

Department of Commerce
Weather Bureau
Office of Hydrologic Director

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Engineer Department

PRELIMINARY REPORT (1145 0117)

ON

DEPTH-DURATION-FREQUENCY CHARACTERISTICS OF PRECIPITATION

OVER

THE MUSKINGUM BASIN

FOR

ONE TO NINE WEEK PERIODS

Submitted by

The Hydrometeorological Section

Office of Hydrologic Director

June 1, 1945

1. Assignment

On January 23, 1945, the Hydrometeorological Section was requested by the Office of the Chief of Engineers to prepare a report giving:

- a. Maximum recorded precipitation over the Muskingum Basin for periods of one week to two months.
- b. The greatest storm of record, in or near the basin, which can logically be transposed to a critical position over the basin.
- c. A reasonable succession of storm precipitation, up to two months duration, to follow the transposed storm.

2. Maximum recorded depths of precipitation

The greatest reported average depths of precipitation over the Muskingum Basin (1906 to date) are as follows:

Table 1

Period (days)	Precipitation (inches)	Year	Dates
1	2.46	1913	Mar. 25
7	6.64	1913	Mar. 21-27
14	8.16	1937	Jan. 12-25
21	9.40	1937	Jan. 5-25
28	10.41	1936-37	Dec. 29-Jan. 25
35	10.72	1936-37	Dec. 22-Jan. 25
42	11.09	1936-37	Dec. 15-Jan. 25
49	11.53	1936-37	Dec. 27-Feb. 13
56	12.95	1926	Aug. 12-Oct. 6
63	13.55	1926	July 27-Sept. 27

Other records of precipitation in and near the Muskingum Basin appear in the appendix, tables 1A to 11A and figures 1A to 3A.

3. Maximum transposed storm

The maximum nearby storm is that of March 1913. Meteorological analysis (see Hydrometeorological Report No. 2) indicates that it can occur in a critical position over the Muskingum Basin, without change of orientation or configuration of isohyets or other adjustment. The result is a total average depth of 8.83 inches over the Muskingum Basin, which is 89% of the maximum average depth over 3000 square miles, as given in Part II of the March 1913 storm study. The same basin configuration factor was applied to other durations to derive the following values:

Table 2

Duration, hours	Average depth, inches
6	2.15
12	3.47
18	4.38
24	4.96
36	5.93
48	6.81
72	7.83
96	8.83

4. Subsequent precipitation

Meteorological and statistical analyses indicate that the termination of a storm of maximum proportions precludes the development of appreciable rains within less than three days. Beyond this limitation, any succession of storm periods is possible. What can be termed reasonable may depend on the probability level deemed appropriate for a definition of reasonableness.

Results of frequency studies defining the probabilities of specific magnitudes of protracted precipitation will be discussed later. Below are examples of sequences of weekly average depths of precipitation over the Muskingum Basin for a number of 13-week periods each of which was characterized by an unusually heavy storm.

Table 3

Beginning of storm period	Average depth of precipitation, in inches, by weeks													Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	
Jan. 29, 1913	0.89	0.02	0.17	0.23	1.67	0.25	0.35	4.43	2.36	0.88	1.02	0.02	0.88	13.17
Mar. 5, 1920	0.56	1.24	0.47	0.03	0.47	0.67	3.51	0.73	0.27	1.17	0.39	0.43	1.13	11.07
Mar. 5, 1922	0.91	1.03	0.31	1.99	0.37	2.84	0.69	0.14	0.85	1.20	1.80	1.35	0.08	13.56
Apr. 30, 1924	1.09	1.55	1.21	0.64	0.81	2.66	0.81	0.88	1.65	0.94	0.97	0.71	0.15	14.07
July 9, 1926	0.60	0.27	1.81	0.64	0.38	3.06	0.68	0.76	2.31	1.58	1.16	1.74	1.61	16.60
Dec. 3, 1929	0.33	1.11	1.55	0.30	0.97	2.86	0.32	0.11	0.22	0.27	0.64	0.92	1.34	10.94
June 4, 1931	1.90	0.29	0.31	0.82	0.07	0.09	2.22	0.14	0.77	2.60	1.16	1.31	1.85	12.53
Apr. 2, 1933	0.99	0.91	1.98	0.21	1.18	2.64	0.82	0.84	0.36	0.71	0.17	0.03	0.69	11.53
Dec. 3, 1936	0.29	0.18	0.37	1.07	0.63	2.00	3.55	3.47	0.25	0.55	0.45	0.43	0.15	13.39
Apr. 30, 1943	0.24	1.60	1.60	1.21	1.55	0.40	1.14	0.15	0.71	1.44	1.27	1.22	1.06	13.59
Jan. 29, 1944	0.19	0.28	0.49	0.68	1.01	1.74	1.13	1.13	0.68	1.04	1.43	0.47	0.92	11.19

5. Source of data for statistical analysis

Lacking processed data for the Muskingum Basin, data for the Middle Ohio climatological section were used in the correlation, probability, and frequency studies. The size, location, and shape of this section with respect to the Muskingum Basin are shown in the location map, figure 2.

Using arithmetic means of stations having records of 30 years or more, the average depths of precipitation over the Middle Ohio section had been tabulated by calendar weeks for the 30 years 1906-1935 by a cooperative WPA project. The data are reproduced as table 1 in the appendix. While depth-duration-frequency functions for the Muskingum and Middle Ohio areas differ somewhat, careful statistical tests indicate that the error in using one for the other is of about the same order of magnitude as the sampling error of gage observations. Precise definition of the complicated relations between the two areas would require as much time as to process the Muskingum data.

6. Lag correlations

Coefficients were computed for the correlation between average depth of precipitation over Middle Ohio for each calendar week and each of the seven subsequent weeks. The frequency distribution of these correlation coefficients was very nearly random, with a mean of +0.037. The mean correlation between precipitation for a given week and the following week was +0.083, indicating slight persistence.

A stratification of the records of weekly precipitation into classes of less than 0.50 and greater than 1.49 inches produced correlations (between and within classes) not significantly different from those obtained from the unstratified data.

7. Probability of abnormal precipitation for various durations

The probability of one to six successive weeks, each having precipitation above or below normal (smoothed mean weekly for Middle Ohio, 1906-35) is given in table 4:

Table 4

Number of successive weeks	Probability, in percent	
	Above normal	Below normal
1	42	59
2	29	50
3	18	40
4	11	28
5	6	22
6	3	13

The skewed distribution of frequency of average depth of precipitation results in a greater probability of below-normal than above-normal precipitation.

8. Depth-duration-frequency relation

In the lower half of figure 1, the measure of depth as a percentage of the mean weekly allows expression of the varying depth-duration-frequency relation as a function of season. Whether the season is on the average comparatively wet or dry, the frequencies of equal percentages of the mean weekly are the same. The figure can be used to determine the probability of a specific average depth over a given period or the average depth having a specific probability of being equaled or exceeded during a given period.

Example a. To determine the probability of 3.00 inches or more average depth of precipitation during a four-week period in July:

The upper portion of figure 1 shows 0.95 inch to be the mean weekly precipitation in July. Three inches is 315% of the mean weekly. The lower portion of the figure shows the probability of 315% for four weeks to be 65% or about 2 to 1.

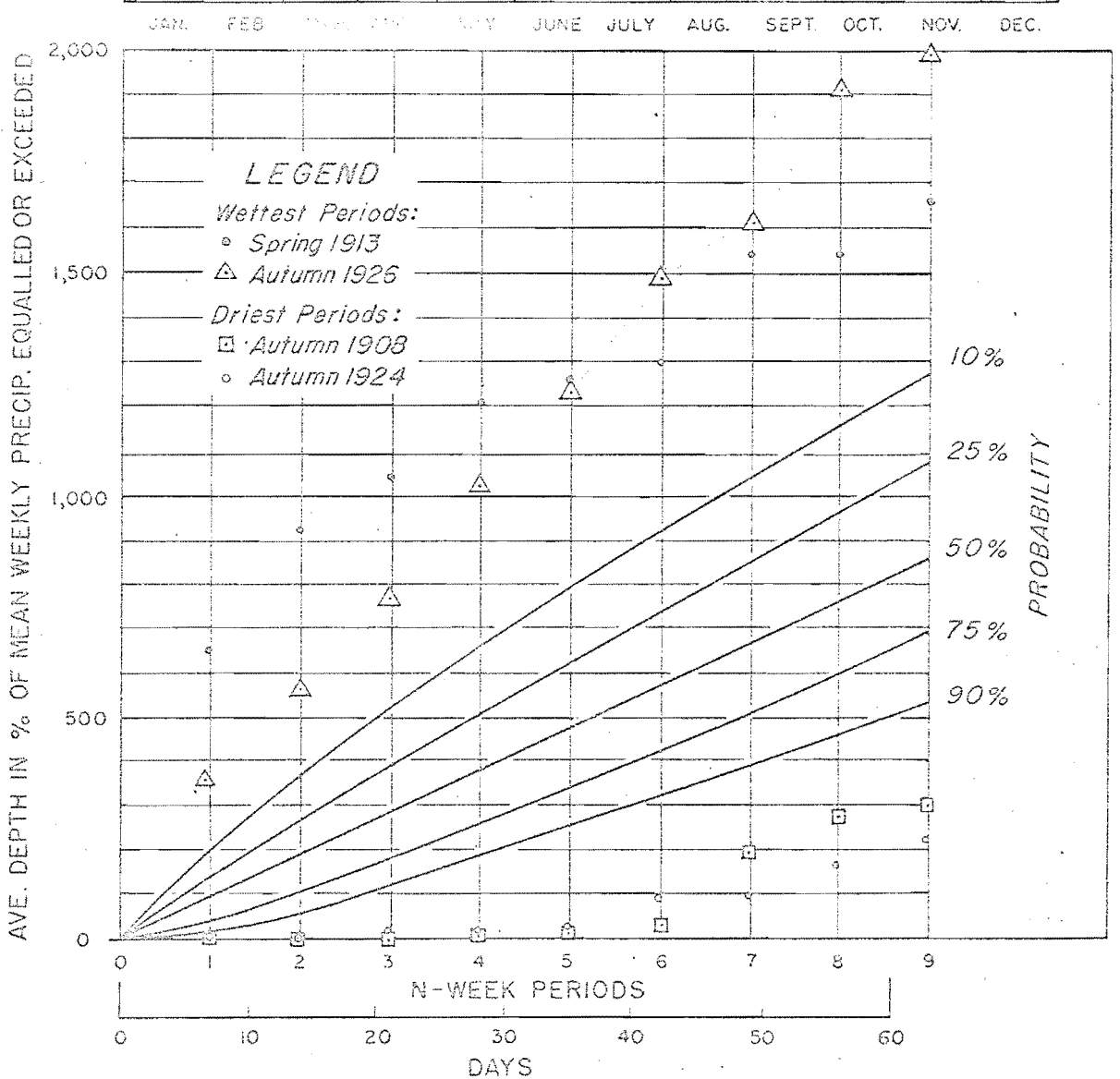
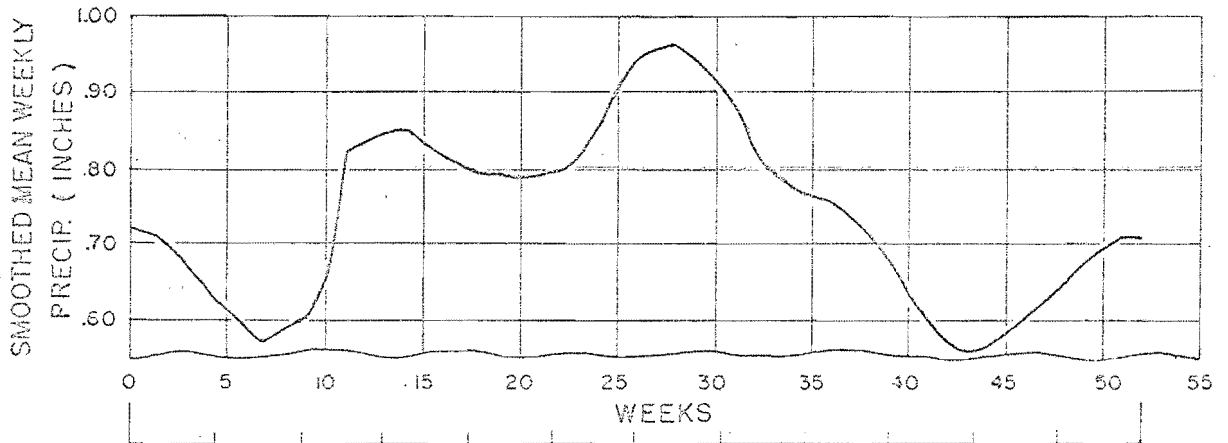
Example b. To determine the average depth for a four-week period in October that will be equaled or exceeded one time in four:

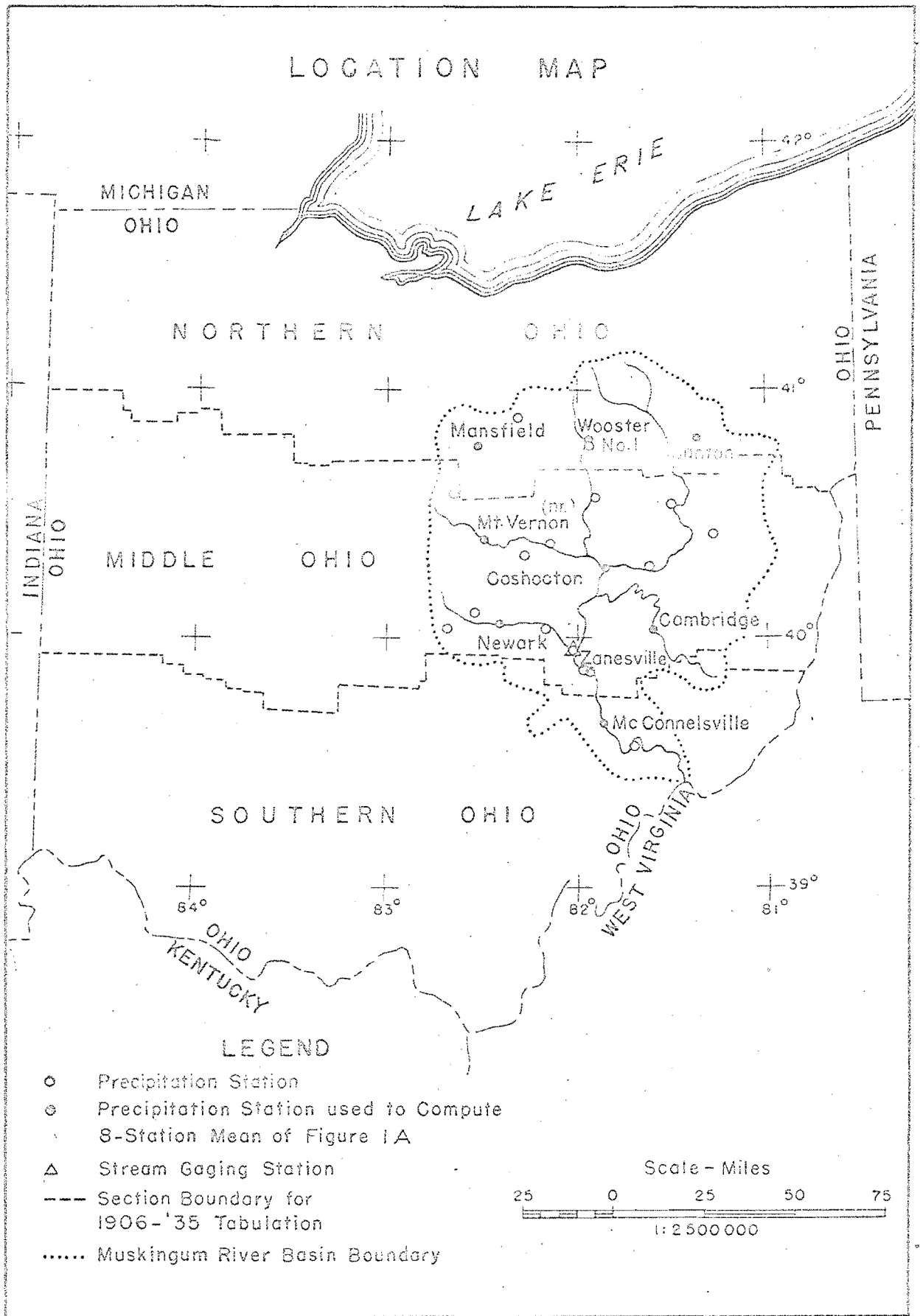
The lower part of figure 1 shows a value of 500% of the mean weekly depth for a probability value of 25% or 1 in 4. From the upper part of the figure the mean weekly precipitation for October is seen to be 0.60 inch. The four-week average depth which can be equaled or exceeded 25% of the time in October is, therefore, 500% of 0.60, or 3.00 inches.

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DEPTH-DURATION-FREQUENCY CURVES WITH SMOOTHED MEAN WEEKLY PRECIPITATION, MIDDLE OHIO





APPENDIX

Table 1A

Maximum Point Rainfall for Periods of 24 Hours or Less, Muskingum Basin (1861-1943) (Based on Mindling, see bibliography)

Period	Rainfall Amount (Inches)	Date			Location
		Year	Month	Day	
15 minutes	0.94	1894	July	24	Newcomerstown
30 minutes	2.75	1907	July	19	McConnellsville
1 hour	over 3.00	1941	July	29	Marietta
80 minutes	12.00 (est.)	1884	June	24	Carroll Township
1½ hours	7.09	1914	July	16	Cambridge
105 minutes	6.56	1879	July	29	Wooster
2 hours	3.50	1889	July	18	Canton
3¼ hours	5.50	1889	July	18-19	Logan
4 hours	5.58	1899	June	20	Wilmington
9 hours	7.17	1913	July	13-14	Philo #2
12 hours	8.70	1935	Aug.	6-7	Newcomerstown
1 day	7.34	1923	July	3	Toboso

Table 2A

Monthly Variation of Officially Observed Maximum Daily Point Precipitation in Ohio (1883-1944) (Based on Mindling, see bibliography)

Month	Maximum Amount (Inches)	Year
January	3.25	1895
February	4.53	1909
March	6.13	1913
April	4.70	1901
May	5.13	1916
June	7.51	1937
July	7.40	1913
August	8.70	1935
September	6.30	1922
October	5.26	1910
November	4.54	1891
December	4.00	1883
Year	8.70	1935

Table 3A

Point Rainfall of 4.00 Inches or More for Periods of 24 Hours in or near the Muskingum Basin, (1878-1943) (Based on Mindling, see bibliography)

Year	Date	Place	Amount (Inches)	Year	Date	Place	Amount (Inches)
1878	Sept. 13	Marietta	4.58	1913	July 13-14	Zanesville	6.70
1879	July 29	Wooster	6.60	1913	July 13-14	Philo(Hardtla)	7.27
1884	June 24	Canton Township	12.00*	1913	July 13-14	Toboso	7.40
1885	Aug. 2	Marietta	4.05	1914	July 16	Cambridge	7.09
1888	July 8-9	Newcomerstown	4.04	1916	May 20	Akron	5.13
1889	July 18-19	Logan	4.75	1916	May 20	Cambridge	6.35
1893	Oct. 13	Cambridge	4.50	1917	July 19-20	Philo(Hardtla)	4.00
1893	Oct. 14	Zanesville	4.20	1919	Aug. 4-5	Ashland	5.10
1899	June 19	Mansfield	4.10	1923	July 3	Toboso	7.34
1899	June 20	Pataskala	5.58	1924	June 29	Akron	4.30
1901	Aug. 15	Nellie	4.84	1926	Sept. 2	Wooster	4.65
1903	Aug. 28	Canton	4.56	1926	Sept. 2	Cambridge	4.25
1905	June 16	New Berlin	4.45	1935	July 3-4	Bangorville	5.91
1907	July 20	Philo (Hardtla)	4.20	1935	Aug. 7	Mt.Vernon(Nr.)	4.12
1909	Aug. 14-15	Gratiot	4.29	1935	Aug. 7	Newcomerstown	8.70#
1909	Aug. 14-15	Milfordton	5.53	1935	Aug. 7	Cambridge	5.82
1909	Aug. 15-16	Philo (Hardtla)	4.93	1935	Aug. 7	Millersburg	6.79
1911	Sept. 15	Wooster	4.12	1935	Aug. 7	Wooster #1	4.44
1913	Mar. 24-25	Ashland	5.96	1935	Aug. 7	Wooster #2	4.08
1913	Mar. 24-25	Akron	4.75	1935	Aug. 7-8	Coshocton	7.32
1913	Mar. 25	Bangorville	5.25	1936	Oct. 9-10	Cambridge	4.53
1913	Mar. 25	Wooster	4.84	1937	June 20-21	Bucyrus	7.51
1913	July 9-10	Marietta(Eiscoe)	4.31	1937	June 21	Philo #2	4.05
1913	July 12	Marietta(Best)	4.00	1938	Sept. 12-13	Akron	4.57
1913	July 13-14	Cambridge	4.46	1939	Aug. 3	Coshocton	4.01
1913	July 13-14	Philo (Burck- holter)	6.48	1943	May 30-31	Medina	4.14
				1943	May 31	Coshocton	5.00
				1943	July 7	Akron	5.96

*Maximum of record (estimated)

#All-time state record for a 24-hour amount measured with a rain gage

Table 4A

Average Depth of Monthly Precipitation for Years of Maximum Calendar Months
and Year of Record, Muskingum Basin (1883-1944)

(Based on mean of observations at all stations shown in Figure 2)

Average Depth of Precipitation (Inches)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1887	1.82	6.87*	2.09	3.92	3.79	4.84	3.13	1.75	1.95	0.75	2.47	1.89	35.65
1890	4.90	5.83	4.81	3.22	5.99	5.70	2.72	5.57	6.27	4.88	2.57	2.20	54.69*
1892	2.47	2.88	2.92	2.50	6.82*	6.02	4.62	3.00	1.92	0.71	2.00	1.77	37.82
1893	2.65	5.95	2.04	6.50*	5.13	3.58	2.71	2.77	1.52	4.84	2.02	2.35	41.92
1896	2.02	2.30	3.62	3.28	2.63	5.52	9.23*	3.12	5.70	1.02	2.89	2.34	43.73
1897	2.05	3.84	4.63	3.28	3.99	3.03	5.38	2.66	0.73	0.53	6.93*	2.46	39.31
1913	7.59	2.21	8.56*	3.21	2.85	1.71	7.83	3.25	3.12	3.34	3.68	2.21	49.53
1919	1.68	1.10	3.99	2.76	5.52	2.82	5.23	5.82	1.95	6.13*	4.26	2.41	43.25
1923	3.60	1.96	3.01	2.63	3.97	3.82	4.00	5.43	3.56	1.71	2.97	5.94*	42.43
1926	2.43	3.28	2.19	2.81	2.89	2.84	4.32	4.98	7.58*	3.05	2.60	2.55	43.30
1935	4.61	1.99	2.93	1.65	1.07	1.07	1.07	1.07	2.85	2.05	2.61	2.97	44.04
1937	9.74*	1.40	1.61	3.73	4.13	1.50	7.55	2.83	1.83	3.44	1.31	3.00	45.51

*Maximum; underscored value is maximum month of record

Table 5A

Average Depth of Monthly Precipitation for Years of Minimum Calendar Months
and Year of Record, Muskingum Basin (1883-1944)

(Based on mean of observations at all stations shown in Figure 2)

Average Depth of Precipitation (Inches)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1894	2.28	3.15	2.38	2.41	4.06	2.91	1.71	1.32*	3.17	2.06	2.53	3.40	31.24
1895	4.48	0.77*	1.72	1.88	1.78	2.57	2.21	3.54	2.11	1.36	3.75	4.30	30.15
1904	3.79	2.57	5.75	4.21	3.61	3.28	5.23	2.85	1.81	1.99	0.39*	3.48	38.96
1908	1.81	3.50	6.39	3.46	5.05	2.34	4.18	2.26	0.41*	1.47	1.27	2.71	34.60
1910	5.22	4.86	0.27*	2.85	4.24	2.88	2.78	1.51	3.09	3.74	1.48	2.46	35.31
1918	2.94	2.52	1.85	3.05	5.56	1.66*	2.56	3.93	3.15	2.86	1.92	3.70	35.69
1924	4.20	2.24	3.84	2.73	4.77	6.13	3.23	2.04	4.97	0.13*	1.69	3.00	38.94
1925	1.92	2.12	2.53	1.63	3.04	3.36	4.97	2.18	2.87	4.44	3.90	0.81	33.85
1930	4.28	3.00	3.15	1.87	1.84	1.93	1.14*	2.03	2.23	1.15	1.45	1.33	25.32*
1933	1.79	1.69	6.07	4.14	5.77	1.66*	2.80	3.49	5.15	1.36	1.48	2.77	37.86
1939	2.33	4.03	3.97	4.08	1.05*	6.69	3.89	2.40	2.26	3.34	0.66	1.53	36.38
1941	1.94	0.78	1.13	0.87*	2.82	5.32	5.39	4.10	1.65	4.52	2.11	1.79	32.88
1944	0.90*	2.02	5.20	3.86	4.24	3.87	1.71	4.26	1.95	1.74	1.44	2.88	34.45

*Minimum; underscored value is minimum month of record

Table 6A

Maximum Average Depth of Seasonal Precipitation, Muskingum Basin (1883-1944)
(Based on mean of observations at all stations shown in Figure 2)

Season	63-Year Mean (Inches)	Maximum Average Depth		
		(Inches)	% of Mean	Year
Winter (Dec.-Feb.)	8.47	13.42	158	1936-37
Spring (Mar.-May)	10.24	15.98	156	1933
Summer (June-Aug.)	11.62	19.71	170	1935
Fall (Sept.-Nov.)	7.98	15.24	191	1926
Annual	38.39	54.69	143	1890

Table 7A

Daily Increments of Average Depth of Precipitation over the Muskingum Basin
March 27-April 28, 1943

(Based largely on mean of observations at all stations shown in Figure 2)

Day	Maximum 7 Days			Maximum 14 Days			Maximum 21 Days			Maximum 28 Days		
	Inc.	Acc.	Acc. By	Inc.	Acc.	Acc. By	Inc.	Acc.	Acc. By	Inc.	Acc.	Acc. By
	Chron.		Rank	Chron.		Rank	Chron.		Rank	Chron.		Rank
1	0.11	0.11	2.46	0.07	0.07	2.46	0.07	0.07	2.46	T	T	2.46
2	0.07	0.18	4.15	0.50	0.57	4.15	0.50	0.57	4.15	0.11	0.11	4.15
3	0.50	0.68	5.44	1.29	1.86	5.44	1.29	1.86	5.44	0.07	0.18	5.44
4	1.29	1.97	5.96	2.46	4.32	5.96	2.46	4.32	5.96	0.50	0.68	5.96
5	2.46	4.43	6.46	1.69	6.01	6.46	1.69	6.01	6.46	1.29	1.97	6.46
6	1.69	6.12	6.57	0.52	6.53	---	0.52	6.53	6.53	2.46	4.43	6.53
7	0.52	6.64	6.64	T	6.53	6.53	T	6.53	6.76	1.69	6.12	6.64
8				---	6.53	7.14	---	6.53	6.98	0.52	6.64	6.64
9				T	6.53	7.35	T	6.53	7.06	T	6.64	6.64
10				0.14	6.67	7.36	0.14	6.67	7.07	---	6.64	6.67
11				0.01	6.68	7.50	0.01	6.68	7.07	T	6.64	6.72
12				0.21	---	7.50	0.21	---	7.07	0.14	6.78	7.13
13				---	6.89	7.50	---	6.89	---	0.01	6.79	7.13
14				0.61	7.50	7.50	0.61	7.50	7.12	0.21	---	7.36
15							0.05	7.55	7.73	---	7.00	7.58
16							T	7.55	7.94	0.61	7.61	7.66
17							---	7.55	7.95	0.05	7.66	7.67
18							0.01	7.56	8.09	T	7.66	7.67
19							0.08	7.64	8.09	---	7.66	7.67
20							0.22	7.86	8.09	0.01	7.67	---
21							0.23	8.09	8.09	0.08	7.75	7.72
22										0.22	7.97	8.33
23										0.23	8.20	8.54
24										T	8.20	8.55
25										0.41	8.61	8.69
26										0.05	8.66	8.69
27										0.03	8.69	8.69
28										0.00	8.69	8.69

Table 8A

Daily Increments of Average Depth of Precipitation over the Muskingum Basin
from December 22, 1936 to January 25, 1937

(Based largely on mean of observations at all stations shown in Figure 2)

Maximum 7 Days				Maximum 28 Days				Maximum 35 Days			
Day	Inc.	Acc. Chron.	Acc. By Rank	Day	Inc.	Acc. Chron.	Acc. By Rank	Day	Inc.	Acc. Chron.	Acc. By Rank
1	0.01	0.01	1.43	1	0.06	0.06	1.43	1	0.00	0.00	1.43
2	0.36	0.37	2.43	2	0.21	0.27	2.43	2	0.00	0.00	2.43
3	1.00	1.37	2.86	3	0.49	0.76	2.86	3	0.00	0.00	2.86
4	1.43	2.80	3.55	4	0.00	0.76	3.55	4	0.00	0.00	3.55
5	0.43	3.23	4.47	5	0.22	0.98	4.47	5	0.00	0.00	4.47
6	0.69	3.92	4.83	6	0.03	1.01	4.83	6	0.13	0.13	4.83
7	0.92	4.84	4.84	7	T	1.01	4.89	7	0.13	0.31	4.84
Maximum 14 Days				8	0.00	1.01	5.10	8	0.06	0.37	5.80
1	T	T	1.43	9	0.01	1.02	5.59	9	0.21	0.58	5.94
2	0.03	0.03	2.43	10	0.37	1.39	5.60	10	0.49	1.07	5.94
3	1.11	1.14	2.86	11	0.06	1.45	6.56	11	0.00	1.07	7.02
4	T	2.22	3.55	12	0.33	1.78	6.70	12	0.22	1.29	8.13
5	T	2.22	4.47	13	0.03	1.81	6.70	13	0.03	1.32	8.16
6	0.14	2.36	4.83	14	0.03	1.84	7.78	14	T	1.32	8.16
7	0.96	3.32	4.84	15	T	2.25	8.89	15	0.00	1.32	8.19
8	0.01	3.33	5.80	16	0.03	2.28	8.92	16	0.01	1.33	8.63
9	0.36	3.69	5.94	17	1.11	3.39	8.92	17	0.37	1.70	8.96
10	1.00	4.69	5.94	18	1.08	4.47	9.14	18	0.06	1.76	9.02
11	1.43	6.12	7.02	19	T	4.47	9.17	19	0.33	2.09	9.39
12	0.43	6.55	8.13	20	0.14	4.61	9.17	20	0.44	2.53	9.40
13	0.69	7.24	8.16	21	0.96	5.57	9.20	21	0.03	2.56	9.40
14	0.92	8.16	8.16	22	0.01	5.58	9.64	22	T	2.56	9.40
Maximum 21 Days				23	0.36	5.94	9.97	23	0.03	2.59	9.43
1	0.00	0.00	1.43	24	1.00	6.94	10.03	24	1.11	3.70	9.65
2	0.01	0.01	2.43	25	1.43	8.37	10.40	25	1.08	4.78	9.65
3	0.37	0.38	2.86	26	0.43	8.80	10.41	26	T	4.78	10.14
4	0.06	0.44	3.55	27	0.69	9.49	10.41	27	0.14	4.92	10.35
5	0.33	0.77	4.47	28	0.92	10.41	10.41	28	0.96	5.88	10.41
6	0.44	1.21	4.83					29	0.01	5.89	10.59
7	0.03	1.24	4.84					30	0.36	6.25	10.72
8	T	1.24	5.80					31	1.00	7.25	10.72
9	0.03	1.27	5.94					32	1.43	8.68	10.72
10	1.11	2.38	5.94					33	0.43	9.11	10.72
11	1.08	3.46	7.02					34	0.69	9.80	10.72
12	T	3.46	8.13					35	0.92	10.72	10.72
13	0.14	3.60	8.16								
14	0.96	4.56	8.16								
15	0.01	4.57	8.19								
16	0.36	4.93	8.63								
17	1.00	5.93	8.96								
18	1.43	7.36	9.02								
19	0.43	7.79	9.39								
20	0.69	8.48	9.40								
21	0.92	9.40	9.40								

Table 9A

Weekly Increments of Average Depth of Precipitation over Middle Ohio,
4 to 9 Week Periods
(Based on 1906-35 Weekly Tabulation)

Week No.	4 Wks.		5 Wks.		6 Wks.		7 Wks.		8 Wks.		9 Wks.	
	Inc.	Acc.	Inc.	Acc.	Inc.	Acc.	Inc.	Acc.	Inc.	Acc.	Inc.	Acc.
1	5.46	5.46	0.41	0.41	1.48	1.48	1.48	1.48	2.71	2.71	0.68	0.68
2	2.36	7.82	5.46	5.87	0.26	1.74	0.26	1.74	0.64	3.35	2.71	3.39
3	1.03	8.85	2.36	8.23	0.41	2.15	0.41	2.15	1.22	4.57	0.64	4.03
4	1.34	10.19	1.03	9.26	5.46	7.61	5.46	7.61	2.68	7.25	1.22	5.25
5			1.34	10.60	2.36	9.97	2.36	9.97	1.48	8.73	2.68	7.93
6					1.03	11.00	1.03	11.00	1.40	10.13	1.48	9.41
7							1.34	12.34	1.79	11.92	1.40	10.81
8									1.87	13.79	1.79	12.60
9											1.87	14.47

TABLE IOA.- GENERAL SUMMARY OF WEEKLY MEANS, MIDDLE OHIO

YR.	CALENDAR WEEK NO.*																																																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41								
1906																																																	
'07	151	110	122	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110					
'08	30	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20			
'09	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110			
1910	155	120	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110			
'11																																																	
'12	1	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5			
'13	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12		
'14	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
'15	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
'16	12	12	33	34	37	36	37	34	36	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37		
'17	100	70	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	
'18	115	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	
'19	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
1920	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	
'21	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	
'22	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
'23	10	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	
'24	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
'25	18	18	50	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17		
'26	11	55	11	50	52	51	66	109	09	41	35	107	53	162	26	06	90	27	09	128	69	44	35	95	56	39	150	83	23	173	108	68	271	64	122	268	148	140	179	187	18								
'27	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15		
'28	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11		
'29	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
1930	111	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	
'31	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
'32	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
'33	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
'34	10	32	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
1935	1	31	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
Smoothed Mean	71	79	67	64	61	59	57	58	60	65	61	64	65	65	64	62	61	69	79	79	78	79	79	81	85	91	94	96	92	91	86	81	79	77	77	75	73	71	66	62	59								
Weekly Mean	72	78	79	68	61	47	56	65	65	29	63	94	97	73	82	75	77	101	77	73	73	95	71	91	704	97	109	97	76	76	93	83	67	77	84	66	68	70	69	66	3								

*See table IIA for calendar week dates

, 1906-35

											ANNUAL
42	43	44	45	46	47	48	49	50	51	52	TOTAL
52	53	01	16	106	118	18	101	105	54	65	3664
11	76	125	11	19	32	07	33	92	104	144	4455
0	57	0	52	06	31	13	101	24	25	69	3524
83	112	42	26	59	75	02	59	138	05	78	4443
35	60	25	37	02	21	71	17	19	51	140	3610
140	28	41	82	133	46	25	65	209	26	112	4398
82	141	26	64	09	03	47	6	01	20	95	3712
80	116	04	187	100	06	96	34	0	55	39	4400
168	13	10	74	45	04	65	222	39	59	51	3469
58	01	05	18	77	109	53	08	42	115	231	4260
154	06	40	38	31	82	34	91	25	84	79	3723
185	118	86	0	70	17	44	81	24	02	26	3513
38	97	39	24	89	40	45	55	180	62	55	3659
108	154	200	62	0	76	171	91	63	27	03	4072
01	172	59	12	27	147	14	31	38	41	39	3758
31	11	215	25	202	102	104	142	134	118	116	4405
27	29	02	22	107	06	24	121	14	37	124	3789
45	75	126	18	8	90	83	202	21	165	85	3948
0	0	10	03	95	54	21	137	25	130	119	3607
88	105	25	151	158	07	102	53	0	10	10	3321
33	143	142	47	72	21	64	66	18	31	119	4250
105	0	38	23	229	46	297	26	205	03	73	4404
145	63	115	46	31	85	36	16	92	18	17	3522
94	221	135	43	192	109	41	27	105	186	21	4710
05	42	14	10	59	04	81	46	13	06	40	2735
25	42	23	22	121	93	54	71	202	59	42	3213
8	126	112	84	03	76	0	59	45	12	55	3653
33	78	11	62	24	12	15	21	71	124	44	3729
23	12	59	14	02	56	57	15	02	60	42	2521
43	61	28	45	77	12	07	92	23	37	42	2927
57	56	57	59	61	63	65	68	69	71	71	3830
12	73	58	47	77	48	59	70	71	61	74	3838

Table 11A

Division of Weeks for Weekly Precipitation Summary

1.	Jan. 1-7	27.	July 2-8
2.	" 8-14	28.	" 9-15
3.	" 15-21	29.	" 16-22
4.	" 22-28	30.	" 23-29
5.	" 29-Feb. 4	31.	" 30-31
6.	Feb. 5-11		
7.	" 12-18	33.	" 13-19
8.	" 19-25	34.	" 20-26
9.	" 26-Mar. 4	35.	" 27-Sept. 2
10.	Mar. 5-11	36.	Sept. 3-9
11.	" 12-18	37.	" 10-16
12.	" 19-25	38.	" 17-23
13.	" 26-Apr. 1	39.	" 24-30
14.	Apr. 2-8	40.	Oct. 1-7
15.	" 9-15	41.	" 8-14
16.	" 16-22	42.	" 15-21
17.	" 23-29	43.	" 22-28
18.	" 30-May 6	44.	" 29-Nov. 4
19.	May 7-13	45.	Nov. 5-11
20.	" 14-20	46.	" 12-18
21.	" 21-27	47.	" 19-25
22.	" 28-June 3	48.	" 26-Dec. 2
23.	June 4-10	49.	Dec. 3-9
24.	" 11-17	50.	" 10-16
25.	" 18-24	51.	" 17-23
26.	" 25-July 1	52.	" 24-31

ANNUAL PRECIPITATION TRENDS, MIDDLE OHIO, 1906-'35 AND MUSKINGUM DRAINAGE BASIN, 1880-1944

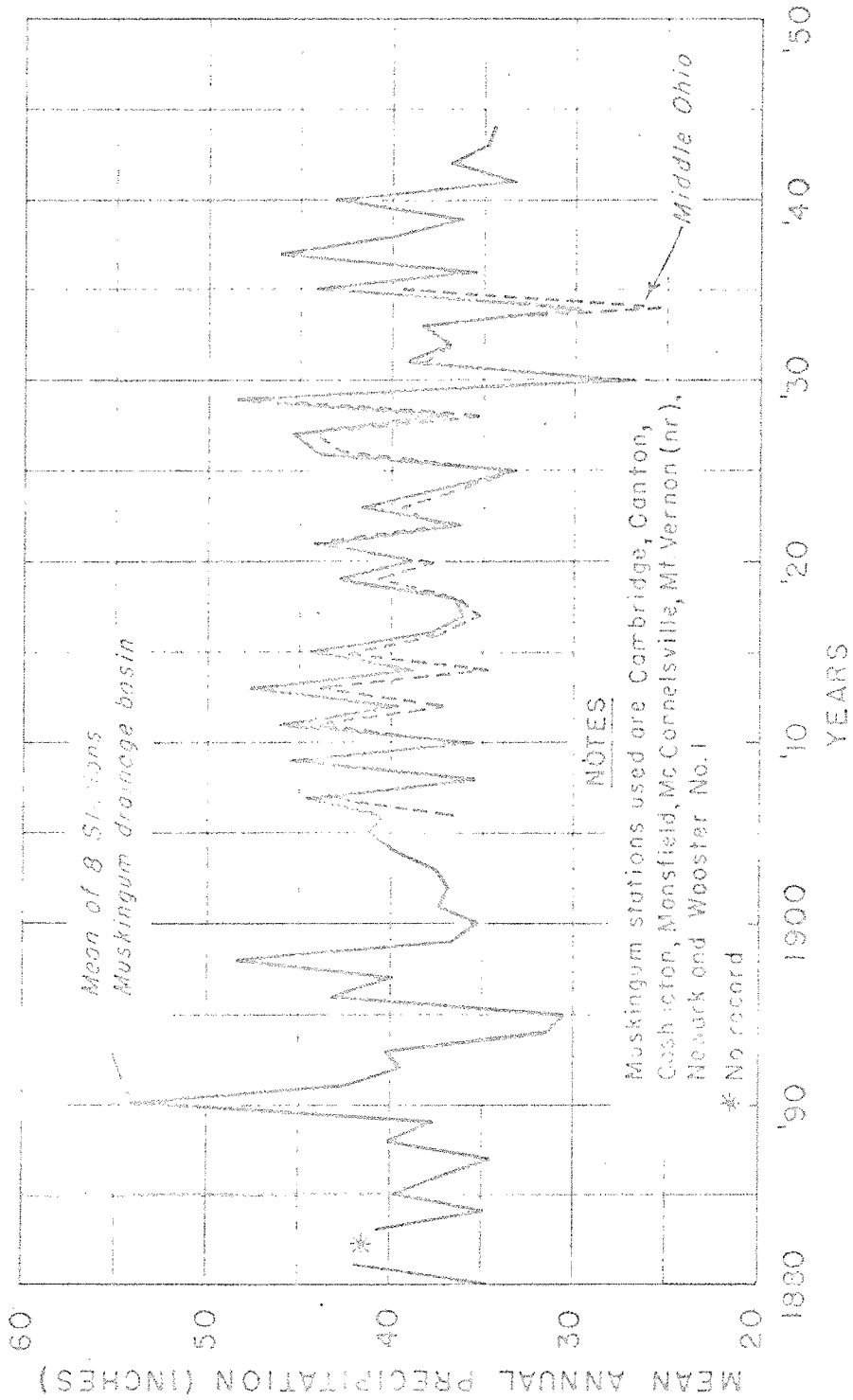


FIGURE 1A
FILE 45012

MASS CURVES FOR MAXIMUM SUCCESSIVE 7 TO 35-DAY PERIODS, MUSKINGUM BASIN

