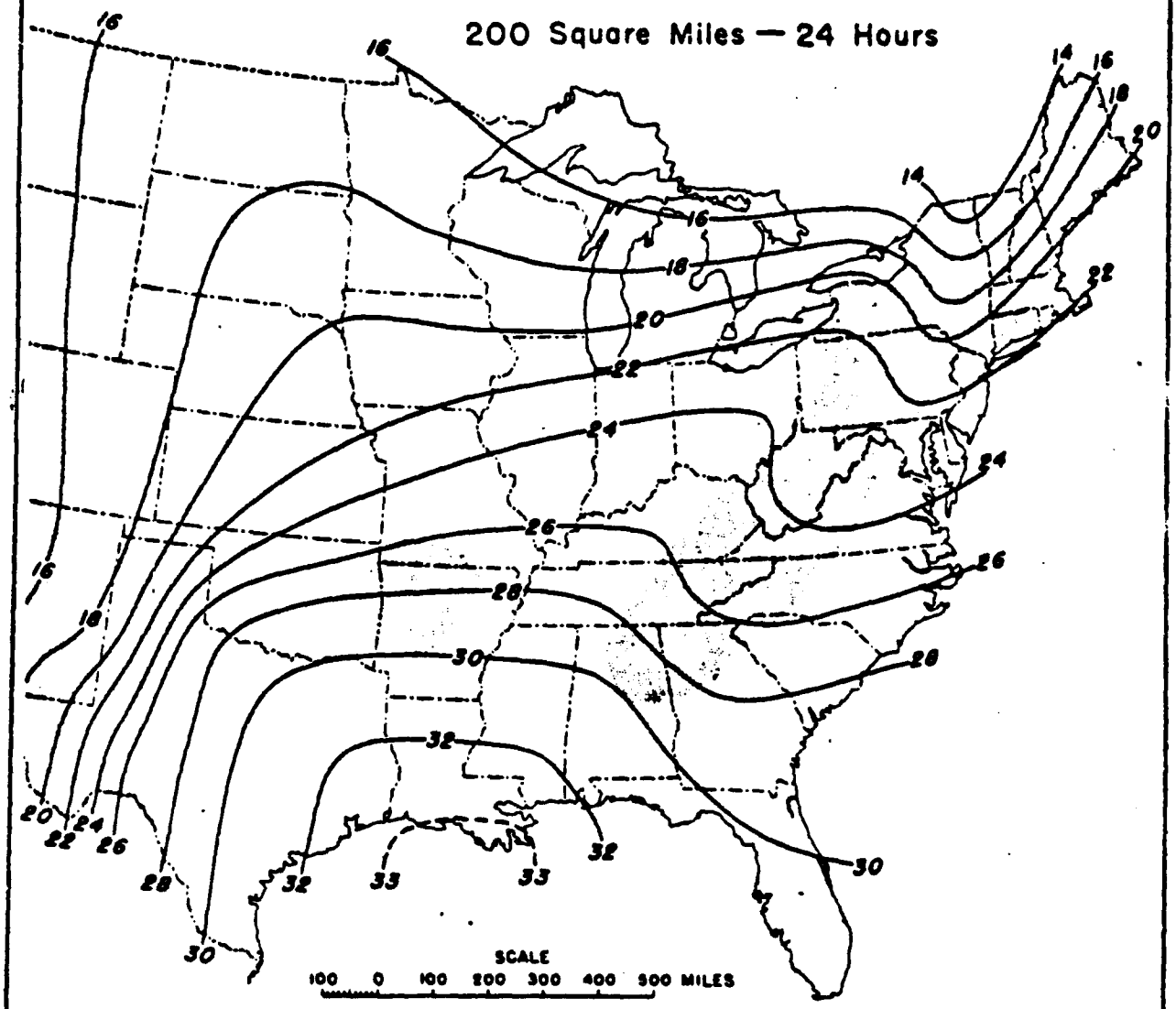
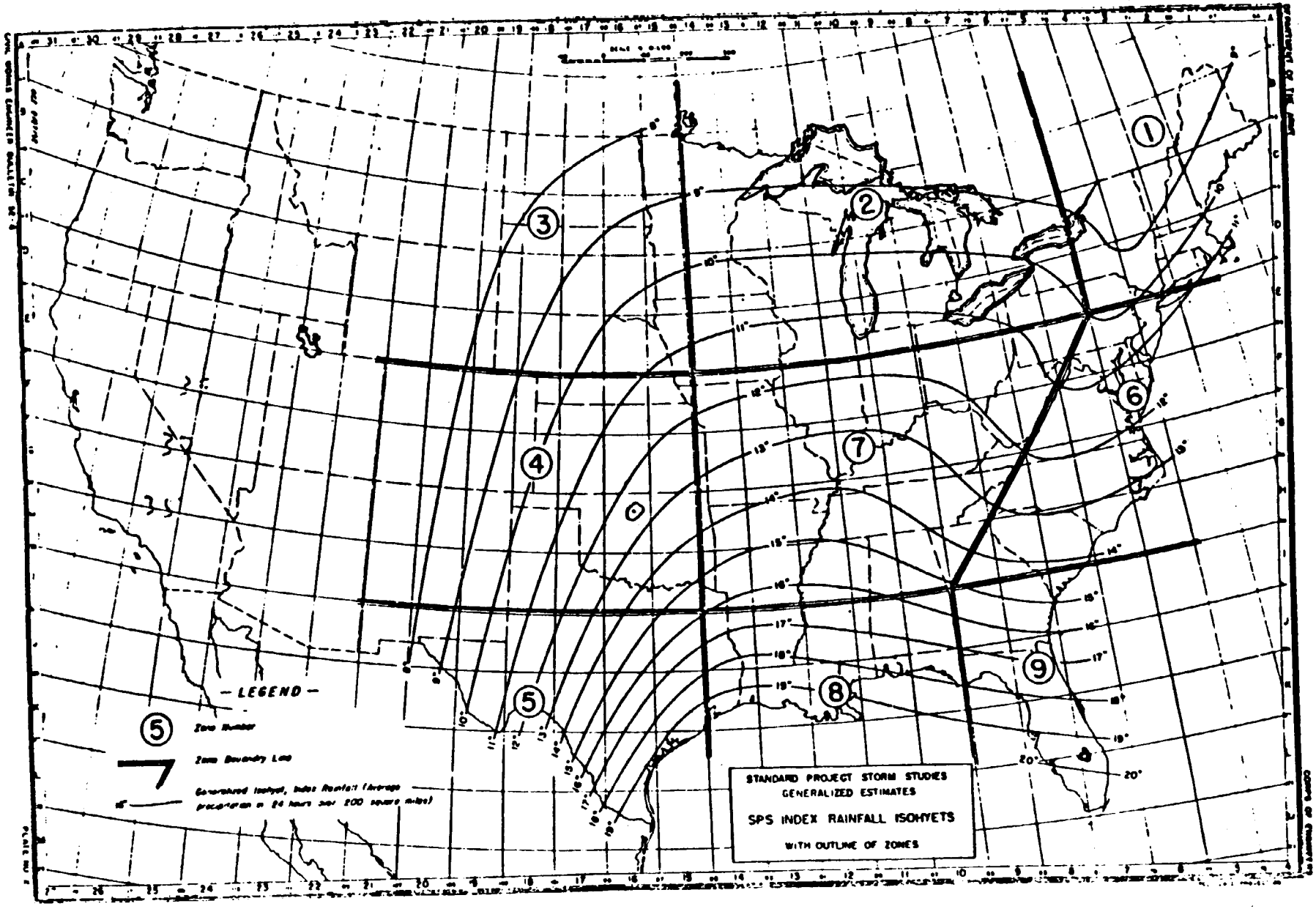
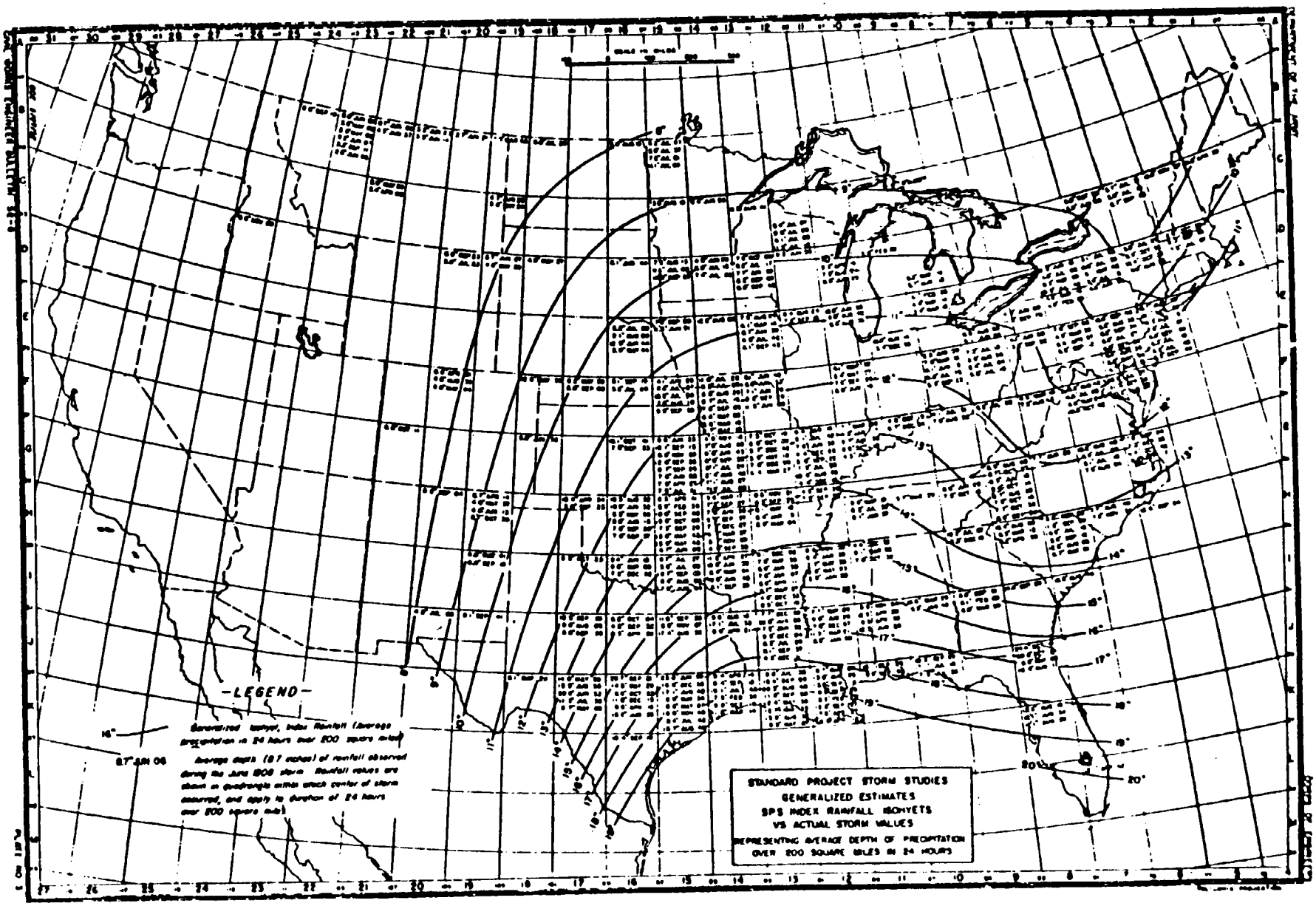
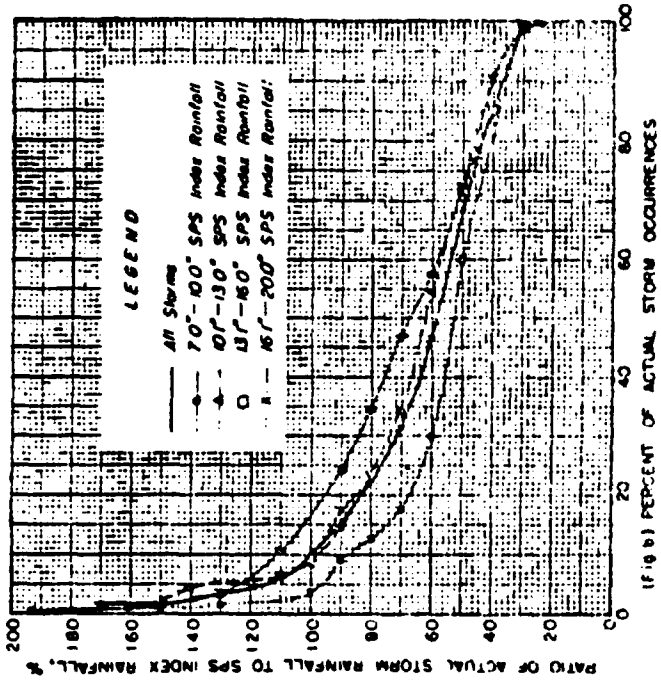
GENERALIZED ESTIMATES
MAXIMUM POSSIBLE PRECIPITATION



This plate is reproduced from H.M.S. Report No. 23 prepared by the Hydrometeorological Section of the U.S. Weather Bureau.

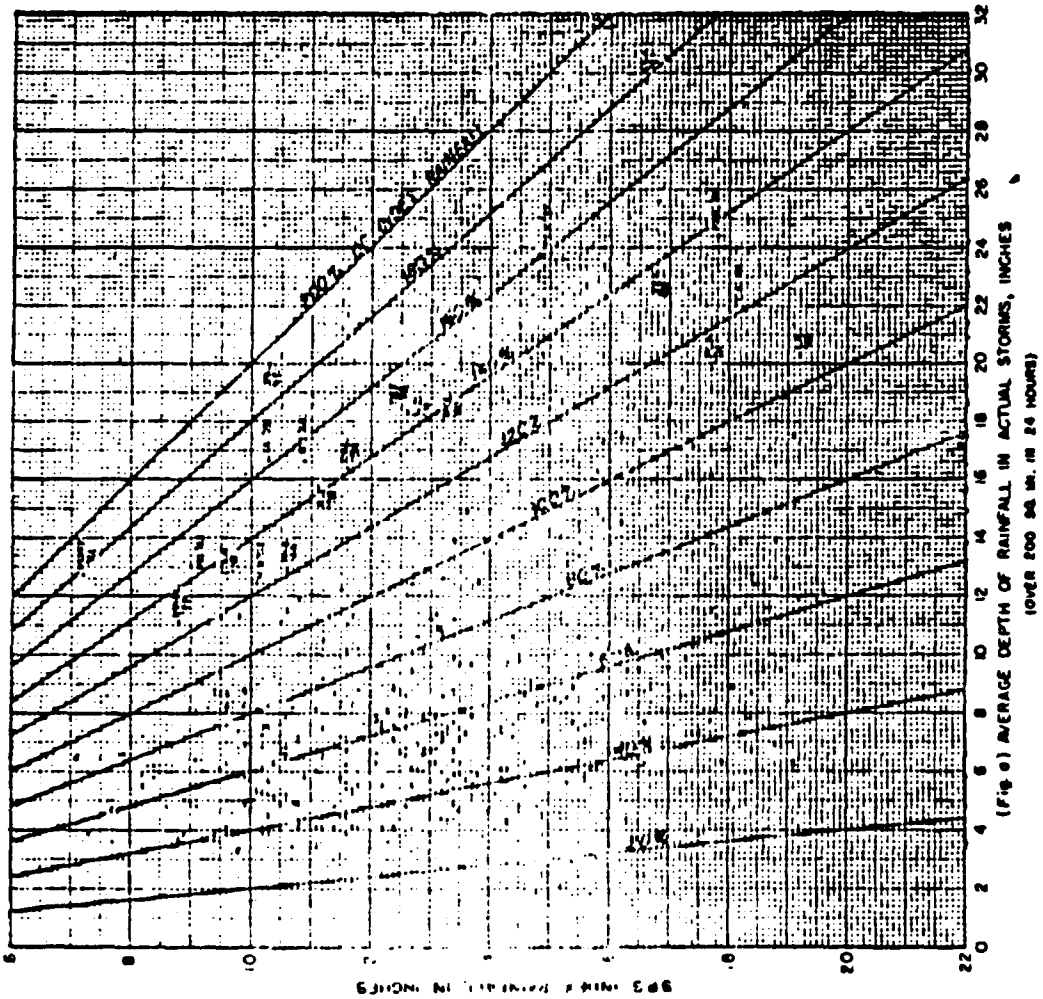

STANDARD PROJECT STORM STUDIES
GENERALIZED ESTIMATES
SPS INDEX RAINFALL ISOHYETS
WITH OUTLINE OF ZONES
— LEGEND —
Zone Number
Zone Boundary Line
Generalized Isohyet, Index Rainfall (Average precipitation in 24 hours over 200 square miles)


-LEGEND-
Generalized isohyet, index Rainfall (average precipitation in 24 hours over 200 square miles)
Average depth (8.7 inches) of rainfall observed during the June 1906 storm. Rainfall values are shown in quadrangle within which center of storm occurred, and apply to duration of 24 hours over 200 square miles
STANDARD PROJECT STORM STUDIES
GENERALIZED ESTIMATES
SPS INDEX RAINFALL ISOHYETS
VS ACTUAL STORM VALUES
REPRESENTING AVERAGE DEPTH OF PRECIPITATION
OVER 200 SQUARE MILES IN 24 HOURS



STANDARD PROJECT STORM STUDIES
GENERALIZED ESTIMATES

RATIO ACTUAL STORM VALUES TO SPS INDEX RAINFALL



STANDARD PROJECT STORM STUDIES

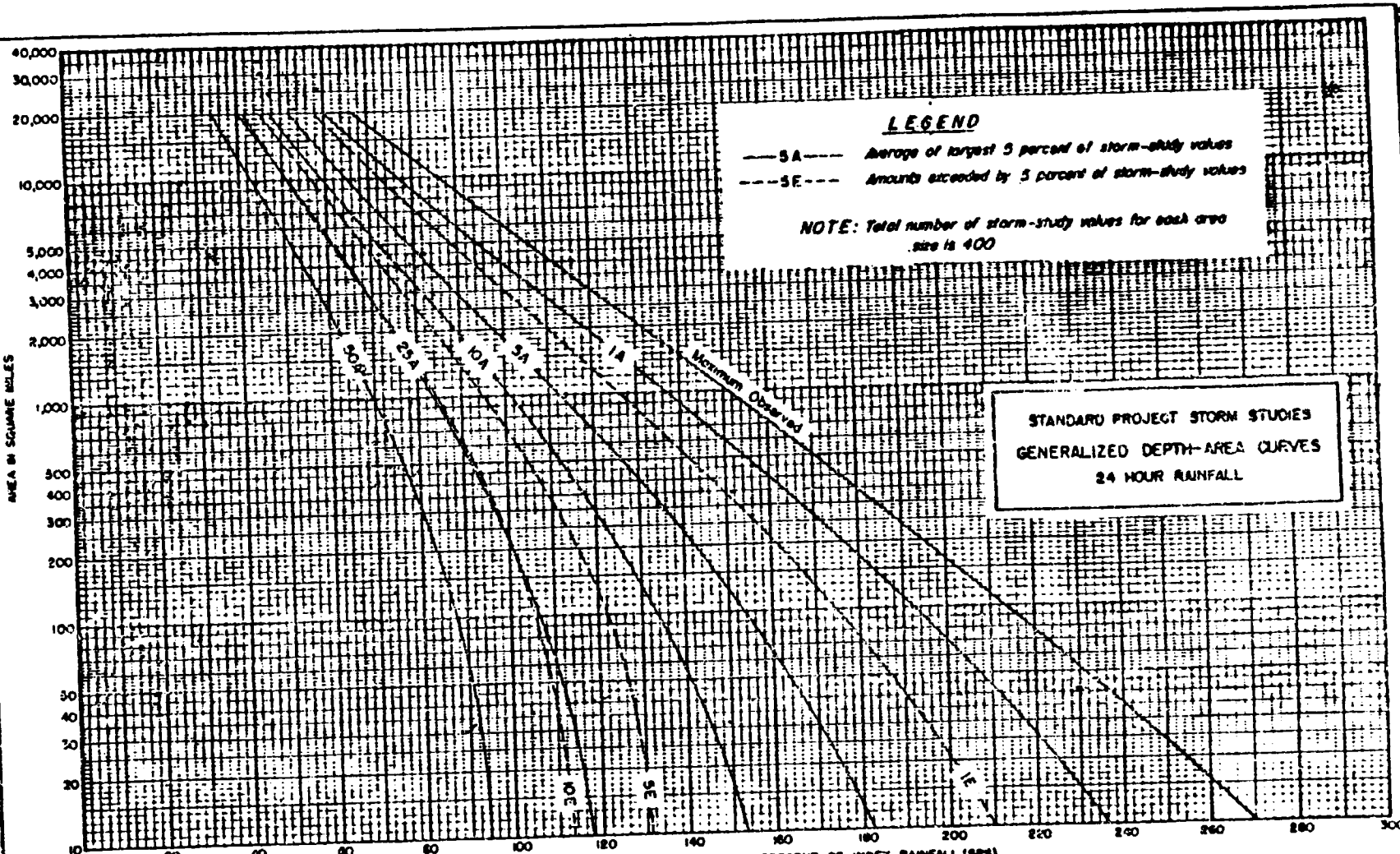
PRECIPITATION DURING MAJOR STORMS OF RECORD IN PERCENT OF SPS INDEX RAINFALL

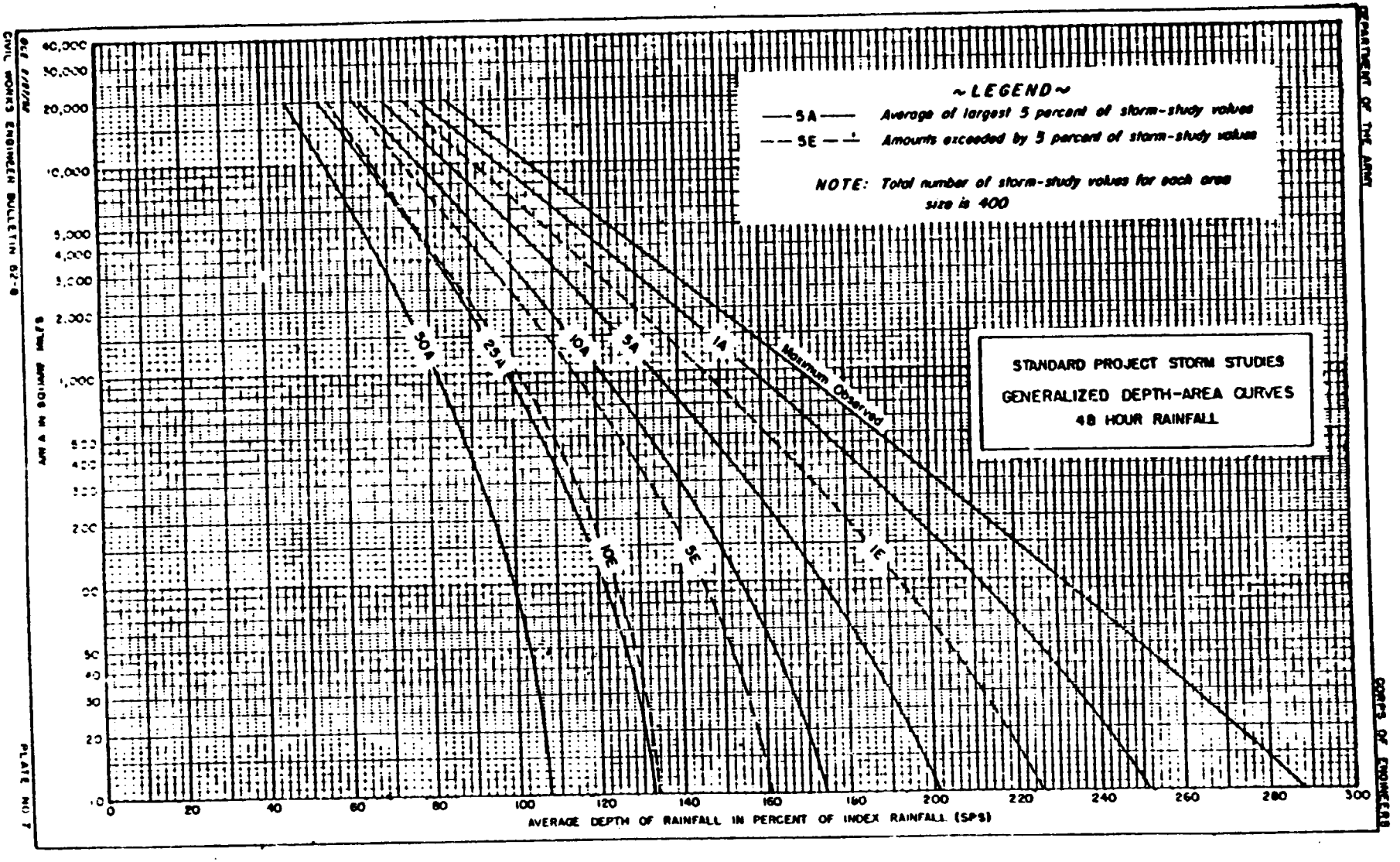
Line	Location	Basin Assignment No.	Grid	Date of Storm	Index Rainfall	Percent of Index Rainfall: 10 Square Miles 6 hr	10 Square Miles 12 hr	10 Square Miles 24 hr	500 Square Miles 6 hr	500 Square Miles 12 hr	500 Square Miles 24 hr	500 Square Miles 48 hr	1,000 Square Miles 6 hr	1,000 Square Miles 12 hr	1,000 Square Miles 24 hr	1,000 Square Miles 48 hr	5,000 Sq. Miles 12 hr	5,000 Sq. Miles 24 hr	5,000 Sq. Miles 96 hr	20,000 Sq. Mi. 24 hr	20,000 Sq. Mi. 96 hr
									Zone 1												
1	Mass.	RA 1-6	D-3	12-14 July 1897	10.5"	42	70	77	36	60	79	93	31	53	64	68	48	58	71	38	55
2	N.H. Vt. Me	RA 1-17	C-3	2-4 Nov 1927	9.0"	87	120	139	69	91	98	113	55	81	87	99	53	74	88	59	71
3	N.Y.	RA 1-21	D-4	4-6 Oct 1932	9.4"	48	77	104	40	65	94	108	34	55	79	89	44	64	73	51	61
4	N.Y. & Pa.	RA 1-24	D-4	20-24 Aug 1933	9.4"	—	—	—	53	80	90	111	46	66	—	90	—	—	—	54	90
5	N.Y.	RA 1-24 (a)	D-4	20-24 Aug. 1933	9.6"	71	97	117	—	—	90	—	—	57	70	81	40	50	76	—	—
6	N.Y. & Pa.	RA 1-27	D-5	6-10 July 1935	9.7"	54	105	122	48	82	103	129	43	69	89	109	46	68	90	58	84
7	Mass.	RA 2-4	D-3	17-22 Sept 1938	10.5"	43	70	108	44	68	86	118	35	60	73	105	37	60	118	47	95
8	N.J. N.Y. Pa.	GL 4-9	D-4	7-11 Oct 1902	10.3"	93	79	134	47	70	125	134	37	65	100	120	46	89	111	62	72
									Zone 2												
8	N.J. N.Y. Pa.	GL 4-9	D-14	7-11 Oct 1902	10.1"	93	79	134	47	70	123	134	37	63	100	120	46	87	101	48	71
9	Pa.	RA 1-1	D-4	30 May-1 June 1889	10.0"	76	88	91	71	88	88	94	67	77	83	88	69	84	81	67	76
10	Mich. Minn.	UMV 1-11	D-12	18-23 July 1909	8.8"	—	—	—	—	—	—	—	—	—	—	—	—	—	101	51	77
11	Mich.	UMV 1-11(b)	D-12	18-23 July 1909	9.2"	57	69	104	50	68	90	125	35	54	75	106	39	54	87	—	—
12	Minn.	UMV 1-22	D-13	28-31 Aug 1941	9.5"	90	121	131	88	118	119	141	59	84	96	121	55	66	100	60	77
13	Minn.	UMV 2-3	C-13	11-15 Sept 1905	10.2"	55	58	63	36	48	51	59	31	48	45	53	39	41	48	38	58
14	Ohio	OL 2-12	C-12	3-8 June 1905	9.9"	75	85	90	67	79	83	100	55	63	71	88	46	54	79	42	84
15	N.Y.	OL 2-16	D-10	31 Aug-1 Sept 1934	10.8"	117	117	117	93	93	93	93	53	53	53	53	—	—	—	—	—
16	Ohio	OL 2-29	D-12	19-24 July 1912	9.8"	56	66	127	53	64	115	115	48	61	94	95	43	67	76	46	58
17	Ohio	OL 4-5	D-12	25-27 July 1877	9.5"	34	67	105	33	69	99	103	30	58	91	94	46	71	76	—	—
18	Ohio	OH 9-19	D-7	10-13 Sept 1878	10.8"	55	104	113	54	100	110	129	48	94	102	119	74	85	105	48	78
19	Pa.	OH 9-23	D-4	17-18 July 1942	10.3"	82	259	284	127	165	193	193	62	100	129	129	—	—	—	—	—
20	Iowa	MR 1-40	D-14	24-28 Aug 1903	11.5"	60	120	120	55	86	106	115	46	76	90	97	56	67	80	46	57
									Zone 3												
21	Minn. S.D.	UMV 1-2	A-15	18-22 July 1897	8.4"	30	68	77	36	55	74	80	32	50	69	75	40	54	76	44	63
22	S.D.	UMV 1-6	D-15	7-11 Sept 1900	10.5"	38	64	76	33	59	67	68	30	50	58	59	40	48	58	39	51
23	Minn.	UMV 1-14(a)	A-15	18-23 July 1909	8.8"	119	122	131	115	118	126	131	104	109	114	121	67	69	—	—	—
24	Ia. Mo.	MR 1-5	C-15	14-17 July 1900	10.5"	64	90	117	58	78	106	113	43	54	87	96	42	65	84	40	57
25	Iowa	MR 1-2	D-15	23-27 June 1891	10.6"	85	105	121	66	90	108	109	50	73	88	90	47	61	68	34	45
26	Wash.	RS 1-21	A-20	17-21 June 1921	7.8"	126	162	185	125	150	176	191	103	133	157	168	86	107	136	54	83
27	Ore.	RS 1-23	C-20	27 Sept-1 Oct 1923	7.6"	79	120	125	69	109	113	200	48	88	87	152	47	53	106	33	79
28	Iowa	MR 1-24	C-15	17-19 Sept 1924	10.3"	147	201	210	114	153	161	161	73	98	103	103	61	66	66	43	48
29	Nebr.	MR 6-15	D-16	10-13 June 1944	10.6"	186	144	144	105	122	122	133	74	85	88	95	38	43	55	—	—
									Zone 4												
30	Ia. Neb.	MR 1-34	E-15	6-7 July 1898	11.6"	60	104	104	47	85	88	88	34	60	72	72	35	43	44	—	—
31	Okla.	MR 2-12	D-16	4-6 June 1916	12.8"	59	64	70	57	61	64	66	34	53	58	60	43	50	58	39	42
32	Nebr.	MR 2-45	E-16	16-19 Sept 1919	11.1"	54	68	78	47	62	73	77	40	55	67	70	44	57	65	44	52
33	Kans.	MR 3-20	F-15	15-17 Nov 1928	12.4"	60	55	80	55	48	71	84	31	43	65	80	36	57	73	44	58
34	Colo.	MR 1-28A	E-16	30-31 May 1935	9.6"	214	232	232	117	131	131	131	60	73	73	73	57	42	42	—	—
35	Okla.	RV 1-5	D-15	1-5 June 1904	11.8"	44	50	55	42	47	53	62	40	46	51	76	40	46	70	34	56
36	N. Mex.	RV 1-6	E-20	26-30 Sept 1904	8.5"	46	51	80	35	46	75	83	29	40	65	77	34	53	82	46	65
37	Okla.	RV 1-10(a)	D-16	21-25 May 1908	12.9"	39	46	57	32	40	51	60	27	35	47	67	30	43	69	37	61
38	Okla.	RV 1-11	E-15	19-24 Oct 1908	13.4"	70	75	85	57	67	74	101	47	56	64	95	40	49	91	34	78
39	N. Mex.	RV 1-16	E-19	29 Apr -2 May 1914	9.6"	55	71	94	48	68	91	97	43	60	82	91	40	65	76	44	58
40	Kans.	RV 2-1	F-15	11-16 Sept 1926	12.2"	104	109	110	91	93	95	95	63	67	70	70	40	42	46	22	35
41	Okla.	RV 2-11	E-17	3-4 April 1934	11.6"	150	179	184	114	135	141	141	78	92	94	94	—	—	—	—	—
42	Okla. Kans.	RV 2-18	E-15	2-4 Sept 1940	13.2"	140	177	179	95	133	136	139	60	101	103	107	55	57	61	38	35
43	Okla.	RV 2-20	E-15	9-12 May 1943	14.1"	70	87	122	52	67	98	116	31	46	80	121	32	59	102	43	79
44	Okla. Kans.	RV 2-21	E-15	12-20 May 1943	13.4"	119	125	125	97	101	104	104	46	59	63	81	37	40	93	31	70
45	N. Mex. Tex.	OH 5-15(a)	D-19	15-17 Sept. 1939	9.2"	43	60	60	33	46	46	46	27	37	34	75	39	43	65	34	34
46	Kans.	MR 10-2	F-15	9-13 July 1951	12.8"	—	—	—	38	52	61	109	34	44	54	54	37	44	107	34	77
									Zone 5												
47	Tex.	OH 5-4	J-15	27 June-1 July 1899	16.9"	41	74	148	37	70	156	173	33	44	125	149	44	87	148	49	110
48	Tex.	OH 5-13	I-20	21-25 July 1909	8.6"	45	50	66	38	48	54	66	30	34	45	70	32	31	71	19	46
49	Tex.	OH 5-14	I-17	4-6 Aug 1906	12.8"	62	63	68	60	63	68	71	56	62	66	72	52	56	65	34	44
50	Tex.	OH 5-12	J-16	8-10 Sept 1921	16.8"	135	179	180	108	146	175	185	81	113	144	151	67	90	98	—	—
51	Tex.	OH 5-1	J-17	30 Jun -2 Jul 1932	15.0"	89	130	211	49	95	157	171	51	70	127	139	45	90	104	47	54
52	Tex.	OH 5-6	J-16	27 June - 4 Jul 1935	17.3"	81	92	104	73	79	87	105	69	71	77	89	55	58	72	35	53
53	Tex.	OH 5-10	J-17	19-25 July 1938	15.0"	89	103	122	65	80	86	110	46	50	61	91	34	42	115	24	75
54	Tex.	OH 5-11	J-15	28-30 June 1940	18.1"	61	99	104	50	84	94	114	35	65	80	102	39	54	73	28	44
55	Tex.	OH 5-14A	I-15	30 Aug-5 Sep 1952	16.2"	82	95	113	47	77	107	112	39	68	91	94	40	54	67	28	43
56	N. Mex.	OH 5-19	I-19	20-23 Sept 1941	9.6"	105	117	126	84	96	84	112	40	57	66	86	43	50	81	39	65
57	Tex.	[illegible]	J-17	31 May 1935	15.8"	135	135	135	98	98	98	98	57	59	59	59	58	58	58	—	—

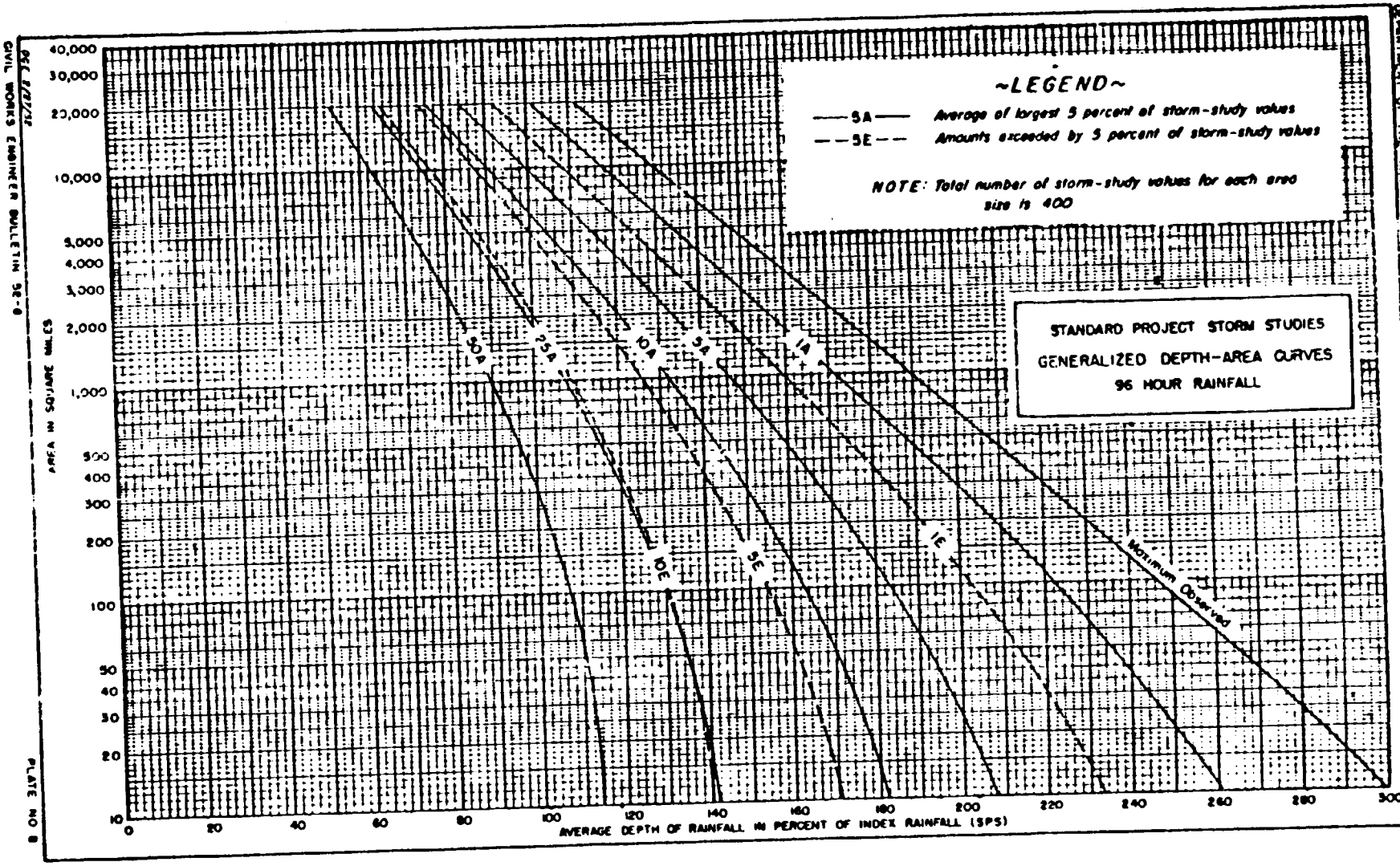
STANDARD PROJECT STORM STUDIES

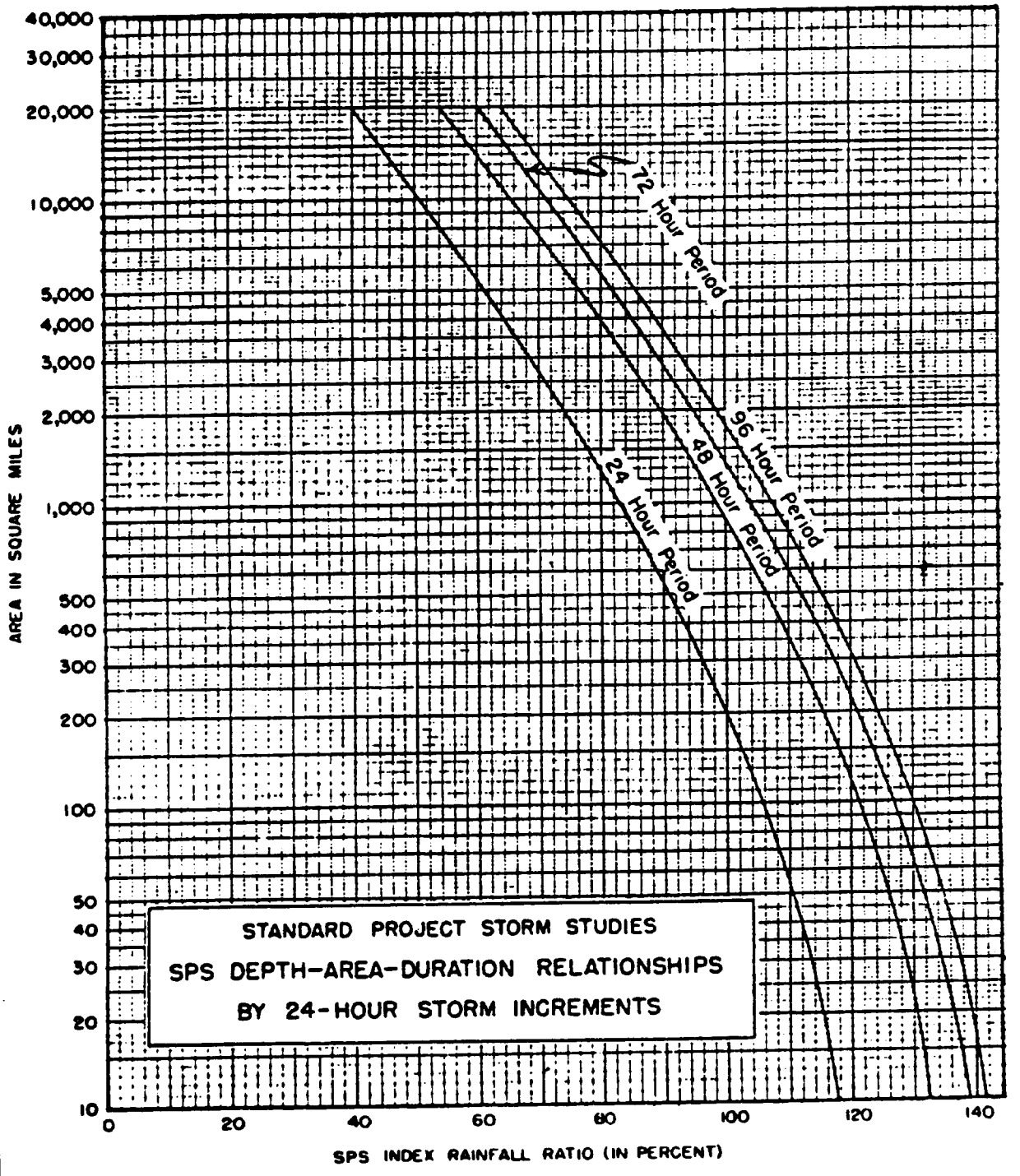
PRECIPITATION DURING MAJOR STORMS OF RECORD IN PERCENT OF SPS INDEX RAINFALL

Item	Location	Name Assignment No.	Chart	Date of Storm	Index Rainfall	Percent of Index Rainfall: 10 Square Miles 6 hr	10 Square Miles 12 hr	10 Square Miles 24 hr	200 Square Miles 6 hr	200 Square Miles 12 hr	200 Square Miles 24 hr	200 Square Miles 48 hr	1,000 Square Miles 6 hr	1,000 Square Miles 12 hr	1,000 Square Miles 24 hr	1,000 Square Miles 48 hr	5,000 Sq. Mi. 12 hr	5,000 Sq. Mi. 24 hr	5,000 Sq. Mi. 96 hr	20,000 Sq. Mi. 24 hr	20,000 Sq. Mi. 96 hr
									ZONE 6												
58	N.J., Pa.	SA 1-3	2-4	22-24 Sept. 1882	10.5"	95	95	112	49	81	99	149	95	66	77	188	44	95	97	38	78
59	Md.	SA 1-7(b)	2-5	26-28 July 1897	11.1"	117	130	138	85	94	95	124	90	94	96	89	34	88	93	-	-
60	N.J.	SA 1-12	2-4	13-14 Aug 1919	11.8"	68	79	84	52	73	88	88	68	64	79	79	69	61	63	-	-
61	Md. Va.	SA 1-18	2-5	10-13 Aug 1933	11.8"	54	77	101	44	69	91	110	57	69	79	98	44	88	85	44	88
62	Pa.,N.J.,Md.	SA 1-24(b)	2-5	22-24 Aug 1933	10.5"	95	81	101	43	70	-	98	36	-	80	-	34	88	97	-	-
63	N. J.	SA 2-3	2-4	19 Aug 1939	11.1"	87	154	160	78	137	141	141	65	102	119	119	54	84	84	-	-
64	N.J.	SA 2-4	2-5	31 Aug-1 Sept 1940	10.9"	175	208	208	126	158	158	158	78	96	96	96	-	-	-	-	-
65	N.Va.	SA 1-19	2-6	27-30 Sept 1896	10.8"	38	55	67	34	58	65	65	34	49	65	64	44	57	58	54	58
66	Md.	SA 1-26	2-5	3-6 Sept 1935	11.3"	53	86	111	37	61	100	136	34	56	95	185	51	87	113	84	89
67	Va.	SA 1-28 (a)	2-6	11-17 Oct 1942	11.2"	54	75	128	35	50	94	146	28	44	81	163	34	84	108	35	70
68	N.C.	SA 2-1	2-7	24-28 Aug 1893	13.8"	61	85	95	46	76	90	91	58	68	80	81	49	61	68	43	43
69	N.C.Va.	SA 2-6	2-8	23-28 Aug 1908	13.0"	68	78	82	46	60	80	105	36	48	73	97	34	59	94	48	75
70	N.C. S.C.	SA 2-9	2-8	13-17 July 1916	12.6"	64	100	176	95	95	116	146	47	82	119	144	99	88	111	47	68
71	N.C.	SA 2-9(a)	2-7	13-17 July 1916	13.6"	68	79	111	38	76	109	120	34	68	99	110	51	74	88	-	-
72	N.C. Va.	SA 2-15	2-7	16-19 Sept 1928	13.4"	58	76	86	43	69	84	98	34	65	80	89	53	70	82	34	72
73	Ga.	SA 3-7	2-9	27-31 July 1887	14.0"	50	78	78	43	65	77	106	35	55	84	94	39	68	90	43	67
74	N.C.Fla.Ga.	SA 3-16	2-5	13-17 Sept 1924	13.2"	73	89	100	54	65	95	108	48	78	87	94	48	71	89	48	74
75	Va.	SA 5-19(a)	2-6	10-17 Aug 1940	11.8"	37	72	97	33	64	84	138	30	55	77	116	48	64	109	48	85
76	N.C.	SA 5-19(b)	2-8	10-17 Aug 1940	12.4"	45	70	89	30	53	72	103	24	44	64	95	-	-	-	-	-
									ZONE 7												
77	Miss. Tenn.	LRV 1-4	3-12	17-21 Nov 1906	15.4"	38	46	63	30	38	50	68	25	33	53	57	29	46	64	38	68
78	Tenn. Miss.	LRV 1-12	6-11	15-17 Mar. 1919	14.5"	44	59	69	37	54	67	71	33	50	64	68	43	56	61	46	48
79	Ia. Ill.	LRV 2-5	8-13	9-10 June 1905	11.7"	86	103	103	76	97	97	97	68	85	85	85	49	68	68	33	33
80	Ohio, Tenn.	LR 1-15	8-9	25-29 Mar.1913	11.7"	39	51	68	28	46	68	79	26	48	56	74	35	50	84	48	78
81	Ill. Ark.	GR 4-8	9-11	3-6 Oct 1910	13.4"	31	47	67	31	46	66	79	27	38	55	89	30	48	93	45	80
82	Tenn.	LR 7-15	6-10	21-23 Mar 1929	13.7"	52	64	74	45	61	71	73	39	54	65	68	45	55	61	43	48
83	Ohio	GR 9-11	8-8	6-7 Aug 1935	11.5"	84	101	103	61	85	86	86	47	68	70	70	46	50	58	-	-
84	Tenn.	LR 5-6	6-11	5-25 Jan 1937	14.2"	34	31	47	22	30	43	64	20	29	40	62	24	34	80	38	75
85	Mo.	MR 1-1	7-13	14-20 Dec 1895	13.2"	33	52	58	28	43	53	66	25	38	49	88	32	43	77	34	66
86	Mo. Kans.	MR 2-29	8-14	9-12 July 1928	11.6"	93	104	105	83	89	95	101	68	73	88	83	41	46	63	36	57
87	Mo.	MR 7-8(a)	7-14	12-15 Aug 1946	12.7"	84	87	118	65	72	98	137	43	52	65	108	37	46	80	35	57
88	Ill.	MR 7-8(b)	7-12	15-16 Aug.1946	12.0"	47	77	94	42	65	83	127	34	55	79	115	38	47	90	35	69
89	Ga. Miss.	GR 3-22	Any	6-10 Dec. 1919	13.9"	45	56	68	35	53	60	82	28	46	54	79	34	46	81	35	73
									ZONE 8												
90	Ala. Fla.	SA 4-23	4-11	17-21 Sept 1926	17.7"	48	68	97	44	65	91	99	34	54	77	87	38	68	78	47	58
91	Ala. Miss.	LRV 2-5	3-11	15-18 Apr 1900	16.2"	47	61	78	40	60	75	83	34	54	69	78	46	61	75	48	65
92	La.	LRV 2-13	4-12	28-30 Sept 1915	18.1"	56	74	80	50	70	75	75	45	64	68	68	48	55	56	39	52
93	Ala. Miss.	LRV 2-18	3-11	1-5 June 1928	16.7"	46	61	74	34	52	72	88	28	46	68	85	38	59	88	45	69
94	Ala.	LRV 2-20	2-10	11-16 Mar. 1929	17.0"	88	90	117	77	85	109	150	60	69	95	136	51	79	116	54	86
95	La.	LRV 2-26	3-14	24-27 July 1933	17.2"	34	69	105	32	65	99	111	29	54	86	103	40	61	99	38	77
96	La.	LRV 4-8	4-12	12-16 Apr 1937	19.1"	72	94	107	61	82	91	91	47	68	77	77	51	68	61	43	47
97	La.	LRV 4-22	4-13	6-9 Aug 1940	19.3"	44	82	110	41	70	106	166	31	57	96	150	33	44	119	39	68
98	Tex.	LRV 1-10	3-14	14-21 Aug 1915	17.5"	38	46	60	25	37	55	97	19	31	49	98	26	38	100	31	78
99	Fla. Miss.	GR 1-19	4-10	5-10 July 1946	17.4"	91	99	105	68	86	98	111	55	75	91	105	54	69	109	43	91
100	La.	LRV 4-7	1-13	13-17 June 1886	18.1"	69	97	123	65	94	121	155	56	87	111	142	54	88	98	-	-
101	Tex.	GR 5-21	4-14	27-29 July 1943	19.1"	56	66	95	40	52	79	114	31	45	72	105	32	34	88	38	80
									ZONE 9												
102	Ga.	SA 5-20	1-8	25-28 Sept 1928	19.4"	54	84	104	51	78	95	117	46	71	85	107	51	64	95	38	49
103	Fla.	SA 4-30	4-8	4-11 Oct 1924	17.8"	76	108	130	48	97	117	119	40	66	84	94	39	43	66	-	-
104	Fla.	SA 5-6	4-8	17-22 Oct 1941	17.8"	72	132	148	54	102	137	163	39	72	102	124	43	63	86	39	51
105	Va.	SA 3-11	4-8	28-31 Aug.1911	17.8"	88	101	112	75	88	96	101	58	70	79	88	36	47	63	36	43


LEGEND
—5A— Average of largest 5 percent of storm-study values
---5E--- Amounts exceeded by 5 percent of storm-study values
NOTE: Total number of storm-study values for each area size is 400
STANDARD PROJECT STORM STUDIES
GENERALIZED DEPTH-AREA CURVES
24 HOUR RAINFALL
Maximum Observed
1A
5A
10A
25A
50A
1E
5E
10E
AREA IN SQUARE MILES
40,000
30,000
20,000
10,000
5,000
4,000
3,000
2,000
1,000
500
400
300
200
100
50
40
30
20
10
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
AVERAGE DEPTH OF RAINFALL IN PERCENT OF INDEX RAINFALL (SPS)


~LEGEND~
5A Average of largest 5 percent of storm-study values
5E Amounts exceeded by 5 percent of storm-study values
NOTE: Total number of storm-study values for each area size is 400
STANDARD PROJECT STORM STUDIES
GENERALIZED DEPTH-AREA CURVES
48 HOUR RAINFALL
Maximum Observed
50A
25A
10A
5A
1A
10E
5E
1E
AREA IN SQUARE MILES
AVERAGE DEPTH OF RAINFALL IN PERCENT OF INDEX RAINFALL (SPS)


~LEGEND~
5A Average of largest 5 percent of storm-study values
5E Amounts exceeded by 5 percent of storm-study values
NOTE: Total number of storm-study values for each area size is 400
STANDARD PROJECT STORM STUDIES
GENERALIZED DEPTH-AREA CURVES
96 HOUR RAINFALL
80A
25A
10A
5A
1A
10E
5E
1E
Maximum Observed
AREA IN SQUARE MILES
40,000
30,000
20,000
10,000
5,000
4,000
3,000
2,000
1,000
500
400
300
200
100
50
40
30
20
10
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
AVERAGE DEPTH OF RAINFALL IN PERCENT OF INDEX RAINFALL (SPS)


40,000
30,000
20,000
10,000
5,000
4,000
3,000
2,000
1,000
500
400
300
200
100
50
40
30
20
10
AREA IN SQUARE MILES
0
20
40
60
80
100
120
140
SPS INDEX RAINFALL RATIO (IN PERCENT)
72 Hour Period
96 Hour Period
48 Hour Period
24 Hour Period
STANDARD PROJECT STORM STUDIES
SPS DEPTH-AREA-DURATION RELATIONSHIPS
BY 24-HOUR STORM INCREMENTS

OCE 10/8/81

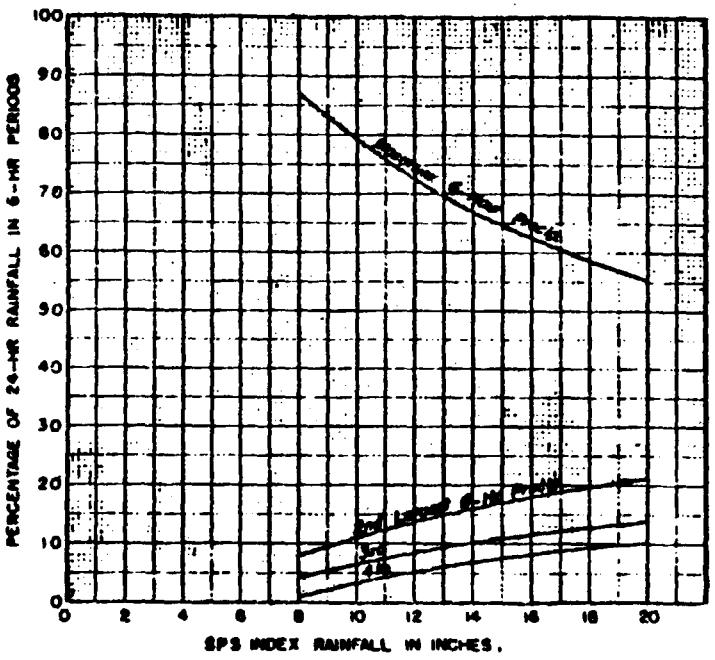


FIG. (a) SPS 24-HOUR PRECIPITATION OVER 200 SQ. MI. vs. PERCENT IN 6-HOUR PERIODS

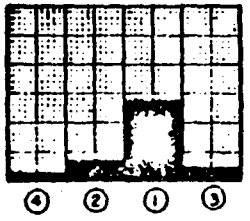


FIG. (b) TYPICAL ARRANGEMENT OF 6-HOUR RAINFALL QUANTITIES IN SPS

INDEX RAINFALL IN INCHES	PERCENTAGE OF 24-HOUR SPS RAINFALL IN DESIGNATED 6-HR PERIOD			
	④	②	①	③
1	2	3	4	5
8	1.0	8.0	87.0	4.0
9	2.1	9.5	83.0	5.4
10	3.2	11.0	79.2	6.6
11	4.3	12.3	75.9	7.5
12	5.3	13.8	72.5	8.4
13	6.1	14.9	69.6	9.4
14	7.0	16.0	66.9	10.1
15	7.6	17.0	64.5	10.9
16	8.1	17.9	62.4	11.6
17	8.8	18.9	60.3	12.0
18	9.1	19.7	58.5	12.7
19	9.8	20.3	56.8	13.1
20	10.1	21.0	55.1	13.8

FIG. (c) TABULATION OF DATA FROM FIG. (a)

STANDARD PROJECT STORM STUDIES
GENERALIZED ESTIMATES

TIME DISTRIBUTION
OF 24-HOUR SPS RAINFALL

TIME DISTRIBUTION OF MAXIMUM 6-HOUR SPS RAINFALL

Rainfall Period (Sub-Division of 6-Hour Period)	Time Distribution of Maximum 6-Hour SPS Rainfall, Expressed in Percent of Total 6-Hour Rainfall *Selected Unit Rainfall Duration, t_R			
	6-Hours	3-Hours	2-Hours	1-Hour
#1	#2	#3	#4	#5
1st	100	33	26	10
2nd		67	53	12
3rd			21	15
4th				38
5th				14
6th				11
TOTAL	100	100	100	100

*NOTE: The "selected unit rainfall duration," t_R is determined approximately from the synthetic unit hydrograph equation, $t_r = \frac{t_p}{5.5}$ in which "t_p" is the lag time from midpoint of unit rainfall duration, t_r, to peak of unit hydrograph, in hours, (See page 11, Engineering Manual for Civil Works, Part CXIV - Hydrologic and Hydraulic Analyses, Chapter 5 - Flood-Hydrograph Analyses and Computations). The following rounded-off values are to be used in the above table:

If t_p exceeds 16, use $t_R = 6$

If t_p is between 12 and 16, use $t_R = 3$

If t_p is between 6 and 12, use $t_R = 2$

If t_p is between 4 and 6, use $t_R = 1$

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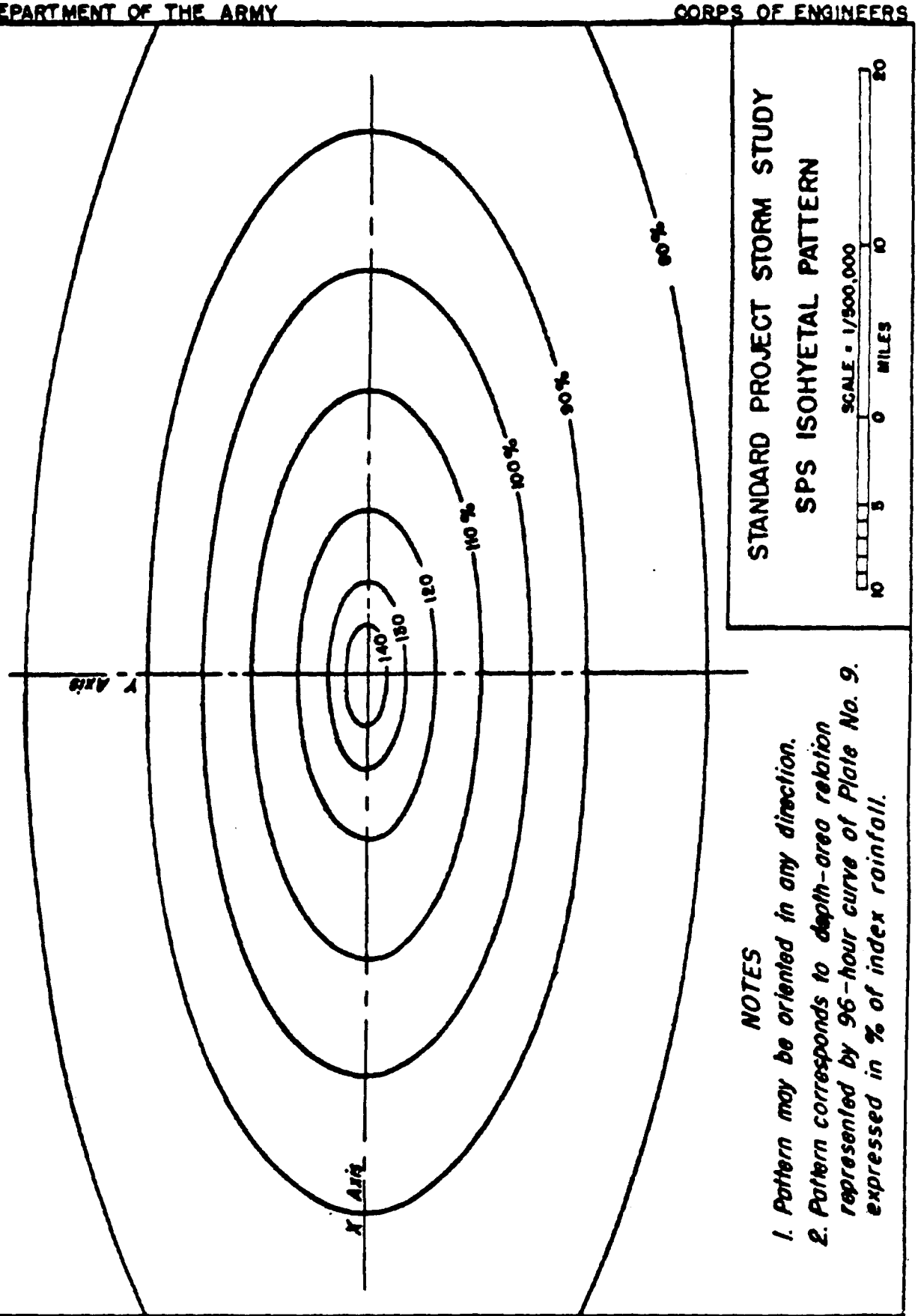
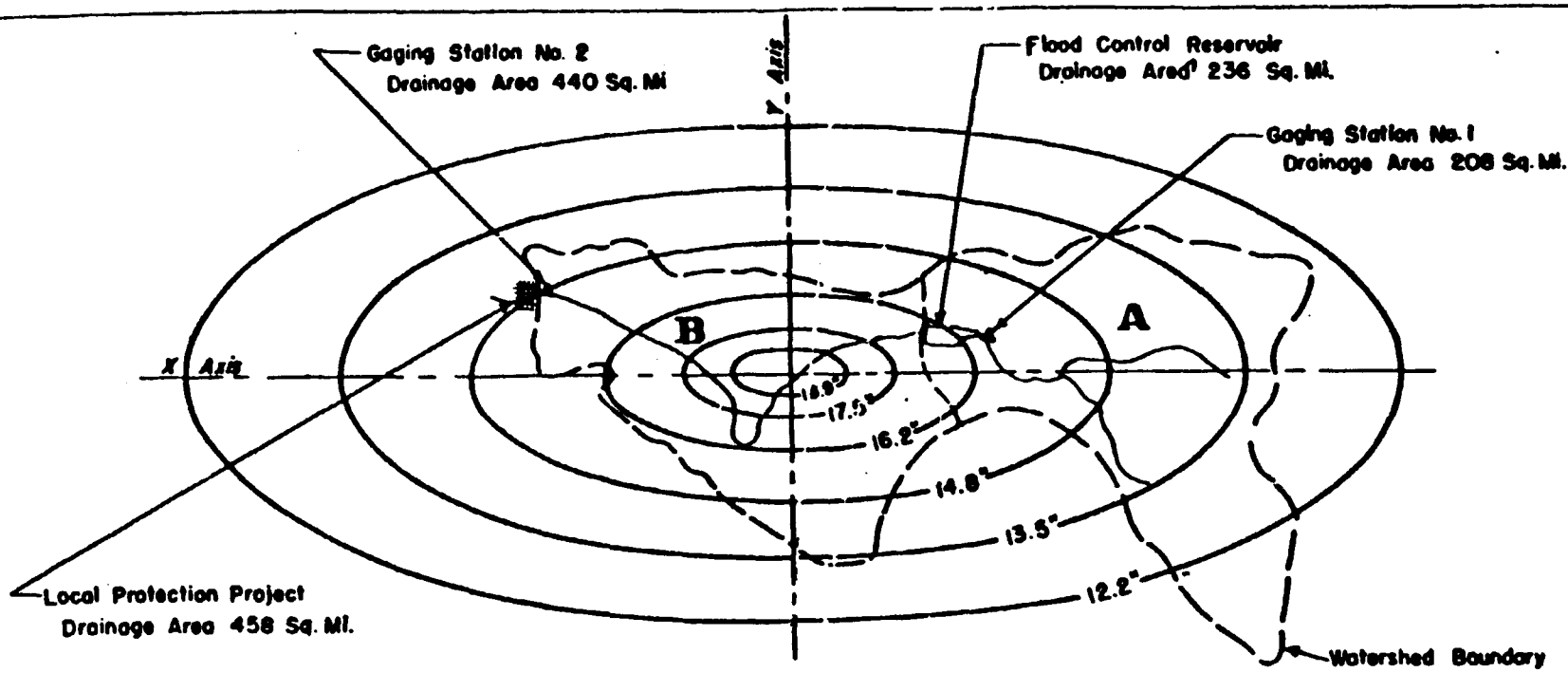


NOTES

1. Pattern may be oriented in any direction.
2. Pattern corresponds to depth-area relation represented by 96-hour curve of Plate No. 9. expressed in % of index rainfall.



UNIT HYDROGRAPH DATA

LOCATION	DRAINAGE AREA	L	L_{ca}	$(L \cdot L_{ca})^{0.3}$	C_t	t_p	t_r	t_R	t_{pR}	$640C_p$	Q_p
Dam A	236	37	20	7.3	1.8	13.1	2.4	3.0	13.2	380	6,800
LPP B	222	35	18	6.9	2.3	15.9	2.9	3.0	15.9	420	5,900

NOTES

1. *Project location: Lat. 37°, Long. 94° (Index rainfall = 13.5").*
2. *Isohyets correspond to those of Plate No. 12 with percentages multiplied by index rainfall of 13.5 inches.*
3. *For definition and application of unit-hydrograph symbols see Engineering Manual for Civil Works, Part CXIV, Chapter 5.*
4. *C_t and C_p based on floods observed at gaging stations 1 & 2.*
5. *t_R based on criteria on Plate No. 11.*

STANDARD PROJECT STORM STUDIES
ILLUSTRATIVE EXAMPLE
APPLICATION OF ISOHYETAL PATTERN
(MAXIMUM 96-HOUR PERIOD OF SPS)

10 5 0 10 20
MILES

PLATE 14

COMPUTATION OF RAINFALL AND RAINFALL EXCESS FOR THE STANDARD PROJECT STORM OVER SAMPLE DRAINAGE BASIN

Line No.	Step No.	Item	Data on Sub-areas: Designation	Area Sq. Mi.	Initial Loss	Loss Rate	Time in Hours: 24	48	72	96	Rainfall, Loss and Excess by Periods — Time from Beginning of Rainfall - Hours: 6	12	18	24	30	36	42	48	54	60	66	Subdivision of Max. 6-Hour Rainfall: 61	62	63	64	65	66	72	78	84	90	96	Total
1		Location of Basin (Lat. 37°, Long. 84°)		500																														
2	1	Index Rainfall in Inches (From Plate 2)		200			13.5																											
3	2	Index Rainfall Ratios in Percent (From Plate 9)		550			92	107	113	116																								
4	2	Maximum Rainfall in Inches for Duration		550			12.4	14.4	15.3	15.7																								
5	3	24-Hour Rainfall Increment in Inches		550			0.4	2.0	12.4	0.9																								
6	5	Average Rainfall for Total Storm in Inches (From Plate 15)	A							24.0																								
7	5	Average Rainfall for Total Storm in Inches	B							26.3																								
8	5	Average Rainfall for Total Storm in Inches	Total							25.1																								
9	6	24-Hour Rainfall Increment in Percent of Total (From Line 5)					2.6	12.7	79.6	5.7																								
10	6	24-Hour Rainfall Increment in Inches	A				0.3	1.8	11.1	0.8																								
11	6	24-Hour Rainfall Increment in Inches	B				0.4	2.1	12.9	0.9																								
12	6	24-Hour Rainfall Increment in Inches	Total				0.4	1.9	11.9	0.9																								
13	6	6-Hour Percentages of 24-Hour Rainfall (From Plate 10)									7	15	48	10	7	15	48	10	7	15	48								10	7	15	48	10	
14	6	6-Hour Rainfall in Inches	A	256							0.0	0.1	0.2	0.0	0.1	0.3	1.2	0.2	0.8	1.7	7.5**								1.1	0.1	0.1	0.5	0.1	11.0
15	6	6-Hour Rainfall in Inches	B	282							0.0	0.1	0.3	0.0	0.2	0.3	1.4	0.2	0.9	1.9	8.8**								1.3	0.1	0.1	0.6	0.1	13.3
16	6	6-Hour Rainfall in Inches	Total	550							0.0	0.1	0.3	0.0	0.1	0.3	1.3	0.2	0.8	1.8	8.1**								1.2	0.1	0.1	0.6	0.1	12.1
17	7	Rainfall Interval in Hours																																
18	7	Percentage Subdivision of Max. 6-Hour Rainfall (From Plate 11)																			100**			3			3							
19	7	Subdivision of Maximum 6-Hour Rainfall in Inches	A	256																	7.5**			1.5			6.0							
20	7	Subdivision of Maximum 6-Hour Rainfall in Inches	B	282																	8.8**			1.8			7.0							
21	7	Subdivision of Maximum 6-Hour Rainfall in Inches	Total	550																	8.1**			1.5			6.5							
22	8	Infiltration Losses in Inches	A	256	0.5	0.15					0.0	0.1	0.2	0.0	0.1	0.3	0.9	0.2	0.8	0.9	0.9**			0.1			0.5		0.0	0.1	0.1	0.5	0.1	6.1
23	8	Infiltration Losses in Inches	B	282	0.5	0.10					0.0	0.1	0.3	0.0	0.2	0.3	0.4	0.2	0.4	0.4	0.4			0.3			0.3		0.0	0.1	0.1	0.4	0.1	5.0
24	8	Rainfall-Excess in Inches	A	256							0	0	0	0	0	0	0.3	0	0	0.8	6.6**			1.1			5.5		0.2	0	0	0	0	7.0
25	8	Rainfall-Excess in Inches	B	282							0	0	0	0	0	0	0.8	0	0.3	1.5	8.2**			1.5			6.7		0.7	0	0	0	0	11.3
26	8	Rainfall-Excess in Inch-Square Miles	A	256							0	0	0	0	0	0	7.1	0	0	189	1560**			260			1300		47	0	0	0	0	1867
27	8	Rainfall-Excess in Inch-Square Miles	B	282							0	0	0	0	0	0	178	0	67	709	1820**			333			2100		155	0	0	0	0	2512
28	8	Rainfall-Excess in Inch-Square Miles	Total	550							0	0	0	0	0	0	246	0	67	478	3380**			593			2750		202	0	0	0	0	4379
29	8	Rainfall-Excess in Inches	Total	550							0	0	0	0	0	0	0.6	0	0.1	0.8	7.4**			1.3			6.1		0.5	0	0	0	0	9.4

*See paragraph 2-05 e of Bulletin

**These values subdivided into 3-hour periods in accordance with procedures and criteria specified in paragraph 2-05 e and Plate 11.

PLATE NO. 15

CUMBERLAND RIVER BASIN, STANDARD PROJECT FLOOD INVESTIGATIONS

TABLE A

ADJUSTMENT OF RAINFALL VALUES FROM MAJOR DEPTH-AREA CURVES OF

SEVERE STORMS FOR TRANSPOSITION TO CUMBERLAND RIVER BASIN ABOVE OLD HICKORY, TENN.

Line Number	Storm Number	Date of Storm	Approximate Location of Storm Center considered (5000 sq. mi. area)	Transposition Factor: For 5000 sq. mi. area: Charleston, W.Va.	Transposition Factor: For 5000 sq. mi. area: Boston, Mass.	Transposition Factor: Adjusted average for Basin	Maximum Average Depth of Rainfall over Specified Areas, Adjusted for Transposition to Cumberland Basin: 200 Square Miles: 12 hrs.	200 Square Miles: 24 hrs.	200 Square Miles: 48 hrs.	200 Square Miles: 120 hrs.	1,000 Square Miles: 12 hrs.	1,000 Square Miles: 24 hrs.	1,000 Square Miles: 48 hrs.	1,000 Square Miles: 120 hrs.	5,000 Square Miles: 12 hrs.	5,000 Square Miles: 24 hrs.	5,000 Square Miles: 48 hrs.	5,000 Square Miles: 120 hrs.	10,000 Square Miles: 12 hrs.	10,000 Square Miles: 24 hrs.	10,000 Square Miles: 48 hrs.	10,000 Square Miles: 120 hrs.
1	CO 9-10	10-13 Sep 1878	Piedmont, Ohio	1.32	1.18	1.25	13.6	16.7	17.4	(18.1)	12.6	15.6	16.1	(16.6)	10.0	13.3	15.4	(16.1)	8.8	10.1	10.1	(10.5)
2	CO 7-18	22-25 Mar 1929	Crossville, Tenn.	1.10	0.97	1.04	8.7	10.1	10.4	-	8.0	9.3	9.8	-	6.8	7.8	8.4	-	5.6	6.9	7.6	-
3	SW 1-4	22-25 Mar 1886	Austin, Ohio.	0.88	0.82	0.85	6.9	7.8	8.1	(8.6)	6.3	6.9	7.4	(8.3)	5.7	6.0	6.6	(10.8)	5.4	5.8	6.3	(11.8)
4	CO 1-6	3-6 Oct 1929	Cairo, Ill.	1.02	.98	0.97	6.0	8.5	10.0	(11.5)	5.0	7.0	11.5	10.6	5.8	6.8	9.0	10.1	5.0	6.3	9.0	11.0
5	CO 1-1	16-20 Dec 1895	Springfield, Mo.	1.12	.99	1.06	6.0	7.4	12.3	(10.4)	5.3	6.9	11.4	(11.0)	4.8	6.0	10.1	(10.7)	4.0	5.0	9.2	(9.0)
6	CO 1-15	15-17 Mar 1913	Richmond, Ind.	1.05	1.18	1.10	6.4	8.3	11.0	13.2	5.0	7.0	10.3	10.0	4.0	6.0	9.4	10.1	4.0	6.4	8.0	11.0
7	CO 5-6	5-15 Jan 1937	Dover, Tenn.	1.00	.89	0.95	5.0	5.4	8.0	13.3	3.7	5.0	8.0	10.5	3.1	4.4	7.2	11.7	2.7	3.0	6.0	11.1
8	SW 1-13	15-19 Oct 1910	Cuba, Ohio	1.11	1.01	1.06	5.7	7.1	10.0	(11.0)	4.0	7.0	10.5	(10.4)	3.0	4.0	9.5	(9.0)	3.1	3.0	8.6	(8.0)
9	SW 1-12	15-17 Mar 1910	Brookville, Tenn.	0.95	0.85	0.90	7.1	8.0	(9.0)	-	4.6	6.4	(8.0)	-	3.7	7.4	(7.0)	-	3.1	6.7	(7.0)	-
10	SW 1-19	15-21 Jan 1915	Bellaire, Tenn.	.95	.85	0.88	4.0	7.4	10.4	(11.7)	4.0	7.0	10.0	(11.5)	3.0	5.6	8.0	(9.0)	2.0	4.0	7.6	(8.0)
11	CO 1-10	1-6 Dec 1916	Hopkinsville, Ky.	1.04	.98	0.89	5.6	6.6	8.0	9.4	4.0	6.1	7.6	8.7	3.4	5.4	6.6	7.6	3.0	5.1	6.0	7.0
12	SW 1-11	9-13 May 1915	Aurora, Ill.	1.06	.97	1.00	5.6	6.8	7.0	(7.0)	5.0	5.0	7.0	(7.3)	4.4	5.0	6.0	(6.0)	3.0	4.0	6.0	(6.4)
13	CO 8-15	15-22 Jan 1916	Farmington, Mo.	1.11	1.00	1.06	5.0	6.0	7.6	9.0	5.3	6.1	7.0	9.0	4.0	5.0	6.3	8.7	3.0	4.4	5.7	8.0
14	SW 1-9	10-12 Jan 1918	Conway, Ark.	.88	.85	0.80	3.3	5.6	6.0	-	3.0	5.3	6.3	-	2.6	4.7	5.0	-	2.0	4.0	5.0	-
15	SW 2-12	6-11 Jan 1919	Hospital, Tenn.	.95	.88	0.88	3.6	5.1	8.0	9.0	3.4	4.0	7.0	8.0	3.0	4.3	7.1	8.0	2.0	4.0	6.0	7.0
16	CO 1-1	15 Aug-5 Aug 1875	Delaware, Ind.	1.17	1.06	1.10	4.0	6.6	7.6	10.0	3.4	5.7	6.0	9.6	2.0	4.0	5.7	8.1	2.6	4.0	5.1	7.0
17	CO 5-6	20-21 Mar 1929	Paducah, Ky.	1.03	.90	0.96	4.6	6.0	7.0	(7.0)	3.7	5.0	6.0	(7.0)	2.6	4.1	5.7	(6.0)	2.1	3.4	4.0	(5.7)
18	CO 3-10	15-18 Dec 1929	Dodson, Ark.	.92	.81	0.87	3.7	4.0	5.0	7.7	2.3	3.7	5.0	7.0	2.0	3.3	4.4	6.0	1.0	3.1	4.0	6.4
19	SW 3-10	7-11 Oct 1919	Hot Spring, Ark.	.89	.82	0.80	4.0	7.6	7.7	8.6	3.6	6.4	6.4	8.3	2.0	3.0	4.0	7.0	2.4	3.0	3.0	6.4

TABLE B

ADJUSTMENT OF RAINFALL VALUES OF SEVERE STORM-MAXIMUM

TRANSPOSED STORMS FOR BASIN OF CUMBERLAND RIVER ABOVE OLD HICKORY, TENN.

Line Number	Storm Number	Date of Storm	Approximate Location of Storm Center considered (5000 sq. mi. Area)	Adjustment for Basin Shape: Total Storm Precip. from D-A Curve	Adjustment for Basin Shape: Total Storm Precip. Distr. Basin Outline	Adjustment for Basin Shape: Basin Shape Factor	Maximum Average Depth of Rainfall over Specified Areas, Adjusted for Transposition and Basin Shape: 200 Square Miles: 12 hrs.	200 Square Miles: 24 hrs.	200 Square Miles: 48 hrs.	200 Square Miles: 120 hrs.	1,000 Square Miles: 12 hrs.	1,000 Square Miles: 24 hrs.	1,000 Square Miles: 48 hrs.	1,000 Square Miles: 120 hrs.	5,000 Square Miles: 12 hrs.	5,000 Square Miles: 24 hrs.	5,000 Square Miles: 48 hrs.	5,000 Square Miles: 120 hrs.	10,000 Square Miles: 12 hrs.	10,000 Square Miles: 24 hrs.	10,000 Square Miles: 48 hrs.	10,000 Square Miles: 120 hrs.
1	CO 9-10	10-13 Aug 1878	Piedmont, Ohio	9.6	6.7	.91	10.3	13.6	15.0	16.5	11.5	12.6	15.7	(15.4)	9.2	10.3	12.4	(12.9)	7.7	9.0	10.0	(13.4)
2	CO 7-18	21-25 Mar 1929	Crossville, Tenn.	7.4	6.0	.86	7.3	8.5	8.7	-	6.7	7.0	8.0	-	5.5	6.4	7.1	-	4.7	5.2	6.5	
3	SW 1-4	17-21 Apr 1886	Austin, Ohio.	13.0	11.0	.95	6.5	6.0	7.4	(16.2)	5.0	6.3	6.7	(13.0)	3.4	5.0	6.0	(11.1)	3.1	3.0	5.7	(10.2)
4	CO 1-6	3-6 Oct 1929	Cairo, Ill.	13.0	10.4	.90	5.4	7.7	11.5	13.0	4.5	6.0	10.3	12.0	3.5	5.7	8.9	10.9	3.2	5.3	6.3	10.1
5	CO 1-1	16-20 Dec 1895	Springfield, Mo.	9.1	8.2	.90	5.4	6.7	10.9	(11.9)	4.0	6.2	10.3	(10.0)	4.0	5.4	9.1	(9.0)	3.6	5.0	8.3	(9.0)
6	CO 1-15	15-17 Mar 1913	Richmond, Ind.	9.6	9.1	.95	6.1	7.0	10.5	12.5	5.5	7.5	9.0	12.5	4.7	6.6	9.0	11.0	4.0	4.1	6.5	10.0
7	CO 5-6	5-15 Jan 1937.	Dover, Tenn.	10.5	10.6	.98	3.6	5.2	7.4	12.0	3.4	4.0	7.4	11.5	2.9	4.0	6.7	10.0	2.6	3.6	6.3	10.0

* Note: The total storm values correspond to those represented by isohyetal maps for durations somewhat longer than 120 hours in some cases.