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LONG-TERM YIELD ANALYSIS OF THE LOWER GULCHES AND DRYDOCK GULCH RESERVOIR TRIBUTARY TO THE BIG RIVER FOR A WATER SUPPLY FOR THE TOWN OF MENDOCINO

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Prepared for:

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Introduction

This report sets forth an investigation of,

(1) the long-term yield of the combined flow of the Lower Gulches (Thicket Draw, Beans Gulch, Waterspout Gulch, and Nelsons Gulch) for the 44-year period 1948 through 1992, and

(2) the long-term combined yield of the Lower Gulches and Drydock Gulch under various alternatives reflecting the height and volume of storage within Drydock Gulch.

Analysis of yield reflect streamflow measurements taken during the summer of 1991 (Lawrence & Associates, July 25, 1991) and 1992. In addition to streamflow measurements, a drawdown test was conducted in late October, 1992 on Drydock Gulch to estimate baseflow.

Of particular importance to this study was to estimate the minimum flow that would occur during the 2-year critical-dry period 1975-76 and 1976-77. A previous study (Lawrence & Associates, July 25, 1991) showed the Big River near the Mendocino Woodlands had gone dry during the summer of 1977. The drainages below and including Drydock Gulch studied for the current analysis, however, drain terrace deposits that contain carry-over storage from one year to the next.

Findings

1. During the 2-year critical-dry period 1975-77, when 2-year cumulative precipitation was 59 percent of normal, the minimum summer yield from the Lower Gulches and Drydock Gulch, based on reservoir capacity of Drydock Gulch, is:

Water Year	Reservoir capacity (AF)/depth (ft)			
	40/13.6	25/9.2	15/6.3	7.2/4 (present condition)
		(GPM)		
1975-76	234	211	196	184
1976-77	171	156	140	124

2. During the critical-dry year 1990-91, when precipitation was 63 percent of normal (the 2nd driest year to 1976-77), the minimum summer yield from the Lower Gulches and Drydock Gulch, based on reservoir capacity of Drydock Gulch, is:

Water Year	Reservoir capacity (AF)/depth (ft)			
	40/13.6	25/9.2	15/6.3	7.2/4 (present condition)
		(GPM)		
1990-91	210	188	172	161
1991-92	253	230	215	203

3. With the exception of the above years, minimum summer yield from the Lower Gulches and Drydock Gulch, based on reservoir capacity of Drydock Gulch, equals or exceeds the following yields:

Reservoir capacity (AF)/depth (ft)			
40/13.6	25/9.2	15/6.3	7.2/4 (present condition)
		(GPM)	
237	214	199	188

4. Depending on the approach, the analysis of the drawdown test on Drydock Gulch gave varying results of baseflow because approximately 2 inches of rainfall occurred during the test. Because of this, a very conservative estimate of baseflow was estimated and used in the yield analysis.

5. Under existing conditions, the Drydock Gulch pond has a maximum depth of 4 feet, a capacity of 7.2 AF (acre-feet), and a surface area of about 3.2 acres, when the water level is at the invert of the culvert which drains the pond to the Big River estuary.

6. Raising the water level of the Drydock Gulch pond by about 6 feet above the culvert inlet would leave the water level about 4 feet below the logging road that dams the pond between the gulch and the Big River estuary.

Conclusions

With the combined flow of the Lower Gulches, a dam constructed across Drydock Gulch that would contain about 25 AF at a maximum depth of about 9 feet, would provide a minimum summer yield of about 190 gpm or greater for every year of the 44-year record, except for one year, when the yield would be about 156 gpm.

Analysis

Discharge of Lower Gulches period 1991 and 1992

The analysis of the Lower Gulches, which include Thicket Draw, Beans Gulch, Waterspout Gulch, and Nelsons Gulch, during the 2-year period 1991 and 1992 is based on measured and estimated flows. A description of the drainages together with field observations of flow and quality are contained in the "Big River Study" (Lawrence & Associates, July 25, 1991).

The "Big River Study" contains field measurements made during the summer of 1991. Additional flow measurements were made on the Lower Gulches during the summer of 1992.

The determination of daily and annual flows of the Lower Gulches for the 44-year long-term period is based on two years when precipitation was below normal for both years. One of the years, 1990-91, was the driest year of record next to the year 1976-77. Because of this dry condition, the estimate of flows herein during a critical dry period (1974-77) is somewhat verified with field observations taken during a similar dry period, and therefore can be treated with some confidence.

As a first step in estimating the historical record of discharge, daily flows for the Lower Gulches were synthesized from stream measurements taken between June 14, 1991 and October 28, 1992, as shown on Table 1, and Figures 1 and 2 for the years 1990-91 and 1991-92, respectively.

Daily flows for each gulch were determined for each year by straight-line interpretation between the days having observed and estimated flows. The daily flows were then summed to give a total flow for the Lower Gulches for each year for the period June 14 through October 28, for both years 1990-91 and 1991-92.

For each day of the period June 14 through October 28, the percent of the average-daily flow to the daily flow was calculated for each year. The average values of the daily percentages for the two years were calculated and plotted, as shown on Figure 3. From this curve a trend curve was drawn to complete the remainder of the year, as shown.

The location of the trend curve between October 29 and June 13 is based on the following criteria/assumptions:

1. The maximum day occurs approximately during the middle of April, as reflected by the shape of the baseflow curves shown on Figures 4 through 7.

2. The flow on the maximum day is only greater than the observed flow on June 14 within reasonable limits of drawing a "smooth" curve thought the data points.

3. The flow observed on October 28 represents the lowest flow of the year.

4. The percentage flow occurring on October 1 at the beginning of the year is the same as the percentage flow occurring at the end of the year. (When the actual daily flow is calculated this would not be absolutely correct, as it would require the preceding year to have the same average discharge between June 14 and October 28 as the year being calculated.)

With the percentage trend-curve completed for the whole year, as shown on Figure 3, the daily flow was calculated for the years 1990-91 and 1991-92 by multiplying the daily percentages by the average summer flow. For 1990-91 and 1991-92 the average summer flow was 140 gpm and 184 gpm, respectively. The calculated daily flows for each year are shown on Figure 8.

44-year-period annual discharge of the Lower Gulches

To calculate the annual discharge of the Lower Gulches a relationship between annual precipitation and gulch flow for the years 1990-91 and 1991-92 was established, as shown on Figure 9.

The intercept of the curve on the y-axis indicates there would be approximately 30 gpm of average summer discharge even if the preceding winter had zero rainfall. This can be believed, because it would be expected that the terrace deposits would not completely drain even with an absolutely dry winter.

The equation for the curve shown on Figure 9 was applied to each year of the 44-year periods to arrive at an annual yield of the Lower Gulches, as shown on Table 2.

Baseflow of Drydock Gulch

A drawdown test to determine baseflow was conducted on the pond behind the logging road within the Drydock Gulch drainage. The test was interrupted by rainfall and the calculated baseflow varies based on the time interval evaluated during the test. The estimated baseflow is shown on Table 3, and varies between about 18 gpm and 90 gpm. The three time intervals evaluated occurred under the following conditions:

(1) Pretest - Water levels were rising in the pond prior to the start of the pumping test, as shown on Figure 10. The inflow of 90 gpm was calculated based on the time interval of 85 minutes and the volume (pond area times rise in level) of water entering the pond.

(2) Drawdown w/o rain - The early part of the drawdown test before rain began, as shown on Figure 11, gave a calculated baseflow of about 18 gpm. Calculated over a period of 3220 minutes, the inflow was calculated as the difference in the volume of water pumped and the change in pond storage.

(3) Drawdown plus recovery - Calculated baseflow during both the drawdown and the recovery period, as shown on Figure 11, gave an estimated inflow of about 49 gpm. During this 4550-minute period, approximately 2 inches of rainfall occurred, as measured in a 5-gallon bucket placed in the open. Baseflow was calculated as difference between volume pumped, volume of direct precipitation, and change in storage.

For the above three intervals of calculation, evaporation was deducted as an outflow. Estimates of evaporation were based on temperature measured during the test, as shown on Figure 12, and the correlation between evaporation and temperature, as shown on Figure 13.

The essence of this evaluation is to be conservative, and not to over estimate the amount of supply which is available. Using this criteria, the lowest calculated baseflow of 17.8 gpm was estimated to be the flow occurring on October 27 and 28, 1992.

Using the daily-percentages-of-summer-flow values, as shown on Figure 3, it can be seen that the October 27/28 value is about 73 percent of the average summer flow. Dividing 17.8 gpm by 0.73 gives an average summer discharge of about 24.4 gpm, for the period June 14 through October 28.

To determine the annual-average summer baseflow for Drydock Gulch, the assumption was made that the flow to Drydock Gulch was in proportion to the Lower Gulches. Using the ratio of the annual discharge for the Lower Gulches to the 1991-92-year discharge from the Lower Gulches, the baseflow to Drydock Gulch was calculated for the critical period 1974-79 and 1990-91, as shown on Table 4.

Using the average-annual summer flows, the daily baseflows for Drydock Gulch were calculated using the daily percentages shown on Figure 3, and the daily baseflows were plotted as shown on Figure 14, for the 4-year modeling-period, 1974-78.

As discussed previously, the daily percentages of flow shown on Figure 3 reflect the year beginning and ending with the same flow. This would rarely be the case because the average summer baseflow is dependent on the magnitude of precipitation occurring during the previous winter.

For the above reason, the ending and beginning of each year was connected with a trend curve for the 4-year-modeling period, as shown on Figure 14. The plot of rainfall shown on the figure was used as a guide in determining if the recession curve at the end of a year continued downward or started upward.

Surface flow to Drydock Gulch

Surface runoff to Drydock Gulch during the 4-year modeling period 1974-78 was based on the daily unit runoff observed for the Navarro River. Unit runoff in cfs/square mile was multiplied by the Drydock drainage area of 0.5657 square miles to estimate the daily surface inflow to the gulch.

Prior to estimating the unit runoff from the Navarro River watershed, the daily flows for each of the four years were "scalped." That is, the surface-runoff portion of the total daily flow was separated from the "baseflow." Baseflow for Drydock was estimated separately. Scalping of the daily flows for the four years 1974-78 is shown on Figures 4 through 7 and 15 through 18.

Unit runoff was calculated by subtracting the daily scalped flow from the daily flow and dividing by the drainage area of the Navarro River above the stream gage.

Evaporation

Evaporation correlated with maximum daily temperature was developed for use in the 4-year modeling period 1974-78. The line equation relating evaporation to temperature is shown on Figure 13, and was developed from four stations of record, as shown on Figures 19 through 22.

Area-depth-capacity curves for Drydock Gulch pond

Area-depth-capacity curves for Drydock Gulch pond were developed for use in the 4-year modeling period 1974-78, as shown on Figures 23 and 24. The curves were developed from a depth-and-area survey conducted on the pond on October 26, 1992. Depth contours drawn from survey data points are shown on Plate II.

4-year modeling period 1974-75 through 1977-78

The 4-year modeling period 1974-75 through 1977-78 was selected to evaluate the discharge that would occur during the driest 2-year period of record, 1975-76 through 1976-77. For these two years the cumulative precipitation was 59 percent of normal, as shown on the cumulative-deviation-from-the-mean curve, Figure 25, and on Table 5. Annual precipitation is shown graphically on Figure 26.

The model used is a computer-simulation model using daily time-steps. The model reflects an operation study of Drydock Gulch under various conditions of reservoir size, and considers items of evaporation, direct precipitation, surface runoff, baseflow, and yield. The model was combined with the daily estimated discharge from the Lower Gulches to determined a combined discharge.

Four reservoir sizes were selected for analysis:

7.2 AF capacity,	maximum	depth	4 feet (existing condition)		
15 AF	"	"	"	6.3 feet	(alternative)
25 AF	"	"	"	9.2 "	"
40 AF	"	"	"	13.6 "	"

Prior to running the model, the daily discharge from the Lower Gulches had to be evaluated for the 4-year period. As discussed previously, the daily percentages of flow shown on Figure 3 reflect the year beginning and ending with the same flow. This would rarely be the case, because the average summer discharge is dependent on the magnitude of precipitation occurring during the previous winter.

For the above reason, the ending and beginning of each year was connected with a trend curve for the 4-year-modeling period, as shown on Figure 27. The plot of rainfall shown on the figure was used as a guide in determining if the recession curve at the end of a year continued downward or started upward.

For each of the reservoir-size alternatives listed above, there is a variable daily yield from the reservoir, that when combined with the yield from the Lower Gulches, results in a constant daily yield. For example, Figure 28 shows the combined yield of Drydock and the Lower Gulches for a reservoir having a capacity of 40 AF. The minimum yield is 171 gpm, and it occurs throughout each day of 1976-77. As shown on the graph, the yield is a combination of water from storage and discharge of the Lower Gulches.

Looking at the year 1975-76 on Figure 28, the minimum yield is also 171 gpm, but the maximum yield is about 250 gpm. The maximum yield being derived from the Lower Gulches and none from the Drydock Reservoir.

For the 40-AF reservoir alternative, the actual water level in the reservoir during the 4-year modeling period would fluctuate as shown on Figure 29. Note the reservoir spills during the winter from storm runoff every year but the critical dry year, 1976-77. During the summer and fall of 1977 the reservoir level is dropped to less than one foot in the process of drawing water out of storage.

The daily draw (or yield) on the Drydock reservoir during the 4-year modeling period is shown on Figure 30. Looking at the year 1976-77 and the few months before and after, beginning in September the draw increases throughout the fall, decreases during the winter, and increase during the summer and fall.

In other words, the draw when added to the discharge of the Lower Gulches, as shown on Figure 28, is just enough to provide a constant combined discharge. The draw is calculated to just deplete the water-in-storage before the next winter storm fills the reservoir and/or discharge from the Lower Gulches increases from precipitation.

Under present conditions at Drydock Gulch (7.2 AF of storage, 4-ft maximum depth), the pond would support a minimum of about 124 gpm (combined Drydock plus the Lower Gulches) during part of the critical dry year 1976-77, as shown on Figure 31; the maximum flow for the year would come from discharge from the Lower Gulches. Reservoir water levels and yield calculated during the 4-year modeling period are shown on Figures 32 and 33, respectively.

For the 15-AF, 6-ft-depth reservoir alternative, the combined yield of Drydock and the Lower Gulches, the reservoir water levels, and the yield, are shown on Figures 34, 35, and 36, respectively.

For the 25-AF, 9-ft-depth reservoir alternative, the combined yield of Drydock and the Lower Gulches, the reservoir water levels, and the yield, are shown on Figures 37, 38, and 39, respectively.

The relationships between reservoir yield versus depth and capacity are plotted on Figure 40. The curves can be used to estimate the minimum yield that would have occurred during the critical dry year 1976-77 under any combination of reservoir depth and capacity.

Long-term yield of Drydock Gulch and the Lower Gulches

The long-term minimum yield of Drydock and the Lower Gulches was estimated for the 44-year period of precipitation October 1, 1948 through September 30, 1992 for the summer period June 1 through November 1, for the four reservoir alternatives:

7.2 AF capacity, maximum depth			4 feet (existing condition)		
15 AF	"	"	"	6.3 feet (alternative)	
25 AF	"	"	"	9.2 "	"
40 AF	"	"	"	13.6 "	"

The long-term minimum summer yield of the combined flow from Drydock Gulch and the Lower Gulches was estimated using relationships developed between combined yield during the 4-year modeling period and precipitation, reservoir storage, and yield from the Lower Gulches and precipitation.

Results of the annual combined-yield analysis are shown on Table 6, and Figures 41 through 44 for the four reservoir alternatives, 7.2 AF, 15 AF, 25 AF, and 40 AF, respectively.

The evaluation process took the following steps:

1. For the 4-year period 1974-78, the daily flow on June 1 and November 1 of the Lower Gulches was read from the model output, and as reflected on Figure 14. For the years 1990-91 and 1991-92 the flow on these dates was determined from estimated data, as shown on Figure 9.

2. For each of the above 6 years, the average of the two flows occurring on June 1 and November 1 was calculated, and is considered to be the average summer flow.

3. The average-daily flow from reservoir storage alone was calculated for a 150-day period (June 1 through November 1) for each of the reservoir alternatives:

Capacity, AF	Storage yield, GPM
7.2	10.86
15	22.63
25	37.71
40	60.34

4. The storage yield for each of the reservoir alternatives was then added to the average summer discharge of the Lower Gulches, as calculated in Step 2.

5. The result calculated in Step 4 was then compared to the results obtained by the model study for the year 1976-77, it being the driest year of record, as shown below:

Drydock + Lower Gulches

Method	Reservoir Storage, AF			
Calculated	7.2	15	25	40
Model	124	140	156	171
Annual method	133.99	145.76	160.84	183.47
Difference	9.99	5.76	4.84	12.47

Average difference = 8.26

For each of the reservoir alternatives, the values above show the <u>minimum</u> sustained yield for the year 1976-77 was, on the average, about 8.26 gpm less than the method used to calculate the <u>average</u> summer discharge.

6. The above difference of 8.26 gpm was subtracted from the combined flow of Drydock storage and the Lower Gulches calculated in Step 4, and plotted versus precipitation, as shown on Figure 45.

7. The plotted points shown on Figure 45 for each of the reservoir alternatives had a regression analysis to determine the equation of the best-fit curve through the points.

8. Using annual precipitation, the line equations shown on Figure 45 were used to calculate the minimum summer discharge that would occur annually for the 44-year period 1948-92, as shown on Table 6.

Drydock Gulch pond survey and drawdown test

Bottom survey

On October 26, 1992 a survey of the depth of Drydock Gulch pond was conducted using a theadolite and EDM. Rod locations within the pond were held from a rubber dinghy, and angle/distance shots were made from one setup on the ground at the southeast corner of the pond.

Approximately 50 shots were made of the pond bottom and shoreline, and are plotted on Plate II. From these points, contours were constructed on the bottom of the pond and used for calculating area-depth-capacity curves, as shown on Figures 23 and 24.

It was noted while rowing the dinghy about that the pond has a number of submerged logs and fallen trees.

Drawdown test

Beginning at 1130 on October 27, 1992 a constant drawdown test was conducted for approximately 54 hours, and a recovery test for about 22 hours. Purpose of the test was to determine baseflow to the gulch.

Average pumping rate was 115.23 gpm. Drawdown in the pond was measured using a pressure transducer and data logger, as shown on Figures 10 and 11. Discharge from the pond was to the Big River estuary through the culvert underlying the logging road at the south end of the pond.

During the drawdown test, the air temperature, and the water temperature and conductivity of the pond were monitored continuously, as shown on Figure 12.

During the drawdown and recovery tests there was approximately 2 inches of rainfall. Rain began about 1730 on October 28, 1992, but did not become heavy until about midnight. As shown on Figure 12, while still pumping, recovery of the pond level began about midnight from rainfall. Rainfall was measured in a 5-gallon bucket set on the ground away from any trees.

Reference

Lawrence & Associates, *Water resource inventory of the Big River drainage and vicinity for a water supply for the Town of Mendocino*, July 25, 1991.

Table 1
Observed and Estimated Gulch Flow During Summers 1991 and 1992

Date	Thicket	Beans	Waterspout	Nelsons	Total
			(GPM)		
6/14/91	23[*a]	37.78[*]	43.18[*]	97.20[*]	201.16
7/8/92	16[*b]	29.3[b]	36.5[b]	86.5[b]	168.30
7/12/91	15[*a]	28.35[*]	35.44[*]	85.05[*]	163.84
10/14/91	10.72[c]	15.14[e]	23.33[f]	53.90[g]	103.09
10/28/91	10.72[d]	15.14[d]	23.33[d]	53.90[d]	103.09
6/14/92	32.17[h]	49.91[i]	58.67[j]	121.73[k]	262.48
7/8/92	22.39[*]	38.71[*]	49.59[*]	108.33[*]	219.02
10/14/92	15.00[*]	20.00[*]	31.67[*]	67.50[n]	134.17
10/28/92	15.96[*]	20.00[*]	30.69[*]	67.50[o]	134.15

Note reference:

* Unless otherwise noted, measured in the field with a 5-gallon bucket and stop watch.

a Visual estimation; not able to measure directly.

b Straight-line interpretation between measurements 6/14/91 and 7/12/91.

c 10/14/92 Thicket flow times ratio of flow 7/8/91 to 7/8/92 (16/22.39 = 0.715; 15 x 0.715 = 10.72).

d Assumed to be same as 10/14/91.

e 10/14/92 Beans flow times ratio of flow 7/8/91 to 7/8/92 (29.3/38.71 = 0.757; 20 x 0.757 = 15.14).

f 10/14/92 Waterspout flow times average of ratios calculated in Notes "c" and "e" above ((0.715 + 0.757)/2 = 0.736; 31.7 x 0.736 = 23.33).

g 10/14/91 Waterspout flow times ratio of 2.31 calculated as the average ratio of 6/14/91 and 92 and 7/8/91 and 92 flows of Nelson to Waterspout ((97.2/43.18 + 86.5/36.5)/2 = 2.31; 2.31 x 23.33 = 53.90).

h 6/14/91 Thicket flow divided by a ratio of 0.715 (23/0.715 = 32.17); see Note "c" above.

i 6/14/91 Beans flow divided by a ratio of 0.757 (37.78/0.757 = 49.91); see Note "e" above.

j 6/14/91 Waterspout divided by a ratio of 0.736 (43.18/0.736 = 58.67); see Note "f" above.

k 6/14/91 Nelsons flow divided by a ratio of 0.7985 ((97.2/0.7985 = 121.73); ratio determined from ratio between Nelsons flow on 10/14/91 and 10/14/92 (53.90/67.5 = 0.7985).

l 7/8/91 Waterspout flow divided by a ratio of 0.736 (36.5/0.736 = 49.59); see Note "f" above for ratio derivation.

m 7/8/91 Nelsons flow divided by a ratio of 0.7985 (86.5/0.7985 = 108.33); see Note "k" for ratio derivation.

n Measured at 60 gpm; based on comparison of flows in the other gulches between 10/14/92 and 10/28/92 measurement appears too low and is questionable; flow estimated to be higher at 67.5 gpm.

o Measured at 74.07 gpm; measurement made twice and assumed reliable; because of low 10/14/92 measurement, flow estimated downward to 67.5.

Table 2
Average Summer Yield (June 14 through October 28) for Combined Flow of Thicket Draw, Beans Gulch, Waterspout Gulch and Nelsons Gulch, 44-Year Period 1948-92

Water Year	Annual Precip	Gulch Yield	Water Year	Annual Precip	Gulch Yield
	(In)	(GPM)		(In)	(GPM)
1948 - 49	35.17	191	1970 - 71	46.24	241
1949 - 50	30.49	169	1971 - 72	31.57	174
1950 - 51	41.41	219	1972 - 73	44.62	234
1951 - 52	47.27	246	1973 - 74	54.84	281
1952 - 53	48.36	251	1974 - 75	40.99	217
1953 - 54	42.32	224	1975 - 76	28.8	162
1954 - 55	31.95	176	1976 - 77	16.56	106
1955 - 56	47.41	247	1977 - 78	47.95	249
1956 - 57	33.45	183	1978 - 79	31.87	176
1957 - 58	58.02	295	1979 - 80	41.28	219
1958 - 59	29.44	165	1980 - 81	30.25	168
1959 - 60	30.72	170	1981 - 82	43.67	230
1960 - 61	39.19	209	1982 - 83	50.45	261
1961 - 62	34.03	186	1983 - 84	36.4	196
1962 - 63	38.43	206	1984 - 85	30.56	170
1963 - 64	32.78	180	1985 - 86	42.41	224
1964 - 65	41.70	221	1986 - 87	31.46	174
1965 - 66	35.10	190	1987 - 88	29.8	166
1966 - 67	46.47	243	1988 - 89	42.25	223
1967 - 68	34.48	188	1989 - 90	35.56	193
1968 - 69	50.62	262	1990 - 91	24.17	140
1969 - 70	41.25	219	1991 - 92	32.53	179

Note - Average summer discharge = (precip x 4.57822) + 29.78191.
- Water year ending September 30.
- Precipitation from Ft. Bragg Station.

Table 3
Analysis of Inflow to Drydock Gulch During Drawdown Test

Parameter	Period of Calculation: Draw-down w\o Rain	Draw-down	Draw-down + Recovery	Pretest	Total Period
Inflow					
Rain, Inches	0	1-3/4	2	0	2
Outflow					
Pumped, Inches	-2.801	-4.441	-4.441	0.000	-4.441
Evaporation, Inches	-0.125	-0.201	-0.284	-0.005	-0.290
Outflow-Inflow, Inches	-2.926	-2.893	-2.726	-0.005	-2.731
Change-in-storage, Inches	-2.500	-1.901	-0.070	0.086	0.017
Imbalance, Inches	0.426	0.991	2.656	0.091	2.748
Time increment, Minutes	2000	3220	4550	85	4635
Subsurface in, GPM	17.803	25.716	48.766	89.836	49.519

Note - Volume based on surface area of 134,012 ft^2
- Total volume pumped 371,004 gallons (115.23 gpm).

Table 4
Estimate of Drydock Gulch Summer Baseflow

Water Year	Average Summer Gulch Discharge	Ratio Gulch Discharge To 1991-92	Average Summer Drydock Discharge
	(GPM)		(GPM)
1974-75	217.44	1.184	28.88
1975-76	161.63	0.880	21.46
1976-77	105.60	0.575	14.02
1978-79	249.31	1.357	33.11
1990-91	140.44	0.765	18.65
1991-92	183.66	1.000	24.39[a]

Note
- Water year ending September 1.
- Average summer flow for period June 14 through October 28.
- Drydock discharge equal to ratio times 1991-92 calculated summer flow.

a 17.80 gpm, observed 10/27/92, divided by 0.73, ratio of October 27 discharge to average summer flow.

Table 5
Ft Bragg Precipitation 44-Year Period 1948 - 1992

WATER YR END	1948	1949	1950	1951	1952	1953	1954	
OCT	0.00	1.49	0.92	7.15	3.44	0.14	2.49	
NOV	0.00	2.74	2.46	5.09	6.60	4.20	6.77	
DEC	0.00	6.58	3.08	6.11	13.41	14.97	2.57	
JAN	0.00	1.82	9.48	9.96	10.00	12.94	11.64	
FEB	0.00	7.02	4.76	6.44	4.90	1.21	3.85	
MAR	0.00	13.61	6.79	3.20	4.23	5.14	5.81	
APR	0.00	0.32	1.86	1.49	1.99	4.82	4.36	
MAY	0.00	1.28	0.80	1.85	0.90	2.50	0.00	
JUN	0.00	0.11	0.21	0.02	1.69	1.48	2.21	
JUL	0.05	0.10	0.00	0.03	0.00	0.00	0.02	
AUG	0.02	0.03	0.04	0.03	0.01	0.94	2.45	
SEP	1.44	0.07	0.09	0.04	0.10	0.02	0.15	
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WATER YR SUM	1.51	35.17	30.49	41.41	47.27	48.36	42.32	inches
	1947	1948	1949	1950	1951	1952	1953	
	1948	1949	1950	1951	1952	1953	1954	
INDEX		91.88	79.65	108.18	123.49	126.33	110.56	
INDEX DEV		-8.12	-20.35	8.18	23.49	26.33	10.56	
CUM DEV	0	-8.12	-28.47	-20.9	3.19	29.53	40.08	

WATER YR END	1955	1956	1957	1958	1959	1960	1961	
OCT	1.56	1.49	3.67	7.36	0.22	0.87	2.09	
NOV	7.69	7.75	0.43	3.03	2.04	0.08	6.20	
DEC	9.28	13.40	1.70	5.24	2.54	2.53	6.37	
JAN	4.59	14.92	5.08	8.31	11.93	7.22	4.24	
FEB	2.19	7.05	5.24	19.53	7.27	7.89	7.03	
MAR	0.91	0.93	7.84	6.90	2.65	7.71	7.38	
APR	5.09	0.71	2.59	5.63	0.41	2.16	2.15	
MAY	0.00	0.70	4.57	0.50	0.35	2.02	2.66	
JUN	0.02	0.44	0.08	1.20	0.07	0.00	0.24	
JUL	0.01	0.00	0.20	0.06	0.03	0.09	0.05	
AUG	0.00	0.00	0.00	0.08	0.04	0.09	0.27	
SEP	0.61	0.02	2.05	0.18	1.89	0.06	0.51	
	------	------	-----	-----	------	-----	------	
WATER YR SUM	31.95	47.41	33.45	58.02	29.44	30.72	39.19	inches
	1954	1955	1956	1957	1958	1959	1960	
	1955	1956	1957	1958	1959	1960	1961	
INDEX	83.47	123.85	87.38	151.57	76.91	80.25	102.38	
INDEX DEV	-16.53	23.85	-12.62	51.57	-23.09	-19.75	2.38	
CUM DEV	23.55	47.40	34.79	86.36	63.27	43.52	45.90	

Table 5 (continued)
Ft Bragg Precipitation 44-Year Period 1948 - 1992

WATER YR END	1962	1963	1964	1965	1966	1967	1968	
OCT	1.79	6.43	5.30	2.57	0.73	0.12	3.60	
NOV	6.48	3.16	10.10	9.63	10.31	9.92	3.90	
DEC	4.61	4.35	2.18	14.58	3.94	7.22	6.51	
JAN	3.44	2.79	7.58	5.27	8.39	9.28	8.05	
FEB	7.18	3.86	0.79	1.87	4.83	1.03	4.33	
MAR	5.53	7.02	3.99	2.06	3.71	9.33	4.43	
APR	1.44	9.43	0.64	4.96	2.18	7.59	0.56	
MAY	0.39	0.98	1.29	0.13	0.22	1.12	1.19	
JUN	0.03	0.14	0.60	0.14	0.10	0.33	0.09	
JUL	0.09	0.01	0.18	0.11	0.03	0.06	0.05	
AUG	1.98	0.07	0.07	0.24	0.22	0.02	1.34	
SEP	1.07	0.19	0.06	0.14	0.44	0.45	0.43	
	------	------	------	------	------	------	------	
WATER YR SUM	34.03	38.43	32.78	41.70	35.10	46.47	34.48	inches
	1961	1962	1963	1964	1965	1966	1967	
	1962	1963	1964	1965	1966	1967	1968	
INDEX	88.90	100.39	85.63	108.94	91.69	121.40	90.07	
INDEX DEV	-11.10	0.39	-14.37	8.94	-8.31	21.40	-9.93	
CUM DEV	34.80	35.19	20.82	29.76	21.45	42.85	32.93	

WATER YR END	1969	1970	1971	1972	1973	1974	1975	
OCT	1.84	2.77	3.32	1.16	3.18	5.67	2.41	
NOV	4.88	2.76	8.76	3.89	8.02	12.98	1.92	
DEC	12.81	14.30	10.81	5.79	6.28	7.39	6.62	
JAN	13.50	13.43	8.56	4.78	10.80	7.60	4.32	
FEB	10.67	3.28	1.54	5.79	7.87	5.18	10.22	
MAR	2.33	3.25	8.35	3.83	5.30	9.84	11.38	
APR	3.23	0.59	2.33	2.17	0.92	4.37	2.47	
MAY	0.29	0.40	0.83	0.71	0.49	0.31	0.34	
JUN	0.44	0.37	0.48	0.50	0.06	0.34	0.17	
JUL	0.02	0.00	0.03	0.04	0.08	0.85	0.53	
AUG	0.03	0.03	0.76	0.22	0.16	0.18	0.49	
SEP	0.58	0.07	0.47	2.69	1.46	0.13	0.12	
	------	------	------	------	------	------	------	
WATER YR SUM	50.62	41.25	46.24	31.57	44.62	54.84	40.99	inches
	1968	1969	1970	1971	1972	1973	1974	
	1969	1970	1971	1972	1973	1974	1975	
INDEX	132.24	107.76	120.80	82.47	116.56	143.26	107.08	
INDEX DEV	32.24	7.76	20.80	-17.53	16.56	43.26	7.08	
CUM DEV	65.16	72.92	93.72	76.19	92.76	136.02	143.10	

Table 5 (continued)
Ft Bragg Precipitation 44-Year Period 1948 - 1992

WATER YR END	1976	1977	1978	1979	1980	1981	1982	
OCT	4.72	0.19	2.38	0.04	6.00	2.41	4.55	
NOV	2.59	2.61	3.83	1.26	9.72	1.49	8.25	
DEC	3.96	0.68	8.37	2.11	4.78	4.47	8.10	
JAN	1.31	1.94	11.24	7.73	3.23	8.89	5.70	
FEB	7.56	2.43	6.59	10.84	9.42	4.73	4.31	
MAR	2.30	2.45	5.60	4.91	3.31	3.98	7.16	
APR	4.08	0.57	6.23	2.37	3.90	0.58	4.75	
MAY	0.19	1.93	0.69	1.91	0.50	1.87	0.01	
JUN	0.05	0.06	0.07	0.03	0.26	0.14	0.43	
JUL	0.36	0.03	0.07	0.35	0.03	0.00	0.06	
AUG	1.58	0.58	0.40	0.01	0.01	0.06	0.06	
SEP	0.10	3.09	2.48	0.31	0.12	1.63	0.29	
	------	------	------	------	------	------	------	
WATER YR SUM	28.80	16.56	47.95	31.87	41.28	30.25	43.67	inches
	1975	1976	1977	1978	1979	1980	1981	
	1976	1977	1978	1979	1980	1981	1982	
INDEX	75.24	43.26	125.26	83.26	107.84	79.02	114.08	
INDEX DEV	-24.76	-56.74	25.26	-16.74	7.84	-20.98	14.08	
CUM DEV	118.34	61.60	86.86	70.12	77.96	56.98	71.06	

WATER YR END	1983	1984	1985	1986	1987	1988	1989	
OCT	4.73	0.86	3.54	2.58	1.70	0.88	1.22	
NOV	9.34	11.44	13.64	4.78	1.39	5.24	11.46	
DEC	7.42	13.53	0.00	4.09	5.34	11.30	5.41	
JAN	7.36	0.55	1.26	6.81	7.54	4.98	3.08	
FEB	11.67	3.63	3.82	11.83	5.28	0.12	1.89	
MAR	0.00	3.67	6.46	7.91	8.25	1.06	12.53	
APR	4.84	0.00	0.24	0.98	0.68	2.11	2.49	
MAY	1.10	1.32	0.39	0.68	0.77	1.24	0.96	
JUN	0.16	0.76	0.06	0.28	0.17	2.79	0.57	
JUL	0.46	0.04	0.10	0.00	0.28	0.03	0.00	
AUG	3.00	0.09	0.14	0.07	0.06	0.00	0.24	
SEP	0.37	0.51	0.91	2.40	0.00	0.05	2.40	
	------	------	------	------	------	------	------	
WATER YR SUM	50.45	36.40	30.56	42.41	31.46	29.80	42.25	inches
	1982	1983	1984	1985	1986	1987	1988	
	1983	1984	1985	1986	1987	1988	1989	
INDEX	131.79	95.09	79.83	110.79	82.19	77.85	110.37	
INDEX DEV	31.79	-4.91	-20.17	10.79	-17.81	-22.15	10.37	
CUM DEV	102.86	97.95	77.78	88.58	70.76	48.61	58.98	

Table 5 (continued)
Ft Bragg Precipitation 44-Year Period 1948 - 1992

WATER YR END	1990	1991	1992	
OCT	6.96	1.92	1.95	
NOV	1.97	0.98	2.21	
DEC	0.32	2.15	4.71	
JAN	7.85	1.49	4.01	
FEB	3.72	3.65	9.88	
MAR	3.31	10.06	5.39	
APR	1.32	1.57	2.43	
MAY	9.46	1.43	0.00	
JUN	0.21	0.50	1.82	
JUL	0.06	0.12	0.13	
AUG	0.16	0.28		
SEP	0.22	0.02		
	------	------	------	
WATER YR SUM	35.56	24.17	32.53	inches
	1989	1990	1991	
	1990	1991	1992	
INDEX	92.90	63.14	84.98	
INDEX DEV	-7.10	-36.86	-15.02	
CUM DEV	51.88	15.02	0.00	

AVERAGE ANNUAL PRECIPITATION 38.28 INCHES

Table 6
Annual Minimum Summer Discharge of Lower Gulches and Drydock Reservoir As A Function of Reservoir Capacity

Water Year	Annual Precip	Average Summer Discharge — Maximum reservoir capacity, AF: 7.2	15	25	40
	(Inches)	(GPM)			
1948 - 49	35.17	217	229	244	266
1949 - 50	30.49	193	205	220	242
1950 - 51	41.41	249	261	276	298
1951 - 52	47.27	279	291	306	328
1952 - 53	48.36	284	296	311	334
1953 - 54	42.32	254	265	280	303
1954 - 55	31.95	200	212	227	250
1955 - 56	47.41	280	291	306	329
1956 - 57	33.45	208	220	235	258
1957 - 58	58.02	334	346	361	383
1958 - 59	29.44	188	199	214	237
1959 - 60	30.72	194	206	221	244
1960 - 61	39.19	238	249	264	287
1961 - 62	34.03	211	223	238	261
1962 - 63	38.43	234	245	260	283
1963 - 64	32.78	205	216	232	254
1964 - 65	41.70	250	262	277	300
1965 - 66	35.10	217	228	243	266
1966 - 67	46.47	275	287	302	324
1967 - 68	34.48	213	225	240	263
1968 - 69	50.62	296	308	323	345
1969 - 70	41.25	248	260	275	298
1970 - 71	46.24	274	285	300	323
1971 - 72	31.57	199	210	225	248
1972 - 73	44.62	265	277	292	315
1973 - 74	54.84	318	329	344	367
1974 - 75	40.99	247	259	274	296
1975 - 76	28.80	184	196	211	234
1976 - 77	16.56	122	133	149	171
1977 - 78	47.95	282	294	309	332
1978 - 79	31.87	200	212	227	250
1979 - 80	41.28	248	260	275	298
1980 - 81	30.25	192	204	219	241
1981 - 82	43.67	260	272	287	310
1982 - 83	50.45	295	307	322	345
1983 - 84	36.40	223	235	250	273

Table 6 (continued)
Annual Minimum Summer Discharge of Lower Gulches and Drydock Reservoir As A Function of Reservoir Capacity

		Average Summer Discharge			
		Maximum reservoir capacity, AF:			
Water Year	Annual Precip	7.2	15	25	40
	(Inches)	(GPM)			
1984 - 85	30.56	193	205	220	243
1985 - 86	42.41	254	266	281	303
1986 - 87	31.46	198	210	225	247
1987 - 88	29.80	189	201	216	239
1988 - 89	42.25	253	265	280	303
1989 - 90	35.56	219	231	246	268
1990 - 91	24.17	161	172	188	210
1991 - 92	32.53	203	215	230	253

Note - Summer-flow period June 1 through November 1
- 7.2-AF reservoir (4.0 ft deep) = (precip x 5.117408) + 36.97192
- 15-AF reservoir (6.3 ft deep) = (precip x 5.117408) + 48.73796
- 25-AF reservoir (9.2 ft deep) = (precip x 5.117408) + 63.82263
- 40-AF reservoir (13.6 ft deep) = (precip x 5.117408) + 86.44963

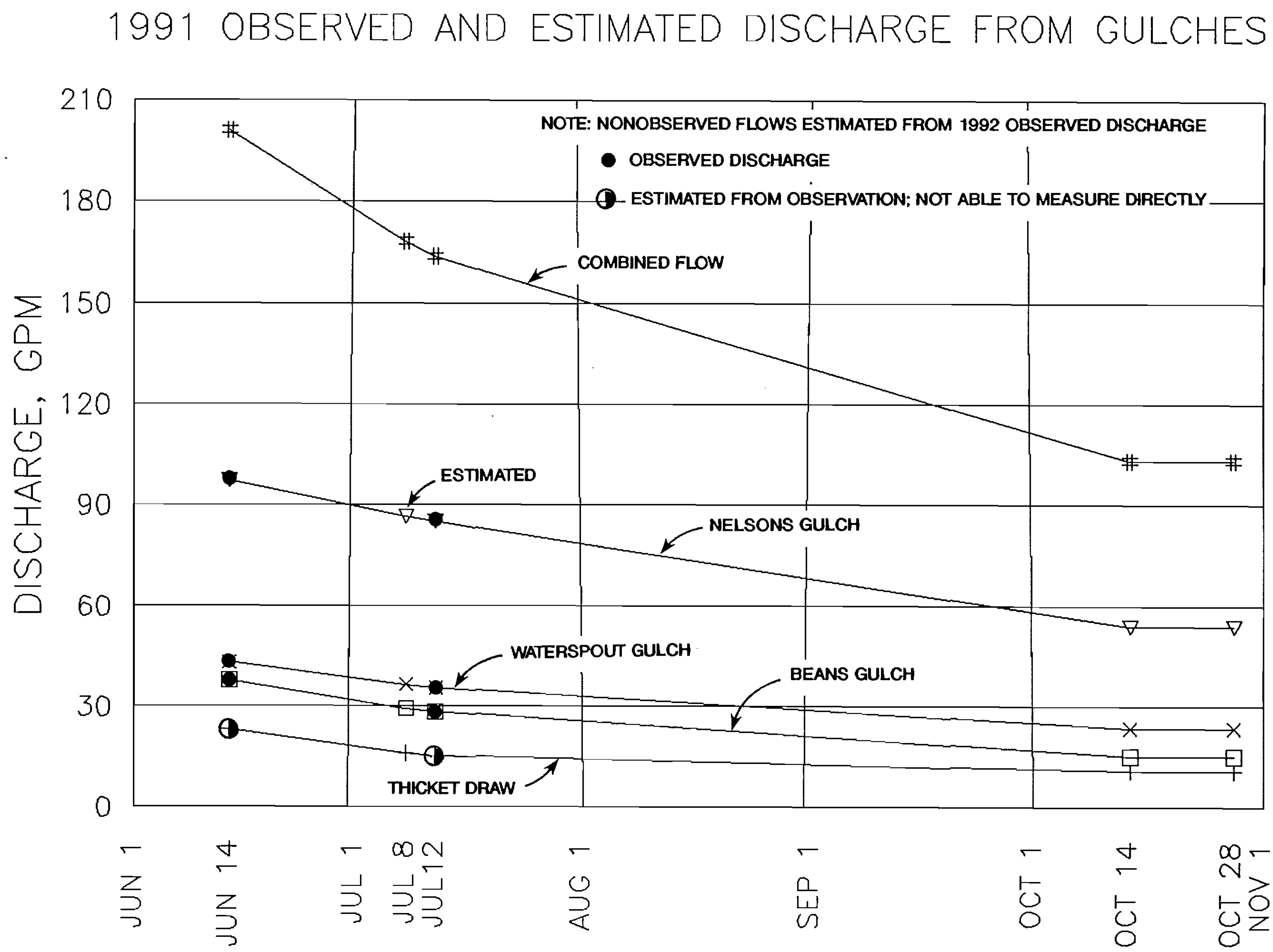

1991 OBSERVED AND ESTIMATED DISCHARGE FROM GULCHES
NOTE: NONOBSERVED FLOWS ESTIMATED FROM 1992 OBSERVED DISCHARGE
OBSERVED DISCHARGE
ESTIMATED FROM OBSERVATION; NOT ABLE TO MEASURE DIRECTLY
COMBINED FLOW
ESTIMATED
NELSONS GULCH
WATERSPOUT GULCH
BEANS GULCH
THICKET DRAW
DISCHARGE, GPM
210
180
150
120
90
60
30
0
JUN 1
JUN 14
JUL 1
JUL 8
JUL12
AUG 1
SEP 1
OCT 1
OCT 14
OCT 28
NOV 1

FIGURE 1

1992 OBSERVED AND ESTIMATED DISCHARGE FROM GULCHES

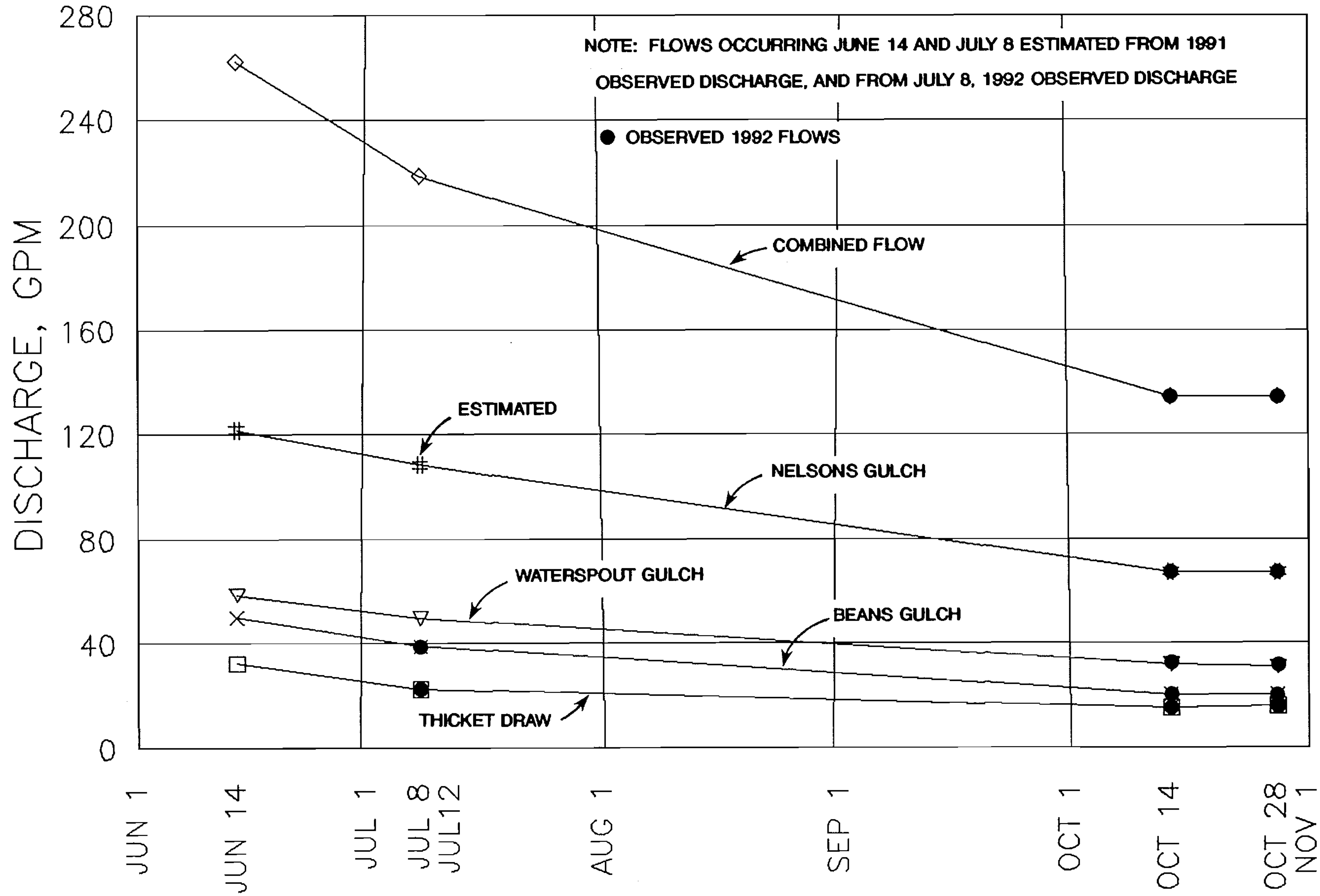


FIGURE 2

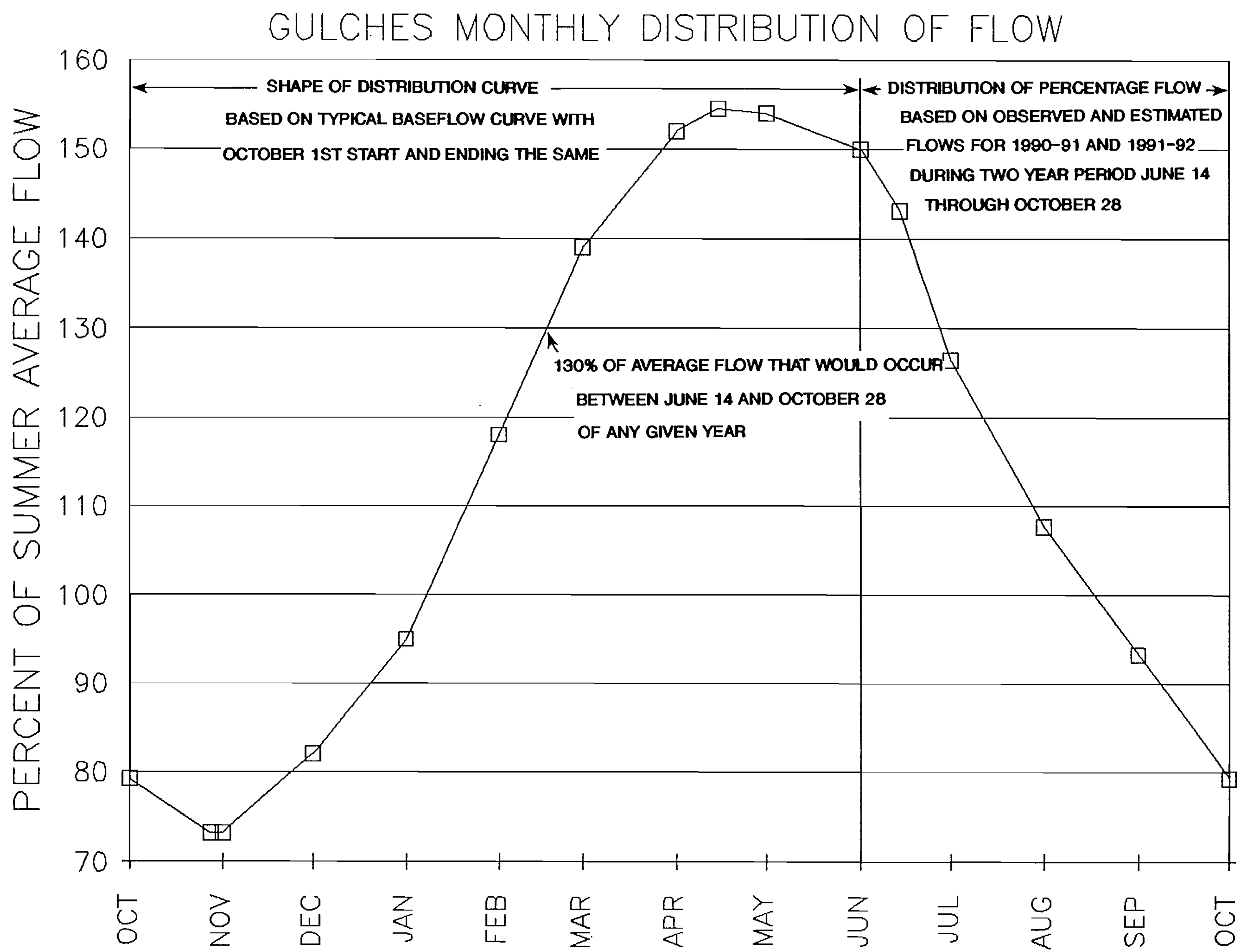

GULCHES MONTHLY DISTRIBUTION OF FLOW
SHAPE OF DISTRIBUTION CURVE
BASED ON TYPICAL BASEFLOW CURVE WITH
OCTOBER 1ST START AND ENDING THE SAME
DISTRIBUTION OF PERCENTAGE FLOW
BASED ON OBSERVED AND ESTIMATED
FLOWS FOR 1990-91 AND 1991-92
DURING TWO YEAR PERIOD JUNE 14
THROUGH OCTOBER 28
130% OF AVERAGE FLOW THAT WOULD OCCUR
BETWEEN JUNE 14 AND OCTOBER 28
OF ANY GIVEN YEAR
PERCENT OF SUMMER AVERAGE FLOW
160
150
140
130
120
110
100
90
80
70
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT

FIGURE 3

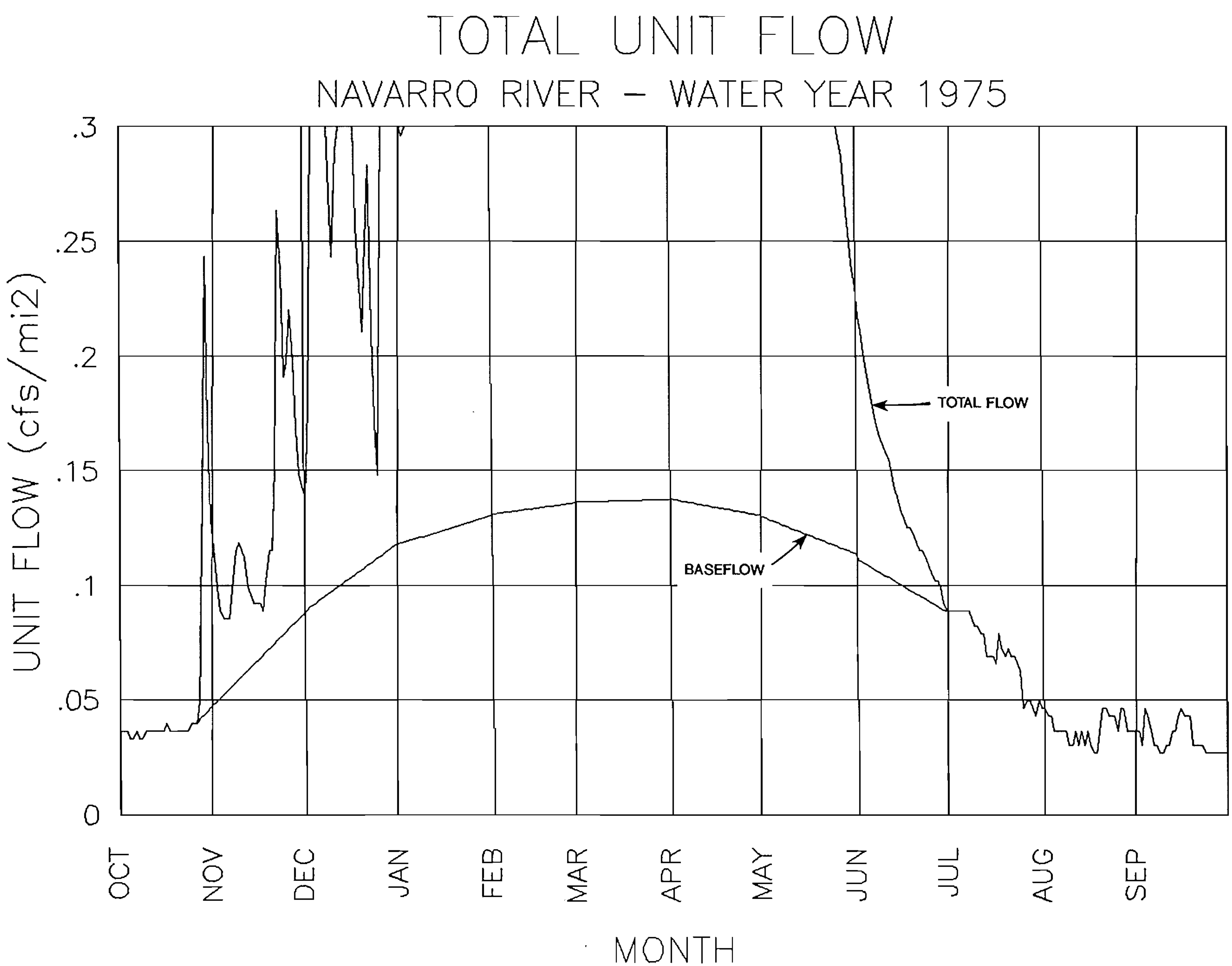

TOTAL UNIT FLOW
NAVARRO RIVER – WATER YEAR 1975
UNIT FLOW (cfs/mi2)
.3
.25
.2
.15
.1
.05
0
TOTAL FLOW
BASEFLOW
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
MONTH

FIGURE 4

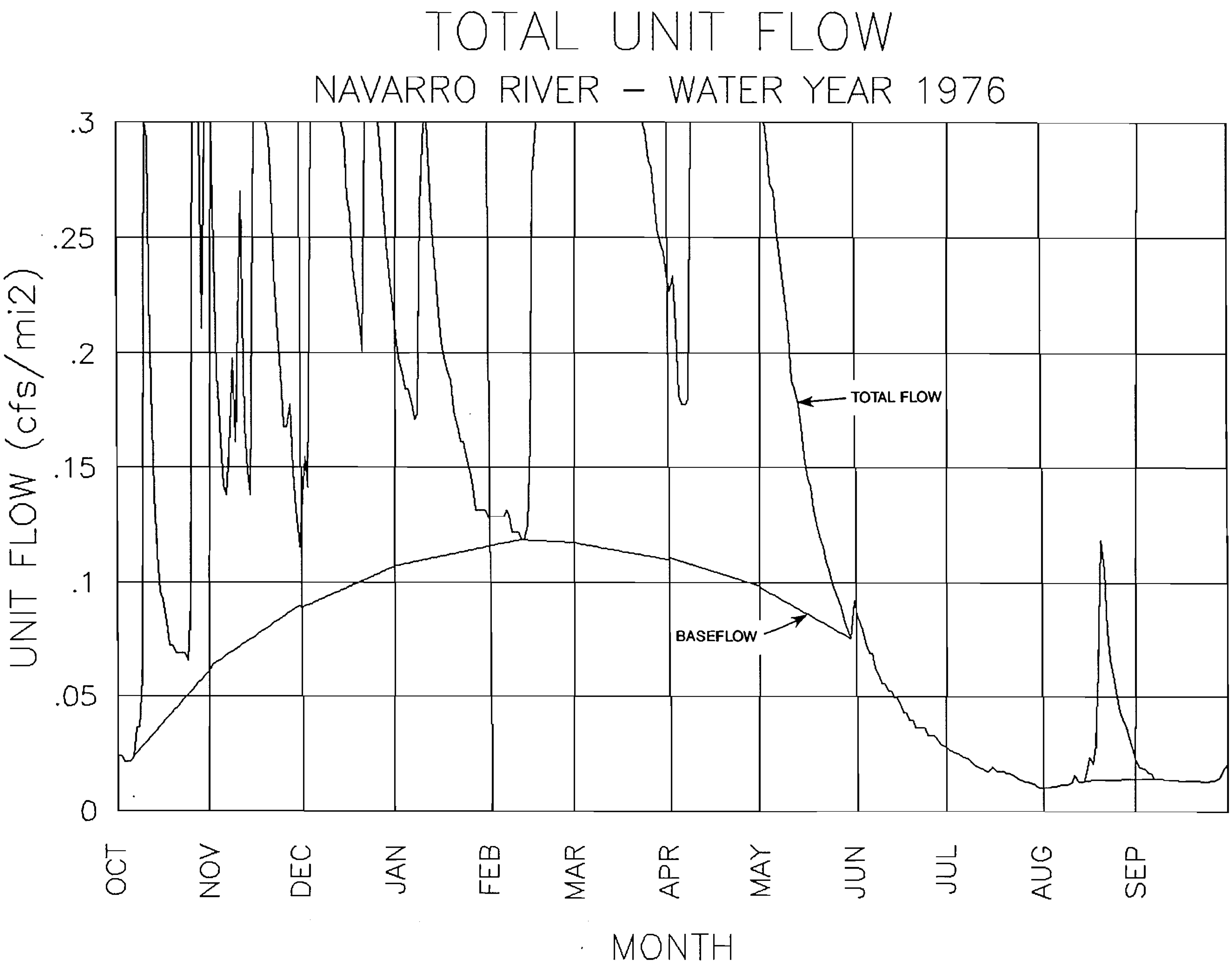

TOTAL UNIT FLOW
NAVARRO RIVER – WATER YEAR 1976
UNIT FLOW (cfs/mi2)
.3
.25
.2
.15
.1
.05
0
TOTAL FLOW
BASEFLOW
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
MONTH

FIGURE 5

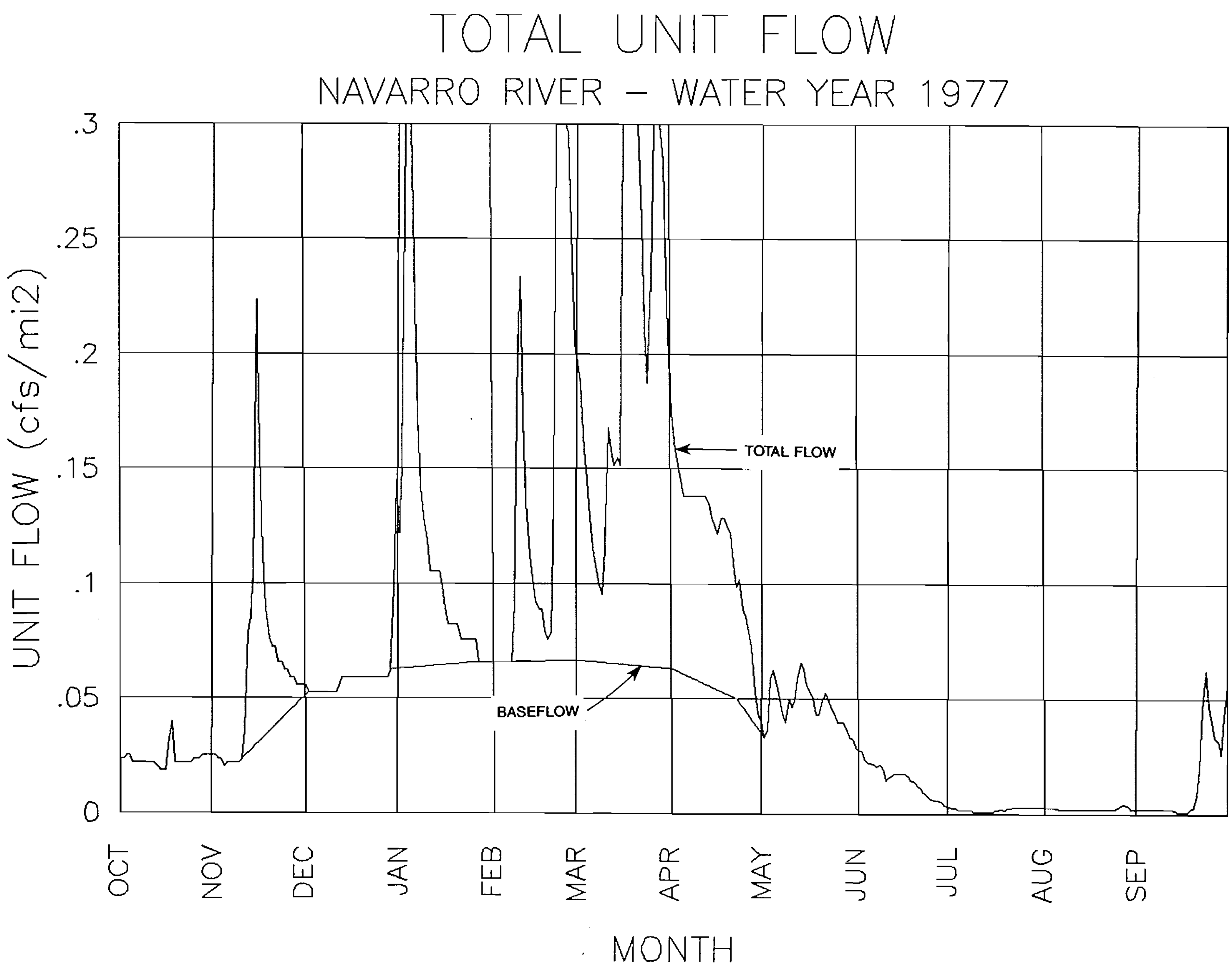

TOTAL UNIT FLOW
NAVARRO RIVER – WATER YEAR 1977
UNIT FLOW (cfs/mi2)
.3
.25
.2
.15
.1
.05
0
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
MONTH
TOTAL FLOW
BASEFLOW

FIGURE 6

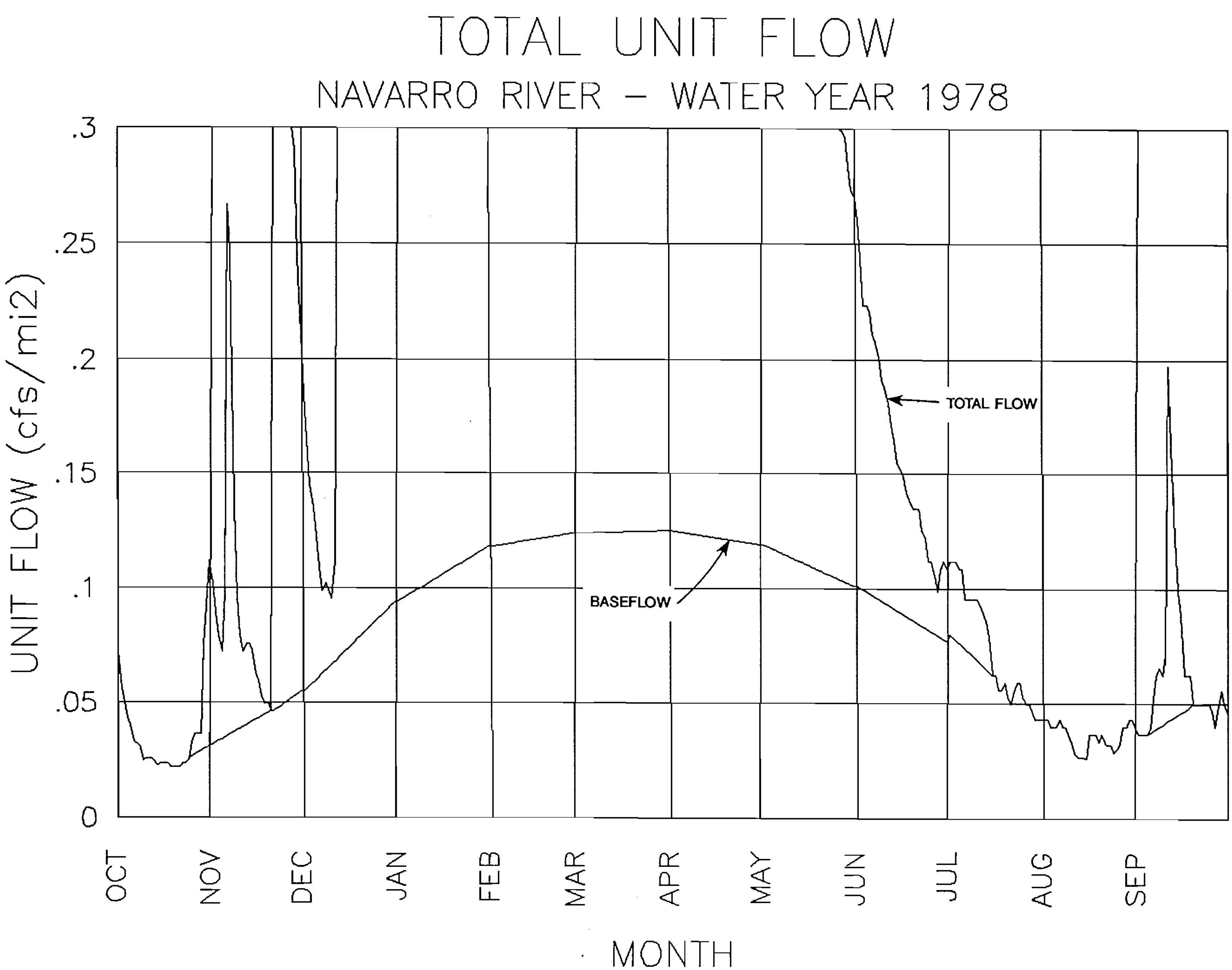
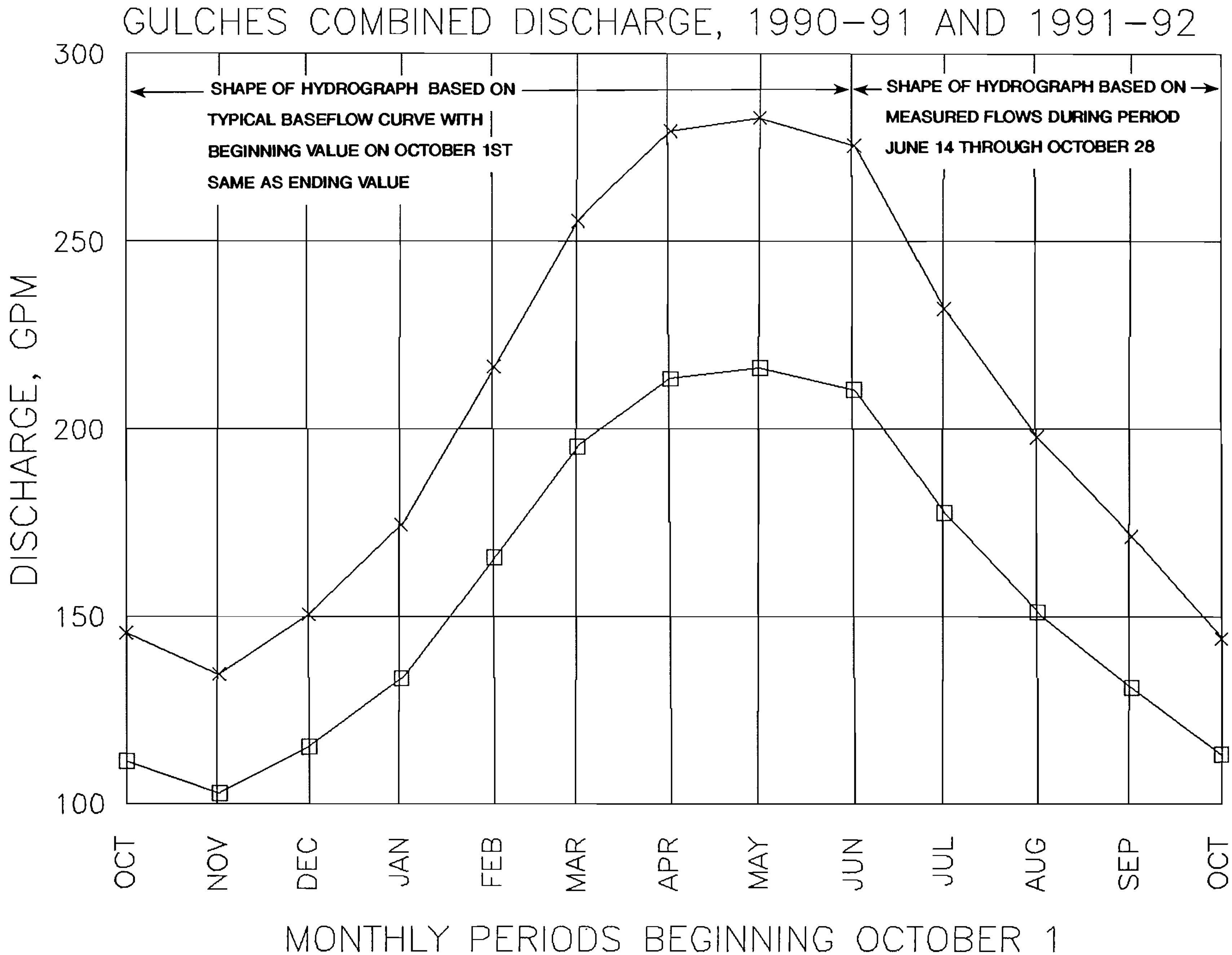

TOTAL UNIT FLOW
NAVARRO RIVER – WATER YEAR 1978
UNIT FLOW (cfs/mi2)
.3
.25
.2
.15
.1
.05
0
TOTAL FLOW
BASEFLOW
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
MONTH

FIGURE 7



GULCHES COMBINED DISCHARGE, 1990-91 AND 1991-92
SHAPE OF HYDROGRAPH BASED ON TYPICAL BASEFLOW CURVE WITH BEGINNING VALUE ON OCTOBER 1ST SAME AS ENDING VALUE
SHAPE OF HYDROGRAPH BASED ON MEASURED FLOWS DURING PERIOD JUNE 14 THROUGH OCTOBER 28
DISCHARGE, GPM
300
250
200
150
100
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
MONTHLY PERIODS BEGINNING OCTOBER 1

FIGURE 8

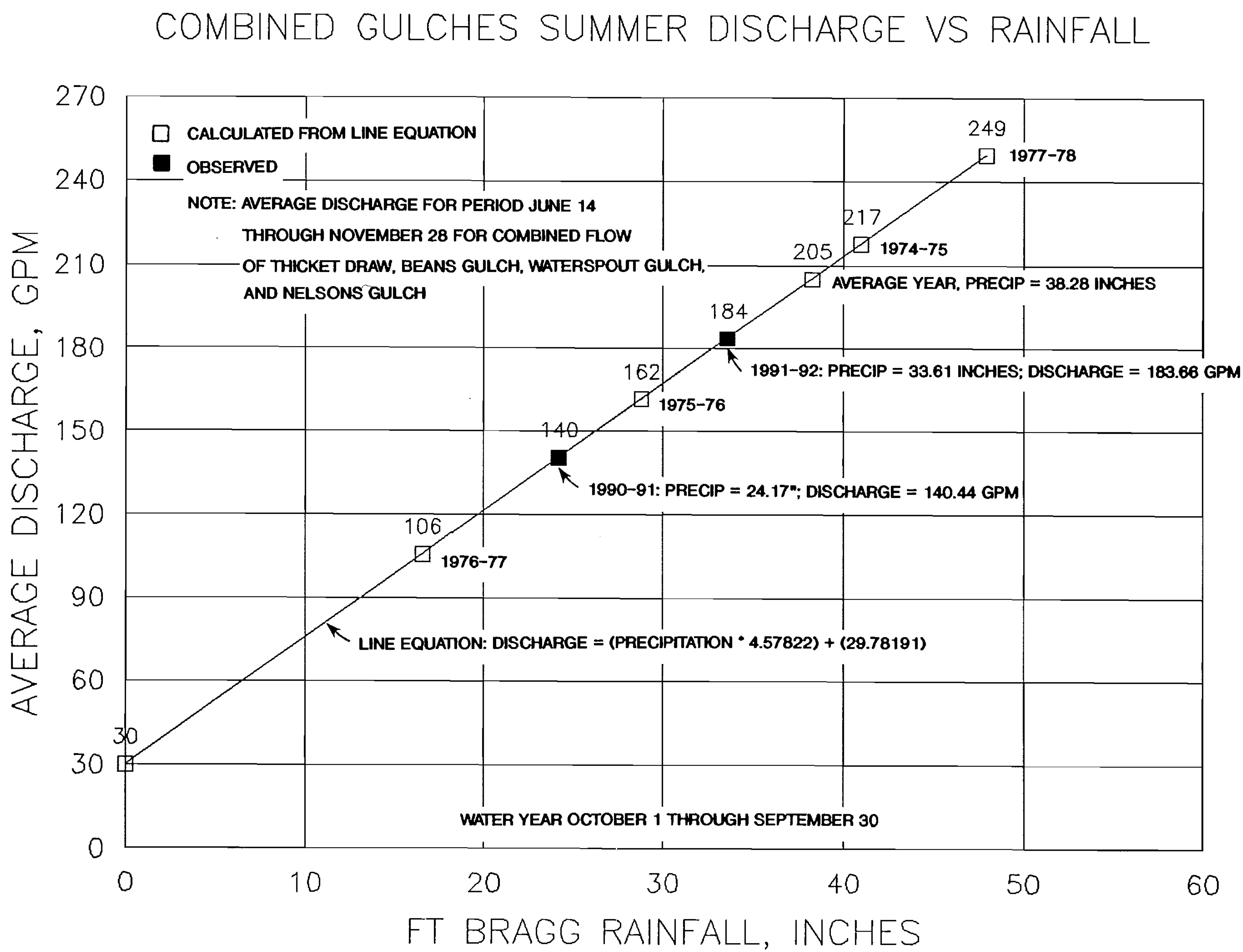

COMBINED GULCHES SUMMER DISCHARGE VS RAINFALL
CALCULATED FROM LINE EQUATION
OBSERVED
NOTE: AVERAGE DISCHARGE FOR PERIOD JUNE 14 THROUGH NOVEMBER 28 FOR COMBINED FLOW OF THICKET DRAW, BEANS GULCH, WATERSPOUT GULCH, AND NELSONS GULCH
249
1977-78
217
1974-75
205
AVERAGE YEAR, PRECIP = 38.28 INCHES
184
1991-92: PRECIP = 33.61 INCHES; DISCHARGE = 183.66 GPM
162
1975-76
140
1990-91: PRECIP = 24.17"; DISCHARGE = 140.44 GPM
106
1976-77
LINE EQUATION: DISCHARGE = (PRECIPITATION * 4.57822) + (29.78191)
30
WATER YEAR OCTOBER 1 THROUGH SEPTEMBER 30
AVERAGE DISCHARGE, GPM
0
30
60
90
120
150
180
210
240
270
0
10
20
30
40
50
60
FT BRAGG RAINFALL, INCHES

FIGURE 9

WATER LEVEL DRYDOCK GULCH PRIOR TO START OF PUMPING TEST

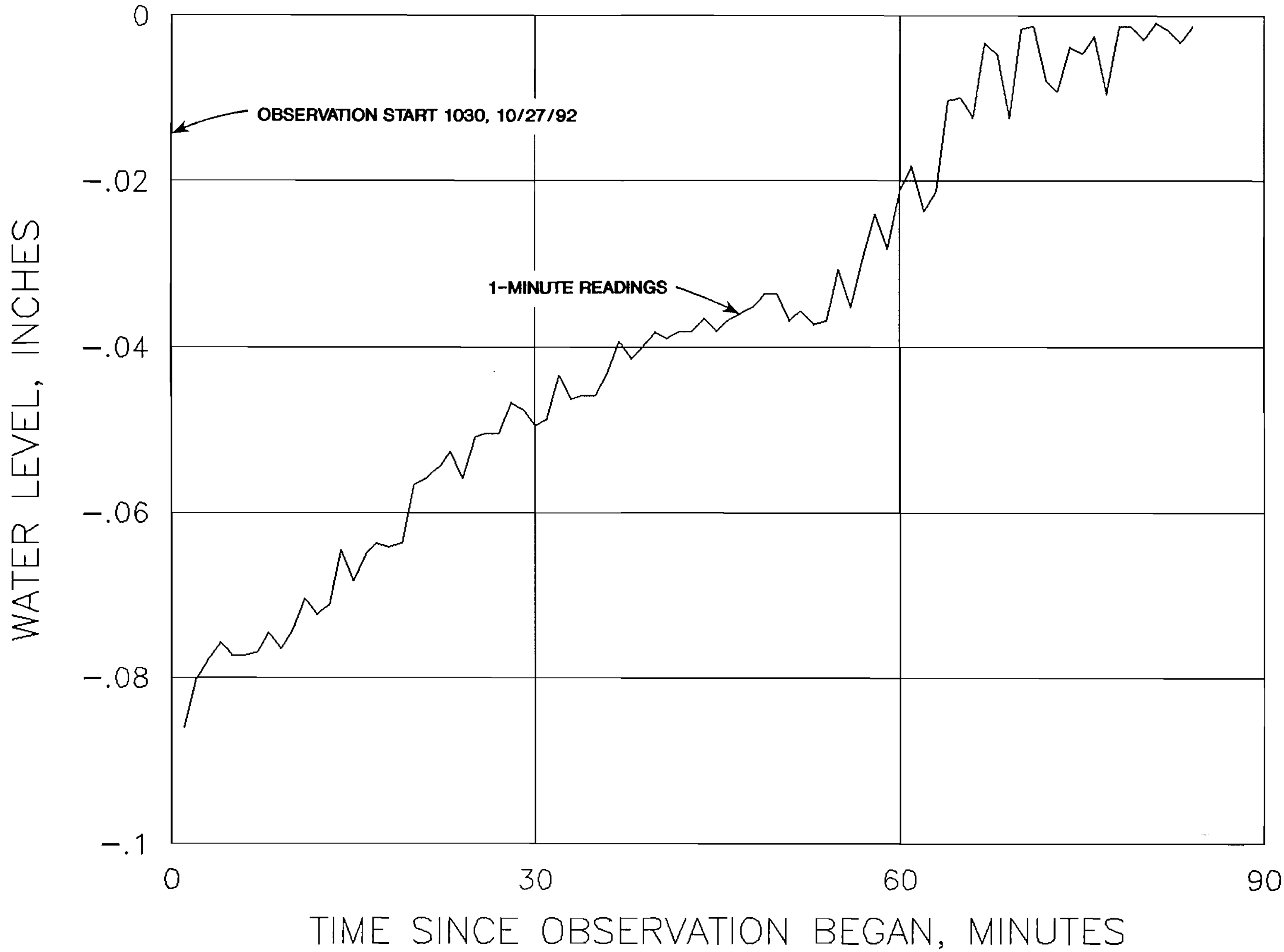


FIGURE 10

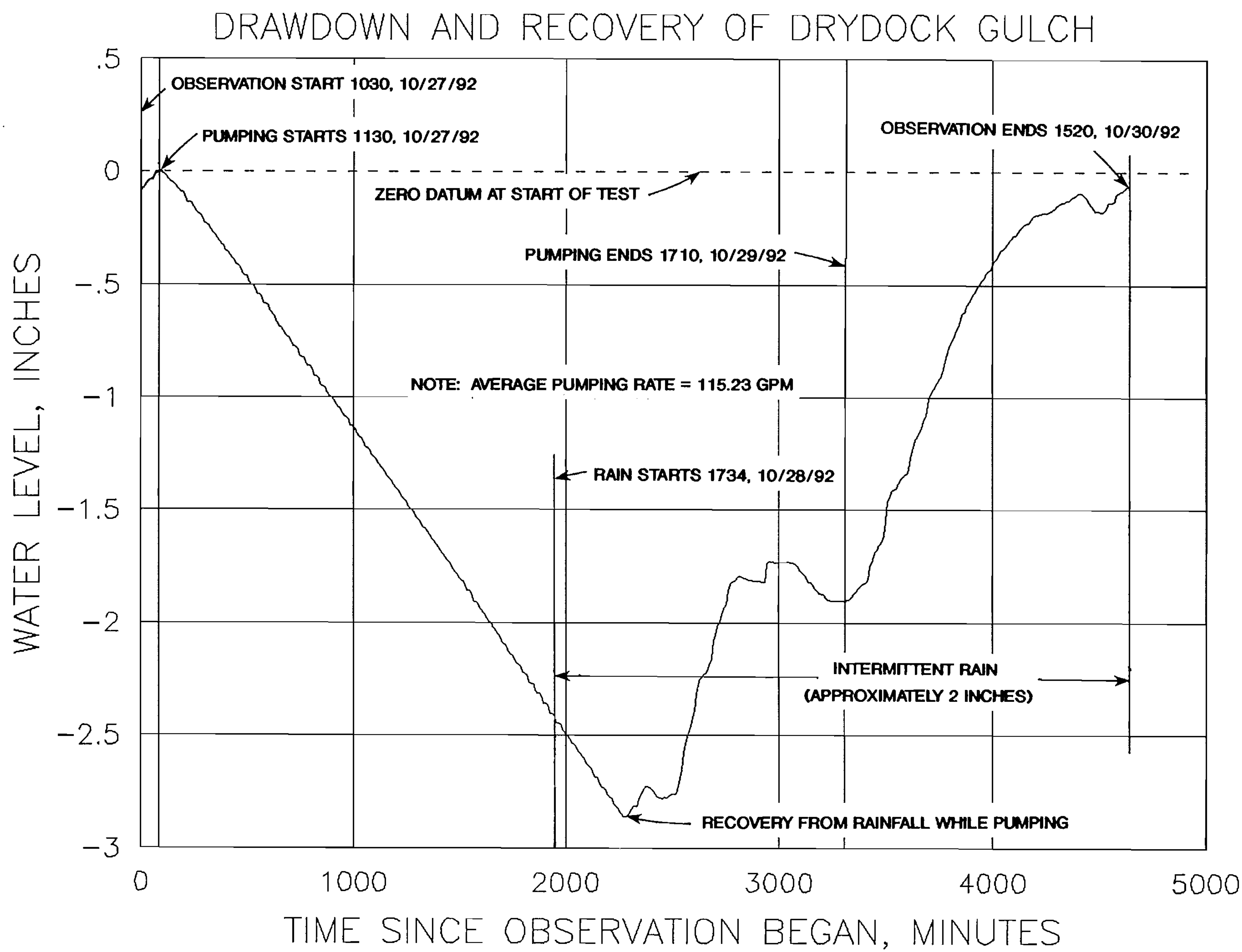

DRAWDOWN AND RECOVERY OF DRYDOCK GULCH
OBSERVATION START 1030, 10/27/92
PUMPING STARTS 1130, 10/27/92
OBSERVATION ENDS 1520, 10/30/92
ZERO DATUM AT START OF TEST
PUMPING ENDS 1710, 10/29/92
NOTE: AVERAGE PUMPING RATE = 115.23 GPM
RAIN STARTS 1734, 10/28/92
INTERMITTENT RAIN
(APPROXIMATELY 2 INCHES)
RECOVERY FROM RAINFALL WHILE PUMPING
WATER LEVEL, INCHES
.5
0
-.5
-1
-1.5
-2
-2.5
-3
0
1000
2000
3000
4000
5000
TIME SINCE OBSERVATION BEGAN, MINUTES

FIGURE 11

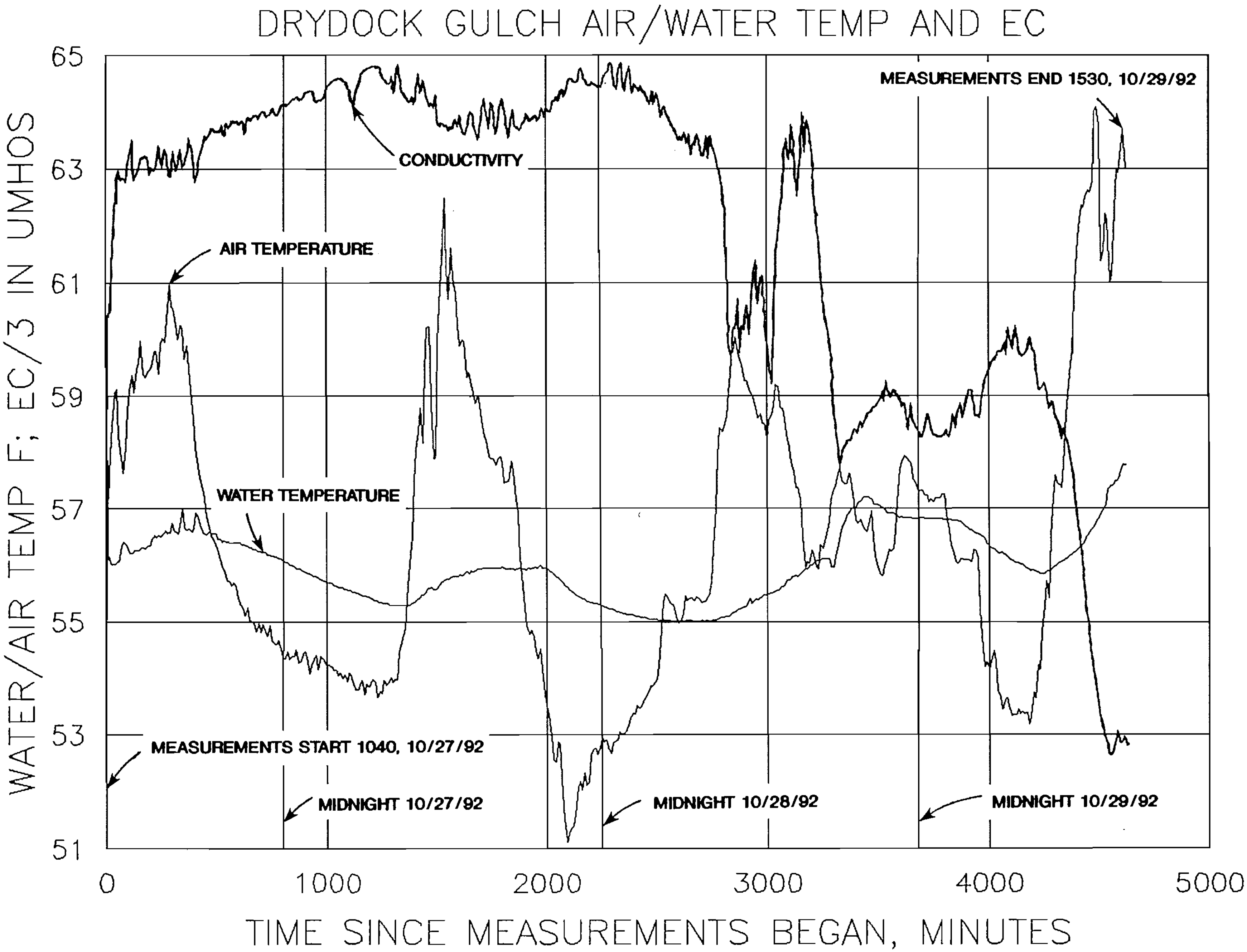
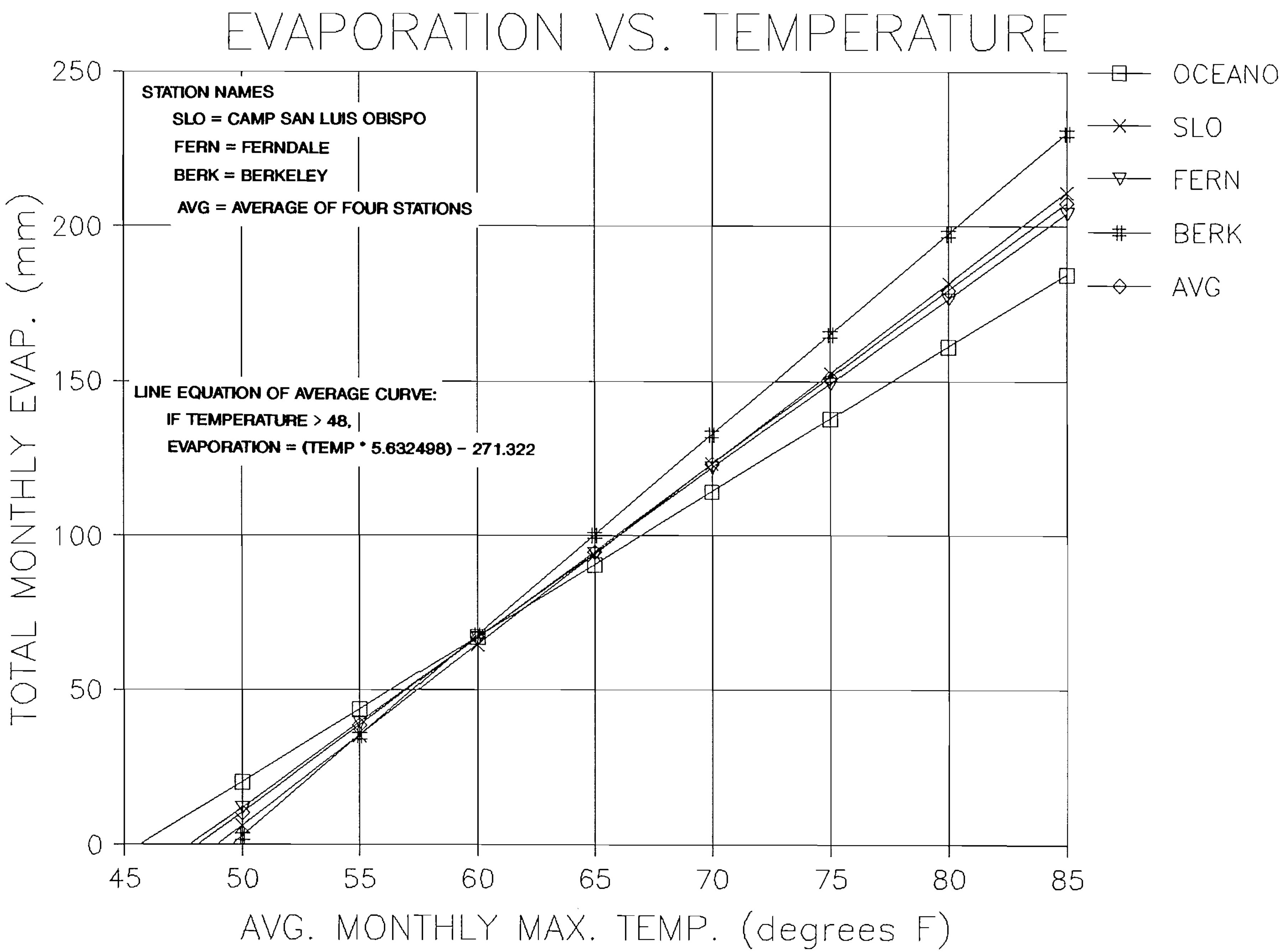

DRYDOCK GULCH AIR/WATER TEMP AND EC
WATER/AIR TEMP F; EC/3 IN UMHOS
TIME SINCE MEASUREMENTS BEGAN, MINUTES
65
63
61
59
57
55
53
51
0
1000
2000
3000
4000
5000
CONDUCTIVITY
AIR TEMPERATURE
WATER TEMPERATURE
MEASUREMENTS START 1040, 10/27/92
MEASUREMENTS END 1530, 10/29/92
MIDNIGHT 10/27/92
MIDNIGHT 10/28/92
MIDNIGHT 10/29/92

FIGURE 12



EVAPORATION VS. TEMPERATURE
STATION NAMES
SLO = CAMP SAN LUIS OBISPO
FERN = FERNDALE
BERK = BERKELEY
AVG = AVERAGE OF FOUR STATIONS
LINE EQUATION OF AVERAGE CURVE:
IF TEMPERATURE > 48,
EVAPORATION = (TEMP * 5.632498) - 271.322
OCEANO
SLO
FERN
BERK
AVG
TOTAL MONTHLY EVAP. (mm)
250
200
150
100
50
0
45
50
55
60
65
70
75
80
85
AVG. MONTHLY MAX. TEMP. (degrees F)

FIGURE 13

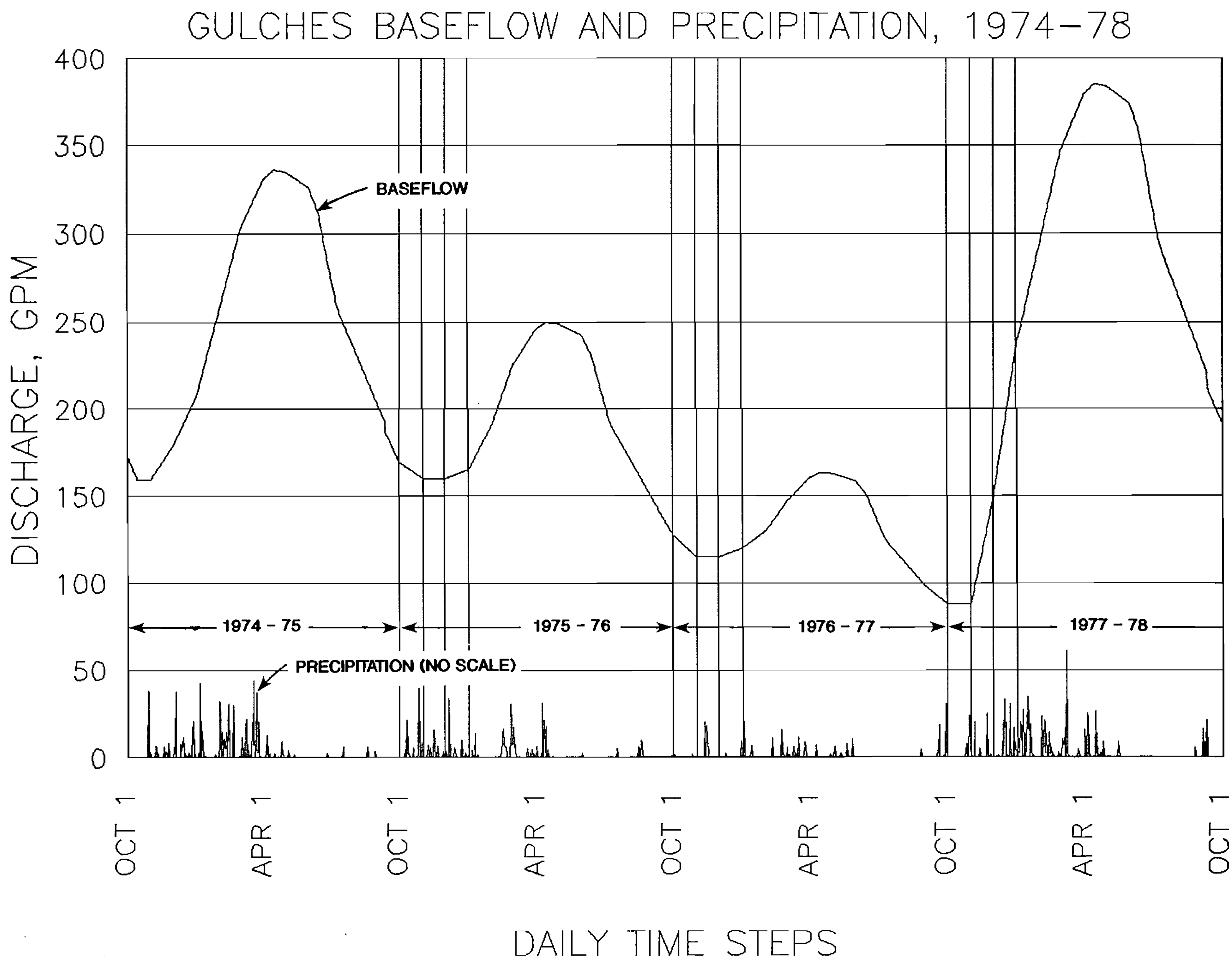

GULCHES BASEFLOW AND PRECIPITATION, 1974–78
DISCHARGE, GPM
400
350
300
250
200
150
100
50
0
BASEFLOW
PRECIPITATION (NO SCALE)
1974 - 75
1975 - 76
1976 - 77
1977 - 78
OCT 1
APR 1
OCT 1
APR 1
OCT 1
APR 1
OCT 1
APR 1
OCT 1
DAILY TIME STEPS

FIGURE 14

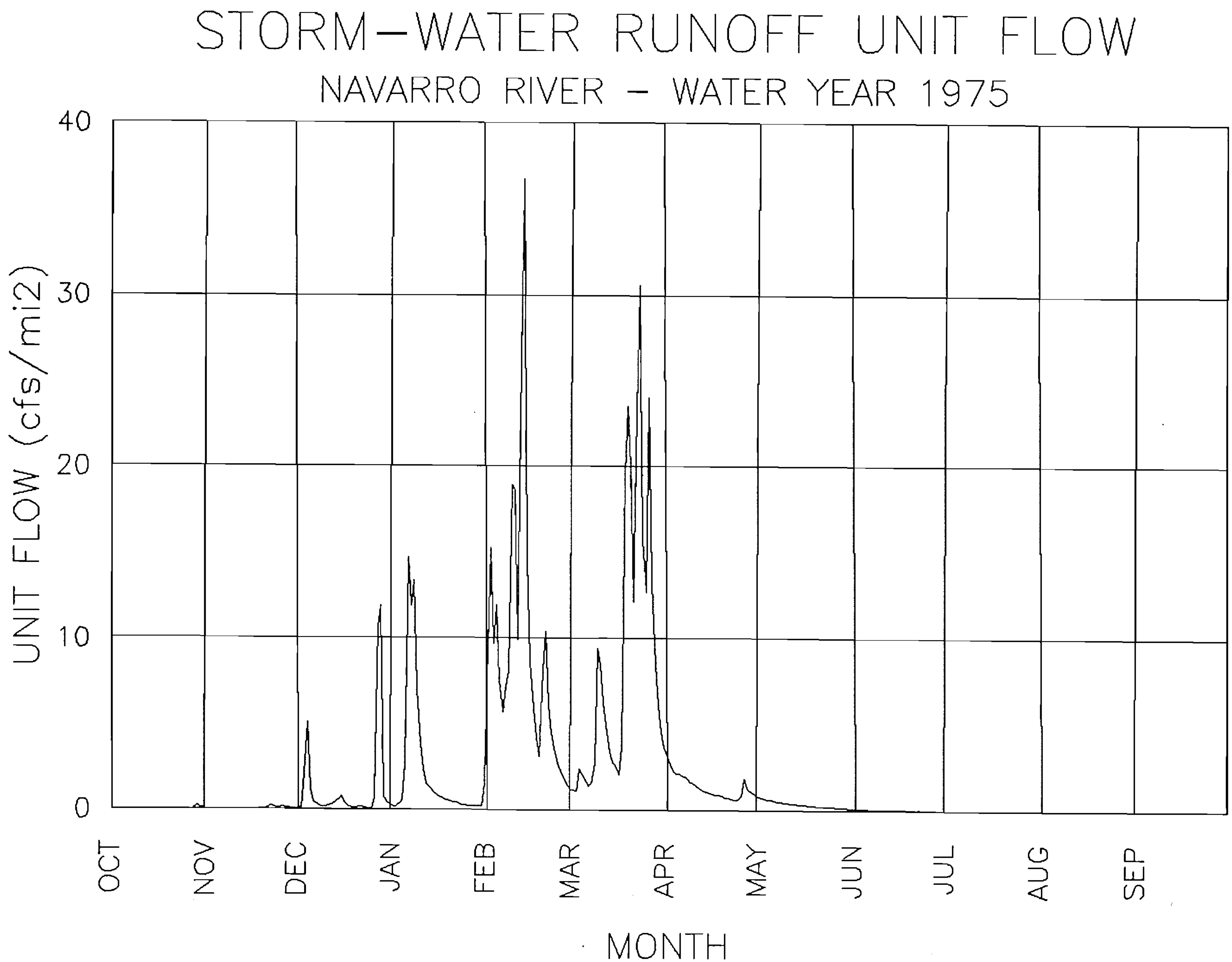
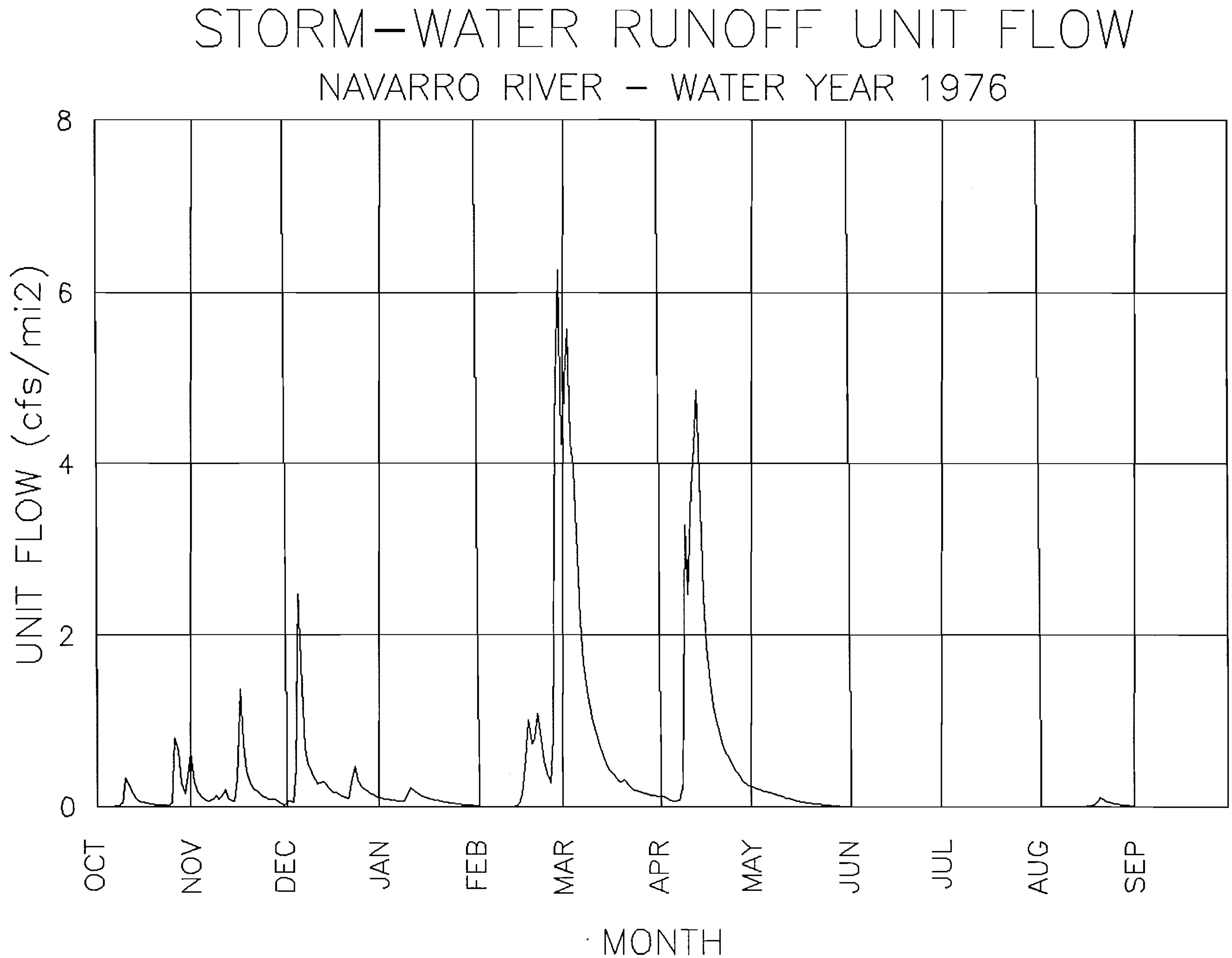

STORM-WATER RUNOFF UNIT FLOW
NAVARRO RIVER - WATER YEAR 1975
UNIT FLOW (cfs/mi2)
0
10
20
30
40
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
MONTH

FIGURE 15



STORM—WATER RUNOFF UNIT FLOW
NAVARRO RIVER - WATER YEAR 1976
UNIT FLOW (cfs/mi2)
0
2
4
6
8
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
MONTH

FIGURE 16

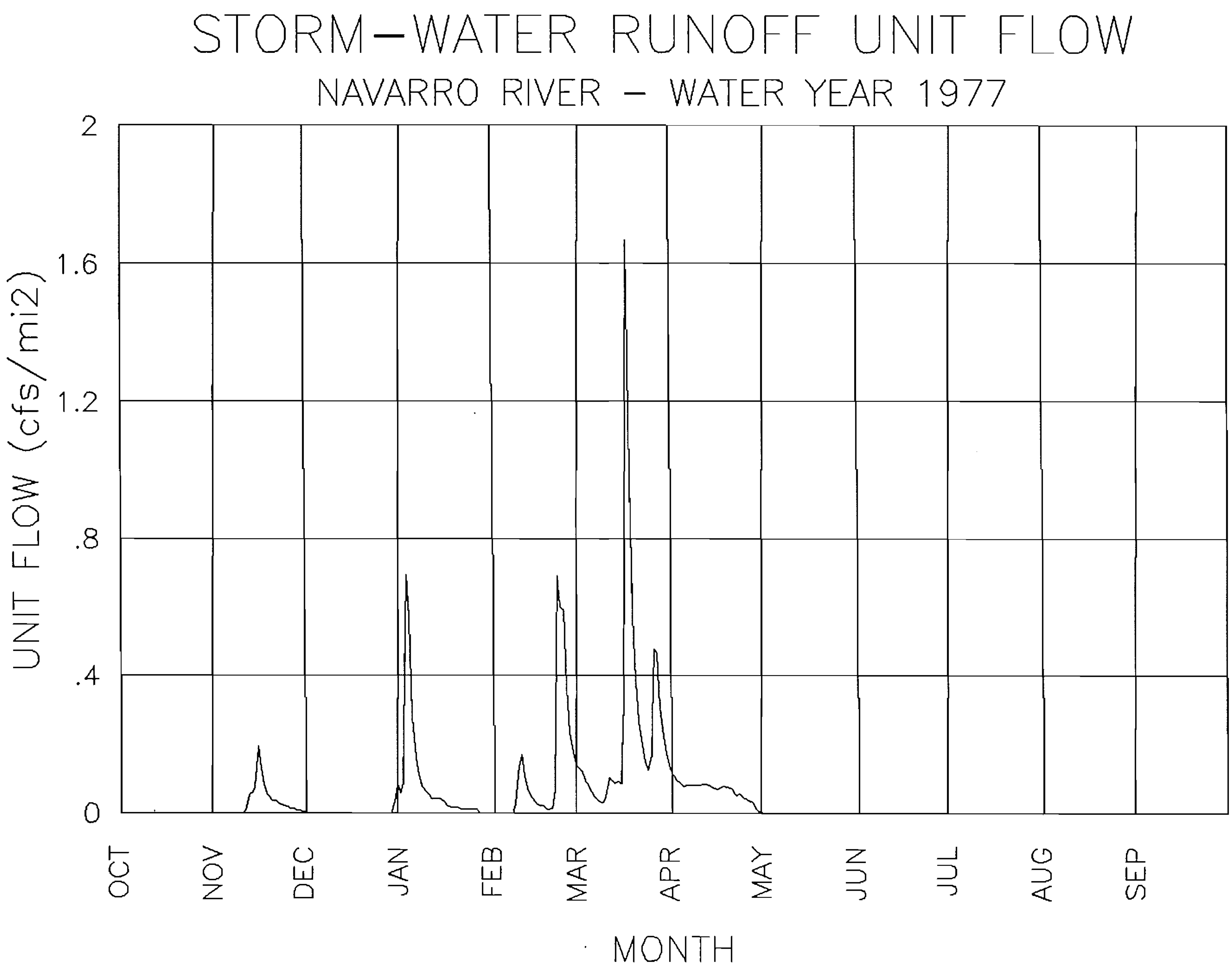

STORM—WATER RUNOFF UNIT FLOW
NAVARRO RIVER – WATER YEAR 1977
2
1.6
1.2
.8
.4
0
UNIT FLOW (cfs/mi2)
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
MONTH

FIGURE 17

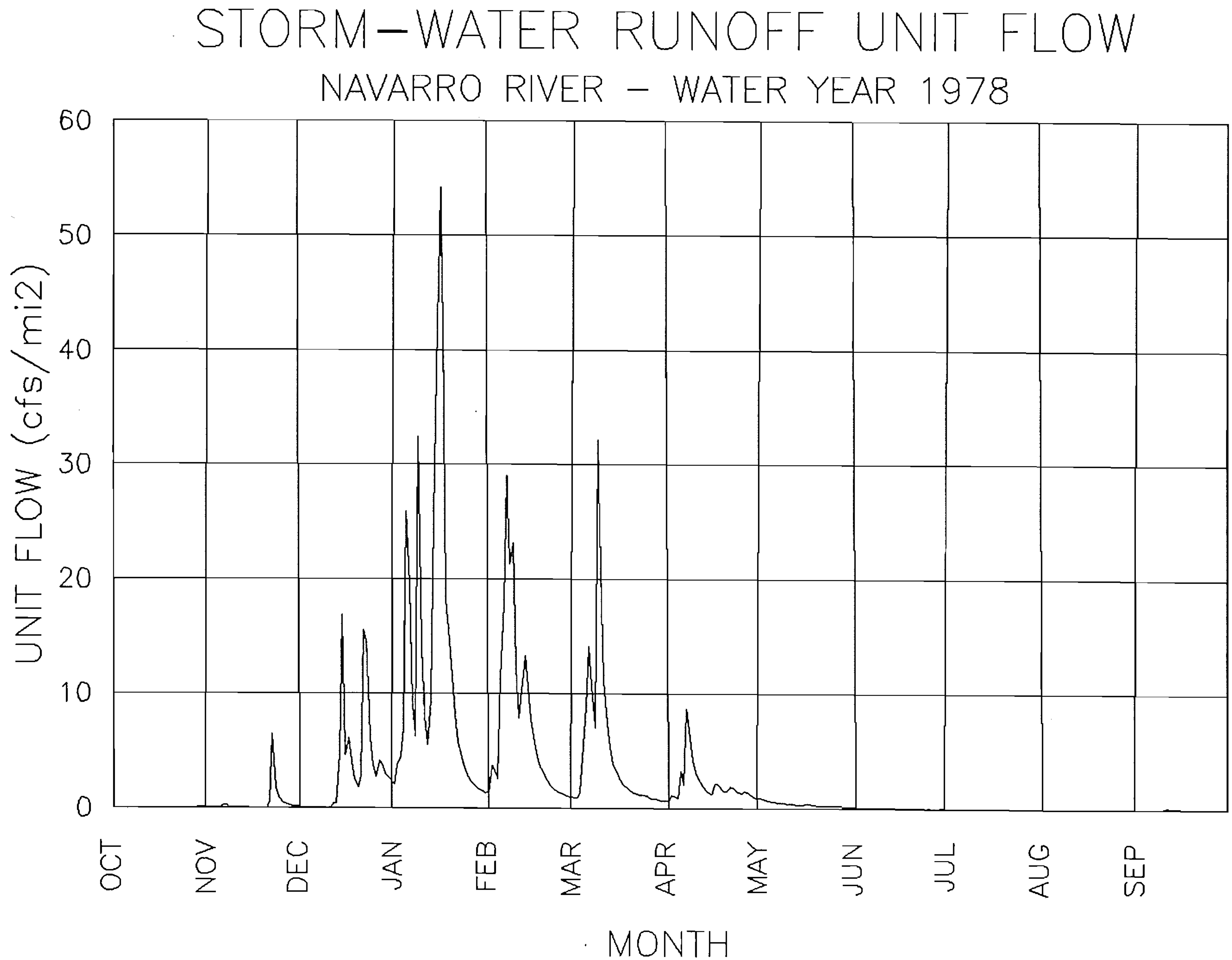

STORM-WATER RUNOFF UNIT FLOW
NAVARRO RIVER - WATER YEAR 1978
UNIT FLOW (cfs/mi2)
60
50
40
30
20
10
0
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
MONTH

FIGURE 18

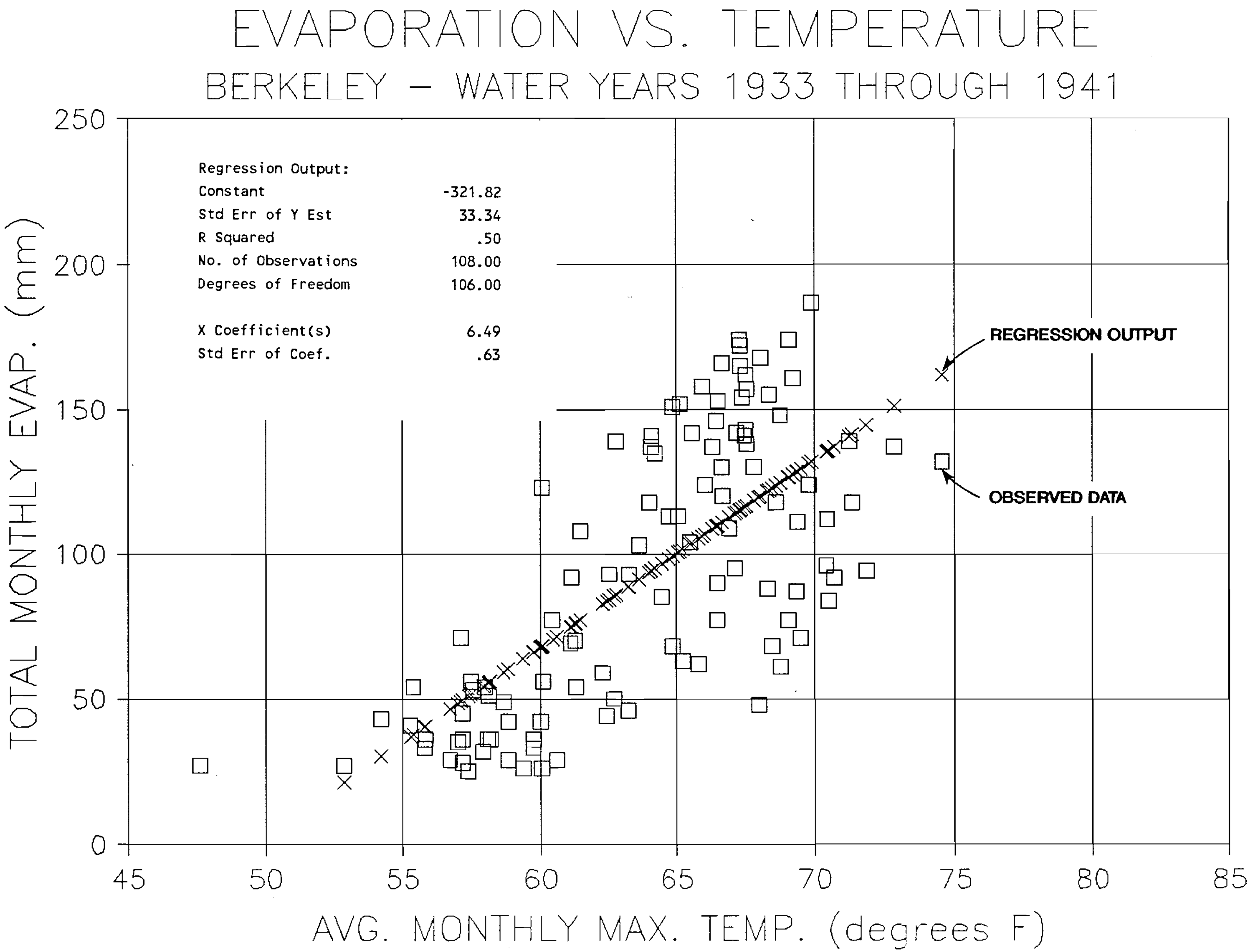
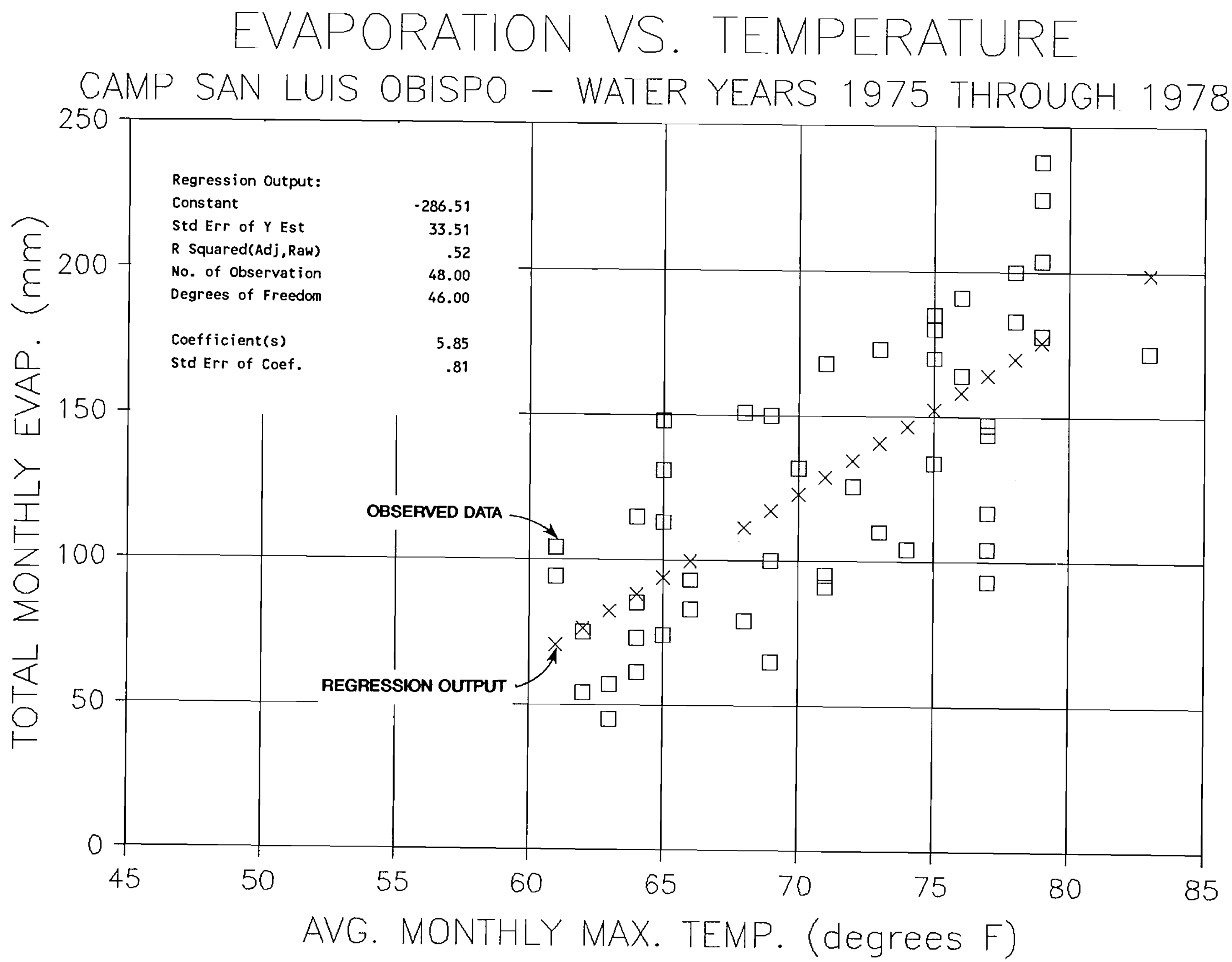

EVAPORATION VS. TEMPERATURE
BERKELEY - WATER YEARS 1933 THROUGH 1941
Regression Output:
Constant -321.82
Std Err of Y Est 33.34
R Squared .50
No. of Observations 108.00
Degrees of Freedom 106.00
X Coefficient(s) 6.49
Std Err of Coef. .63
REGRESSION OUTPUT
OBSERVED DATA
TOTAL MONTHLY EVAP. (mm)
AVG. MONTHLY MAX. TEMP. (degrees F)
0
50
100
150
200
250
45
50
55
60
65
70
75
80
85

FIGURE 19



EVAPORATION VS. TEMPERATURE
CAMP SAN LUIS OBISPO – WATER YEARS 1975 THROUGH 1978
Regression Output:
Constant -286.51
Std Err of Y Est 33.51
R Squared(Adj,Raw) .52
No. of Observation 48.00
Degrees of Freedom 46.00
Coefficient(s) 5.85
Std Err of Coef. .81
OBSERVED DATA
REGRESSION OUTPUT
TOTAL MONTHLY EVAP. (mm)
0
50
100
150
200
250
45
50
55
60
65
70
75
80
85
AVG. MONTHLY MAX. TEMP. (degrees F)

FIGURE 20

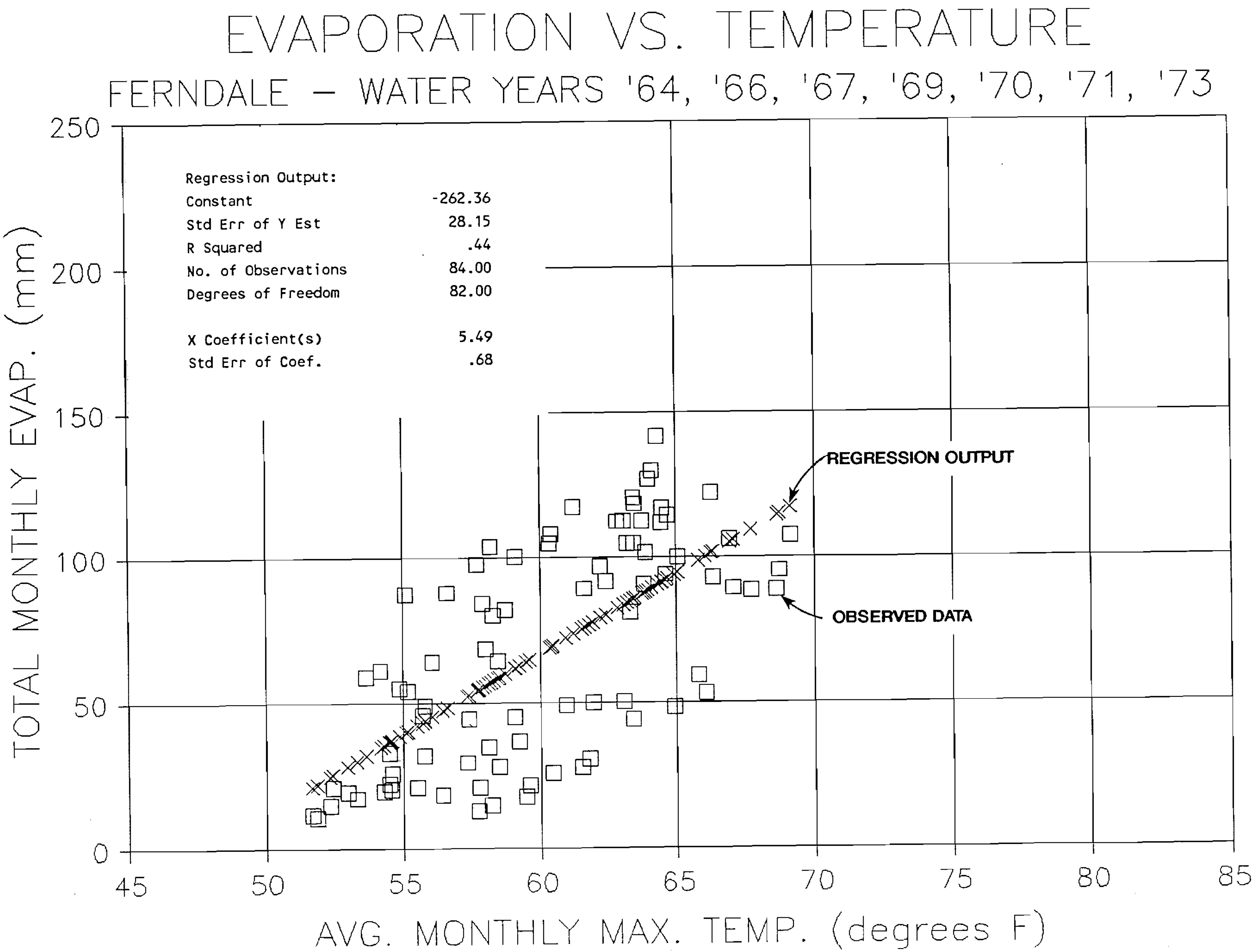
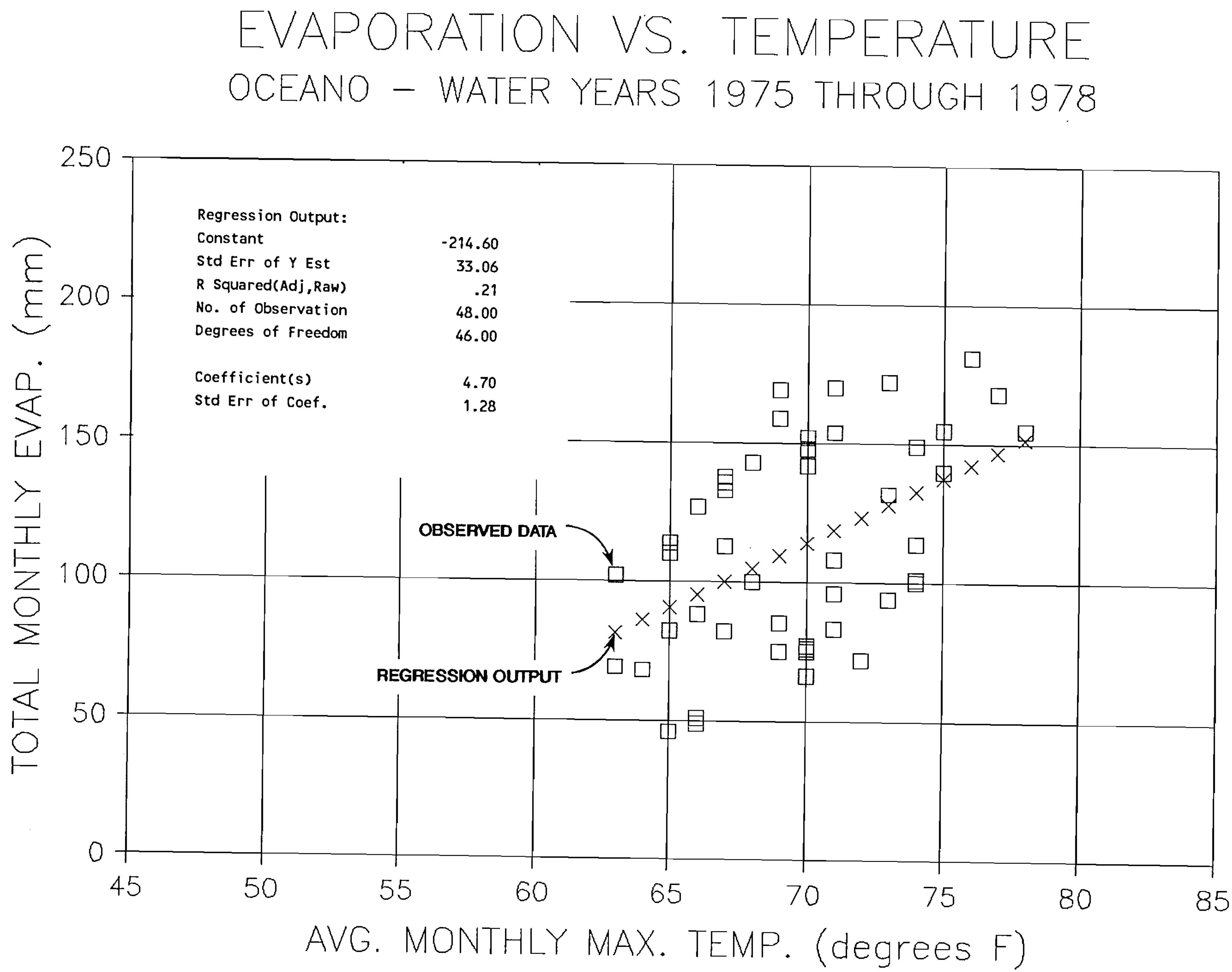

EVAPORATION VS. TEMPERATURE
FERNDALE — WATER YEARS '64, '66, '67, '69, '70, '71, '73
Regression Output:
Constant -262.36
Std Err of Y Est 28.15
R Squared .44
No. of Observations 84.00
Degrees of Freedom 82.00
X Coefficient(s) 5.49
Std Err of Coef. .68
REGRESSION OUTPUT
OBSERVED DATA
TOTAL MONTHLY EVAP. (mm)
0
50
100
150
200
250
45
50
55
60
65
70
75
80
85
AVG. MONTHLY MAX. TEMP. (degrees F)

FIGURE 21



EVAPORATION VS. TEMPERATURE
OCEANO — WATER YEARS 1975 THROUGH 1978
Regression Output:
Constant -214.60
Std Err of Y Est 33.06
R Squared(Adj,Raw) .21
No. of Observation 48.00
Degrees of Freedom 46.00
Coefficient(s) 4.70
Std Err of Coef. 1.28
OBSERVED DATA
REGRESSION OUTPUT
TOTAL MONTHLY EVAP. (mm)
AVG. MONTHLY MAX. TEMP. (degrees F)
250
200
150
100
50
0
45
50
55
60
65
70
75
80
85

FIGURE 22

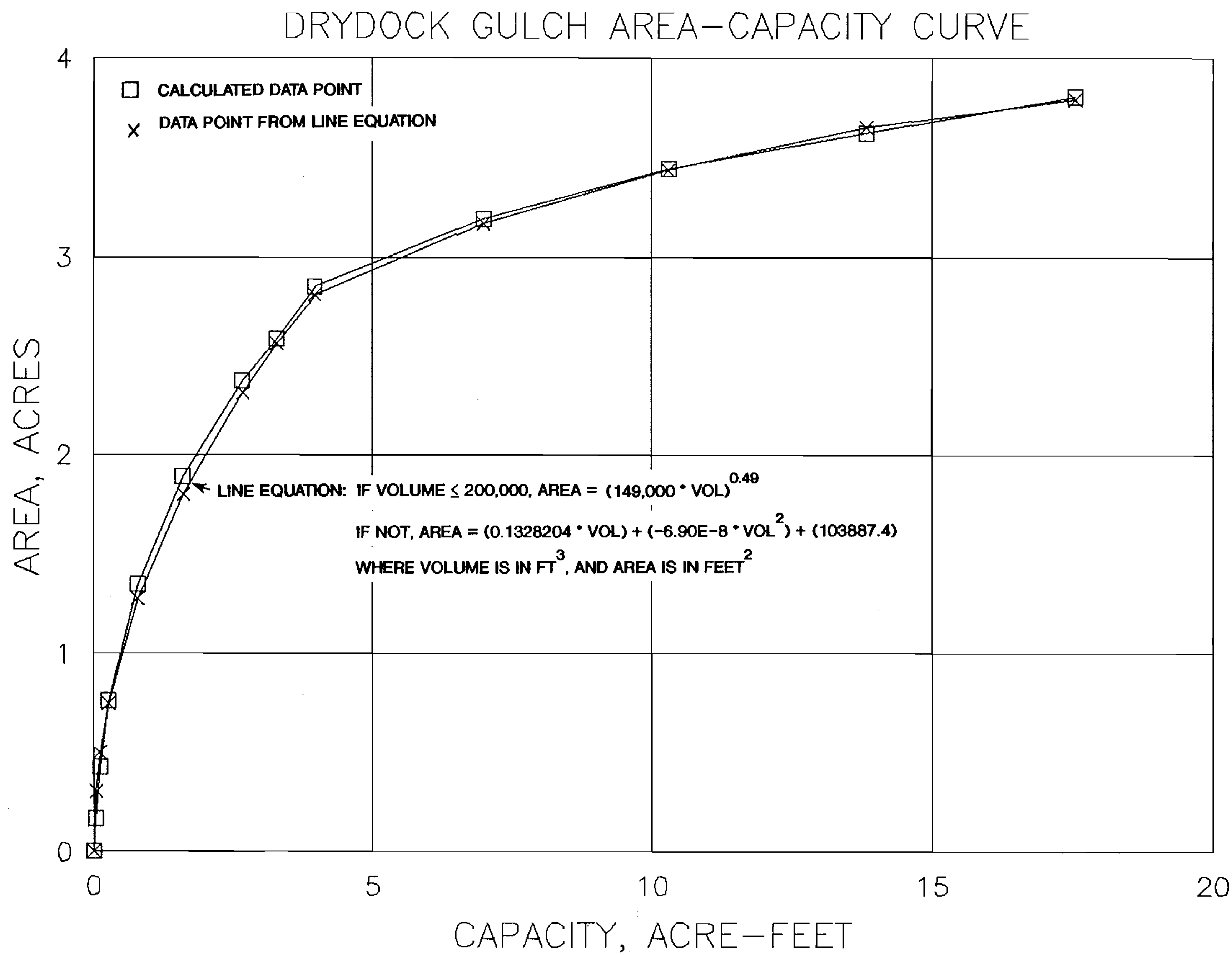

DRYDOCK GULCH AREA-CAPACITY CURVE
CALCULATED DATA POINT
DATA POINT FROM LINE EQUATION
LINE EQUATION: IF VOLUME ≤ 200,000, AREA = $(149{,}000 * VOL)^{0.49}$
IF NOT, AREA = $(0.1328204 * VOL) + (-6.90E-8 * VOL^2) + (103887.4)$
WHERE VOLUME IS IN FT^3, AND AREA IS IN $FEET^2$
AREA, ACRES
CAPACITY, ACRE-FEET
0
1
2
3
4
0
5
10
15
20

FIGURE 23

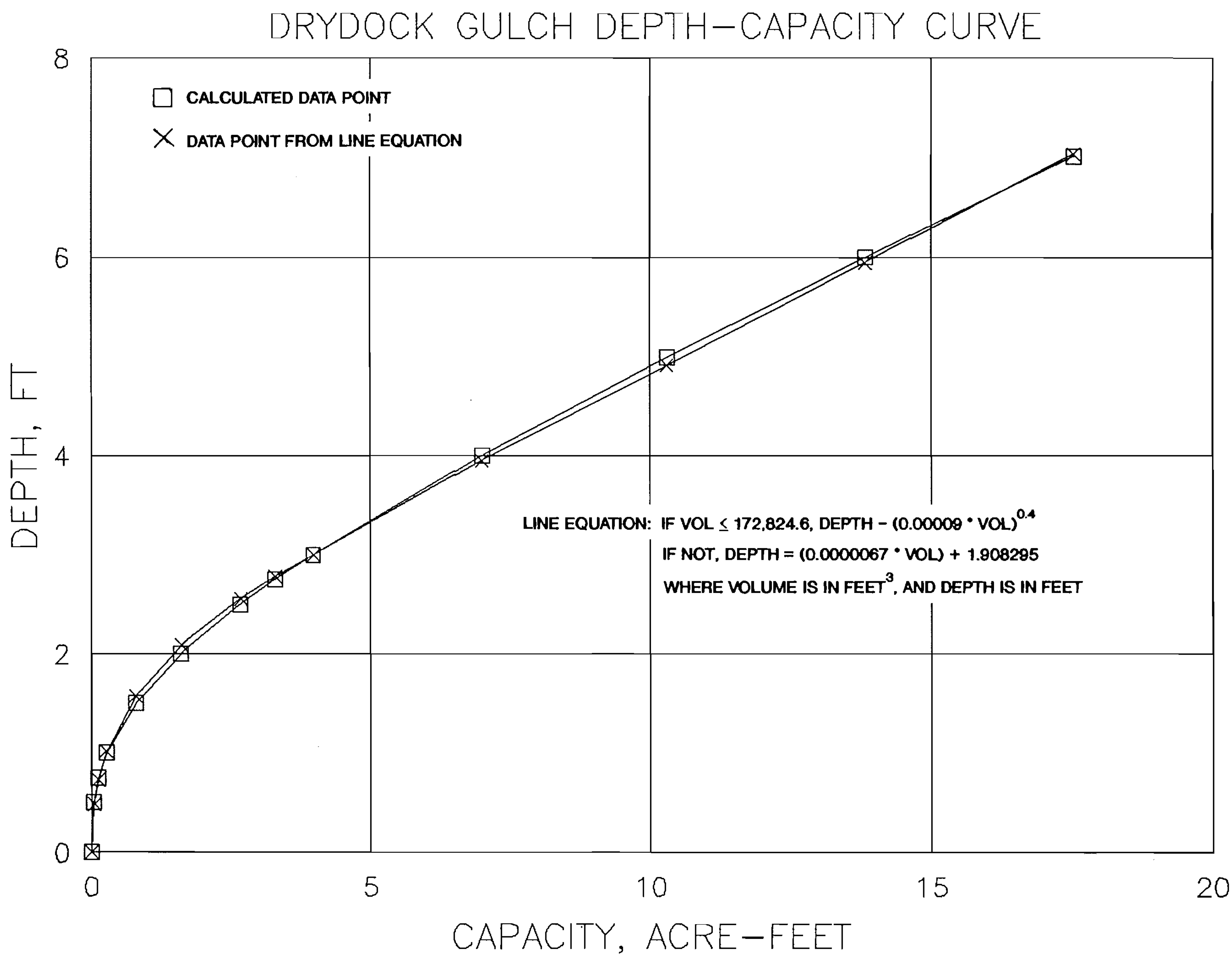

DRYDOCK GULCH DEPTH-CAPACITY CURVE
CALCULATED DATA POINT
DATA POINT FROM LINE EQUATION
LINE EQUATION: IF VOL ≤ 172,824.6, DEPTH - (0.00009 * VOL)^0.4
IF NOT, DEPTH = (0.0000067 * VOL) + 1.908295
WHERE VOLUME IS IN FEET^3, AND DEPTH IS IN FEET
DEPTH, FT
CAPACITY, ACRE-FEET
0
2
4
6
8
0
5
10
15
20

FIGURE 24

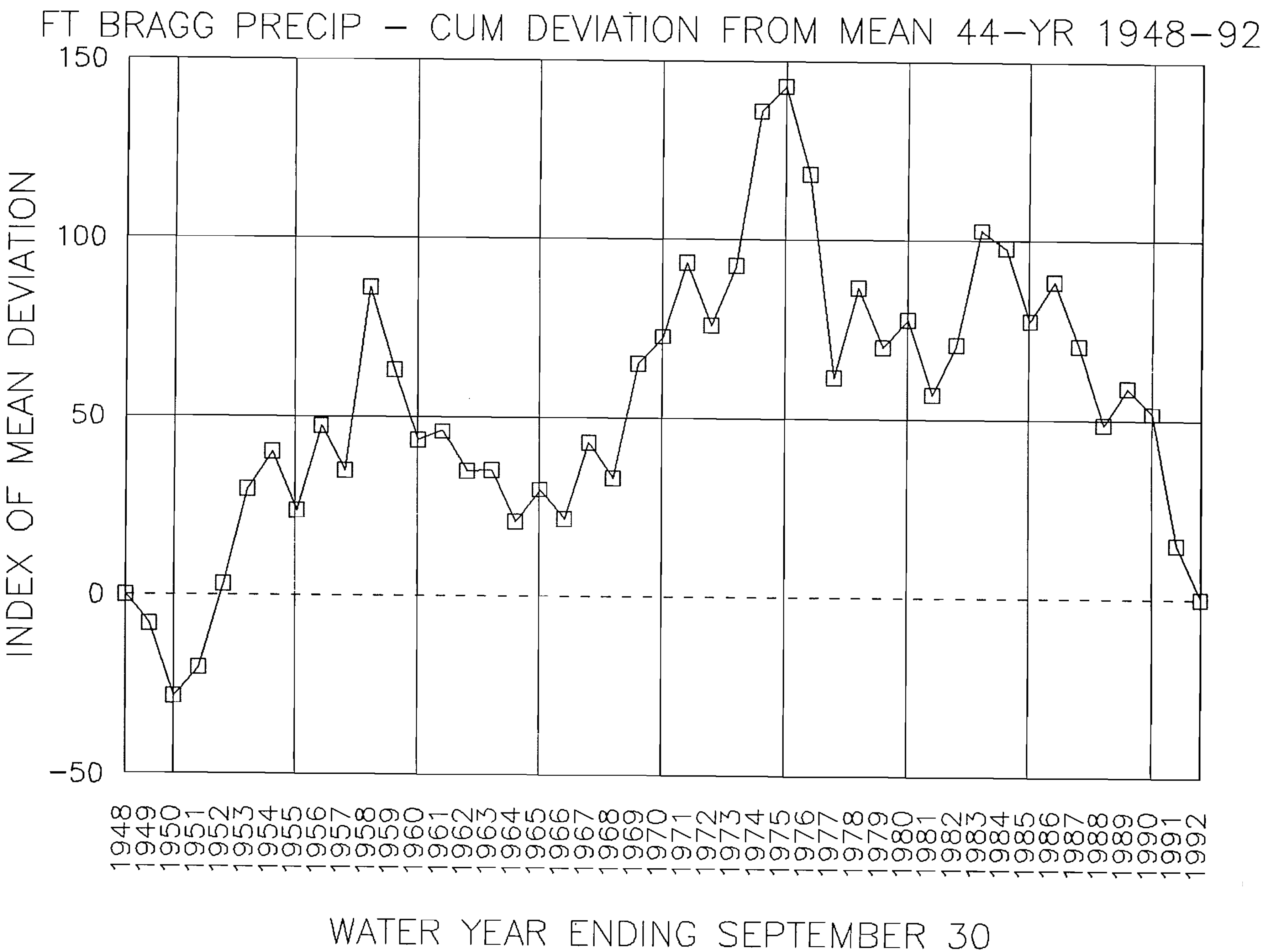

FT BRAGG PRECIP – CUM DEVIATION FROM MEAN 44–YR 1948–92
INDEX OF MEAN DEVIATION
150
100
50
0
–50
1948 1949 1950 1951 1952 1953 1954 1955 1956 1957 1958 1959 1960 1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992
WATER YEAR ENDING SEPTEMBER 30

FIGURE 25

FT BRAGG PRECIPITATION 44-YR PERIOD 1948-92

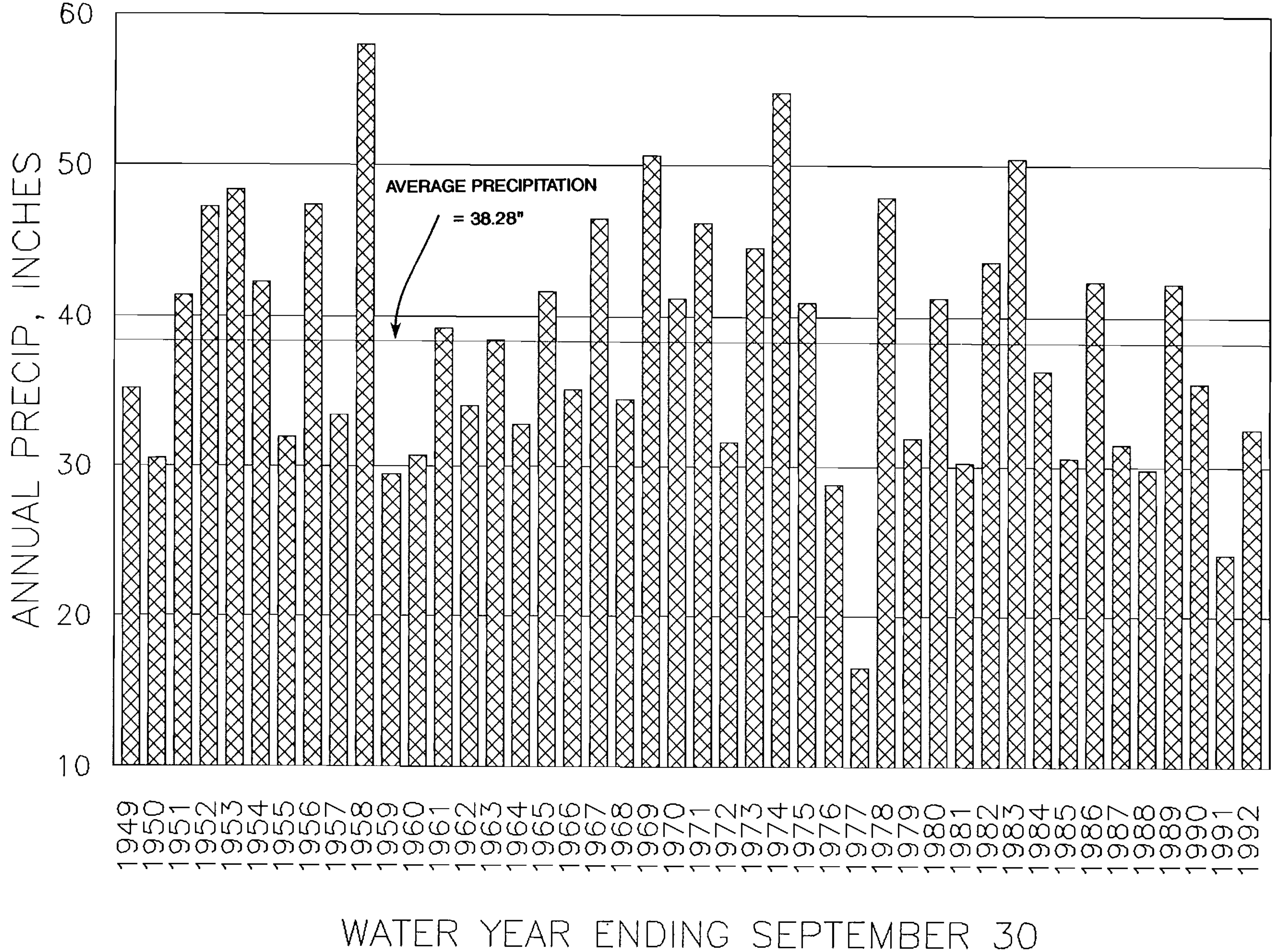


FIGURE 26

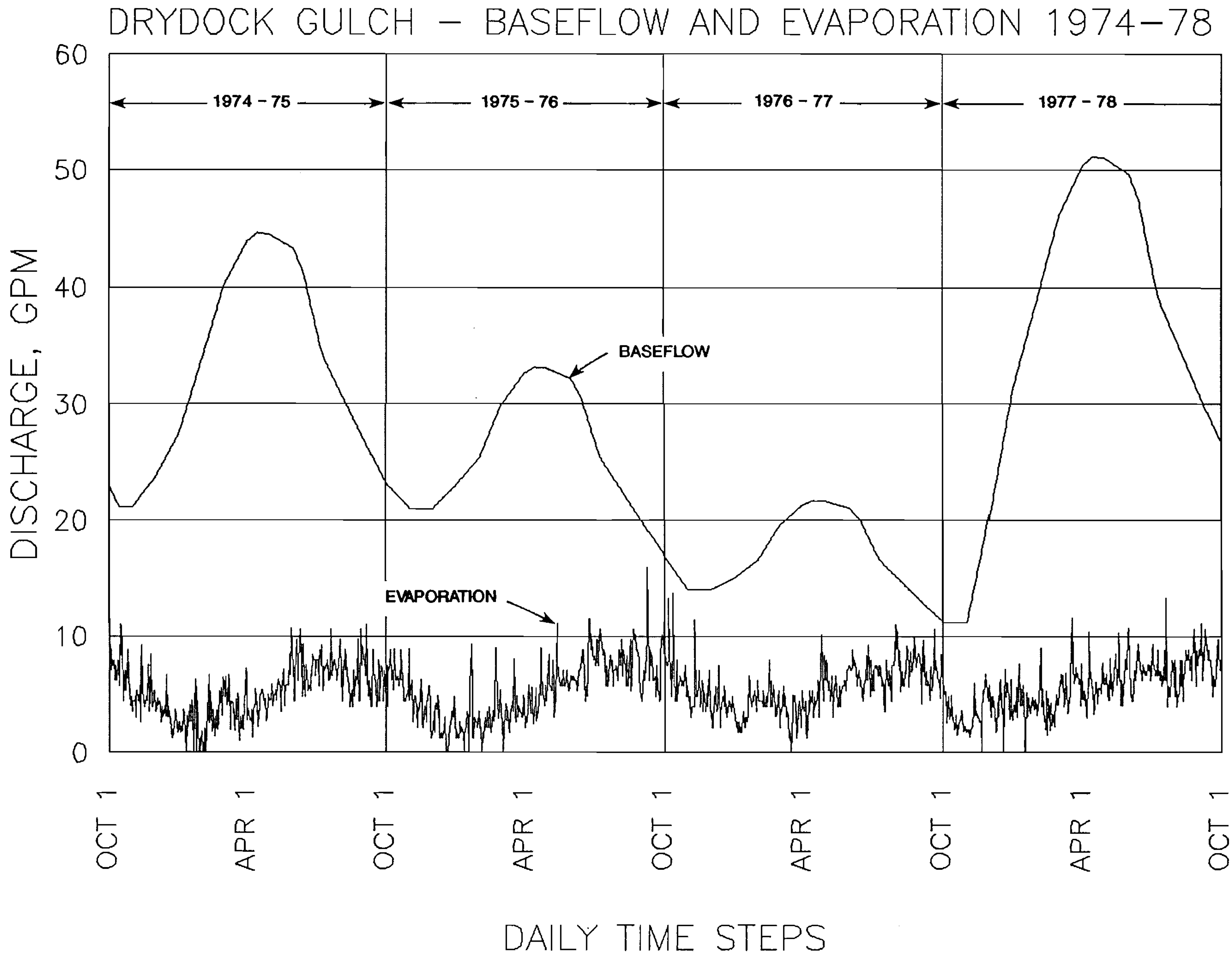

DRYDOCK GULCH - BASEFLOW AND EVAPORATION 1974-78
DISCHARGE, GPM
60
50
40
30
20
10
0
1974 - 75
1975 - 76
1976 - 77
1977 - 78
BASEFLOW
EVAPORATION
OCT 1
APR 1
OCT 1
APR 1
OCT 1
APR 1
OCT 1
APR 1
OCT 1
DAILY TIME STEPS

FIGURE 27

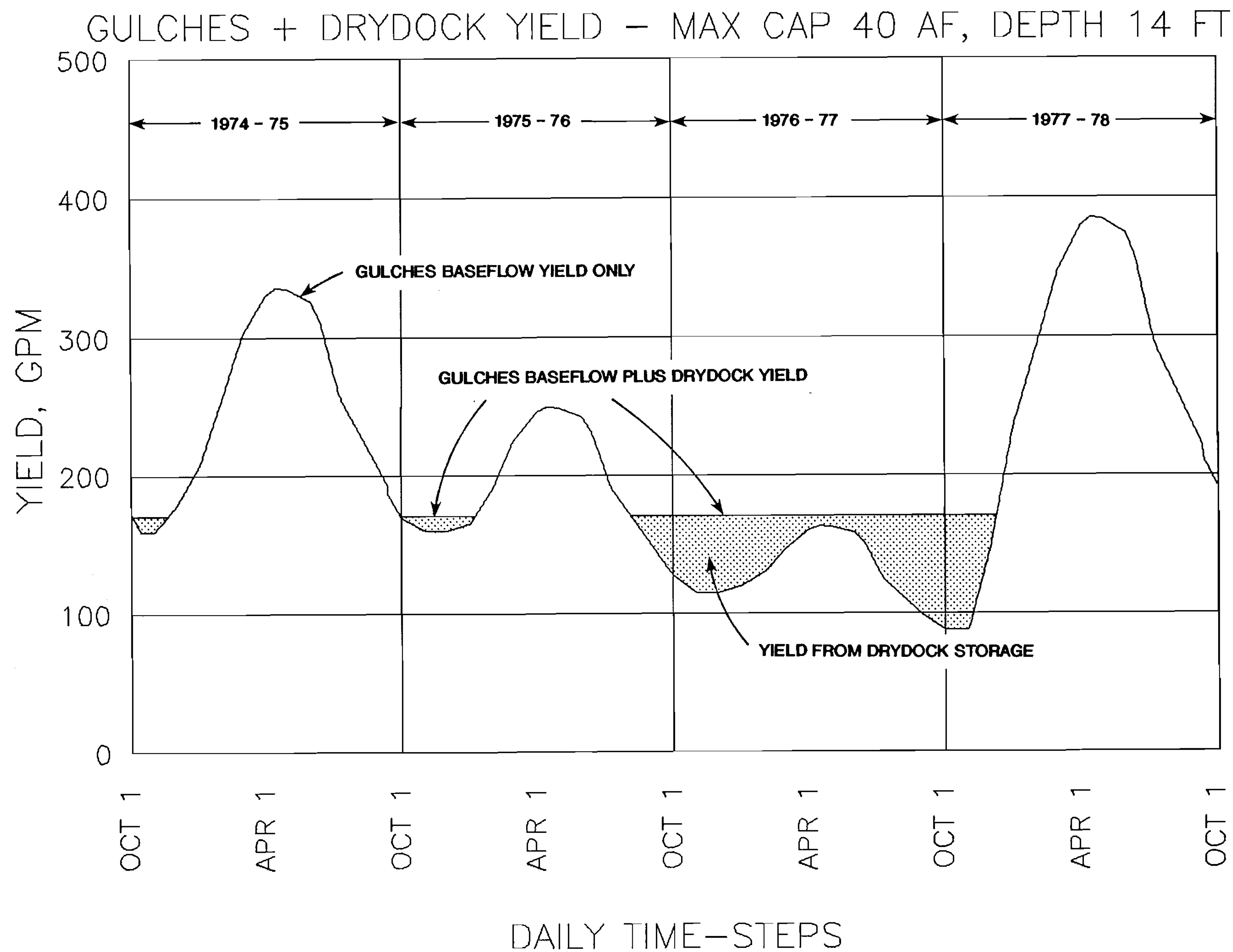

GULCHES + DRYDOCK YIELD – MAX CAP 40 AF, DEPTH 14 FT
500
400
300
200
100
0
YIELD, GPM
1974 - 75
1975 - 76
1976 - 77
1977 - 78
GULCHES BASEFLOW YIELD ONLY
GULCHES BASEFLOW PLUS DRYDOCK YIELD
YIELD FROM DRYDOCK STORAGE
OCT 1
APR 1
OCT 1
APR 1
OCT 1
APR 1
OCT 1
APR 1
OCT 1
DAILY TIME–STEPS

FIGURE 28

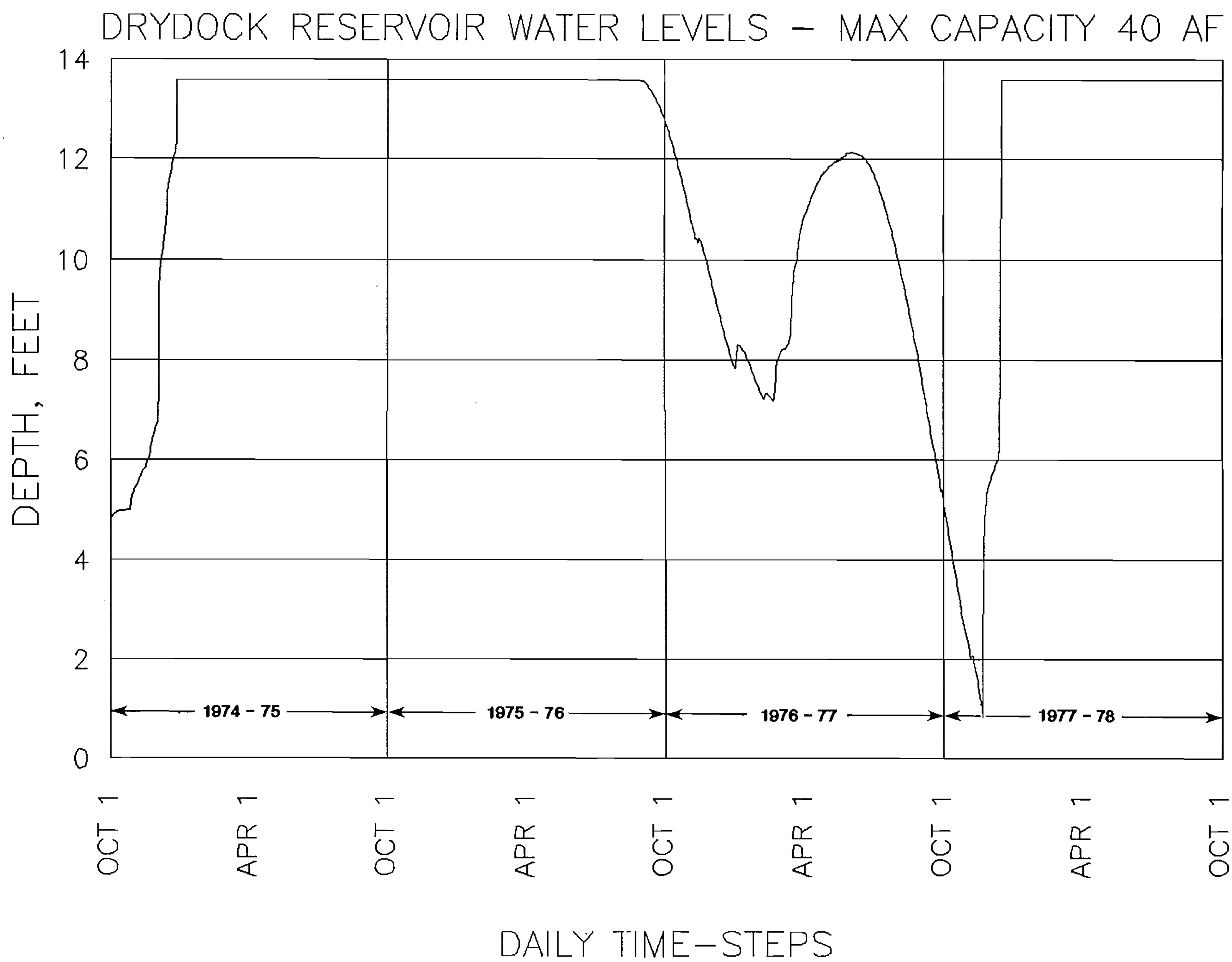

DRYDOCK RESERVOIR WATER LEVELS - MAX CAPACITY 40 AF
DEPTH, FEET
14
12
10
8
6
4
2
0
1974 - 75
1975 - 76
1976 - 77
1977 - 78
OCT 1
APR 1
OCT 1
APR 1
OCT 1
APR 1
OCT 1
APR 1
OCT 1
DAILY TIME-STEPS

FIGURE 29

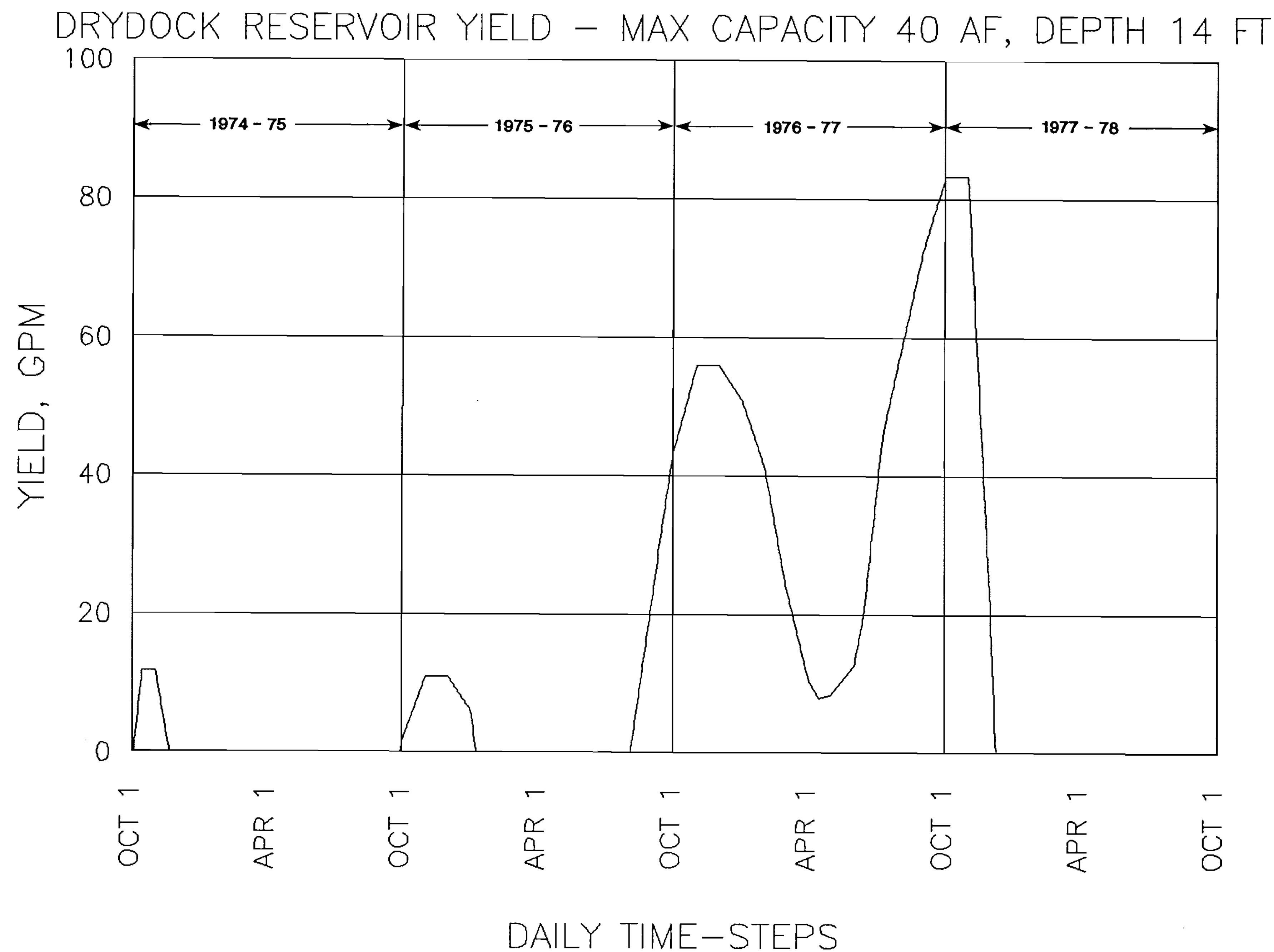

DRYDOCK RESERVOIR YIELD – MAX CAPACITY 40 AF, DEPTH 14 FT
YIELD, GPM
100
80
60
40
20
0
1974 - 75
1975 - 76
1976 - 77
1977 - 78
OCT 1
APR 1
OCT 1
APR 1
OCT 1
APR 1
OCT 1
APR 1
OCT 1
DAILY TIME–STEPS

FIGURE 30

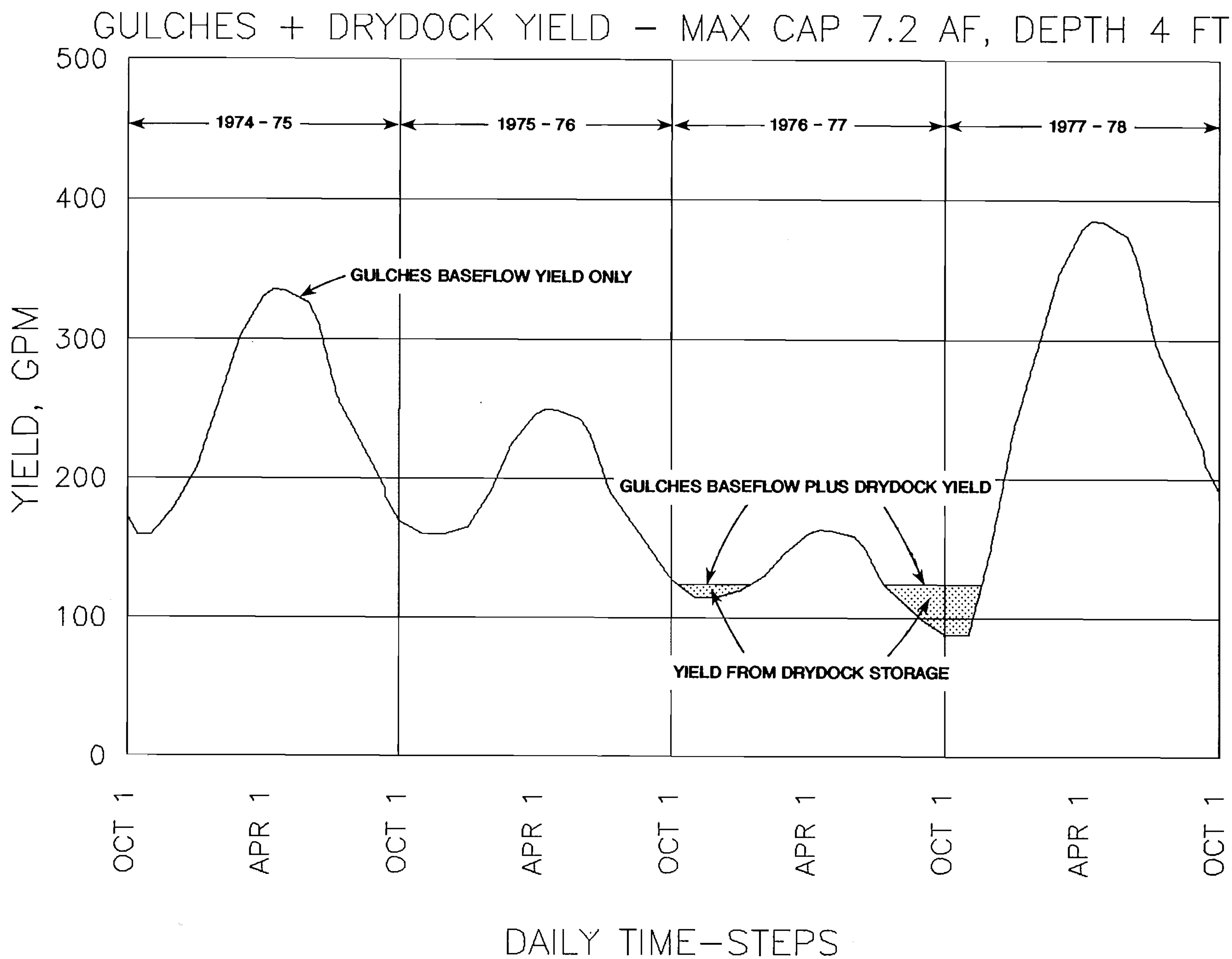

GULCHES + DRYDOCK YIELD - MAX CAP 7.2 AF, DEPTH 4 FT
YIELD, GPM
500
400
300
200
100
0
1974 - 75
1975 - 76
1976 - 77
1977 - 78
GULCHES BASEFLOW YIELD ONLY
GULCHES BASEFLOW PLUS DRYDOCK YIELD
YIELD FROM DRYDOCK STORAGE
OCT 1
APR 1
OCT 1
APR 1
OCT 1
APR 1
OCT 1
APR 1
OCT 1
DAILY TIME-STEPS

FIGURE 31

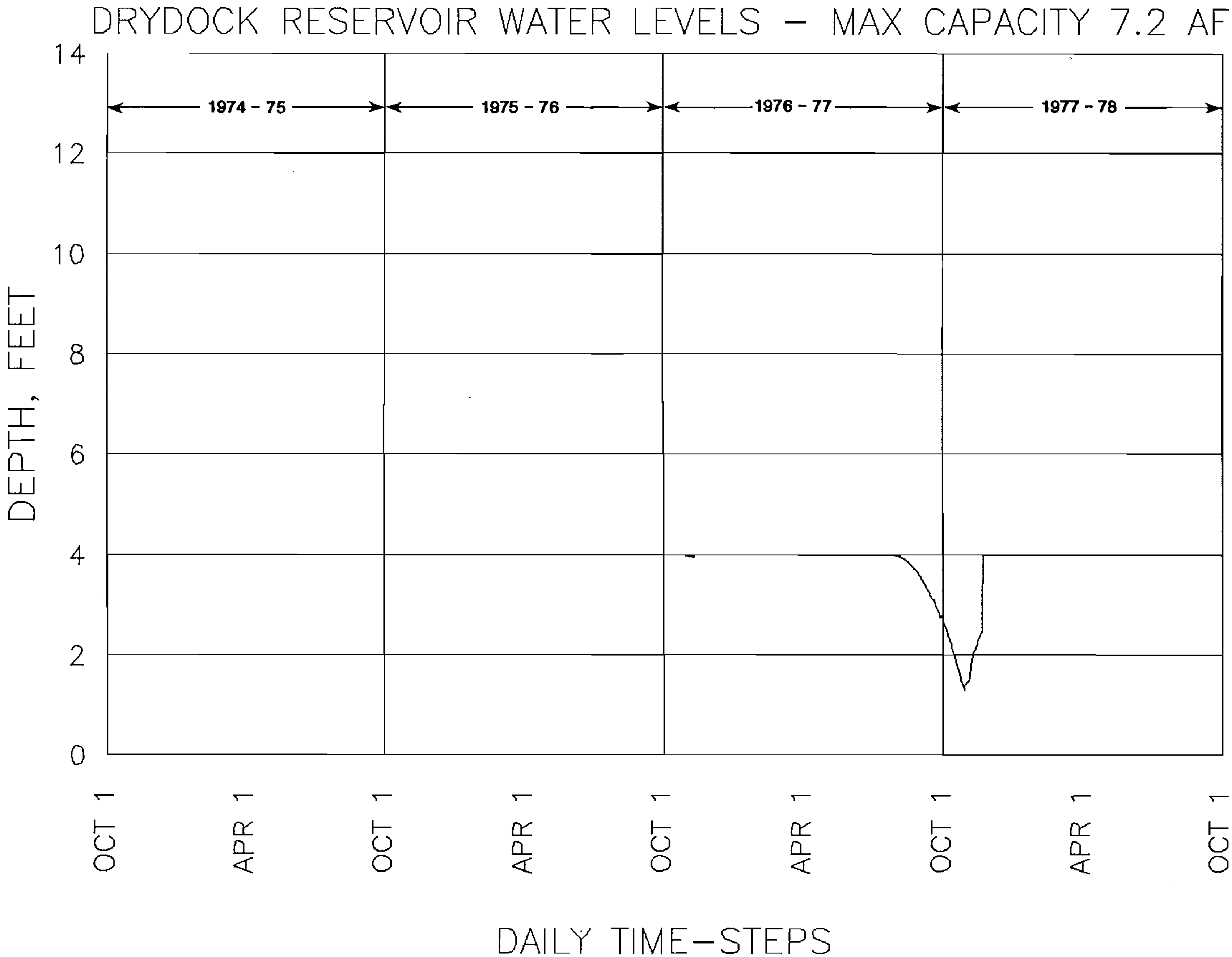

DRYDOCK RESERVOIR WATER LEVELS - MAX CAPACITY 7.2 AF
DEPTH, FEET
14
12
10
8
6
4
2
0
1974 - 75
1975 - 76
1976 - 77
1977 - 78
OCT 1
APR 1
OCT 1
APR 1
OCT 1
APR 1
OCT 1
APR 1
OCT 1
DAILY TIME-STEPS

FIGURE 32

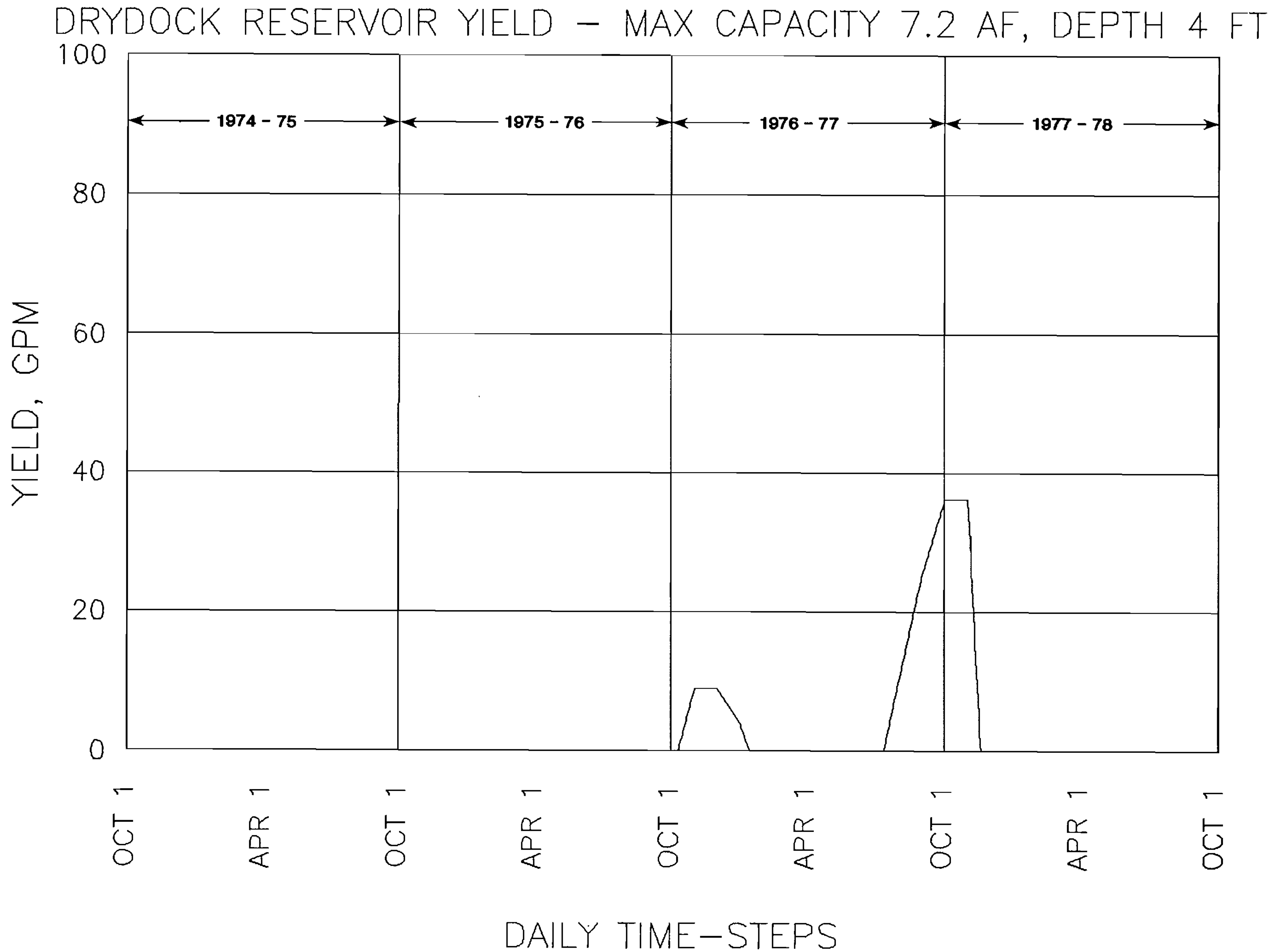

DRYDOCK RESERVOIR YIELD – MAX CAPACITY 7.2 AF, DEPTH 4 FT
YIELD, GPM
100
80
60
40
20
0
1974 - 75
1975 - 76
1976 - 77
1977 - 78
OCT 1
APR 1
OCT 1
APR 1
OCT 1
APR 1
OCT 1
APR 1
OCT 1
DAILY TIME–STEPS

FIGURE 33

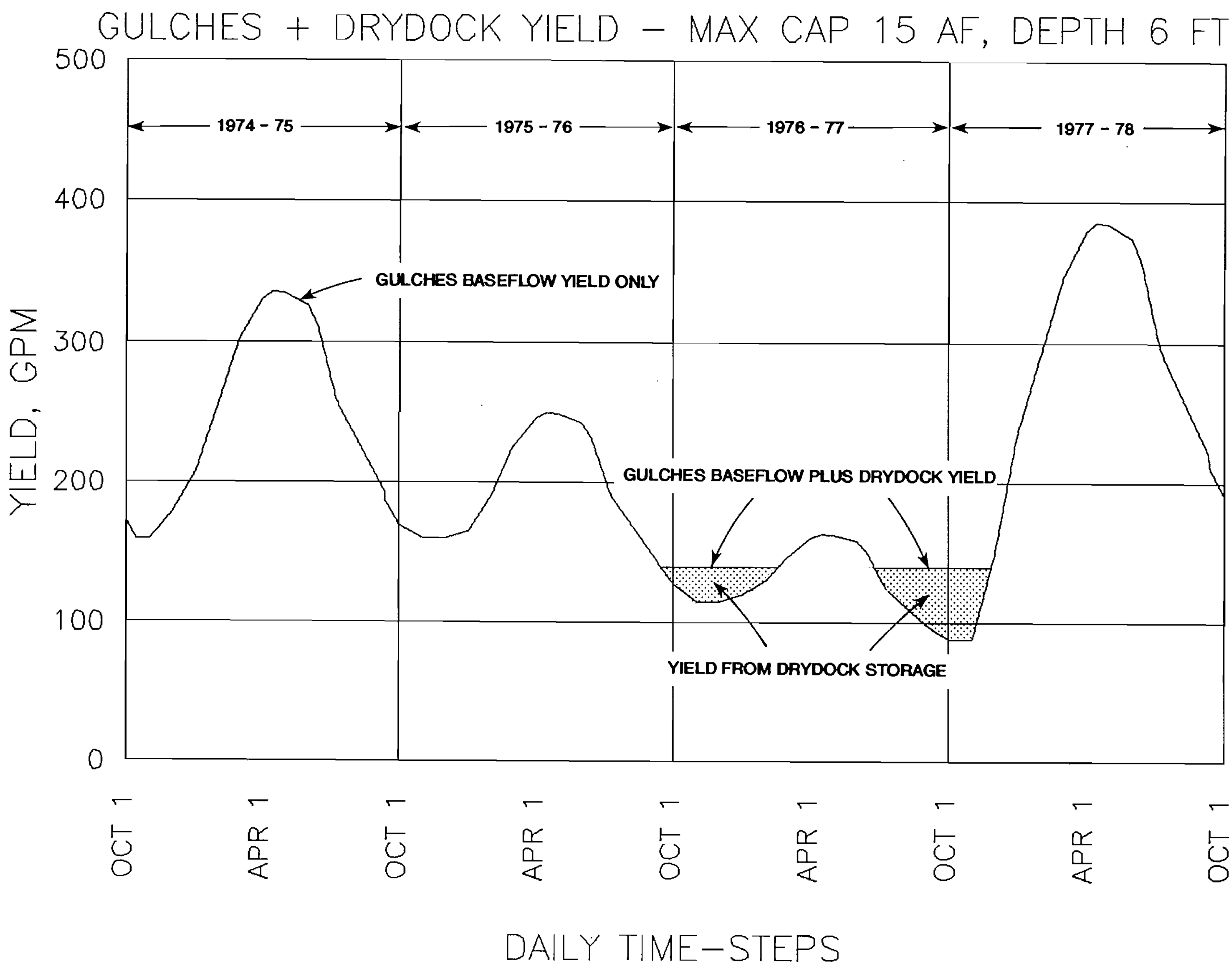

GULCHES + DRYDOCK YIELD – MAX CAP 15 AF, DEPTH 6 FT
YIELD, GPM
500
400
300
200
100
0
1974 - 75
1975 - 76
1976 - 77
1977 - 78
GULCHES BASEFLOW YIELD ONLY
GULCHES BASEFLOW PLUS DRYDOCK YIELD
YIELD FROM DRYDOCK STORAGE
OCT 1
APR 1
OCT 1
APR 1
OCT 1
APR 1
OCT 1
APR 1
OCT 1
DAILY TIME–STEPS

FIGURE 34

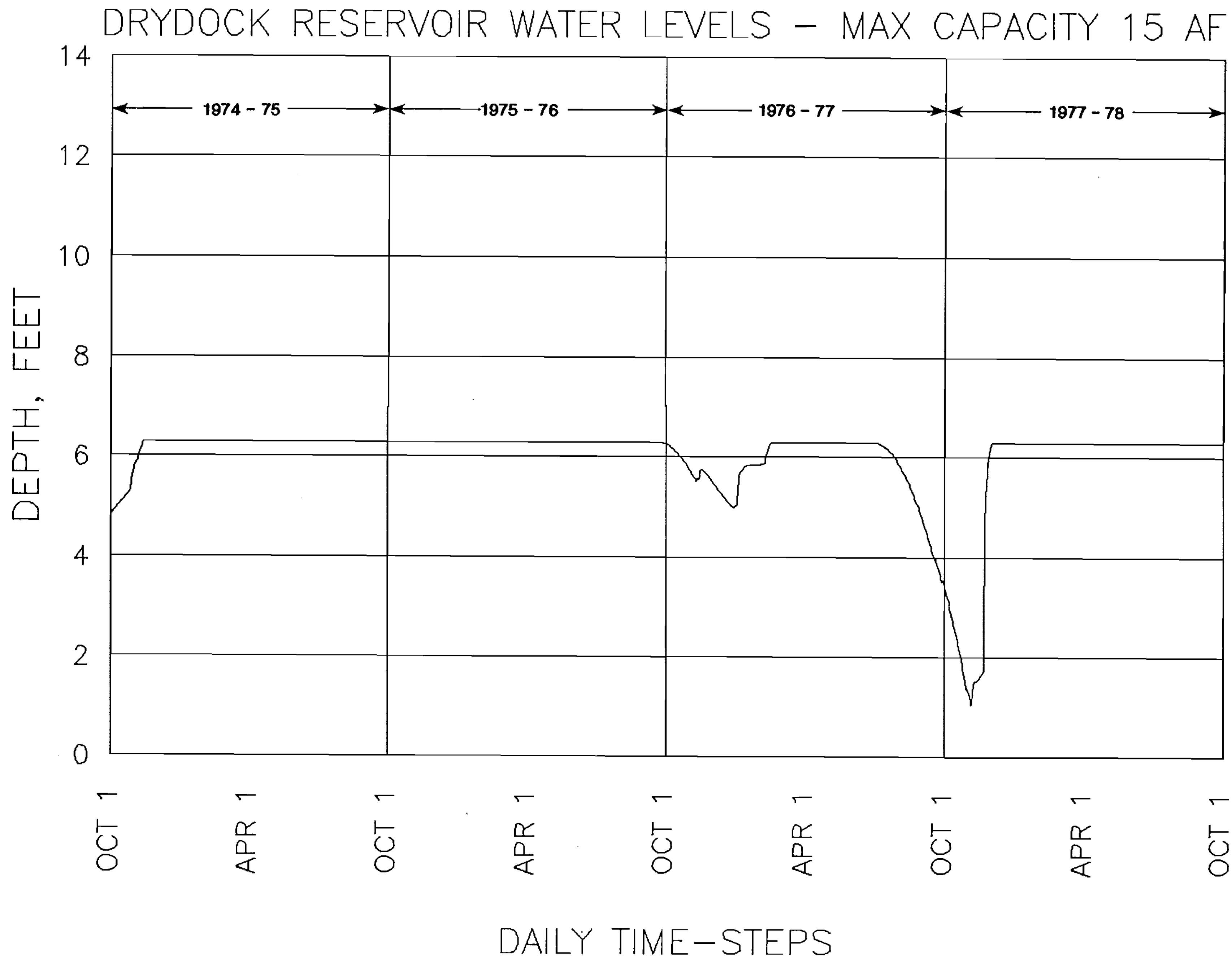

DRYDOCK RESERVOIR WATER LEVELS - MAX CAPACITY 15 AF
14
12
10
8
6
4
2
0
DEPTH, FEET
1974 - 75
1975 - 76
1976 - 77
1977 - 78
OCT 1
APR 1
OCT 1
APR 1
OCT 1
APR 1
OCT 1
APR 1
OCT 1
DAILY TIME-STEPS

FIGURE 35

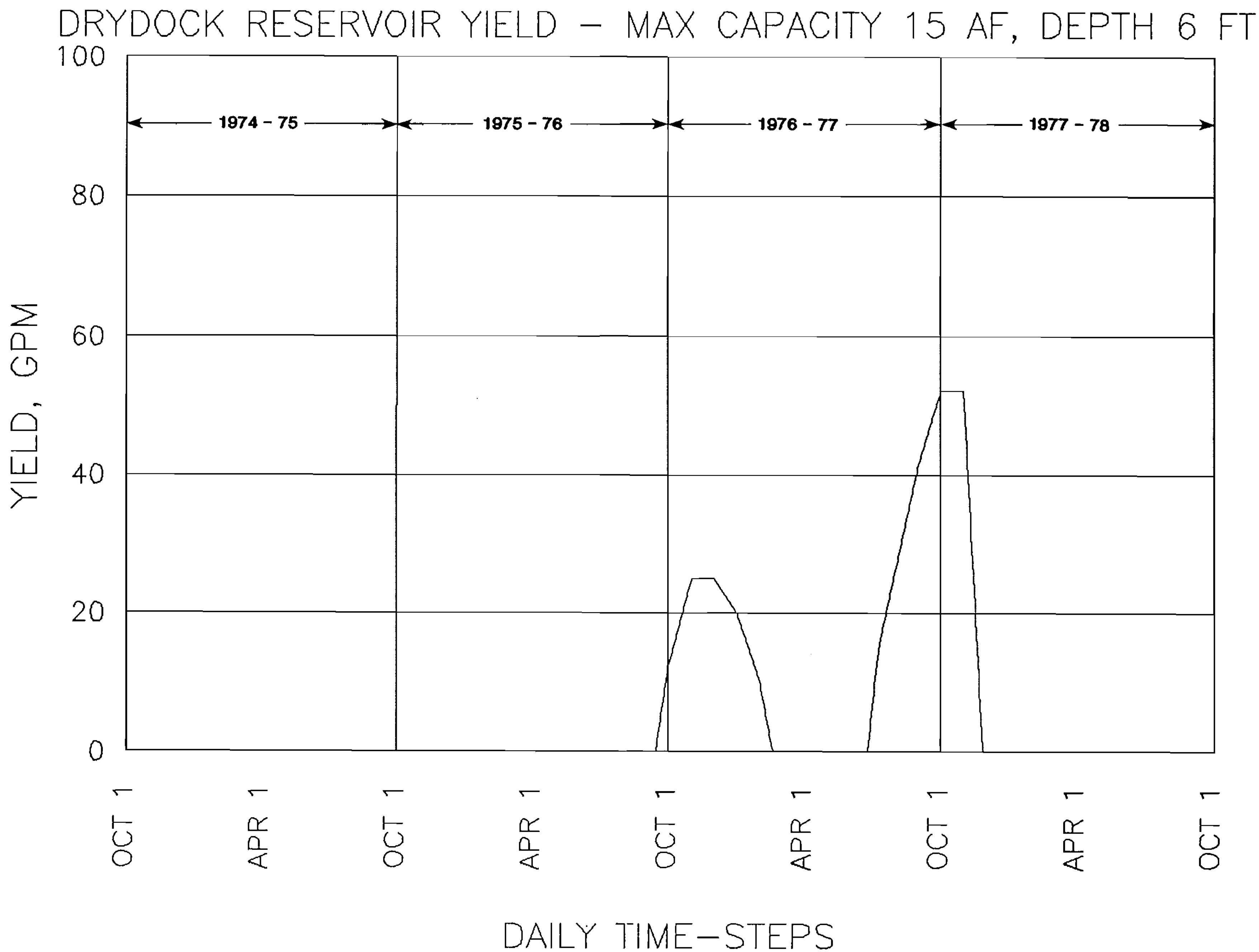

DRYDOCK RESERVOIR YIELD – MAX CAPACITY 15 AF, DEPTH 6 FT
YIELD, GPM
100
80
60
40
20
0
1974 - 75
1975 - 76
1976 - 77
1977 - 78
OCT 1
APR 1
OCT 1
APR 1
OCT 1
APR 1
OCT 1
APR 1
OCT 1
DAILY TIME–STEPS

FIGURE 36

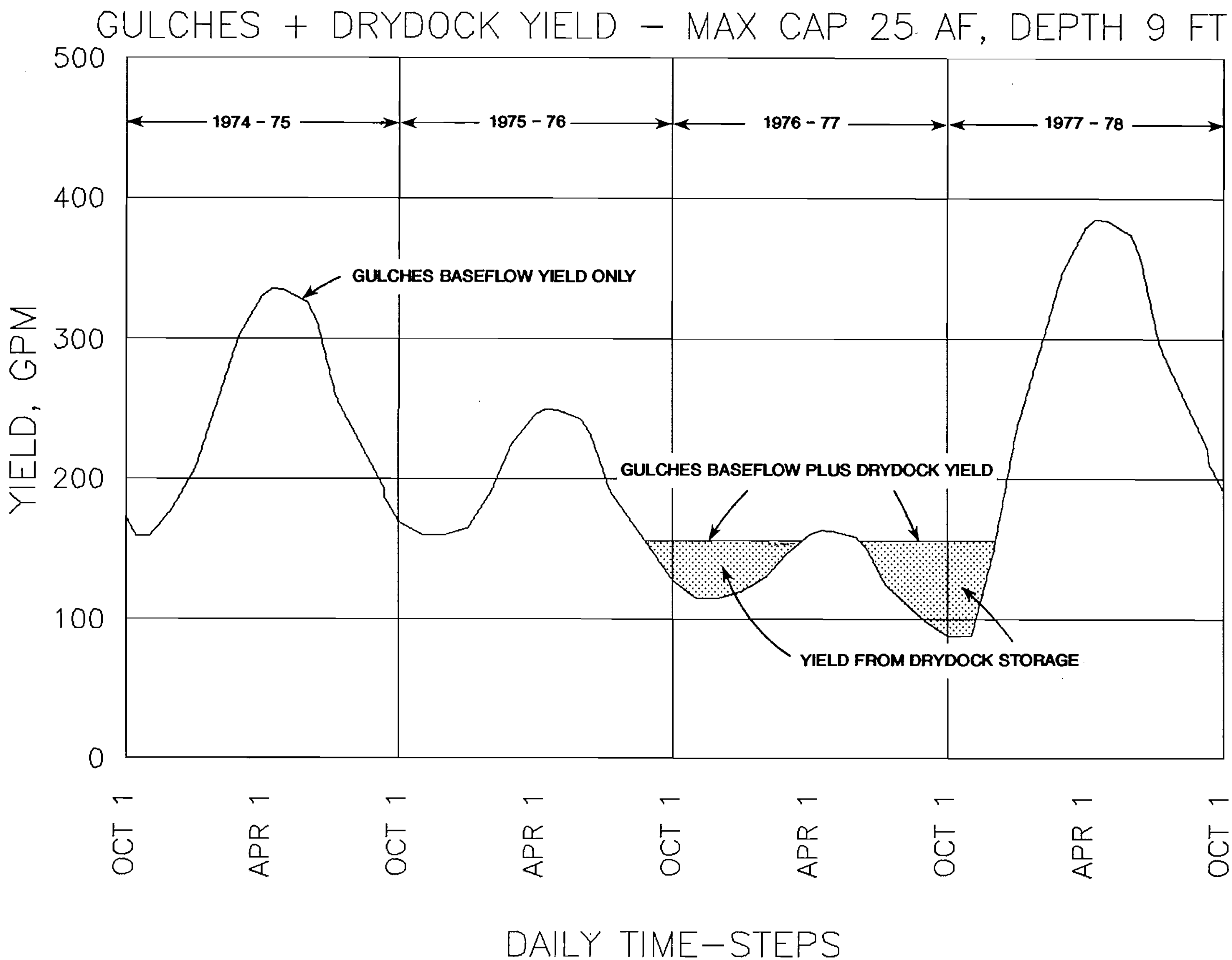

GULCHES + DRYDOCK YIELD – MAX CAP 25 AF, DEPTH 9 FT
YIELD, GPM
500
400
300
200
100
0
1974 - 75
1975 - 76
1976 - 77
1977 - 78
GULCHES BASEFLOW YIELD ONLY
GULCHES BASEFLOW PLUS DRYDOCK YIELD
YIELD FROM DRYDOCK STORAGE
OCT 1
APR 1
OCT 1
APR 1
OCT 1
APR 1
OCT 1
APR 1
OCT 1
DAILY TIME–STEPS

FIGURE 37

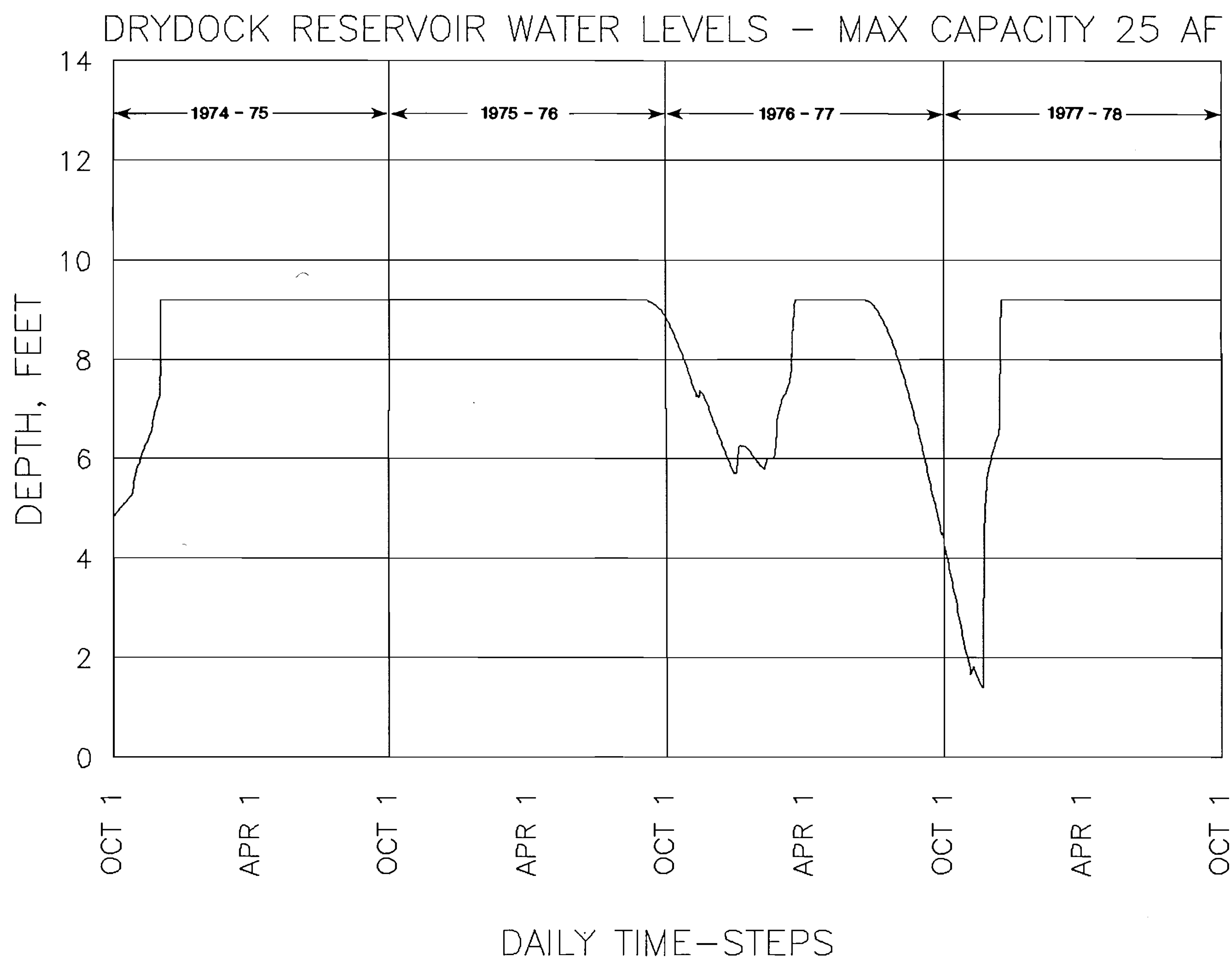

DRYDOCK RESERVOIR WATER LEVELS - MAX CAPACITY 25 AF
DEPTH, FEET
14
12
10
8
6
4
2
0
1974 - 75
1975 - 76
1976 - 77
1977 - 78
OCT 1
APR 1
OCT 1
APR 1
OCT 1
APR 1
OCT 1
APR 1
OCT 1
DAILY TIME-STEPS

FIGURE 38

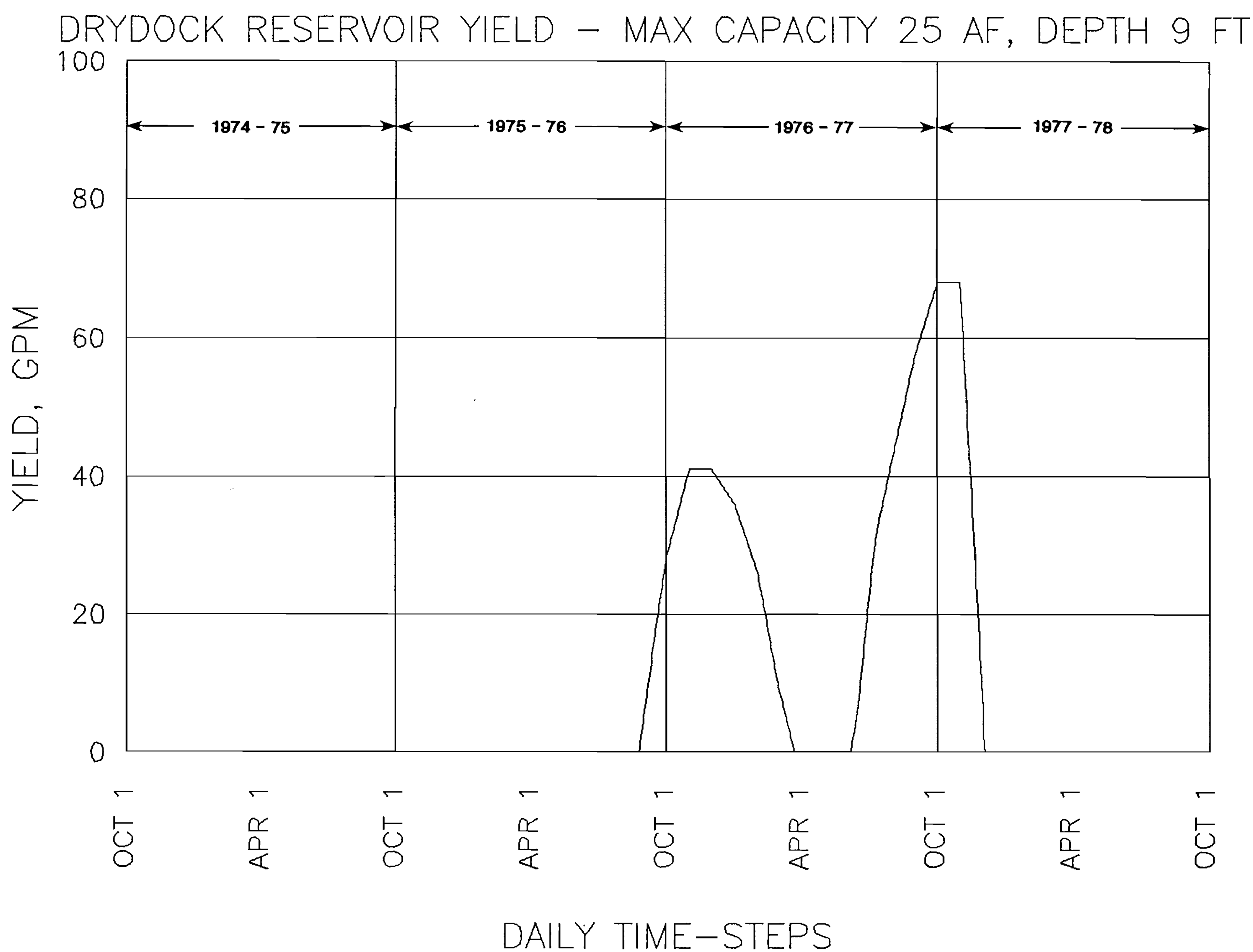

DRYDOCK RESERVOIR YIELD – MAX CAPACITY 25 AF, DEPTH 9 FT
100
80
60
40
20
0
YIELD, GPM
1974 - 75
1975 - 76
1976 - 77
1977 - 78
OCT 1
APR 1
OCT 1
APR 1
OCT 1
APR 1
OCT 1
APR 1
OCT 1
DAILY TIME–STEPS

FIGURE 39

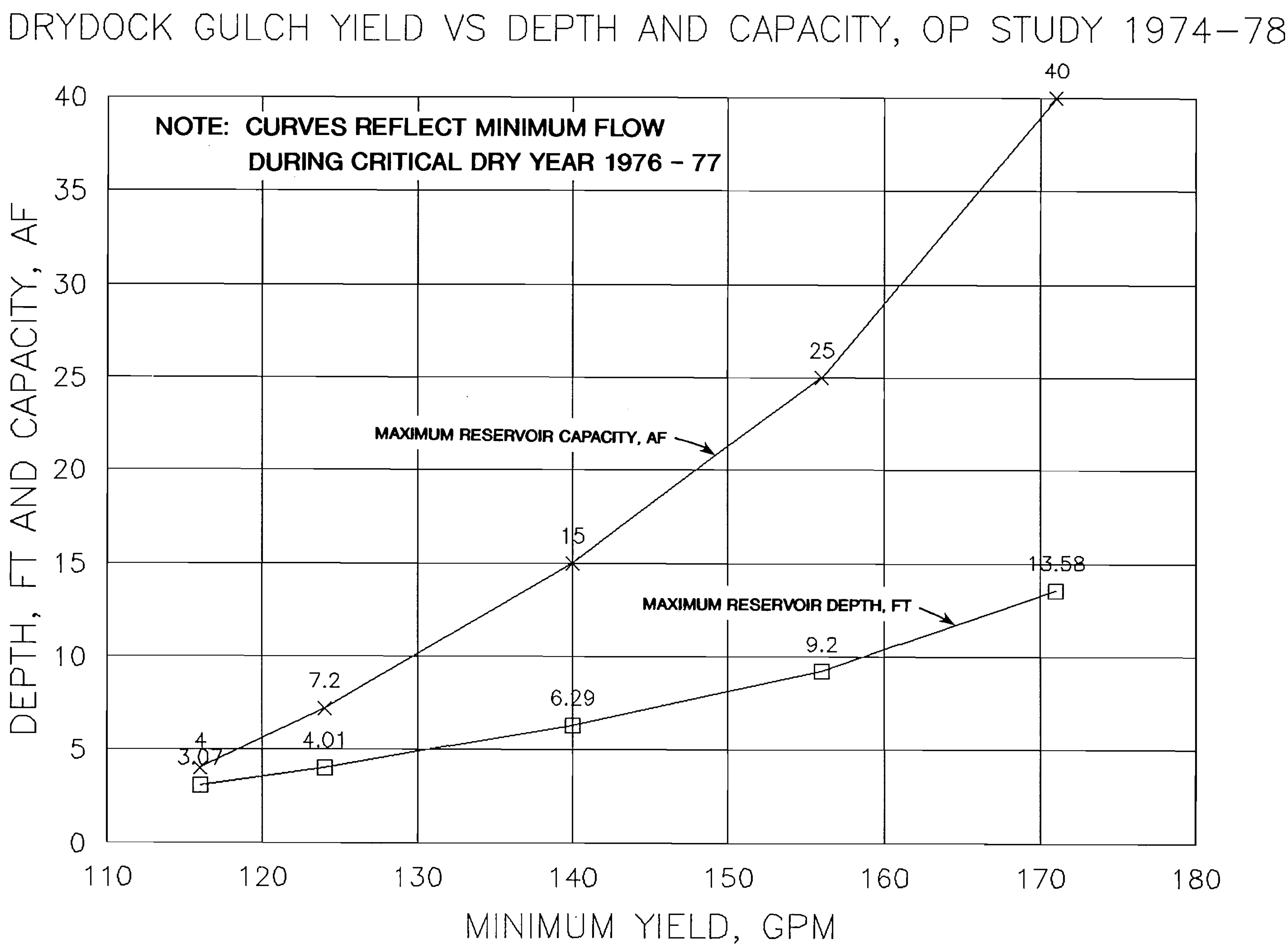

DRYDOCK GULCH YIELD VS DEPTH AND CAPACITY, OP STUDY 1974–78
NOTE: CURVES REFLECT MINIMUM FLOW
DURING CRITICAL DRY YEAR 1976 - 77
MAXIMUM RESERVOIR CAPACITY, AF
MAXIMUM RESERVOIR DEPTH, FT
40
25
15
7.2
4
3.07
4.01
6.29
9.2
13.58
DEPTH, FT AND CAPACITY, AF
0
5
10
15
20
25
30
35
40
110
120
130
140
150
160
170
180
MINIMUM YIELD, GPM

FIGURE 40

LOWER GULCHES + DRYDOCK MINIMUM SUMMER YIELD, RES 7.2 AF, DEPTH 4 FT

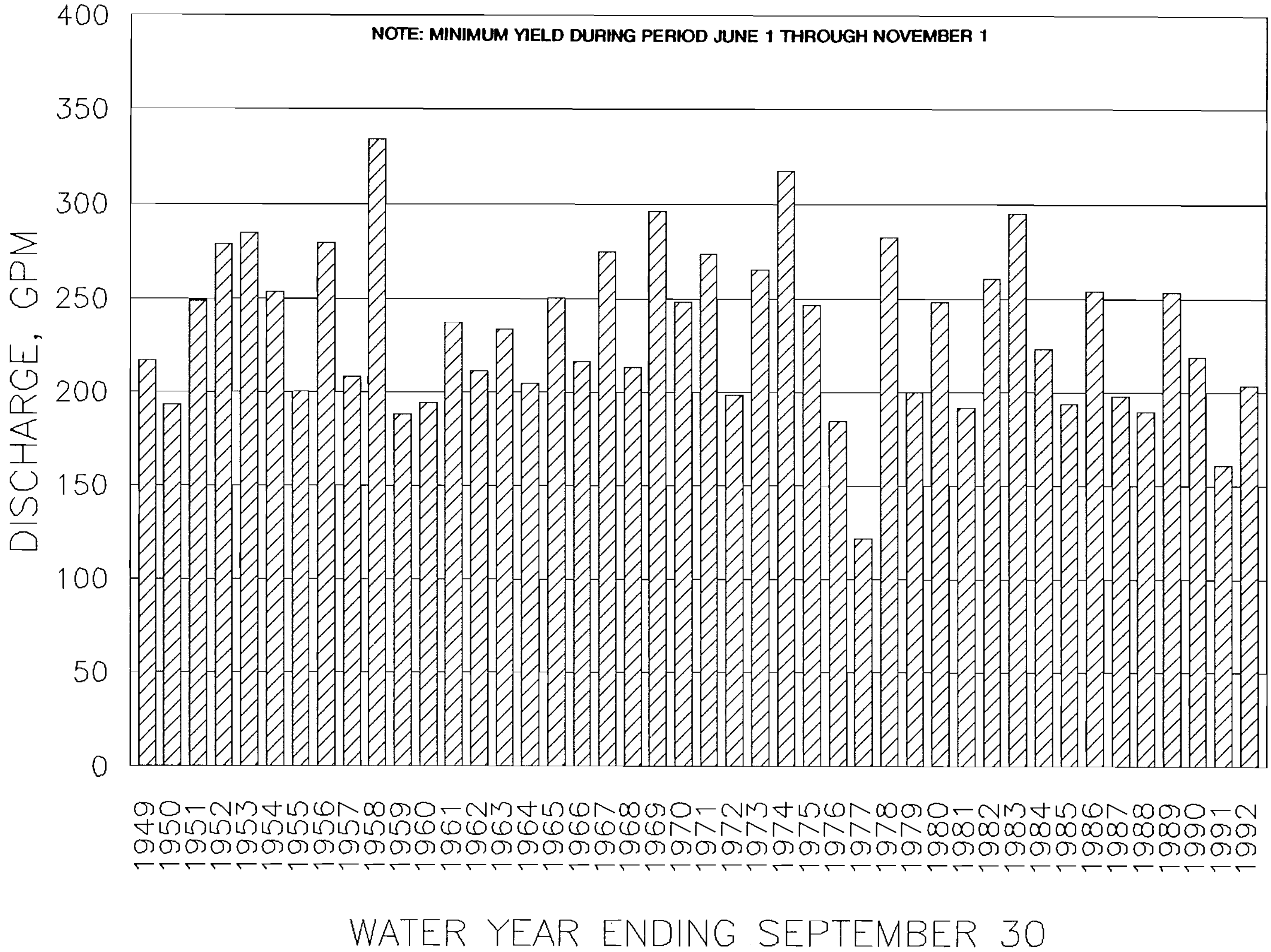


FIGURE 41

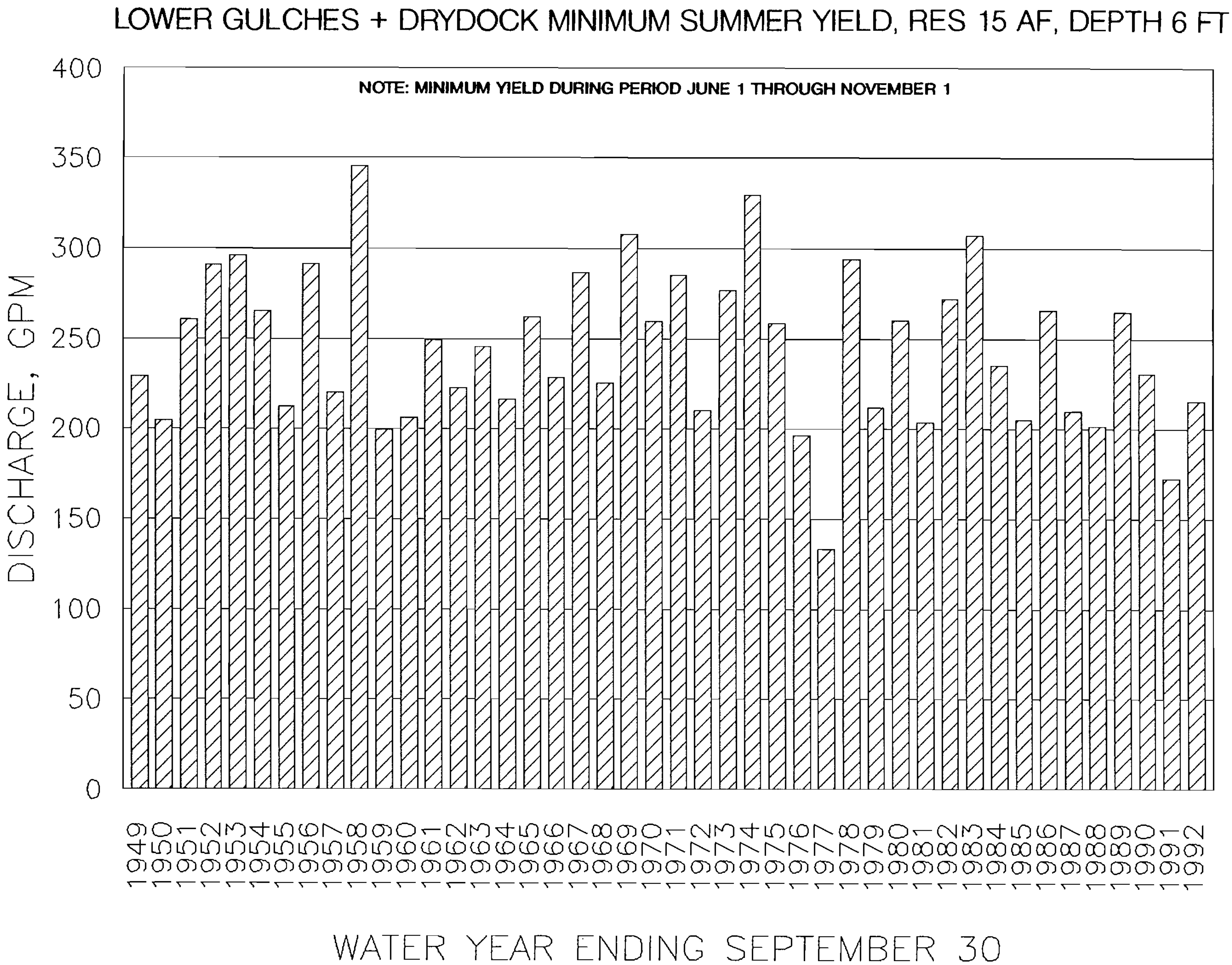

LOWER GULCHES + DRYDOCK MINIMUM SUMMER YIELD, RES 15 AF, DEPTH 6 FT
NOTE: MINIMUM YIELD DURING PERIOD JUNE 1 THROUGH NOVEMBER 1
DISCHARGE, GPM
0
50
100
150
200
250
300
350
400
1949
1950
1951
1952
1953
1954
1955
1956
1957
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
WATER YEAR ENDING SEPTEMBER 30

FIGURE 42

LOWER GULCHES + DRYDOCK MINIMUM SUMMER YIELD, RES 25 AF, DEPTH 9 FT

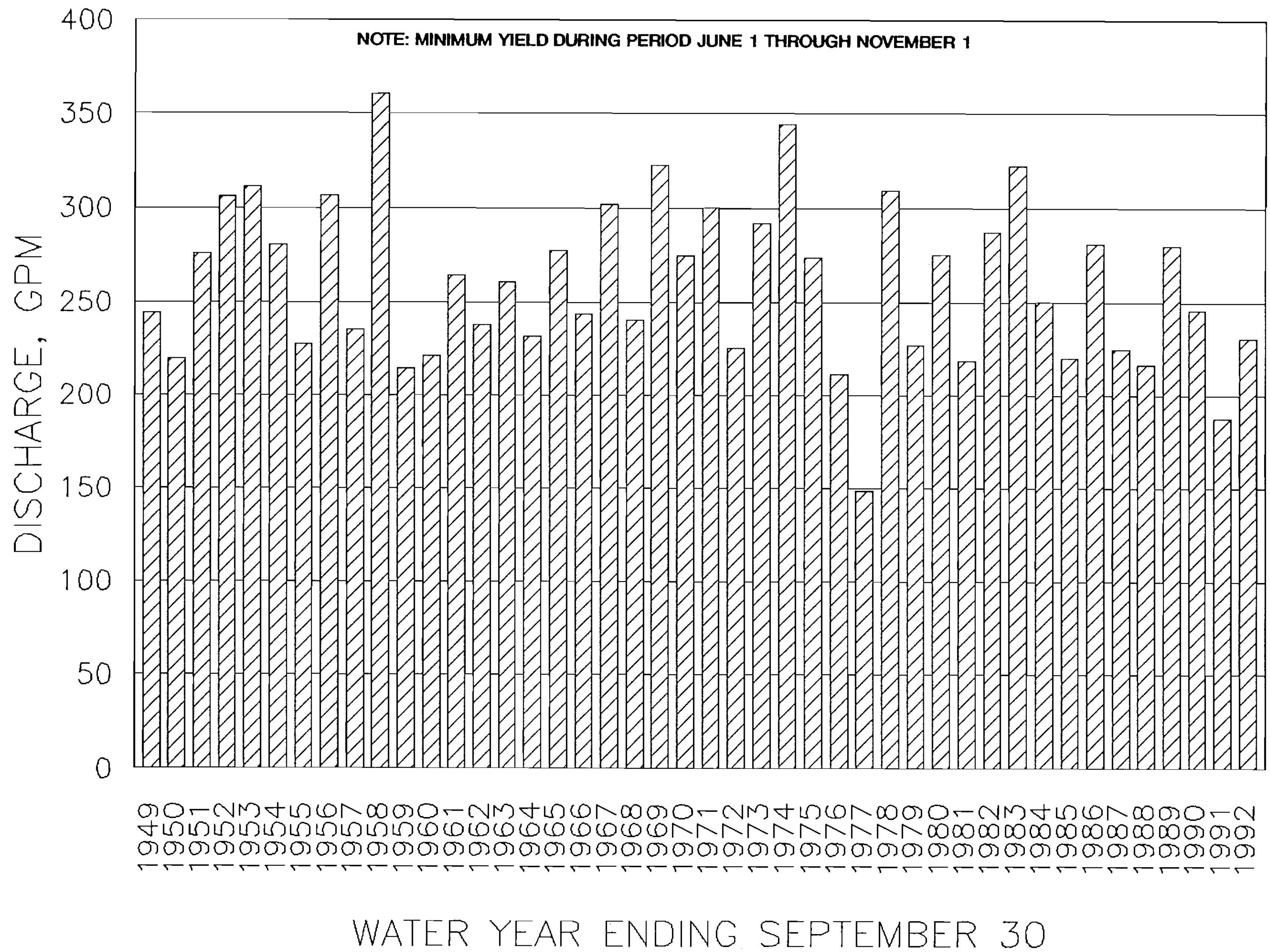


FIGURE 43

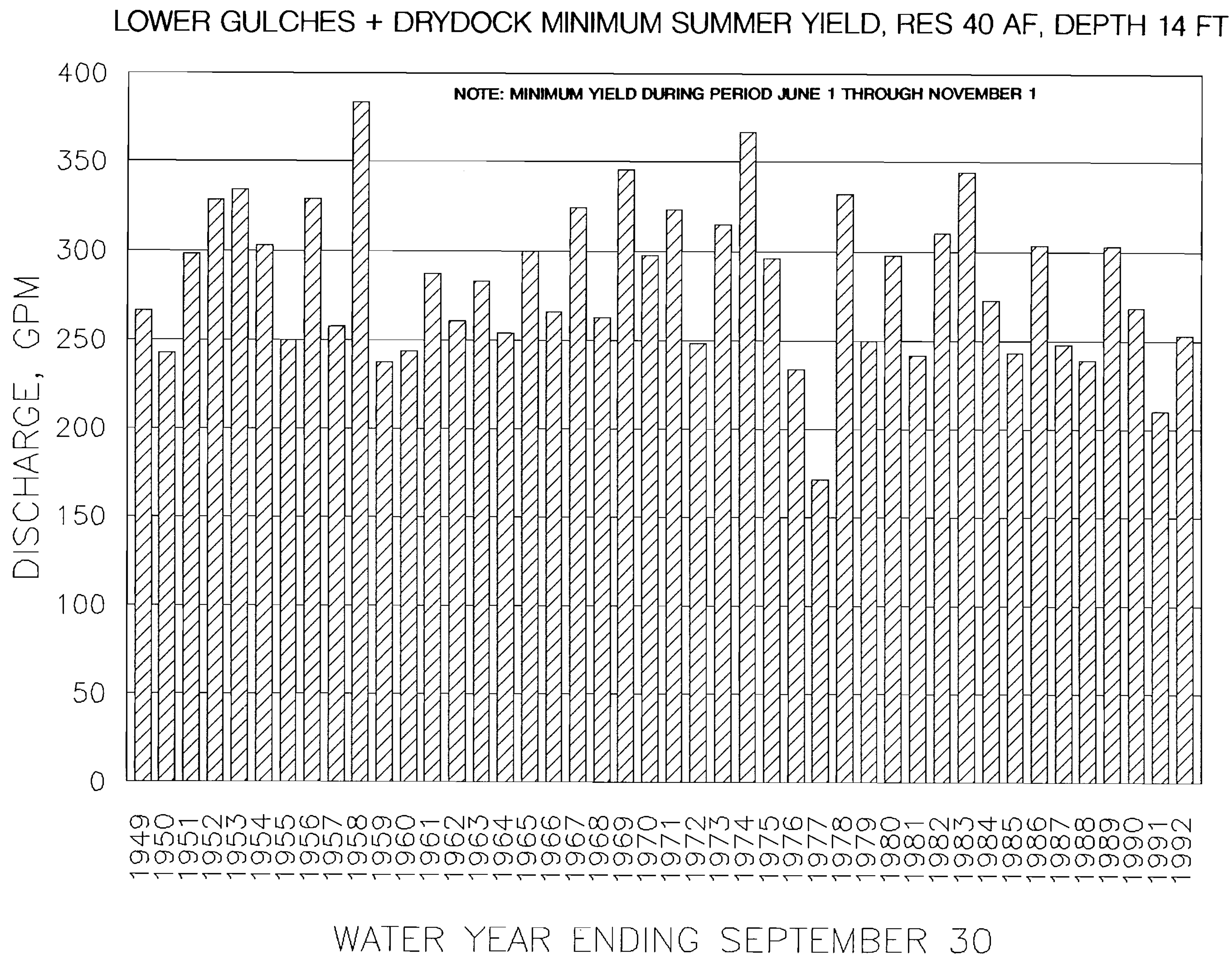

LOWER GULCHES + DRYDOCK MINIMUM SUMMER YIELD, RES 40 AF, DEPTH 14 FT
NOTE: MINIMUM YIELD DURING PERIOD JUNE 1 THROUGH NOVEMBER 1
DISCHARGE, GPM
0
50
100
150
200
250
300
350
400
1949 1950 1951 1952 1953 1954 1955 1956 1957 1958 1959 1960 1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992
WATER YEAR ENDING SEPTEMBER 30

FIGURE 44

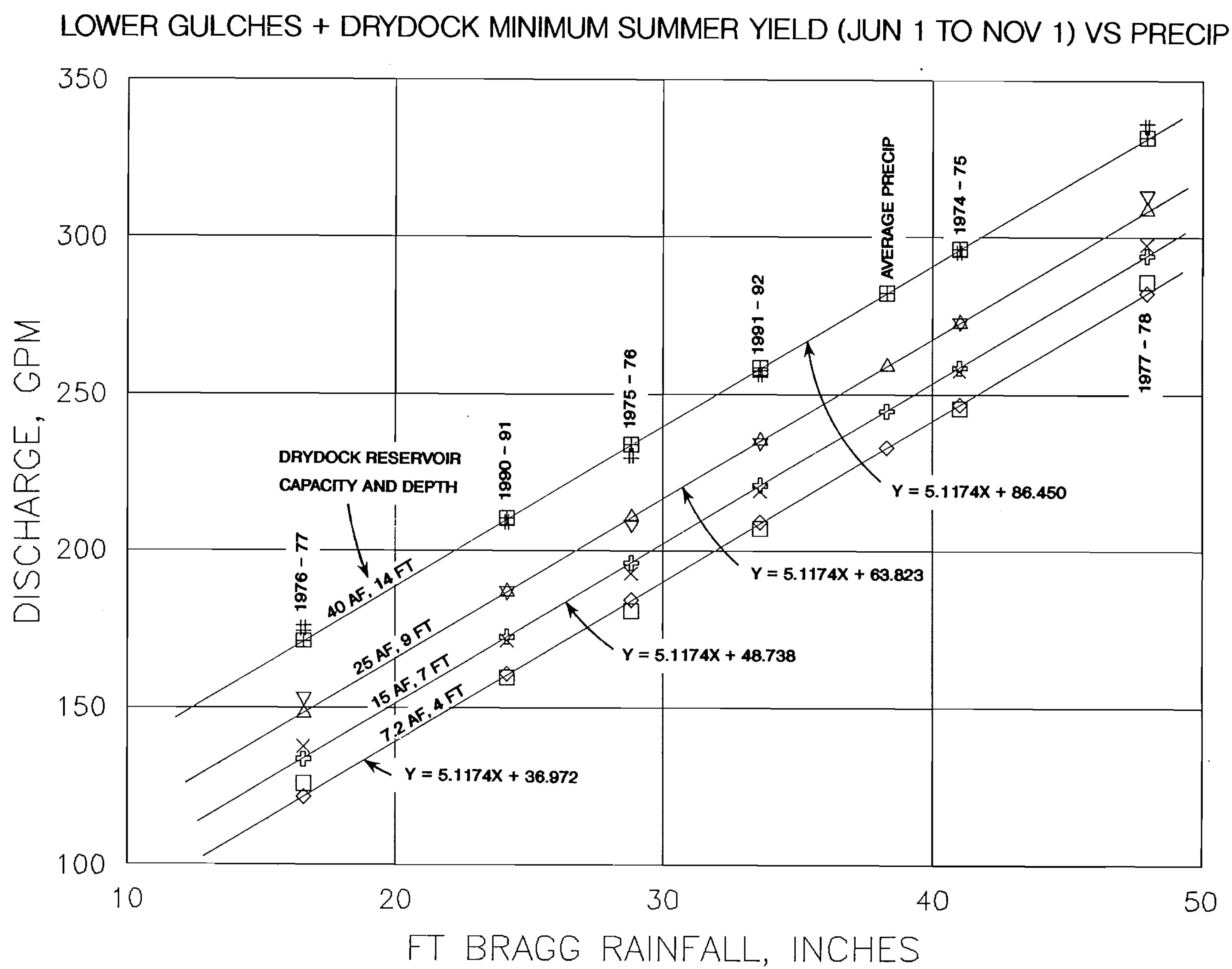
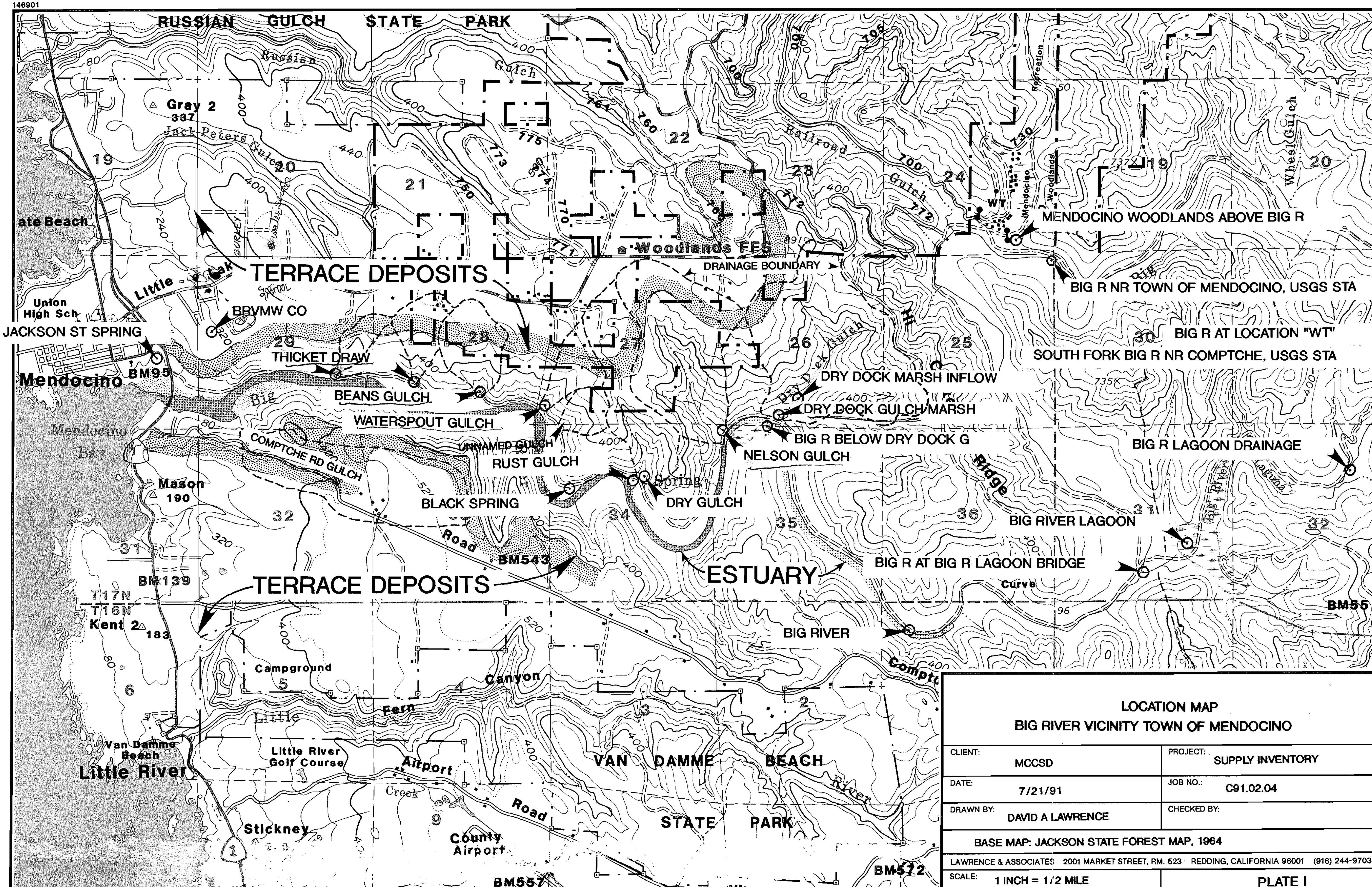

LOWER GULCHES + DRYDOCK MINIMUM SUMMER YIELD (JUN 1 TO NOV 1) VS PRECIP
DISCHARGE, GPM
350
300
250
200
150
100
10
20
30
40
50
FT BRAGG RAINFALL, INCHES
DRYDOCK RESERVOIR
CAPACITY AND DEPTH
40 AF, 14 FT
25 AF, 9 FT
15 AF, 7 FT
7.2 AF, 4 FT
1976 - 77
1990 - 91
1975 - 76
1991 - 92
AVERAGE PRECIP
1974 - 75
1977 - 78
Y = 5.1174X + 86.450
Y = 5.1174X + 63.823
Y = 5.1174X + 48.738
Y = 5.1174X + 36.972

FIGURE 45

146901


RUSSIAN GULCH STATE PARK
MENDOCINO WOODLANDS ABOVE BIG R
Woodlands FFS
DRAINAGE BOUNDARY
BIG R NR TOWN OF MENDOCINO, USGS STA
TERRACE DEPOSITS
BRVMW CO
JACKSON ST SPRING
BIG R AT LOCATION "WT"
SOUTH FORK BIG R NR COMPTCHE, USGS STA
THICKET DRAW
BEANS GULCH
DRY DOCK MARSH INFLOW
DRY DOCK GULCH/MARSH
WATERSPOUT GULCH
BIG R BELOW DRY DOCK G
UNNAMED GULCH
RUST GULCH
NELSON GULCH
BIG R LAGOON DRAINAGE
COMPTCHE RD GULCH
BLACK SPRING
DRY GULCH
BIG RIVER LAGOON
BIG R AT BIG R LAGOON BRIDGE
ESTUARY
TERRACE DEPOSITS
BIG RIVER
Mendocino
Mendocino Bay
Little River
Van Damme Beach
VAN DAMME BEACH STATE PARK
Little River Golf Course
County Airport
LOCATION MAP
BIG RIVER VICINITY TOWN OF MENDOCINO
CLIENT: MCCSD
PROJECT: SUPPLY INVENTORY
DATE: 7/21/91
JOB NO.: C91.02.04
DRAWN BY: DAVID A LAWRENCE
CHECKED BY:
BASE MAP: JACKSON STATE FOREST MAP, 1964
LAWRENCE & ASSOCIATES 2001 MARKET STREET, RM. 523 REDDING, CALIFORNIA 96001 (916) 244-9703
SCALE: 1 INCH = 1/2 MILE
PLATE I