U. S. DEPARTMENT OF COMMERCE
SINCLAIR WEEKS, *Secretary*

WEATHER BUREAU
F. W. REICHELDERFER, *Chief*

TECHNICAL PAPER NO. 29

Rainfall Intensity-Frequency Regime

Part 3—The Middle Atlantic Region

(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 region east of longitude 80° W. and south of latitude 41° 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.
JULY 1958

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

CONTENTS

TABLES

SECTION I.

SECTION II.

FIGURES

SECTION I.

SECTION II.

Rainfall Intensity-Frequency Regime
Part 3: The Middle Atlantic Region

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 region east of longitude 80° W. and south of latitude 41° N.

INTRODUCTION

1. Authority. This report is the third in 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). Parts 1 [1] and 2 [2] covered the region of the United States south of latitude 40° N. between longitude 80° W. and 90° W.

2. Background. Heretofore, economic and engineering design requiring rainfall intensity-frequency analysis has been based largely on "Rainfall Intensity-Frequency Data" [3] by David L. Yarnell, which was first printed more than 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. Scope. 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 additional storm characteristics includes the portrayal of the seasonal variation in the intensity-frequency regime.

4. Separation of "Analysis" and "Applications". For convenience in practical application of the results of the work reported here, the paper is divided into two major sections. The first section, entitled 'Analysis', describes what was done with the data and gives reasons for the way some things were done. 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. Relation to Parts 1 and 2. The framework of this part of Technical Paper No. 29 is unchanged, but some new material has been added, and most topics have been treated more briefly. The added material includes a discussion of mass curves of rainfall for one, 6, and 24 hours and a set of curves for transforming 'among storm' rainfall depth-duration-frequency curves to 'within storm' time distribution curves. Topics that are presented more briefly are the discussions of the analyses of the duration, frequency, and area-depth relationships. The emphasis in this paper is on the applications of the various relationships rather than their derivation. Frequent references are made to the two earlier papers for the user who desires a more thorough understanding of the many analyses.

6. Acknowledgments. This investigation was directed by David M. Hershfield, project leader, in the Cooperative Studies Section, (Walter T. Wilson, Chief), of Hydrologic Services Division (William E. Hiatt, Chief). Technical assistance was furnished by Leonard L. Weiss; collection and processing of data were performed by Margaret R. Cullen, Normalee S. Foat, Donald E. Hiller, Robert B. Holleman, Elizabeth C. I'Anson, Lillian C. Langdon, E. Eloise Marlowe, William E. Miller, and Samuel Otlin; typing was by Robert B. Holleman and Laura L.

Nelson, and drafting by Caroll W. Gardner. Coordination with the Soil Conservation Service, Department of Agriculture, was maintained through Harold O. Ogrosky, Staff Hydrologist of the Engineering Division. Max A. Kohler, Chief Research Hydrologist, and A. L. Shands, Assistant Chief, Hydrologic Services Division, acted as consultants. Lillian K. Rubin of the Hydrometeorological Section edited the text.

SECTION I. ANALYSIS

Climate

7. General. The region covered by this paper receives a uniform and abundant supply of moisture because of its favorable geographical location with respect to the usual storm paths. The average annual precipitation varies from about 60 inches in the southeast portion of the area to less than 40 inches in the northwest. This precipitation is fairly well distributed throughout the year with no pronounced wet and dry seasons. The four summer months of June, July, August, and September receive about 40 percent of the annual total.

8. Hurricane or tropical storm rainfall. Since the period June through September comprises a substantial part of the hurricane season, the rainfall averages are affected by the few downpours which develop as a result of the proximity of hurricanes. Stations near the seacoast usually experience the fringe effects of one or more hurricanes during the late summer or fall season each year. Some tropical-storm rainfalls [4, 5] which exceeded the magnitude of the 100-year events are listed below:

Storm Date	Location	Amount (Inches)	Duration (Hours)
August 31-September 1, 1940	Ewan, N. J.	24.0	9
July 13-14, 1916	Kingstree, S. C.	15.1	24
October 14-15, 1942	Big Meadows, Va.	13.4	24
August 11-12, 1928	Cheltenham, Md.	11.5	24

9. Non-tropical storm rainfall. Rain during the warm half of the year is generally associated with thunderstorm activity and storms generally last only a few hours. An occasional period of excessive rainfall may result from a series of closely-spaced thundershowers, or from a storm moving northward along the coast. During the cold half of the year rainfall is more uniform, being associated with overrunning moist air and extratropical cyclones which cause intermittent rainy periods of one to 7 days. Some exceedingly large rainfalls not associated with tropical storms [5, 6, 7] are recorded below:

Storm Date	Location	Amount (Inches)	Duration (Hours)
July 26-27, 1897	Jewell, Md.	14.7	24
June 29-30, 1949	Mesic, N. C.	12.0	24
May 15-16, 1942	Montebello Fish Nursery, Va.	10.0	24
September 29, 1938	Wilmington, N. C.	9.5	24
July 22-23, 1945	Cedar Grove, N. J.	9.0	21
August 13-14, 1919	Atlantic City, N. J.	8.6	24
July 22-23, 1927	Lykens, Pa.	8.0	12

10. Tropical vs. non-tropical rainfall. As indicated above, large rainfalls are associated with both hurricanes and non-hurricane storms. The question of whether these two sets of data are really different with respect to the three characteristics, (1) frequency distribution, (2) depth-area relationship, and (3) time distribution, was answered in Part 2 [2]. It was found that the rainfall associated with tropical storms in the southeastern U. S. does not stand out as being significantly different from the rain associated with other types of storms, and this is also true in the Middle Atlantic Region for the range of duration and area covered in this paper.

Basic data

11. 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 200 long-record Weather Bureau stations, 20 of which are in the region of interest. Long records from 156 stations were analyzed to define the frequency relationships, and relatively short portions of the record from 651 additional stations were analyzed to define the regional pattern.

Table 1-1

SOURCES OF POINT RAINFALL DATA

Duration	No. of Stations	Average Length of Record (yrs)	Source*
20 min-24 hr	20 recorder (WB first order)	51	8, 9, 10
hourly	167 recorder	13	6, 7, 11
6-hour	167 recorder	13	6, 7, 11
daily	167 recorder	13	6, 7, 11
daily	484 non-recorder	12	6
daily	136 non-recorder	55	6

*These numbers indicate references listed on page 20.

12. Period and length of record. The non-recording short-record data were compiled for the period 1939-1956 and long-record data from the beginning of record to 1956. The recording gage data covers the period 1940-1950 with selected stations processed through 1956. Data from long-record Weather Bureau stations were processed through 1956. No record of less than five years was used to estimate any of the 2-year values.

13. 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 [12] . Such methods do not apply to extreme values. Except for some subjective selection of stations that have had consistent exposures, (particularly for those with long records), 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.

14. 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.

Duration analysis

15. Duration interpolation diagrams. A generalized duration relationship is portrayed in the diagrams of figure 1-1 in which the rainfall rate or depth can be computed for any duration,

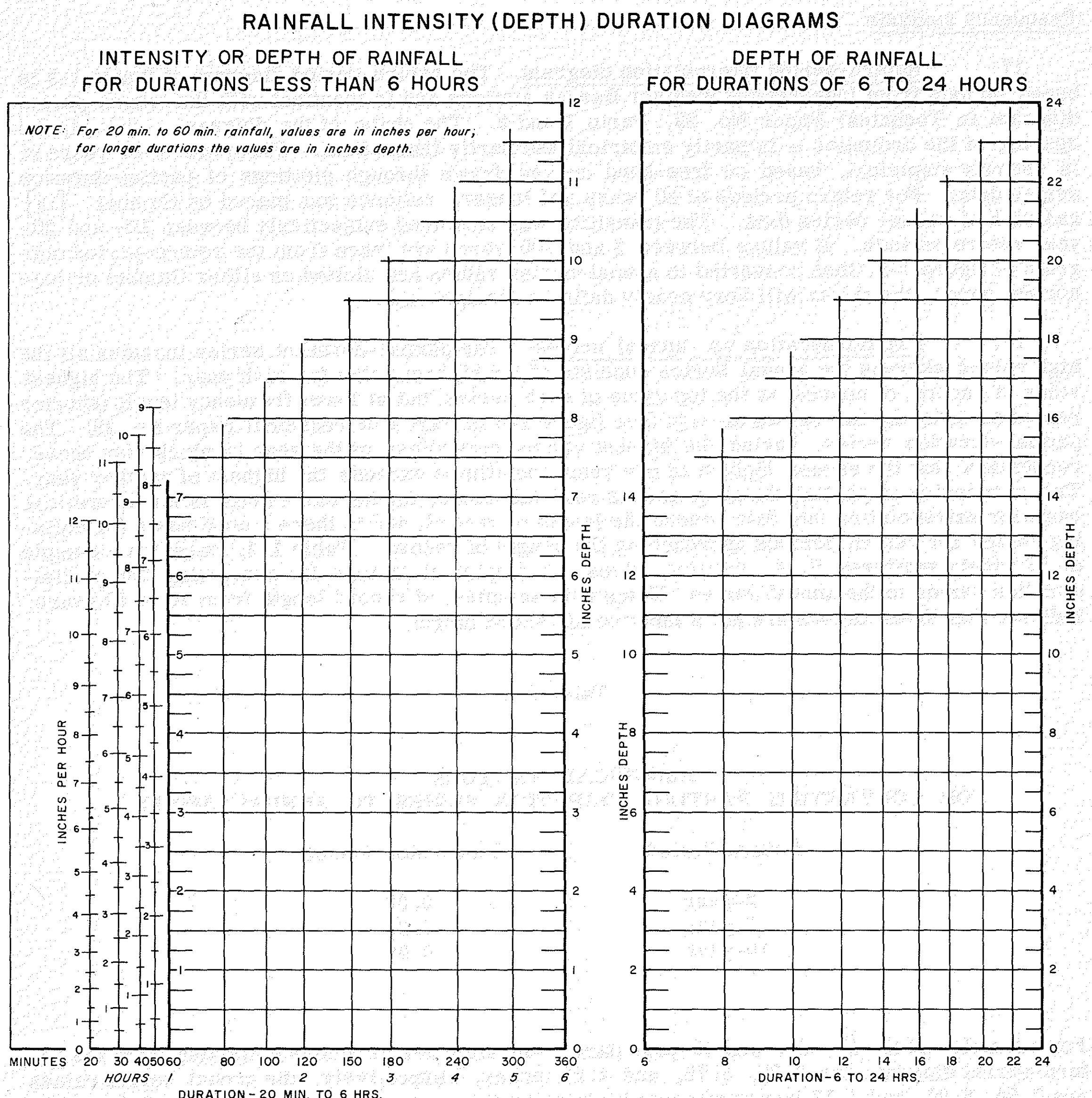


Figure 1-1

from 20 minutes to 24 hours, provided the values for one, 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 in Parts 1 and 2 of Technical Paper No. 29. For example, the 30-minute intensity or 3-hour rainfall depth may be obtained if the one-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 values are obtained merely by laying a straightedge across the two given values (one and 6, or 6 and 24 hours) and reading the value for the desired duration. No regional variation is evident in this duration-depth or duration-intensity relationship.

16. The one-, 6-, and 24-hour values for use in figure 1-1 are obtained from isopluvial maps which will be described later. Two large working copies (figure 2-1) containing diagrams and instructions with examples (table 2-1) for obtaining the desired depth-area-duration-frequency values are furnished in the pocket inside the back cover of this paper.

475025 O-58-2

Frequency analysis

17. Return-period interpolation diagram. The return-period diagram of figure 1-2 is based on data from long-record Weather Bureau stations and is identical with the return-period diagram in Technical Paper No. 29, Parts 1 and 2. The shape of the diagram — that is, the spacing of the ordinates — is partly empirical and partly theoretical. From one to 10 years it is entirely empirical, based on free-hand curves drawn through plottings of partial-duration series data. For return periods of 20 years and longer, reliance was placed on Gumbel [13] 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 of figure 1-2, then converted to annual-series values and plotted on either Gumbel or log-normal paper, the points will very nearly define a straight line.

18. Partial-duration vs. annual series. The partial-duration series includes all the high values whereas 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 (see figure 1-4 in Part 1 of Technical Paper No. 29). The partial-duration series, having the highest values regardless of the year in which they occur, recognizes that the second highest of one year sometimes exceeds the highest of another year. The processing of partial-duration data is very laborious; furthermore there is no theoretical basis for extrapolating this data beyond the length of record, nor is there a good basis for defining values for return periods approaching the length of record. Table 1-2, based on a sample of 50 widely scattered U. S. stations, gives the empirical factors for converting the partial-duration series to the annual series. Tests with samples, of record length from 10 to 50 years, indicate that these factors are not a function of record length.

Table 1-2

EMPIRICAL FACTORS
FOR CONVERTING PARTIAL - DURATION SERIES TO ANNUAL SERIES

Return Period	Conversion Factor
2-year	0.88
5-year	0.96
10-year	0.99

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 1-2.

19. Use of diagram. The two intercepts needed for the frequency relation in the diagram of figure 1-2 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 the frequency diagram 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.

20. General applicability of diagram. The frequency diagram is independent of the units used as long as the same units (inches, tenths of inches, etc.) 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 the diagram of figure 1-2, which appears to have application in the regions studied thus far and perhaps the entire United States.

21. 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

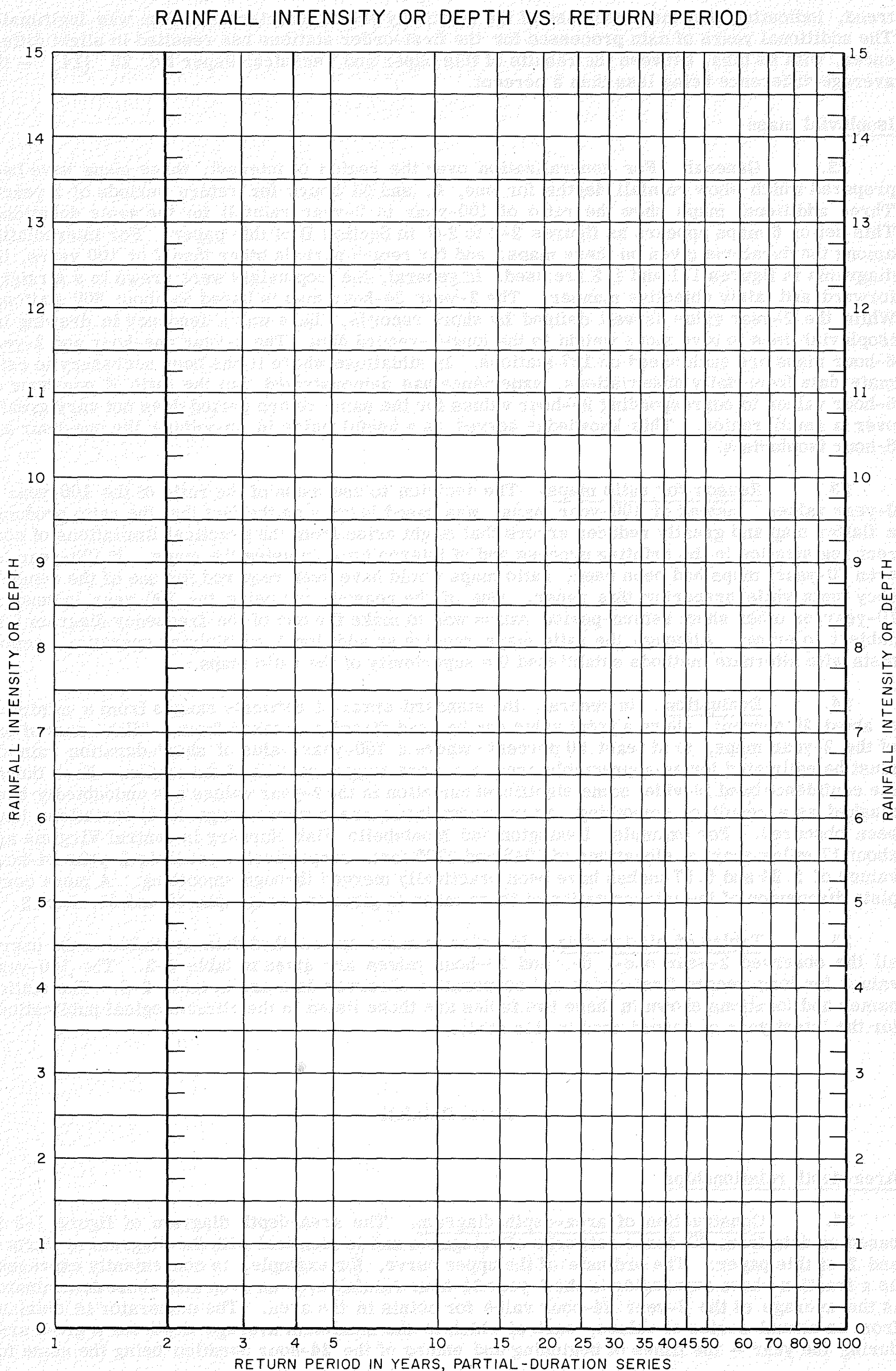

RAINFALL INTENSITY OR DEPTH VS. RETURN PERIOD
RAINFALL INTENSITY OR DEPTH
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
1 2 3 4 5 10 15 20 25 30 35 40 45 50 60 70 80 90 100
RETURN PERIOD IN YEARS, PARTIAL-DURATION SERIES

Figure 1-2

trend, indicating that the direct use of the relatively recent short-record data was legitimate. The additional years of data processed for the first-order stations has resulted in slight differences, with no bias, between the results of this paper and Technical Paper No. 25 [14] — the average difference being less than 5 percent.

Isopluvial maps

22. General. 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 2 years. Three additional maps show the ratio of 100-year to 2-year rainfall for the same durations. This set of 6 maps appears as figures 2-2 to 2-7 in Section II of this paper. For interpolation among the durations given on these maps, and for return periods other than 2 or 100 years, the diagrams in figures 1-1 and 1-2 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 800 stations. While the 2-year value is well defined by short records, there was a tendency in drawing the isopluvial lines to give more weight to the longer-record data. The 2-year one-hour and 2-year 6-hour maps are each based on 187 stations. In situations where it has been necessary to estimate data from daily observations, experience has demonstrated that the ratio of one-hour or 6-hour values to corresponding 24-hour values for the same return period does not vary greatly over a small region. This knowledge served as a useful guide in smoothing the one-hour and 6-hour isopluvials.

23. 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 paper. 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 the frequency diagram less subject to error. Although the ratio maps require an additional multiplying operation, actual tests with alternate methods established the superiority of the ratio maps.

24. Evaluation. In general, the standard error of estimate ranges from a minimum of about 20 percent, 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 percent, 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 variation in the 2-year values has undoubtedly been masked as a result of smoothing, as in mountainous areas where large local variations have been obscured. For example, Lexington and Montebello Fish Nursery in central Virginia are about 17 miles apart at elevations of 1045 and 2700 feet, respectively, yet their 2-year 24-hour values of 2.94 and 5.57 inches have been practically merged through smoothing. A more complete discussion of the interpretation of these maps is given in paragraphs 50 and 51, Part 2.

25. Tables of station data. In order to make unsmoothed data available to the user, all the observed 2-year one-, 6-, and 24-hour values are given in table 2-2. The 100-year values for long-record first-order and cooperative observer data are in table 2-3. 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

Area-depth relationships

26. Construction of area-depth diagram. The area-depth diagram of figure 1-3 is based on data from 20 dense networks of raingages and is identical with the diagram in Parts 1 and 2 of this paper. The ordinate of the upper curve, for example, is conveniently expressed as a fraction whose numerator is the 2-year 24-hour rainfall over an area and whose denominator is the average of the 2-year 24-hour value for 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 being the same for

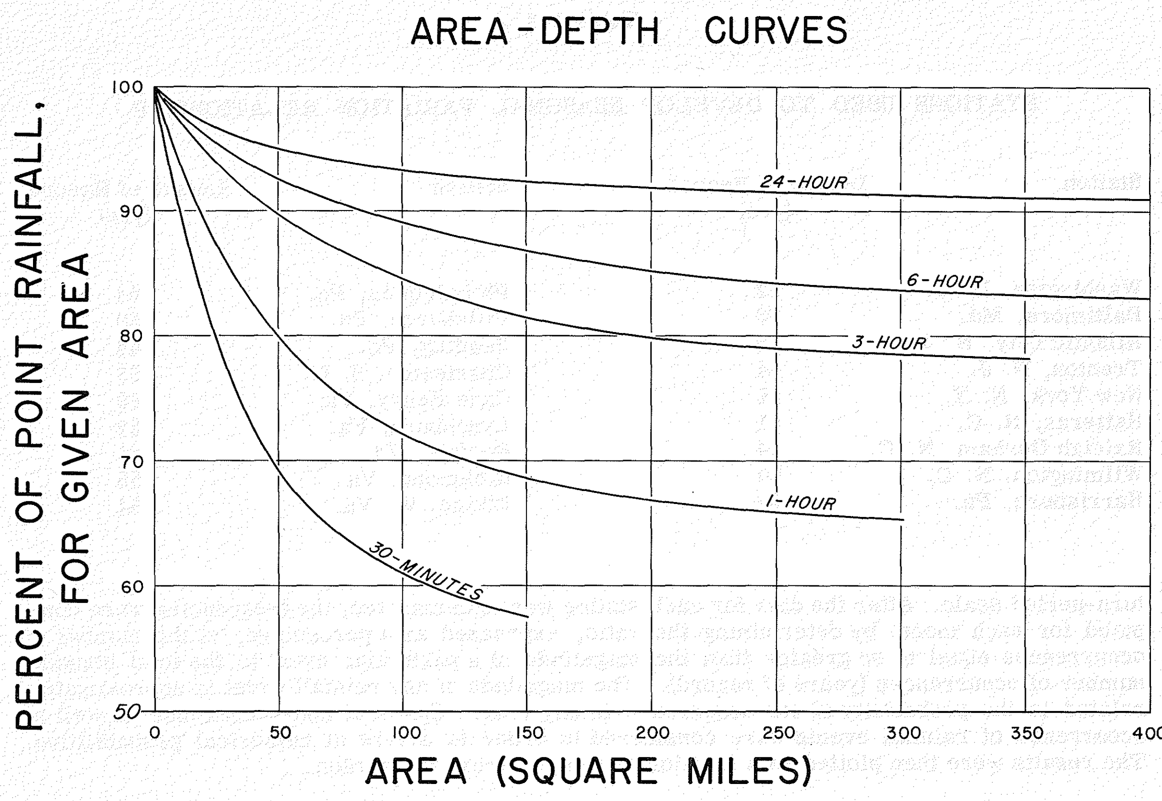


Figure 1-3

each station in the area covered by the dense network. 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.

27. Generalization. The results from the limited number of widely scattered dense networks were studied in detail and it was found that (1) there was no systematic regional variation, (2) the relationship varies with duration as shown in figure 1-3, and (3) storm magnitude is not a parameter. A more complete discussion of the rationale and development of this relationship is given in Parts 1 and 2.

Seasonal Variation

28. Monthly vs. annual series. The frequency analysis so far discussed 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 to these two series at all. The purpose of this analysis is to show how often these rainfall events occur during part of the year, or a specific calendar month.

29. Basic data. The seasonal variation relationship was developed from 18 first-order stations in the region of interest. The stations and length of record are shown in table 1-3.

30. Computation of monthly probabilities. For each of 3 durations (one, 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 re-

Table 1-3

STATIONS USED TO DEVELOP SEASONAL VARIATION RELATIONSHIP

Station	Length of Record (yrs)	Station	Length of Record (yrs)
Washington, D. C.	52	Philadelphia, Pa.	54
Baltimore, Md.	63	Pittsburgh, Pa.	50
Atlantic City, N. J.	56	Reading, Pa.	44
Trenton, N. J.	44	Charleston, S. C.	53
New York, N. Y.	55	Cape Henry, Va.	49
Hatteras, N. C.	51	Lynchburg, Va.	52
Raleigh Durham, N. C.	54	Norfolk, Va.	65
Wilmington, N. C.	60	Richmond, Va.	58
Harrisburg, Pa.	59	Elkins, W. Va.	54

turn-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 occurrence 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.

31. Construction of seasonal probability diagrams. Some variation exists from station to station suggesting a slight regional pattern, but no attempt has been made to define it because there is uncertainty as to 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 18 stations were combined, giving 973 station-years of record, and smoothed isopleths of frequency were drawn for each significant duration: one, 6, and 24 hours. These isopleths appear in 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 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 percent of the time.

32. 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 analyzed in the same manner as the point data. The results exhibited no substantial difference from those of the point data, which lends additional confidence in using these diagrams as a guide for small areas.

33. Comparison with monthly probabilities in Parts 1 and 2. The seasonal-probability curves in this paper follow the same general pattern as those in Parts 1 and 2. They differ in that they are more peaked for all three durations than the curves in either of the preceding parts. This means that the larger amounts are relatively more likely to occur during the summer months. There is some regional discontinuity between the curves of the three papers which can be smoothed locally for all practical purposes.

Time Distribution

34. General. The data for the frequency analysis of point rainfall hitherto considered has been based on the annual maximum for each duration. These maxima for a particular year often come from different storms with the result that a rainfall intensity-duration-frequency curve constructed from these data shows larger amounts for all durations than the corresponding within-storm amounts for total storm depths of the same frequency. For example, the 2-year 24-hour value might be 3.0 inches, and the 2-year one-hour value for the same station might be

1.5 inches. This does not mean that the maximum one-hour increment of the 2-year 24-hour value is 1.5 inches. The maximum one-hour increment of the 2-year 24-hour value is slightly less than the 2-year one-hour depth. The 2-year one-hour value is taken from the annual series of one-hour maxima, and includes high values that would not be included in the series of one-hour values that were the largest within the annual series of 24-hour storms. Figure 1-4 shows, for one hour of a 24-hour total duration, an adjustment factor of 0.85, which multiplied by 1.5 inches gives 1.27 for the maximum one-hour rain during the 24-hour storm of 3.0 inches. The depth-transformation curves of figure 1-4 serve the purpose of providing adjustment factors for converting the among-storm rainfall to within-storm rainfall. These average curves are based on more than 100 storms from 12 stations located in the regions covered by all parts of this paper completed thus far.

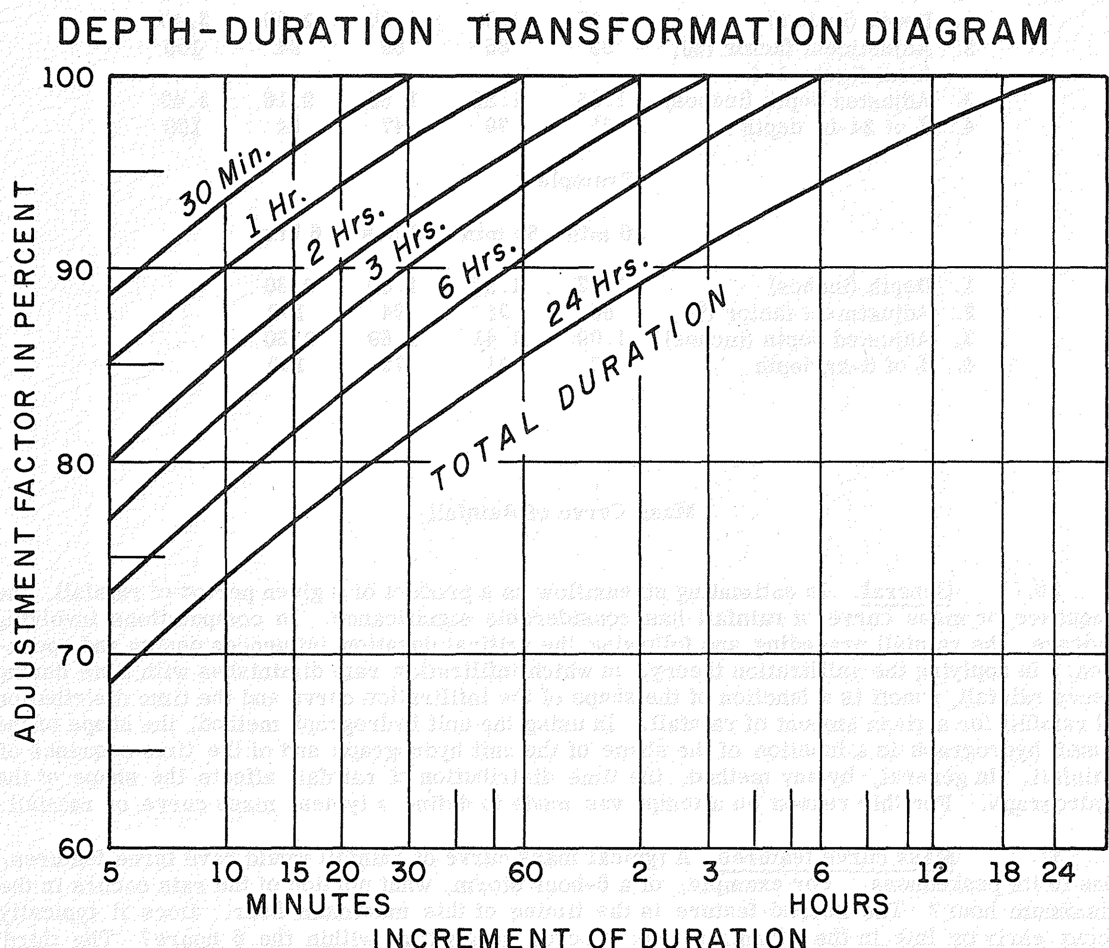


Figure 1-4

35. Examples of computation. The specific mechanics for computing the within-storm rainfall are shown in table 1-4. Assume that the 2-year 24-hour within-storm rainfall is desired for the point at 38° 00' W and 78° 00' N. First, the rainfall intensity or depth values are determined from a combination of the isopluvial maps, duration and return-period diagrams and the intensities for durations less than one hour are converted to depths in inches (line 1). The adjustment factors for durations less than 24 hours are next read off the 24-hour total duration curve (line 2). The items on line 1 are multiplied by those on line 2 to give the within-storm

24-hour rainfall (line 3). The percent of 24-hour rainfall is given on line 4. No sequence is implied but this subject is discussed in the next section. Example number 2 is for a 6-hour storm at the same location.

Table 1-4

EXAMPLES OF DEPTH - DURATION TRANSFORMATION COMPUTATION

Example 1

	30 min	60 min	2 hrs	6 hrs	24 hrs
1. Depth (inches)	1.27	1.55	1.80	2.30	3.40
2. Adjustment factor (%), from figure 1-4	82	85	89	94	100
3. Adjusted depth (inches)	1.04	1.32	1.60	2.16	3.40
4. % of 24-hr. depth	31	39	47	64	100

Example 2

	30 min	60 min	2 hrs	6 hrs
1. Depth (inches)	1.27	1.55	1.80	2.30
2. Adjustment factor (%)	86	91	94	100
3. Adjusted depth (inches)	1.09	1.41	1.69	2.30
4. % of 6-hr. depth	47	61	73	100

Mass Curve of Rainfall

36. General. In estimating streamflow as a product of a given period of rainfall, the sequence or mass curve of rainfall has considerable significance. In computations involving storage, the rainfall preceding and following the critical duration influences design and operation. In applying the infiltration theory, in which infiltration rate diminishes with time during heavy rainfall, runoff is a function of the shape of the infiltration curve and the time distribution of rainfall for a given amount of rainfall. In using the unit hydrograph method, the shape of the runoff hydrograph is a function of the shape of the unit hydrograph and of the time sequence of rainfall. In general, by any method, the time distribution of rainfall affects the shape of the hydrograph. For this reason an attempt was made to define a typical mass curve of rainfall.

37. Mass curve features. A typical mass curve of rainfall would have three features. One is its peakedness. For example, of a 6-hour storm, what portion of the rain occurs in the maximum hour? The second feature is the timing of this maximum hour. Does it typically occur early or late in the storm, or can it occur at any time within the 6 hours? The third feature is the distribution of the remaining 5 hours of rainfall: how much of it occurs before and how much after the maximum hour?

38. Precision. Except where there is orographic control, the areal distribution of rainfall as far as is known now, occurs essentially in a random manner: there is no such thing as a typically shaped isohyetal pattern for a given drainage area. As a result of this fact, and because the time and areal distributions are interrelated, any definition of a central tendency in timing must be limited by random variation in areal distribution. This dispersion in the effective time sequence of rainfall, caused by areal variation, imposes a practical limit on the precision and degree of detail that is pertinent to defining the typical mass curve.

39. Another factor that limits the precision of defining the typical mass curve is the variability of sequence among storms. Examination of many storms shows that in some ways a

central tendency is obscured by the dispersion of the data themselves. In other words, there is only a very limited central tendency inherent among storms.

40. Methods of processing data. The method of processing the data affects the nature of the result. Different results would be obtained if data were selected on the basis of total storm amounts than if they were selected on the basis of incremental amounts. For example, the data might be gathered on the basis of 6-hour totals exceeding a given value and taking the distribution of the hourly amounts as they happened to occur in the selected storms. Another way to select data for study would be to take the hourly values exceeding a given base and letting the other 5 hourly values occur as shown in the record. The latter method gives a slightly steeper peak, and possibly one that occurs earlier within the 6 hours, but the difference is regarded as trivial with respect to considerations of sampling and of practical application.

41. Another aspect of processing the data concerns the method of arrangement for computation. For example, suppose a study is made of three hypothetical 6-hour storms which occur at a particular location as follows:

hour	1	2	3	4	5	6	7	8	9	10
rain (inches)			1	2	6	3	2	1		
	1	6	3	2	1	1				
				1	2	2	3	6	1	
sum	1	6	4	5	9	6	5	7	1	

42. The time sequence of the sums is partly a product of the sequence within each storm, and partly a product of the time at which each storm started. To eliminate the randomness or arbitrariness of time of beginning of each storm the data should be arrayed differently, and one possible method, using the same time of beginning of each storm, is as follows:

hour	1	2	3	4	5	6	7	8	9	10
rain (inches)			1	2	6	3	2	1		
			1	6	3	2	1	1		
			1	2	2	3	6	1		
sum			3	10	11	8	9	3		

43. This rearrangement is not satisfactory because the peaks all occur at different times, and the feature of peakedness, which typifies most storms, is obscured in the generalized sum. To preserve the peakedness, the storms can be arranged on the time scale so that the peaks, rather than the times of beginning, occur at the same time:

hour	1	2	3	4	5	6	7	8	9	10
rain (inches)			1	2	6	3	2	1		
				1	6	3	2	1	1	
	1	2	2	3	6	1				
sum	1	2	3	6	18	7	4	2	1	

This last tabulation is also deficient in one respect. The data must be examined to see how much rain occurred before and after the 6-hour periods that were selected for study. The next tabulation shows, in parentheses, the values that did occur, and that should be considered:

475025 O-58-3

hour	1	2	3	4	5	6	7	8	9	10
rain (inches)	(0)	(1)	1	2	6	3	2	1	(0)	(1)
	(0)	(1)	(1)	1	6	3	2	1	1	(1)
	1	2	2	3	6	1	(0)	(2)	(1)	(0)
sum	1	4	4	6	18	7	4	4	2	2

Dividing each of these sums by 3 gives the ordinates for an average time sequence of 6-hour rainfall. The next question is, where in the sequence does the maximum hour occur? There is a choice between two 6-hour sequences:

4 4 6 18 7 4 or 4 6 18 7 4 4

44. The difference between these two sequences is trivial. When working with 24-hour data this same type of problem exists but is magnified and complicated. Instead of the successive values smoothly rising to a peak and lowering smoothly again, the hourly sequence is irregular as indicated by the sequence below which was computed from 35 storms for Richmond, Va.

.4 .7 .5 .5 .7 .9 1.1 1.0 .5 .4 .5 1.1 1.0 1.2 1.8 3.1 8.1 11.6 41.1 11.6

5.4 5.0 3.0 2.1 2.0 1.4 1.5 1.0 1.1 1.1 1.1 2.1 1.2 1.2 .6 .4 .5 .6 .8 1.0

45. Except for the 8 large central values the series is practically random, and the selection of the maximum 24 successive values is practically indeterminate. In other words, there is not much question about the portion of 24-hour rain falling in the maximum hour or the maximum n hours up to 6 or 8. But the time at which the peak occurs, on the average, is nearly unanswerable because there is no well-defined average. Perhaps it suffices to say merely that it usually occurs near the middle of the maximum 24-hour period but can occur any hour. Actually, because so many storms that give large 24-hour totals last only a few hours, the average time at which the peak occurs is early rather than late in the storm. The portion of the rain occurring before or after the peak is relatively small but is as indeterminate as the timing of the peak. The following frequency distribution gives the time of occurrence of the maximum hourly value, among the 238 maximum 24-hour rains for selected stations, starting with the first hour of the 24-hour sequence that makes up the maximum.

Table 1-5

HOURLY FREQUENCY OF OCCURRENCE OF MAXIMUM CLOCK - HOUR RAINFALL FROM 24-HOUR RAINFALLS ≥ 2-YEAR VALUE

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Miami, Fla.	2	2	0	3	2	0	3	1	2	1	5	1	0	1	0	2	2	2	1	6	2	3	2	1
Montgomery, Ala.	2	3	2	4	1	1	1	1	5	2	1	1	3	1	1	2	2	1	0	1	2	1	2	0
Richmond, Va.	3	3	5	2	5	1	1	4	2	0	0	2	2	1	0	1	1	0	0	1	0	0	1	0
Louisville, Ky.	4	4	1	1	2	3	1	0	1	0	2	1	2	2	3	0	0	2	4	2	1	1	2	1
Boston, Mass.	1	2	3	6	1	2	1	3	3	1	1	3	1	2	0	1	0	1	2	2	3	1	2	0
Harrisburg, Pa.	6	4	2	2	2	1	1	2	2	2	1	4	2	1	0	0	1	3	1	1	0	1	1	1
Frequency	18	18	13	18	13	8	8	11	15	6	10	12	10	8	5	6	6	9	3	13	8	7	10	3
Cumulative Frequency	18	36	49	67	80	88	96	107	122	128	138	150	160	168	173	179	185	194	197	210	218	225	235	238

46. Not only is there a large sequential variation from storm to storm at the same station, there is also a large variation among stations. This is illustrated in table 1-5 which provides additional evidence for not attempting to construct a typical or modal mass curve. Analysis of one-hour data by 5-minute increments and 6-hour data by one-hour increments shows nearly as much irregularity in the time sequence.

Table 1-6

DISTRIBUTION OF 1-, 6-, 24-, AND 168-HOUR RAINFALL FOR SELECTED STATIONS

7-DAY PRECIPITATION (1-day increments)

	1	2	3	4	5	6	7	Total	Date
Boston, Mass.	[6.04]						.26	6.30	7/9-15/21
Harrisburg, Pa.	.39					[.02	4.36]	4.77	8/15-22/15
Richmond, Va.	[7.26]	1.82	.09			.31	.19	9.67	7/30-8/6/23
Louisville, Ky.	.57	.03			.15	[5.13]	.69	6.57	3/20-27/13
Montgomery, Ala.	1.10	[.96	7.56]	.98				10.60	6/2-5/28
Miami, Fla.	.30	.44	[4.04	7.69]	.04	1.13	.15	13.79	9/25-10/2/29
Washington, D. C.	.19	.01				[3.06]		3.26	5/14-20/08
Cape Henry, Va.	1.92				.16	[5.67]		7.75	6/29-7/5/22

24-HOUR PRECIPITATION (1-hour increments)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total	Date
Boston, Mass.	1.00	1.35	.12	.12	.04	T	T	.72	.01	.01	.01							[1.45	.33	.80	.07	.01]	T		6.04	7/9/21
Harrisburg, Pa.	.02	T		.08		T	.02	.01	.02	T	.01	T	T			T	T	[1.79	.82	.77	.18	.58	.08]		4.38	8/21-22/15
Richmond, Va.	[.04	2.56	2.98	1.50	.14	.02]	T	T	T	T	T	T	.01	.01	T										7.26	7/30-31/23
Louisville, Ky.	T	.21	.30	.30	.57	.04	.07	.10	.12	T	T	[1.29	.26	.76	.21	.16	.18]	.25	.13	.15	.05	T			5.13	3/25-26/13
Montgomery, Ala.	.06	.36	.21	.09	.33	.49	.13	.21	.25	.14	.16	.52	.81	.26	[.33	.39	.68	.65	.59	.82]	.12	.12	.07	.02	7.81	6/4-5/28
Miami, Fla.	.02	.04		.03	.16	.25	.24	.33	.77	.81	.20	.69	.40	.22	.40	.46	[1.01	.81	.83	.95	.69	.63]	.43	.17	10.54	9/28-29/29
Washington, D. C.	.03	[.52	.29	.25	.11	.05	.16]	.12	.12	.12	.12	.12	.01							[.27	.77]				3.06	5/19-20/08
Cape Henry, Va.	T	.10	.11	[1.71	1.65	.03	.23	.15	.27]	.10	.01				.08	.02			T	.48	.14	.51	.11	.06	5.76	7/4-5/22

6-HOUR RAINFALL (1-hour increments)

	1	2	3	4	5	6	Total	Date
Boston, Mass.	[1.45	.33]	.80	.07	.01		2.66	7/9/21
Harrisburg, Pa.	[1.79	.82]	.77	.18	.58	.08	4.22	8/21-22/15
Richmond, Va.	.04	[2.56	2.98]	1.50	.14	.02	7.24	7/30/23
Louisville, Ky.	[1.29	.26]	.76	.21	.16	.18	2.86	3/25/13
Montgomery, Ala.	.33	.39	[.68	.65]	.59	.82	3.46	6/4/28
	[.52	.81]	.26	.33	.39	.68	2.99	6/4/28
Miami, Fla.	1.01	.81	[.83	.95]	.69	.63	4.92	9/28/29
Washington, D. C.	.52	.29	.25	.11	.05	.16	1.38	5/19-20/08
Cape Henry, Va.	[1.71	1.65]	.03	.23	.15	.27	4.04	7/4/22

1-HOUR RAINFALL (5-minute increments)

	1	2	3	4	5	6	7	8	9	10	11	12	Total	Date
Boston, Mass.	.13	.08	.08	.06	.06	.21	.21	.15	.12	.08	*	.44	1.62	7/9/21
Harrisburg, Pa.	.05	.06	.01		.02	.07	.24	.30	.27	.49	.32	.09	1.92	8/21/15
Richmond, Va.	.33	.63	.30	.40	.45	.29	.12	.19	.23	.39	.34	.35	4.02	7/30/23
Louisville, Ky.	.07	.16	.21	.17	.24	.23	.04	.04	.11	.04			1.31	3/25/13
Montgomery, Ala.	.10	.05	.05	.07	.11	.11	.13	.02	.01	.09	*	.26	1.00	6/4/28
	.08	.08	.08	.12	.06	.13	.01	.01	.09	.14	*	.20	1.00	6/4/28
Miami, Fla.	.14	.09	.09	.18	.19	.11	.11	.04	.18	.06	*	.06	1.25	9/28/29
Washington, D. C.	.07	.11	.05	.01	.01	.05	.05	.09	.23	.17	*	.15	.99	5/20/08
Cape Henry, Va.	.27	.49	.13	.06	.12	.31	.32	.12	.06	.24	*	.36	2.48	7/4/22

*Included in next 5-minute amount

[ ] Includes maximum rainfall for next shorter duration

47. Table 1-6 records the distribution of one-, 6-, 24-, and 168-hour rainfall for selected stations. The one-, 6-, and 24-hour amounts for a particular station are from their respective 168-hour totals. The one- or 2-day amounts enclosed by brackets under 7-day precipitation indicate the total which went to make up the daily maximum. Brackets enclosing one- and 6-hour amounts also denote maxima. Examination of this data shows a few of the wide variety of time sequences that actually occur and that no well-defined sequential pattern emerges. These data also do not reveal periodicity. Usually the maximum 10-minute increment occurs within the maximum hour, and maximum hour within the maximum 6 hours, etc.

SECTION II. APPLICATIONS

Introduction

48. 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 degree of detail presently available, 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 this paper he can easily find them for future use, without having to look through the entire paper 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 paper.

Use of Maps and Tables

Need for judgment

49. Site location. 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.

50. Orographic influences. 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 plains region there is little question but that the smoothed isopluvials give a better estimate of the rainfall regime of a locality than single station data. 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 these influences may have to be made by a person familiar with local conditions, who has more information of storm patterns, and who has observed them. He may even be able to transfer a local topographic relation from a mountain slope where there are good data to a similar nearby slope which lacks data.

51. Average depth over an area. The 3 examples given in table 2-1 include reduction for area. If the particular area of interest is large enough and the isopluvial pattern is complicated enough, there may be a question as to 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.

Table 2-1, with 3 examples, outlines the steps in the order they should be carried through in solving for the required rainfall intensities or depths.

Table 2-1

EXAMPLES OF RAINFALL INTENSITY (DEPTH) DURATION - FREQUENCY - AREA COMPUTATIONS

1.	Location	40° 00' N 75° 00' W	38° 00' N 79° 00' W	35° 00' N 77° 00' W
2.	Required Intensity (Depth) Duration-Frequency-Area	25-Year 3-Hour Rainfall (Inches) for 100 Square Miles	50-Year 12-Hour Rainfall (Inches) for 400 Square Miles	15-Year 30-Min Intensity (In/Hr) for 50 Square Miles
3.	2-Year 1-Hour Rainfall Figure 2-2	1.4 Inches	———	2.0 Inches
4.	2-Year 6-Hour Rainfall Figure 2-3	2.3 Inches	2.3 Inches	3.5 Inches
5.	2-Year 24-Hour Precip. Figure 2-4	———	3.8 Inches	———
6.	Straightedge connecting (3) and (4) or (4) and (5) intersects required duration. Figure 1-1	(2-Year 3-Hour) 1.9 Inches	(2-Year 12-Hour) 3.0 Inches	(2-Year 30-Min) 3.2 In/Hr
7.	100-Year 1-Hour Rainfall / 2-Year 1-Hour Rainfall Figure 2-5	1.9	———	2.2
8.	100-Year 6-Hour Rainfall / 2-Year 6-Hour Rainfall Figure 2-6	1.9	2.1	2.5
9.	100-Year 24-Hour Precip. / 2-Year 24-Hour Precip. Figure 2-7	———	2.2	———
10.	(7) x (3)	(100-Year 1-Hour) 2.7 Inches	———	(100-Year 1-Hour) 4.4 Inches
11.	(8) x (4)	(100-Year 6-Hour) 4.4 Inches	(100-Year 6-Hour) 4.8 Inches	(100-Year 6-Hour) 8.8 Inches
12.	(9) x (5)	———	(100-Year 24-Hour) 8.4 Inches	———
13.	Straightedge connecting (10) and (11) or (11) and (12) intersects required duration. Figure 1-1	(100-Year 3-Hour) 3.7 Inches	(100-Year 12-Hour) 6.7 Inches	(100-Year 30-Min) 6.2 In/Hr
14.	Straightedge connecting (6) and (13) intersects required return period. Figure 1-2	3.0 Inches	6.0 Inches	4.7 In/Hr
15.	Percent of Point Rainfall Figure 1-3	85	87	69
16.	(14) x (15) = (2)	2.6 Inches	5.2 Inches	3.2 In/Hr

52. Examples illustrating use of the seasonal probability diagrams.

Example 1

Determine the probability of occurrence in July of a one-hour rainfall within the range of magnitude of the one- and 2-year values. The one-year one-hour value of 1.2 inches for Philadelphia is estimated from a combination of figures 1-2, 2-2, and 2-5. From figure 2-8, the empirical probability that the one-year one-hour rainfall will be equalled or exceeded in July of any one year is 27 percent or 27 chances out of 100. Similarly, the probability that Philadelphia's 2-year one-hour value of 1.4 inches will be equalled or exceeded in any one July is 14 percent by interpolation. The difference (27% — 14% = 13%) is the probability of occurrence in any one July of a one-hour rainfall within the range 1.2—1.4 inches, inclusive.

Example 2

Assume the hurricane season to be June through October and determine the probability of getting 2.5 inches in 6 hours during this season at a point near Richmond, Va. For a first approximation, determine from the isopluvial map the 2-year 6-hour value near Richmond to be 2.6 inches. Referring to the seasonal probability chart for 6 hours for the 2-year return period, it may be seen that for June through October there is about a 44 percent chance of getting 2.6 inches or more for 6 hours (corresponding to the 2-year 6-hour return period) during the hurricane season. Since the chance of equalling or exceeding 2.5 inches is obviously greater than for 2.6 inches, use the return-period diagram for a second approximation to get a rainfall value for the one-year return period. At the point near Richmond (referring to the map of figure 2-6) we find that the ratio of 100-year to 2-year rainfall is about 2.2. Multiplying 2.6 inches by the ratio, 2.2, to get the 100-year value, we then enter the return-period diagram of figure 1-2 with the 2-year value, 2.6, and 100-year value, 5.7, and obtain a one-year value of 2.2 inches. Referring again to the seasonal probability chart for 6 hours, the probability for the hurricane season at the one-year return period is about 80 percent. The probability of the 2-year value is about 44 percent and one can safely interpolate to the conclusion that the probability of 2.5 inches is about 50 percent. In other words, the probability of 2.5 inches or more rain in 6 hours during the hurricane season is 50 percent; this depth of rainfall will be equalled or exceeded in one season out of two.

If 55 percent, rather than 50 percent, had been interpolated between the one- and 2-year return-period probabilities, the magnitude would, for all practical purposes, be the same; for 55 percent during the hurricane season, the 6-hour value is estimated to be 2.4 inches and for 50 percent it is 2.5 inches.

Example 3

Consider the problem of what infiltration and other loss is necessary in the 2 summer months of June and July for the runoff to equal that in the 4 winter months, assuming 100 percent runoff in the winter, with a 2-year 6-hour rainfall. From the maps and diagrams it is determined that the 2-year 6-hour rainfall for this watershed is 3.0 inches. For June and July, in the 6-hour seasonal probability chart, at the 2-year return-period level, the percentage values are about 6 and 12, respectively, giving a total of 18 percent probability of 3.0 inches being equalled or exceeded during the 2-summer-month season of any one year. For equal probability in the 4-month winter season, in the one-year return period, the seasonal probability chart for December, January, February, and March gives values of 3, 1, 1, and 2, respectively, which is low compared with the total of 18 percent for summer. However, this is at the limit of the chart. Using the return-period diagram, 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 one-year value. Since there is only a 7 percent chance of this value being equalled or exceeded in wintertime, and the 18 percent value is a little smaller, it can be inferred that the infiltration and other loss must be at least the difference between 3.0 inches and 1.4 inches, or 1.6 inches.

Example 4

As an example where interpolation between durations is necessary, consider the first example of table 2-1 where the 25-year 3-hour rainfall is estimated to be 3.0 inches. If the probability of occurrence for July is required, 1.3 and 1.5 percent are estimated from the one- and 6-hour seasonal probability charts, respectively. The 3-hour probability is then interpolated to be 1.4 percent or 14 chances in 1,000 of equalling or exceeding a 3-hour rainfall of 3.0 inches in July of a particular year.

REFERENCES

1, 2. U. S. Weather Bureau, Technical Paper No. 29, "Rainfall intensity-frequency regime, Part 1: The Ohio Valley", June 1957; "Part 2: Southeastern United States", March 1958.

3. U. S. Department of Agriculture, Miscellaneous Publication No. 204, 1935.

4. U. S. Weather Bureau, National Hurricane Research Project Report No. 3, "Rainfall associated with hurricanes (and other tropical disturbances)", July 1956.

5. Corps of Engineers, U. S. Army, "Storm rainfall in the United States", February 1954.

6. U. S. Weather Bureau, Climatological Data, 1897-1956.

7. U. S. Weather Bureau, Hydrologic Bulletin, 1940-1948.

8. U. S. Weather Bureau, Climatological Record Book, 1890-1956.

9. U. S. Weather Bureau, Form 1017, 1890-1956.

10. U. S. Weather Bureau, Climatological Data, National Summary, 1950-1956.

11. U. S. Weather Bureau, Hourly Precipitation Data, 1951-1956.

12. R. K. Linsley Jr., M. A. Kohler, and J. L. H. Paulhus, Applied Hydrology, McGraw-Hill, New York, 1949, p. 76.

13. E. J. Gumbel, "The return periods of flood flows", The Annals of Mathematical Statistics, Volume XII, June 1941, pp. 163-190.

14. U. S. Weather Bureau, Technical Paper No. 25, "Rainfall intensity-duration-frequency curves for selected stations in the United States, Alaska, Hawaiian Islands, and Puerto Rico", December 1955.

RAINFALL INTENSITY (DEPTH) DURATION DIAGRAMS

INTENSITY OR DEPTH OF RAINFALL FOR DURATIONS LESS THAN 6 HOURS

DEPTH OF RAINFALL FOR DURATIONS OF 6 TO 24 HOURS

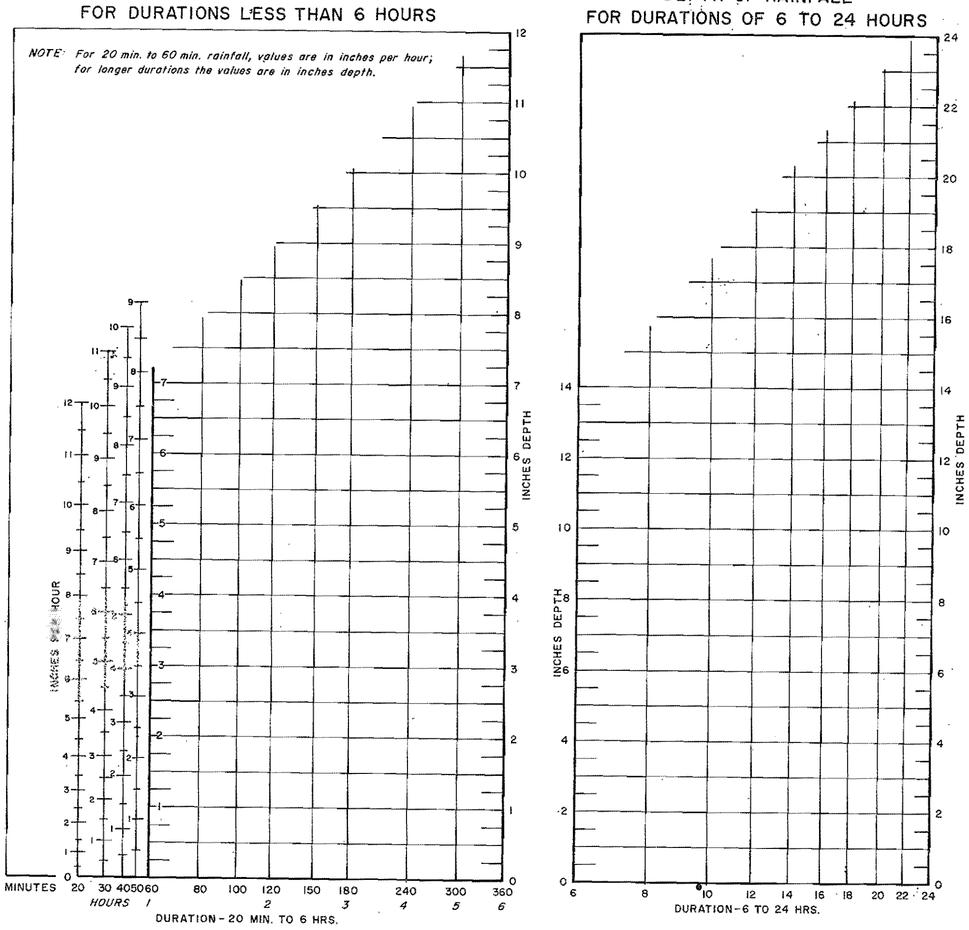


FIGURE 1-1

RAINFALL INTENSITY OR DEPTH VS. RETURN PERIOD

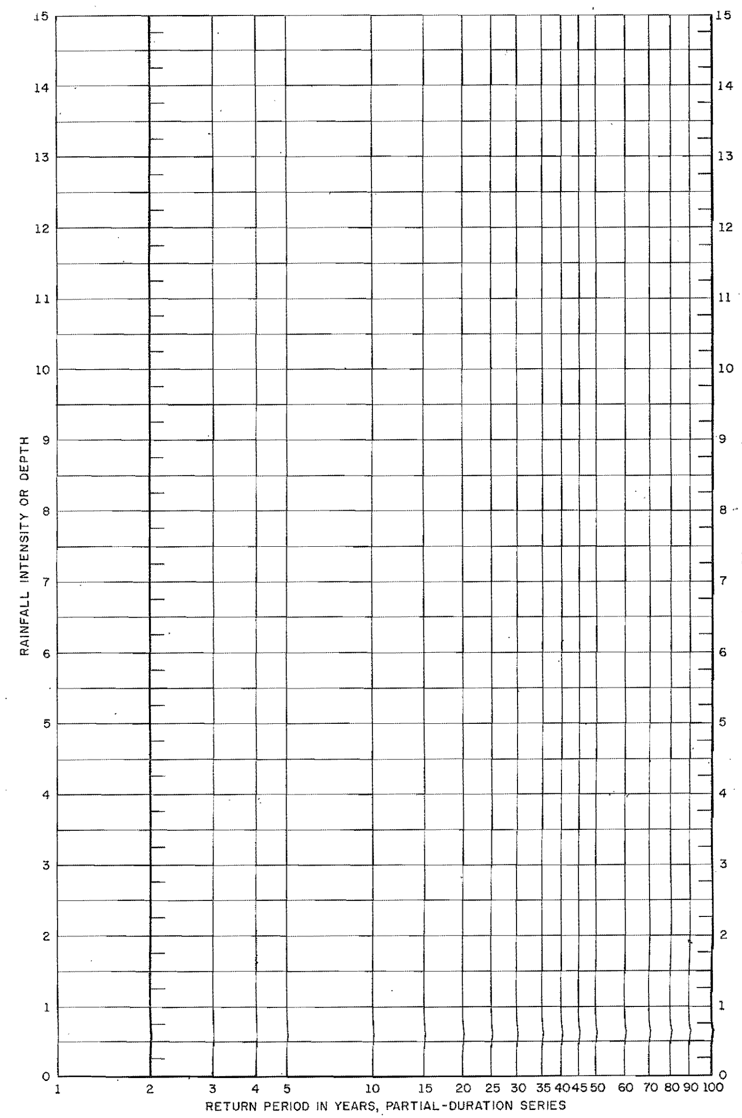


FIGURE 1-2

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

TABLE 2-1

1.	Location	40° 00' N 75° 00' W	38° 00' N 79° 00' W	35° 00' N 77° 00' W
2.	Required Intensity (Depth) Duration-Frequency-Area	25-Year 3-Hour Rainfall (Inches) for 100 Square Miles	50-Year 12-Hour Rainfall (Inches) for 400 Square Miles	15-Year 30-Min Intensity (In/Hr) for 50 Square Miles
3.	2-Year 1-Hour Rainfall Figure 2-2	1.4 Inches	———	2.0 Inches
4.	2-Year 6-Hour Rainfall Figure 2-3	2.3 Inches	2.3 Inches	3.5 Inches
5.	2-Year 24-Hour Precip. Figure 2-4	———	3.8 Inches	———
6.	Straightedge connecting (3) and (4) or (4) and (5) intersects required duration. Figure 1-1	(2-Year 3-Hour) 1.9 Inches	(2-Year 12-Hour) 3.0 Inches	(2-Year 30-Min) 3.2 In/Hr
7.	100-Year 1-Hour Rainfall / 2-Year 1-Hour Rainfall Figure 2-5	1.9	———	2.2
8.	100-Year 6-Hour Rainfall / 2-Year 6-Hour Rainfall Figure 2-6	1.9	2.1	2.5
9.	100-Year 24-Hour Precip. / 2-Year 24-Hour Precip. Figure 2-7	———	2.2	———
10.	(7) x (3)	(100-Year 1-Hour) 2.7 Inches	———	(100-Year 1-Hour) 4.4 Inches
11.	(8) x (4)	(100-Year 6-Hour) 4.4 Inches	(100-Year 6-Hour) 4.8 Inches	(100-Year 6-Hour) 8.8 Inches
12.	(9) x (5)	———	(100-Year 24-Hour) 8.4 Inches	———
13.	Straightedge connecting (10) and (11) or (11) and (12) intersects required duration. Figure 1-1	(100-Year 3-Hour) 3.7 Inches	(100-Year 12-Hour) 6.7 Inches	(100-Year 30-Min) 6.2 In/Hr
14.	Straightedge connecting (6) and (13) intersects required return period. Figure 1-2	3.0 Inches	6.0 Inches	4.7 In/Hr
15.	Percent of Point Rainfall Figure 1-3	85	87	69
16.	(14) x (15) = (2)	2.6 Inches	5.2 Inches	3.2 In/Hr

AREA-DEPTH CURVES

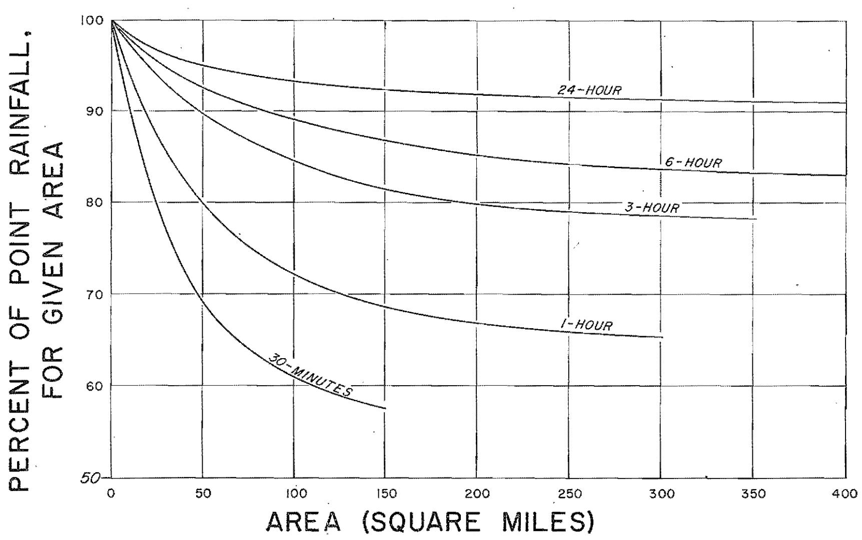


FIGURE 1-3

FIGURE 2-1. DURATION, FREQUENCY, AREA-DEPTH DIAGRAMS, AND EXAMPLES OF COMPUTATION FOR WEATHER BUREAU TECHNICAL PAPER NO. 29, PART 3 (PREPARED JUNE, 1958)

475025 O - 58 (Face p.20) No.1

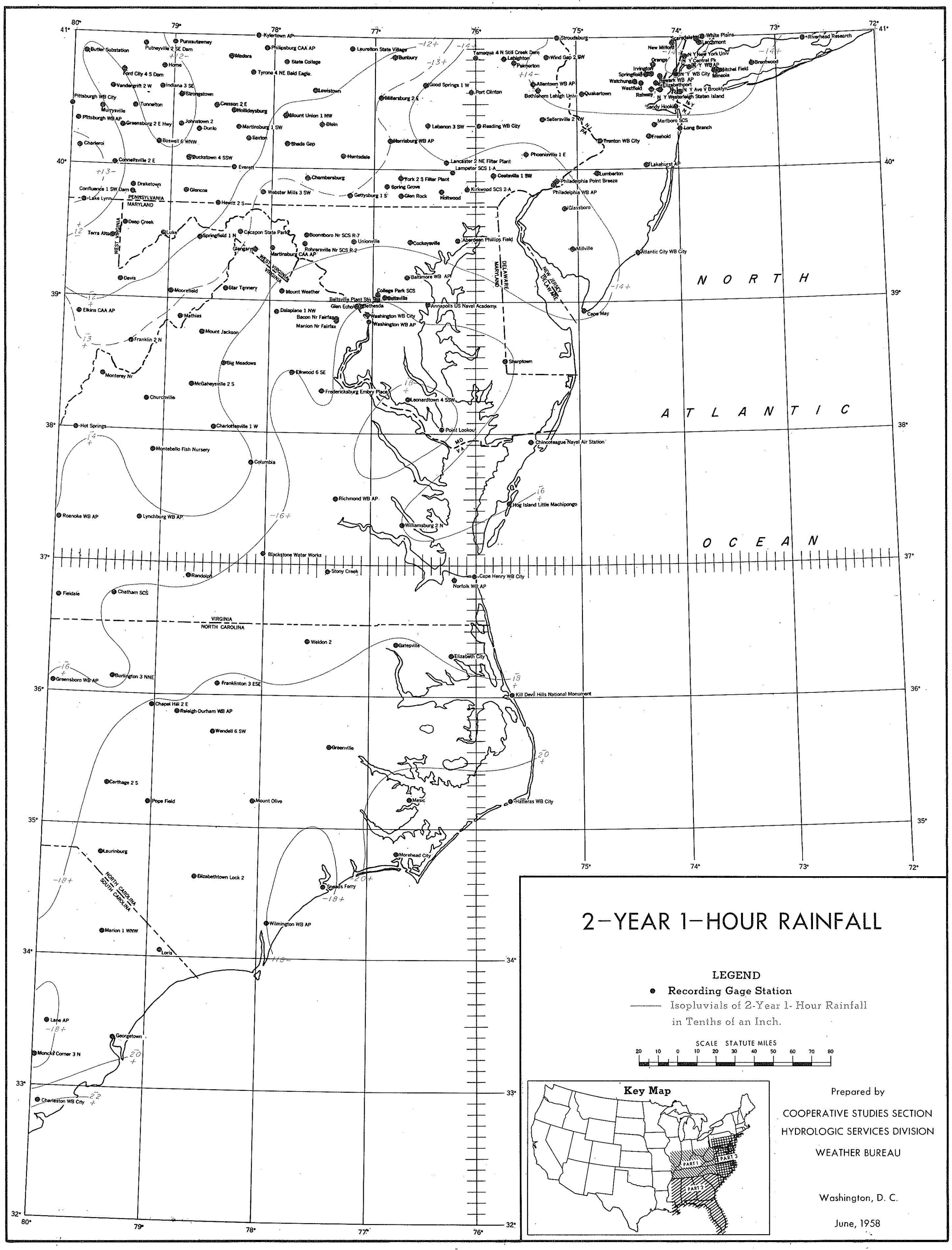


Figure 2-2

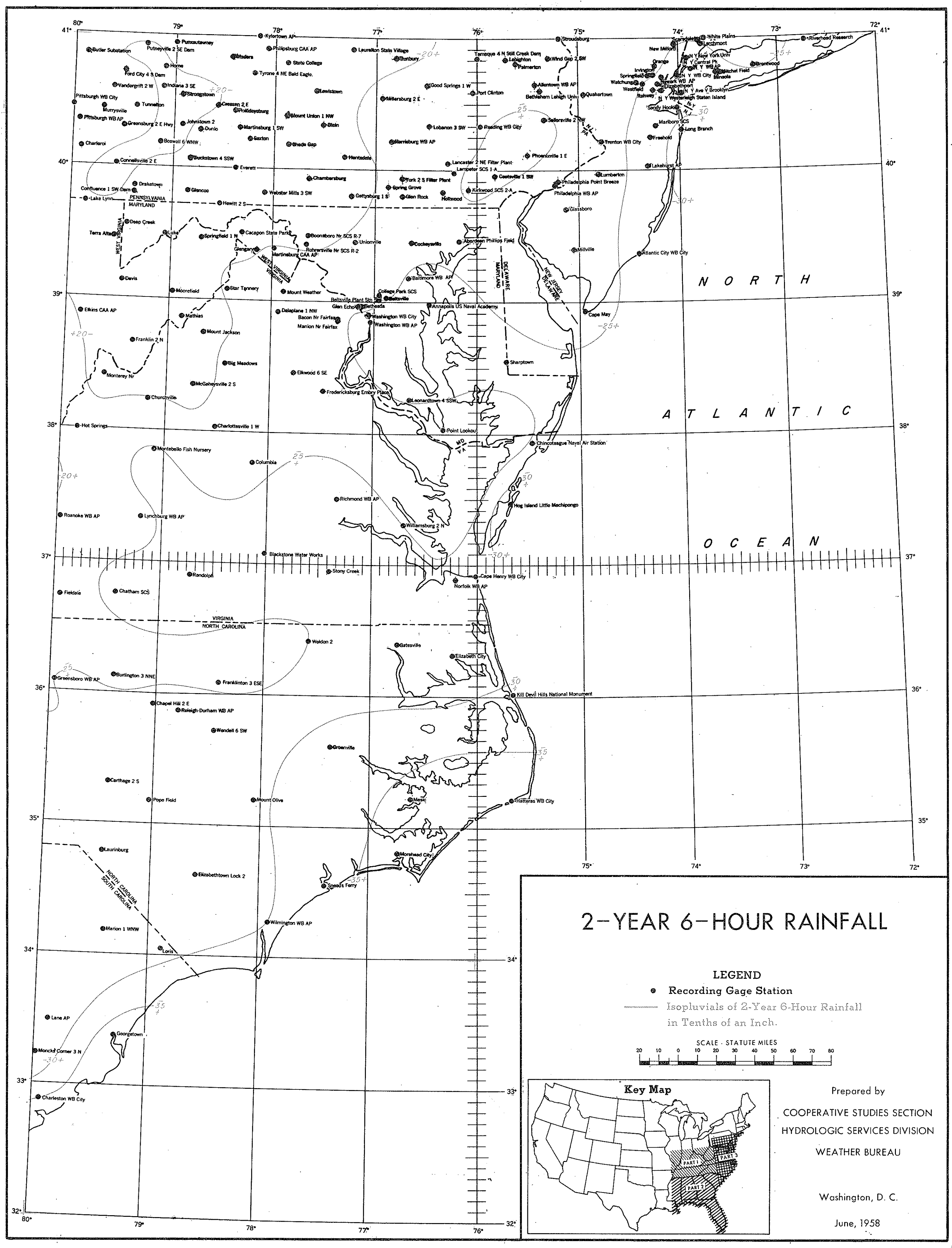

2-YEAR 6-HOUR RAINFALL
LEGEND
Recording Gage Station
Isopluvials of 2-Year 6-Hour Rainfall in Tenths of an Inch.
SCALE - STATUTE MILES
Key Map
Prepared by
COOPERATIVE STUDIES SECTION
HYDROLOGIC SERVICES DIVISION
WEATHER BUREAU
Washington, D. C.
June, 1958
NORTH
ATLANTIC
OCEAN
PENNSYLVANIA
MARYLAND
VIRGINIA
NORTH CAROLINA

Figure 2-3

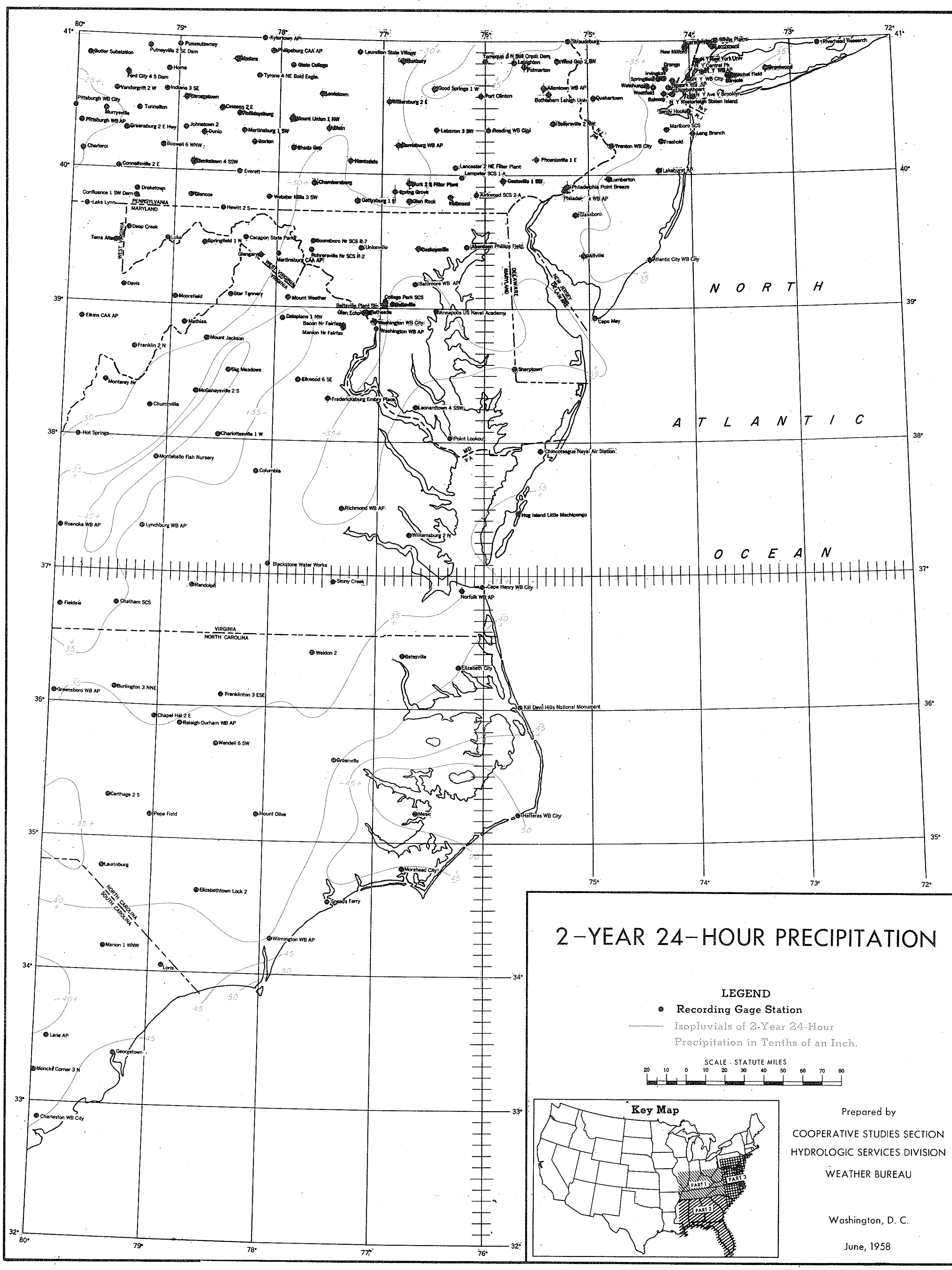

NORTH ATLANTIC OCEAN
2-YEAR 24-HOUR PRECIPITATION
LEGEND
Recording Gage Station
Isopluvials of 2-Year 24-Hour Precipitation in Tenths of an Inch.
SCALE - STATUTE MILES
Key Map
Prepared by
COOPERATIVE STUDIES SECTION
HYDROLOGIC SERVICES DIVISION
WEATHER BUREAU
Washington, D. C.
June, 1958

Figure 2-4

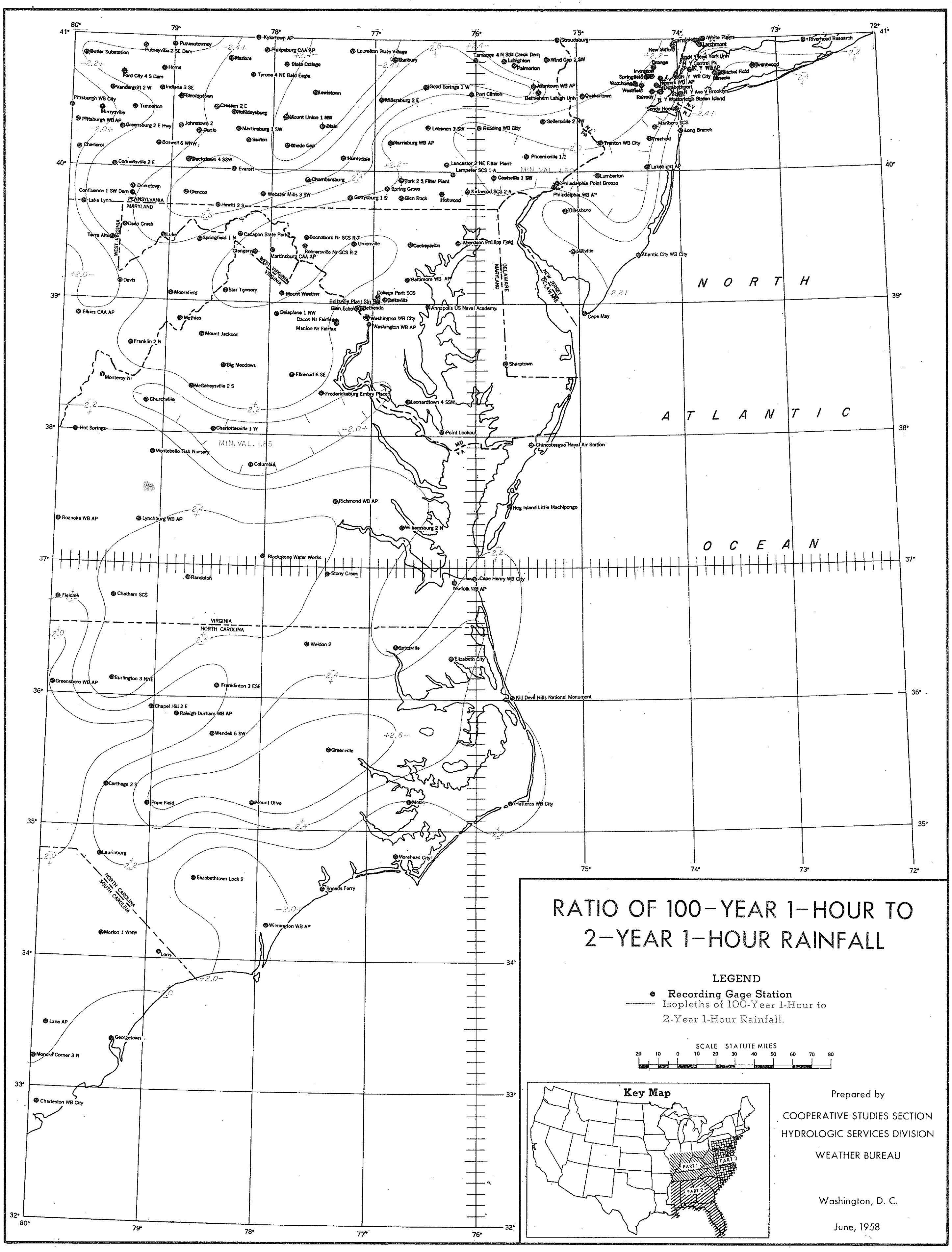

RATIO OF 100-YEAR 1-HOUR TO
2-YEAR 1-HOUR RAINFALL
LEGEND
Recording Gage Station
Isopleths of 100-Year 1-Hour to
2-Year 1-Hour Rainfall.
SCALE STATUTE MILES
Key Map
Prepared by
COOPERATIVE STUDIES SECTION
HYDROLOGIC SERVICES DIVISION
WEATHER BUREAU
Washington, D. C.
June, 1958
NORTH
ATLANTIC
OCEAN

Figure 2-5

475025 O - 58 (Face p. 20) No. 5

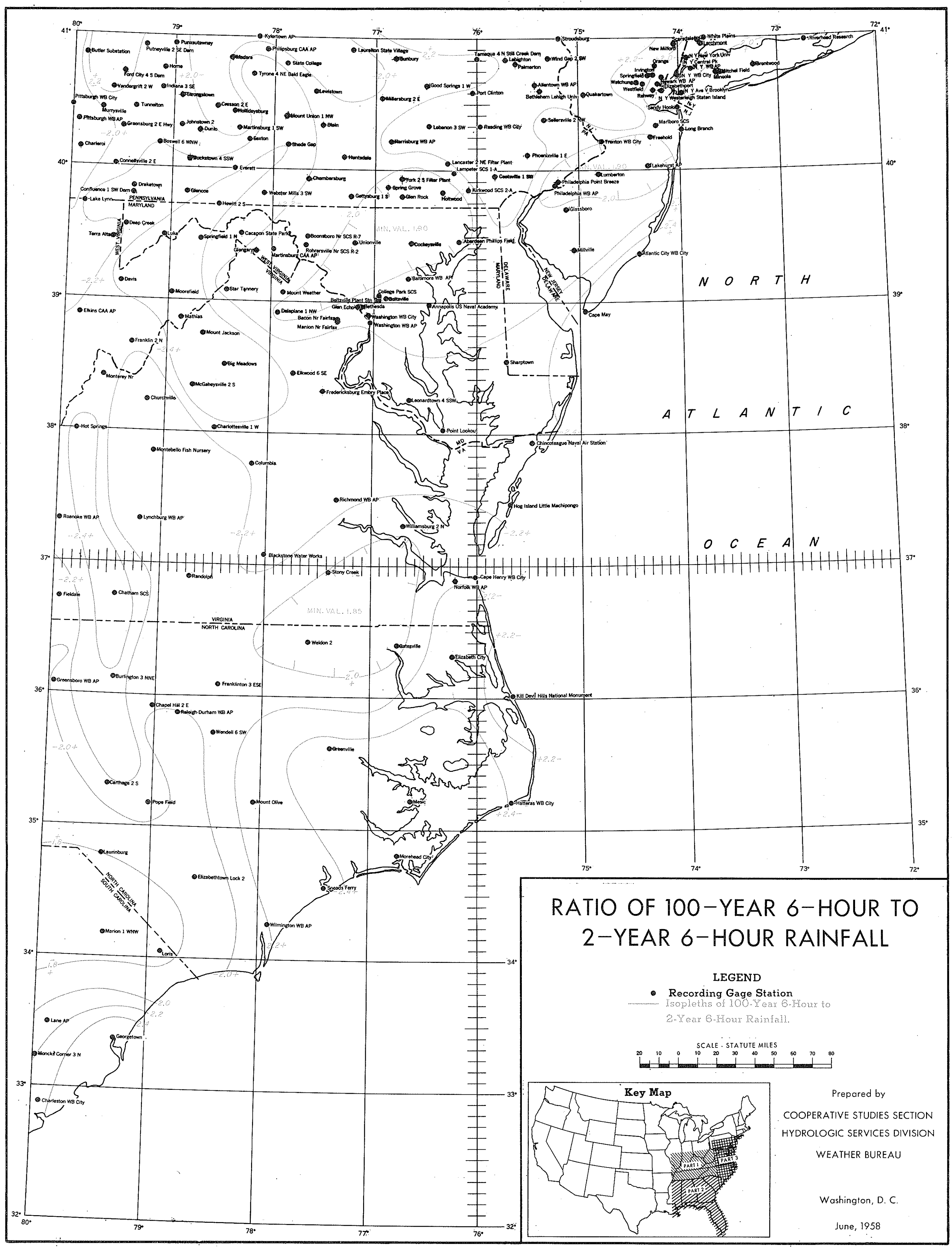


Figure 2-6

475025 O -58 (Face p.20) No. 6

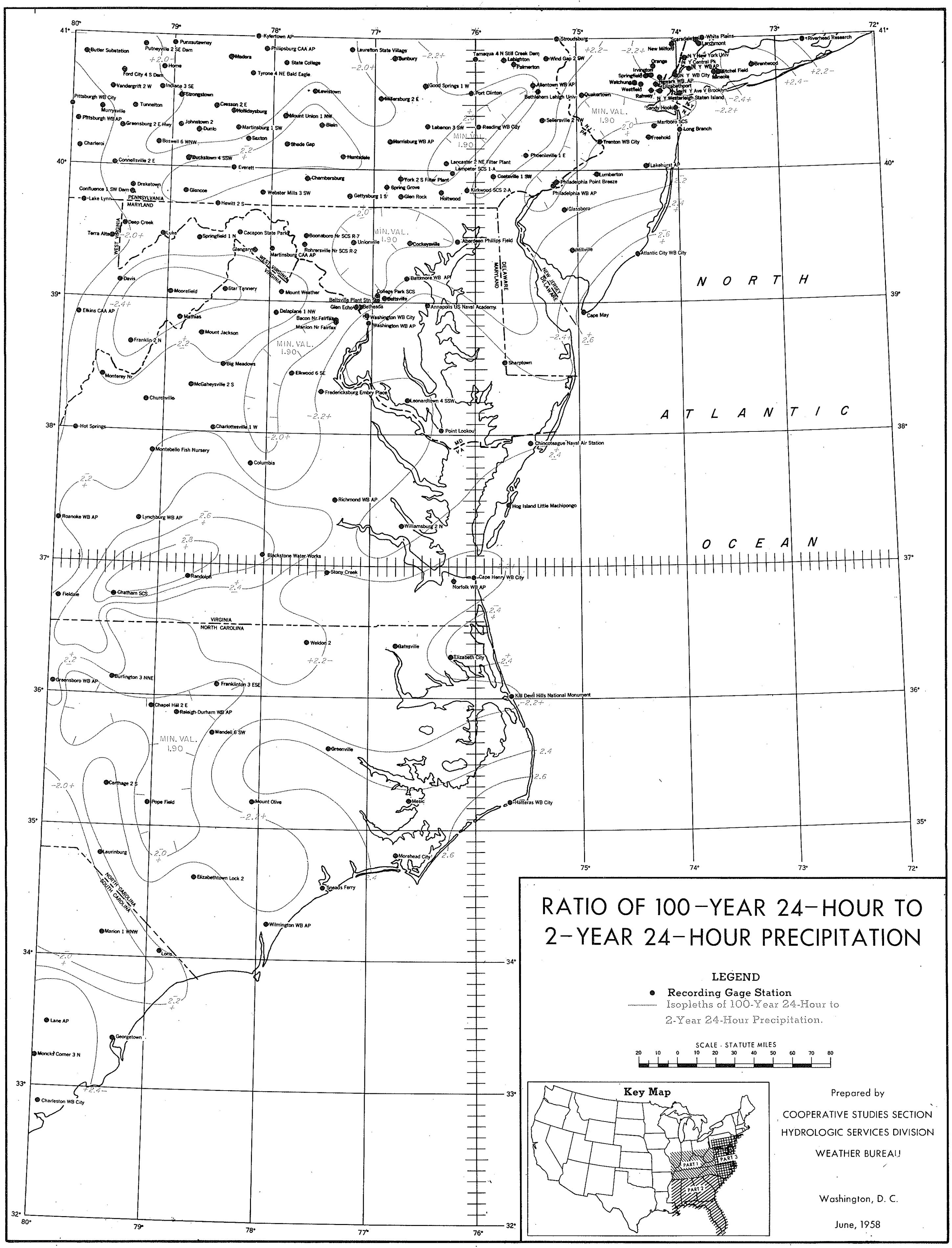


Figure 2-7

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

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour Rainfall (inches)	2-Year 6-Hour Rainfall (inches)	2-Year 24-Hour Precipitation (inches)
DELAWARE							
Bridgeville 1 NW	38 45	75 37	1939-56	18			3.49
Delaware City Reedy Point	39 34	75 35	1939-53	15			3.19
Dover	39 09	75 31	1892-56*	53			3.61
Georgetown 5 SW	38 38	75 28	1947-56	10			3.64
Lewes	38 46	75 08	1945-56	12			3.94
Milford	38 55	75 26	1893-56*	60			3.54
Millsboro	38 35	75 19	1893-53	61			3.42
Newark College Farm	39 40	75 44	1940-56	17			3.22
Newark Pumping Station	39 40	75 45	1939-48	10			3.41
Wilmington City Hall	39 45	75 33	1939-56	18			3.10
Wilmington New Castle WB AP	39 41	75 36	1948-56	9			3.19
Wilmington Porter Reservoir	39 46	75 32	1939-56	18			3.64
DISTRICT OF COLUMBIA							
Dalecarlia Reservoir	38 56	77 07	1949-56	8			3.04
National Arboretum	38 54	76 58	1949-56	8			3.78
U. S. Soldiers Home	38 56	77 01	1949-56	8			3.62
Washington WB City	38 54	77 03	1905-56	52	1.77	2.66	3.44
MARYLAND							
Aberdeen Phillips Field	39 28	76 10	1939-56	18			3.04
Aberdeen Phillips Field	39 28	76 10	1943-50	8	1.22	2.04	3.19
Annapolis U. S. Naval Academy	38 59	76 29	1896-56*	60			3.41
Annapolis U. S. Naval Academy	38 59	76 28	1942-48	7	1.44	2.99	4.13
Annapolis 2 WNW	38 59	76 31	1952-56	5			3.67
Baltimore Parkville	39 23	76 32	1949-56	8			3.58
Baltimore Sledds Point	39 12	76 34	1950-56	7			3.44
Baltimore WB AP	39 11	76 40	1894-56	63	1.58	2.56	3.54
Beltsville	39 02	76 53	1942-56	15			4.31
Beltsville	39 02	76 53	1940-50	11	1.70	1.98	2.45
Beltsville Plant Station 1	39 02	76 56	1949-56	8			3.78
Beltsville Plant Station 2	39 02	76 56	1949-56	8			3.29
Beltsville Plant Station 3	39 02	76 56	1949-56	8			3.59
Beltsville Plant Station 4	39 02	76 56	1949-56	8			3.26
Beltsville Plant Station 5	39 01	76 57	1949-56	8			3.70
Beltsville Plant Station 5	39 01	76 57	1949-56	8	1.34	2.21	3.50
Beltsville Plant Station 6	39 01	76 57	1949-56	8			3.73
Benson Police Barracks	39 30	76 23	1949-56	8			3.67
Bentley Springs 1 WNW	39 41	76 42	1939-56	18			3.80
Bethesda	38 58	77 07	1945-56	12	1.52	2.34	3.15
Bethesda National Institute of Health	39 00	77 06	1951-56	6			3.25
Blackwater Refuge	38 26	76 08	1942-56	15			3.40
Boonsboro (nr) SCS R-7	39 30	77 39	1941-47*	6	1.22	1.94	3.05
Boyds 2 NW	39 12	77 20	1939-56	18			3.12
Brighton Dam	39 12	77 01	1949-56	8			3.48
Brookdale	38 57	77 06	1949-56	8			3.05
Burnt Mills Reservoir	39 02	77 00	1949-56	8			3.42
Cambridge 4 W	38 34	76 09	1893-56*	54			3.64
Charlotte Hall 2 ESE	38 28	76 45	1939-56	18			3.82
Cheltenham 1 NW	38 44	76 51	1901-56	56			3.74
Chestertown	39 13	76 04	1939-56	18			3.17
Chewsville Bridgeport	39 38	77 41	1899-56	58			2.96
Clear Spring	39 40	77 54	1899-56*	45			2.95
Cockeysville	39 27	76 38	1942-50	9	1.38	2.37	3.75
Coleman 3 WNW	39 21	76 08	1899-56*	56			3.19
College Park	38 59	76 56	1894-56	63			3.27
College Park SCS	39 03	76 57	1941-49*	8	1.48	2.44	3.82
Conowingo Dam	39 39	76 10	1939-56	18			3.24
Conowingo Police Barracks	39 39	76 11	1949-56	8			3.10
Crisfield	37 59	75 52	1939-56	18			3.26
Cumberland	39 39	78 45	1892-56*	60			2.51
Cumberland Police Barracks	39 38	78 50	1949-56	8			2.72
Deep Creek	39 34	79 26	1935-39	5	1.44	2.18	3.09
Denton	38 53	75 50	1939-56	18			3.35
District Heights	38 51	76 54	1949-56	8			3.55
Dundalk	39 16	76 31	1939-56*	15			3.48
Easton Police Barracks	38 46	76 01	1892-56*	64			3.34
Edgemont	39 40	77 33	1939-56	18			3.22
Elkton	39 36	75 50	1939-56	18			3.53
Emmitsburg 2 SE	39 41	77 18	1939-56	18			3.01
Fallston	39 31	76 25	1892-52	61			3.44
Fort George G. Meade	39 06	76 45	1942-56	15			4.14
Frederick Police Barracks	39 25	77 26	1892-56	65			3.01
Frederick WB AP	39 25	77 23	1944-56	13			3.02
Frederick 3 E	39 24	77 22	1949-56	8			3.43
Friendsville 4 NNW	39 42	79 25	1939-52	11			2.39
Frostburg	39 39	78 56	1939-56	18			3.28
Georgetown District Reservoir	39 22	75 54	1939-44	6			2.63
Glen Echo	38 58	77 09	1944-56	13	1.51	2.42	3.20
Glenn Dale Bell Station	38 58	76 48	1939-56	18			3.90
Great Falls	39 00	77 15	1892-50*	58			2.86

*Breaks in Record

Table 2-2, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour Rainfall (inches)	2-Year 6-Hour Rainfall (inches)	2-Year 24-Hour Precipitation (inches)
MARYLAND (continued)							
Greenbelt	39 01	76 52	1949-56	8			4.09
Hagerstown	39 39	77 44	1948-56	9			3.20
Hancock Fruit Laboratory	39 42	78 11	1895-56*	45			2.78
Keedysville	39 29	77 42	1939-56	18			3.30
La Plata 1 W	38 32	77 00	1939-56*	16			3.80
Laurel 3 W	39 06	76 54	1895-56*	57			3.35
Leonardtown 4 SSW	38 15	76 39	1939-53*	13			3.36
Leonardtown 4 SSW	38 15	76 39	1944-50	7	2.00	2.75	3.83
Loch Raven Dam	39 26	76 33	1951-56	6			3.46
Luke	39 28	79 04	1939-56	18			2.90
Luke	39 29	79 03	1943-50	8	1.10	1.90	2.43
Merrill	39 36	79 05	1951-56	6			3.16
Middle River	39 18	76 25	1950-56	7			3.48
Millington	39 15	75 50	1939-56	18			3.19
Mount Savage Summit	39 40	78 58	1939-45	7			3.04
New Germany	39 38	79 07	1950-56*	5			3.82
Oakland 1 SE	39 24	79 24	1893-56*	56			2.57
Ocean City	38 20	75 05	1939-56*	16			2.94
Owings Ferry Landing	38 42	76 41	1939-56	18			4.10
Oxford	38 42	76 10	1939-54	16			3.36
Parkton 2 SW	39 38	76 42	1939-56	18			3.29
Perry Point	39 33	76 04	1939-53	15			3.37
Picardy	39 33	78 30	1939-56*	17			2.78
Pikesville Police Barracks	39 23	76 43	1949-56	8			3.38
Pleasant Hill	39 26	76 48	1939-43	5			2.98
Pocomoke City 4 SW	38 01	75 37	1940-56*	12			3.84
Point Lookout	38 02	76 19	1942-46	5	2.03	2.39	3.16
Preston 1 S	38 42	75 55	1949-56	8			4.19
Prince Frederick	38 32	76 35	1939-56	18			4.02
Princess Anne 1 E	38 12	75 40	1894-55*	59			3.32
Randallstown Police Barracks	39 23	76 50	1949-56	8			3.37
Riverdale	38 58	76 56	1949-54	6			3.42
Rock Hall 3 N	39 11	76 14	1939-56*	17			3.18
Rockville	39 05	77 09	1949-56	8			3.13
Rohrersville (nr) SCS R-2	39 26	77 40	1941-47*	6	1.14	1.90	3.03
Royal Oak	38 43	76 11	1949-56	8			4.54
Salisbury	38 22	75 36	1906-56*	50			3.51
Salisbury CAA AP	38 20	75 30	1949-56	8			3.62
Salisbury Police Barracks	38 25	75 34	1949-56	8			3.18
Savage River Dam	39 31	79 08	1949-56	8			3.76
Shallmar	39 23	79 12	1950-56	7			3.79
Sharptown	38 33	75 43	1942-50	9	1.64	2.70	3.07
Sines Deep Creek	39 31	79 25	1939-56	18			2.66
Snow Hill	38 10	75 24	1939-56	18			4.00
Solomons	38 19	76 27	1892-56	65			3.15
State Sanatorium	39 43	77 27	1939-47	9			3.06
Takoma Park Baltimore Avenue	38 59	77 01	1899-48*	49			2.85
Takoma Park Mississippi Avenue	38 59	77 00	1939-56	18			3.32
Tonoloway	39 40	78 15	1939-56	18			2.68
Towson	39 24	76 36	1907-56*	40			3.22
Unionville	39 27	77 11	1940-56	17			3.60
Unionville	39 27	77 11	1940-50	11	1.80	2.55	3.57
Vienna	38 29	75 50	1949-56	8			2.94
Viers Mill	39 03	77 05	1950-56	7			3.00
Waldorf Police Barracks	38 39	76 53	1949-56	8			3.37
Waterloo Police Barracks	39 10	76 47	1949-56	8			3.43
Western Port	39 29	79 02	1895-56	62			2.55
Westminster	39 35	77 00	1939-56	18			3.46
White Hall	39 37	76 38	1948-52	5			3.14
Williamsport	39 37	77 51	1939-56	18			3.12
Woodstock	39 20	76 53	1892-56*	64			3.37
NEW JERSEY							
Atlantic City WB City	39 22	74 25	1901-56	56	1.47	2.67	3.65
Audubon	39 54	75 04	1950-56	7			3.16
Barnegat City	39 46	74 06	1940-45	6			3.14
Bass River State Forest	39 37	74 26	1946-56*	10			3.53
Belleplain	39 16	74 52	1939-56	18			4.06
Belmar	40 10	74 02	1942-56	15			4.18
Belvidere	40 50	75 05	1897-56	60			3.29
Berlin 1 W	39 48	74 57	1941-56	16			3.40
Boonton 2 SE	40 54	74 24	1939-56	18			3.31
Bridgeton 1 NE	39 28	75 12	1897-56*	58			3.33
Brooklawn	39 53	75 07	1941-49	9			3.20
Burlington	40 04	74 53	1907-56	50			3.00
Canoe Brook	40 45	74 21	1939-56	18			3.61
Canton	39 28	75 25	1946-56	11			3.42
Cape May	38 56	74 57	1942-49	8	1.33	2.41	3.10
Cape May 3 W	38 56	74 57	1897-56*	50			2.98
Cedar Grove	40 52	74 13	1949-56	8			4.07
Chatham	40 44	74 23	1939-56	18			3.53

*Breaks in Record

Table 2-2, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour Rainfall (inches)	2-Year 6-Hour Rainfall (inches)	2-Year 24-Hour Precipitation (inches)
NEW JERSEY (continued)							
Chatsworth 5 S	39 44	74 32	1941-55	15			2.95
Clayton	39 39	75 06	1897-56*	46			3.40
Clinton	40 38	74 55	1943-56	14			3.34
Deepwater	39 41	75 30	1949-56	8			2.89
Dover	40 53	74 34	1897-44	48			3.37
Elizabeth	40 40	74 14	1897-56*	58			3.62
Elizabethport	40 39	74 12	1940-56	17	1.34	2.65	3.87
Essex Fells Service Building	40 50	74 18	1945-56	12			3.78
Flemington 1 NE	40 31	74 51	1898-56	59			3.14
Fortscue	39 14	75 10	1949-55	7			3.02
Freehold	40 15	74 17	1939-56	18			3.60
Freehold	40 15	74 17	1941-56	16	1.47	3.02	3.81
Glassboro	39 42	75 07	1941-56	16	1.25	1.93	2.81
Hammonton 2 NNE	39 39	74 48	1897-56*	43			3.49
Hightstown 1 N	40 16	74 31	1897-56*	57			3.20
Indian Mills 2 W	39 48	74 47	1901-56	56			3.67
Irvington	40 43	74 15	1940-56	17	1.38	2.65	3.68
Jersey City	40 44	74 04	1906-56	51			3.42
Lakehurst AP	40 02	74 19	1941-49	9	1.88	2.59	3.40
Lakewood 2 ENE	40 06	74 11	1901-56*	51			3.81
Lambertville	40 22	74 57	1897-56	60			3.10
Little Falls 1 E	40 53	74 14	1939-56	18			3.92
Long Branch	40 18	73 59	1939-56	18			4.10
Long Branch	40 18	73 59	1941-56	16	1.55	3.02	4.15
Long Valley	40 48	74 46	1940-56	17			3.50
Lumberton	39 58	74 48	1946-50	5	1.63	2.45	3.43
Manville	40 33	74 34	1946-56	11			3.32
Marlboro SCS	40 20	74 14	1941-56	16	1.74	2.93	4.03
Marlton 1 W	39 54	74 57	1941-56	16			3.36
Mays Landing	39 27	74 44	1944-56	13			3.60
Midland Park	40 59	74 09	1945-56	12			4.15
Millville	39 24	75 03	1941-56	16			3.12
Millville	39 24	75 03	1941-56	16	1.33	2.33	3.02
Millville CAA AP	39 22	75 04	1949-56	8			3.08
Moorestown	39 58	74 58	1897-56	60			3.43
Morris Plains	40 50	74 30	1942-56	15			3.84
Newark WB AP	40 42	74 10	1897-43*	36			3.84
Newark WB AP	40 42	74 10	1944-56	13	1.21	2.34	3.25
New Brunswick Experimental Station	40 28	74 26	1897-56	60			3.47
New Milford	40 57	74 02	1940-56	17	1.21	2.74	3.68
Orange	40 47	74 14	1940-56*	16			3.66
Orange	40 47	74 14	1940-49	10	1.31	2.79	3.77
Paterson	40 55	74 09	1897-56*	58			3.48
Pemberton 3 E	39 58	74 38	1939-56	18			4.04
Phillipsburg	40 41	75 12	1903-56*	53			3.30
Phillipsburg Bridge	40 42	75 12	1949-56	8			3.36
Plainfield	40 36	74 25	1897-56*	59			3.69
Plainsboro	40 19	74 36	1941-48	8			3.22
Pleasantville 1 N	39 25	74 31	1903-56	54			3.72
Princeton Water Works	40 19	74 40	1950-56	7			3.83
Quakertown	40 34	74 57	1940-49	10	1.15	1.81	2.75
Rahway	40 36	74 15	1940-56	17			4.18
Rahway	40 36	74 15	1940-56	17	1.32	2.68	3.93
Ridgefield	40 50	74 01	1939-56	18			3.79
Runnemede	39 51	75 04	1948-52	5			3.01
Runyon	40 26	74 20	1939-56	18			3.36
Rutherford	40 49	74 07	1945-50	6			3.07
Sandy Hook	40 28	74 01	1941-50	10	1.37	2.73	3.68
Sandy Hook	40 28	74 01	1915-40*	24	1.38	2.45	3.10
Sandy Hook Life Boat Station	40 28	74 01	1951-56	6			3.89
Somerville	40 34	74 37	1897-56*	59			3.29
Split Rock Pond	40 58	74 28	1949-56	8			3.53
Springfield	40 43	74 18	1941-56	16	1.34	2.72	3.72
Swedesboro	39 44	75 19	1946-53	8			3.54
Swedesboro 5 NW	39 47	75 24	1948-56	9			3.37
Toms River	39 57	74 14	1939-56	18			4.13
Trenton	40 14	74 46	1897-12*	15			3.58
Trenton WB City	40 13	74 46	1913-56	44	1.47	2.30	3.05
Trenton 2	40 14	74 46	1939-56	18			3.76
Tuckerton	39 36	74 20	1898-53*	54			3.67
Vineland	39 29	75 00	1939-56	18			3.77
Watchung	40 40	74 25	1945-50	6	1.10	2.32	2.99
Westfield	40 39	74 21	1940-56*	16			3.60
Westfield	40 39	74 21	1940-56*	16	1.34	2.59	3.58
Woodstown 2 NW	39 40	75 20	1940-55*	14			2.76
NEW YORK							
Babylon	40 42	73 19	1943-56	14			4.44
Brentwood	40 47	73 15	1942-56	15	1.36	3.04	3.76
Bridgehampton	40 57	72 18	1939-56	18			3.61
Eastchester	40 56	73 48	1948-56	9			3.64
Farmingdale 2 NE	40 45	73 26	1945-56	12			3.41

*Breaks in Record

Table 2-2, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour Rainfall (inches)	2-Year 6-Hour Rainfall (inches)	2-Year 24-Hour Precipitation (inches)
NEW YORK (continued)							
Fort Schuyler	40 48	73 48	1948-56	9			3.29
Freeport	40 40	73 36	1948-56	9			3.44
Hempstead Garden City	40 43	73 38	1950-56	7			4.40
Hempstead Malverne	40 41	73 40	1948-56	9			3.56
Lake Ronkonkoma	40 50	73 08	1948-56	9			3.79
Larchmont	40 57	73 46	1941-50	10	1.74	2.81	3.56
Mineola	40 44	73 38	1939-56*	8			3.97
Mineola	40 44	73 38	1941-50	10	1.21	2.64	3.31
Mitchel Field	40 44	73 36	1941-50*	9	1.21	2.43	3.07
New York Avenue V Brooklyn	40 35	73 58	1940-50	11	1.22	2.14	3.10
New York Central Park	40 47	73 58	1944-56	13			3.06
New York Central Park	40 47	73 58	1940-50	11	1.34	2.47	3.22
New York Laurel Hill	40 44	73 56	1951-56	6			4.61
New York University	40 51	73 55	1940-50	11	1.49	2.82	3.52
New York WB AP	40 46	73 52	1940-56*	16	1.46	2.51	3.50
New York WB City	40 42	74 01	1899-56*	55	1.45	2.55	3.58
New York Westerleigh Staten Island	40 36	74 10	1951-56	6			4.26
New York Westerleigh Staten Island	40 36	74 10	1940-50	11	1.55	2.81	3.57
Patchogue	40 46	73 01	1939-56	18			3.68
Riverhead Research	40 58	72 43	1939-56	18			3.32
Riverhead Research	40 58	72 43	1946-50	5	1.67	2.81	3.62
Scarsdale	40 59	73 48	1904-56*	50			3.61
Scarsdale	40 59	73 48	1944-50	7	1.37	2.57	4.01
Setauket	40 57	73 06	1897-56	60			3.38
White Plains	41 00	73 44	1944-50	7	1.19	2.26	3.66
NORTH CAROLINA							
Arcola	36 16	77 39	1939-47	9			3.42
Asheboro 2 W	35 42	79 50	1939-56	18			4.56
Beaufort	34 43	76 40	1939-47	9			4.02
Belhaven	35 33	76 38	1939-56*	16			5.09
Burlington Filter Plant	36 05	79 25	1946-56	11			3.85
Burlington 3 NNE	36 08	79 24	1941-56*	15	1.41	2.28	3.12
Carthage 1 SSE	35 20	79 24	1946-56	11			4.73
Carthage 2 S	35 19	79 25	1941-56	16	1.89	2.96	3.86
Cedar Island	34 59	76 18	1950-56*	6			4.56
Chapel Hill 2 E	35 55	79 01	1943-50	8	1.69	2.49	3.19
Chapel Hill 2 W	35 55	79 06	1897-56*	58			3.35
Clinton	35 00	78 19	1939-56	18			3.52
Durham	36 02	78 58	1899-56*	48			3.14
Edenton	36 03	76 37	1897-56	60			3.99
Elizabeth City	36 19	76 13	1939-56*	17			4.44
Elizabeth City	36 19	76 13	1942-56	15	1.73	2.86	3.96
Elizabethtown Lock 2	34 37	78 35	1939-56	18			3.62
Elizabethtown Lock 2	34 37	78 35	1941-56	16	1.88	2.63	3.77
Enfield 3 S	36 09	77 41	1910-56	47			3.32
Fayetteville 2 SE	35 02	78 50	1897-56	60			3.84
Franklinton 3 ESE	36 06	78 25	1940-56	17	1.67	2.46	3.39
Gatesville	36 24	76 45	1941-56	16	1.88	2.75	3.65
Goldsboro	35 23	77 59	1897-56	60			3.79
Goldsboro 3 SSW	35 21	78 02	1949-56	8			3.80
Graham	36 04	79 24	1902-56	55			3.56
Greensboro Pump Station	36 05	79 48	1897-56*	58			3.43
Greensboro WB AP	36 05	79 57	1929-56*	27	1.57	2.55	3.67
Greenville	35 37	77 22	1897-56*	54			3.74
Greenville	35 37	77 22	1942-56	15	1.90	3.32	4.19
Hamlet	34 53	79 43	1950-56	7			4.33
Hatteras WB City	35 13	75 41	1905-56*	51	2.10	3.72	5.07
Henderson 2 SW	36 19	78 26	1897-56	60			3.42
Jackson	36 24	77 25	1949-56	8			3.42
Jackson Springs 5 WNW	35 13	79 44	1949-56	8			5.16
Kill Devil Hills National Monument	36 01	75 40	1941-56	16	1.88	3.21	4.49
Kinston	35 16	77 35	1900-56*	52			3.84
Lake Michie	36 11	78 52	1946-56	11			3.32
Lake Raleigh	35 45	78 41	1946-56	11			4.18
Laurinburg	34 47	79 27	1946-56	11			4.24
Laurinburg	34 47	79 27	1941-56	16	1.99	2.88	3.85
Louisburg	36 06	78 19	1897-56	60			3.40
Lumberton	34 37	79 01	1897-56*	58			3.80
Lumberton CAA AP	34 37	79 04	1949-56	8			4.03
Manchester	35 12	78 59	1947-56	10			3.56
Mangums Store	36 11	78 49	1946-56	11			3.59
Manteo	35 55	75 40	1905-56	52			4.48
Maysville 6 SW	34 50	77 18	1950-56	7			4.98
McCullers 1 W	35 40	78 42	1946-56	11			4.32
Mesic	35 13	76 37	1941-50	10	2.20	3.83	5.61
Moncure 3 SE	35 35	79 03	1897-56	60			3.58
Morehead City	34 43	76 44	1941-50	10	2.08	3.59	4.34
Mount Olive	35 12	78 04	1941-56	16	1.88	2.93	3.83
Nashville	35 58	77 58	1904-56	53			3.79
Neuse	35 54	78 34	1939-56	18			4.30
New Bern CAA AP	35 05	77 02	1948-56	9			5.34

* Breaks in Record

Table 2-2, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour Rainfall (inches)	2-Year 6-Hour Rainfall (inches)	2-Year 24-Hour Precipitation (inches)
NORTH CAROLINA (continued)							
New Bern 3 NW	35 08	77 05	1897-56	60			4.19
New Holland	35 27	76 11	1939-56	18			5.34
Oriental	35 02	76 42	1952-56	5			4.39
Oxford 2 SW	36 17	78 37	1939-56	18			3.29
Pinehurst	35 12	79 28	1904-56	53			3.82
Plymouth 5 E	35 52	76 39	1945-56	12			4.45
Pope Field	35 11	79 02	1941-56	16	1.81	2.80	4.33
Raleigh Durham WB AP	35 52	78 47	1903-56	54	1.80	2.78	3.71
Raleigh State College	35 47	78 38	1939-56*	7			4.14
Raleigh 3 W	35 47	78 41	1950-56	7			4.32
Ramseur 6 S	35 38	79 39	1946-56	11			4.56
Randleman	35 48	79 49	1905-56	52			3.58
Red Springs	34 49	79 12	1939-56*	17			4.37
Reidsville	36 22	79 40	1902-56	55			3.50
Rockingham	34 57	79 47	1939-47	9			3.29
Rocky Mount	35 57	77 50	1939-56	18			3.95
Rocky Mount CAA AP	35 58	77 48	1949-56*	7			3.76
Rocky Mount 8 ESE	35 54	77 43	1949-56	8			3.55
Rougemont	36 13	78 55	1939-56	18			3.37
Roxboro 2 WNW	36 24	79 00	1939-56	18			3.34
Sanford 4 ESE	35 29	79 07	1952-56	5			5.22
Scotland Neck 5 NE	36 12	77 23	1904-56	53			3.34
Siler City	35 43	79 27	1939-56	18			3.98
Sloan 3 S	34 47	77 49	1897-56	60			3.72
Smithfield	35 30	78 20	1939-56	18			4.13
Sneads Ferry	34 33	77 24	1943-50	8	1.75	3.19	4.46
Southern Pines	35 11	79 23	1897-56	60			3.74
Southport	33 55	78 01	1897-56	60			5.14
Tarboro	35 54	77 32	1897-56	60			3.49
Tungsten Mines	36 31	78 27	1952-56	5			3.74
Washington	35 32	77 03	1947-56	10			5.15
Weldon	36 26	77 36	1897-56	60			3.24
Weldon 2	36 25	77 35	1941-56	16	1.39	2.07	2.95
Wendell 6 SW	35 43	78 27	1941-50	10	1.98	3.29	3.80
Wenona	35 44	76 39	1939-44	6			3.84
Whiteville	34 19	78 43	1946-56	11			4.61
Willard 1 N	34 43	77 59	1939-56	18			3.85
Williamston 1 ESE	35 51	77 02	1939-56	18			3.42
Wilmington WB AP	34 16	77 55	1894-56*	60	1.80	2.98	4.09
Wilmington 7 N	34 19	77 55	1949-56*	5			4.43
Wilson 2 W	35 43	77 56	1939-56	18			3.70
Yanceyville 2 NNE	36 26	79 20	1949-56	8			3.94
PENNSYLVANIA							
Acmetonia Lock 3	40 32	79 49	1939-54	16			2.57
Allentown Gas Company	40 36	75 28	1912-56	45			3.16
Allentown WB AP	40 39	75 26	1938-56	19	1.44	2.26	2.96
Altoona Horseshoe Curve	40 30	78 29	1888-56	69			2.67
Arendtsville	39 55	77 18	1939-56	18			2.87
Bakerstown 3 WNW	40 39	79 59	1948-56	9			2.45
Bear Gap	40 50	76 30	1948-56	9			3.16
Beavertown	40 45	77 10	1946-56*	10			3.20
Bedford	40 01	78 30	1939-43	5			2.41
Bellefonte 4 S	40 51	77 47	1939-56*	12			2.94
Bethlehem	40 37	75 22	1948-56	9			3.70
Bethlehem Lehigh University	40 36	75 23	1939-56*	10			3.37
Bethlehem Lehigh University	40 36	75 23	1941-50*	8	1.22	2.31	3.16
Blain	40 20	77 31	1938-50	13	1.44	1.81	2.22
Blairsville 6 ENE	40 27	79 09	1939-56	18			2.84
Bloserville 1 N	40 16	77 22	1913-56	44			3.33
Boswell 6 WNW	40 11	79 08	1944-56	13			3.02
Boswell 6 WNW	40 11	79 08	1938-56	19	1.42	2.19	2.90
Braddock Lock 2	40 24	79 52	1948-56	9			2.69
Breezewood	40 00	78 14	1942-56	15			2.72
Bruceton 1 S	40 18	79 59	1949-56*	7			2.22
Buckstown 4 SSW	40 04	78 50	1938-50	13	1.18	1.49	2.16
Buffalo Mills	39 57	78 39	1939-56	18			2.94
Burnt Cabin 2 NE	40 05	77 52	1942-56	15			3.13
Butler	40 52	79 54	1939-56	18			2.69
Butler Substation	40 51	79 53	1938-56	19	1.17	1.90	2.39
Camp Hill	40 15	76 55	1948-56	9			3.64
Carlisle	40 12	77 11	1939-56	18			2.87
Carrolltown 2 SSE	40 35	78 42	1944-56	13			2.84
Chadds Ford	39 52	75 36	1948-56	9			3.68
Chambersburg	39 56	77 39	1938-50	13	1.26	1.93	2.47
Chambersburg 1 ESE	39 56	77 38	1888-56*	50			3.05
Charleroi	40 08	79 55	1938-56	19	1.09	1.84	2.67
Charleroi Lock 4	40 09	79 54	1948-56	9			2.70
Claussville	40 37	75 39	1948-56	9			3.12
Coaldale 2 NW	40 50	75 56	1948-56	9			4.03
Coatesville	39 59	75 49	1949-55	7			3.26

* Breaks in Record

Table 2-2, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour Rainfall (inches)	2-Year 6-Hour Rainfall (inches)	2-Year 24-Hour Precipitation (inches)
PENNSYLVANIA (continued)							
Coatesville 1 SW	39 58	75 50	1939-56	18			3.67
Coatesville 1 SW	39 58	75 50	1938-56	19	1.44	2.65	3.72
Columbia	40 02	76 30	1943-56	14			2.99
Confluence 1 NW	39 50	79 22	1939-56	18			2.74
Confluence 1 SW Dam	39 48	79 22	1945-50	6	.97	1.96	2.74
Connellsville	40 01	79 36	1939-56	18			3.18
Connellsville 2 E	40 01	79 33	1938-56	19	1.31	2.06	2.97
Conshohocken	40 04	75 19	1939-56*	16			3.13
Creekside	40 41	79 12	1948-56	9			2.74
Cresson 2 E	40 28	78 34	1933-50	13	1.18	2.04	2.85
Cresson 2 SE	40 27	78 34	1948-56	9			3.48
Danville	40 58	76 37	1942-56	15			2.69
Dauphin 3 N	40 25	76 56	1942-49	8			2.64
Derry	40 20	79 18	1897-56*	59			2.58
Donegal	40 07	79 23	1944-54	11			3.36
Donora	40 11	79 51	1939-56	18			2.71
Doylestown	40 18	75 08	1939-56	18			3.64
Draketown	39 51	79 22	1938-44	7	1.18	1.75	2.29
Dunlo	40 17	78 44	1938-50	13	1.10	1.68	2.45
East Waterford 3 E	40 21	77 33	1939-54	16			3.10
Ebensburg	40 29	78 43	1939-56	18			2.83
Elizabethtown	40 09	76 37	1948-56	9			2.88
Ephrata	40 11	76 10	1900-56*	55			3.29
Everett	40 00	78 23	1938-50*	8	1.07	1.46	2.44
Everett 1 SW	40 00	78 23	1944-56	13			2.66
Ford City 4 S Dam	40 43	79 30	1944-56	13			2.75
Ford City 4 S Dam	40 43	79 30	1941-50	10	1.30	1.68	2.42
Fredericksville 2 SE	40 26	75 40	1939-55*	16			3.12
Geigertown	40 13	75 50	1946-56	11			3.23
George School	40 13	74 56	1907-56*	49			3.18
Gettysburg	39 50	77 14	1890-56*	57			3.25
Gettysburg 1 S	39 48	77 14	1937-50	14	1.30	2.10	3.03
Glencoe	39 49	78 51	1940-56	17	1.03	1.82	2.81
Glen Rock	39 48	76 44	1942-50	9	1.23	1.99	2.73
Good Springs 1 W	40 38	76 30	1937-50	14	1.45	2.59	3.63
Gordon	40 45	76 20	1939-55	17			3.54
Grantville 2 SW	40 22	76 41	1942-56	15			3.30
Graterford	40 14	75 27	1939-56	18			3.16
Greensboro Lock 7	39 47	79 55	1939-56	18			2.84
Greensburg 2 E Highway	40 18	79 30	1938-50	13	1.16	1.77	2.45
Greensburg 2 S	40 16	79 33	1908-51	44			2.56
Greensburg 3 SE Unity	40 17	79 30	1948-56	9			3.06
Hanover	39 48	76 59	1904-56	53			2.88
Harrisburg North	40 18	76 54	1948-56	9			3.25
Harrisburg WB AP	40 13	76 51	1898-56	59	1.29	2.09	2.79
Hewitt 2 S	39 44	78 32	1944-49	6			2.26
Hewitt 2 S	39 44	78 32	1940-49	10	1.08	1.54	2.31
Hollidaysburg	40 26	78 24	1937-50*	13	1.07	1.83	2.56
Holtwood	39 50	76 20	1939-56	18			2.59
Holtwood	39 50	76 20	1941-56	16	1.54	2.07	2.91
Home	40 45	79 06	1938-56	19	1.20	1.99	2.50
Hooversville	40 09	78 55	1948-56	9			2.69
Huntingdon	40 29	78 01	1888-56	69			2.71
Huntsdale	40 06	77 18	1942-56	15			3.13
Huntsdale	40 06	77 18	1937-56	20	1.25	1.84	2.76
Hyndman	39 49	78 43	1939-56	18			2.63
Indiana	40 37	79 10	1941-52	12			2.25
Indiana 3 SE	40 36	79 07	1948-54	7			2.64
Indiana 3 SE	40 36	79 07	1938-56	19	1.43	2.03	2.56
Irwin	40 20	79 42	1897-56*	59			2.18
Jim Thorpe	40 52	75 45	1939-56*	16			4.00
Johnstown	40 20	78 55	1888-56*	68			2.62
Johnstown 2	40 19	78 55	1937-50	14	1.44	2.10	2.79
Kirkwood SCS 2-A	39 51	76 05	1940-47	8	1.88	2.64	3.62
Kregar 4 SE	40 06	79 14	1939-56*	17			2.88
Kresgeville 3 W	40 54	75 34	1948-56	9			2.83
Kylertown	41 00	78 10	1938-43	6	1.07	1.49	2.13
Lampeter SCS 1-A	39 59	76 14	1941-48	8	1.27	2.02	2.94
Lancaster 2 NE Filter Plant	40 03	76 17	1937-56	20	1.40	2.30	3.26
Lancaster 2 NE Pump Station	40 03	76 17	1939-56	18			3.18
Lansford	40 50	75 53	1939-53	15			3.68
Latrobe	40 19	79 23	1948-55	8			2.69
Laurelton State Village	40 54	77 13	1940-56	17	1.11	1.86	3.08
Lebanon 3 SW	40 20	76 28	1938-50	13	1.49	2.25	3.18
Lebanon 3 W	40 20	76 29	1888-56*	67			3.13
Lehighton	40 50	75 43	1939-56*	12			3.42
Lehighton	40 50	75 43	1938-56	19	1.46	2.64	3.68
Lewistown	40 35	77 35	1939-56	18			2.77
Lewistown	40 35	77 35	1938-56*	18	1.17	1.91	2.66
Lycippus 1 E	40 14	79 24	1939-48	10			2.80
Madera	40 50	78 26	1945-50	6	1.34	2.04	2.59

* Breaks in Record

Table 2-2, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour Rainfall (inches)	2-Year 6-Hour Rainfall (inches)	2-Year 24-Hour Precipitation (inches)
PENNSYLVANIA (continued)							
Maple Glen	40 11	75 11	1946-56	11			3.37
Mapleton Depot	40 24	77 56	1939-56	18			2.75
Marcus Hook	39 49	75 25	1939-56	18			3.43
Marion Center 2 SE	40 45	79 02	1949-56	8			3.02
Martinsburg CAA AP	40 18	78 19	1939-56	18			2.56
Martinsburg 1 SW	40 18	78 20	1937-56	20	1.04	1.79	2.50
McConnellsburg	39 56	78 00	1939-56	18			3.18
McConnellstown 4 NW	40 30	78 08	1942-49	8			2.41
McKeesport	40 21	79 52	1939-56*	12			2.26
Mercersburg	39 50	77 54	1945-56	12			2.95
Meyersdale	39 49	79 01	1942-54	13			3.22
Middletown Olmsted Field	40 11	76 46	1942-56	15			2.81
Millersburg 2 E	40 32	76 56	1938-56	19	1.41	2.19	2.88
Milroy	40 43	77 35	1942-56*	11			2.76
Mosgrove Lock 8	40 54	79 29	1939-50	12			2.35
Mount Union 1 NW	40 24	77 53	1938-50	13	1.31	1.80	2.28
Murrysville	40 26	79 42	1941-56	16	1.30	1.99	2.69
Myerstown	40 22	76 18	1939-56*	10			3.40
Natrona Lock 4	40 37	79 43	1939-56*	12			2.63
Neffs Mills 4 NE	40 40	77 55	1942-53	12			2.56
Neshaminy Falls	40 09	74 57	1939-56*	12			3.34
New Bloomfield	40 25	77 11	1939-47*	7			2.27
Newburg 3 W	40 09	77 37	1942-56	15			2.84
Newell	40 05	79 54	1939-56*	16			2.82
New Park	39 44	76 30	1939-56	18			3.78
Newport	40 29	77 08	1939-56	18			2.92
New Stanton	40 13	79 36	1952-56	5			3.41
New Tripoli	40 41	75 45	1939-56	18			3.11
Norristown	40 07	75 21	1948-56	9			2.82
Palm	40 26	75 32	1948-56	9			2.95
Palmerton	40 48	75 37	1948-56	9			3.68
Palmerton	40 48	75 37	1942-50	9	1.50	2.19	3.37
Park Place WB	40 51	76 07	1943-53	11			3.84
Philadelphia Drexel Institute of Technology	39 57	75 11	1948-56	9			3.18
Philadelphia Point Breeze	39 55	75 12	1948-56	9			2.78
Philadelphia Point Breeze	39 55	75 12	1941-50	10	1.58	2.30	3.15
Philadelphia Shawmont	40 02	75 15	1939-56	18			3.11
Philadelphia WB AP	39 53	75 14	1903-56	54	1.50	2.32	3.25
Philipsburg CAA AP	40 54	78 05	1943-56*	12			3.10
Philipsburg CAA AP	40 54	78 05	1944-50	7	1.26	2.05	3.07
Phoenixville 1 E	40 07	75 30	1939-56	18			3.30
Phoenixville 1 E	40 07	75 30	1938-55	18	1.54	2.71	4.00
Pine Grove 1 NE	40 34	76 22	1939-56	18			3.19
Pittsburgh WB AP	40 21	79 56	1903-52	50	1.22	1.80	2.35
Pittsburgh WB City	40 27	80 00	1941-56	16	1.32	2.03	2.80
Port Clinton	40 35	76 02	1939-56	18			3.34
Port Clinton	40 35	76 02	1938-50	13	1.15	2.14	3.43
Portland	40 55	75 06	1948-54	7			2.87
Pottstown	40 15	75 39	1939-56*	16			2.82
Pottsville	40 42	76 11	1901-56	56			3.45
Punxsutawney	40 57	79 00	1939-52	14			2.46
Punxsutawney	40 57	79 00	1938-56	19	1.16	1.78	2.32
Putneyville 2 SE Dam	40 55	79 17	1944-56	13			2.76
Putneyville 2 SE Dam	40 55	79 17	1941-56	16	1.25	2.02	2.64
Quakertown 1 E	40 26	75 20	1939-56	18			3.59
Reading WB City	40 20	75 58	1913-56	44	1.42	2.40	3.25
Ringtown 1 SW	40 51	76 17	1939-50*	7			3.19
Sagamore 1 S	40 46	79 14	1949-56	8			2.86
Saltsburg	40 27	79 29	1939-52	14			2.42
Saxton	40 12	78 15	1942-56	15			3.14
Saxton	40 13	78 14	1945-50	6	1.09	1.80	2.70
Schenley Lock 5	40 41	79 40	1948-56	9			2.56
Selinsgrove CAA AP	40 49	76 52	1889-56*	66			2.88
Sellersville 2 NW	40 23	75 20	1937-56	20	1.46	2.52	3.40
Seward	40 25	79 01	1939-52	14			2.76
Shade Gap	40 11	77 52	1938-56	19	1.29	2.01	2.83
Shamokin	40 48	76 33	1945-56	12			2.82
Shippensburg	40 03	77 32	1939-56	18			2.74
Somerset Main Street	40 01	79 05	1888-56*	67			2.91
South Mountain	39 51	77 30	1941-56	16			3.53
Spring Grove	39 52	76 52	1948-56	9			2.95
Spring Grove	39 52	76 52	1942-50	9	1.44	1.95	2.85
Springs 1 SW	39 44	79 10	1939-56	18			2.93
Spruce Creek	40 37	78 09	1948-52	5			2.23
State College	40 48	77 52	1888-56*	56			2.55
State College	40 48	77 52	1938-50	13	1.01	1.58	2.28
Strausstown	40 29	76 11	1946-56	11			3.44
Strongstown	40 33	78 55	1941-56	16	1.36	2.09	2.82
Stroudsburg	40 59	75 12	1939-56*	16			3.41
Stroudsburg	41 00	75 11	1938-50	13	1.44	2.46	3.03
Sunbury	40 51	76 48	1939-56	18			2.89

* Breaks in Record

Table 2-2, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour Rainfall (inches)	2-Year 6-Hour Rainfall (inches)	2-Year 24-Hour Precipitation (inches)
PENNSYLVANIA (continued)							
Sunbury	40 51	76 48	1938-50	13	1.21	1.85	2.65
Sutersville	40 14	79 48	1948-56*	8			2.03
Tamaqua	40 48	75 58	1948-56	9			4.14
Tamaqua 4 N Dam	40 51	75 59	1948-56	9			3.72
Tamaqua 4 N Still Creek Dam	40 51	76 00	1938-50	13	1.50	2.41	3.84
Tower City 5 SW	40 31	76 37	1948-56	9			3.43
Tunnelton	40 27	79 23	1941-50	10	1.13	1.58	2.41
Tyrone 4 NE Bald Eagle	40 43	78 12	1949-56	8			3.22
Tyrone 4 NE Bald Eagle	40 43	78 12	1937-56	20	1.19	1.98	2.82
Uniontown	39 54	79 44	1888-56*	68			2.67
Upper Darby	39 58	75 18	1949-56	8			3.37
Vandergrift	40 36	79 33	1914-56	43			2.84
Vandergrift 2 W	40 36	79 36	1938-50	13	1.16	1.52	2.07
Virginville	40 31	75 52	1946-56	11			3.12
Webster Mills 3 SW	39 49	78 05	1940-56	17	1.46	2.19	2.88
Wellsville	40 03	76 57	1947-56	10			2.89
Wernersville 1 W	40 20	76 06	1939-56	18			3.22
West Chester	39 58	75 36	1888-56*	67			3.51
West Grove 1 E	39 49	75 49	1939-56	18			3.28
Whitesburg	40 45	79 24	1948-56	9			2.84
Williamsburg	40 28	78 12	1950-56	7			3.24
Williamstown	40 35	76 38	1939-48*	9			3.00
Wind Gap 2 SW	40 51	75 18	1946-50	5	1.30	2.08	2.78
Wolfsburg	40 03	78 32	1951-56	6			3.25
Woodward	40 55	77 20	1942-46	5			2.86
York 2 S Filter Plant	39 56	76 44	1937-56	20	1.42	2.17	3.01
York 3 SSW Pump Station	39 55	76 45	1939-56	18			3.14
York Haven	40 07	76 43	1939-56	18			2.57
Zionsville 3 SE	40 27	75 27	1939-56	18			3.08
SOUTH CAROLINA							
Bethera 4 SW	33 10	79 50	1942-56	15			4.46
Charleston WB City	32 47	79 56	1898-56*	53	2.29	3.43	4.54
Cheraw	34 42	79 54	1939-56	18			3.48
Conway	33 50	79 03	1899-56	58			3.73
Coward 6 WSW	33 58	79 50	1942-48	7			4.51
Darlington	34 17	79 52	1939-56	18			4.16
Dillon 4 SW	34 22	79 24	1941-56*	14			4.36
Effingham	34 04	79 45	1939-56	18			3.70
Florence WB AP	34 11	79 43	1941-56	16			4.16
Florence 2 N	34 13	79 46	1939-56	18			4.00
Georgetown	33 23	79 17	1899-56*	53			4.52
Georgetown	33 23	79 17	1941-55	15	1.95	3.76	4.98
Kingstree	33 40	79 49	1899-56	58			3.76
Lake City	33 52	79 45	1939-56	18			3.82
Lane AP	33 29	79 53	1941-47	7	1.72	2.49	4.17
Loris	34 03	78 53	1946-56	11			3.77
Loris	34 03	78 53	1941-55	15	1.92	2.89	4.04
Marion	34 11	79 23	1939-56	18			3.84
Marion 1 WNW	34 11	79 25	1944-56	13	1.87	2.93	4.11
Mars Bluff Bridge	34 12	79 34	1939-46	8			3.59
McColl	34 40	79 33	1939-56	18			3.97
Moncks Corner 3 N	33 14	79 59	1946-55	10	1.72	2.71	3.48
Myrtle Beach CAA AP	33 41	78 56	1949-56	8			6.14
Myrtle Beach 2 SE	33 42	78 53	1939-49*	10			4.39
Pee Dee	34 12	79 32	1947-56	10			3.35
Society Hill 6 S	34 25	79 51	1939-56	18			3.86
Sullivans Island	32 46	79 46	1951-56	6			4.38
VIRGINIA							
Afton Boxwood Gardens	38 02	78 50	1939-56	18			4.08
Alexandria Potomac Yards	38 49	77 03	1949-56	8			3.16
Altavista	37 06	79 18	1949-56	8			3.34
Amissville	38 41	78 01	1949-56	8			3.29
Appomattox	37 21	78 50	1949-56	8			3.74
Ashland 1 SW	37 45	77 29	1947-56*	8			2.86
Bacon (nr) Fairfax	38 52	77 21	1940-48	9	.98	1.57	2.43
Balcony Falls	37 38	79 27	1939-56	18			4.27
Bedford	37 21	79 31	1939-56*	17			4.46
Berryville	39 09	77 59	1941-56	16			3.35
Big Meadows	38 31	78 26	1939-56*	17			4.50
Big Meadows	38 31	78 26	1944-49	6	1.43	2.07	4.00
Blackstone CAA AP	37 04	77 57	1949-56*	7			3.25
Blackstone Water Works	37 05	78 01	1940-56	17	1.69	2.70	3.90
Bowling Green	38 03	77 21	1950-56	7			3.64
Bremo Bluff	37 42	78 18	1948-56	9			3.47
Brookneal	37 03	78 57	1951-56	6			3.10
Buchanan	37 32	79 41	1905-56	52			3.28
Buckingham	37 33	78 33	1950-56	7			3.26
Buena Vista	37 44	79 21	1948-56*	6			3.49
Callaville	36 50	77 41	1897-44	48			3.34

* Breaks in Record

Table 2-2, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour Rainfall (inches)	2-Year 6-Hour Rainfall (inches)	2-Year 24-Hour Precipitation (inches)
VIRGINIA (continued)							
Cape Henry WB City	36 56	76 00	1903-53*	49	1.66	2.65	3.41
Capron	36 44	77 15	1939-53*	13			3.18
Chantilly	38 53	77 26	1949-53	5			2.82
Charlotte Court House	37 03	78 38	1948-56	9			2.99
Charlottesville 1 W	38 02	78 31	1952-56	5			4.01
Charlottesville 1 W	38 02	78 31	1940-56*	16	1.34	2.19	3.58
Charlottesville 2 W	38 02	78 31	1898-56	59			3.50
Chatham SCS	36 45	79 25	1941-56	16	1.61	2.64	3.76
Chatham 2 NE	36 50	79 22	1939-56	18			4.07
Cheriton	37 17	75 58	1939-56	18			3.52
Chincoteague Naval Air Station	37 56	75 28	1941-56*	12	1.46	2.53	3.06
Churchville	38 14	79 10	1940-56	17	1.39	2.01	2.88
Clarendon Lyon Park	38 54	77 05	1939-56*	16			3.74
Clarksville	36 38	78 33	1901-56	56			3.11
Clifton Forge	37 49	79 50	1939-56	18			3.08
Columbia	37 46	78 09	1899-56	58			3.36
Columbia	37 46	78 09	1940-56	17	1.37	2.15	3.25
Concord 5 S	37 17	78 58	1951-56	6			3.60
Cootes Store	38 38	78 51	1949-56*	6			3.61
Crozet 2 N	38 05	78 42	1942-56	15			4.22
Culpeper	38 29	77 59	1907-56	50			3.63
Dahlgren Proving Grounds	38 20	77 02	1939-56	18			3.67
Dale Enterprise	38 27	78 56	1897-56	60			2.84
Danville	36 36	79 23	1901-56	56			3.14
Danville CAA AP	36 34	79 20	1949-56	8			3.48
Deerfield 1 S	38 10	79 22	1939-56*	13			2.88
Delaplane 1 NW	38 55	77 56	1940-56	17	1.50	2.30	3.20
Diamond Springs	36 54	76 12	1910-56	47			4.06
Driver 4 NE	36 53	76 29	1941-56	16			3.49
Elkwood 6 SE	38 27	77 46	1940-56	17			3.38
Elkwood 6 SE	38 27	77 46	1942-56	15	1.79	2.86	3.55
Emporia 1 WNW	36 41	77 33	1939-56	18			3.97
Episcopal High School	38 49	77 06	1948-56	9			3.62
Fairfax	38 50	77 19	1949-56*	7			3.98
Falls Church	38 53	77 11	1950-56	7			3.49
Farmville	37 18	78 23	1939-56	18			3.47
Fieldale	36 43	79 56	1943-50	8	1.45	2.14	3.06
Fort Lee	37 14	77 20	1949-56	8			3.60
Fredericksburg	38 18	77 28	1897-56	60			3.39
Fredericksburg Embry Place	38 19	77 29	1943-50	8	1.28	2.27	3.32
Front Royal 6 NNW	39 00	78 14	1948-55	8			2.82
Gordonsville CAA AP	38 04	78 10	1946-56	11			3.43
Goshen	37 59	79 30	1949-56	8			3.13
Groveton	38 46	77 06	1952-56	5			3.28
Halifax 1 N	36 47	78 55	1939-56	18			3.90
Hog Island Little Machipongo	37 28	75 41	1942-48	7	1.61	3.45	4.19
Holland 1 E	36 41	76 47	1939-56	18			3.85
Hopewell	37 18	77 18	1939-56	18			3.48
Hot Springs	38 00	79 50	1897-56	60			2.96
Hot Springs	38 00	79 50	1940-56	17	1.28	2.15	3.06
Huddleston	37 10	79 29	1951-56	6			3.90
John H. Kerr Dam	36 36	78 17	1949-56*	7			3.25
Kenbridge	36 58	78 07	1939-44	6			3.60
Kerrs Creek	37 51	79 31	1949-56	8			3.85
Langley Air Force Base	37 05	76 21	1939-56	18			3.46
Lawrenceville	36 46	77 51	1945-56*	10			3.29
Lexington	37 47	79 26	1897-56	60			2.94
Lincoln	39 07	77 43	1901-56	56			2.96
Louisa	38 01	78 00	1941-56	16			3.40
Luray 5 E	38 41	78 23	1942-56	15			4.37
Lynchburg Madison Heights	37 25	79 08	1948-56	9			3.71
Lynchburg WB AP	37 20	79 12	1902-56*	52	1.42	2.38	3.30
Manassas	38 45	77 28	1897-56*	37			3.09
Manion (nr) Fairfax	38 51	77 21	1940-48	9	1.62	2.28	3.00
Marshall	38 52	77 53	1947-53	7			2.65
Martinsville Filter Plant	36 42	79 53	1939-56	18			3.65
Mathews 1 SSW	37 25	76 20	1951-56*	5			5.34
McGaheysville 2 S	38 21	78 44	1940-56	17	1.22	1.95	3.24
Mons	37 28	79 36	1948-56	9			4.25
Montebello Fish Nursery	37 51	79 06	1940-56	17	1.36	3.22	5.57
Montebello 3 NE	37 53	79 06	1949-56	8			4.03
Monterey	38 25	79 35	1939-56*	17			2.75
Monterey (nr)	38 25	79 36	1940-44	5	1.26	1.95	2.78
Moores Creek Dam	37 45	79 38	1939-56*	14			2.78
Mount Jackson	38 45	78 39	1940-45	6	1.06	1.74	2.92
Mount Weather	39 04	77 53	1906-55	50			3.47
Mount Weather	39 04	77 53	1940-56	17	1.57	2.51	3.84
Natural Bridge Station	37 35	79 30	1949-56	8			4.99
New Canton	37 42	78 18	1915-56	42			3.45
New Church	37 59	75 32	1941-45	5			3.65
Newport News	36 59	76 26	1949-56	8			3.41

* Breaks in Record

Table 2-2, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour Rainfall (inches)	2-Year 6-Hour Rainfall (inches)	2-Year 24-Hour Precipitation (inches)
VIRGINIA (continued)							
Norfolk	36 52	76 17	1943-56*	9			3.85
Norfolk WB AP	36 53	76 12	1892-56	65	1.73	2.62	3.44
North River Dam	38 22	79 16	1939-56	18			3.79
Onley 1 S	37 41	75 43	1939-55	17			3.38
Orange 1 SW	38 14	78 06	1939-51	13			3.48
Partlow 3 WNW	38 03	77 42	1952-56	5			4.13
Pedlar Dam	37 40	79 17	1949-56	8			3.83
Piedmont Field Station	38 13	78 06	1949-56	8			3.62
Powhatan 5 SW	37 29	77 59	1939-56*	10			3.31
Quantico 1 S	38 30	77 19	1905-56*	49			3.20
Randolph	36 54	78 43	1905-56	52			3.09
Randolph	36 54	78 43	1944-49	6	1.58	3.22	4.55
Rapidan	38 18	78 04	1949-56	8			3.38
Richmond WB AP	37 30	77 20	1899-56	58	1.70	2.69	3.56
Riverton	38 56	78 12	1939-56	18			3.43
Roanoke	37 16	79 56	1901-56*	52			3.64
Roanoke WB AP	37 19	79 58	1940-56	17	1.27	2.25	3.53
Rockfish	37 48	78 45	1948-56	9			3.67
Rockymount	37 00	79 54	1897-56*	58			3.45
Saluda	37 36	76 36	1942-49*	7			3.32
Smithfield 3 NE	37 01	76 37	1942-56	15			3.83
Somerset	38 14	78 15	1948-56	9			3.56
Star Tannery	39 05	78 26	1940-56	17	1.31	2.03	3.04
State Farm	37 38	77 48	1940-56	17			3.73
Staunton D. & B. Institute	38 09	79 04	1897-56*	58			2.86
Stony Creek	36 57	77 24	1941-50	10	2.08	2.66	3.15
Stuarts Draft	38 00	79 03	1949-56	8			3.48
Suffolk Lake Kilby	36 44	76 36	1948-56	9			3.43
Surry 4 SW	37 05	76 52	1942-54*	10			3.04
Timberville 2 N	38 40	78 46	1939-56	18			3.17
Tye River 1 SE	37 39	78 56	1949-56	8			3.23
Urbanna	37 38	76 34	1948-56	9			3.49
Vienna Dunn Loring	38 54	77 13	1943-56	14			3.78
Walkerton	37 44	77 01	1939-56	18			3.64
Wallaceton Lake Drummond	36 37	76 26	1939-56*	17			3.86
Warrenton 5 NE	38 45	77 44	1951-56	6			4.04
Warsaw 2 N	37 59	76 46	1897-56*	45			3.14
Washington	38 43	78 10	1949-56	8			3.94
Washington WB AP	38 51	77 02	1943-56	14	1.75	2.78	3.66
Waterford	39 11	77 36	1945-56	12			3.24
Waverly Hills	38 53	77 06	1949-56	8			3.11
Williamsburg 2 N	37 18	76 42	1901-56*	52			3.43
Williamsburg 2 N	37 18	76 42	1942-56	15	1.57	2.50	3.25
Williamsville	38 12	79 34	1949-54	6			3.05
Winchester 2 SSW	39 09	78 11	1912-56	45			2.91
Woodstock	38 53	78 31	1897-56	60			2.58
WEST VIRGINIA							
Alpena 1 NW	38 55	79 40	1939-56*	13			2.95
Arbovale 2	38 26	79 49	1939-56	18			2.80
Bayard	39 16	79 22	1903-56*	52			2.65
Belington	39 02	79 56	1939-56	18			2.82
Berkeley Springs	39 37	78 14	1949-56	8			3.40
Brandonville	39 40	79 37	1943-56	14			3.01
Brandywine	38 38	79 14	1939-48*	9			2.21
Brushy Run	38 50	79 15	1939-56	18			3.37
Cacapon State Park	39 31	78 18	1940-44	5	1.07	1.62	2.78
Canaan Valley	39 03	79 26	1945-56	12			2.87
Dailey 1 NE	38 49	79 53	1939-56	18			2.24
Davis	39 08	79 28	1940-56	17	1.15	1.95	2.83
Elkins CAA AP	38 53	79 51	1903-56	54	1.24	1.97	2.60
Franklin 2 N	38 40	79 20	1947-56*	7			2.44
Franklin 2 N	38 40	79 20	1940-56	17	1.29	1.90	2.72
Glengary	39 23	78 09	1940-44	5	1.39	1.67	2.41
Harpers Ferry	39 19	77 44	1899-56	58			3.24
Hopemont	39 26	79 31	1952-56	5			3.59
Inwood	39 22	78 03	1939-48	10			2.62
Kearneysville 1 NW	39 23	77 53	1939-56	18			3.08
Knobly Mountain	39 22	79 00	1939-56	18			2.64
Lake Lynn	39 43	79 51	1950-56	7			2.72
Lake Lynn	39 43	79 51	1940-56	17	1.25	1.95	2.74
Martinsburg CAA AP	39 24	77 59	1899-56	58			2.93
Martinsburg CAA AP	39 24	77 59	1945-50	6	1.82	2.18	3.07
Mathias	38 52	78 52	1940-56	17	1.40	2.10	2.92
Moorefield	39 03	78 58	1950-56	7			2.88
Moorefield	39 03	78 58	1940-56	17	1.22	1.81	2.56
Moorefield McNeill	39 09	78 54	1939-56	18			2.57
Morgantown CAA AP	39 38	79 55	1948-56	9			2.66
Morgantown Lock & Dam	39 37	79 58	1939-56	18			2.54
Morgantown 1	39 38	79 57	1899-51*	52			2.29
Mount Storm	39 17	79 14	1951-56	6			2.80

* Breaks in Record

Table 2-2, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour Rainfall (inches)	2-Year 6-Hour Rainfall (inches)	2-Year 24-Hour Precipitation (inches)
WEST VIRGINIA (continued)							
Omps	39 30	78 17	1948-56	9			3.23
Parsons 1 SW	39 05	79 42	1899-56*	54			2.94
Petersburg	39 00	79 07	1939-56	18			2.95
Piedmont	39 29	79 02	1916-56	41			2.62
Romney 3 NNE	39 23	78 44	1899-56*	48			2.71
Rowlesburg 1	39 21	79 40	1899-56*	54			2.75
Seneca State Forest	38 18	79 56	1939-45	7			2.76
Springfield 1 N	39 28	78 42	1940-56	17	1.29	1.96	2.68
Spruce Knob	38 41	79 31	1939-56	18			2.77
Stony River Dam	39 08	79 18	1920-56	37			2.76
Terra Alta	39 27	79 33	1940-56	17	1.08	1.86	2.71
Terra Alta 1	39 27	79 31	1899-50*	39			2.75
Thomas	39 09	79 30	1939-56	18			2.82
Thornwood	38 34	79 44	1939-43	5			2.69
Wardensville Raymond Memorial Farm	39 06	78 35	1918-56*	38			2.80

* Breaks in Record

Table 2-3. Station Data 100-Year 1-, 6-, and 24-Hour

STATION	Lat.	Long.	Period of Record	Length of Record (years)	100-Year 1-Hour Rainfall (inches)	100-Year 6-Hour Rainfall (inches)	100-Year 24-Hour Precipitation (inches)
DELAWARE							
Dover	39 09	75 31	1892-56*	53			7.84
Milford	38 55	75 26	1893-56*	60			7.35
Millsboro	38 35	75 19	1893-53	61			7.87
DISTRICT OF COLUMBIA							
Washington WB City	38 54	77 03	1905-56	52	3.69	5.80	7.80
MARYLAND							
Annapolis U. S. Naval Academy	38 59	76 29	1896-56*	60			8.60
Baltimore WB AP	39 11	76 40	1894-56	63	3.36	5.25	7.75
Cambridge 4 W	38 34	76 09	1893-56*	54			9.04
Cheltenham 1 NW	38 44	76 51	1901-56	56			10.88
Chewsville Bridgeport	39 38	77 41	1899-56	58			6.20
Clear Spring	39 40	77 54	1899-56*	45			6.72
Coleman 3 WNW	39 21	76 08	1899-56*	56			6.65
College Park	38 59	76 56	1894-56	63			6.86
Cumberland	39 39	78 45	1892-56*	60			5.11
Easton Police Barracks	38 46	76 01	1892-56*	64			8.29
Fallston	39 31	76 25	1892-52	61			6.62
Frederick Police Barracks	39 25	77 26	1892-56	65			6.05
Great Falls	39 00	77 15	1892-50*	58			5.84
Hancock Fruit Laboratory	39 42	78 11	1895-56*	45			5.70
Laurel 3 W	39 06	76 54	1895-56*	57			6.53
Oakland 1 SE	39 24	79 24	1893-56*	56			5.26
Princess Anne 1 E	38 12	75 40	1894-56*	59			8.00
Salisbury	38 22	75 36	1906-56*	50			9.72
Solomons	38 19	76 27	1892-56	65			7.56
Takoma Park Baltimore Avenue	38 59	77 01	1899-48*	49			5.80
Towson	39 24	76 36	1907-56*	40			8.49
Western Port	39 29	79 02	1895-56	62			5.57
Woodstock	39 20	76 53	1892-56*	64			6.74
NEW JERSEY							
Atlantic City WB City	39 22	74 25	1901-56	56	3.46	6.43	9.87
Belvidere	40 50	75 05	1897-56	60			7.31
Bridgeton 1 NE	39 28	75 12	1897-56*	58			7.59
Burlington	40 04	74 53	1907-56	50			5.91
Cape May 3 W	38 56	74 57	1897-56*	50			7.81
Clayton	39 39	75 06	1897-56*	46			7.40
Dover	40 53	74 34	1897-44	48			6.80
Elizabeth	40 40	74 14	1897-56*	58			8.32
Elizabethport	40 39	74 12	1940-56	17	2.66	7.45	9.11
Flemington 1 NE	40 31	74 51	1898-56	59			5.74
Freehold	40 15	74 17	1941-56	16	2.79	5.94	7.13
Glassboro	39 42	75 07	1941-56	16	3.08	4.12	6.08
Hammonton 2 NNE	39 39	74 48	1897-56*	43			8.15
Hightstown 1 N	40 16	74 31	1897-56*	57			6.80
Indian Mills 2 W	39 48	74 47	1901-56	56			7.92
Irvington	40 43	74 15	1940-56	17	2.94	5.31	7.44
Jersey City	40 44	74 04	1906-56	51			7.67
Lakewood 2 ENE	40 06	74 11	1901-56*	51			8.03
Lambertville	40 22	74 57	1897-56	60			6.12
Long Branch	40 18	73 59	1941-56	16	3.53	6.15	8.36
Marlboro SCS	40 20	74 14	1941-56	16	3.42	7.22	9.79
Millville	39 24	75 03	1941-56	16	2.84	4.91	5.65
Moorestown	39 58	74 58	1897-56	60			7.01
Newark WB AP	40 42	74 10	1897-43*	36			8.81
New Brunswick Experimental Station	40 28	74 26	1897-56	60			7.52
New Milford	40 57	74 02	1940-56	17	2.42	6.30	10.19
Paterson	40 55	74 09	1897-56*	58			8.71
Phillipsburg	40 41	75 12	1903-56*	53			7.86
Plainfield	40 36	74 25	1897-56*	59			7.70
Pleasantville 1 N	39 25	74 31	1903-56	54			9.97
Rahway	40 36	74 15	1940-56	17	2.82	5.18	8.91
Sandy Hook	40 28	74 01	1915-40*	24	2.79	4.94	5.47
Somerville	40 34	74 37	1897-56*	59			6.55
Springfield	40 43	74 18	1941-56	16	3.05	5.05	7.25
Trenton WB City	40 13	74 46	1913-56	44	2.99	4.59	6.17
Tuckerton	39 36	74 20	1898-53*	54			9.11
Westfield	40 39	74 21	1940-56*	16	2.85	5.53	7.54
NEW YORK							
Brentwood	40 47	73 15	1942-56	15	3.33	7.99	10.32
New York WB AP	40 46	73 52	1940-56*	16	3.43	4.53	7.93
New York WB City	40 42	74 01	1899-56*	55	3.03	5.10	7.71
Scarsdale	40 59	73 48	1904-56*	50			8.30
Setauket	40 57	73 06	1897-56	60			8.02
NORTH CAROLINA							
Burlington 3 NNE	36 08	79 24	1941-56*	15	4.14	5.64	7.25
Carthage 2 S	35 19	79 25	1941-56	16	4.41	7.55	8.59

*Breaks in Record

Table 2-3, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	100-Year 1-Hour Rainfall (inches)	100-Year 6-Hour Rainfall (inches)	100-Year 24-Hour Precipitation (inches)
NORTH CAROLINA (continued)							
Chapel Hill 2 W	35 55	79 06	1897-56*	58			6.42
Durham	36 02	78 58	1899-56*	48			6.74
Edenton	36 03	76 37	1897-56	60			8.13
Elizabeth City	36 19	76 13	1942-56	15	4.58	7.04	9.63
Elizabethtown Lock 2	34 37	78 35	1941-56	16	3.60	4.79	8.70
Enfield 3 S	36 09	77 41	1910-56	47			7.94
Fayetteville 2 SE	35 02	78 50	1897-56	60			7.66
Franklinton 3 ESE	36 06	78 25	1940-56	17	3.51	5.25	7.00
Gatesville	36 24	76 45	1941-56	16	3.46	5.20	7.72
Goldsboro	35 23	77 59	1897-56	60			9.35
Graham	36 04	79 24	1902-56	55			7.48
Greensboro Pump Station	36 05	79 48	1897-56*	58			6.69
Greensboro WB AP	36 05	79 57	1929-56*	27	3.05	6.00	8.36
Greenville	35 37	77 22	1897-56*	54			9.36
Greenville	35 37	77 22	1942-56	15	6.17	11.74	12.29
Hatteras WB City	35 13	75 41	1905-56*	51	4.86	8.93	14.23
Henderson 2 SW	36 19	78 26	1897-56	60			7.59
Kill Devil Hills National Monument	36 01	75 40	1941-56	16	4.13	5.60	9.44
Kinston	35 16	77 35	1900-56*	52			8.57
Laurinburg	34 47	79 27	1941-56	16	4.86	5.41	9.43
Louisburg	36 06	78 19	1897-56	60			6.47
Lumberton	34 37	79 01	1897-56*	58			8.16
Manteo	35 55	75 40	1905-56	52			9.92
Moncure 3 SE	35 35	79 03	1897-56	60			7.26
Mount Olive	35 12	78 04	1941-56	16	5.02	8.29	10.51
Nashville	35 58	77 58	1904-56	53			8.08
New Bern 3 NW	35 08	77 05	1897-56	60			10.40
Pinehurst	35 12	79 28	1904-56	53			8.85
Pope Field	35 11	79 02	1941-56	16	5.23	6.52	7.37
Raleigh Durham WB AP	35 52	78 47	1903-56	54	3.61	5.64	7.33
Randleman	35 48	79 49	1905-56	52			6.81
Reidsville	36 22	79 40	1902-56	55			8.62
Scotland Neck 5 NE	36 12	77 23	1904-56	53			6.82
Sloan 3 S	34 47	77 49	1897-56	60			7.82
Southern Pines	35 11	79 23	1897-56	60			8.89
Southport	33 55	78 01	1897-56	60			11.00
Tarboro	35 54	77 32	1897-56	60			6.32
Weldon	36 26	77 36	1897-56	60			7.18
Weldon 2	36 25	77 35	1941-56	16	3.27	3.75	5.80
Wilmington WB AP	34 16	77 55	1894-56*	60	3.32	6.62	9.11
PENNSYLVANIA							
Allentown Gas Company	40 36	75 28	1912-56	45			6.09
Allentown WB AP	40 39	75 26	1938-56	19	3.78	5.37	5.92
Altoona Horseshoe Curve	40 30	78 29	1888-56	69			5.48
Bloserville 1 N	40 16	77 22	1913-56	44			7.52
Boswell 6 WNW	40 11	79 08	1938-56	19	3.29	4.79	5.56
Butler Substation	40 51	79 53	1938-56	19	2.66	4.27	5.09
Chambersburg 1 ESE	39 56	77 38	1888-56*	50			6.19
Charleroi	40 08	79 55	1938-56	19	2.01	3.16	4.66
Coatesville 1 SW	39 58	75 50	1938-56	19	2.85	6.38	8.61
Connellsville 2 E	40 01	79 33	1938-56	19	3.34	4.30	7.46
Derry	40 20	79 18	1897-56*	59			5.28
Ephrata	40 11	76 10	1900-56*	55			6.10
George School	40 13	74 56	1907-56*	49			6.51
Gettysburg	39 50	77 14	1890-56*	57			6.55
Glencoe	39 49	78 51	1940-56	17	2.76	4.29	6.03
Greensburg 2 S	40 16	79 33	1908-51	44			5.19
Hanover	39 48	76 59	1904-56	53			5.81
Harrisburg WB AP	40 13	76 51	1898-56	59	2.75	4.69	5.85
Holtwood	39 50	76 20	1941-56	16	3.36	3.43	6.17
Home	40 45	79 06	1938-56	19	2.79	4.07	4.62
Huntingdon	40 29	78 01	1888-56	69			5.25
Huntsdale	40 06	77 18	1937-56	20	3.31	3.92	6.53
Indiana 3 SE	40 36	79 07	1938-56	19	3.50	4.27	5.44
Irwin	40 20	79 42	1897-56*	59			3.86
Johnstown	40 20	78 55	1886-56*	68			5.20
Lancaster 2 NE Filter Plant	40 03	76 17	1937-56	20	3.03	4.81	6.19
Laurelton State Village	40 54	77 13	1940-56	17	2.53	3.65	5.77
Lebanon 3 W	40 20	76 29	1886-56*	67			6.55
Lehighton	40 50	75 43	1938-56	19	3.34	5.81	8.47
Lewistown	40 35	77 35	1938-56*	18	2.39	3.83	5.75
Martinsburg 1 SW	40 18	78 20	1937-56	20	2.56	3.41	4.76
Millersburg 2 E	40 32	76 56	1938-50	19	3.81	4.58	5.35
Murrysville	40 26	79 42	1941-56	16	2.15	3.54	4.65
Philadelphia WB AP	39 53	75 14	1903-56	54	2.92	4.22	6.14
Phoenixville 1 E	40 07	75 30	1938-55	18	3.77	6.93	9.43
Pittsburgh WB AP	40 21	79 56	1903-52	50	2.21	3.10	4.11
Pittsburgh WB City	40 27	80 00	1941-56	16	3.21	3.70	4.46
Pottsville	40 42	76 11	1901-56	56			7.77
Punxsutawney	40 57	79 00	1938-56	19	2.40	3.66	4.03
Putneyville 2 SE Dam	40 55	79 17	1941-56	16	2.49	4.41	5.37

* Breaks in Record

Table 2-3, cont.

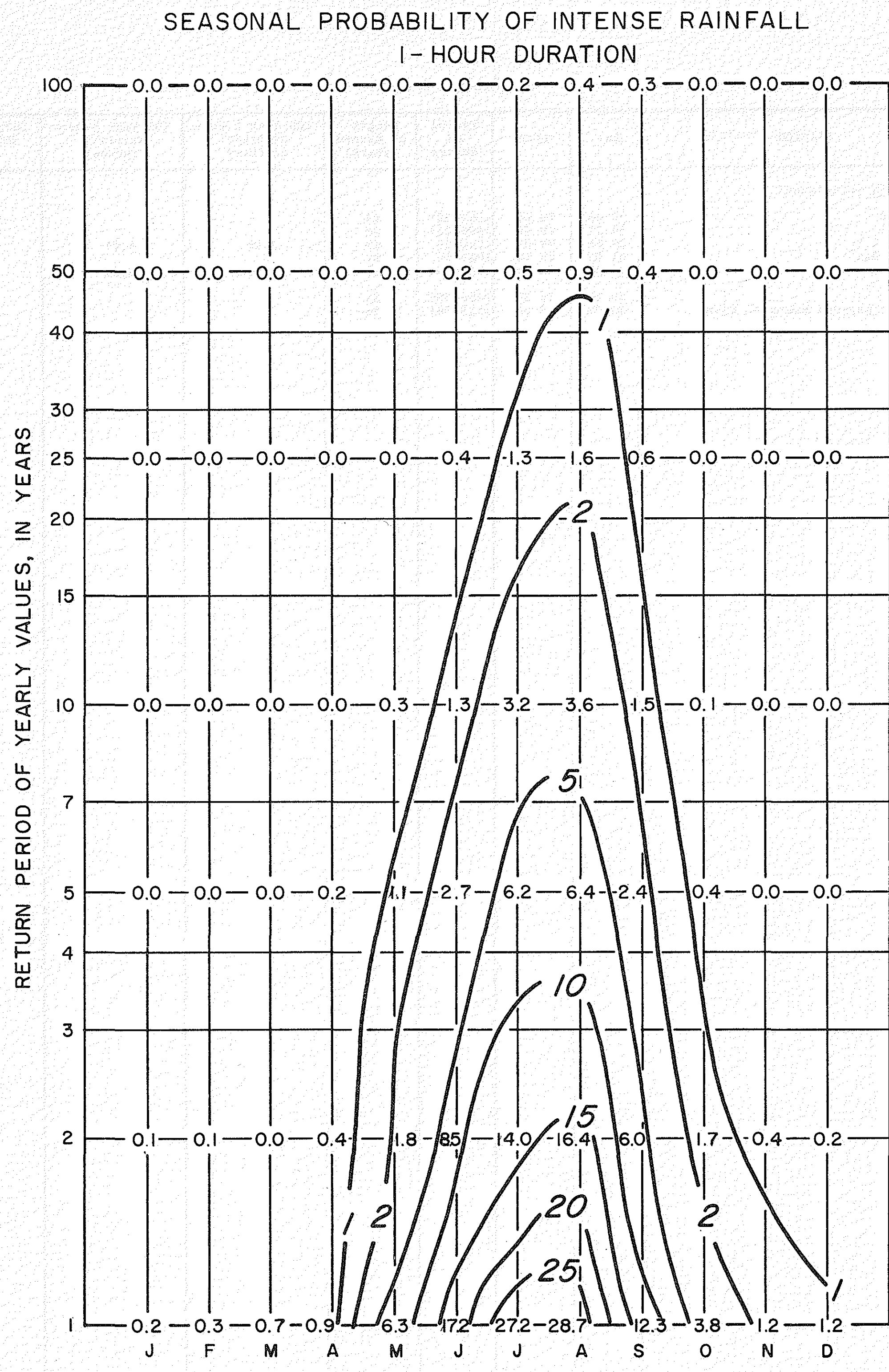
STATION	Lat.	Long.	Period of Record	Length of Record (years)	100-Year 1-Hour Rainfall (inches)	100-Year 6-Hour Rainfall (inches)	100-Year 24-Hour Precipitation (inches)
PENNSYLVANIA (continued)							
Reading WB City	40 20	75 58	1913-56	44	2.78	5.65	6.63
Selinsgrove CAA AP	40 49	76 52	1889-56*	66			5.89
Sellersville 2 NW	40 23	75 20	1937-56	20	3.09	5.15	8.12
Shade Gap	40 11	77 52	1938-56	19	2.72	4.82	6.75
Somerset Main Street	40 01	79 05	1888-56*	67			6.38
State College	40 48	77 52	1888-56*	56			4.52
Strongstown	40 33	78 55	1941-56	16	3.08	4.83	6.00
Tyrone 4 NE Bald Eagle	40 43	78 12	1937-56	20	3.11	4.48	5.52
Uniontown	39 54	79 44	1888-56*	68			4.94
Vandergrift	40 36	79 33	1914-56	43			6.02
Webster Mills 3 SW	39 49	78 05	1940-56	17	3.86	4.43	6.01
West Chester	39 58	75 36	1888-56*	67			7.51
York 2 S Filter Plant	39 56	76 44	1937-56	20	3.13	4.32	6.45
SOUTH CAROLINA							
Charleston WB City	32 47	79 56	1898-56*	53	4.23	7.46	10.92
Conway	33 50	79 03	1899-56	58			7.12
Georgetown	33 23	79 17	1899-56*	53			10.85
Georgetown	33 23	79 17	1941-55	15	3.76	10.06	15.14
Kingstree	33 40	79 49	1899-56	58			10.02
Loris	34 03	78 53	1941-55	15	4.17	5.18	8.91
VIRGINIA							
Blackstone Water Works	37 05	78 01	1940-56	17	4.61	6.32	10.69
Buchanan	37 32	79 41	1905-56	52			7.71
Callaville	36 50	77 41	1897-44	48			7.21
Cape Henry WB City	36 56	76 00	1903-53*	49	3.85	5.29	7.13
Charlottesville 1 W	38 02	78 31	1940-56*	16	2.66	5.05	9.61
Charlottesville 2 W	38 02	78 31	1898-56	59			7.82
Chatham SCS	36 45	79 25	1941-56	16	4.02	7.50	10.98
Churchville	38 14	79 10	1940-56	17	2.68	3.32	5.31
Clarksville	36 38	78 33	1901-56	56			7.02
Columbia	37 46	78 09	1899-56	58			6.77
Columbia	37 46	78 09	1940-56	17	2.38	3.74	6.08
Culpeper	38 29	77 59	1907-56	50			7.02
Dale Enterprise	38 27	78 56	1897-56	60			5.88
Danville	36 36	79 23	1901-56	56			5.96
Delaplane 1 NW	38 55	77 56	1940-56	17	3.34	4.14	7.30
Diamond Springs	36 54	76 12	1910-56	47			8.64
Elkwood 6 SE	38 27	77 46	1942-56	15	4.14	6.81	7.66
Fredericksburg	38 18	77 28	1897-56	60			7.59
Hot Springs	38 00	79 50	1897-56	60			6.10
Hot Springs	38 00	79 50	1940-56	17	2.80	5.45	7.61
Lexington	37 47	79 26	1897-56	60			6.12
Lincoln	39 07	77 43	1901-56	56			6.90
Lynchburg WB AP	37 20	79 12	1902-56*	52	3.35	4.97	7.55
Manassas	38 45	77 28	1897-56*	37			5.93
McGaheysville 2 S	38 21	78 44	1940-56	17	2.70	5.09	9.91
Montebello Fish Nursery	37 51	79 06	1940-56	17	3.08	6.80	13.61
Mount Weather	39 04	77 53	1906-55	50			7.67
Mount Weather	39 04	77 53	1940-56	17	2.99	5.31	9.86
New Canton	37 42	78 18	1915-56	42			8.81
Norfolk WB AP	36 53	76 12	1892-56	65	3.55	5.76	7.40
Quantico 1 S	38 30	77 19	1905-56*	49			7.60
Randolph	36 54	78 43	1905-56	52			9.64
Richmond WB AP	37 30	77 20	1899-56	58	3.97	6.14	8.25
Roanoke	37 16	79 56	1901-56*	52			8.58
Roanoke WB AP	37 19	79 58	1940-56	17	2.37	4.93	9.00
Rockymount	37 00	79 54	1897-56*	58			6.84
Star Tannery	39 05	78 26	1940-56	17	2.42	4.41	9.34
Staunton D. & B. Institute	38 09	79 04	1897-56*	58			5.88
Warsaw 2 N	37 59	76 46	1897-56*	45			6.70
Williamsburg 2 N	37 18	76 42	1901-56*	52			8.60
Williamsburg 2 N	37 18	76 42	1942-56	15	3.90	5.13	8.35
Winchester 2 SSW	39 09	78 11	1912-56	45			6.71
Woodstock	38 53	78 31	1897-56	60			5.77
WEST VIRGINIA							
Bayard	39 16	79 22	1903-56*	52			5.19
Davis	39 08	79 28	1940-56	17	2.34	4.93	6.03
Elkins CAA AP	38 53	79 51	1903-56	54	2.50	4.15	5.32
Franklin 2 N	38 40	79 20	1940-56	17	3.40	4.27	7.00
Harpers Ferry	39 19	77 44	1899-56	58			6.68
Lake Lynn	39 43	79 51	1940-56	17	3.05	4.51	5.98
Martinsburg CAA AP	39 24	77 59	1899-56	58			5.99
Mathias	38 52	78 52	1940-56	17	2.99	5.42	7.96
Moorefield	39 03	78 58	1940-56	17	2.71	4.64	6.46
Morgantown 1	39 38	79 57	1899-51*	52			4.40
Parsons 1 SW	39 05	79 42	1899-56*	54			6.12
Piedmont	39 29	79 02	1916-56	41			5.15

* Breaks in Record

Table 2-3, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	100-Year 1-Hour Rainfall (inches)	100-Year 6-Hour Rainfall (inches)	100-Year 24-Hour Precipitation (inches)
WEST VIRGINIA (continued)							
Romney 3 NNE	39 23	78 44	1899-56*	48			5.77
Rowlesburg 1	39 21	79 40	1899-56*	54			4.97
Springfield 1 N	39 28	78 42	1940-56	17	3.09	4.74	6.37
Stony River Dam	39 08	79 18	1920-56	37			7.31
Terra Alta	39 27	79 33	1940-56	17	2.58	3.81	6.03
Terra Alta 1	39 27	79 31	1899-50*	39			4.93
Wardensville Raymond Memorial Farm	39 06	78 35	1918-56*	38			7.02

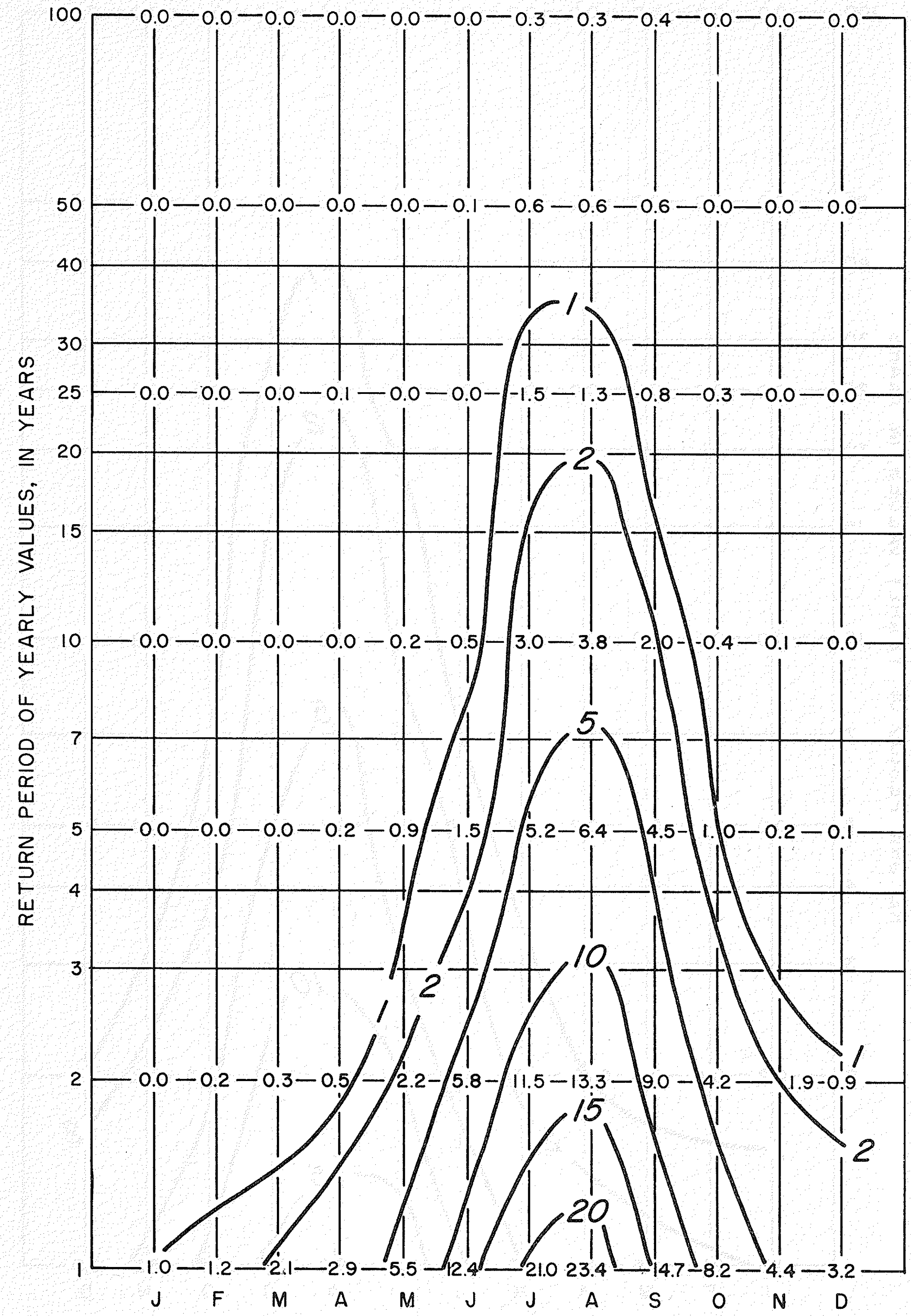
* Breaks in Record



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.

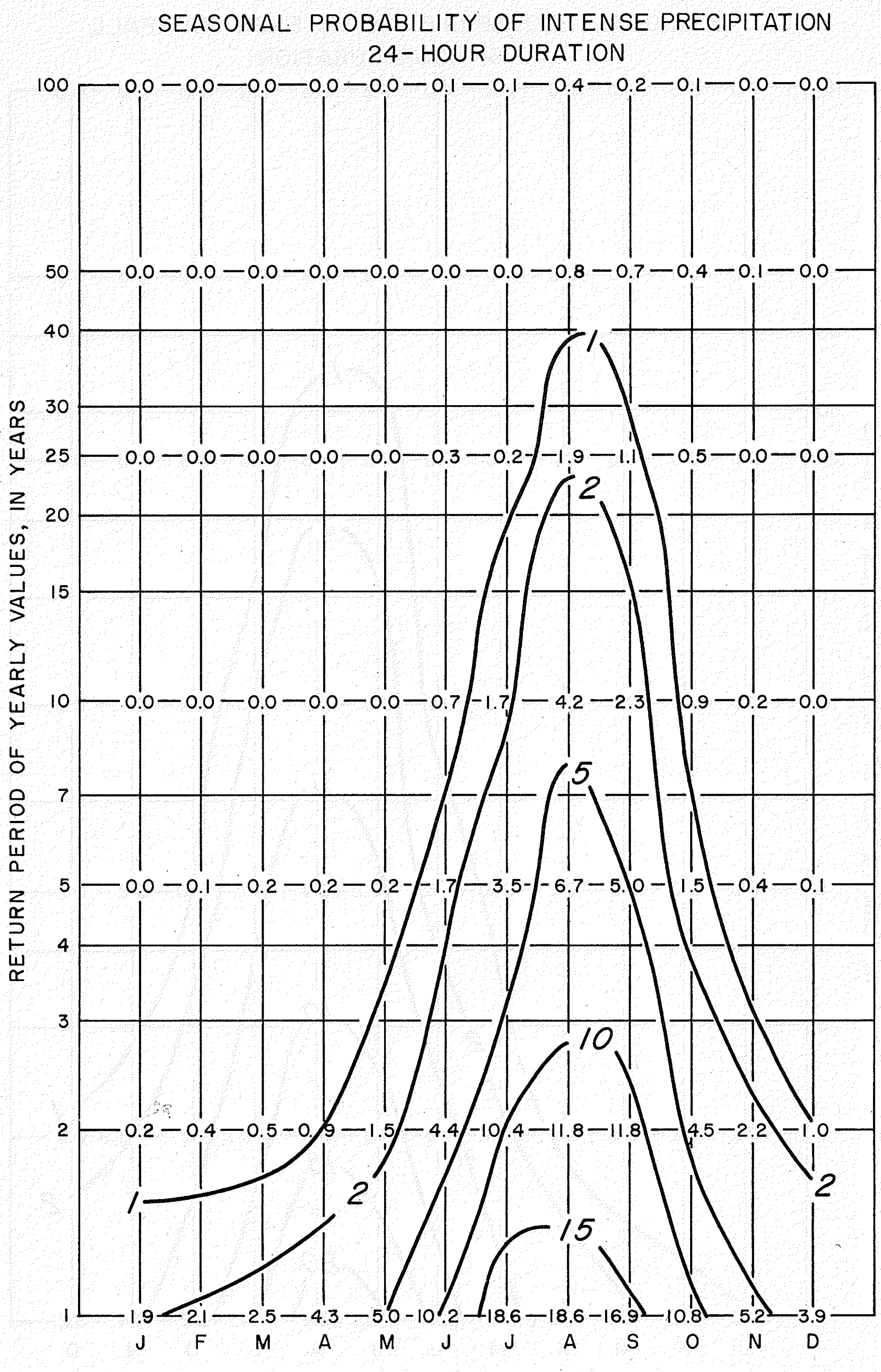
Figure 2-8

SEASONAL PROBABILITY OF INTENSE RAINFALL
6-HOUR DURATION



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.

Figure 2-9



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.

Figure 2-10

U. S. GOVERNMENT PRINTING OFFICE : 1958 O - 475025