SUMMARY OF 1983-1984 DRY SEASON HYDROLOGIC CONDITIONS

DRE 202

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ACKNOWLEDGMENTS

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The rainfall pattern for the dry season from November 1983 through May 1984 can be summarized as wet overall, but dry in January. For the South Florida Water Management District basins (District) as a whole, the total dry season rainfall was 22.96 inches, or 130% of normal. Tables 1 and 2 present the monthly rainfall distribution over the District's basins in inches and percent of normal, respectively.

The November 1983 rainfall was quite variable, ranging from about 50% of normal in Water Conservation Area (WCA) 1 to almost 195% of normal in the Lower West Coast. At the beginning of the dry season, the water level in Lake Okeechobee was a foot below regulation schedule, but was 1.33 feet and 600,000 acre-feet above the historical average. East Lake Tohopekaliga was about 0.8 feet below its regulation schedule. Lake Tohopekaliga, WCA-1, and WCA-3A were at the top of their regulation schedules. WCA-2A was over 1.0 foot above its drawdown schedule. With below normal rainfall in November, the water level in WCA-1 and WCA-3A declined slightly, and WCA-2A declined substantially.

The December 1983 rainfall in the District was above normal. Except for Lake Okeechobee, the water levels in most of the major water storage areas rose to or above regulation schedules.

The January 1984 rainfall was below normal in all basins of the District, ranging from only 6.3% of normal in WCA-3A to 59.6% of normal in the Upper Kissimmee basins. Surface storage in the lakes and water conservation areas remained well above normal and close to their regulation schedules, except in Lake Okeechobee. The water level in Lake Okeechobee was only 0.5 feet from its regulation schedule at the end of January.

Table 1. Dry Season Rainfall of November 1983-May 1984 in Inches

	Nov 83	Dec 83	Jan 84	Feb 84	March 84	April 84	May 84	Total
Upper Kissimmee Lakes	2.11	5.35	1.24	3.06	1.06	4.43	4.71	21.96
Lower Kissimmee River	1.38	3.55	.53	3.77	3.15	2.85	7.20	22.43
Lake Okeechobee	1.46	2.80	1.09	3.49	4.64	3.44	6.21	23.13
Upper East Coast	2.10	4.32	.64	3.37	4.05	1.72	6.44	22.64
Everglades Agri. Areas	1.22	4.26	.22	1.76	4.17	3.29	7.36	22.28
WCA-1	1.21	4.60	.63	1.31	4.29	4.23	8.08	24.35
WCA-2A	1.15	5.47	.44	1.37	4.62	3.61	7.56	24.22
WCA-3A	1.16	4.29	.10	1.44	3.81	1.61	7.11	19.52
Lower East Coast	2.53	7.27	1.32	2.06	4.80	3.20	11.55	32.73
Lower West Coast	2.76	3.74	.32	2.70	4.54	.94	6.47	21.47
Fisheating Creek	1.85	3.17	.42	3.91	4.27	3.02	5.28	21.92
Everglades Natl. Park	2.43	3.41	.29	1.45	2.92	2.63	5.72	18.85

Table 2. Dry Season Rainfall of November 1983-May 1984 in Percent of Normal

	Nov 83	Dec 83	Jan 84	Feb 84	March 84	April 84	May 84	% Normal
Upper Kissimmee Lakes	118.50	259.70	50.60	112.90	32.70	167.80	110.00	116.90
Lower Kissimmee River	85.70	227.60	26.40	155.80	118.00	106.70	169.80	130.60
Lake Okeechobee	109.80	183.00	63.00	155.10	180.50	165.40	131.30	142.60
Upper East Coast	86.10	226.20	28.20	141.60	142.10	56.00	145.70	117.10
Everglades Agri. Areas	66.70	243.40	12.60	92.10	151.10	124.20	147.20	126.20
WCA-1	50.60	284.00	35.60	53.00	191.50	245.90	161.30	141.40
WCA-2A	62.50	333.50	26.20	64.00	223.20	237.50	142.60	149.60
WCA-3A	61.70	317.80	6.30	70.90	200.50	86.60	154.90	128.30
Lower East Coast	86.60	358.10	54.30	93.60	179.80	93.00	199.10	152.30
Lower West Coast	194.40	259.70	18.10	131.70	174.60	43.10	145.70	135.00
Fisheating Creek	125.90	217.10	24.90	176.90	154.20	121.30	125.70	134.60
Everglades Natl. Park	132.80	248.90	17.20	78.00	154.50	103.10	105.10	113.30

February 1984 rainfall was above normal in most parts of the District, except in WCA-3A and Everglades National Park (ENP or Park) (Table 2). The water level in Lake Okeechobee was slightly below its regulation schedule. All three water conservation areas and the lakes in the Upper Kissimmee basin were held essentially on schedule during this month.

March 1984 rainfall was above normal in most parts of the District except for the Upper Kissimmee basin (Table 2). Early releases from Lake Okeechobee during this dry season were made to avoid unwanted regulatory releases. In spite of this action, the above normal rainfall during March caused the lake stage to rise above its regulation schedule and forced lake releases to be increased to the regulatory level through the Caloosahatchee River. Releases were also made through the Everglades Agricultural Areas (EAA) to WCA-3A and the St. Lucie Canal. All lakes in the Upper Kissimmee basin maintained their declining schedule.

April 1984 rainfall was above normal in most parts of the District with the exception of the Lower West Coast, WCA-3A, and the Upper East Coast. The Lower East Coast rainfall was near normal. The heavy releases in March and April were successful in bringing Lake Okeechobee's stage below its regulation schedule by the end of April, yet it still remained 2.0 feet over its historical average. Stages in all three water conservation areas declined during this month. All lakes in the Upper Kissimmee basin were held essentially at their declining schedule except East Lake Tohopekaliga which rose above its schedule during the middle of the month.

A 30-day experiment of releases from S-333 was started April 19, and the releases were made from WCA-3A to the Tamiami Canal and into the natural channel of Shark River Slough. This experimental program included a careful monitoring of surface and ground water measurements in the area south of Shark

River Slough. This experiment combined with a below normal rainfall period caused a decline in WCA-3A stages.

May 1984 rainfall, as usual, brought widely varying rainfall conditions. The first three weeks of the month were as dry as in late April; however, during the last week of May, the rainy season began with a heavy rainfall. As a result, the western C-51 basin experienced severe flooding with flood waters overtopping the south bank of C-51 at Sucrose Grower's cane field.

The May 1984 rainfall was above normal in all parts of the District (Table 2). The water level in the lakes and water conservation areas declined and closely followed their regulation schedules during most of the month. The heavy rains during the last week of May caused the Lake Okeechobee stage to rise above schedule; similarly, all three water conservation areas rebounded late in the month in response to heavy rainfall. All lakes in the Upper Kissimmee basin essentially maintained their declining schedules.

The 30-day experimental release from S-333 was terminated on May 19. The canal and groundwater levels in the area south of Shark River Slough remained well below critical levels throughout the entire test period.

The experimental delivery schedule (in effect since June 9, 1983) to the ENP was continued in WCA-3A. This schedule involved fully opening the westernmost 18 of the 24 S-12 gates. The water level in WCA-3A remained well above historical average thoughout this dry season, but well below its regulation schedule.

The areal rainfall distribution of the District's basins for the 1983-84 dry season rainfall are shown in Figures 2 and 3. Detailed monthly rainfall and discharge statistics are presented in Figures 4 through 15. Daily stage hydrographs for the major water storage areas are presented in Figures 16 through 19.

Upper Kissimmee Lakes Basin

The total dry season rainfall from November 1, 1983 through May 31, 1984 was 21.96 inches, or 116.9% of the 68-year historical average. Monthly rainfall was above normal except in January and March of 1984 (60% and 33% of normal, see Table 2 and Figure 4). The December rainfall of 5.35 inches was only 0.05 of an inch below its historical maximum of 5.40 inches (recorded in 1916).

At the beginning of the dry season (November 1, 1983), lake stages were slightly below their regulation schedules (see Figures 16-17); however, the stages reached their schedules during December 1983, and except for East Lake Tohopekaliga, the water levels were held close to regulation throughout the dry season. East Lake Tohopekaliga rose well above its regulation stage during mid-April, but maximum regulatory releases brought it down close to its regulation schedule by the end of April.

The above normal rainfall (260% of normal) during December 1983 had not only caused the lake stages to rise above regulation, but also caused some shore erosion around low lying areas of Lake Alligator and Lake Kissimmee. These problems were aggravated by adverse wind conditions during December 1983.

Lower Kissimmee River Basin

The total dry season rainfall was 22.43 inches, or 130.6% of the 68-year historical average. Rainfall was above normal in most months except November 1983 and February 1984.

The water levels in Lake Istokpoga were held close to regulation schedule with some regulatory releases. No operational problem was encountered.

Lake Okeechobee

Direct rainfall over the lake during this dry season was 23.13 inches, or 142.6% of the 31-year historical average. Rainfall was above normal except during January 1984 (see Table 2 and Figure 4).

At the beginning of the dry season, the lake level was a foot below its regulation schedule; however, it still was 1.33 feet or 600,000 acre-feet above average. The lake level changed slightly during November and December 1983 which is normal for the lake. Some irrigation releases were made from the lake to the EAA. Lake levels remained below schedule but still above the historical average (see Figure 17).

In January 1984, the staff recommended to initiate moderate releases from Lake Okeechobee through the St. Lucie and Caloosahatchee Rivers in order to avoid major regulatory releases later in the dry season. As a consequence, the regulatory releases through the St. Lucie Canal during March and April were maintained between 500 and 1500 cfs instead of the Zone B requirements of 2500 cfs.

Upper East Coast Area

The total dry season rainfall was about 22.64 inches or 117.1% of the 69-year historical average. November 1983, and January and April 1984 were below normal while the rest of the months were above normal rainfall (Figure 4).

Water levels in all canals were maintained a foot or more above their optimum during December 1983 providing an ample water supply source for frost control during the cold snap on Christmas weekend. Citrus growers lowered the District canals almost 4 feet at that time, but the water levels returned to their normal range the next day. However, this cold snap did cause substantial frost damage to the citrus industry in central Florida.

The below normal rainfall in April and the first three weeks of May caused the canal stages in St. Lucie County to drop several feet and remain below optimum until the last week of May. The heavy rains late in May provided for a full recovery of water levels in the canals.

Everglades Agricultural Areas

The total dry season rainfall was 22.28 inches or 126.2% of the 54-year historical average. Heavy rainfall during the months of December 1983, March, April, and the last week of May 1984 did require some backpumping into the lake and considerable pumping into the water conservation areas. Table 3 presents monthly pumpage from the Everglades Agricultural Area.

Due to the above normal rainfall during most of this dry season (Figure 6), the required irrigation releases from Lake Okeechobee were very small except during May. During November 1983, and January and February 1984, rainfall was below normal and the irrigation releases were increased slightly. No irrigation releases were required from Lake Okeechobee during March and April. The dry conditions of the first three weeks in May caused a substantial irrigation demand from the lake. Irrigation releases from the lake are summarized in Table 4.

Water Conservation Areas

Direct rainfall over the three water conservation areas were 19.52 to 24.35 inches, or 128 to 141% of the 21-year historical average. WCA-1 received slightly more rainfall than WCA-2A and WCA-3A (see Figure 5 and Tables 2 and 3). The rainfall isohyetal map (see Figure 2) was based on long term rainfall stations and presents a better picture of the areal distribution of the rainfall pattern over the District basins.

At the beginning of the dry season, the water levels in the three water conservation areas were either above or near their regulation schedules. The

Table 3. Pumpage from the Everglades Agricultural Areas

Month	Into Lake Okeechobee (1000 Acre-Feet)			Into Water Conservation Area (1000 Acre-Feet)				
	S-3	S-2	Total	S-5A	S-6	S-7	S-8	Total
November 1983	0.0	0.0	0.0	7.6	0.0	3.2	0.0	10.8
December 1983	0.0	0.3	0.3	39.0	19.0	18.4	18.5	94.9
January 1984	0.0	0.0	0.0	10.3	6.1	4.9	8.6	29.9
February 1984	0.0	0.0	0.0	13.7	0.6	3.1	0.0	17.4
March 1984	5.1	10.3	15.4	28.7	15.7	17.6	9.7	71.7
April 1984	0.0	2.5	2.5	20.1	14.3	20.6	7.7	62.7
May 1984	3.1	17.7	20.8	67.6	19.8	16.2	9.9	113.5
Total	8.2	30.8	39.0	187.0	75.5	84.0	54.4	400.9

Table 4. Irrigation Releases from Lake Okeechobee (in thousands of Acre-Feet)

	Miami Canal (HGS-3)	North New River & Hillsboro Canal (HGS-4)	West Palm Beach Canal (HGS-5	Total
November 1983	1.4	4.7	5.2	11.3
December 1983	3.9	4.9	5.5	14.3
January 1984	3.8	3.8	2.8	13.4
February 1984	13.6	9.2	5.5	28.3
March 1984	0.0	0.0	0.0	0.0
April 1984	0.0	0.0	0.0	0.0
May 1984	33.8	58.2	16.1	108.1
Total	59.5	80.8	35.1	175.4

water levels in the three water conservation areas declined at different rates after January 1 in response to different operational strategies (Figures 18, 19).

The water level of WCA-1 dropped very sharply from the annual maximum of 17.0 feet msl on November 1, 1983, to the annual minimum of 14.0 feet msl on April 30, 1984, and reached 11.0 feet msl on May 22, 1984, (see Figure 18). Large releases were made through the West Palm Beach and Hillsboro canals to tidewater and some through S-10 (see Figure 10). Some irrigation releases were made through S-5A(S) and S-5A(W) to EAA during the latter part of April and the early part of May.

In WCA-2A near maximum releases were made through S-11 (see Figure 11) in an effort to follow the special drawdown schedule; however, the stage never reached the drawdown schedule.

In WCA-3A the experimental program of opening all structures at S-12, except S-12D, has been continued since June 9, 1983. Large releases through S-12 (see Figure 13) were made this dry season. The water level in WCA-3A continued to decline well below schedule but remained well above average (see Figure 19). Table 5 presents monthly discharges to Everglades National Park and Shark River Slough via the S-12 structures and S-333. The purpose of this experiment was to seek better water distribution to the Park and to reduce the chance of abnormally high discharges during the dry season. In addition, flow through the westernmost S-12 structures more closely approximate the natural sheet flow conditions. Figures 10, 11, and 13 present the discharge conditions in the water conservation areas during this dry season.

Lower East Coast

The total dry season rainfall was about 32.73 inches, or 152.3% of the 68-year historical average. The area near Boynton Beach and Delray Beach received a total rainfall of over 44 inches during this dry season (see Figure 2). Heavy rainfall over the Memorial Day weekend flooded streets, causing traffic jams in most parts of the Lower East Coast. The flood waters in the western C-51 basin overtopped the canal's south bank and flooded thousands of acres of agricultural land.

The dry season is normally a growing season of agricultural products. Canal stages in south Dade County were held 0.5 to 1.0 feet below optimum at coastal structures and from 1.5 to 2.5 feet at interior structures. The stages in the coastal areas became critically low in January and February 1984 due to below normal rainfall. Gravity deliveries were begun in January to south Dade County through the south Dade conveyance system and continued through February by opening S-151, S-337, S-335, S-173, and by syphoning through pump station S-331. The water levels in the coastal areas rose above their critical levels at the end of February and the gravity deliveries were terminated. Figure 12 presents the dry season discharges in the Lower East Coast basins.

Lower West Coast

The total dry season rainfall was about 21.47 inches, or 135.0% of the 56-year historical average. January and February rainfall was below normal, the rest of the months were above normal rainfall.

Regulatory releases from Lake Okeechobee via the Caloosahatchee River were small during the first four months of the dry season. Most of the discharges during that time were due to local runoff. On Feburary 14, 1984 a constant discharge of 2000 cfs from Lake Okeechobee through the Caloosahatchee River was begun in order to minimize the possibility of major regulatory releases later in the year. These early releases of 2000 cfs were later increased to 3000 cfs and to 4500 cfs by the end of March, but reduced to 3500 cfs during April. Regulatory releases from Lake Okeechobee through the Caloosahatchee River reached 8000 cfs at the end of May due to heavy rainfall in the last week of May.

Fisheating Creek and C-41 Basin

The total dry season rainfall for Fisheating Creek and the C-41A basin was 21.92 inches, or 134.6% of the 52-year historical average. Except for January 1984, monthly rainfall in the basins was above normal (see Figure 6).

The stream flow at Fisheating Creek was above average except during January and February due to below normal rainfall.

Everglades National Park

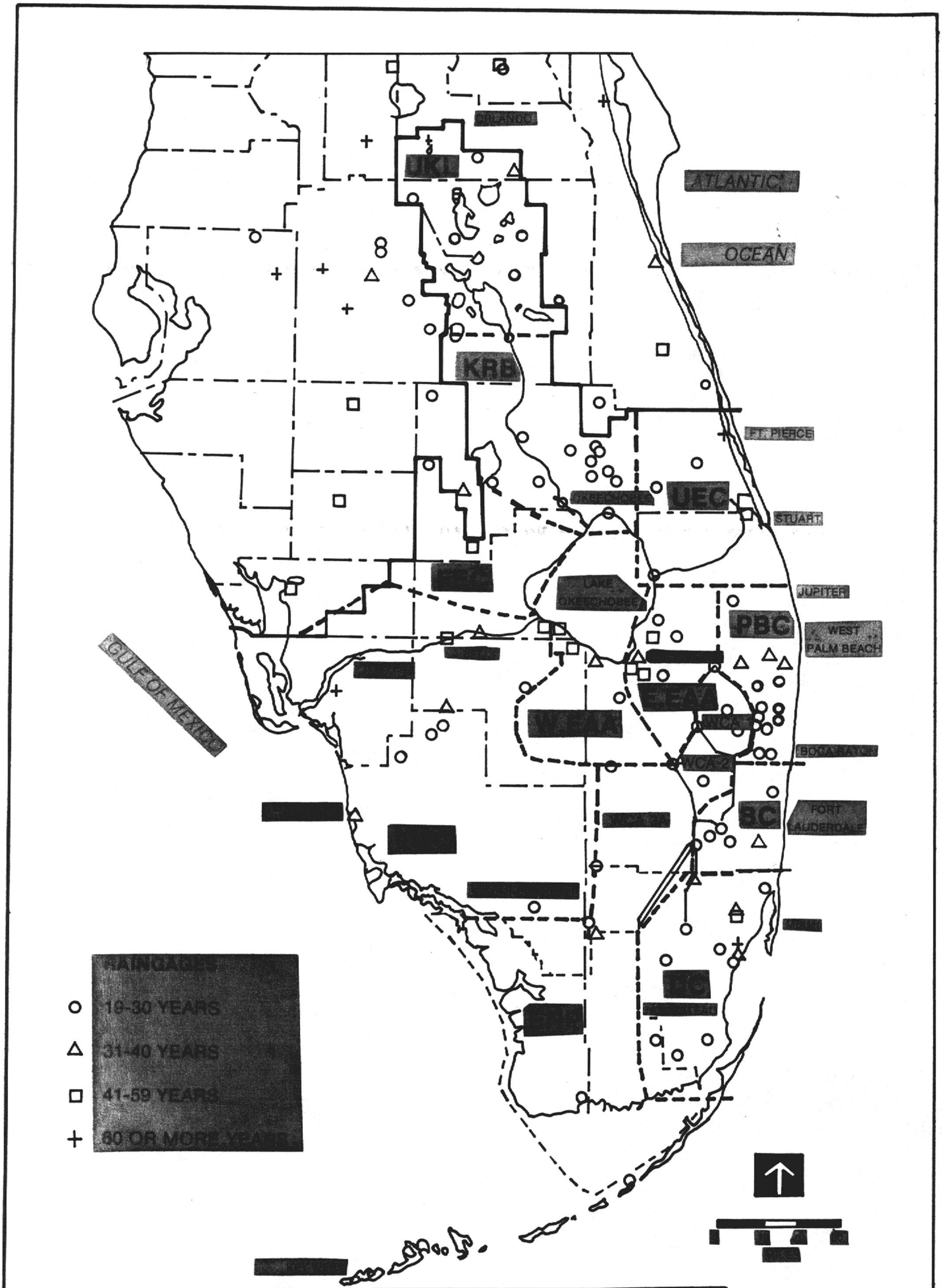
The total dry season rainfall was 18.85 inches, or 113.3% of the 43-year average. November and December 1983 rainfall was above normal but during January and February 1984 rainfall was below normal, especially January which was only 17% of normal. March, April, and May rainfall was slightly above normal.

Water deliveries to the Park were significantly above the minimum delivery schedule, as shown in Table 5. Deliveries through the S-12 structures ranged from 144% to 2000% of the scheduled minimum delivery. This was because all S-12 structures, except S-12D, were opened full during the dry season. The water deliveries to Taylor Slough through S-332 were continued at the level specified in the interagency agreement between the COE, ENP, and the District. Total S-12 deliveries from November 1, 1983 through May 31, 1984 were 400,738 acre feet as compared to the minimum requirements of 129,400 acre feet.

The 30-day experimental releases from S-333 began on April 19. Stages at all critical locations in the area south of Shark River Slough were monitored throughout the entire test period.

Table 5. Monthly Discharge to Everglades National Park and Shark River Slough (S-12, S-333)

Month	Schedule A-F	Actual A-F	Actual % of Min. Del. Schedule	Northeast Shark River Slough (S-333) A-F
Nov. 1983	59,000	85,092	144.2	0
Dec. 1983	32,000	86,639	270.7	0
Jan. 1984	22,000	86,877	394.9	0
Feb. 1984	9,000	51,672	574.1	0
Mar. 1984	4,000	40,440	1,011.1	0
Apr. 1984	1,700	34,785	2,046.1	24,381
May 1984	1,700	15,233	896.1	39,684
Total	129,400	400,738	309.7	64,065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KRB
FT. PIERCE
OKEECHOBEE
UEC
STUART
LAKE OKEECHOBEE
JUPITER
PBC
WEST PALM BEACH
GULF OF MEXICO
E EAA
W EAA
WCA-1
BOCA RATON
WCA-2
BC
FORT LAUDERDALE

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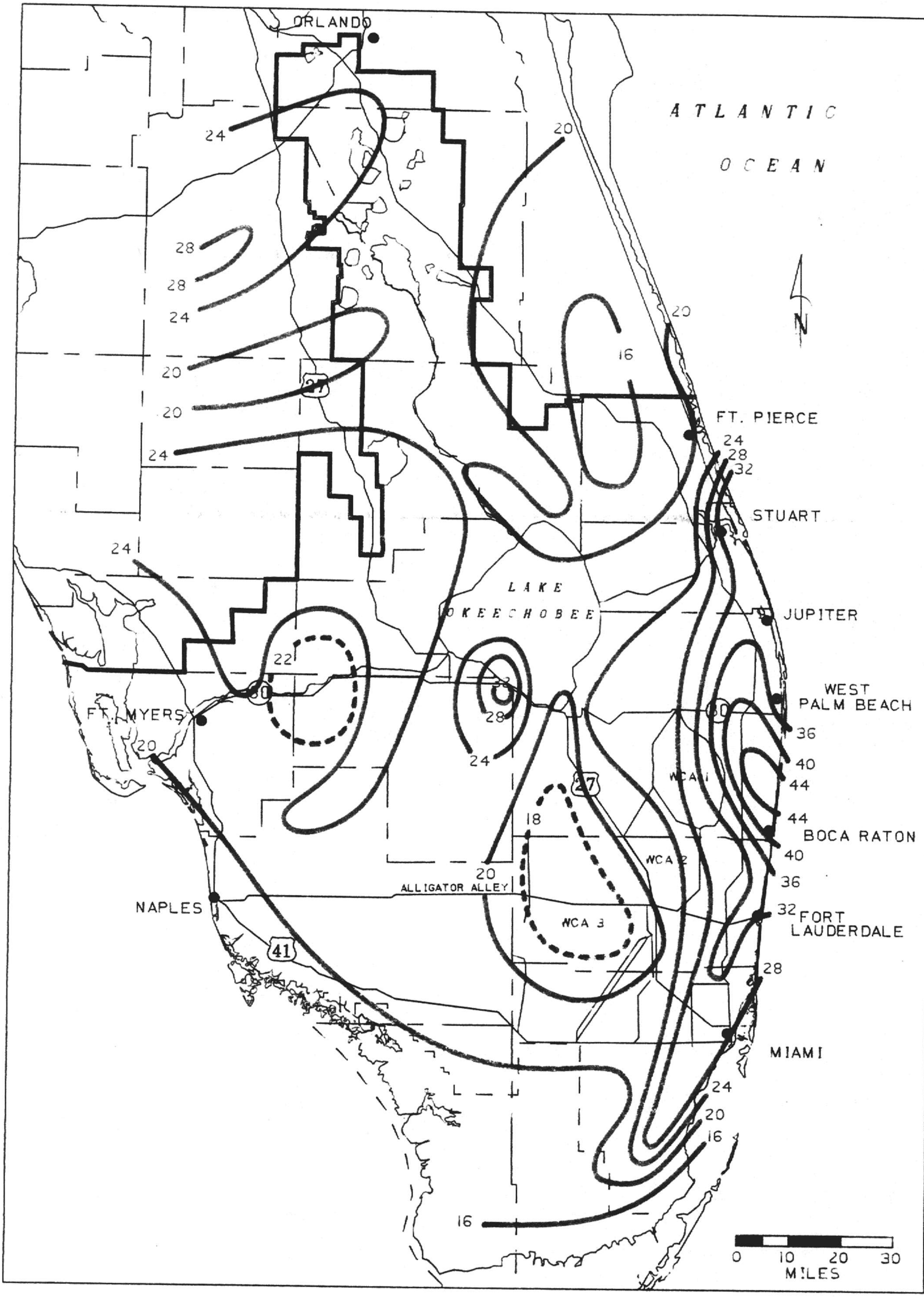


FIGURE 2. RAINFALL - NOV. 1983 - MAY 1984 (Inches)

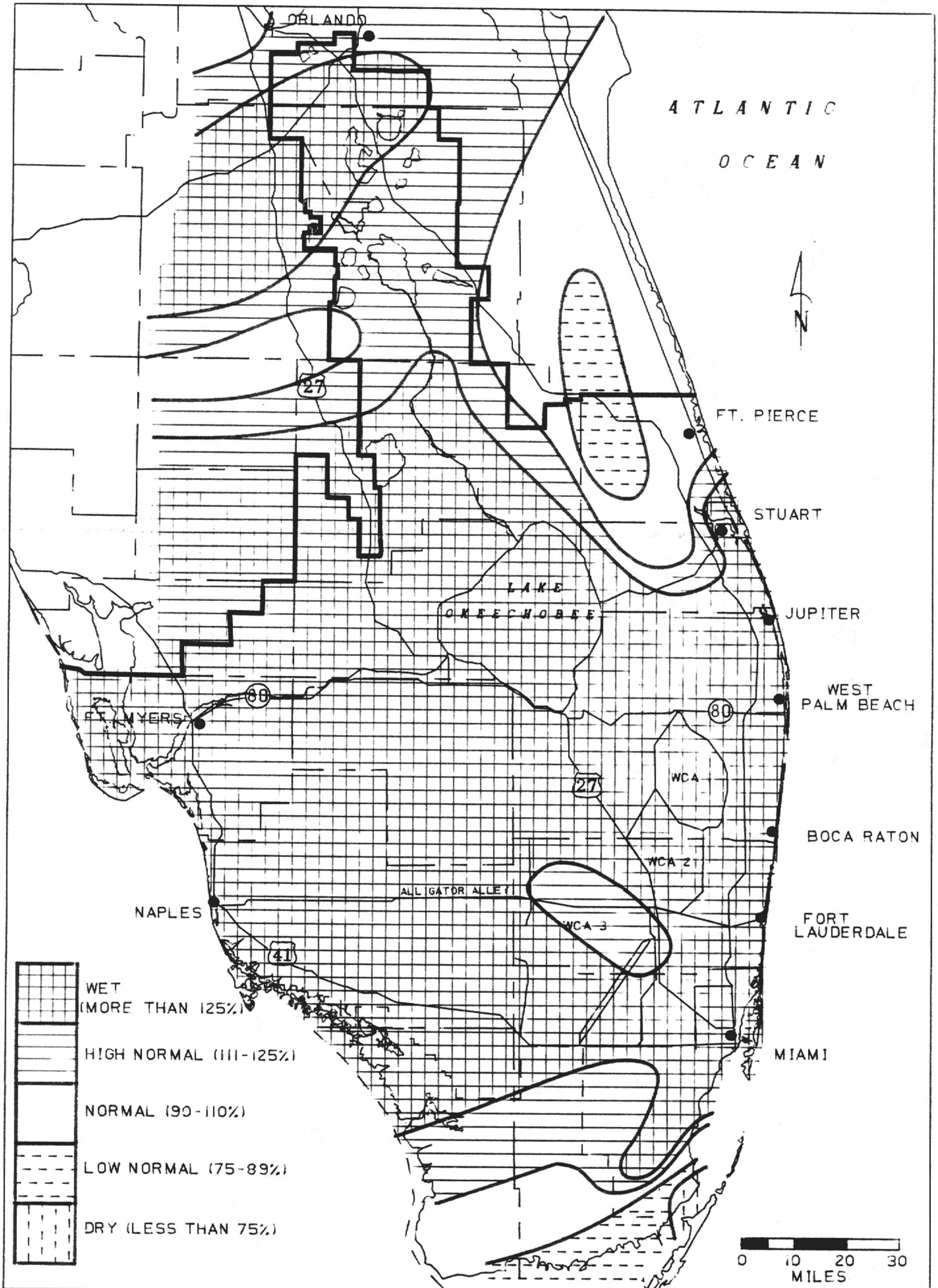


FIGURE 3.
RAINFALL - PERCENT OF NORMAL - NOV. 1983-MAY 1984

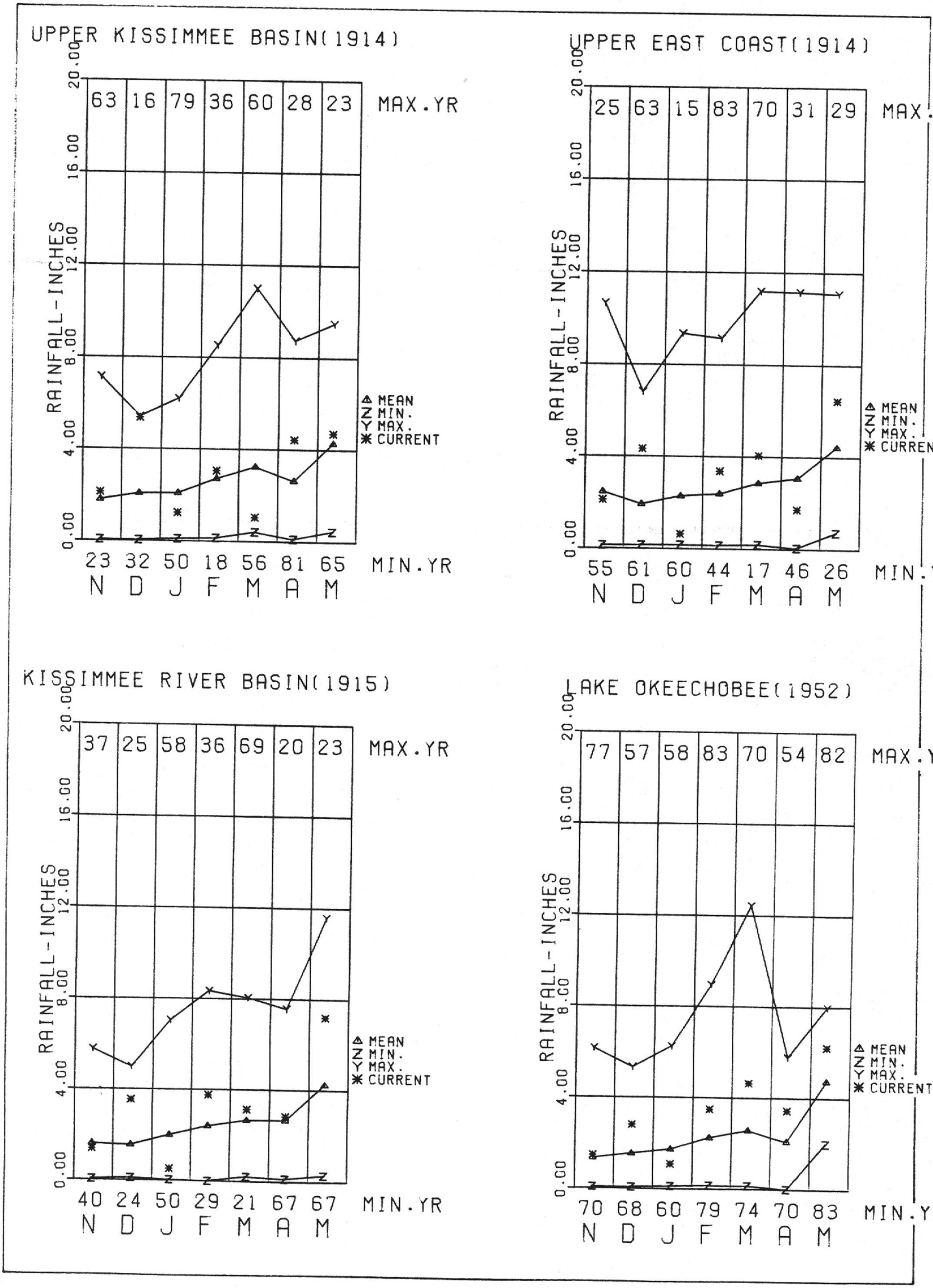


FIGURE 4. RAINFALL IN DISTRICT AREAS

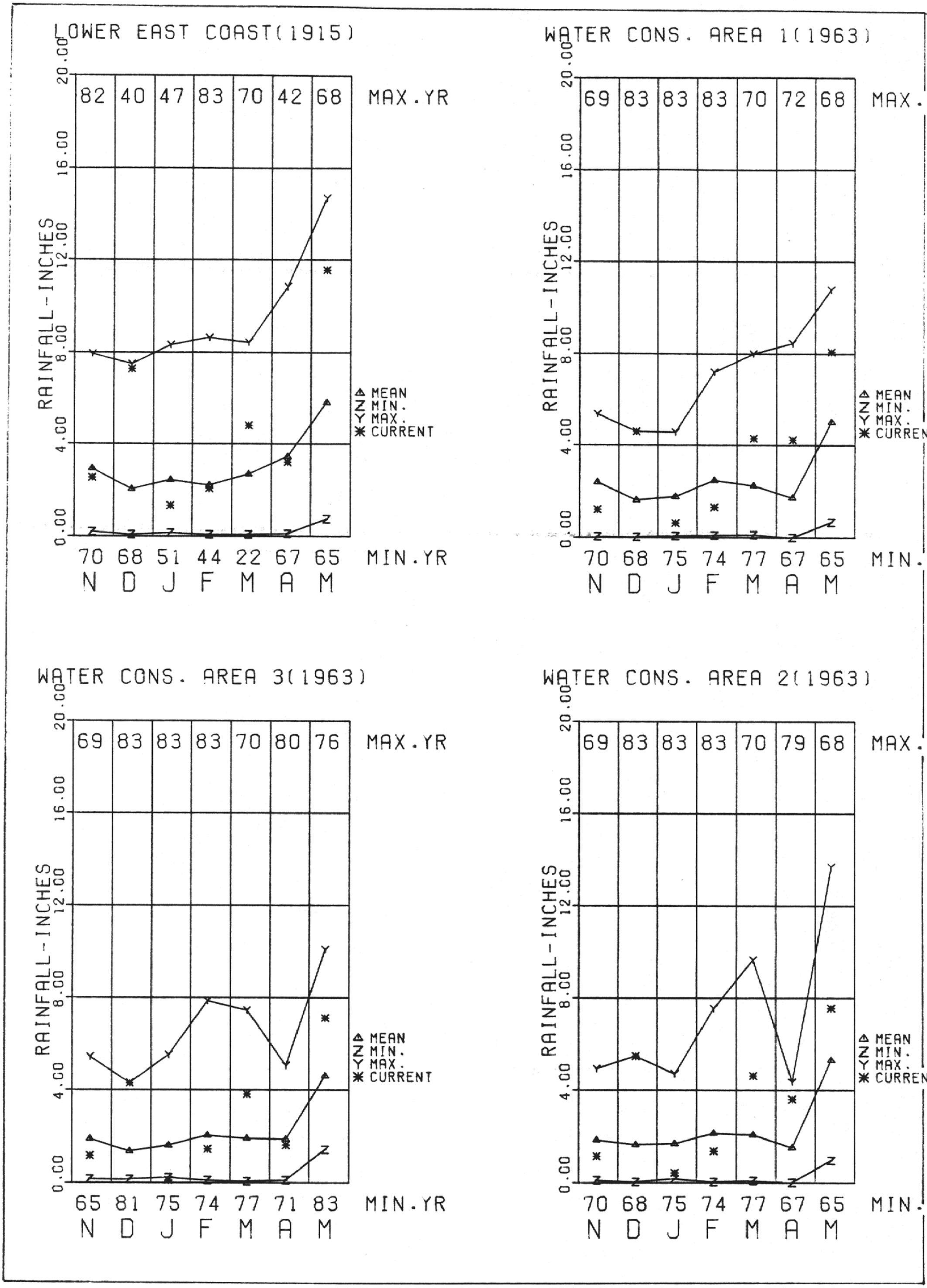


FIGURE 5. RAINFALL IN DISTRICT AREAS

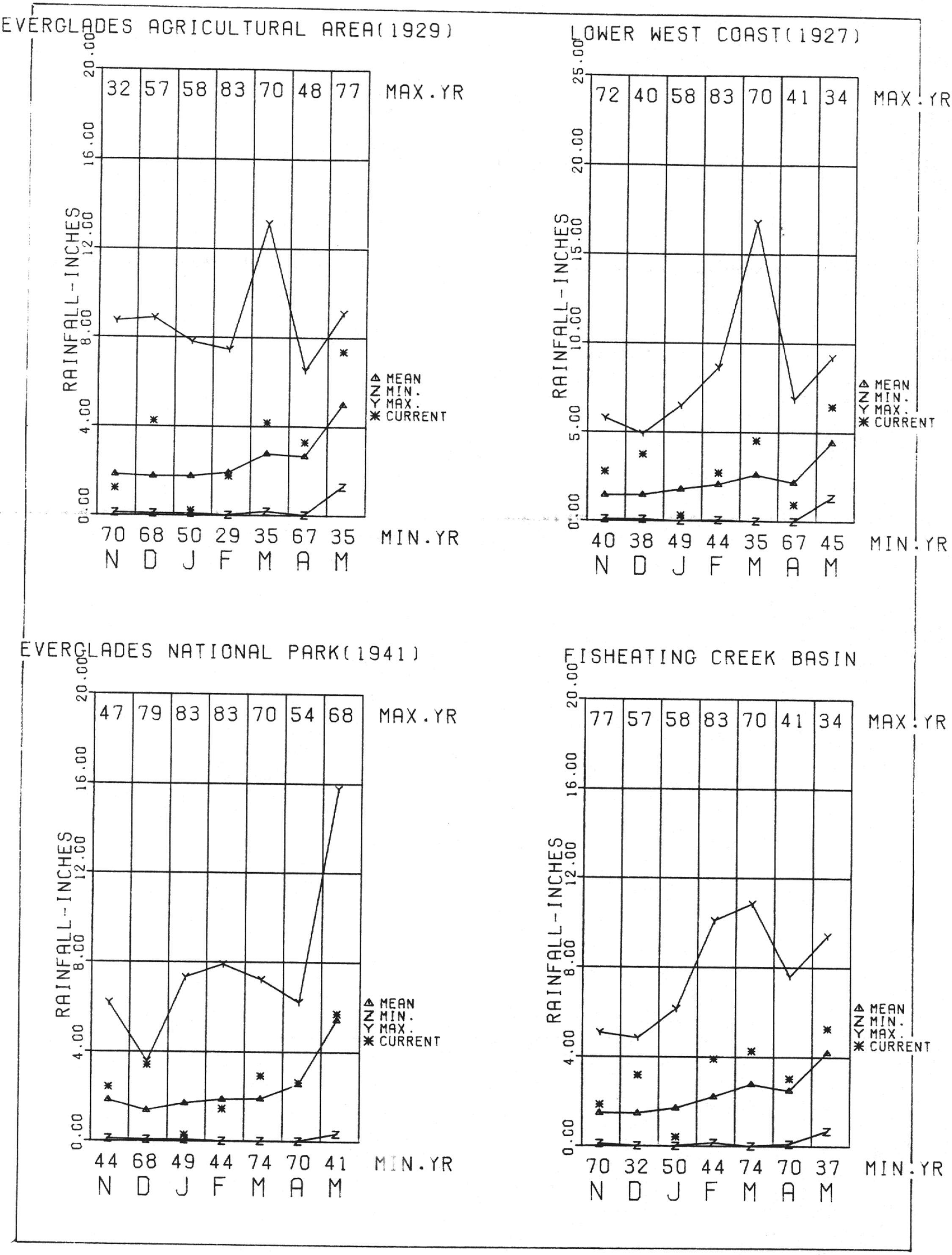


FIGURE 6. RAINFALL IN DISTRICT AREAS

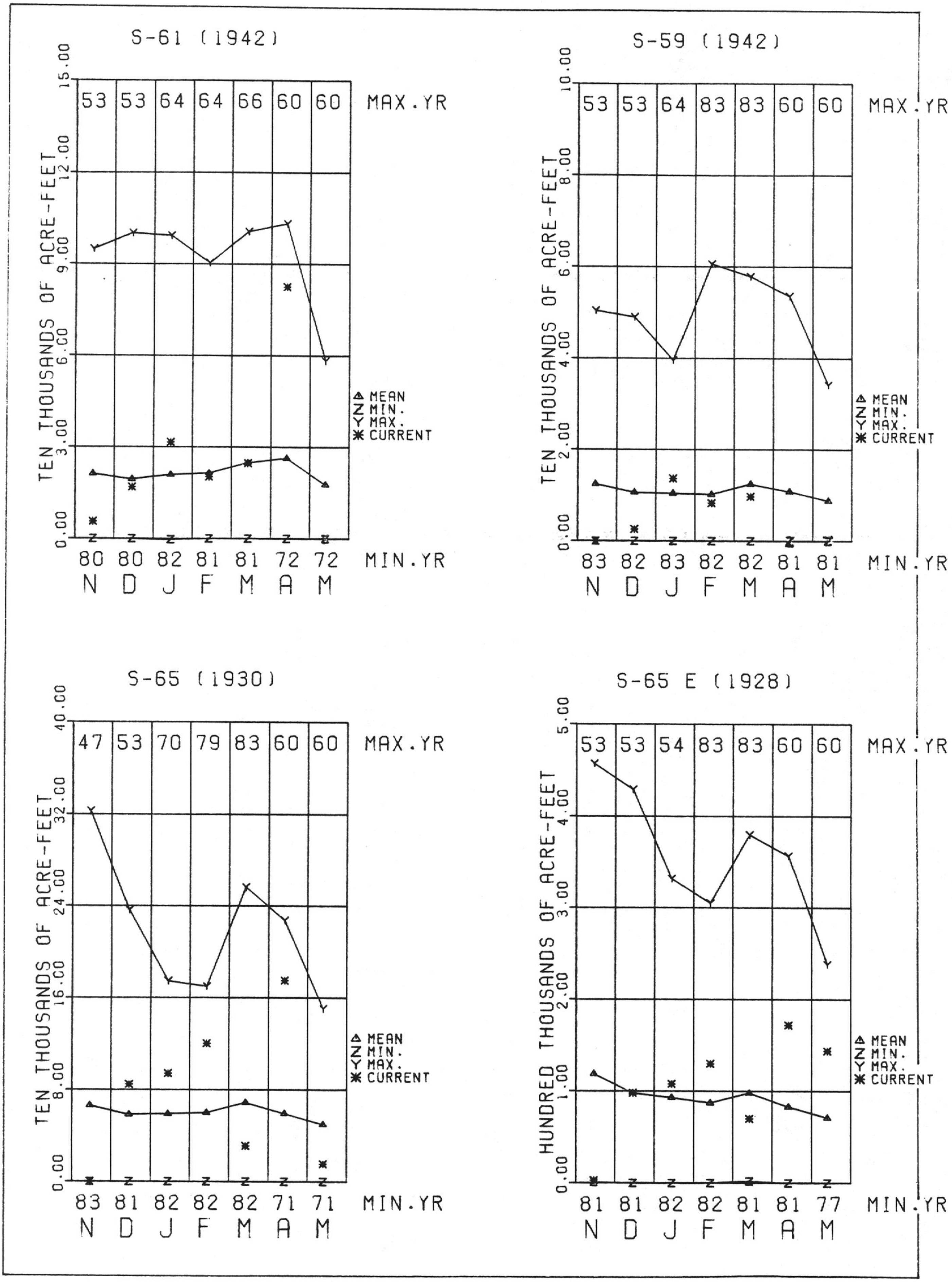


FIGURE 7. DISCHARGE AT UPPER KISSIMMEE AND LOWER KISSIMMEE BASIN

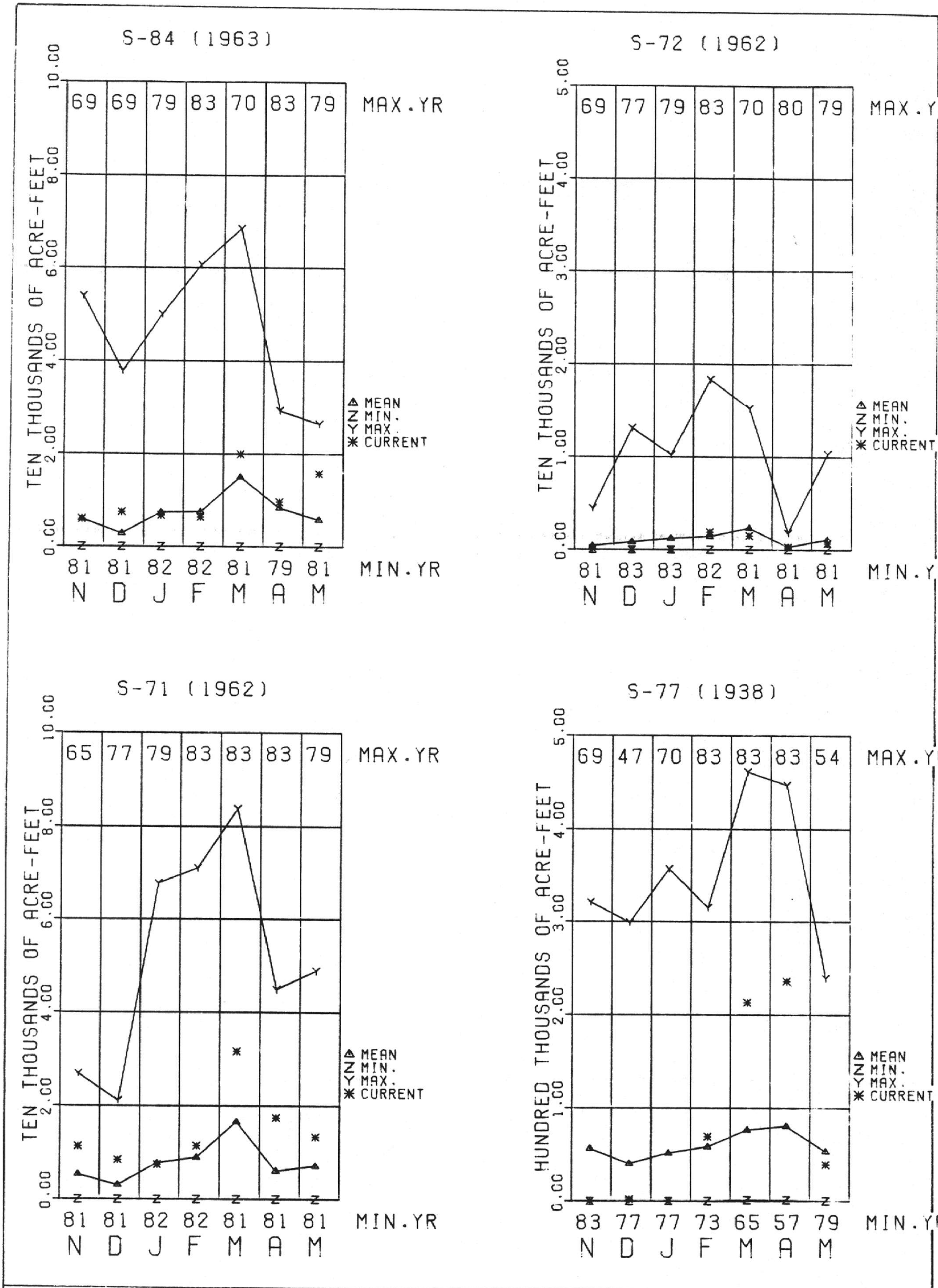


FIGURE 8. DISCHARGE AT LAKE OKEECHOBEE

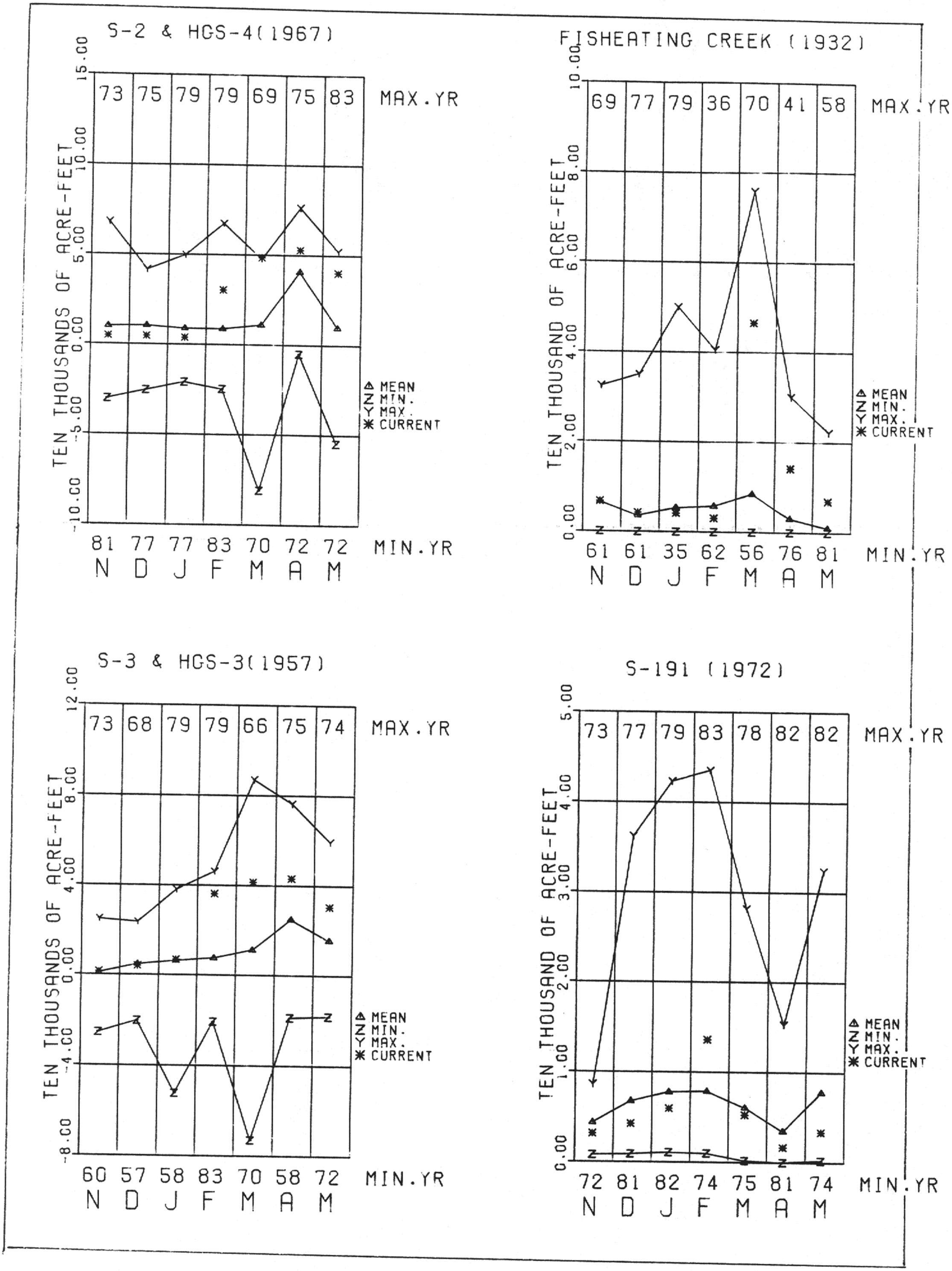


FIGURE 9. DISCHARGE AT LAKE OKEECHOBEE

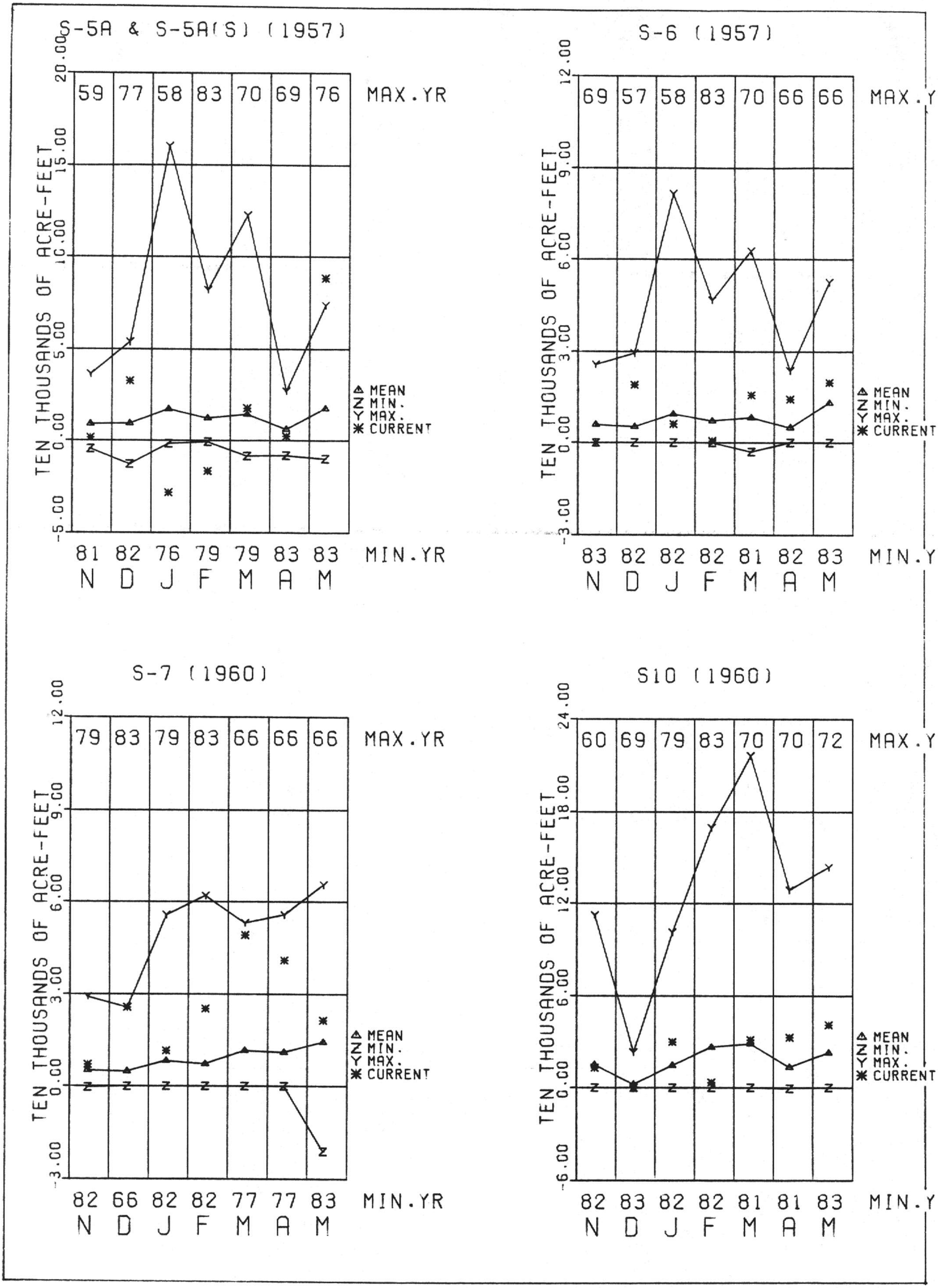


FIGURE 10. DISCHARGE AT WATER CONSERVATION AREAS

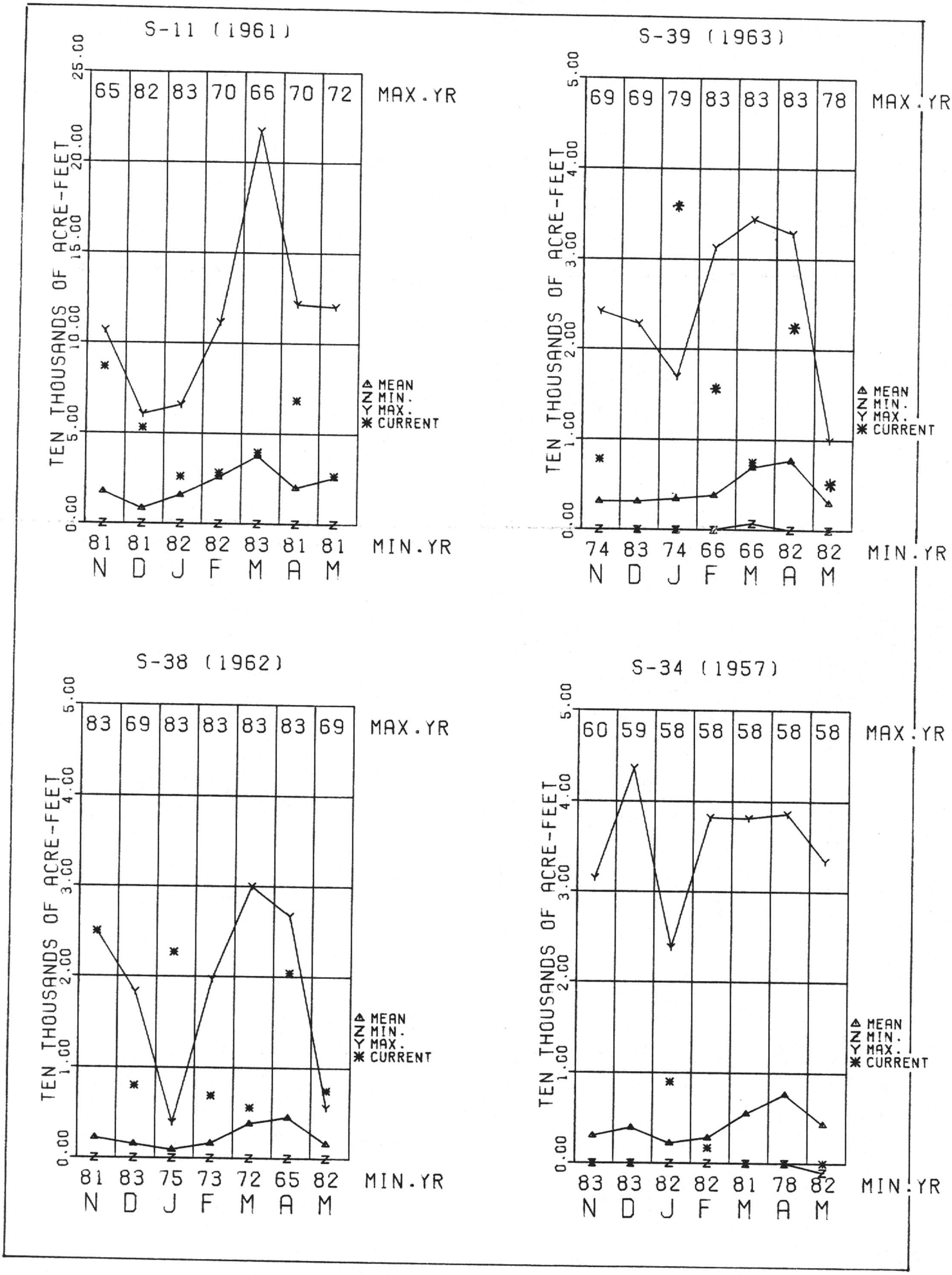


FIGURE 11. DISCHARGE AT WATER CONSERVATION AREAS

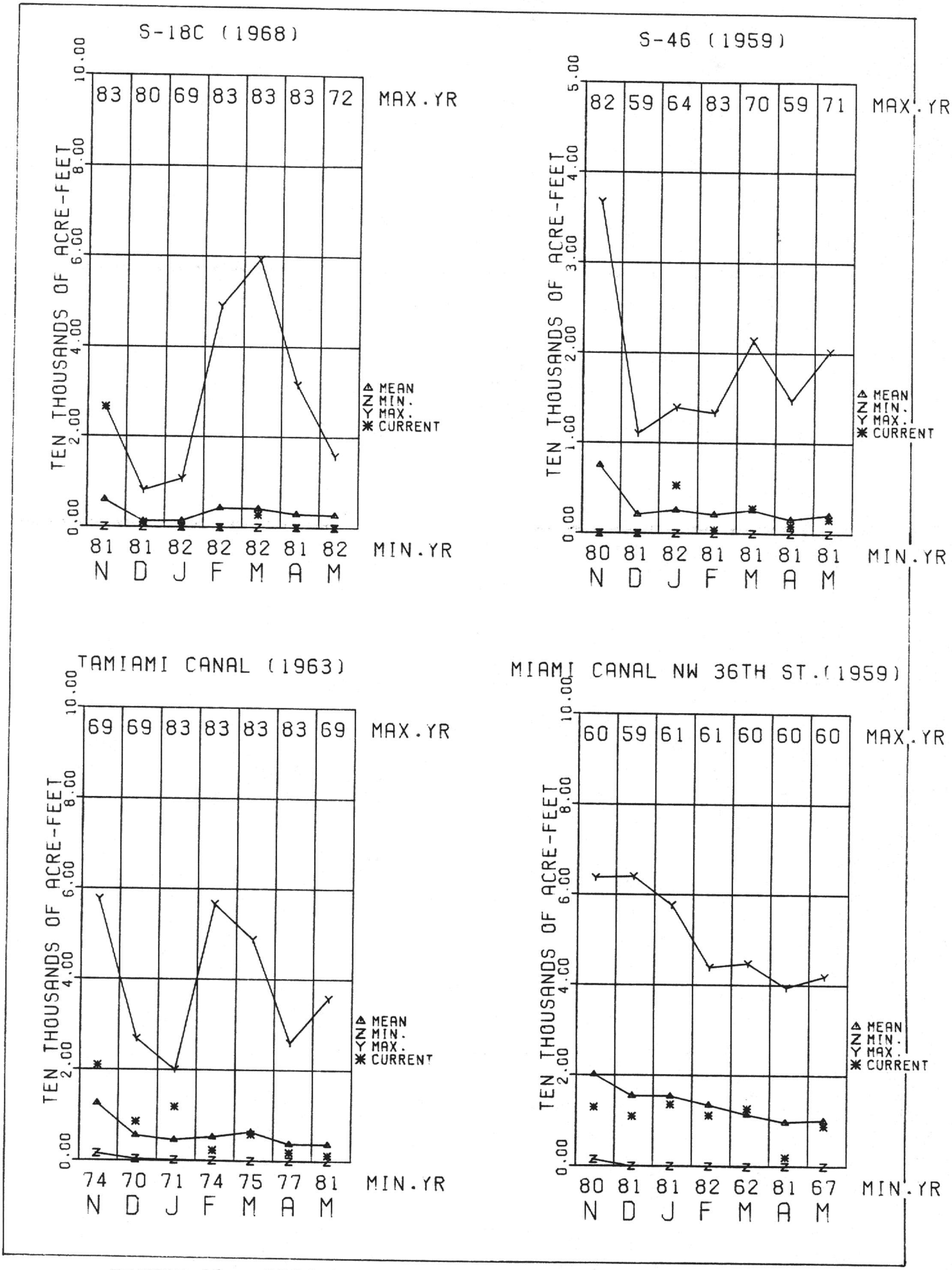
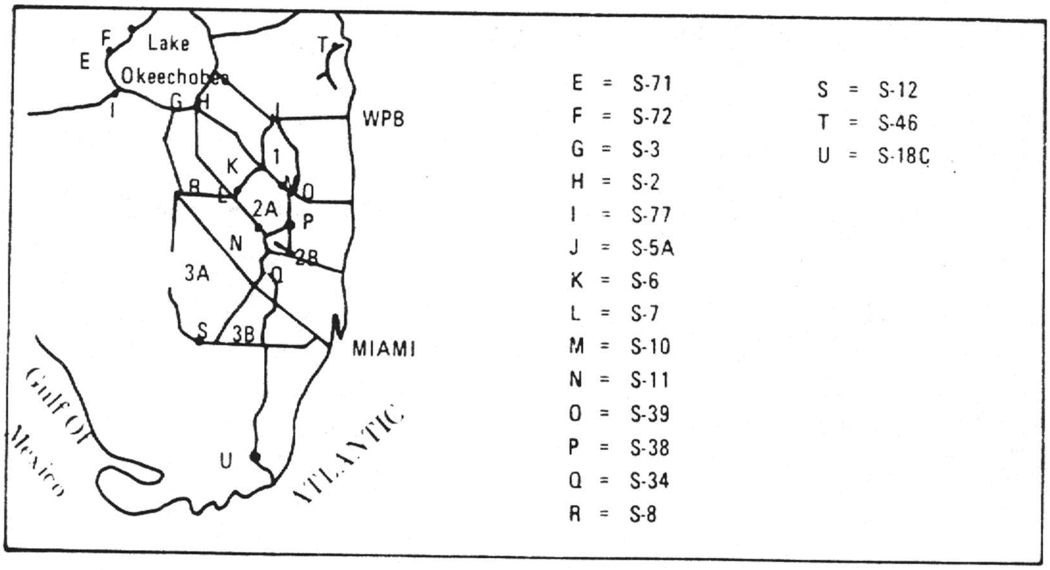
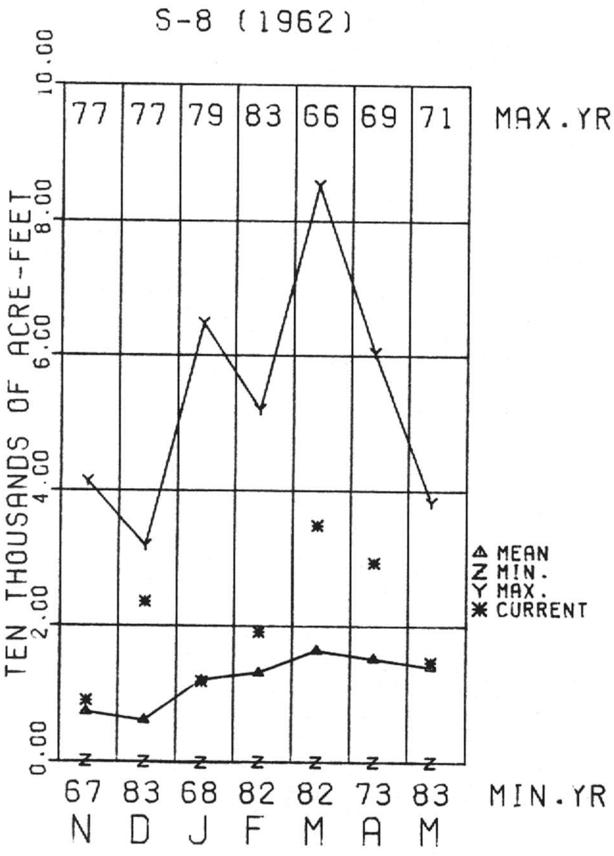


FIGURE 12. DISCHARGE AT LOWER EAST COAST



STRUCTURE LOCATION MAP



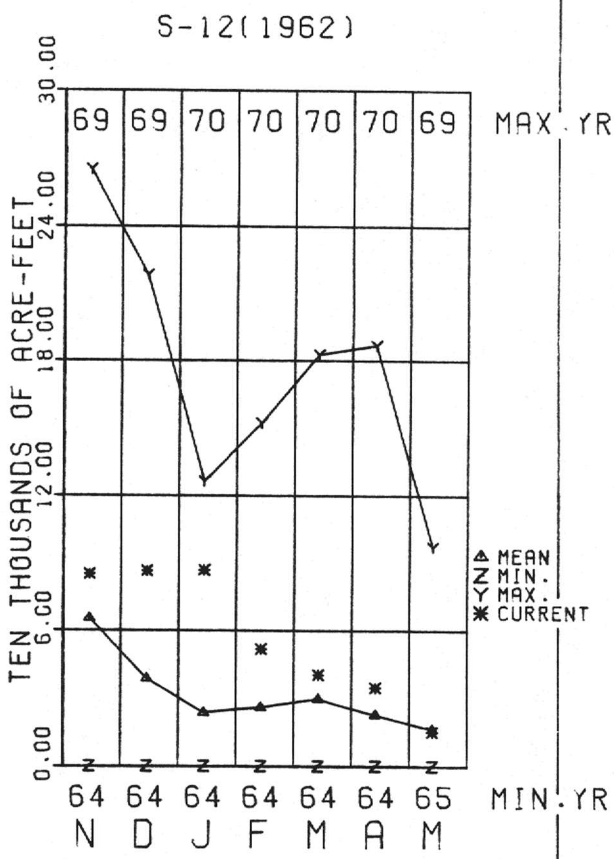


FIGURE 13. DISCHARGE AT S-8 AND S-12

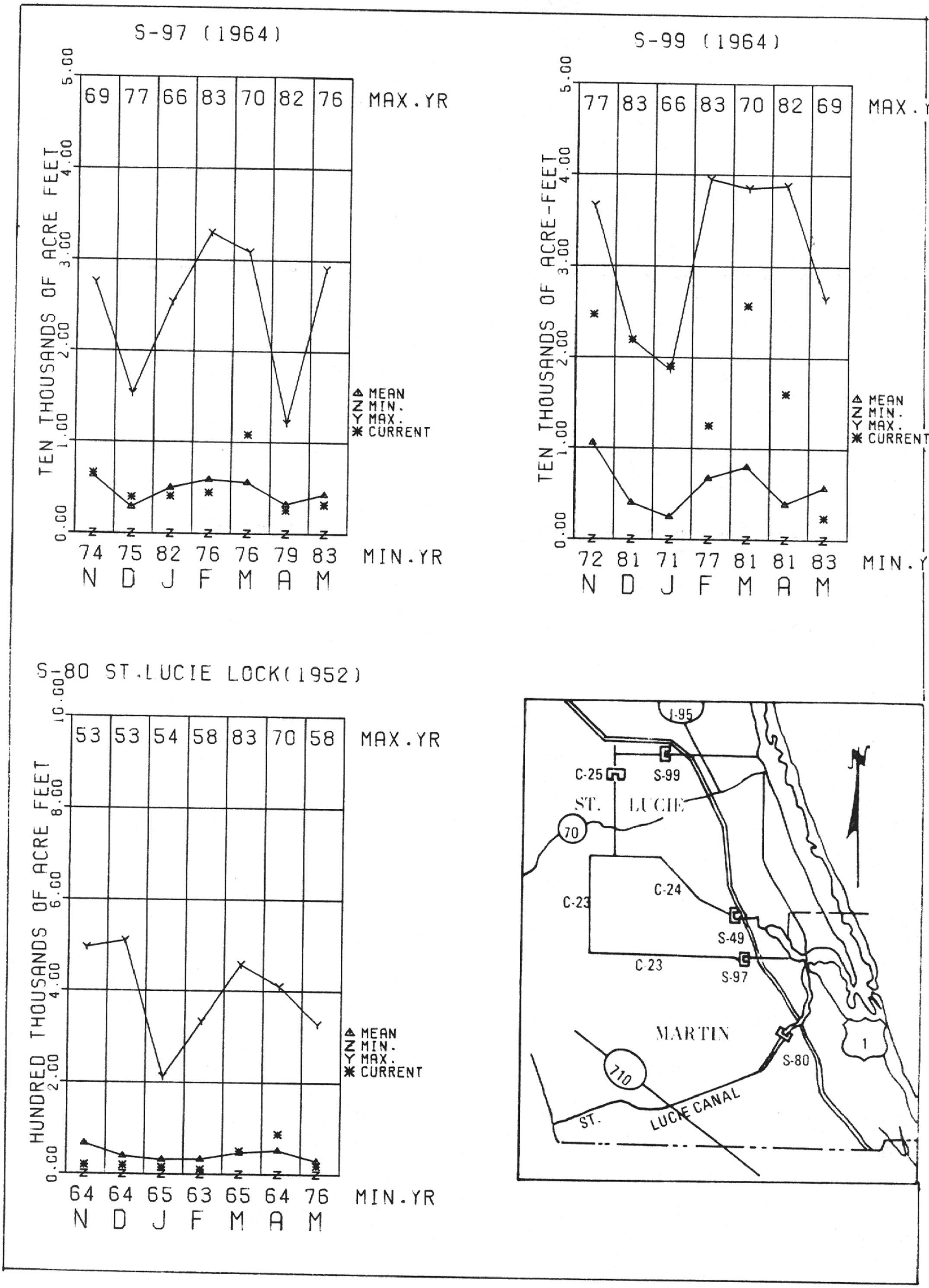


FIGURE 14. DISCHARGE AT UPPER EAST COAST AREAS

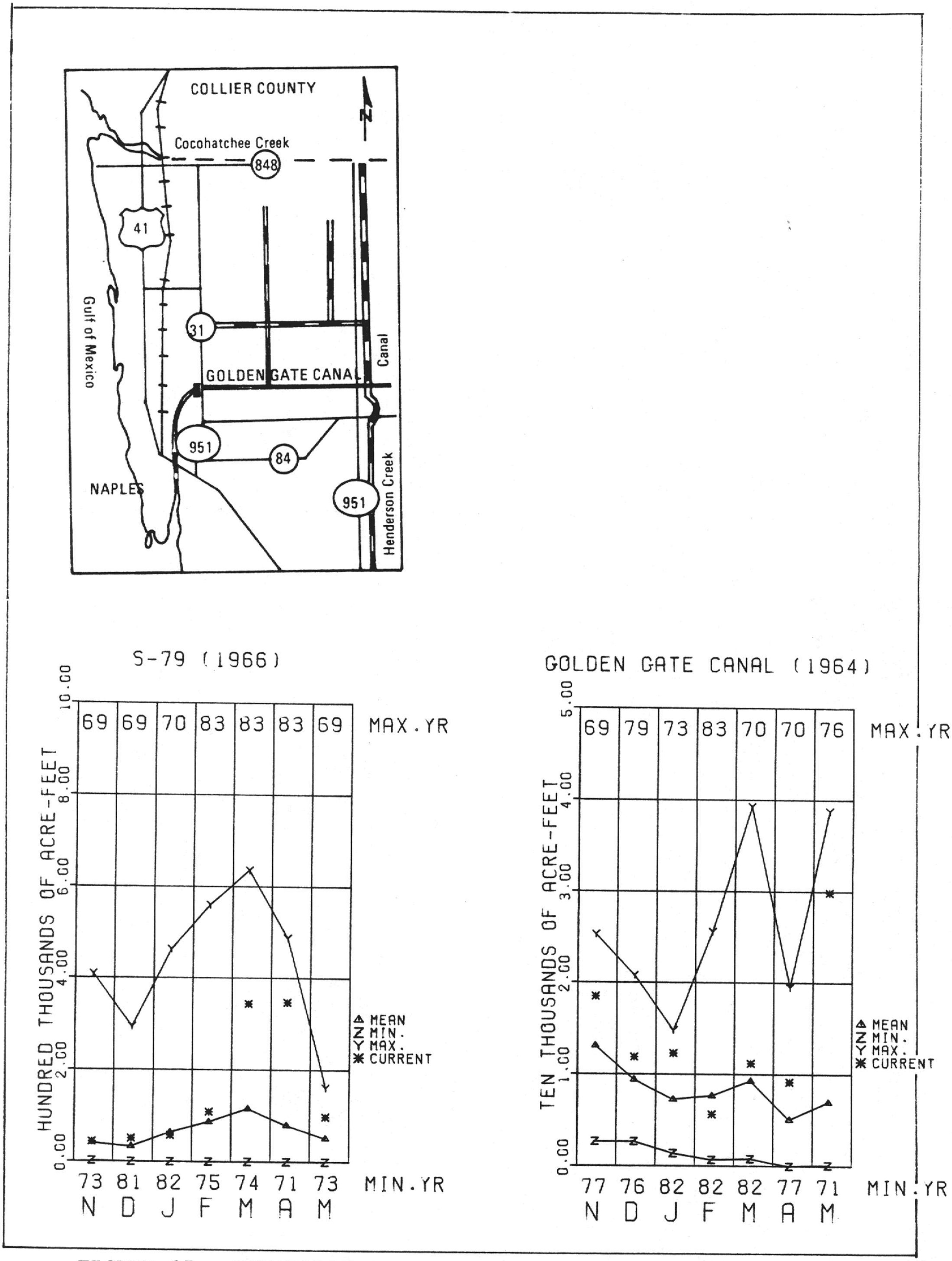
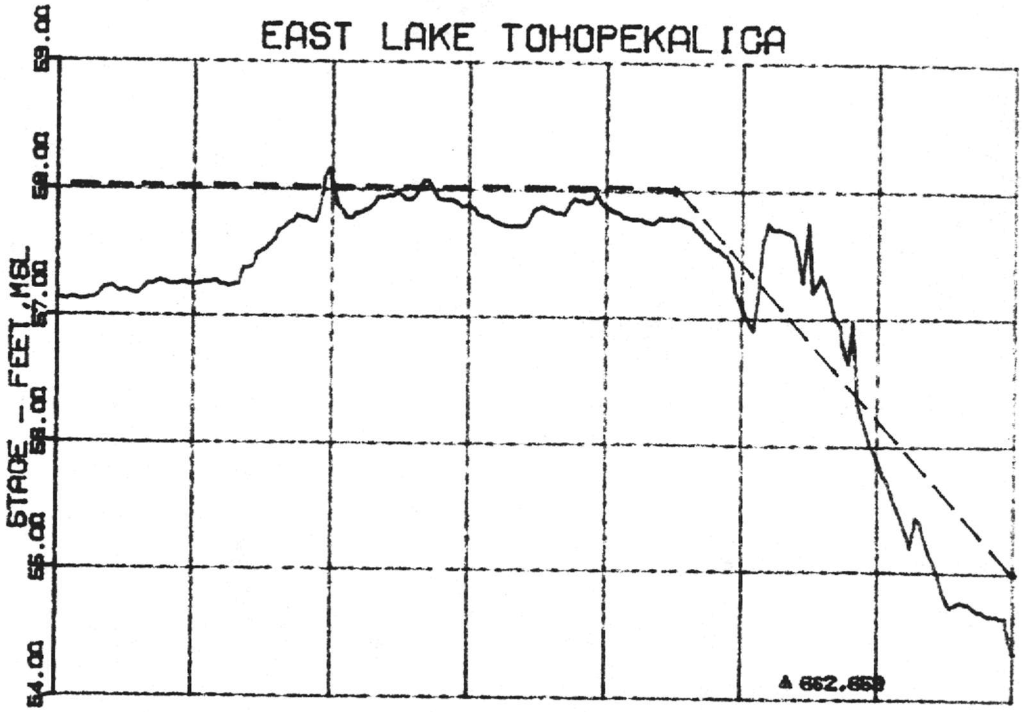
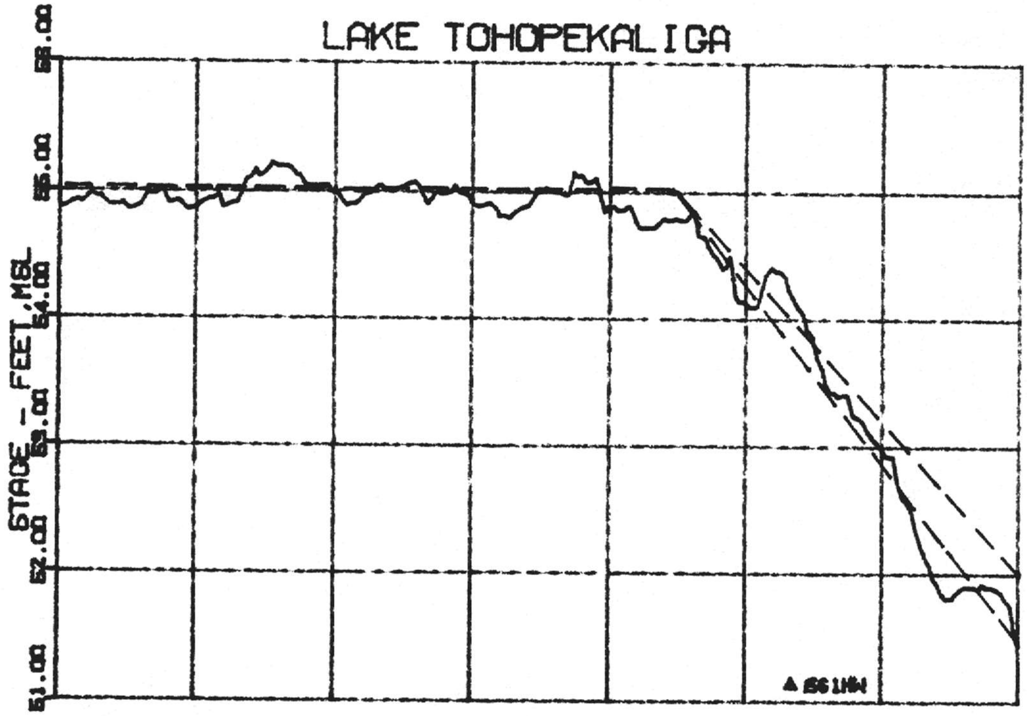


FIGURE 15. DISCHARGE AT LOWER WEST COAST AREAS

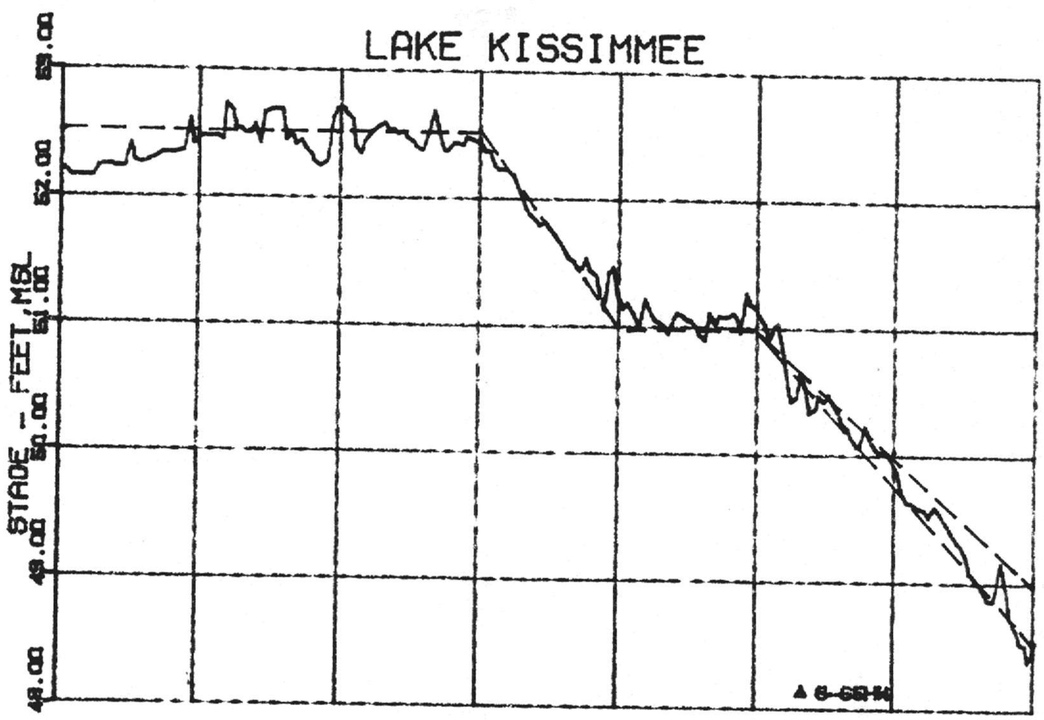


	NOV	DEC	JAN	FEB	MAR	APR	MAY
1984 MONTH END	57.25	58.16	57.87	57.91	57.12	55.93	54.37
MONTH END MEAN	56.89	56.61	56.30	56.14	56.11	55.54	54.91
DEVIATION	+0.36	+1.55	+1.57	+1.77	+1.01	+0.39	-0.54

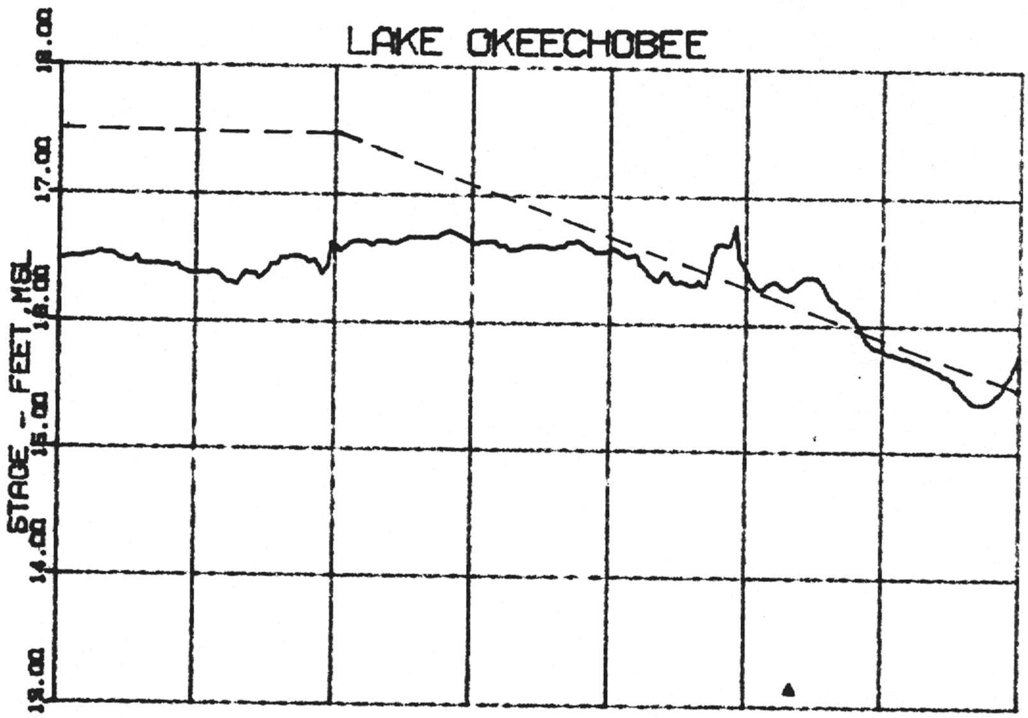


	NOV	DEC	JAN	FEB	MAR	APR	MAY
1984 MONTH END	54.85	54.99	54.91	54.83	54.13	53.00	51.44
MONTH END MEAN	54.00	53.82	53.42	53.36	52.69	52.16	52.45
DEVIATION	+0.85	+1.17	+1.49	+1.47	+1.44	+0.84	-1.01

FIGURE 16. DAILY STAGE HYDROGRAPHS

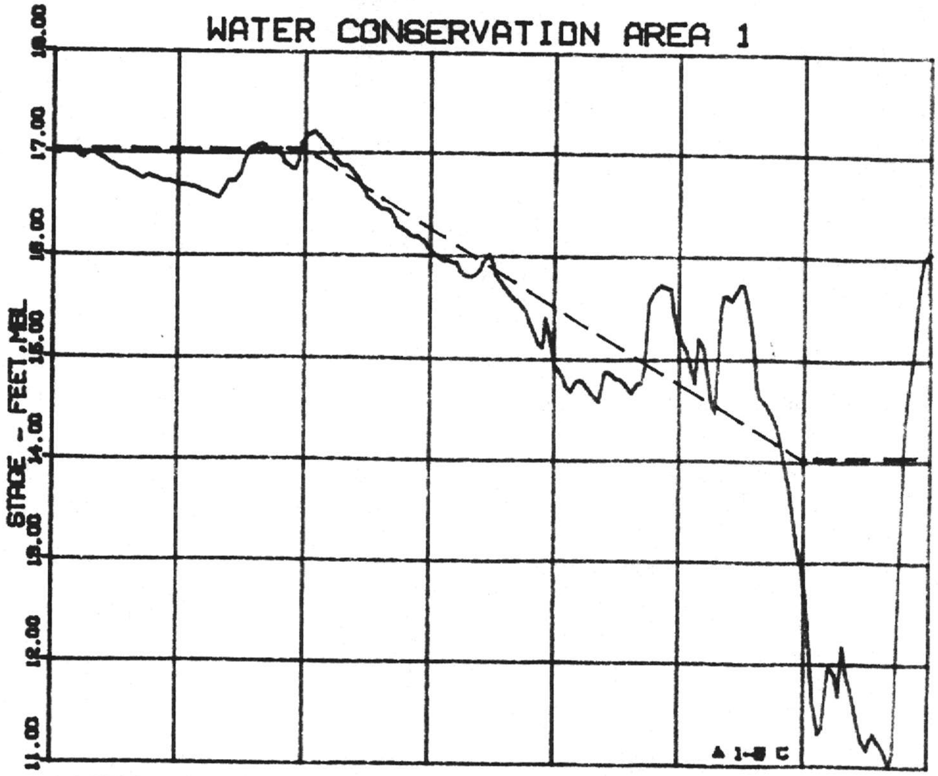


	NOV	DEC	JAN	FEB	MAR	APR	MAY
1984 MONTH END	52.42	52.69	52.45	51.46	51.16	49.92	48.46
MONTH END MEAN	51.19	50.81	50.54	50.36	50.11	49.67	49.17
DEVIATION	+1.23	+1.88	+1.91	+1.10	+1.05	+0.25	-0.71

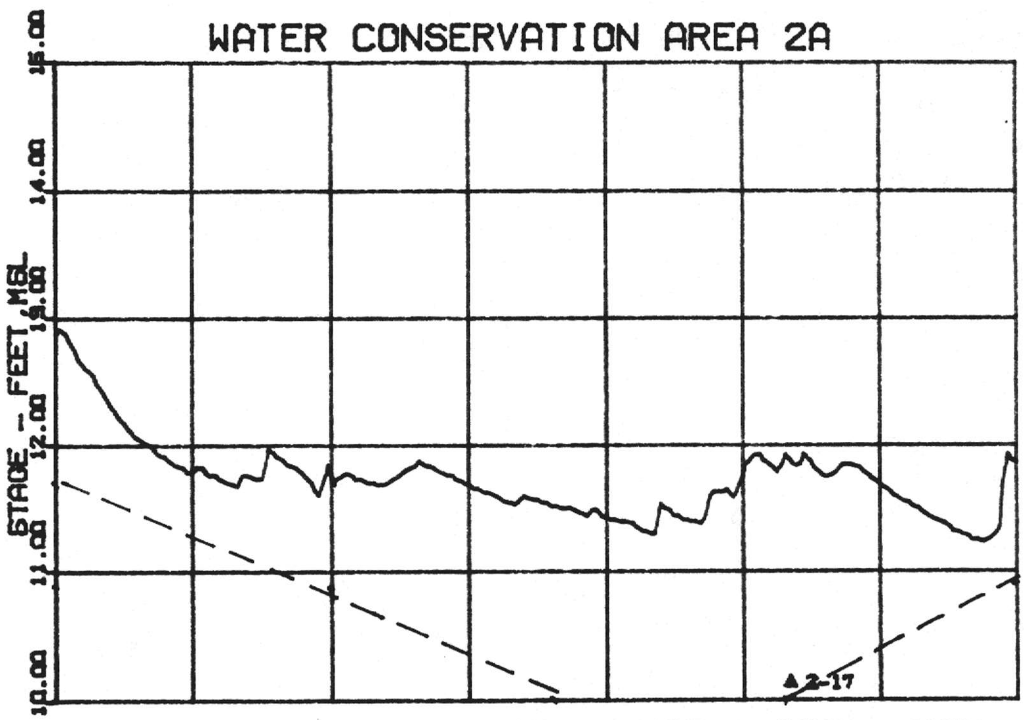


	NOV	DEC	JAN	FEB	MAR	APR	MAY
1984 MONTH END	16.37	16.61	16.62	16.55	16.45	15.80	15.76
MONTH END MEAN	15.01	14.83	14.67	14.56	14.32	13.76	13.41
DEVIATION	+1.36	+1.78	+1.95	+1.99	+2.13	+2.04	+2.35

FIGURE 17. DAILY STAGE HYDROGRAPHS

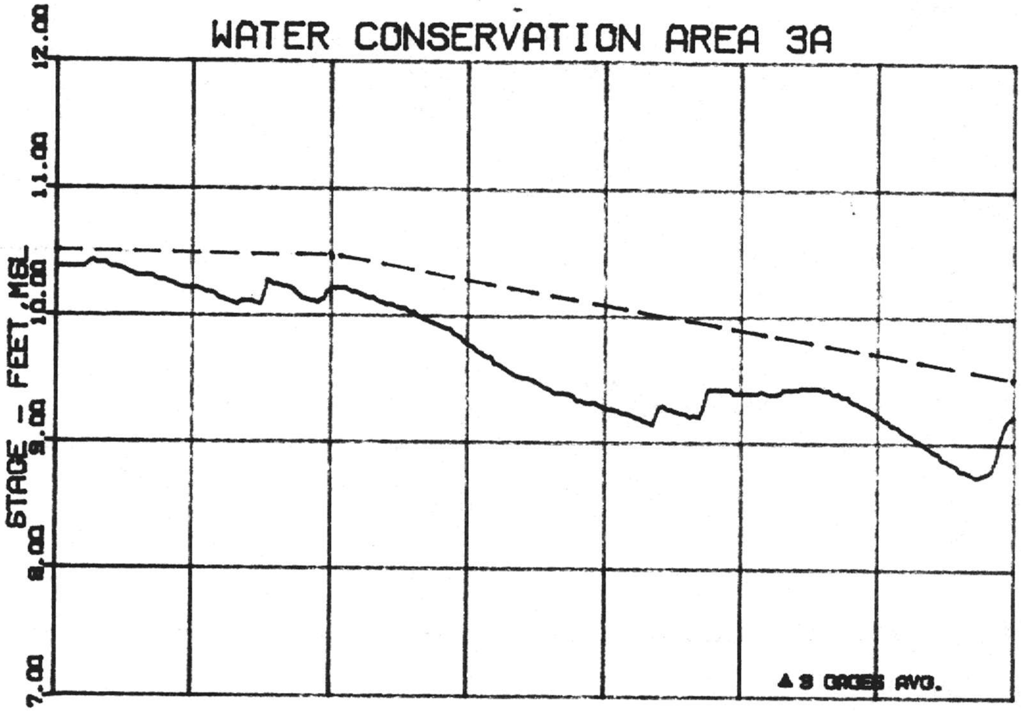


	NOV	DEC	JAN	FEB	MAR	APR	MAY
1984 MONTH END	16.72	17.10	16.05	15.24	15.28	12.94	16.06
MONTH END MEAN	16.34	16.11	15.88	15.57	14.94	13.96	14.15
DEVIATION	+0.38	+0.99	+0.17	-0.33	+0.34	-1.02	+1.91



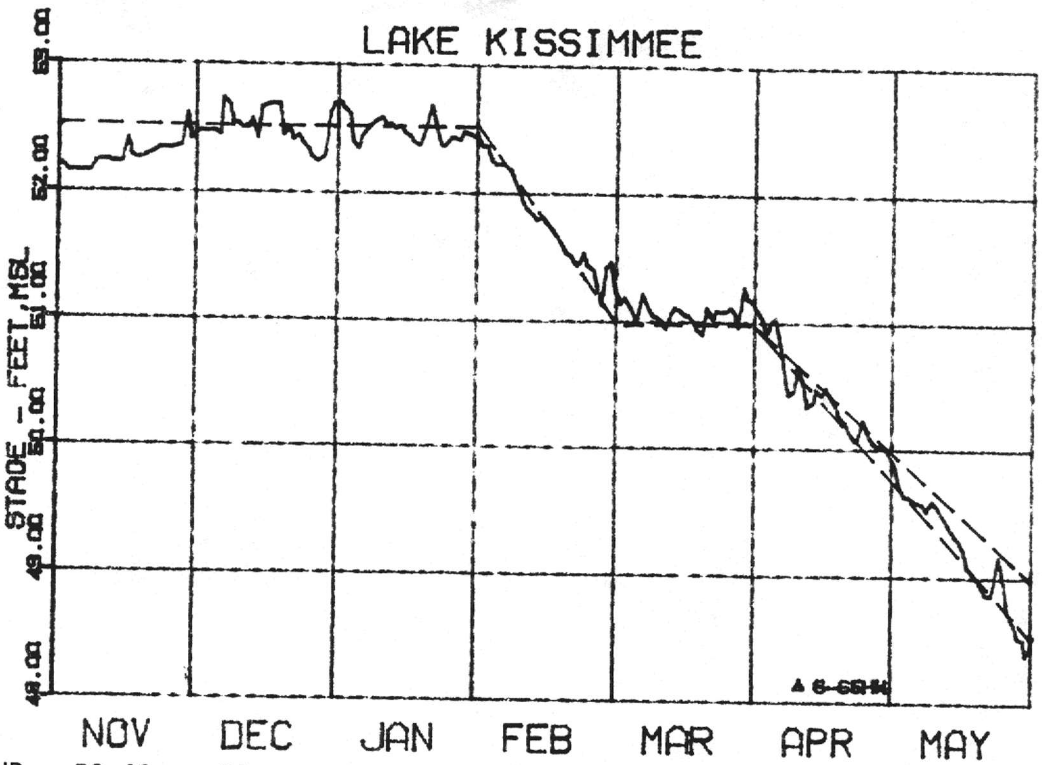
	NOV	DEC	JAN	FEB	MAR	APR	MAY
1984 MONTH END	11.80	11.86	11.69	11.45	11.74	11.71	11.87
MONTH END MEAN	13.39	13.16	13.09	13.04	12.71	12.22	12.03
DEVIATION	-1.59	-1.30	-1.40	-1.59	-0.97	-0.51	-0.16

FIGURE 18. DAILY STAGE HYDROGRAPHS

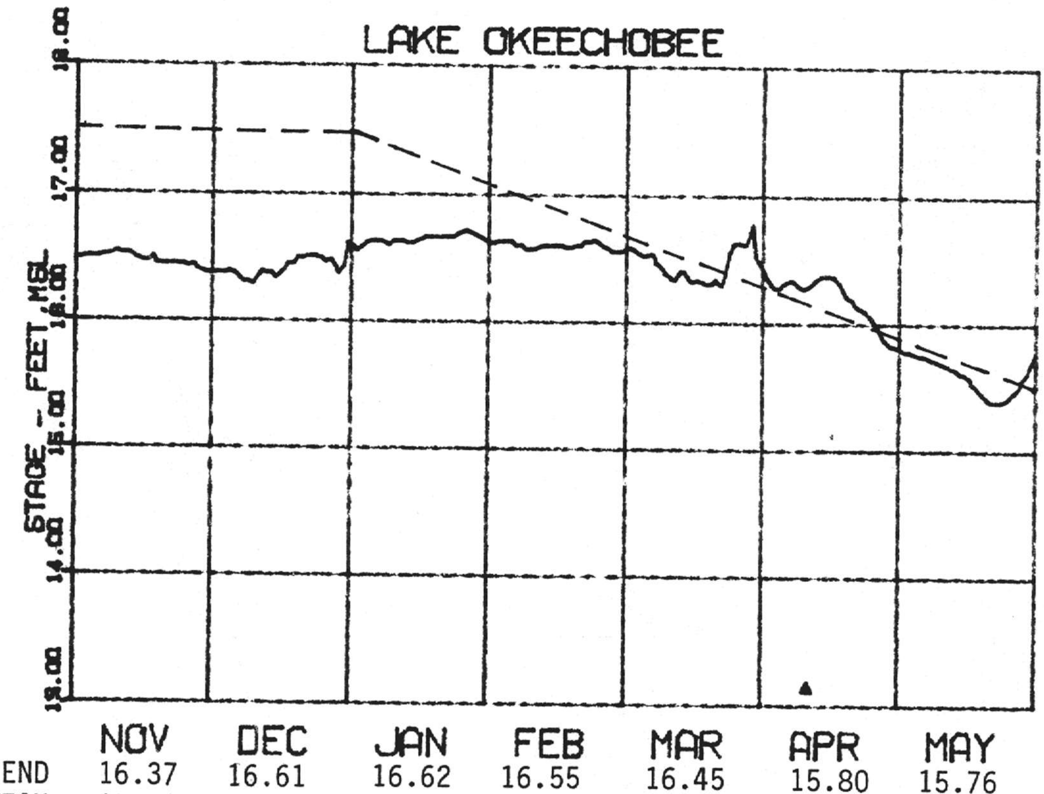


	NOV	DEC	JAN	FEB	MAR	APR	MAY
1984 MONTH END	10.22	10.18	9.78	9.30	9.40	9.24	9.22
MONTH END MEAN	9.79	9.49	9.12	8.94	8.66	8.06	8.20
DEVIATION	+0.43	+0.69	+0.66	+0.36	+0.74	+1.18	+1.02

FIGURE 19. DAILY STAGE HYDROGRAPH



	NOV	DEC	JAN	FEB	MAR	APR	MAY
1984 MONTH END	52.42	52.69	52.45	51.46	51.16	49.92	48.46
MONTH END MEAN	51.19	50.81	50.54	50.36	50.11	49.67	49.17
DEVIATION	+1.23	+1.88	+1.91	+1.10	+1.05	+0.25	-0.71



	NOV	DEC	JAN	FEB	MAR	APR	MAY
1984 MONTH END	16.37	16.61	16.62	16.55	16.45	15.80	15.76
MONTH END MEAN	15.01	14.83	14.67	14.56	14.32	13.76	13.41
DEVIATION	+1.36	+1.78	+1.95	+1.99	+2.13	+2.04	+2.35

FIGURE 17. DAILY STAGE HYDROGRAPHS