1949-54	6			2.68
Gaffney 6 E	35-05	81-34	1945-54	10			3.61
Gaston Shoals	35-08	81-36	1939-54	16			3.50
Landrum	35-11	82-11	1939-54	16			4.18
Ninety Nine Islands	35-03	81-32	1949-54	6			3.16
Rainbow Lake	35-06	81-55	1947-54	8			3.85
Sassafras Mountain	35-04	82-47	1949-54	6			3.77

*Breaks in Record

Table 2-1, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour (inches)	2-Year 6-Hour (inches)	2-Year 24-Hour (inches)
<u>TENNESSEE</u>							
Abrams Creek	35-37	83-56	1946-54	9			3.66
Alcoa	35-48	83-58	1939-50	12			2.99
Allardt	36-23	84-53	1949-54	6			2.64
Altamont	35-26	85-43	1940-54	15			3.61
Apalachia Dam TVA 575A	35-10	84-18	1943-50	8	1.57	2.22	3.32
Apalachia Power House	35-11	84-26	1944-54	11			3.52
Arthur	36-33	83-38	1939-54	16			2.93
Ashwood	35-36	87-09	1897-54	58			3.55
Athens Substation	35-29	84-35	1939-54	16			3.41
Beauty Spot TVA 224	36-07	82-20	1940-50	11	1.37	2.07	2.84
Beech Grove	35-38	86-14	1939-54	16			3.78
Belleville	35-15	86-34	1942-54	13			4.20
Belvidere TVA 60	35-08	86-11	1940-50	11	1.49	2.57	3.43
Bethel	35-00	87-03	1939-54	16			3.85
Big Barren TVA 331	36-25	83-40	1940-44	5	1.13	2.07	3.07
Big Lick	35-48	85-01	1950-54	5			3.53
Big Spring	35-24	84-54	1940-54	15			3.74
Big Sycamore TVA 336	36-31	83-22	1941-50	10	1.36	2.39	3.43
Bledsoe State Forest	35-41	85-16	1941-49	9			3.01
Bluff City	36-28	82-16	1897-54	58			2.41
Bolivar 2	35-15	88-59	1897-54*	50			4.13
Bolivar	35-15	88-59	1941-50	10	1.66	2.48	3.91
Bolton	35-19	89-46	1949-54	6			3.56
Boonshill	35-13	86-44	1942-54	13			4.06
Boyd Gap TVA 502	35-02	84-25	1944-50	7	1.56	2.34	4.32
Breedenton 2 NW	35-33	84-48	1940-51	12			3.73
Bristol WB AP	36-29	82-24	1940-50	11	1.61	1.99	2.63
Brownsville	35-36	89-16	1939-54	16			3.89
Brownsville 5 NE	35-38	89-13	1941-50	10	1.56	2.99	4.07
Buchanan TVA 456	36-26	88-14	1940-50	11	1.36	2.34	3.16
Bulls Gap	36-15	83-05	1939-54	16			2.96
Butler TVA 491	36-22	82-02	1943-50	8	1.30	1.83	2.46
Byrdstown 1 W	36-34	85-09	1939-51	13			3.47
Cagle TVA 438	35-28	85-27	1941-50	10	1.54	2.59	3.38
Calderwood Power House	35-30	83-59	1939-54	16			2.94
Camp Creek Bald TVA 218	36-02	82-43	1940-50	11	1.62	2.73	3.68
Carthage	36-16	85-57	1897-54	58			3.55
Carthage Lock 7	36-18	86-02	1949-54	6			3.90
Carthage Lock 7	36-18	86-02	1941-50	10	1.51	2.65	3.33
Carthage Substation	36-15	85-58	1940-54	15			3.65
Cavvia	35-50	88-12	1940-54	15			3.90
Cedar Creek	36-22	82-29	1939-54	16			2.45
Cedar Hill	36-33	87-45	1939-46	8			2.88
Celina	36-40	85-31	1939-49	11			3.68
Center	35-29	84-23	1949-54	6			3.37
Center Hill Dam	36-06	85-49	1946-54	9			3.97
Centerville	35-47	87-28	1945-54	10			4.10
Centerville Substation	35-47	87-28	1940-54	15			3.52
Chapel Hill	35-38	86-42	1939-54	16			3.84
Charleston	35-17	84-45	1939-54	16			3.58
Chattanooga WB AP	35-04	85-18	1903-48	46	1.56	2.64	3.84
Cherokee Dam	36-10	83-30	1942-54	13			3.08
Chickamauga Dam	35-06	85-14	1941-54	14			3.76
Clarkrange	36-11	85-01	1939-54	16			3.46
Clarksville	36-31	87-22	1939-54	16			3.08
Cleveland Substation	35-11	84-49	1940-54	15			3.61
Clifton Junction	35-19	87-55	1940-54	15			3.56
Clinton	36-06	84-06	1897-54	58			3.44
Coker Creek	35-16	84-17	1939-54	16			3.37
Coldwater 1 E	35-05	86-44	1939-54	16			3.56
Colesville	36-27	82-02	1939-54	16			2.65
College Junction	35-31	85-17	1939-54	16			3.40
Collinwood	35-11	87-44	1949-54	6			3.60
Columbia Power House	35-37	87-01	1940-50	11			3.88
Columbia	35-37	87-03	1942-54*	10			3.77
Columbia Substation	35-40	87-02	1939-54	16			4.00
Conasauga 1 N	35-01	84-44	1949-54	6			4.39
Concord	35-54	84-11	1939-54	16			3.56
Cookeville	36-09	85-31	1942-47	6	1.44	2.14	3.32
Cookeville 1 W	36-10	85-30	1939-54*	12			3.35
Copperhill	35-01	84-23	1939-54	16			3.77
Copperhill Substation	35-00	84-23	1939-54	16			3.71
Cosby	35-47	83-13	1941-54	14			3.04
Covington	35-33	89-36	1939-54	16			4.22
Crandull	36-32	81-58	1939-54	16			2.26
Crossville CAA AP	35-57	85-05	1939-54	16			3.53
Crossville Experiment Station	36-01	85-08	1939-54	16			3.28
Cuba Landing TVA 29	35-52	87-53	1940-50	11	1.48	2.35	3.27
Dale Hollow Dam	36-32	85-27	1942-54*	8			3.54
Dale Hollow Dam	36-32	85-27	1944-50	7	1.21	2.25	3.47

*Breaks in Record

Table 2-1, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour (inches)	2-Year 6-Hour (inches)	2-Year 24-Hour (inches)
<u>TENNESSEE</u> (continued)							
Dandridge	36-01	83-25	1939-54	16			2.52
Decatur 1 N	35-32	84-47	1897-54*	55			3.59
Dibrell	35-48	85-48	1940-54	15			3.91
Dickson	36-04	87-24	1939-54	16			3.47
Dickson	36-04	87-24	1940-50	11	1.48	2.67	3.63
Double Springs TVA	35-20	84-38	1949-54	6			3.94
Douglas Dam	35-58	83-32	1942-54	13			2.84
Dover Fire Tower	36-23	87-56	1947-54	8			3.29
Dover 1 NW	36-29	87-50	1898-54*	56			3.64
Dresden	36-17	88-43	1939-54	16			3.56
Dunbar	35-27	88-09	1940-54	15			3.38
Dunlap	35-22	85-24	1939-54	16			4.19
Dyersburg	36-02	89-23	1942-50	9	1.60	2.66	3.52
Dyersburg CAA AP	36-01	89-24	1948-54	7			3.18
Eastland	35-54	85-15	1940-54	15			3.35
Elizabethton	36-21	82-14	1939-54	16			2.45
Elkmont	35-39	83-34	1939-43	5			2.81
Elk Valley 2 W	36-28	84-16	1940-54	15			3.44
Elora	35-01	86-21	1942-54	13			3.47
Embreeville	36-11	82-28	1939-54	16			3.11
Englewood	35-24	84-31	1944-54	11			3.54
Enville	35-24	88-26	1940-54	15			3.43
Erin	36-10	87-45	1939-54	16			3.86
Erwin	36-10	82-25	1939-54	16			2.52
Ethridge	35-19	87-18	1941-54	14			3.65
Etowah	35-20	84-32	1939-47	9			2.82
Falls Creek Park	35-41	85-19	1940-54	15			3.61
Farner	35-08	84-19	1941-54	14			3.86
Fayetteville 1 NE	35-09	86-34	1939-54	16			3.77
Flat Gap	36-25	83-13	1939-54	16			2.76
Fort Loudoun Dam TVA 490	35-48	84-15	1950-54	5			3.05
Fort Loudoun Dam TVA 490	35-48	84-15	1941-50	10	1.50	2.32	3.85
Fountain City	36-02	83-56	1945-53	9			3.06
Frankfort	36-07	84-48	1941-54	14			2.99
Franklin 2 SE	35-53	86-51	1939-54	16			3.49
Friendship School	35-16	85-05	1949-54	6			4.29
Gainesboro	36-22	85-37	1940-54	15			3.67
Gatlinburg 2 SW	35-43	83-31	1939-54	16			2.92
Greeneville Experiment Station	36-04	82-50	1939-54	16			2.96
Greeneville 5 SSW	36-05	82-50	1939-54	16			3.04
Greenfield	36-09	88-48	1942-50*	8	1.79	2.57	3.33
Hales Bar Dam	35-03	85-32	1940-54	15			3.40
Halls	35-51	89-26	1939-49	11			3.35
Hampton	36-17	82-10	1949-54	6			2.30
Harriman TVA 484	35-56	84-33	1941-50	10	1.51	2.31	4.01
Hartford	35-49	83-09	1939-54	16			2.66
Haw Knob TVA 179	35-19	84-02	1940-50	11	1.38	2.33	3.87
Hebbertsburg	36-01	84-46	1939-54	16			3.48
Herbert	35-46	85-15	1940-54	15			2.95
Hickory Grove	35-25	84-23	1949-54	6			3.66
Hillsboro 2 SE	35-23	85-57	1950-54	5			4.10
Hohenwald	35-33	87-33	1939-54	16			3.67
Humboldt	35-50	88-55	1940-50	11	1.48	2.73	3.47
Huntingdon	36-01	88-26	1939-54	16			3.70
Iron City	35-01	87-35	1939-54	16			3.68
Irving College	35-35	85-44	1940-54	15			3.52
Isabella TVA 106	35-02	84-22	1943-50	8	1.60	2.39	4.09
Jacks Creek	35-30	88-30	1944-48	5			4.03
Jackson Experiment Station	35-37	88-50	1939-54	16			4.24
Jackson 2 SE	35-39	88-50	1939-54	16			4.03
Jackson Substation	35-35	88-48	1939-54	16			3.94
Jamestown 1 NE	36-26	84-56	1950-54	5			2.82
Jasper	35-04	85-37	1940-54	15			3.84
Jearoldstown	36-22	82-42	1939-54	16			3.72
Jefferson City Evaporation	36-07	83-30	1950-54	5			2.83
Jefferson City 2 W	36-06	83-32	1940-50	11	1.27	1.95	3.19
Johnson City ETSC	36-18	82-22	1949-54	6			2.78
Johnson City Substation	36-20	82-20	1948-54	7			2.39
Johnson City Veterans Hospital	36-19	82-23	1939-54	16			2.64
Johnsonville Steam Plant	36-02	87-59	1939-54	16			3.53
Joppa	36-14	83-37	1939-54	16			2.60
Kenton	36-12	89-01	1940-54	15			3.67
Kingsport 3 SE	36-31	82-30	1939-54	16			2.59
Kingston	35-52	84-32	1939-54	16			3.48
Kingston Springs 2 NE	36-07	87-08	1941-54*	13			3.95
Kittie	35-27	84-10	1939-54	16			3.10
Knoxville Garage	35-59	83-55	1946-53	8			2.98
Knoxville WB AP	35-49	83-59	1903-51	49	1.48	2.31	3.27
LaFollette	36-22	84-08	1939-54	16			2.28
Lake City	36-14	84-10	1940-50	11			3.23

*Breaks in Record

Table 2-1, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour (inches)	2-Year 6-Hour (inches)	2-Year 24-Hour (inches)
TENNESSEE (continued)							
Lantana TVA 507	35-53	85-05	1941-50	10	1.55	2.18	3.37
Lawrenceburg	35-14	87-19	1949-54	6			4.04
Leapwood	35-16	88-27	1940-54	15			3.80
Lebanon	36-13	86-16	1944-50	7	1.40	2.73	4.73
Lebanon TVA	36-12	86-17	1940-54	15			3.71
Lewisburg Experiment Station	35-27	86-48	1939-54	16			3.82
Lewisburg Experiment Station	35-27	86-48	1940-50	11	1.46	2.57	3.68
Lewisburg Substation	35-28	86-48	1940-54	15			3.48
Lewis Chapel	35-20	85-18	1939-54	16			4.14
Liberty	36-02	85-57	1939-45	7			3.76
Lick Creek TVA 214	36-19	82-48	1940-50	11	1.31	2.13	3.08
Limestone Cove	36-11	82-16	1944-54	11			2.68
Limestone TVA	36-13	82-38	1939-54	16			2.59
Linden	35-37	87-50	1942-51	10			3.86
Little Chucky	36-07	82-59	1939-54	16			2.68
Little War Gap	36-30	83-01	1939-54	16			2.99
Litton	35-44	85-02	1939-54	16			3.31
Livingston	36-22	85-18	1940-50	11	1.56	2.28	3.75
Lock A Cumberland River	36-19	87-12	1939-46	8			3.46
Lock B Cumberland River	36-25	87-17	1940-54	15			3.16
Lock C Cumberland River	36-26	87-34	1940-54	15			2.89
Lock 2 Cumberland River	36-15	86-42	1941-54	14			3.60
Lock 3 Cumberland River	36-17	86-39	1939-54	16			3.50
Lock 4 Cumberland River	36-19	86-28	1940-54	15			3.29
Lock 5 Cumberland River	36-19	86-15	1939-54	16			3.80
Lock 6 Cumberland River	36-21	86-09	1939-54	16			3.58
Lock 8 Cumberland River	36-17	85-55	1940-51	12			3.43
Lockhart Tower	35-16	85-32	1939-54	16			3.94
Loretto	35-05	87-26	1939-54	16			3.84
Loudon 1 E	35-44	84-20	1939-54	16			3.34
Lynchburg	35-16	86-24	1942-54	13			4.07
Lynnville 4 SW	35-20	87-03	1939-54	16			4.02
Madison College	36-16	86-41	1939-46	8			3.61
Manchester	35-28	86-06	1942-50	9	1.26	2.06	2.96
Manchester TVA	35-29	86-05	1950-54	5			3.94
Martin Junior College	36-19	88-51	1939-54	16			3.50
Martin Substation	36-19	88-51	1939-54	16			3.95
Mason	35-24	89-31	1941-50	10	1.80	3.21	4.13
Maymead	36-25	81-49	1945-50	6			2.21
McEwen 5 S	36-02	87-39	1942-54	13			3.71
McGhee	35-37	84-13	1939-54	16			3.26
McKenzie	36-09	88-31	1940-54*	12			3.18
McMinnville	35-41	85-48	1939-54	16			3.92
McMinnville TVA	35-42	85-44	1942-54	13			3.71
Milan	35-55	88-48	1939-54	16			3.80
Mint	35-38	84-01	1939-54	16			3.14
Monsanto	35-40	87-07	1948-54	7			3.65
Monteagle	35-15	85-50	1940-54	15			3.62
Monterey	36-09	85-16	1939-52	14			3.84
Morgan Springs	35-32	85-03	1939-54	16			3.90
Morgantown	35-20	85-01	1940-54	15			3.98
Morristown	36-14	83-20	1939-54	16			2.91
Moscow	35-05	89-24	1939-54	16			3.95
Mountain City	36-28	81-49	1939-54	16			2.66
Mount Pleasant	35-32	87-12	1940-54	15			3.95
Murfreesboro	35-51	86-24	1939-54	16			3.71
Murfreesboro	35-51	86-24	1940-50	11	1.42	2.72	3.86
Murfreesboro Substation	35-50	86-23	1940-54	15			3.77
Nashville	36-10	86-47	1942-54	13			3.74
Nashville WB AP	36-07	86-41	1905-51	47	1.53	2.44	3.51
Neptune 3 S	36-19	87-13	1947-54	8			3.67
Newburn	36-07	89-16	1939-54	16			3.49
New Bethel	35-19	84-33	1949-54	6			3.50
Newport	35-58	83-12	1897-54	58			2.51
New River	36-23	84-34	1939-52	14			4.02
Nolichucky Dam	36-04	82-52	1948-54	7			2.46
Norris	36-11	84-04	1939-48	10			3.22
Norris Dam	36-13	84-05	1939-54	16			3.24
Norris Evaporation Station TVA 322	36-12	84-05	1941-50	10	1.36	2.21	3.62
Oak Grove TVA 519	35-40	88-21	1943-50	8	1.51	2.93	4.02
Oak Ridge	35-56	84-19	1947-54	8			3.25
Oak Ridge WB	36-01	84-14	1948-54	7			3.42
Ocoee Power House 2	35-06	84-33	1939-54	16			3.34
Odomville	36-15	82-00	1939-54	16			2.29
Ooltewah	35-05	85-04	1940-54	15			3.95
Ovilla	35-19	87-34	1948-54	7			3.48
Palmetto	35-29	86-35	1939-54	16			4.24
Paris	36-18	88-18	1939-54	16			3.62
Parksville	35-06	84-39	1939-54	16			3.62
Paulette	36-12	83-53	1941-54	14			3.12

*Breaks in Record

Table 2-1, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour (inches)	2-Year 6-Hour (inches)	2-Year 24-Hour (inches)
TENNESSEE (continued)							
Perryville	35-38	88-02	1939-54	16			3.60
Petersburg	35-19	86-39	1939-54	16			3.91
Petros	36-06	84-26	1939-54	16			3.71
Pickwick Landing Dam	35-04	88-15	1939-54	16			3.56
Pickwick 2 (nr) TVA 39	35-03	88-15	1940-45	6	1.51	2.49	3.73
Pigeon Forge	35-47	83-33	1941-54	14			2.40
Pilot Mountain	36-12	84-40	1939-54	16			3.02
Pinewood	35-54	87-28	1939-54	16			3.42
Pleasantville	35-42	87-44	1940-54	15			3.79
Pt. Park Lookout Mountain	35-00	85-22	1949-54	6			4.03
Porter Lake	35-37	84-50	1941-54	14			3.32
Portland	36-35	86-30	1944-50	7	1.63	2.54	3.39
Portland (nr)	36-33	86-26	1942-47	6			2.94
Providence	35-51	83-47	1939-54	16			3.06
Pulaski	35-12	87-01	1939-54	16			3.83
Reagan TVA 31	35-30	88-20	1940-50	11	1.34	2.57	3.62
Red Boiling Springs 4 NNW	36-34	85-53	1945-54	10			3.89
Riddles Store	35-37	84-33	1940-54	15			3.50
Ritta	36-03	83-52	1945-54	10			3.06
Roan High Knob TVA 231	36-06	82-08	1940-50	11	1.25	1.86	3.25
Rock Island 2 NW	35-48	85-38	1939-54*	15			3.74
Rock Island 2 NW	35-48	85-38	1940-50	11	1.56	2.46	3.64
Rockwood	35-52	84-41	1941-54	14			4.13
Rocky River	35-39	85-34	1940-54	15			3.43
Roddy TVA 157	35-46	84-46	1943-50	8	1.24	2.39	4.24
Rogersville 1 S	36-24	83-01	1939-54	16			2.62
Rugby	36-22	84-42	1939-48	10			3.72
Samburg Wildlife Refuge	36-23	89-21	1942-54	13			3.53
Samburg Wildlife Refuge	36-23	89-21	1942-50	9	1.92	2.78	3.94
Sassafras Knob TVA 101	35-06	84-25	1943-50	8	1.80	2.60	3.80
Savannah	35-14	88-15	1897-54	58			4.07
Savannah TVA 34A	35-13	88-14	1945-50	6	1.79	2.79	4.40
Selmer	35-10	88-37	1939-54	16			3.91
Sevierville	35-53	83-35	1944-54	11			2.99
Sewanee	35-12	85-55	1939-54*	15			3.91
Shady Grove TVA 380	35-43	87-17	1940-50	11	1.45	2.67	3.88
Shelbyville	35-29	86-28	1940-54	15			3.76
Shiloh	35-09	88-19	1939-54	16			4.02
Signal Mountain	35-07	85-21	1949-54	6			4.22
Smithville CAA AP	35-55	85-49	1941-48	8			3.43
Smyrna 4 NE	36-00	86-28	1943-54	13			3.46
Sneedville (nr)	36-27	83-14	1939-44	6			2.70
South Holston Dam	36-31	82-05	1948-54	7			2.57
South Nashville	36-10	86-43	1940-54	15			3.73
Sparta 2 NW	35-57	85-30	1941-54	14			3.14
Sparta TVA	35-55	85-28	1940-54	15			3.43
Springfield Experiment Station	36-26	86-51	1944-54	11			3.26
Springfield Experiment Station	36-26	86-51	1940-50	11	1.45	2.45	3.18
Springville	36-17	88-09	1939-54	16			3.42
Stanley Knobs TVA 516	36-31	82-54	1943-50	8	1.46	1.79	2.50
Stone Mountain	36-12	82-14	1939-54	16			2.68
Strawberry Plains	36-04	83-41	1939-54	16			2.64
Sugar Hill TVA 505	35-33	87-49	1941-50	10	2.09	3.27	4.45
Summitville TVA 443	35-33	85-59	1942-50	9	1.44	2.49	3.80
Sunbright 2 SW	36-14	84-42	1940-50	11	1.58	2.12	3.26
Taylors	36-00	85-23	1940-54	15			3.70
Tazewell 2 SE	36-25	83-33	1939-54	16			3.07
Tellico Plains	35-22	84-18	1939-54	16			3.23
Tellico Ranger Station	35-21	84-14	1947-54	8			3.17
Thorn Hill	36-22	83-25	1947-54	8			2.96
Trade	36-21	81-44	1943-52	10			2.65
Tri City AP	36-29	82-24	1939-48	10			2.53
Trousdale	35-40	85-56	1940-54	15			3.70
Tullahoma	35-22	86-12	1939-54	16			3.67
Turley	36-22	84-16	1942-54	13			2.98
Turtletown	35-07	84-21	1939-54	16			3.55
Tusculum College	36-10	82-46	1941-53	13			3.26
Union City	36-25	89-04	1939-54	16			3.32
Union City 2 SE	36-25	89-03	1942-50	9	1.68	2.64	3.25
U. S. Cotton Field Station	35-53	83-56	1944-54	11			3.22
University of Tennessee Farm	35-57	83-57	1949-54	6			3.26
University of Tennessee Lysimeter Plot	35-57	83-57	1944-54	11			3.58
Vasper	36-16	84-11	1939-54	16			2.93
Victory TVA 40	35-06	87-51	1940-50	11	1.61	2.80	3.42
Walkers Ford	36-20	83-42	1941-54	14			3.18
Walland	35-46	83-51	1941-51	11			3.06
Watauga Dam	36-20	82-07	1947-54	8			2.52
Watts Bar Dam TVA 421	35-37	84-47	1939-54	16			3.71
Watts Bar Dam TVA 421	35-37	84-47	1940-44	5	1.50	2.25	3.49
Waynesboro	35-18	87-48	1939-54	16			3.73

*Breaks in Record

Table 2-1, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour (inches)	2-Year 6-Hour (inches)	2-Year 24-Hour (inches)
TENNESSEE (continued)							
Waynesboro 5 NW	35-21	87-50	1945-53	9			3.79
Well Spring	36-26	83-59	1939-54	16			2.99
Westbourne	36-29	84-02	1940-52	13			3.32
White Hollow TVA 327	36-22	83-54	1940-50	11	1.35	1.78	2.89
White Pine	36-07	83-17	1939-54	16			2.82
Whittle Springs	36-01	83-55	1945-53	9			3.22
Wildersville	35-47	88-22	1939-54	16			3.85
Winchester Substation	35-14	86-06	1949-54	6			4.03
Wolf Creek	35-55	82-56	1939-54	16			2.74
Worsham	36-20	86-41	1939-44	6			3.26
VIRGINIA							
Abingdon	36-42	82-00	1949-54*	5			2.76
Big Knob TVA 314	36-40	82-30	1940-50	11	.96	1.51	2.45
Blacksburg 2	37-14	80-25	1897-54	58			2.72
Bristol	36-36	82-10	1941-54	14			2.48
Bristol TVA	36-37	82-10	1948-54	7			2.28
Burkes Garden	37-06	81-20	1897-54	58			2.66
Byllesby	36-48	80-55	1948-54	7			2.60
Catawba Sanitarium	37-23	80-05	1911-54	44			3.36
Cleveland	36-57	82-09	1939-54	16			3.25
Clinchport	36-40	82-45	1939-54	16			2.68
Copper Hill	37-06	80-07	1948-54	7			4.45
Covington	37-48	80-00	1949-54	6			3.08
Damascus	36-38	81-48	1939-54	16			2.77
Dante	36-59	82-18	1939-54	16			2.71
Dante	36-59	82-18	1941-50*	9	1.33	2.22	2.90
Darwin	37-05	82-30	1950-54	5			2.34
Davenport	37-07	82-06	1949-54	6			2.40
Dunbar	36-58	82-45	1939-54	16			2.63
Dungannon	36-50	82-26	1939-54	16			2.64
Emory	36-46	81-50	1939-51*	12			2.76
Floyd	36-55	80-19	1939-54	16			4.24
Floyd 2	36-55	80-18	1950-54	5			3.76
Galax 3 S	36-38	80-56	1949-54	6			2.63
Glen Lyn	37-22	80-52	1939-54	16			2.56
Groseclose	36-52	81-20	1942-54*	11			2.69
Grundy	37-17	82-06	1949-54	6			2.64
Haysi	37-13	82-17	1949-54	6			2.92
High Knob TVA 344	36-54	82-38	1941-50	10	1.68	2.32	2.90
Hillsville 1 NW	36-46	80-45	1948-54	7			3.11
Holston	36-50	82-05	1939-54	16			2.41
Honaker 3 NE	37-03	82-02	1939-54	16			2.88
Honaker TVA 614	37-01	81-59	1943-50*	7	1.40	2.00	2.44
Hurley	37-26	82-02	1941-50	10	1.42	2.01	2.58
Independence	36-36	81-07	1949-54	6			2.68
Indian Valley	36-54	80-34	1941-50	10	1.54	2.21	2.81
Ivanhoe	36-50	80-58	1939-48*	9			2.60
Jewell Ridge	37-11	81-47	1939-54	16			2.72
Jonesville	36-41	83-06	1939-49	11			2.92
Jonesville 2 SSE	36-40	83-06	1947-54	8			2.75
Jordan Mines	37-41	80-05	1940-50	11	1.40	1.79	2.56
Loves Mill	36-45	81-41	1939-54	16			2.53
Marion	36-51	81-31	1939-54	16			2.34
Mendota	36-42	82-18	1905-54	50			2.50
Mountain Lake	37-24	80-30	1939-47	9			3.02
New Castle	37-30	80-06	1949-54	6			2.71
Newport 2 NW	37-19	80-31	1948-54	7			2.64
North Bristol Substation	36-37	82-11	1948-54	7			2.57
Olinger	36-49	82-52	1939-54	16			2.81
Pennington Gap 1 W	36-45	83-03	1939-54	16			2.66
Pilot	37-03	80-22	1949-54	6			2.77
Pinnacles Meadows Dam	36-41	80-25	1939-49	11			4.42
Pulaski	37-02	80-47	1949-54	6			2.84
Pulaski CAA AP	37-05	80-47	1950-54	5			2.40
Pulaski CAA AP	37-05	80-47	1942-50	9	1.28	2.14	2.66
Radford	37-05	80-35	1939-54	16			2.38
Rocky Knob	36-51	80-22	1949-54	6			3.40
Rose Hill	36-40	83-22	1939-54	16			3.06
Saltville	36-53	81-46	1941-54	14			2.42
Saltville 1 N	36-53	81-46	1949-54	6			2.66
Slate	37-16	81-56	1948-54	7			1.98
Speedwell	36-49	81-10	1948-54	7			2.39
Spring Creek TVA 355	37-00	81-39	1940-50	11	1.27	1.86	2.65
Stuart	36-38	80-16	1939-54*	15			3.66
Sugar Grove	36-46	81-25	1939-54	16			2.58
Swords Creek	37-02	81-55	1939-54	16			2.52
Tazewell	37-07	81-31	1939-54	16			2.64
Trout Dale	36-42	81-26	1940-50	11	1.37	2.34	3.34
Wallace	36-39	82-08	1939-54*	14			2.57
White Gate	37-12	80-50	1941-50	10	1.25	1.84	2.56

*Breaks in Record

Table 2-1, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour (inches)	2-Year 6-Hour (inches)	2-Year 24-Hour (inches)
VIRGINIA (continued)							
Wytheville	36-58	81-06	1939-54*	14			2.69
Wytheville WB City	36-58	81-06	1903-40	38	1.31	1.97	2.67
WEST VIRGINIA							
Aberdeen	39-04	80-18	1939-54	16			3.11
Alderson	37-43	80-38	1945-54*	8			2.27
Alexander	38-47	80-13	1949-54	6			2.45
Arnold	38-54	80-31	1948-54	7			2.60
Athens Concord College	37-25	81-01	1944-54	11			2.22
Beckley Veterans Administration Hospital	37-47	81-11	1939-54*	12			2.60
Belleville Dam 20	39-09	81-45	1939-54	16			2.66
Benson	39-09	80-33	1939-54	16			3.04
Bens Run	39-27	81-07	1939-54	16			2.82
Berlin	39-02	80-21	1948-54	7			4.25
Big Skin Creek	38-58	80-26	1940-54	15			2.71
Birch River 6 SSW	38-25	80-47	1950-54	5			2.30
Bluefield 1	37-16	81-13	1899-54*	53			2.54
Bluefield 2	37-16	81-13	1949-54	6			3.30
Blue Stone Dam	37-39	80-53	1947-54	8			2.12
Branchland	38-13	82-12	1949-54	6			3.06
Brownsville	39-00	80-29	1939-54	16			2.66
Brushy Fork	39-13	80-13	1948-52	5			2.29
Buckhannon	39-00	80-16	1939-54	16			3.01
Burnsville	38-52	80-40	1950-54	5			2.69
Cabwaylingo State Forest	37-59	82-21	1949-54	6			3.37
Cairo 3 S	39-10	81-10	1939-54	16			2.66
Camden-on-Gauley	38-22	80-36	1939-54	16			2.71
Charleston WB AP	38-22	81-36	1943-54	12			2.30
Charleston 1	38-21	81-39	1939-54	16			2.64
Charleston 3	38-21	81-38	1942-50	9	1.37	1.71	2.43
Clarksburg 1	39-16	80-21	1939-54	16			2.50
Clarksburg 1	39-16	80-21	1940-50	11	1.20	1.78	2.53
Clarksburg 2	39-17	80-20	1948-53	6			2.41
Clay 1	38-27	81-05	1939-54*	13			3.31
Clay 2	38-28	81-04	1943-50	8	1.34	2.01	2.60
Coburn Creek	39-15	80-26	1948-53	6			2.98
Cranberry Glades	38-11	80-16	1946-54	9			2.65
Crawford	38-52	80-26	1939-54	16			2.84
Creston	38-57	81-16	1939-54	16			2.69
Davisson Run	39-16	80-24	1948-54	7			2.78
Duck Creek	39-09	80-24	1949-54	6			2.88
East Rainelle	37-58	80-45	1949-54	6			2.84
Elizabeth Dam 3	39-07	81-24	1939-46	8			2.41
Elk	39-11	80-14	1939-53	15			2.57
Fairmont	39-28	80-08	1939-54	16			2.39
Fink Run	39-00	80-16	1948-54	7			3.26
Flat Top	37-35	81-07	1939-54	16			2.54
Flat Top	37-35	81-06	1941-50*	9	1.46	1.98	2.87
Freemansburg	39-06	80-31	1940-50	11	1.50	2.57	3.38
Gary	37-22	81-33	1939-54	16			2.33
Gary	37-22	81-33	1941-50	10	1.16	1.65	2.70
Glenville 1	38-56	80-51	1939-54	16			3.04
Grafton 1 NE	39-21	80-00	1899-54*	50			2.60
Grantsville 2 NW	38-56	81-06	1948-54	7			2.34
Griffithsville	38-14	81-58	1940-50	11	1.67	2.30	3.10
Hackers Creek	39-08	80-26	1939-54	16			3.02
Hall	39-03	80-07	1939-53	15			2.74
Hall	39-03	80-07	1941-50	10	1.56	2.11	2.91
Hamlin	38-17	82-06	1947-54	8			2.90
Harrison County AP	39-17	80-14	1940-48	9			2.60
Hastings	39-33	80-40	1939-54	16			2.50
Hinton 1	37-40	80-53	1939-48	10			1.99
Hogsett Gallipolis Dam	38-41	82-11	1939-54	16			2.57
Horner	38-59	80-22	1939-54	16			2.70
Hoult Lock 15	39-30	80-08	1939-54	16			2.63
Hundred	39-41	80-27	1940-50	11	1.36	1.85	2.59
Huntington 1	38-25	82-22	1939-54	16			3.00
Huntington 2	38-25	82-26	1940-50	11	1.38	2.08	2.78
Huntington WB City	38-25	82-27	1949-54	6			2.65
Iaeger	37-28	81-49	1948-53	6			2.45
Ireland	38-49	80-28	1939-54	16			2.83
Isaacs Creek	39-12	80-30	1948-54	7			2.77
Jane Lew	39-06	80-25	1939-54	16			3.14
Jesse Run	39-06	80-20	1949-54	6			3.34
Kayford	38-01	81-27	1939-52	14			2.46
Kermit	37-50	82-24	1949-54	6			2.70
Kumbrabow State Forest	38-35	80-05	1940-54	15			2.62
Lake Floyd	39-17	80-30	1948-53	6			3.18
Lakin	38-58	82-05	1941-50	10	1.60	1.99	2.78
LeSage - Greenbottom	38-33	82-17	1939-46	8			2.78
Lewisburg	37-48	80-26	1900-54*	50			2.60

*Breaks in Record

Table 2-1, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour (inches)	2-Year 6-Hour (inches)	2-Year 24-Hour (inches)
WEST VIRGINIA (continued)							
Lindside	37-27	80-40	1949-54	6			2.34
Little Skin Creek	38-58	80-25	1948-54*	6			2.95
Liverpool	38-54	81-32	1940-50	11	1.43	1.81	2.42
Lockney	38-51	80-58	1944-50	7	1.40	1.81	2.35
Logan	37-51	82-00	1902-54*	42			2.67
Logan	37-51	82-00	1941-50	10	1.36	1.83	2.31
London Locks	38-12	81-22	1939-54	16			2.63
MacFarlan	39-05	81-12	1941-50	10	1.76	2.38	2.94
Madison	38-03	81-49	1939-54*	15			2.98
Man	37-44	81-53	1948-54	7			2.68
Mannington 1 N	39-33	80-21	1948-54	7			2.66
Mannington 1 W	39-32	80-22	1939-54	16			2.78
Marlington	38-13	80-05	1899-52*	37			2.62
Marlington	38-13	80-05	1944-50	7	1.21	1.71	2.39
McMechen Dam 13	39-59	80-44	1939-54	16			2.48
Middlebourne 2 ESE	39-29	80-52	1941-54	14			2.96
Midvale	38-57	80-05	1939-53	15			2.88
Mount Clare	39-13	80-20	1939-54	16			2.57
Naoma 1 SE	37-52	81-30	1950-54	5			2.68
Naoma 1 E	37-52	81-30	1941-50	10	1.25	1.70	2.42
New Martinsville	39-39	80-52	1899-54	56			2.50
Oak Hill	37-58	81-09	1943-54	12			2.93
Oak Hill	37-58	81-09	1942-50	9	1.49	1.99	2.63
Parkersburg CAA AP	39-21	81-26	1948-54	7			2.84
Parkersburg WB City	39-16	81-34	1903-51	49	1.23	1.90	2.52
Philippi	39-09	80-02	1939-54	16			2.57
Pickens 1	38-40	80-13	1939-54*	14			3.18
Pineville	37-35	81-32	1942-54*	12			2.72
Point Pleasant	38-51	82-08	1939-53	15			2.70
Polk Creek	39-03	80-34	1948-54	7			3.25
Princeton	37-22	81-05	1940-54	15			2.33
Rainelle	37-58	80-47	1939-54	16			2.60
Ravenswood Dam 22	38-57	81-46	1939-54	16			2.54
Renick 2 S	37-58	80-21	1949-54	6			2.78
Richwood 2 N	38-15	80-32	1939-54	16			2.93
Right Fork Stonecoal Creek	38-57	80-20	1948-54	7			3.12
Ripley	38-49	81-43	1944-54	11			2.51
Roanoke	38-56	80-29	1939-54	16			2.53
Rockford	39-08	80-20	1939-54	16			2.95
Rohrbough	38-59	80-30	1948-54	7			2.89
Ryan	38-39	81-28	1939-44	6			3.07
St. Marys	39-23	81-12	1939-54*	15			3.13
Salem	39-17	80-34	1939-53	15			2.90
Sand Fork	38-55	80-26	1947-54	8			2.52
Shady Springs 2 ESE	37-42	81-03	1949-53	5			2.96
Shinnston	39-23	80-18	1939-53	15			2.80
Smithburg	39-17	80-43	1940-50	11	1.34	2.48	3.06
Spencer	38-48	81-21	1900-54*	51			2.66
Sugarcamp Run	38-50	80-25	1948-54	7			2.62
Summersville 2	38-17	80-51	1941-54	14			2.68
Summersville 2	38-17	80-51	1940-50	11	1.21	1.92	2.60
Sutton 2	38-40	80-43	1950-54	5			2.64
Sutton 3 SE	38-39	80-40	1945-50	6	1.40	2.47	3.00
Sutton 3 SE	38-39	80-40	1939-50	12			3.26
Sycamore Creek	39-14	80-25	1948-54	7			3.13
Tribble	38-41	81-50	1942-50	9	1.22	1.84	2.73
Tygart Dam	39-19	80-02	1940-50	11	1.04	1.73	2.63
Union	37-36	80-32	1939-54	16			2.39
Union	37-36	80-32	1940-50	11	1.00	1.50	2.14
Upper Davisson Run	39-16	80-26	1947-54	8			2.69
Upper Sycamore Creek	39-14	80-27	1948-53*	5			2.90
Valley Chapel	39-06	80-24	1939-54	16			3.10
Valley Head	38-33	80-02	1939-54	16			2.46
Valley Head	38-33	80-02	1940-50	11	1.38	2.00	2.63
Vandalia	38-56	80-24	1939-54	16			2.54
Vienna-Briscoe	39-21	81-32	1948-54	7			2.83
Washington Dam 19	39-15	81-42	1939-54	16			2.58
Wayne	38-13	82-26	1939-48	10			2.76
Webster Springs	38-29	80-25	1943-54	12			2.98
Webster Springs	38-29	80-25	1943-50	8	1.26	2.27	2.97
West Milford	39-12	80-24	1939-54	16			2.70
Weston	39-02	80-28	1939-54	16			3.25
White Sulphur Springs	37-48	80-18	1939-54	16			2.16
Williamson	37-40	82-17	1939-54	16			2.87
Winfield Locks	38-32	81-52	1939-54	16			2.68

*Breaks in Record

Table 2-2. Station Data (100-Year 1-, 6-, and 24-Hour)

STATION	Lat.	Long.	Period of Record	Length of Record (years)	100-Year 1-Hour (inches)	100-Year 6-Hour (inches)	100-Year 24-Hour (inches)
ILLINOIS							
Cairo WB City	37-00	89-10	1903-51	49	3.08	5.52	7.29
Charleston	39-29	88-10	1897-54*	57			6.16
Chester	37-54	89-49	1897-54*	57			8.18
Decatur	39-51	88-58	1897-54	58			5.37
Greenville	38-53	89-24	1897-54	58			6.29
Mascoutah	38-29	89-48	1897-53	57			8.13
McLeansboro	38-05	88-32	1897-54	58			7.40
Mt. Carmel 3 N	38-27	87-46	1898-54*	56			7.24
New Burnside	37-35	88-46	1897-54	58			7.18
Olney Radio Station	38-43	88-04	1897-53	57			6.65
Springfield WB City	39-48	89-39	1903-50	48	3.06	4.69	6.38
INDIANA							
Evansville WB AP	38-02	87-32	1903-51	49	2.80	4.60	6.48
Indianapolis WB City	39-46	86-10	1903-51	49	3.10	5.08	5.50
Jeffersonville	38-16	85-45	1897-54	58			6.04
Madison	38-44	85-23	1897-54	58			5.67
Moores Hill	39-07	85-06	1902-54	53			5.34
Mount Vernon	37-56	87-54	1897-54	58			7.00
Paoli	38-34	86-28	1898-54	57			6.58
Princeton 1 W	38-21	87-35	1897-54	58			6.25
Salem	38-37	86-06	1897-54	58			5.86
Scottsburg	38-42	85-47	1897-54	58			6.42
Terre Haute WB AP	39-27	87-18	1912-51	40	3.27	5.15	6.49
KENTUCKY							
Anchorage	38-16	85-33	1901-54	54			6.82
Berea College	37-34	84-18	1901-54	54			7.11
Falmouth	38-40	84-20	1897-54	58			6.48
Hopkinsville	36-51	87-30	1897-54	58			7.41
Leitchfield	37-29	86-18	1897-54	58			6.15
Lexington WB AP	38-02	84-36	1903-53*	40	3.21	5.46	7.31
Louisville WB City	38-15	85-46	1903-51	49	2.48	3.72	6.41
Mount Sterling	38-04	83-56	1897-54*	56			5.82
Owensboro 2 W	37-46	87-09	1897-54	58			6.45
Shelbyville 2 W	38-13	85-16	1897-54	58			6.07
Williamsburg	36-44	84-10	1897-54	58			5.86
MISSOURI							
Jackson	37-23	89-40	1899-54	56			7.67
Marble Hill	37-18	89-58	1897-54*	57			7.70
NORTH CAROLINA							
Asheville WB City	35-36	82-32	1903-51	49	2.67	4.49	7.18
Brevard	35-14	82-44	1902-54*	48			9.29
Charlotte WB City	35-13	80-51	1903-51	49	3.14	4.93	6.90
Hendersonville	35-20	82-28	1898-54	57			9.96
Highlands 2 S	35-01	83-12	1897-54*	48			10.54
Lenoir	35-55	81-32	1897-54*	56			7.68
Marion	35-41	82-01	1897-54*	55			10.41
Morganton	35-45	81-41	1897-54*	56			8.69
Mt. Airy	36-30	80-36	1897-54	58			8.33
Murphy	35-05	84-02	1897-54*	54			6.99
Salisbury	35-40	80-29	1897-54	58			7.66
OHIO							
Circleville	39-36	82-57	1897-54	58			5.82
Cincinnati WB City	39-06	84-30	1903-51	49	2.63	4.19	5.65
Columbus WB City	39-58	83-00	1903-51	49	2.63	3.48	4.50
Dayton WB AP	39-54	84-12	1912-54*	38	2.61	3.78	5.11
Hillsboro	39-12	83-37	1897-54*	50			6.08
Philo	39-52	81-54	1897-54	58			4.83
Portsmouth	38-43	82-59	1897-54	58			5.49
Waverly	39-08	82-59	1897-54*	55			4.49
TENNESSEE							
Ashwood	35-36	87-09	1897-54	58			6.78
Bluff City	36-28	82-16	1897-54	58			3.83
Bolivar 2	35-15	88-59	1897-54*	50			8.38
Carthage	36-16	85-57	1897-54	58			6.46
Chattanooga WB AP	35-04	85-18	1903-48	46	2.90	4.72	6.80
Clinton	36-06	84-06	1897-54	58			7.09
Decatur 1 N	35-32	84-47	1897-54*	55			6.93
Dover 1 NW	36-29	87-50	1898-54*	56			6.84
Knoxville WB AP	35-49	83-59	1903-51	49	3.36	4.92	6.18
Nashville WB AP	36-07	86-41	1905-51	47	2.86	4.54	5.97
Newport	35-58	83-12	1897-54	58			4.30
Savannah	35-14	88-15	1897-54	58			8.14

*Breaks in Record

Table 2-2, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	100-Year 1-Hour (inches)	100-Year 6-Hour (inches)	100-Year 24-Hour (inches)
VIRGINIA							
Blacksburg 2	37-14	80-25	1897-54	58			5.09
Burkes Garden	37-06	81-20	1897-54	58			4.76
Catawba Sanitarium	37-23	80-05	1911-54	44			7.35
Mendota	36-42	82-18	1905-54	50			3.93
Wytheville WB City	36-58	81-06	1903-40	38	2.95	4.14	5.29
WEST VIRGINIA							
Bluefield 1	37-16	81-13	1899-54*	53			4.85
Grafton 1 NE	39-21	80-00	1899-54*	50			5.25
Lewisburg	37-48	80-26	1900-54*	50			4.89
Logan	37-51	82-00	1902-54*	42			5.30
Marlinton	38-13	80-05	1899-52*	37			4.95
New Martinsville	39-39	80-52	1899-54	56			4.40
Parkersburg WB City	39-16	81-34	1903-51	49	2.48	3.90	4.96
Spencer	38-48	81-21	1900-54*	51			5.19

*Breaks in Record

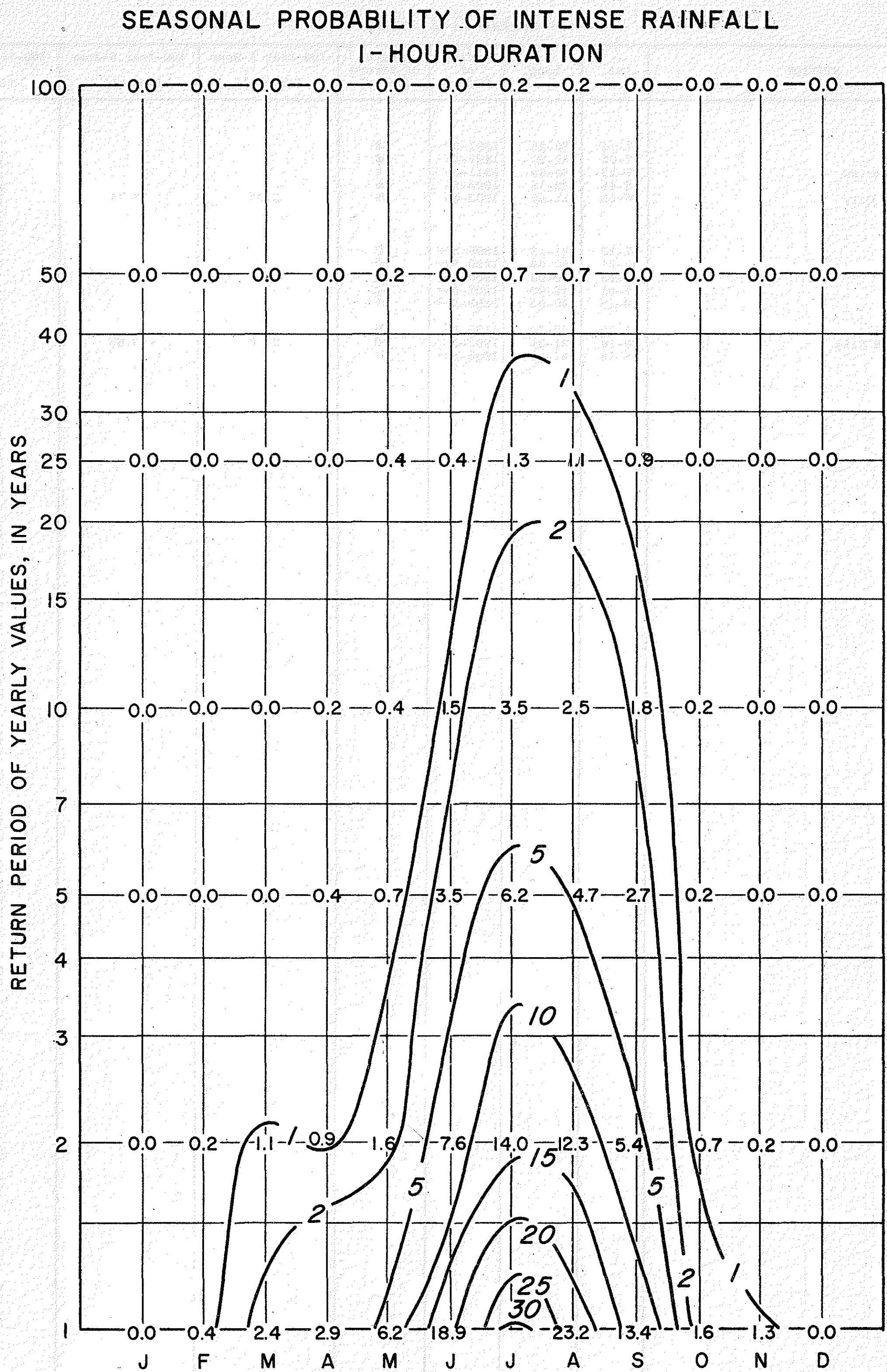


Fig. 2-8 Probability in percent of obtaining a rainfall in any month of a particular year equal to or exceeding the yearly return period values taken from the isopluvial maps and diagrams.

SEASONAL PROBABILITY OF INTENSE RAINFALL
6-HOUR DURATION

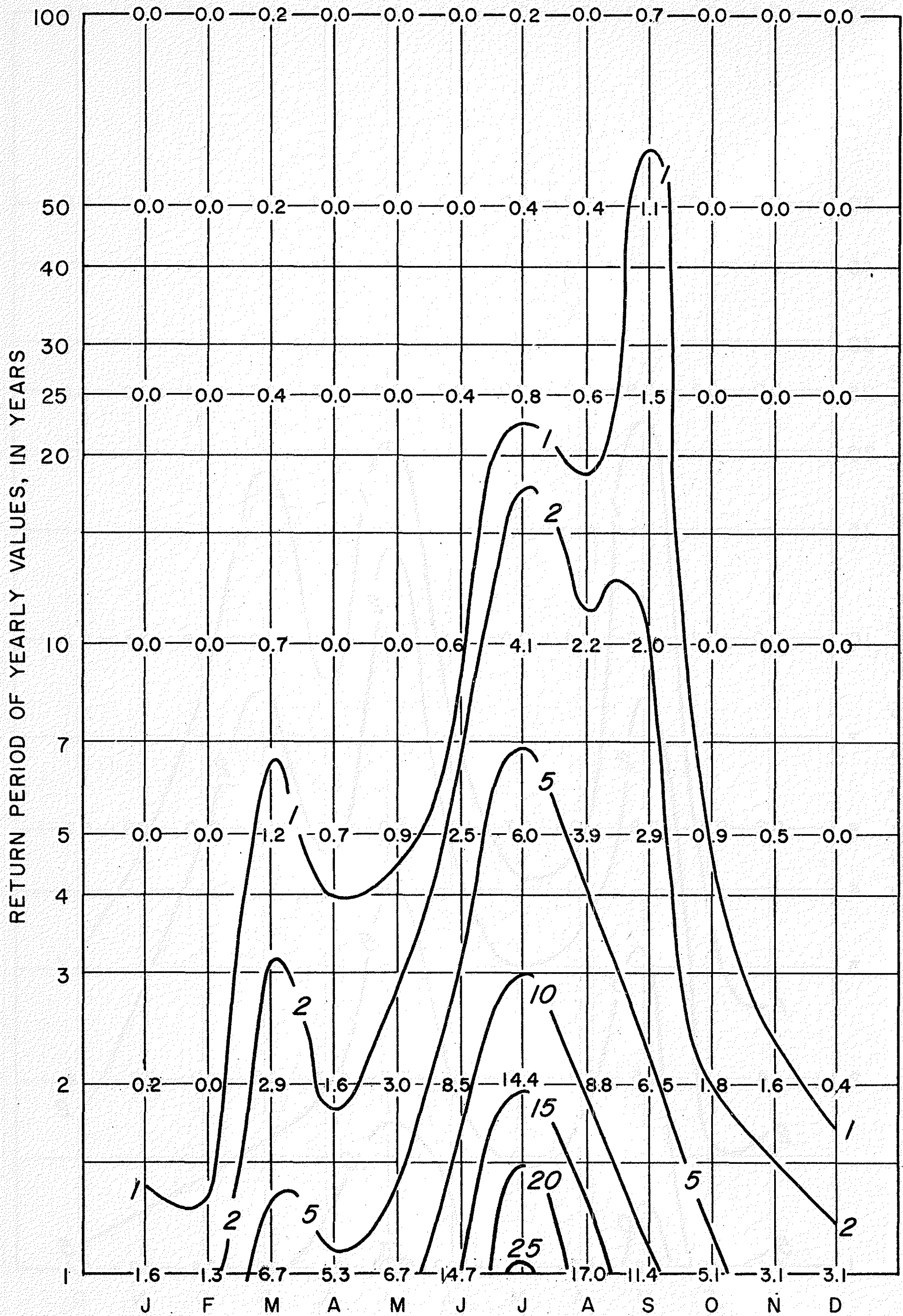


Fig. 2-9 Probability in percent of obtaining a rainfall in any month of a particular year equal to or exceeding the yearly return period values taken from the isopluvial maps and diagrams.

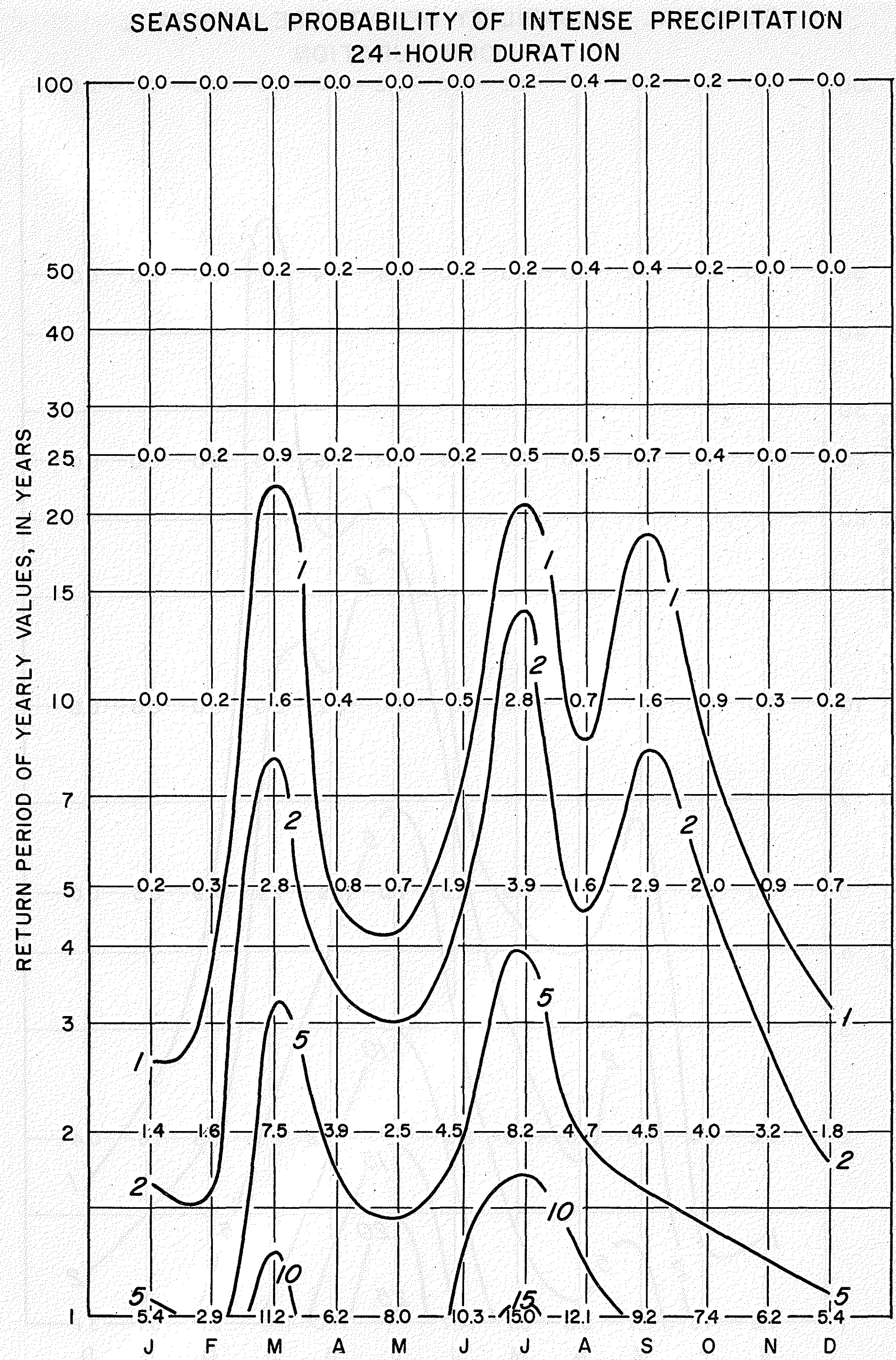


Fig. 2-10 Probability in percent of obtaining a precipitation in any month of a particular year equal to or exceeding the yearly return period values taken from the isopluvial maps and diagrams.

U. S. GOVERNMENT PRINTING OFFICE : 1957 O - 428981