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CVL.

4/1/92
AMM

ATTACHMENT 8

HYDROLOGY REPORT
INCLUDING APPROVAL LETTER

FOR

FLOOD INSURANCE STUDY
NEW RIVER
FROM NEW RIVER DAM TO ROCK SPRINGS
MARICOPA COUNTY, ARIZONA

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Phoenix, AZ 85009

DECEMBER, 1987

20

JOB 1090-01
CVL-4-0056

CVL

NOTES

Comments from the FEMA Approval letter dated March 30, 1987 have been incorporated into this HEC-1 Computer Run.

Rec'd-
4-1-87
CVL

Federal Emergency Management Agency

Washington, D.C. 20472

MAR 3 0 1987

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. Ashok C. Patel, P.E.
Senior Vice President
Coe and Van Loo Consulting Engineers, Inc.
4550 North 12th Street
Phoenix, Arizona 85014

Dear Mr. Patel:

This is in response to your letter dated February 2, 1987, to the Federal Emergency Management Agency (FEMA). In this letter you requested that FEMA review the report entitled "Hydrology Report for New River Upstream of New River Dam" dated January 21, 1987, prepared by Coe and Van Loo Consulting Engineers, Inc. (CVL), and confirm your understanding of the FEMA requirements for the level of detail to be used in the analysis of areas previously studied by approximate methods in the Flood Insurance Study (FIS).

In a report entitled "Hydrology Part 2, Gila River Basin, Phoenix, Arizona and Vicinity," dated 1982, the U.S. Army Corps of Engineers (COE) presented an analysis of the impacts of the New River Dam on the peak discharges of the 100-year recurrence interval flood along the New River downstream of the dam. Included in this report was a determination of the peak inflow discharge of the 100-year flood upstream of the dam. Our review indicates that the 100-year discharge at the New River Dam inflow obtained from the HEC-1 rainfall-runoff computer model contained in the CVL report agrees well with the COE value. Therefore, it is felt that the peak discharge values for the 10-, 50-, 100-, and 500-year floods in the subject reach as reported by CVL are appropriate for use in the hydraulic analysis of the New River in the 26 mile reach upstream of the New River Dam. Please note that our review indicates a slight discrepancy between the discharge values reported in the summary of discharges on Table 5 of the CVL report and the HEC-1 printout. The discharges contained in the HEC-1 printout should be used in the hydraulic analysis.

You also inquired if the 10-, 50-, and 500-year recurrence interval profiles are required in addition to the 100-year recurrence interval profile. For a detailed study of the referenced New River reach we recommend that the 10-, 50-, and 500-year profiles also be determined. This determination must be based on a hydraulic computer model which computes water-surface profiles considering the effects of backwater and structures. In addition, an equal conveyance loss floodway should be determined.

We have discussed the development potential along the New River with our regional office in San Francisco and the Maricopa County Flood Control District, and believe this level of detail study will be adequate to meet the future needs of the county by providing the county with additional tools for use in the administration of sound floodplain management practices.

Should you have any questions regarding this matter, please do not hesitate to contact Mr. Philip Myers of my staff in Washington, D.C., at (202) 646-2755.

Sincerely,

John L. Matticks
Chief, Risk Studies Division
Federal Insurance Administration

cc: Mr. Dan Sagramoso, P.E.
Floodplain Administrator
Flood Control District of Maricopa County
Mr. George L. Campbell, Chairman
Maricopa County Board of Supervisors
Mr. James Morris, P.E.
National Flood Insurance Program
Arizona Department of Water Resources

HYDROLOGY REPORT
FOR
NEW RIVER UPSTREAM OF NEW RIVER DAM

January 21, 1987

Prepared For:
Federal Emergency Management Agency
Risk Studies Division
Federal Insurance Administration
500 C Street, SW Room 422
Washington, D.C. 20472

Submitted By:
Coe & Van Loo Consulting Engineers, Inc.
4550 North 12th Street
Phoenix, AZ 85014
(602) 264-6831

on behalf of:
Maricopa County Flood Control District
3335 W. Durango
Phoenix, AZ 85009
(602) 262-1501

Job #1090-01
CVL #4/26/2

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February 2, 1987

Mr. John Matticks, Acting Chief
Federal Emergency Management Agency (FEMA)
Risk Studies Division
Federal Insurance Administration
500 C Street, SW Room 422
Washington, D.C. 20472

Attn: Mr. Philip Myers

CERTIFIED MAIL

Re: New River FIS
New River Upstream of New River Dam (26 Miles)
Maricopa County, AZ (Community No. 040037)

Gentlemen:

As you are aware, Coe and Van Loo Consulting Engineers, Inc., (CVL) has been retained by the Flood Control District of Maricopa County (FCDMC) to perform a detailed study of New River for the referenced reach.

The referenced reach has currently been designated as Zone "A" on the FIRM Panels 040037-0175A, 0400A, 0425A, and 0635A, dated July 2, 1979.

It is the intent of FCDMC to study in detail, per FEMA Guidelines, the referenced reach including:

1. Prepare detailed hydrologic analysis.
2. Prepare new topographic mapping.
3. Perform hydraulic analysis to establish 100-year floodplain and floodzone.
4. Submit above data and report to your office for review and approval.

We are therefore submitting a copy of detailed hydrologic study for your review and approval.

It is our understanding, in accordance with the recent guidelines, that for those study areas currently defined as Zone "A" by approximate methods and any future new study areas, FEMA requires the 100-year floodplain and floodway delineations. Flood profiles for the 10-, 50- and 500-year sotrms, however, are no longer required. We respectfully request that our understanding of these requirements be confirmed by your office.

Should you need any further information on the documents submitted herewith, please do not hesitate to call.

Very truly yours,

COE & VAN LOO
Consulting Engineers, Inc.

Ashok C. Patel, P.E., L.S.
Senior Vice President

ACP/ls
2/30/62

Enclosure

CC: Ray Lenaburg, FEMA Region IX
Dan Sagramoso, FCDMC
Dave Johnson, FCDMC
Doug Plasencia, FCDMC

CVL

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INTRODUCTION

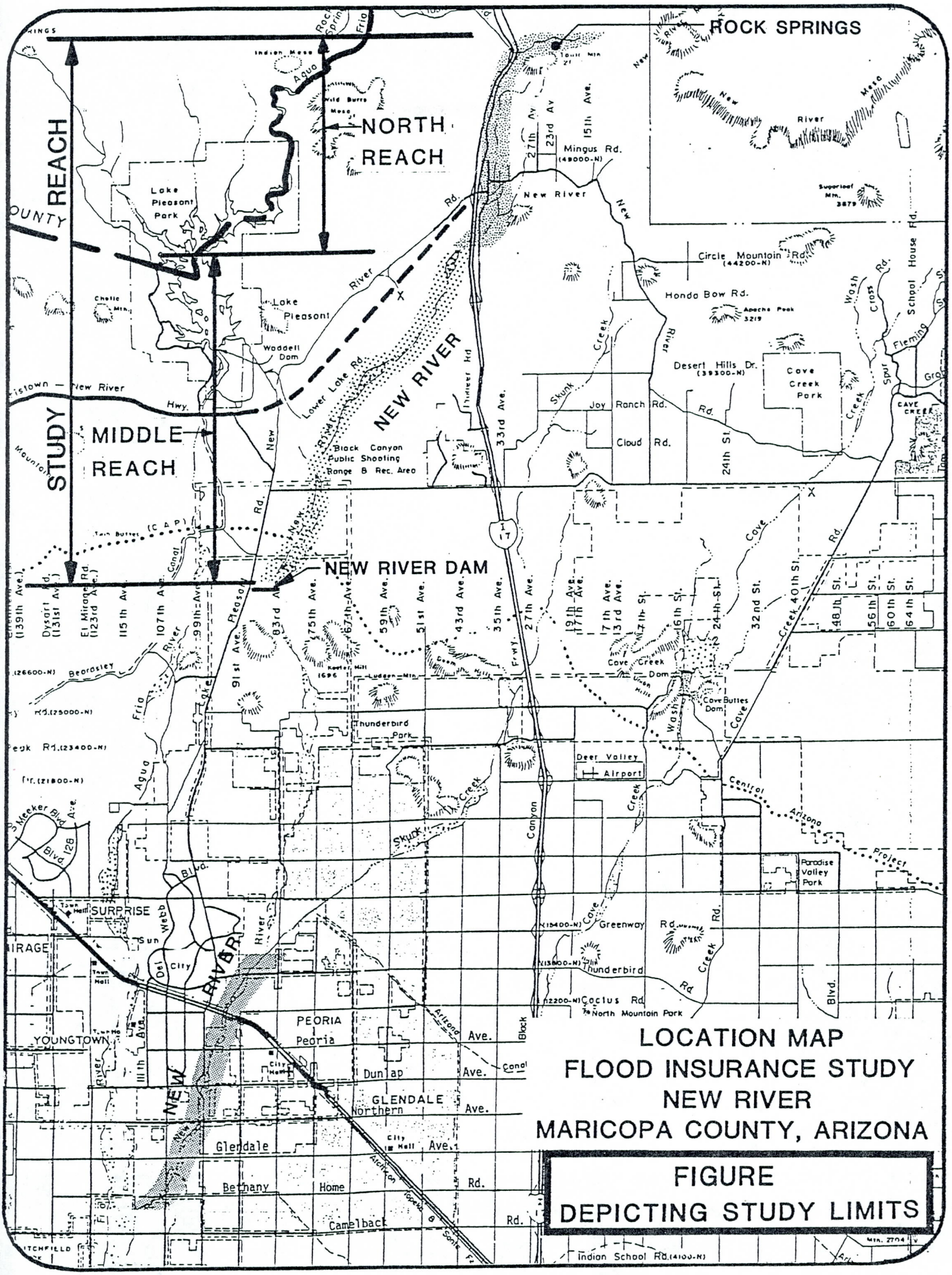
An accurate estimate of the potential for flood damage is a key element in a effective flood damage abatement program. Provided with an estimate of the potential discharge at a site for a given return period, it is possible to perform a backwater analysis and thereby determine the area which would be subjected to flooding by that discharge. In order for municipalities to qualify for the Federal flood insurance program, the Federal Emergency Management Agency (FEMA) requires that such an analysis be conducted and floodways and floodplains be delineated through these areas.

This report relates the results of a study undertaken by the Flood Control District of Maricopa County (FCDMC) to determine the estimated 100-year discharge at points along the New River watercourse in central Arizona. The peak discharge for the 500 year event has also been developed. This study has been submitted to FEMA by the study contractor, Coe & Van Loo Consulting Engineers, Inc., (CVL) for their review and approval. It is proposed that these discharges be used in the determination of water surface elevations in accordance with the FEMA Guidelines and Specifications.

CVL has been contracted with FCDMC to perform a Flood Insurance Study of New River upstream of New River Dam (See Location Map, Figure 1).

STUDY LOCATION

New River is located in north central Maricopa County, Arizona. From its headwaters in the New River Mountains, it flows generally southwest approximately 40 miles to its confluence with Skunk Creek. New River Dam is located about 9 miles upstream from this confluence. The New River drainage basin above the dam site has an areal extent of 170 square miles, the upper 40 per cent of which are mountainous. Stream gradients decrease from 370 feet per



LOCATION MAP
FLOOD INSURANCE STUDY
NEW RIVER
MARICOPA COUNTY, ARIZONA

FIGURE
DEPICTING STUDY LIMITS

FIGURE 1

mile in this area to nearly 10 feet per mile in the broad plain between the community of New River and the dam site.

The climate in this locale is primarily semi-desert with the annual precipitation averaging about 11 inches and occuring predominantly in the summer or winter months. The summer storms are associated with moist air masses that enter the state from the Gulf of Mexico producing moderate to intense afternoon and evening thundershowers. Winter precipitation originates from the Pacific Ocean is is generally much less severe.

PREVIOUS STUDIES

Estimates of the 100-year flood (20,750 cfs) and Standard Project Flood (SPF) (45,000 cfs) at New River were given in a U.S. Army Corps of Engineers (COE) Floodplain Information Study in 1967 (Ref. 1). After the 1970 flooding event at New River (19,500 cfs), it was felt by local floodplain administrators that the existing 100-year estimate was inaccurate. As part of the design work for New River Dam, estimates of the 100-year (53,000 cfs) and SPF (76,000 cfs) at the dam site were developed by the COE in 1974 (Ref. 2). Rather than completing an exhaustive study or adjusting the hydrograph at the dam site for the change in watershed area and other watershed characteristics, the 100-year discharge estimate at the dam site was merely transposed to the community of New River and an interim floodplain delineation was established based upon the 1974 COE hydrology.

CURRENT STUDY

Log-Pearson Type III Analysis

A statistical analysis of the recorded flows for New River near Rock Springs and for New River at the community of New River was conducted as set forth in

Bulletin 17B (Ref. 3). The drainage area for the former gage is 67.3 square miles and that for the latter, located approximately 6.5 miles downstream, is 83.3 square miles. The annual maximum recorded flows for these two stations are presented in Table 1. The statistical parameters determined in this analysis are presented in Table 2. The estimated discharges with return periods of 10, 50, 100 and 500 years are presented in Table 3. The discharge-frequency curves (Plates 1, 2) developed from this analysis are provided in Appendix 1.

It should be noted that records exist for both of these stations for the twenty-one year period extending from 1962-82, and that in only 5 of these years is the flow at New River less than it is at the station near Rock Springs. However, the log-Pearson analysis indicates that the 100-year flood event at the community of New River is 18,000 cfs less than at the station near Rock Springs, a not too plausible estimate. This apparent misestimation is due to the fact that the standard deviation and the weighted skew are much larger for the station near Rock Springs than for the station at the community of New River.

TABLE 1. Annual maximum discharges (cfs) for New River near Rock Springs and for New River near community of New River.

Year	near Rock Springs	near Community of New River
1961	--	325
1962	1050	1430
1963	765	4620
1964	4900	4380
1965	1510	1990
1966	4020	4180
1967	425	1420
1968	10600	12600
1969	1530	1310
1970	18600	19500
1971	6320	5090
1972	231	525
1973	1550	4250
1974	68	49
1975	1570	2280
1976	3230	7050
1977	4	805
1978	13600	18000
1979	6530	5560
1980	9350	14900
1981	35	0
1982	1760	2510
1983	12500	--
1984	692	--

Table 2. Statistical parameters determined from log-Pearson Type 3 analysis of annual maximum flows of New River near Rock Springs near community of New River.

	near Rock Springs	near Community of New River
Length of record	23 years	22 years
Length of record used in final analysis*	22 years	20 years
Mean of log of flows	3.2122	3.4398
Standard deviation	0.7986	0.5418
Weighted Skew	-0.5	-0.2

*After deletion of zero flow data and low/high outliers.

Table 3. Estimated flows (cfs) from log-Pearson Type 3 analysis for New River near Rock Springs and near the Community of New River.

	10 year	50 year	100 year	500 year
near Rock Springs	15256	42800	59325	108516
near Community of New River	13329	31160	41692	73854

Comparisons with similar watershed

Due to the paucity of stream gage data in this area and the dissimilarities in watersheds and climatological conditions, comparisons with other watersheds were not thought to be of any great worth and therefore were not made.

Flood estimates from precipitation

A rainfall-runoff model of the New River drainage basin was created using the HEC-1 Flood Hydrograph Package (Ref. 4). Precipitation excess was determined using the Soil Conservation Service Curve Number method. For this modeling effort it was assumed that the t-year flood resulted from the t-year rainfall event. A complete description of the modeling process follows.

The New River drainage basin above New River Dam can be broadly divided into two topographic regions: the upper portion (above community of New River) which is a rugged mountainous region with steep channel slopes, and the lower portion which is a flat desert plain with very braided channels and mild channel slopes. The upper portion of the basin (see Figure 2, Watershed Map) was divided into 21 sub-basins and unit hydrographs were developed from the Corps of Engineers (COE) Phoenix Mountain S-hydrography (Ref. 2) for each of these sub-basins. The lower portion was divided into 33 sub-basins. Inasmuch as sheetflow is the dominant form of runoff in this area, most of these sub-basins were modeled using the kinematic wave option of HEC-1. Where this was determined not to be the appropriate methodology, unit hydrographs were developed from the COE Phoenix Valley S-hydrograph (Ref. 2). Appendix 2 contains a summarized listing of the more important sub-basin characteristics.

Area adjusted 100-year rainfall values for 6-, 12-, and 24-hour storm were determined for both the upper and loer basins using NOAA Atlas 2 (Ref. 5). It was assumed that these rainfall events had Type II storm distributions.

The model was calibrated by adjusting the curve numbers of the sub-basins so that the peak discharge at New River Dam matched the COE 1974 estimate at that site. The 24-hour storm was used for this calibration procedure.

As an indication of the validity of this modeling effort it is worth noting that the curve numbers used agree with those recommended by the Arizona Highway Department (Ref. 6), and that the timing of the peak discharge at the dam site closely matches the time of peak discharge generated by the COE study (Ref. 2).

After the calibration procedure, the model was run again for the 6- and 12-hour storms in order to determine if these events generated higher peak discharges. As expected, the 24-hour storm resulted in the highest peak discharge. The model was then run using 10-, 50- and 500-year, 24-hour precipitation values in order to obtain estimates of the floods with those return intervals. These precipitation values for both the upper and lower drainages are presented in Table 4.

The 500-year, 24-hour precipitation values were obtained by: 1) converting the partial-duration series rainfall values with return periods of 2-, 5- and 10-years to annual series values, 2) plotting these values along with the 25-, 50-, and 100-year values on extreme-value probability paper, and 3) extrapolating the 500-year value from this plot.

Table 4. 24 hour precipitation values (inches).

Return Period	Upper Basin	Lower Basin
10 Years	3.50	3.00
50 Years	4.45	4.10
100 Years	4.95	4.40
500 Years	6.32	5.78

Reduction factor of 0.94 used for upper and lower basins.

Table 5. Discharge values obtained from rainfall-runoff model of New River drainage basin.

Return Period	at Community of New River	at New River Dam
10 Years	20645 cfs	29270 cfs
50 Years	28420 cfs	49025 cfs
100 Years	32480 cfs	55560 cfs
500 Years	47110 cfs	84125 cfs

RESULTS AND RECOMMENDATIONS

A copy of the HEC-1 model inputs and outputs for the 100 year rainfall event is presented in Appendix 3. Results of the model runs for the 10, 50, 100 and 500 year storms are presented in Table 5.

It is recommended that the discharge values determined in this study be adopted by FEMA for the purpose of Flood Insurance Study.

which one?

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2. Gila River Basin, New River and Phoenix City Streams, Arizona, Design Memorandum No. 2, Hydrology, Part 1, U.S. Army Engineer District, Los Angeles, Corps of Engineers, October 1974.

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5. Precipitation-Frequency ATlas of the Western United States, NOAA Atlas 2, Volume VIII-Arizona, National Weather Service, 1973.

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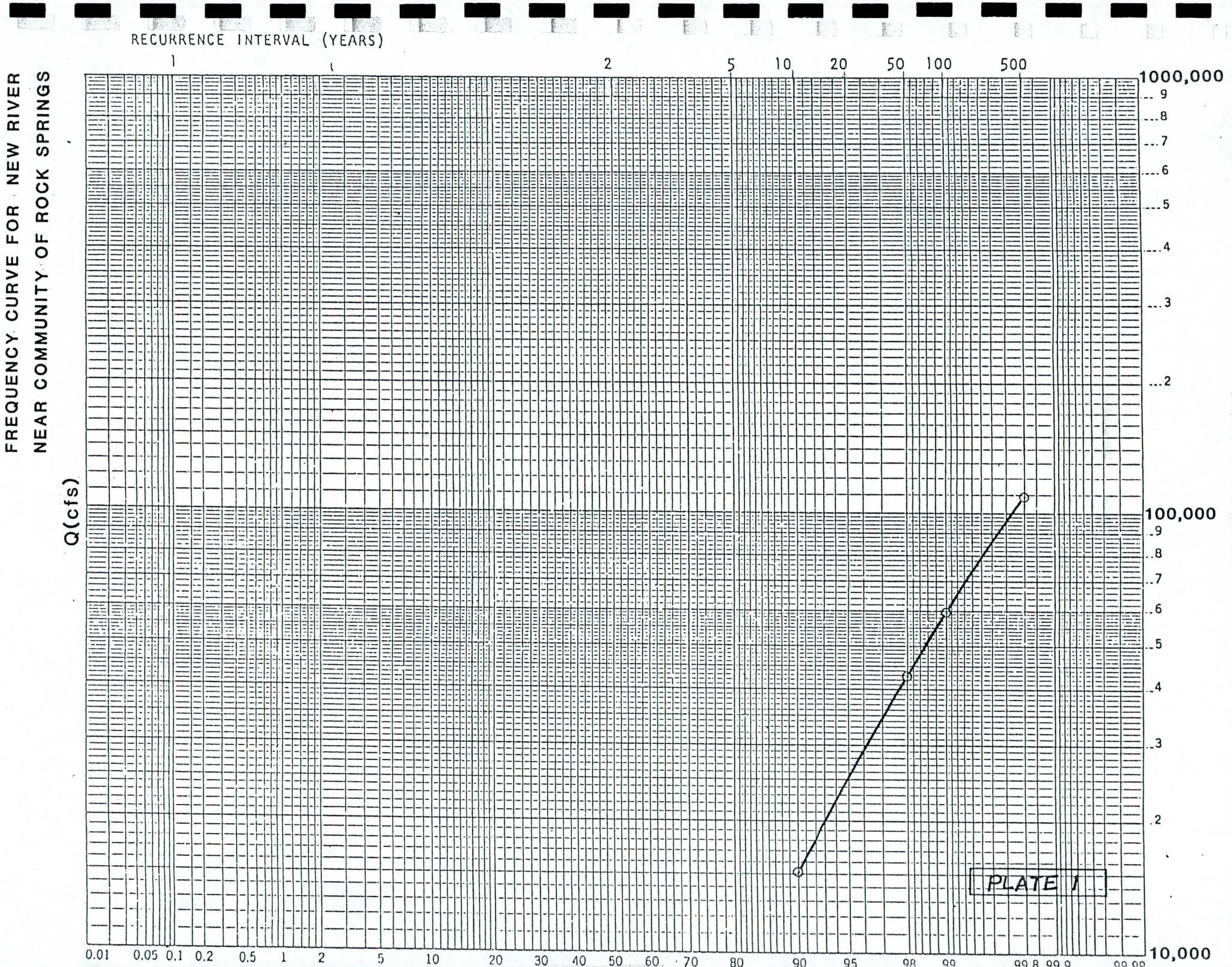
7. Gila River Basin, New River and Phoenix City Streams, Arizona, Design Memorandum 3, General Design Memorandum - Phase I, Plan Formulation, U.S. Army Engineer District, Los Angeles, Corps of Engineers, July 1976.

8. Gila River Basin, Phoenix, Arizona and Vicinity (including New River), Skunk Creek and the New and Agua Fria Rivers, Design Memorandum No. 3, General Design Memorandum - Phase II, Project Design - Part 4, May 1986.

A P P E N D I X 1

Frequency Discharge Curves

Job #1090-01
CVL #4/26/2


FREQUENCY CURVE FOR NEW RIVER
NEAR COMMUNITY OF ROCK SPRINGS
RECURRENCE INTERVAL (YEARS)
1
2
5
10
20
50
100
500
Q(cfs)
1000,000
100,000
10,000
0.01
0.05
0.1
0.2
0.5
1
2
5
10
20
30
40
50
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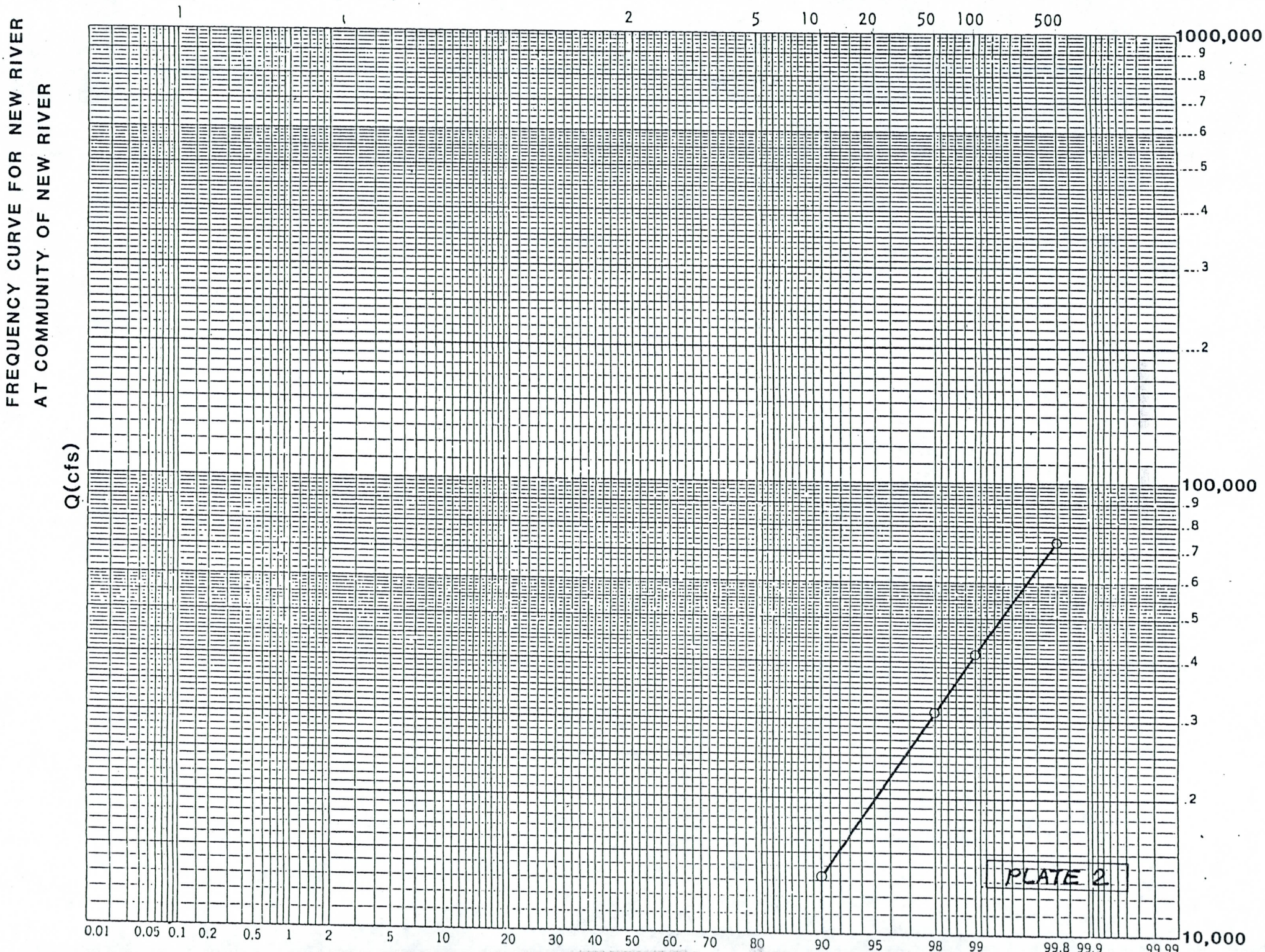
70
80
90
95
98
99
99.8
99.9
99.99
PLATE 1


FREQUENCY CURVE FOR NEW RIVER
AT COMMUNITY OF NEW RIVER
RECURRENCE INTERVAL (YEARS)
1
2
5
10
20
50
100
500
Q(cfs)
1000,000
100,000
10,000
0.01
0.05
0.1
0.2
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1
2
5
10
20
30
40
50
60
70
80
90
95
98
99
99.8
99.9
99.99
PLATE 2

APPENDIX 2

Sub-basin Characteristics

Job #1090-01
CVL #4/26/2

CVL

Sub-basin Characteristics

AREA NO.	AREA (mi^2)	MAX. ELEV. (feet)	MIN. ELEV. (feet)	CURVE NUMBER	LAG (hrs)
Upper Drainage					
1a	15.78	4950	3305	90	1.30
1b	4.27	5320	3305	90	.96
1c	6.88	4990	3305	90	1.00
2a	9.18	4525	3050	90	.97
2b	2.54	5360	3050	90	.74
2c	1.67	4240	3050	90	.50
2d	2.13	4260	2970	90	.68
2e	1.23	4280	2970	90	.45
2f	.30	3650	2910	90	.21
2g	1.71	4420	2910	90	.75
2h	3.16	4575	2910	90	.76
2i	3.02	4640	2820	90	.62
2j	.96	3955	2820	90	.41
2k	2.35	4170	2820	90	.61
2l	5.39	4150	2460	90	.87
2m	6.17	3910	2460	90	.78
2n	4.20	3280	2300	90	.84
3a	7.87	2315	1990	85	1.50
3b	8.29	2750	1990	85	1.06
3c	1.02	2285	1980	90	.71
3d	.22	2200	1980	90	.32
Lower Drainage					
1e	14.13	2880	1720	89	.64
2e	17.63	1720	1475	89	1.39
3e	4.35	1620	1390	89	.85
4e	.23	1453	1390	87	**
1w	6.57	2440	1740	89	1.15
2w	7.90	2560	1710	89	.97
3w	1.29	2080	1760	87	**
4w	4.14	1970	1780	88	.91
5w	.70	1780	1630	87	**
6w	.71	1790	1640	87	**
7w	1.47	1840	1590	87	**
8w	1.37	1900	1640	88	**
9w	6.68	2160	1630	89	.70
10w	.93	2250	1620	88	**
11w	.45	1785	1615	88	**
12w	.42	1715	1590	88	**
13w	.52	1730	1590	88	**
14w	.22	1670	1580	88	**
15w	.87	1775	1560	88	**
16w	.79	1680	1550	87	**
17w	.38	1645	1540	88	**

Job #1090-01
CVL #4/26/2

Sub-basin Characteristics (cont.)

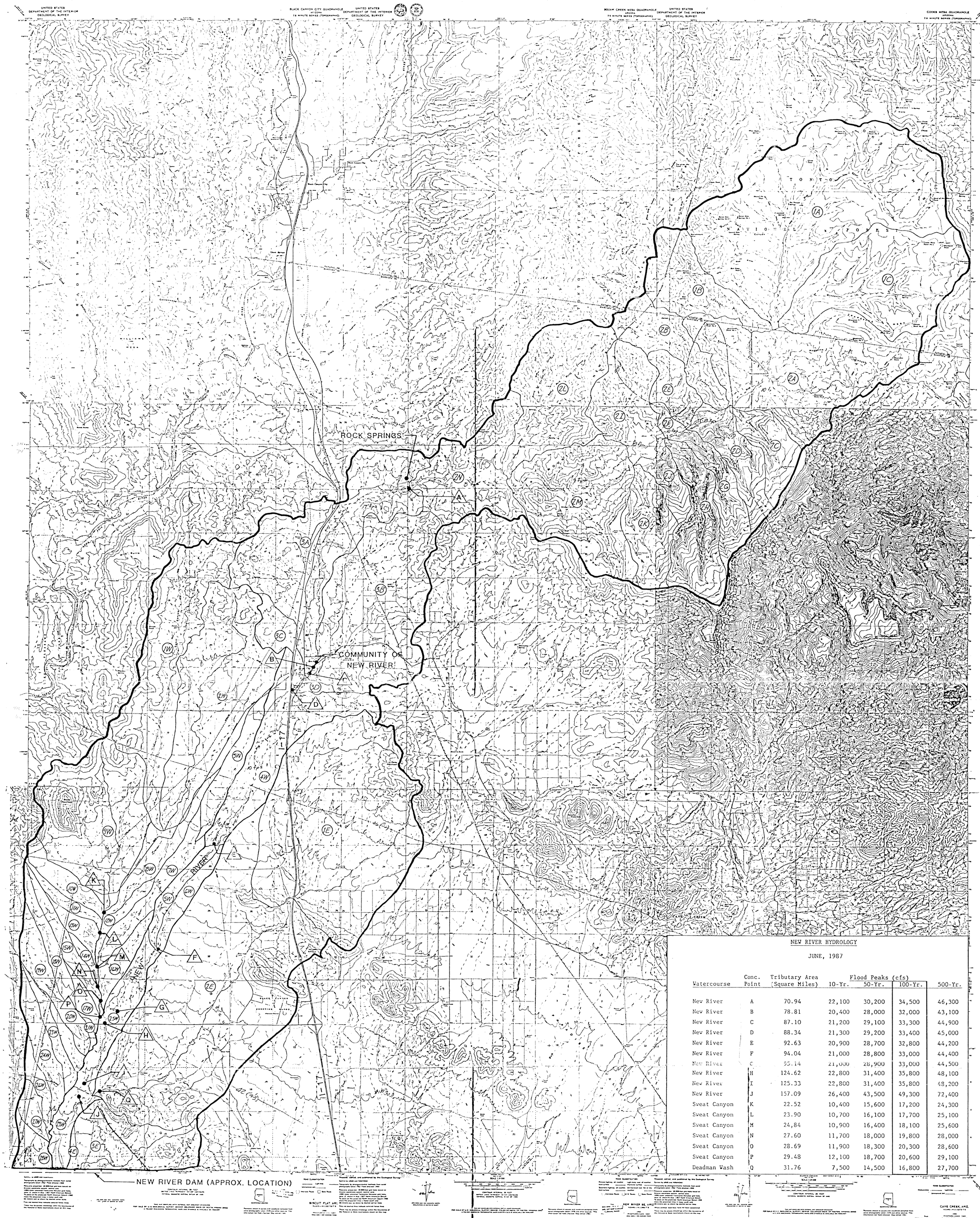
AREA NO.	AREA (mi^2)	MAX. ELEV. (feet)	MIN. ELEV. (feet)	CURVE NUMBER	LAG (hrs)
18w	.75	1775	1570	88	**
19w	.90	1725	1570	88	**
20w	.52	1570	1510	88	**
21w	.09	1575	1515	87	**
22w	.34	1600	1490	88	**
23w	.66	1640	1470	88	**
24w	1.16	1640	1450	88	**
25w	1.81	1665	1470	87	**
26w	.51	1565	1440	88	**
27w	.47	1520	1435	88	**
28w	1.52	1930	1390	88	**

** Sub-basin modeledusing kinematic wave option; lag time is not an input parameter for this methodology.

A P P E N D I X 3

HEC-1 Computer Printouts

Job #1090-01
CVL #4/26/2



NEW RIVER HYDROLOGY

JUNE, 1987

Watercourse	Conc. Point	Tributary Area (Square Miles)	Flood Peaks (cfs) 10-Yr.	50-Yr.	100-Yr.	500-Yr.
New River	A	70.94	22,100	30,200	34,500	46,300
New River	B	78.81	20,400	28,000	32,000	43,100
New River	C	87.10	21,200	29,100	33,300	44,900
New River	D	88.34	21,300	29,200	33,400	45,000
New River	E	92.63	20,900	28,700	32,800	44,200
New River	F	94.04	21,000	28,800	33,000	44,400
New River	G	95.14	21,000	28,900	33,000	44,500
New River	H	124.62	22,800	31,400	35,800	48,100
New River	I	125.33	22,800	31,400	35,800	48,200
New River	J	157.09	26,400	43,500	49,300	72,400
Sweat Canyon	K	22.52	10,400	15,600	17,200	24,300
Sweat Canyon	L	23.90	10,700	16,100	17,700	25,100
Sweat Canyon	M	24,84	10,900	16,400	18,100	25,600
Sweat Canyon	N	27.60	11,700	18,000	19,800	28,000
Sweat Canyon	O	28.69	11,900	18,300	20,300	28,600
Sweat Canyon	P	29.48	12,100	18,700	20,600	29,100
Deadman Wash	Q	31.76	7,500	14,500	16,800	27,700

LEGEND

WATERSHED BOUNDARY

SUBWATERSHED BOUNDARY

(2E) WATERSHED DESIGNATION

(A) CONCENTRATION POINT IDENTIFICATION

WATERSHED MAP

NEW RIVER UPSTREAM OF NEW RIVER DAM

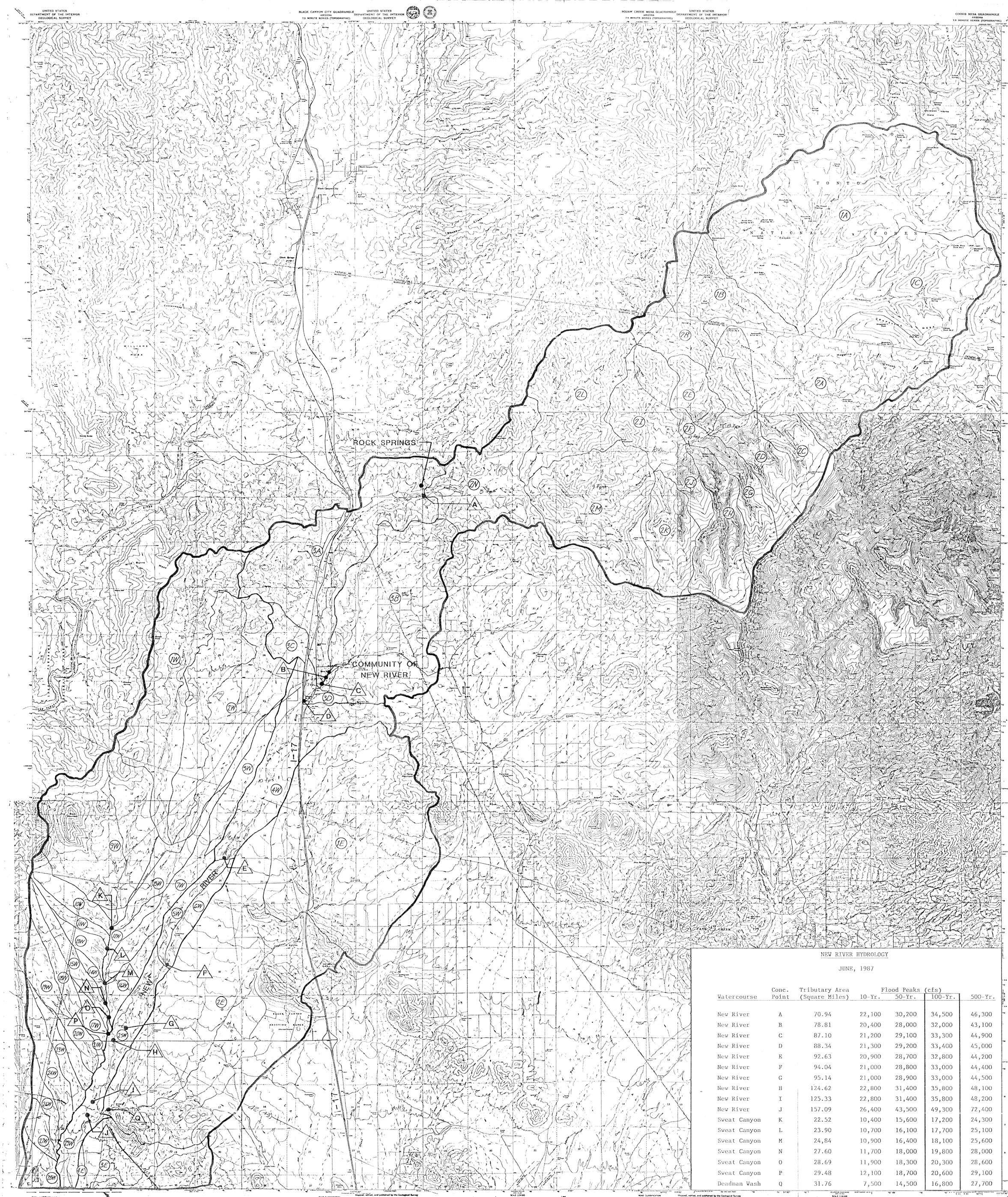
FLOOD INSURANCE STUDY

MARICOPA COUNTY, ARIZONA

JANUARY 1987
REVISED JUNE 1987

COE & VAN LOO CONSULTING ENGINEERS INC. PHOENIX ARIZONA

CVL FILE NO. 1090-01-1 FIGURE 2



NEW RIVER HYDROLOGY

JUNE, 1987

Watercourse	Conc. Point	Tributary Area (Square Miles)	Flood Peaks (cfs) 10-Yr.	50-Yr.	100-Yr.	500-Yr.
New River	A	70.94	22,100	30,200	34,500	46,300
New River	B	78.81	20,400	28,000	32,000	43,100
New River	C	87.10	21,200	29,100	33,300	44,900
New River	D	88.34	21,300	29,200	33,400	45,000
New River	E	92.63	20,900	28,700	32,800	44,200
New River	F	94.04	21,000	28,800	33,000	44,400
New River	G	95.14	21,000	28,900	33,000	44,500
New River	H	124.62	22,800	31,400	35,800	48,100
New River	I	125.33	22,800	31,400	35,800	48,200
New River	J	157.09	26,400	43,500	49,300	72,400
Sweat Canyon	K	22.52	10,400	15,600	17,200	24,300
Sweat Canyon	L	23.90	10,700	16,100	17,700	25,100
Sweat Canyon	M	24,84	10,900	16,400	18,100	25,600
Sweat Canyon	N	27.60	11,700	18,000	19,800	28,000
Sweat Canyon	O	28.69	11,900	18,300	20,300	28,600
Sweat Canyon	P	29.48	12,100	18,700	20,600	29,100
Deadman Wash	Q	31.76	7,500	14,500	16,800	27,700

LEGEND

WATERSHED BOUNDARY

SUBWATERSHED BOUNDARY

(2E) WATERSHED DESIGNATION

(A) CONCENTRATION POINT IDENTIFICATION

WATERSHED MAP

NEW RIVER UPSTREAM OF NEW RIVER DAM

FLOOD INSURANCE STUDY

MARICOPA COUNTY, ARIZONA

JANUARY 1987
REVISED JUNE 1987

COE & VAN LOO CONSULTING ENGINEERS INC. PHOENIX ARIZONA

CVL FILE NO. 1090-01-1 FIGURE 2