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HYDROLOGIC ANALYSES FOR BUCHANAN WASH
MARICOPA COUNTY, ARIZONA

Registered Professional Engineer (Civil)
CERTIFICATE NO.
10283
SAMUEL E.
KAO
Date Signed 11-30-87
ARIZONA, U.S.A.

NOVEMBER 1987

AGK ENGINEERS, INC.

Suite 220
2255 North 44th Street
Phoenix, Arizona 85008

AGK Project No. 310.40

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OF MARICOPA COUNTY

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A. Determination of Rainfall Input

B. Determination of Runoff Curve Number

C. HEC-1 Results

1.0 INTRODUCTION

The hydrologic analyses for Buchanan Wash is a part of the scope of work performed by AGK Engineers, Inc. for the Flood Control District of Maricopa County under Contract FCD 86-26.

The purpose of this study is to evaluate the peak discharges to be used in the Flood Insurance Study for Buchanan Wash from Skunk Creek to C.A.P. Canal, Maricopa County, Arizona. Peak discharges for 10-, 50-, 100-, and 500-year events were developed and summarized in this report.

2.0 STUDY LOCATION

Buchanan Wash, a tributary of Skunk Creek, is situated immediately west of Interstate 17 between Happy Valley Road and Carefree Highway. The watershed of Buchanan Wash is approximately 11 square miles, which generally drains from north to south and joins Skunk Creek just north of Happy Valley Road. The natural drainage pattern of the watershed has been slightly altered since the C.A.P. Canal was constructed in the early 1980's.

A portion of the runoff on the east side of the watershed is now intercepted by the canal and routed westerly along the canal to Buchanan Wash where the natural channel was replaced by a

triple-barrel 66-inch diameter pipe culvert under the canal crossing, as shown in Figure 1.

General topography throughout the watershed is a combination of alluvial plain on the north and east as well as isolated steep bare rock hills on the south and west. The predominant hilly terrain is known as Deem Hills which forms the southwest boundary of the watershed.

The climate of the study area is characterized by hot summer, mild winter and infrequent rainfall. The mean annual rainfall is about 7.1 inches, falling normally in two seasons. One season, primarily resulting from local convective storms, lasts from July to mid-September; the other season, mainly created by cyclonic (frontal) storms, extends from December through March. Of the two types of storms, the summer convective storm is considered to be the critical flood producing event in this area.

3.0 SOILS AND LAND USE

Soils in the study area are composed of three major groups: Rillito-Gunsight-Pinal association, Ebon-Pinamt-Tremant association, and Cherioni-Gachado-Rock Outcrop association. More detailed information on soils is presented in Appendix B.

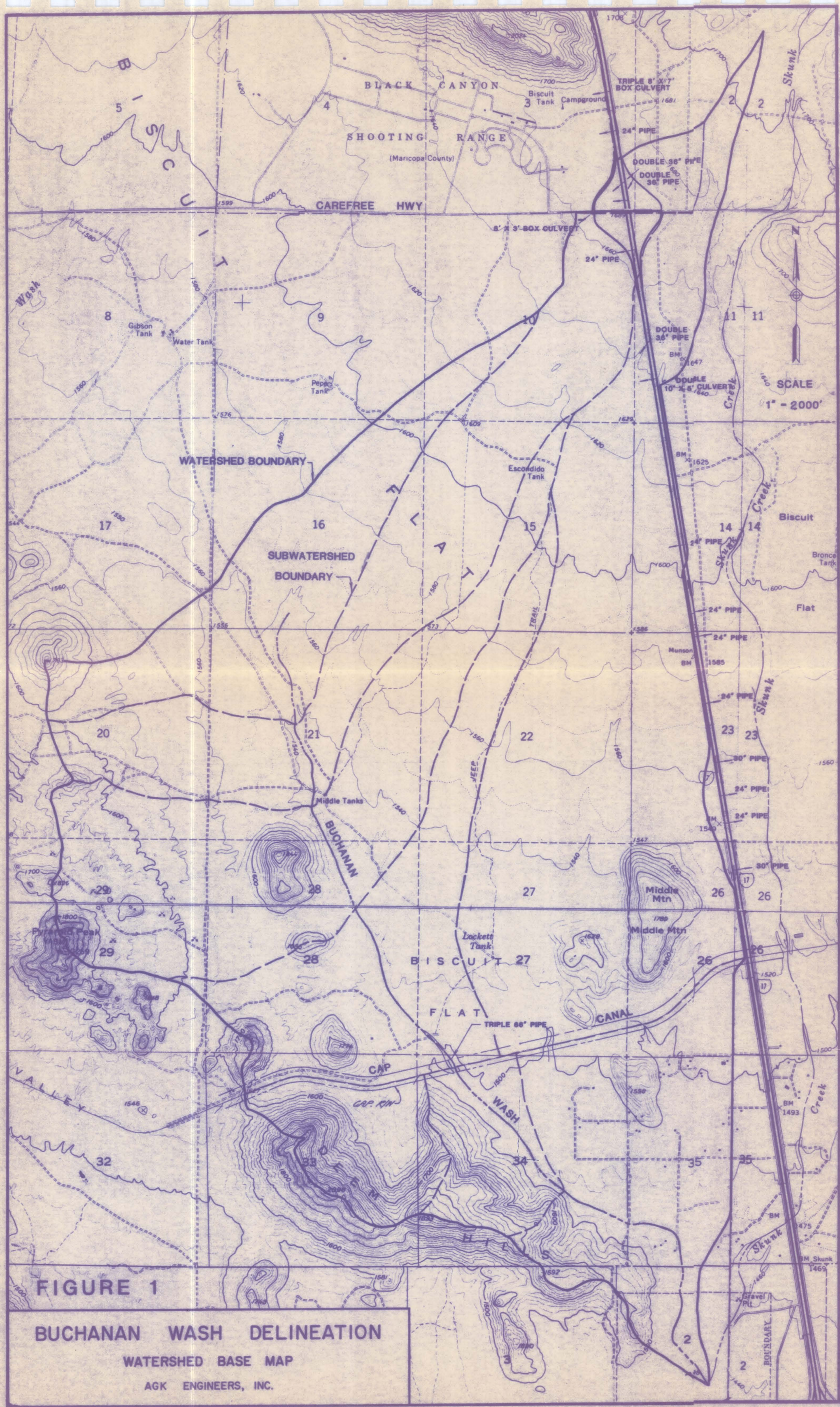

FIGURE 1

BUCHANAN WASH DELINEATION

WATERSHED BASE MAP

AGK ENGINEERS, INC.

Natural vegetation is sparse with plant species being typical to desert areas. Cacti, along with other desert shrubs grow throughout the watershed. Scattered trees such as palo verde and mesquite exist among the shrubs. The vegetation tends to be thicker along, and adjacent to, the stream courses. Perennial grasses grow after winter rains.

The majority of the land within the watershed is still in its natural state. The current development south of the canal, between Interstate 17 and Buchanan Wash, consists of light residential with some mobile homes. The same pattern of development is anticipated for the future.

4.0 METHODOLOGY

Since no gaging station is available in the watershed, there is no means to develop discharge-frequency relationships from historical flood records. As a result, the HEC-1 computer model as developed by the U. S. Army Corps of Engineers (Reference 1) was used for generating flood peaks at various concentration points in the watershed.

4.1 Subwatersheds

The watershed was subdivided into eight (8) subwatersheds to form an interconnected system of stream network components,

as shown in Figure 2. The boundaries of the subwatersheds were determined based on the USGS quadrangle maps (Reference 5) and the 1 inch=1000 feet aerial photographs obtained from Cooper Aerial Survey Company (Reference 7). The drainage boundaries near the Carefree Highway interchange were determined with the aid of the as-built highway plans for Interstate 17, obtained from Arizona Department of Transportation (Reference 8). Field verification supplemented the mapping inadequacies in determination of drainage boundaries.

The interrelationship among the stream network components is illustrated in Figure 3, where Subwatershed 5 denotes the triple-barrel culvert at the C.A.P. Canal crossing.

4.2 Rainfall Input

The precipitation frequencies for the study area were obtained from isopluvial charts as shown on NOAA Atlas 2, prepared by the U. S. Department of Commerce (Reference 4). The SCS Type II dimensionless distribution of cumulative rainfall table (revised in May 1982) was used for generating the rainfall hyetographs. The detailed procedure for rainfall input determination is presented in Appendix A.

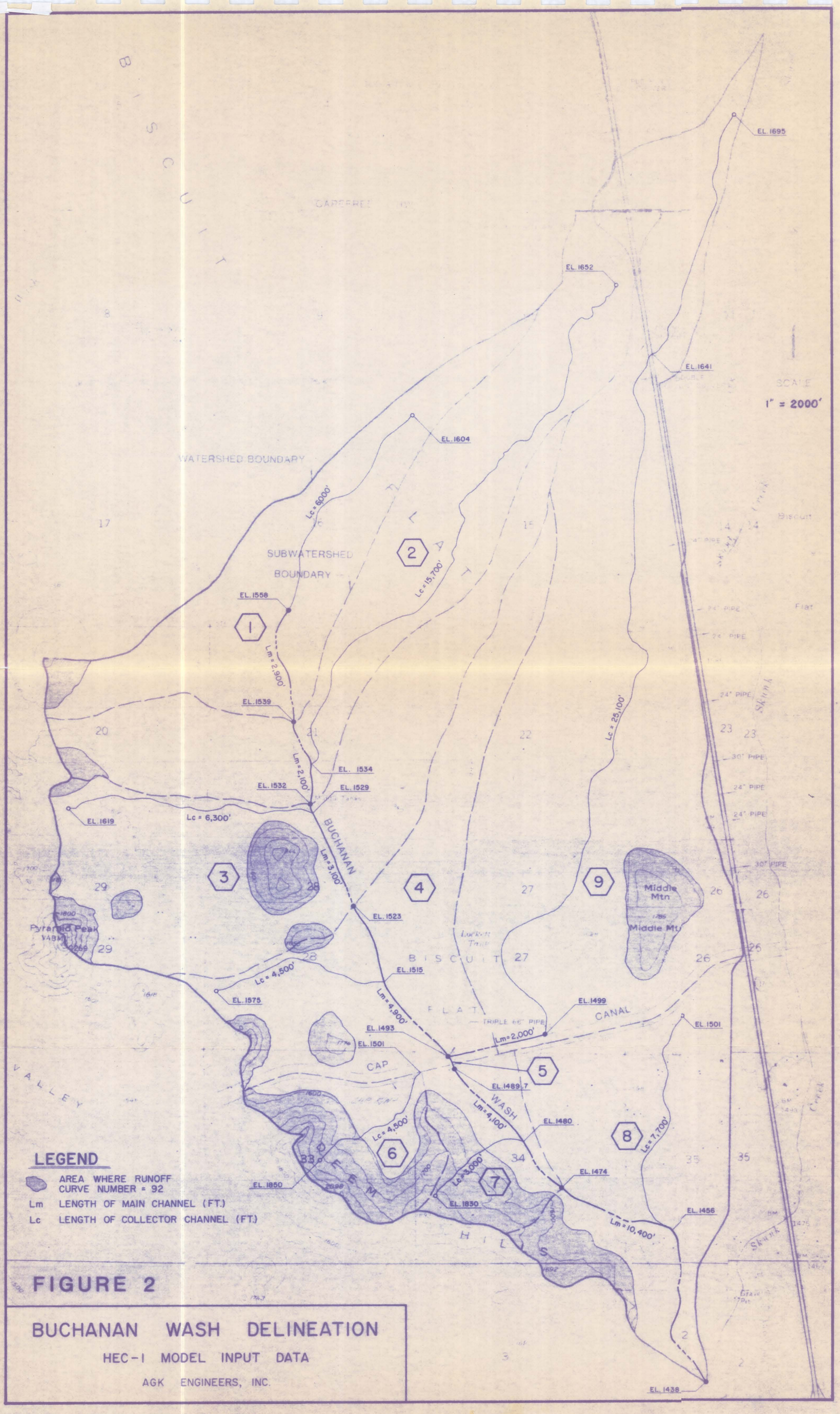

FIGURE 2

BUCHANAN WASH DELINEATION

HEC-1 MODEL INPUT DATA

AGK ENGINEERS, INC.

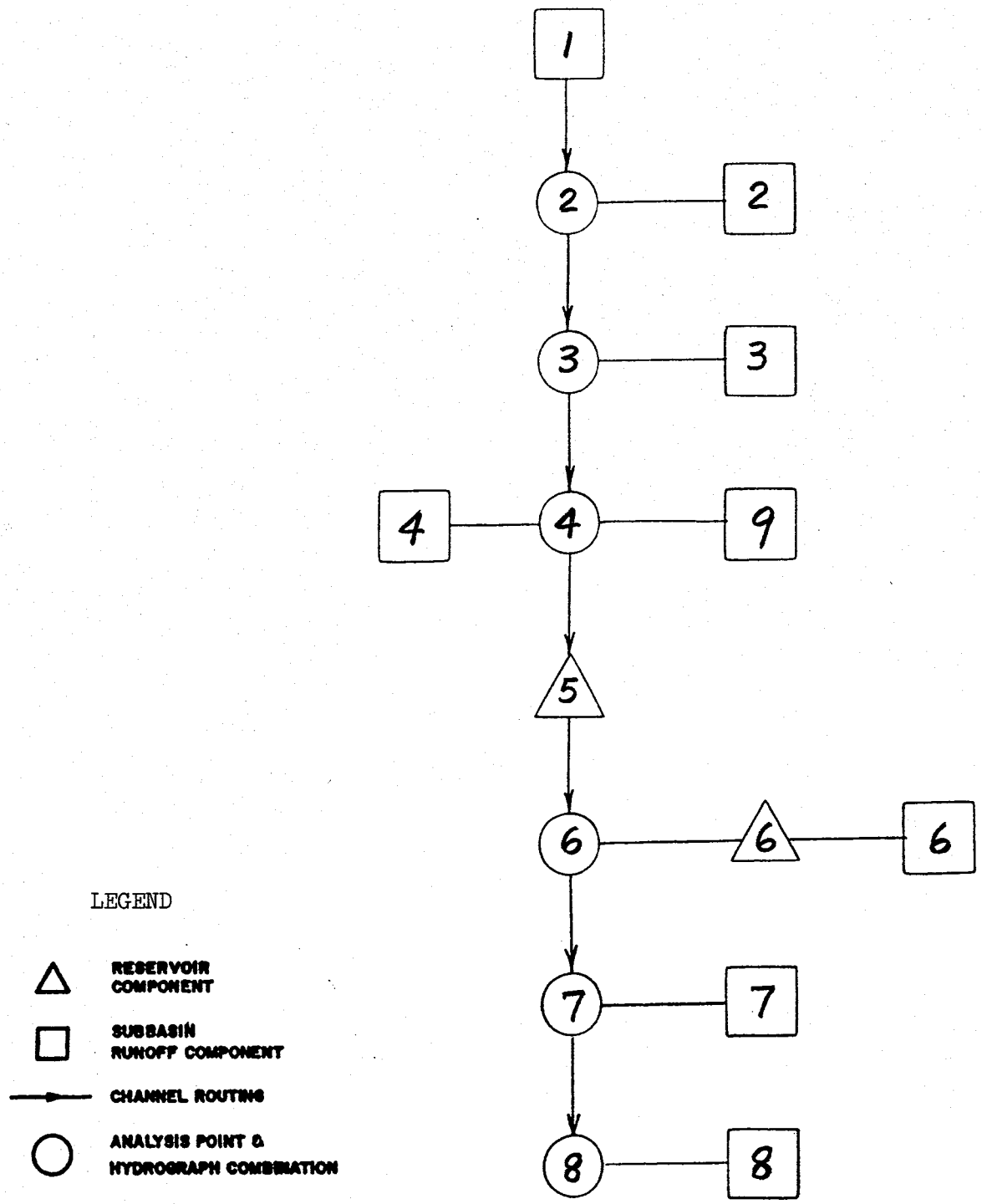

FIGURE 3. HEC-1 CODING SCHEMATIC FOR BUCHANAN WASH

4.3 Runoff Curve Number

The SCS curve number was used for the determination of rainfall losses due to interception and infiltration. The curve numbers were estimated from the tables in the SCS National Engineering Handbook Section 4, Hydrology, 1972 (Reference 3), according o the soil information obtained from the General Soil Map for Maricopa County, as prepared by SCS in 1973 (Reference 2). The detailed derivation for runoff curve numbers is presented in Appendix B.

4.4 Overland Flow

The kinematic wave overland-flow option of the HEC-1 computer model was used in this study. The effective roughness parameters were based on the category of sparse vegetation, per Table 3.5 of the HEC-1 Users Manual. The characteristics of the overland flow for each subwatershed are summarized in Table 1.

4.5 Flood Routing

The kinetic wave method was used for flood routing from upstream to downstream. The cross-sectional geometry was approximated by a trapezoidal shape. The input data are summarized in Table 2. The level-pool reservoir routing was

used for flows through culverts, such as at the C.A.P. Canal. The relationship between the volume of storage and the elevation was established based on the aerial photographs with 2-foot contour intervals.

TABLE 1. OVERLAND FLOW DATA

Subbasin Data	Overland Flow Length (Ft.)	Overland Flow Slope (Ft/Ft)	Roughness Parameter	% Subbasin Area	Drain Area (Sq.Mi)	Loss Rate (L.S. Record) SCS Curve Number
1	1200	0.008	0.13	0.97	1.15	86
1A	600	0.070	0.15	0.03		92
2	1100	0.008	0.13	0.99	1.89	86
2A	600	0.070	0.15	0.01		92
3	700	0.044	0.13	0.87	1.72	86
3A	500	0.090	0.15	0.13		92
4	650	0.015	0.13	0.94	1.29	86
4A	500	0.080	0.15	0.06		92
5	N/A (C.A.P. Crossing)					
5A	N/A (C.A.P. Crossing)					
6	550	0.400	0.15	0.37	0.43	86
6A	550	0.400	0.15	0.63		92
7	400	0.100	0.15	0.54	0.39	86
7A	400	0.100	0.15	0.46		92
8	1100	0.009	0.13	0.91	1.30	86
8A	500	0.060	0.15	0.09		92
9	950	0.0087	0.13	0.95	3.12	86
9A	500	0.060	0.15	0.05		92
				Total Area =	11.29 sq. mi.	

TABLE 2. CHANNEL DATA

Subbasin	Length (Ft)	Slope (Ft/Ft)	Manning N	Area (Sq.Mi)	Shape	Width (Ft)	Side Slope (Ft/Ft)	Upstream Inflow
1 Collector	6,000	0.0077	0.070	1.15	Trapezoid	10	10:1	
Main	2,900	0.0066	0.055		Trapezoid	12	4:1	No
2 Collector	15,700	0.0075	0.070	1.37	Trapezoid	10	10:1	
Main	2,100	0.0033	0.055		Trapezoid	13	4:1	Yes
3 Collector	6,300	0.0143	0.070	0.46	Trapezoid	10	3:1	
Main	3,100	0.0029	0.055		Trapezoid	17	4:1	Yes
4 Collector	4,500	0.0130	0.070	0.24	Trapezoid	10	5:1	
Main	4,900	0.0062	0.055		Trapezoid	20	4:1	Yes
5 Collector	N/A (C.A.P. Crossing)							
Main	N/A (C.A.P. Crossing)							
6 Collector	4,500	0.0780	0.070	0.13	Trapezoid	10	3:1	
Main	10	0.0080	0.055		Trapezoid	24	2:1	Yes
7 Collector	3,000	0.1170	0.070	0.06	Trapezoid	10	3:1	
Main	4,100	0.0044	0.050		Trapezoid	25	2:1	Yes
8 Collector	7,700	0.0058	0.070	0.37	Trapezoid	10	10:1	
Main	10,400	0.0035	0.050		Trapezoid	28	2:1	Yes
9 Collector	25,100	0.0078	0.070	2.45	Trapezoid	10	5:1	
Main	2,000	0.0020	0.055		Trapezoid	20	5:1	No

5.0 RESULTS

Because the runoff peak may occur from storms ranging in duration from one hour to 24 hours, the peak rates were computed for storm durations of one-hour, two-hours, three-hours, six-hours, and 24-hours, and the greatest peaks which were produced by six-hour storm were selected as the input for hydraulic analyses. Peak discharge-drainage area relationships for Buchanan Wash and its tributary are shown in Table 3. The complete computer output for HEC-1 modeling is presented in Appendix C.

TABLE 3. SUMMARY OF DISCHARGES

Flood Source and Location	Drainage Area Sq. Miles	Peak Discharges (cfs) 10-Yr	50-Yr	100 Yr	500-Yr
Main Channel					
At 800 feet downstream of C.A.P. Canal	9.17	1065	1253	1308	1407
At 4300 feet downstream of C.A.P. Canal	9.99	1175	1467	1609	1958
At Confluence of Skunk Creek	11.29	1422	2005	2304	3067
Initial Water Surface Elevation		1456.50	1458.93	1460.42	1465.95
Tributary					
At Cross Section 2.045 of Main Channel	0.43	100	231	301	467
Initial Water Surface Elevation		1491.37	1491.72	1491.87	1492.24

6.0 BIBLIOGRAPHY AND REFERENCES

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   ASY 965-6265

5. U. S. Department of the Interior, Geological Survey, 7.5 Minute Series Topographic Maps, Scale 1:24,000, Contour Intervals vary: Biscuit Flat, Hedgpeth Hills, New River SE, and Union Hills, Maricopa County, Arizona.

6. Aerial Mapping Company, Inc., Topographic Maps for Buchanan Wash, Scale 1"=200', Contour Interval = 2 feet, September 1986.

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11. U. S. Department of Commerce, Bureau of Public Roads, Hydraulic Charts for the Selection of Highway Culverts, September 1961.

12. Hill, R.H. and Seller, W.D., Arizona Climate 1931-1972, 1974.

$$Q = CLH^{3/2} = 2.67 \sum \Delta x h^{3/2}$$

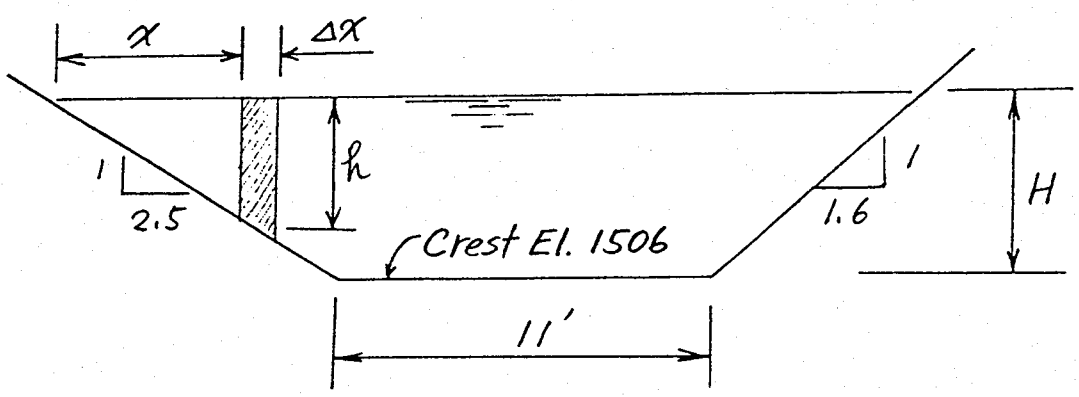


FIGURE 4. STAGE - DISCHARGE RELATIONSHIP AT THE OUTLET OF SUBWATERSHED 6

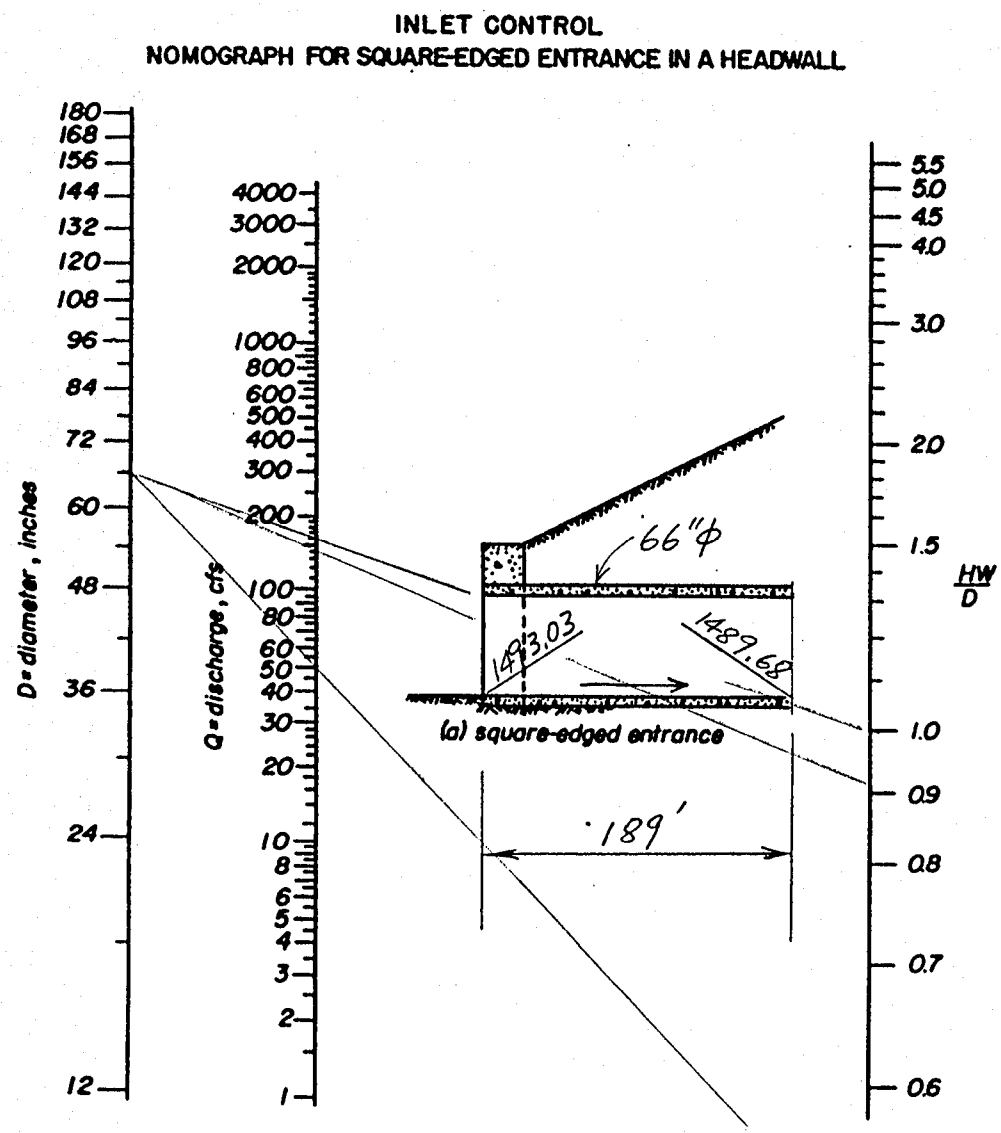


FIGURE 5. STAGE - DISCHARGE RELATIONSHIP AT C.A.P. CANAL CROSSING

Elev.	HW/D	Discharge per Barrel (cfs)	Total Discharge (cfs)
1493	0	0	0
1495.75	0.50	51	153
1498	0.91	140	420
1498.5	1.00	160	480

When water stage above 1498.5, use orifice flow equation for discharge:

$$Q = CA\sqrt{2gh}$$

where $C = 0.62$

A = X-sectional area in s.f.

$g = 32.2$ ft/sec^2

h = Depth of flow measured to the ℄ of 66" culvert.

APPENDIX A

DETERMINATION OF RAINFALL INPUT

ACK ENGINEERS, INC.
2255 N. 44th St. Suite 220 • Phoenix, Az. 85008 • Phone (602) 244-2566

BY SK DATE 11/4/86

CHECK CH DATE 11/86

CLIENT FCDMC

JOB BUCHANAN WASH DELINEATION JOB NO. 310.40

DETERMINATION OF RAINFALL INPUT

1. RAINFALL AMOUNT

A. Based on NOAA Atlas 2 (1973) which is the same as ADOT Charts (1970). See attached sheets.

B.

Return Period	Map Value (in) 6-hr	Map Value (in) 24-hr	Adjusted Value (in) 6-hr	Adjusted Value (in) 24-hr
10-yr	2.10	2.60	2.09	2.60
25-yr	2.60	3.20	2.50	3.12
50-yr	2.85	3.60	2.88	3.60
100-yr	3.25	4.05	3.25	4.09
2-yr	1.25	1.50	1.25	1.59

C. Determination of 1-hr precipitation

$$Y_2 = -0.011 + 0.942\left(X_1^2/X_2\right) = -0.011 + 0.942\left(\frac{1.25^2}{1.59}\right)$$
$$= 0.915''$$

$$Y_{100} = 0.494 + 0.755\left(X_3^2/X_4\right) = 0.494 + 0.755\left(\frac{3.25^2}{4.09}\right)$$
$$= 2.444''$$

ACK ENGINEERS, INC.
2255 N. 44th St. Suite 220 • Phoenix, Az. 85008 • Phone (602) 244-2566

BY SK DATE 11/5/86

CHECK CH DATE 11/86

CLIENT FCDMC

JOB BUCHANAN WASH DELINEATION JOB NO. 310.40

D. Precipitation for Various Durations (in inches)

Return Period	1-Hr Precip.	2-Hr Precip.	3-Hr Precip	6-Hr Precip	24-Hr Precip
10-yr	1.55	1.75	1.85	2.09	2.60
25-yr	1.87	2.10	2.22	2.50	3.12
50-yr	2.15	2.40	2.58	2.88	3.60
100-yr	2.45	2.73	2.90	3.25	4.09
500-yr	3.10	3.45	3.68	4.10	5.10

E. 500-Yr Precipitation

Obtained by extending the plotted precipitation figures on log-probability paper.

Project No. BUCHANAN WASH Station _____

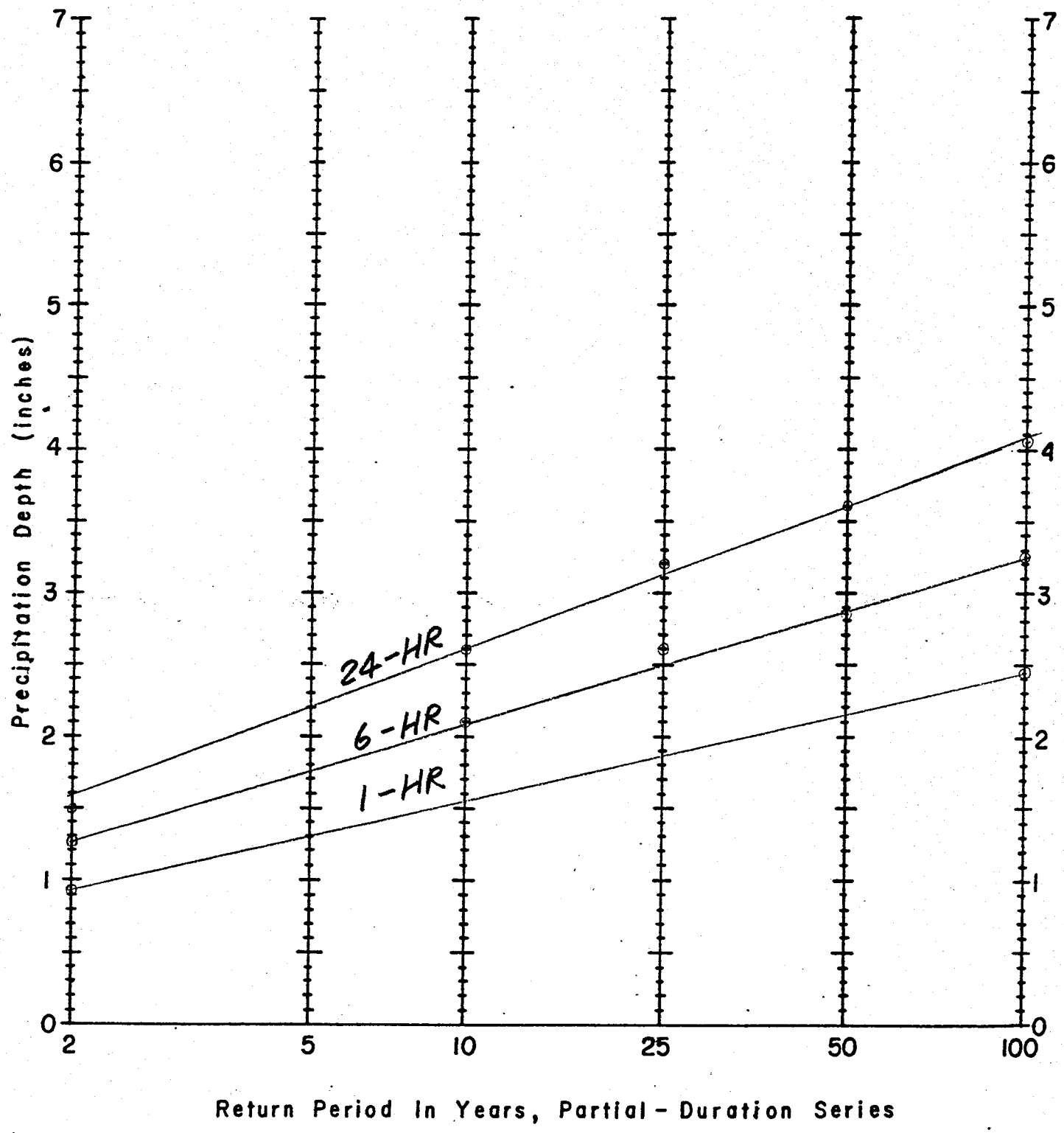
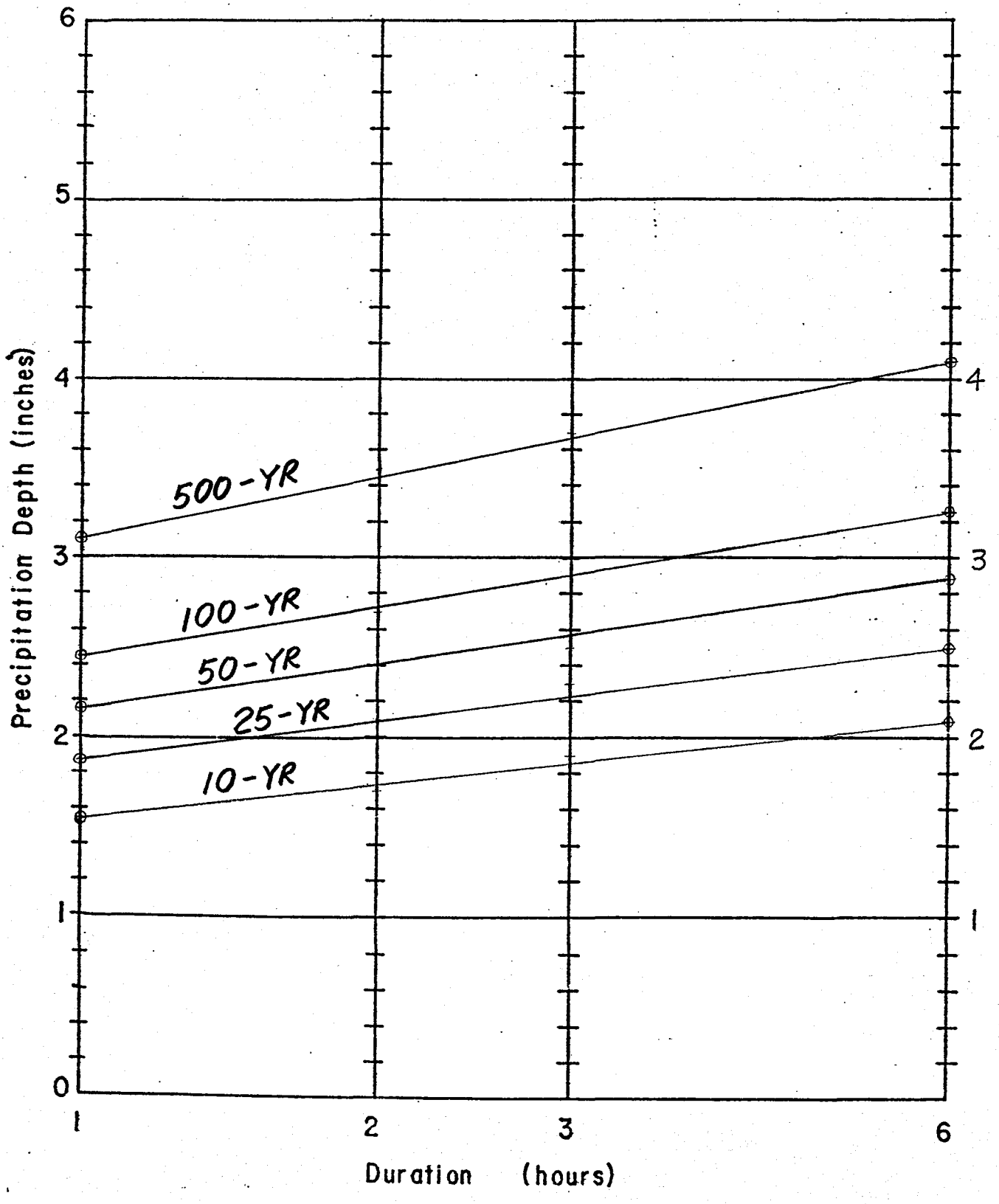


Figure 1 Precipitation Depth Versus Return Period for Partial-Duration Series

Figure 2-2 (revised 4-75)

Precipitation Depth — Duration Diagram (1—6 hours)



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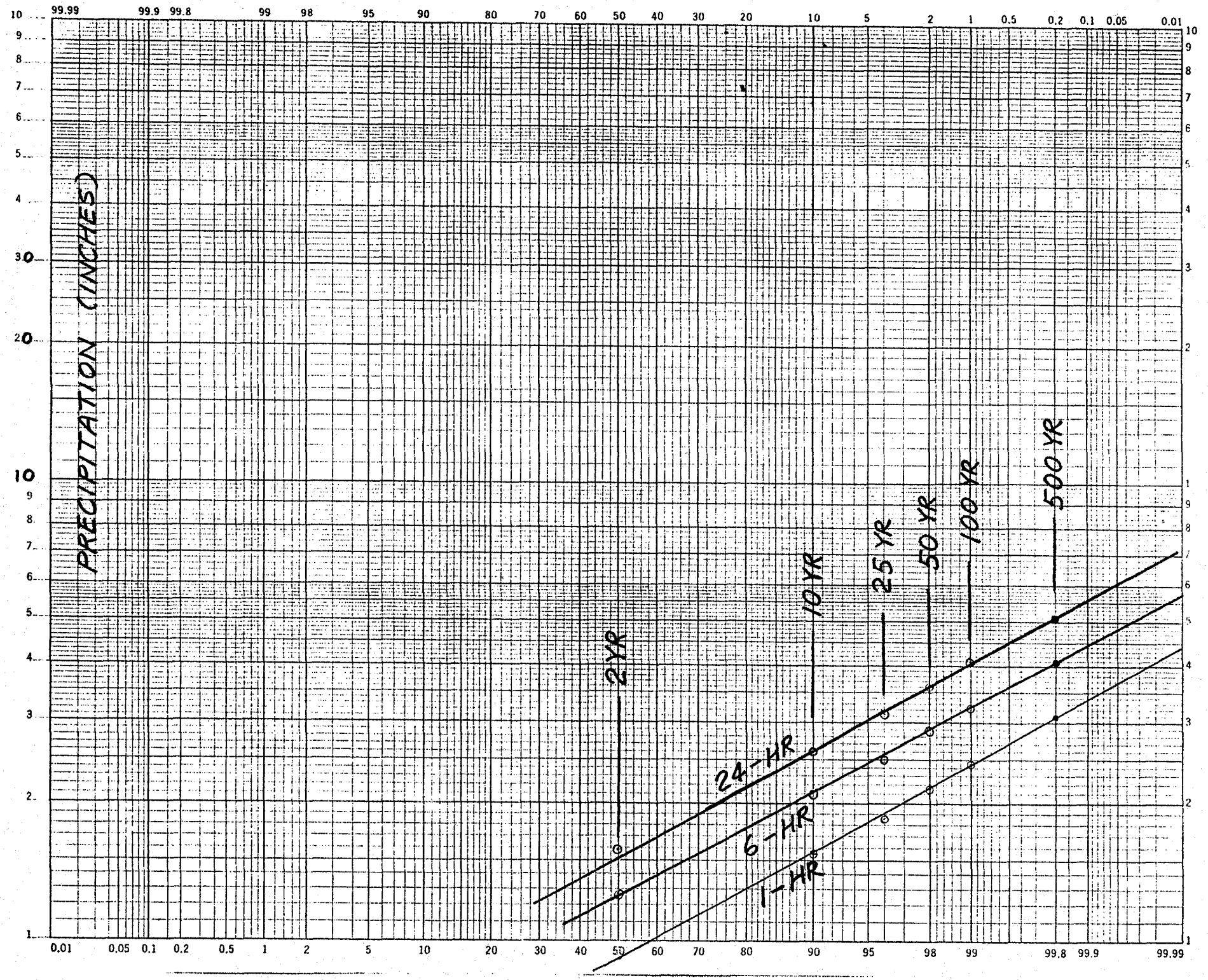
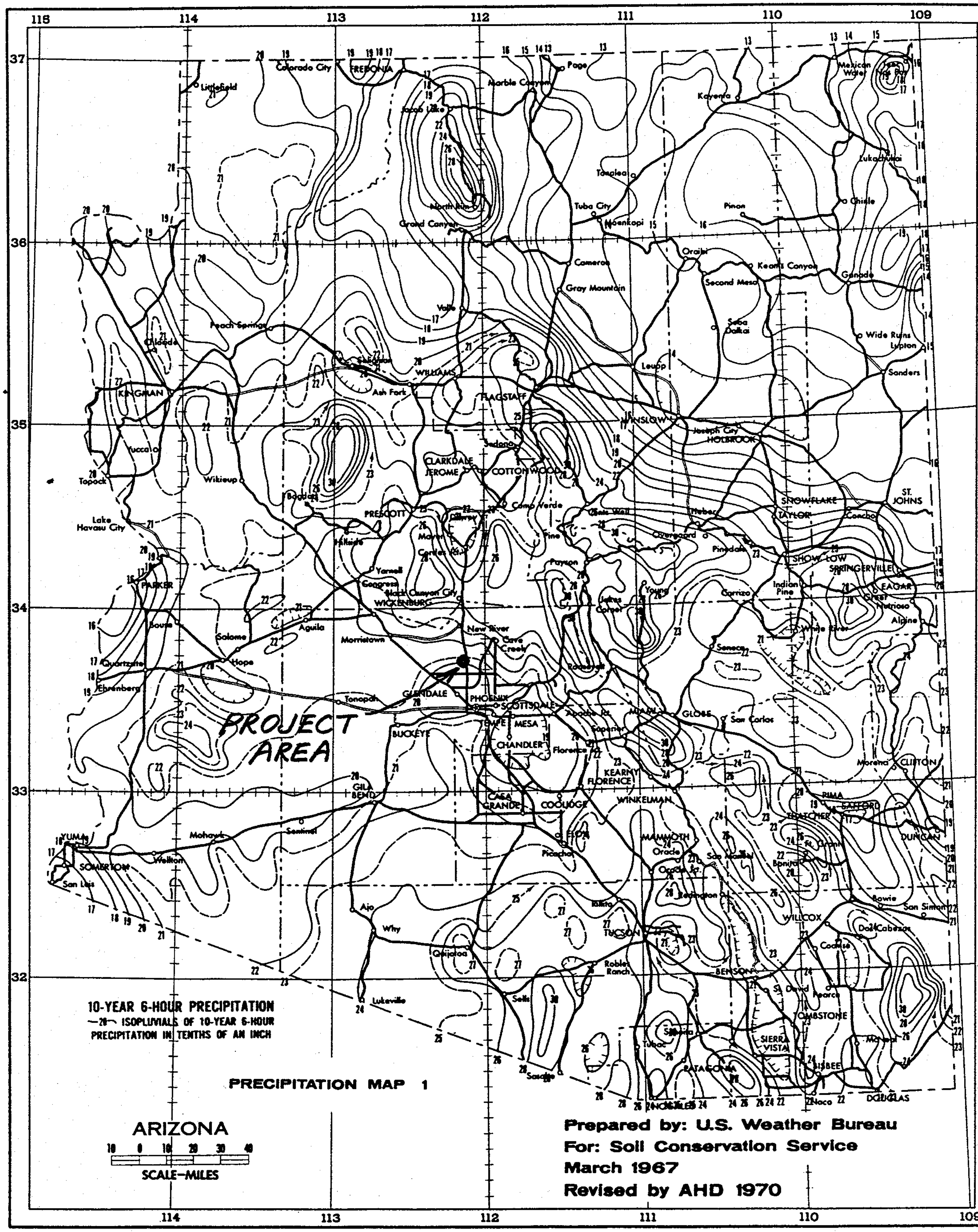
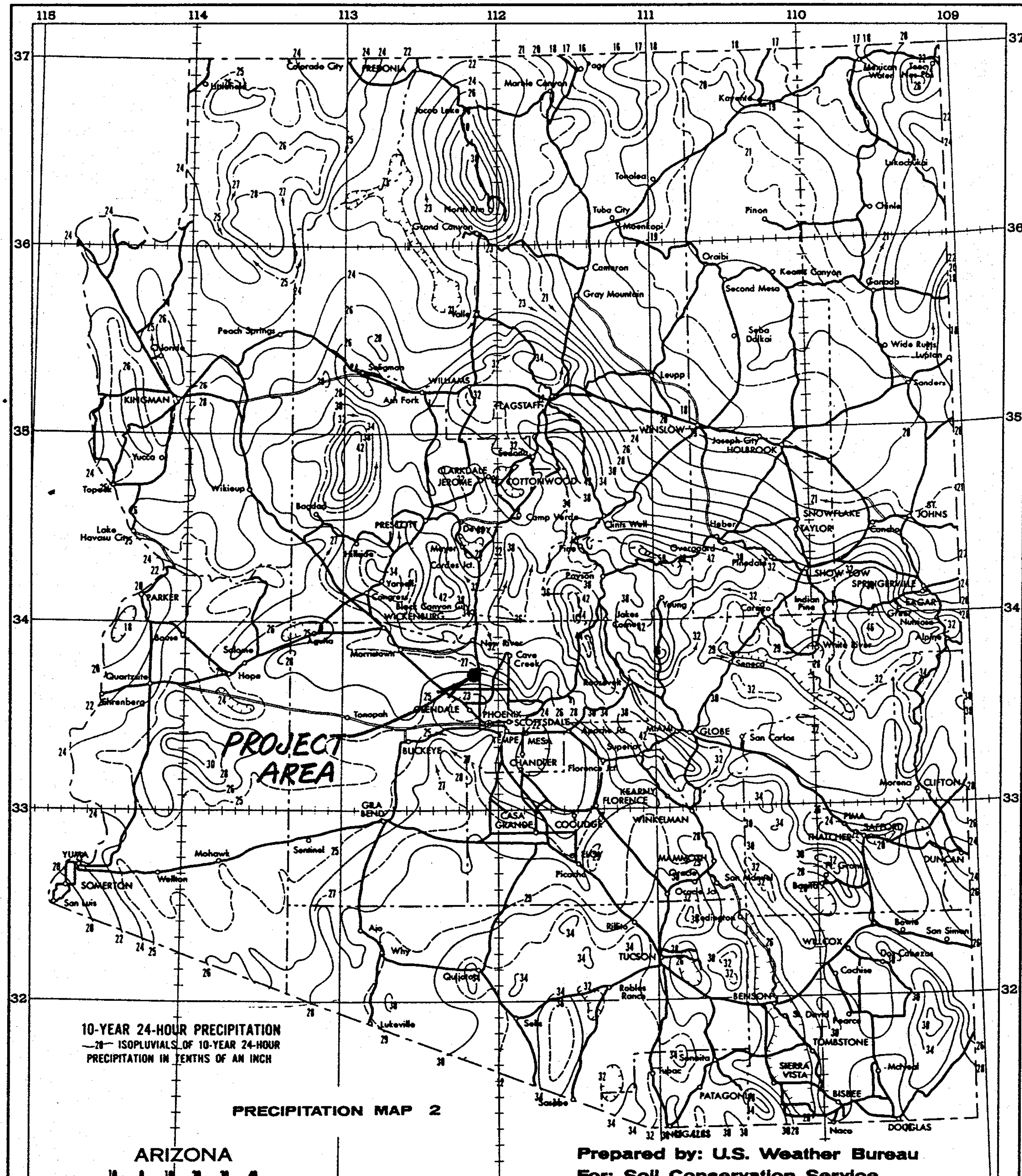
2 CYC




10-YEAR 6-HOUR PRECIPITATION
—20— ISOPLUVIALS OF 10-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH
PRECIPITATION MAP 1
ARIZONA
SCALE-MILES
PROJECT AREA
Prepared by: U.S. Weather Bureau
For: Soil Conservation Service
March 1967
Revised by AHD 1970


10-YEAR 24-HOUR PRECIPITATION
—28— ISOPLUVIALS OF 10-YEAR 24-HOUR PRECIPITATION IN TENTHS OF AN INCH
PRECIPITATION MAP 2
ARIZONA
SCALE-MILES
PROJECT AREA
Prepared by: U.S. Weather Bureau
For: Soil Conservation Service
March 1967
Revised by AHD 1970
KINGMAN
FLAGSTAFF
WINSLOW
HOLBROOK
PRESCOTT
WICKENBURG
PHOENIX
GLENDALE
SCOTTSDALE
TEMPE
MESA
CHANDLER
BUCKEYE
GILA BEND
CASA GRANDE
COOLIDGE
FLORENCE
GLOBE
TUCSON
BENSON
TOMBSTONE
BISBEE
DOUGLAS
NOGALES
YUMA
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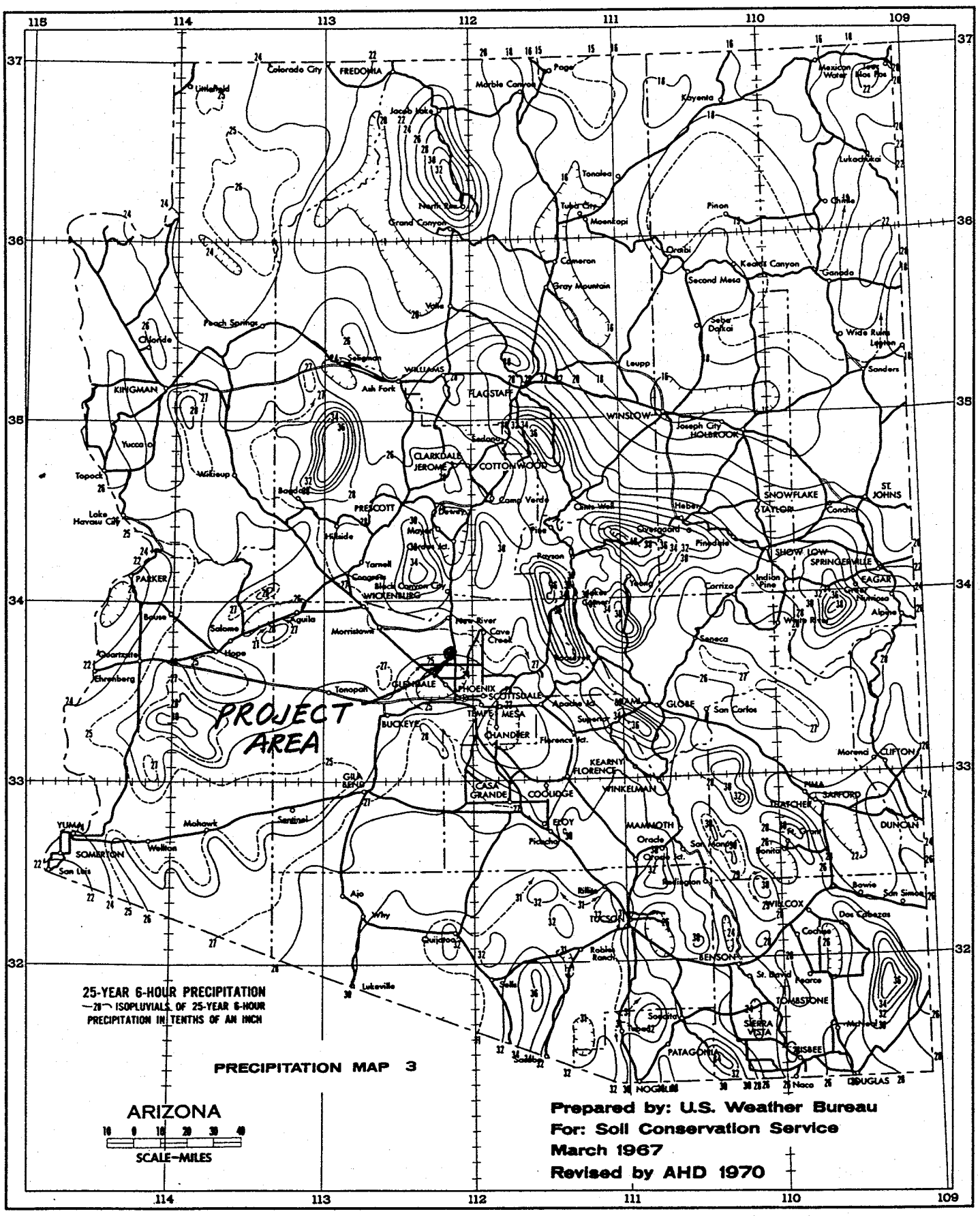
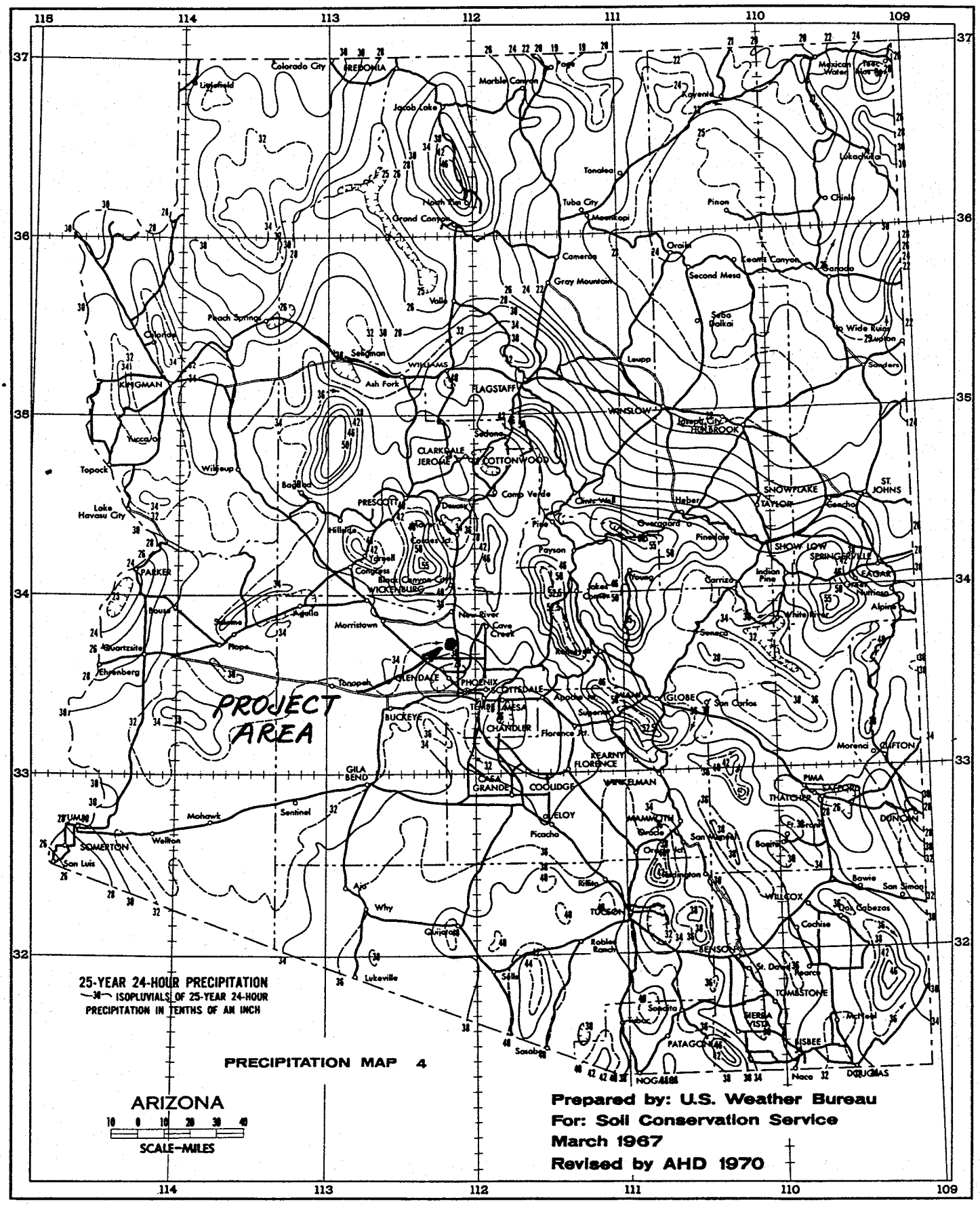
PARKER
SAFFORD
CLIFTON
DUNCAN
WILLCOX
SPRINGERVILLE
SNOWFLAKE
ST. JOHNS


PROJECT AREA
25-YEAR 6-HOUR PRECIPITATION
—20— ISOPLUVIALS OF 25-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH
PRECIPITATION MAP 3
ARIZONA
SCALE-MILES
Prepared by: U.S. Weather Bureau
For: Soil Conservation Service
March 1967
Revised by AHD 1970
FREDONIA
Colorado City
Page
Marble Canyon
Kayenta
Tonalea
Tuba City
Moenkopi
Grand Canyon
North Rim
Cameron
Gray Mountain
Valle
Peach Springs
Chloride
KINGMAN
Seligman
WILLIAMS
Ash Fork
FLAGSTAFF
WINSLOW
Joseph City
HOLBROOK
Leupp
Second Mesa
Keams Canyon
Ganado
Sanders
Wide Ruins
Sedona
CLARKDALE
JEROME
COTTONWOOD
Yucca
Topock
Bagdad
PRESCOTT
Camp Verde
Clints Well
Heber
Overgaard
Pinedale
SNOWFLAKE
TAYLOR
ST. JOHNS
Concho
Lake Havasu City
Hillside
Payson
SHOW LOW
SPRINGERVILLE
EAGAR
Alpine
PARKER
Yarnell
Congress
Black Canyon City
WICKENBURG
Yuma
Corrizo
Indian Pine
Salome
Aguila
Morristown
New River
Cave Creek
Seneca
Hope
Quartzsite
Ehrenberg
Tonopah
GLENDALE
PHOENIX
SCOTTSDALE
TEMPE
MESA
CHANDLER
BUCKEYE
Apache Jct.
Superior
GLOBE
San Carlos
Morenci
CLIFTON
KEARNY
FLORENCE
GILA BEND
CASA GRANDE
COOLIDGE
WINKELMAN
SAFFORD
THATCHER
DUNCAN
YUMA
SOMERTON
Mohawk
Sentinel
Wellton
San Luis
ELOY
Picacho
MAMMOTH
Oracle
Oracle Jct.
San Manuel
Bonita
Bowie
San Simon
Ajo
Why
Quijotoa
TUCSON
Rillito
Robles Ranch
WILCOX
Dos Cabezas
Cochise
BENSON
St. David
Pearce
TOMBSTONE
Lukeville
Sells
Sonoita
Tubac
SIERRA VISTA
BISBEE
PATAGONIA
Naco
DOUGLAS
NOGALES


PROJECT AREA
25-YEAR 24-HOUR PRECIPITATION
ISOPLUVIALS OF 25-YEAR 24-HOUR PRECIPITATION IN TENTHS OF AN INCH
PRECIPITATION MAP 4
ARIZONA
SCALE-MILES
Prepared by: U.S. Weather Bureau
For: Soil Conservation Service
March 1967
Revised by AHD 1970
Colorado City
FREDONIA
Marble Canyon
Jacob Lake
North Rim
Grand Canyon
Tuba City
Moenkopi
Tonalea
Kayenta
Pinon
Chinle
Lukachukai
Mexican Water
Oraibi
Keams Canyon
Second Mesa
Ganado
Gray Mountain
Cameron
Valle
Peach Springs
Seligman
WILLIAMS
Ash Fork
FLAGSTAFF
KINGMAN
Chloride
Yucca
Topock
Wikieup
Bagdad
Lake Havasu City
PARKER
Bouse
Quartzsite
Ehrenberg
Salome
Aguila
Morristown
Wickenburg
Congress
Yarnell
Hillside
Prescott
Dewey
Cottonwood
Jerome
Clarkdale
Sedona
Camp Verde
New River
Cave Creek
Tonopah
GLENDALE
PHOENIX
SCOTTSDALE
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MESA
CHANDLER
BUCKEYE
GILA BEND
Mohawk
Sentinel
Wellton
SOMERTON
San Luis
YUMA
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Ajo
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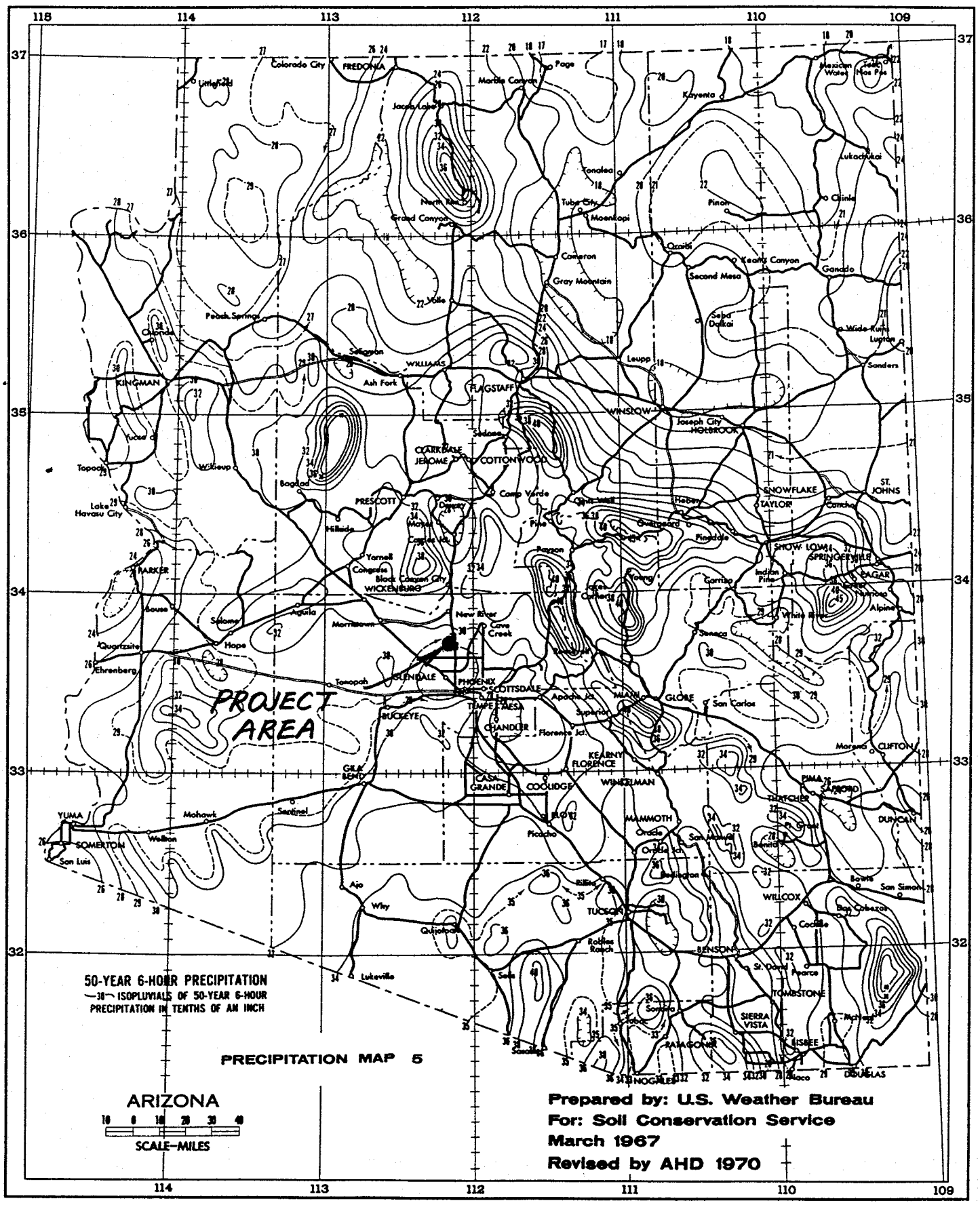
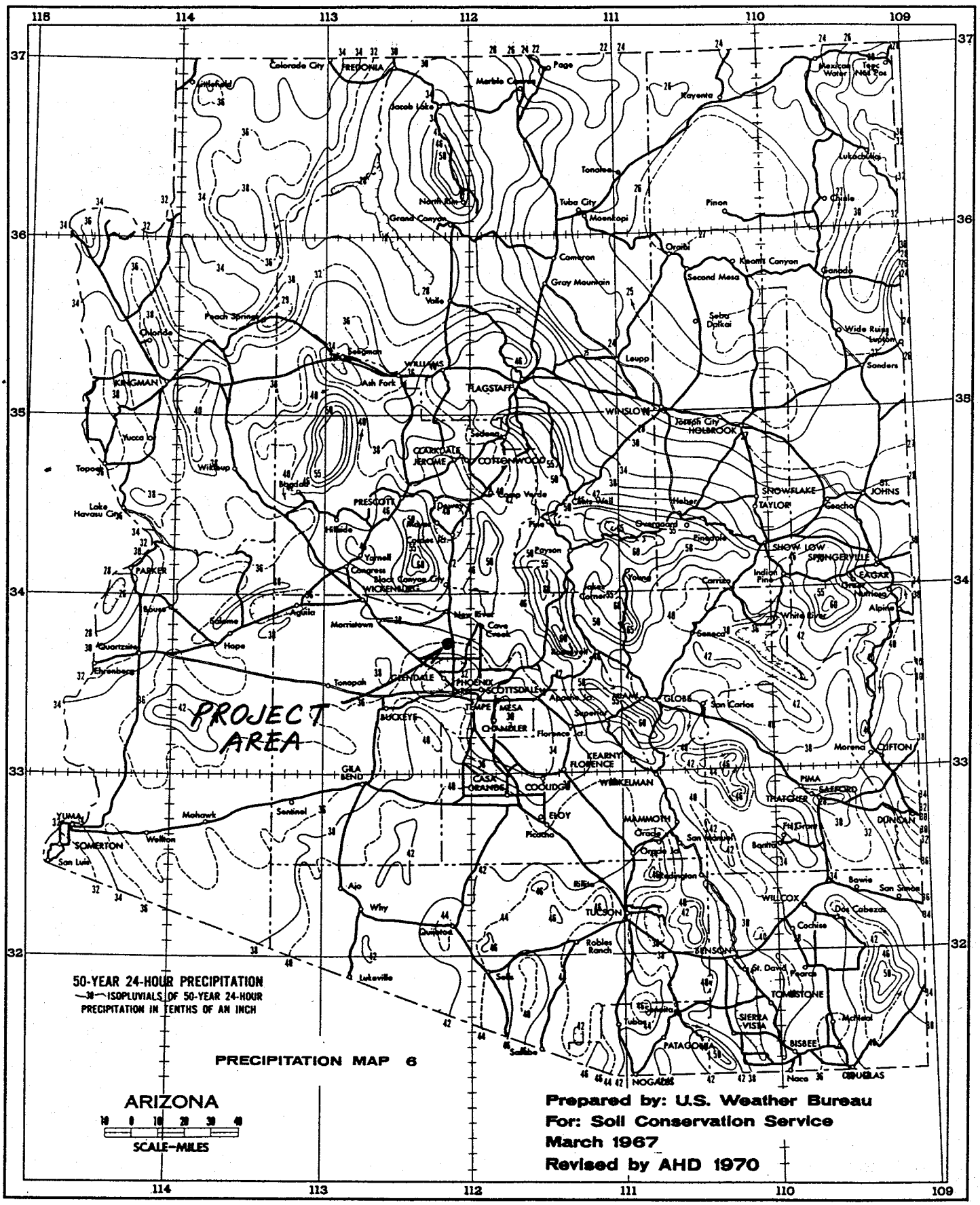
Quitaque
Sells
Sasabe
Picacho
ELOY
CASA GRANDE
COOLIDGE
FLORENCE
KEARNY
Florence Jct.
Superior
Apache Jct.
Roosevelt
Payson
Pine
Strawberry
Heber
Overgaard
Pinetop
Lakeside
Show Low
Snowflake
Taylor
Holbrook
Winslow
Leupp
Sanders
Wide Ruin
Chinle
Ganado
Young
Carrizo
Indian Pine
Springerville
Eagar
Alpine
Nutrioso
White River
Seneca
Kingman
GLOBE
San Carlos
Morenci
CLIFTON
PIMA
THATCHER
DUNCAN
Bowie
San Simon
WILLCOX
Cochise
Dos Cabezas
Rillito
TUCSON
Robles Ranch
BENSON
St. David
Pearce
TOMBSTONE
Sonoita
Sahuarita
SIERRA VISTA
Mc Neal
BISBEE
PATAGONIA
NOGALES
Naco
DOUGLAS
Mammoth
Oracle
San Manuel
Hayden
Winkelman
Kearny


PROJECT AREA
50-YEAR 6-HOUR PRECIPITATION
—30— ISOPLUVIALS OF 50-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH
PRECIPITATION MAP 5
ARIZONA
SCALE-MILES
Prepared by: U.S. Weather Bureau
For: Soil Conservation Service
March 1967
Revised by AHD 1970
FREDONIA
Colorado City
Page
Marble Canyon
Kayenta
Tonalea
Tuba City
Moenkopi
Cameron
Gray Mountain
Second Mesa
Ganado
Pinon
Chinle
Lukachukai
Leupp
Sanders
Valle
Peach Springs
Chloride
Seligman
WILLIAMS
Ash Fork
KINGMAN
FLAGSTAFF
WINSLOW
Joseph City
HOLBROOK
Sedona
CLARKDALE
JEROME
COTTONWOOD
Topock
Wickiup
Bagdad
PRESCOTT
Camp Verde
Pine
Payson
Heber
SNOWFLAKE
TAYLOR
ST. JOHNS
Concho
Lake Havasu City
Hillside
Yarnell
Congress
Wickenburg
Black Canyon City
Young
Globe
Indian Pine
SHOW LOW
SPRINGERVILLE
EAGAR
Alpine
PARKER
Bouse
Salome
Aguila
Morristown
New River
Cave Creek
Quartzsite
Hope
Ehrenberg
Tonopah
GLENDALE
PHOENIX
SCOTTSDALE
TEMPE
MESA
CHANDLER
BUCKEYE
Apache Jct.
Superior
MIAMI
GLOBE
San Carlos
Florence Jct.
Morenci
CLIFTON
KEARNY
FLORENCE
GILA BEND
CASA GRANDE
COOLIDGE
WINKELMAN
PIMA
SAFFORD
THATCHER
DUNCAN
YUMA
SOMERTON
San Luis
Mohawk
Sentinel
Wellton
Picacho
MAMMOTH
Oracle
San Manuel
Benson
Bisbee
Ajo
Why
Quitobaquito
TUCSON
Rillito
Rillito Ranch
BENSON
WILLCOX
Bowie
San Simon
Cochise
Pearce
TOMBSTONE
SIERRA VISTA
Sonoita
Patagonia
NOGALES
DOUGLAS
Lukeville
Sasabe


PROJECT AREA
50-YEAR 24-HOUR PRECIPITATION
ISOPLUVIALS OF 50-YEAR 24-HOUR PRECIPITATION IN TENTHS OF AN INCH
PRECIPITATION MAP 6
ARIZONA
SCALE-MILES
Prepared by: U.S. Weather Bureau
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March 1967
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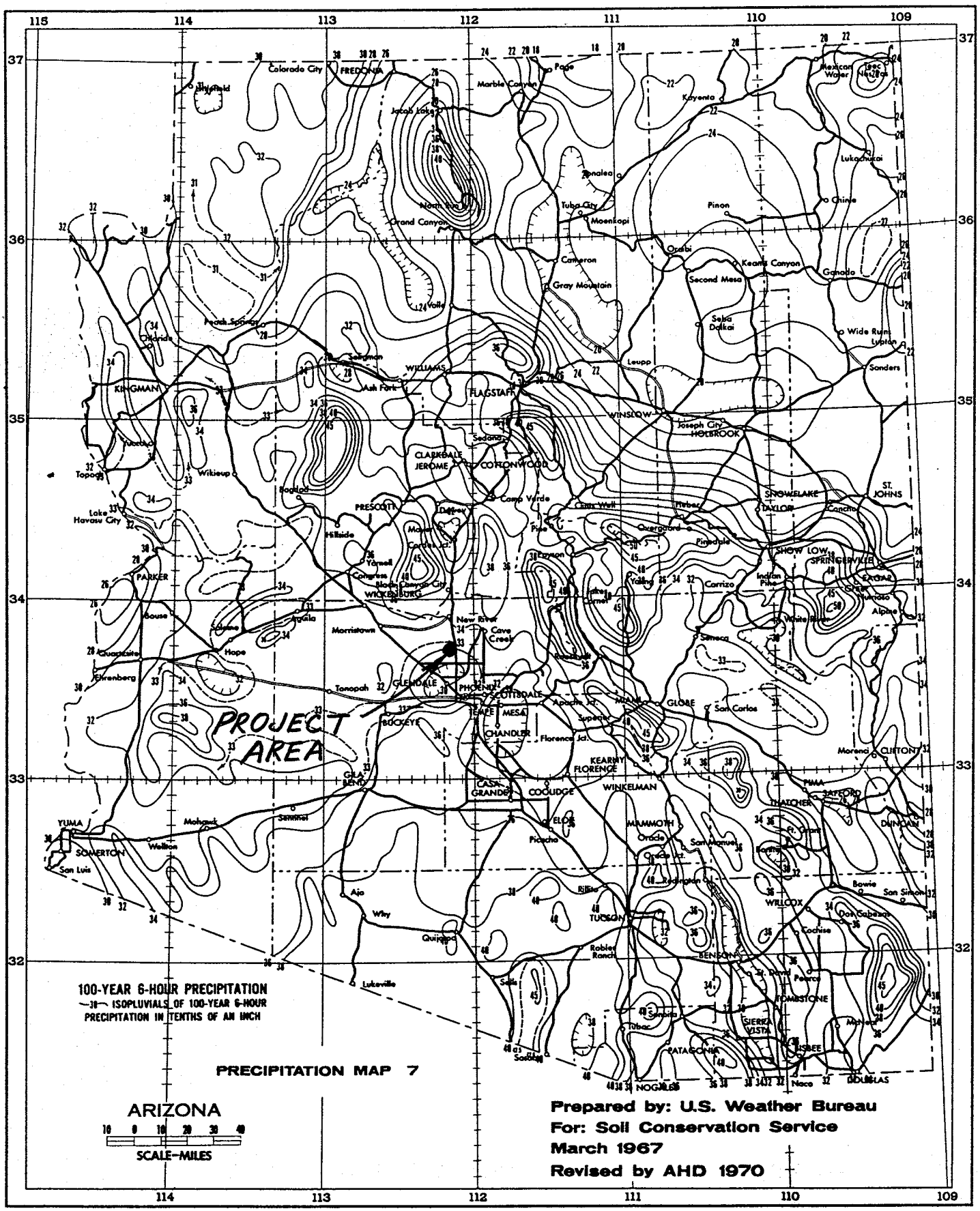
Colorado City
FREDONIA
Page
Marble Canyon
Kayenta
Tonalea
Tuba City
Moenkopi
Pinon
Cameron
Gray Mountain
Second Mesa
Keams Canyon
Ganado
Wide Ruins
Sanders
Leupp
Valle
Peach Springs
Chloride
Seligman
WILLIAMS
Ash Fork
KINGMAN
FLAGSTAFF
WINSLOW
Joseph City
HOLBROOK
Sedona
COOLIDGE
JEROME
COTTONWOOD
Cottonwood
Yucca
Topock
Wickiup
Bagdad
Lake Havasu City
PRESCOTT
Prescott Jct.
Mayer
Cordes Jct.
Cordes
Camp Verde
Clarkdale
Clarkdale Jct.
Pine
Payson
Heber
Overgaard
Pinedale
SNOWFLAKE
TAYLOR
Geronimo
ST. JOHNS
SHOW LOW
SPRINGERVILLE
EAGAR
Greer
Nutrioso
Alpine
Indian Pine
Carrizo
Young
Lake Cromer
Yarnell
Congress
Black Canyon City
WICKENBURG
PARKER
Bouse
Salome
Aguila
Morristown
Hope
Quartzsite
Ehrenberg
New River
Cave Creek
Tonopah
GLENDALE
PHOENIX
SCOTTSDALE
TEMPE
MESA
CHANDLER
BUCKEYE
Alpine Jct.
Superior
Miami
GLOBE
San Carlos
Seneca
White River
Florence Jct.
KEARNY
FLORENCE
Morenza
CLIFTON
GILA BEND
CASA GRANDE
COOLIDGE
WINKELMAN
PIMA
SAFFORD
THATCHER
DUNCAN
YUMA
SOMERTON
San Luis
Mohawk
Wellton
Sentinel
ELOY
Picacho
MAMMOTH
Oracle
San Manuel
Oracle Jct.
Redington
Benson
Bowie
San Simon
WILCOX
Dos Cabezas
Cochise
Ajo
Why
Quitobaquito
Lukeville
TUCSON
Robles Ranch
BENSON
Fort Davis
Pearce
TOMBSTONE
Sells
Tubac
Sasabe
SIERRA VISTA
McNeal
BISBEE
PATAGONIA
NOGALES
Naco
DOUGLAS


PROJECT AREA
100-YEAR 6-HOUR PRECIPITATION
ISOPLUVIALS OF 100-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH
PRECIPITATION MAP 7
ARIZONA
SCALE-MILES
Prepared by: U.S. Weather Bureau
For: Soil Conservation Service
March 1967
Revised by AHD 1970
Colorado City
FREDONIA
Page
Marble Canyon
Kayenta
Mexican Water
Lukachukai
Jacob Lake
North Rim
Grand Canyon
Tuba City
Moenkopi
Pinon
Chinle
Oraibi
Keams Canyon
Ganado
Cameron
Gray Mountain
Second Mesa
Peach Springs
Seligman
Selka Dalkai
Wide Ruin
Lupton
Sanders
Leupp
WILLIAMS
Ash Fork
FLAGSTAFF
KINGMAN
WINSLOW
Joseph City
HOLBROOK
Sedona
CLARKDALE
JEROME
COTTONWOOD
Topock
Wikieup
Bagdad
Camp Verde
Cave Creek
SNOWFLAKE
TAYLOR
ST. JOHNS
Lake Havasu City
PRESCOTT
Hillside
Overgaard
Pinedale
SHOW LOW
SPRINGERVILLE
EAGAR
PARKER
Yarnell
Congress
WICKENBURG
Canyon City
Carrizo
Indian Pine
Alpine
Bouse
Salome
Aguila
Morristown
New River
Cave Creek
Seneca
Guadalupe
Hope
Ehrenberg
Tonopah
GLENDALE
PHOENIX
SCOTTSDALE
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BUCKEYE
CHANDLER
Florence Jct.
MIAMI
GLOBE
San Carlos
Superior
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GILA BEND
CASA GRANDE
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San Manuel
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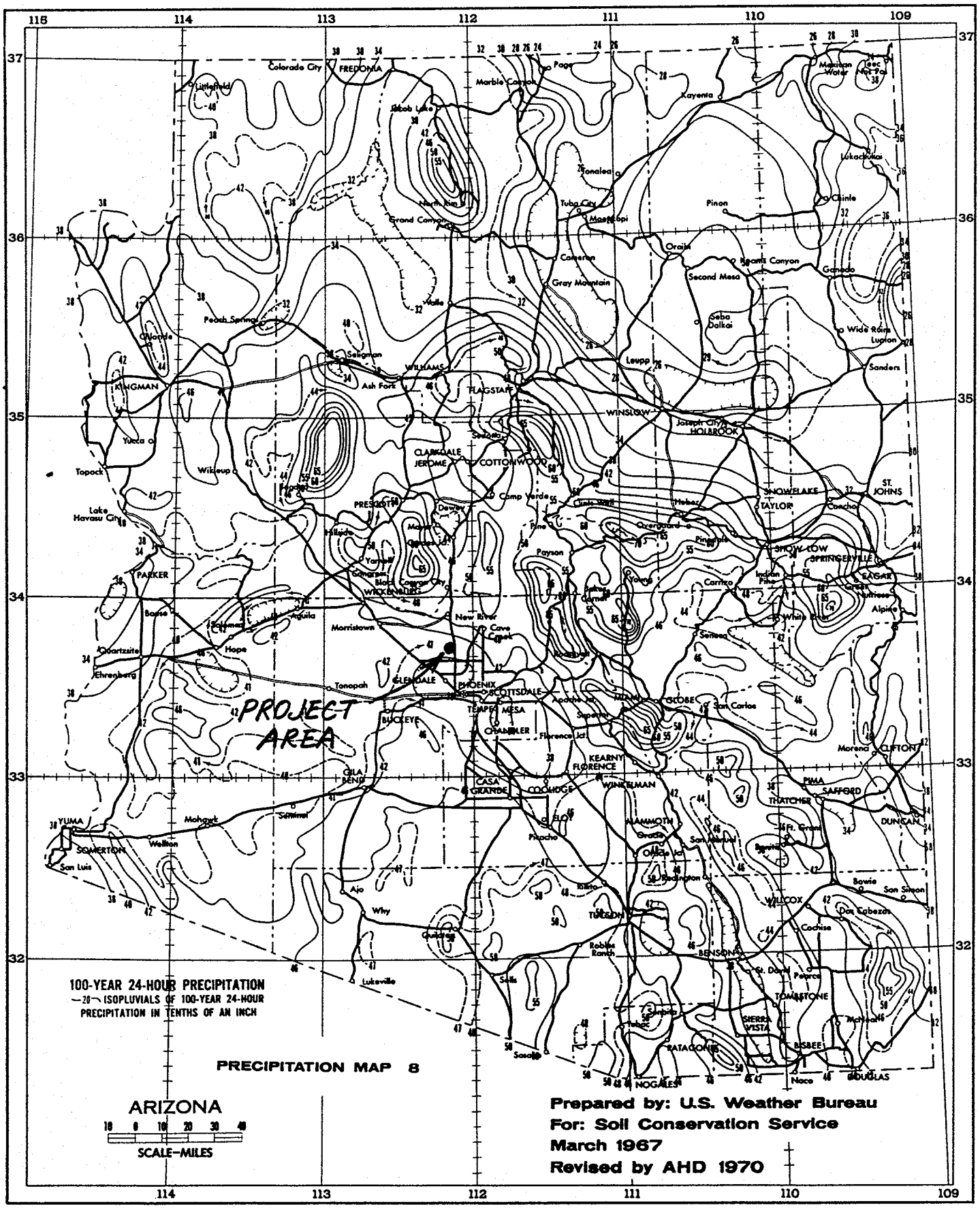
Quitobaquito
Rillito
TUCSON
Rincon
WILLCOX
Bowie
San Simon
Dos Cabezas
Cochise
Robles Ranch
BENSON
Lukeville
Sells
Pearce
TOMBSTONE
Sonoita
Tubac
SIERRA VISTA
Mescal
PATAGONIA
BISBEE
Sasabe
NOGALES
Naco
DOUGLAS


PROJECT AREA
100-YEAR 24-HOUR PRECIPITATION
—20— ISOPLUVIALS OF 100-YEAR 24-HOUR PRECIPITATION IN TENTHS OF AN INCH
PRECIPITATION MAP 8
ARIZONA
SCALE—MILES
Prepared by: U.S. Weather Bureau
For: Soil Conservation Service
March 1967
Revised by AHD 1970
FREDONIA
Colorado City
Page
Marble Canyon
Kayenta
Tonalea
Tuba City
Grand Canyon
Cameron
Gray Mountain
Second Mesa
Ganado
Pinon
Chinle
Lukachukai
Oraibi
Leupp
Sanders
Lupton
Wide Ruins
Seba Dalkai
Peach Springs
Seligman
Ash Fork
WILLIAMS
FLAGSTAFF
KINGMAN
Yucca
Topock
Lake Havasu City
Wikieup
WINSLOW
Joseph City
HOLBROOK
Sedona
CLARKDALE
JEROME
COTTONWOOD
Camp Verde
PRESCOTT
Dewey
Chino Valley
Heber
Overgaard
Pinetop
SNOWFLAKE
TAYLOR
Concho
ST. JOHNS
Payson
Pine
SHOW LOW
SPRINGERVILLE
EAGAR
Greer
Nutrioso
Alpine
Carrizo
Indian Pine
PARKER
Bouse
Quartzsite
Ehrenberg
Aguila
Wickenburg
Morristown
New River
Cave Creek
Hope
Tonopah
GLENDALE
PHOENIX
SCOTTSDALE
TEMPE
MESA
CHANDLER
BUCKEYE
Superior
GLOBE
San Carlos
Apache Jct.
Florence Jct.
Morenci
CLIFTON
KEARNY
FLORENCE
GILA BEND
CASA GRANDE
COOLIDGE
WINKELMAN
PIMA
SAFFORD
THATCHER
DUNCAN
YUMA
Mohawk
Sentinel
Wellton
SOMERTON
San Luis
ELOY
Picacho
MAMMOTH
Oracle Jct.
Redington
Ft. Grant
San Manuel
Bowie
San Simon
Ajo
Why
Gila Bend
Lukeville
TUCSON
Rillito
WILCOX
Cochise
Dos Cabezas
Robles Ranch
BENSON
St. David
Pearce
TOMBSTONE
Sonoita
Tubac
SIERRA VISTA
BISBEE
Sasabe
PATAGONIA
NOGALES
Naco
DOUGLAS

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BY SK DATE 11/6/86

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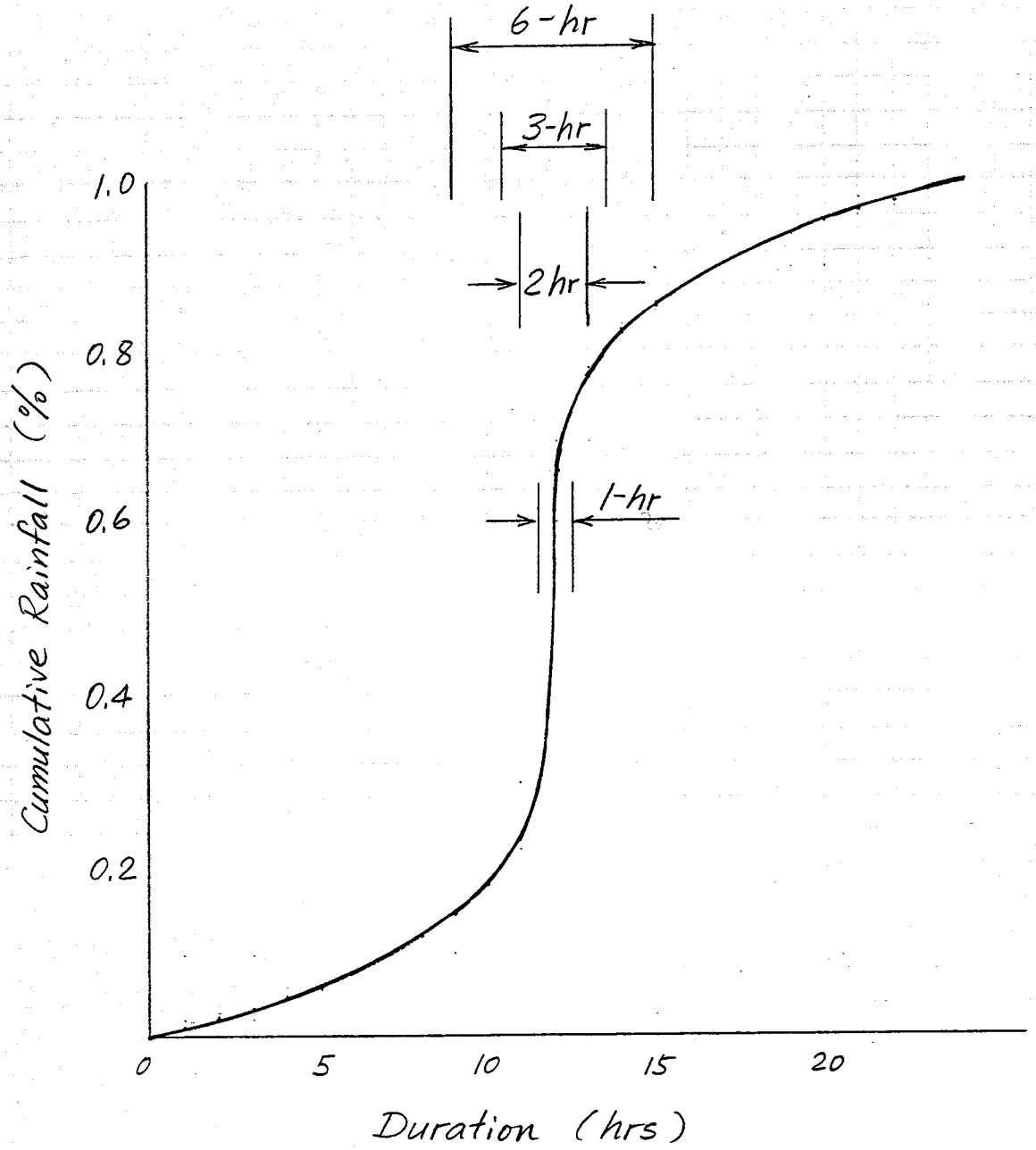
CLIENT FCDMC

JOB BUCHANAN WASH DELINEATION JOB NO. 310.40

STANDARD 24-HR, TYPE II DISTRIBUTION



STANDARD SCS 24-HOUR, TYPE II DISTRIBUTION
CUMULATIVE RAINFALL TABLE
(REVISED MAY 1982)

TABLE NO.
5 RAINFL 2

TIME INCREMENT
0.2500 Hrs = 15 min.

8	0.0	0.0020	0.0050	0.0080	0.0110 (1)
8	0.0140	0.0170	0.0200	0.0230 (2)	0.0260
8	0.0290	0.0320	0.0350 (3)	0.0380	0.0410
8	0.0440	0.0480 (4)	0.0520	0.0560	0.0600
8	0.0640 (5)	0.0680	0.0720	0.0760	0.0800 (6)
8	0.0850	0.0900	0.0950	0.1000 (7)	0.1050
8	0.1100	0.1150	0.1200 (8)	0.1260	0.1330
8	0.1400	0.1470 (9)	0.1550	0.1630	0.1720
8	0.1810 (10)	0.1910	0.2030	0.2180	0.2360 (11)
8	0.2570	0.2830	0.3870	0.6630 (12)	0.7070
8	0.7350	0.7580	0.7760 (13)	0.7910	0.8040
8	0.8150	0.8250 (14)	0.8340	0.8420	0.8490
8	0.8560 (15)	0.8630	0.8690	0.8750	0.8810 (16)
8	0.8870	0.8930	0.8980	0.9030 (17)	0.9080
8	0.9130	0.9180	0.9220 (18)	0.9260	0.9300
8	0.9340	0.9380 (19)	0.9420	0.9460	0.9500
8	0.9530 (20)	0.9560	0.9590	0.9620	0.9650 (21)
8	0.9680	0.9710	0.9740	0.9770 (22)	0.9800
8	0.9830	0.9860	0.9890 (23)	0.9920	0.9950
8	0.9980	1.0000 (24)	~~1.0000~~	~~1.0000~~	~~1.0000~~
9 ENDTBL					

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JOB BUCHANAN WASH DELINEATION JOB NO. 310.40

RAINFALL DISTRIBUTION

1. 1-HR RAINFALL DISTRIBUTION

Time Increment (hrs)	Reading from SCS Table (%)	Diff. in Reading	Cumulative Rainfall (%)
0	0.283		
		0.104	0.230
0.25	0.387		
		0.276	0.611
0.50	0.663		
		0.044	0.097
0.75	0.707		
		0.028	0.062
1.00	0.735		
		0.452	1.000

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JOB BUCHANAN WASH DELINEATION JOB NO. 310.40

2. 2-HR RAINFALL DISTRIBUTION

Time Increment (hrs)	Reading from SCS Table (%)	Diff. in Reading	Cumulative Rainfall (%)
0	0.236		
		0.021	0.039
0.25	0.257		
		0.026	0.048
0.50	0.283		
		0.104	0.193
0.75	0.387		
		0.276	0.511
1.00	0.663		
		0.044	0.081
1.25	0.707		
		0.028	0.052
1.50	0.735		
		0.023	0.043
1.75	0.758		
		0.018	0.033
2.00	0.776		
		0.540	1.000

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JOB BUCHANAN WASH DELINEATION

JOB NO. 310.40

3. 3-HR RAINFALL DISTRIBUTION

Time Increment (hrs)	Reading from SCS Table (%)	Diff. in Reading	Cumulative Rainfall (%)
0	0.203		
		0.015	0.025
0.25	0.218		
		0.018	0.030
0.50	0.236		
		0.021	0.035
0.75	0.257		
		0.026	0.043
1.00	0.283		
		0.104	0.173
1.25	0.387		
		0.276	0.459
1.50	0.663		
		0.044	0.073
1.75	0.707		
		0.028	0.047
2.00	0.735		
		0.023	0.038
2.25	0.758		
		0.018	0.030
2.50	0.776		
		0.015	0.025
2.75	0.791		
		0.013	0.022
3.00	0.804		
		0.601	1.000

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6. 6-HR RAINFALL DISTRIBUTION

Time Increment (hrs)	Reading from SCS Table (%)	Diff. in Reading	Cumulative Rainfall (%)
0	0.147		
		0.008	0.011
0.25	0.155		
		0.008	0.011
0.50	0.163		
		0.009	0.013
0.75	0.172		
		0.009	0.013
1.00	0.181		
		0.010	0.014
1.25	0.191		
		0.012	0.017
1.50	0.203		
		0.015	0.021
1.75	0.218		
		0.018	0.025
2.00	0.236		
		0.021	0.030
2.25	0.257		
		0.026	0.037
2.50	0.283		
		0.104	0.147
2.75	0.387		
		0.276	0.390
3.00	0.663		
		0.044	0.062
3.25	0.707		
		0.028	0.039
3.50	0.735		
		0.023	0.032
3.75	0.758		
		0.018	0.025
4.00	0.776		

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6. 6-HR RAINFALL DISTRIBUTION (CONTINUED)

Time Increment (hrs)	Reading from SCS Table (%)	Diff. in Reading	Cumulative Rainfall (%)
		0.015	0.021
4.25	0.791		
		0.013	0.018
4.50	0.804		
		0.011	0.016
4.75	0.815		
		0.010	0.014
5.00	0.825		
		0.009	0.013
5.25	0.834		
		0.008	0.011
5.50	0.842		
		0.007	0.010
5.75	0.849		
		0.007	0.010
6.00	0.856		
		0.709	1.000

APPENDIX B

DETERMINATION OF RUNOFF CURVE NUMBER

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JOB BUCHANAN WASH DELINEATION JOB NO. 310.40

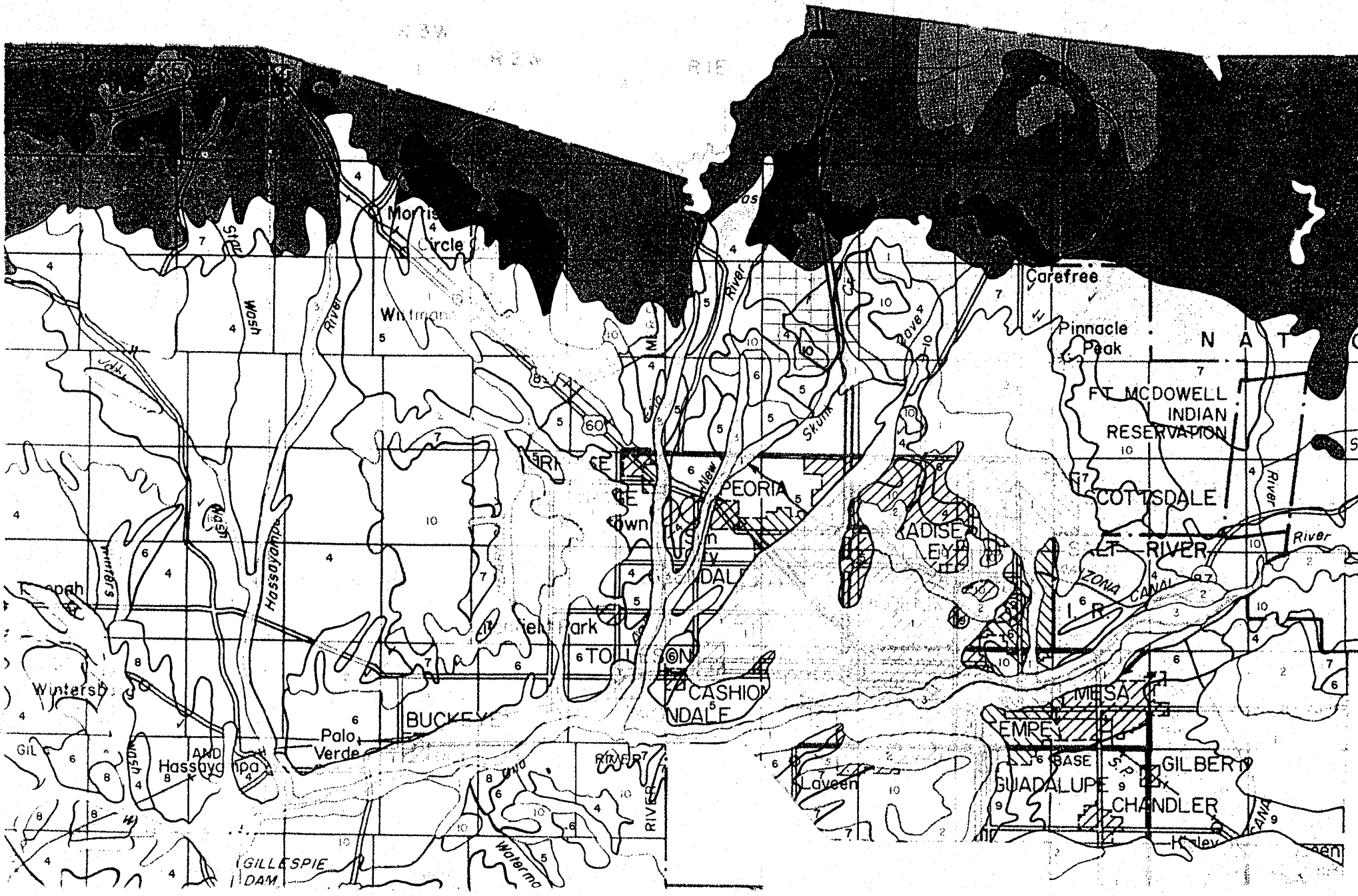
DETERMINATION OF RUNOFF CURVE NUMBER

1. Based on the General Soil Map for Maricopa County as prepared by U.S. Soil Conservation Service (SCS) in November 1973, the watershed area of Buchanan Wash is composed of the following major soil components:

   A. Rillito - Gunsight - Pinal Association
   B. Ebon - Pinamt - Tremant Association
   C. Cherioni - Gachado - Rock Outcrop Association

2. Hydrologic Group of Soils

Soil Component	Hydrologic Group
A. Rillito - Gunsight - Pinal	
a. Rillito	B
b. Gunsight	B
c. Pinal	D
B. Ebon - Pinamt - Tremant	
a. Ebon	C
b. Pinamt	B
c. Tremant	B


Carefree
Pinnacle Peak
FT. MCDOWELL INDIAN RESERVATION
COTTSDALE
PEORIA
SALT RIVER
I.R.
CASHION
MESA
EMPEY
BASE
GILBERT
GUADALUPE
CHANDLER
Laveen
BUCKEYE
Palo Verde
Hassayampa
Wintersb
GILLESPIE DAM
Wash
River
Skunk
Cave
Creek
Canal
Arizona
60

GENERAL SOIL MAP

MARICOPA COUNTY

ARIZONA

U.S. SOIL CONSERVATION SERVICE
in cooperation with
NATURAL RESOURCE CONSERVATION DISTRICTS
in MARICOPA COUNTY

Compiled from detailed soil surveys, and available information on soils, geology, topography, climate and vegetation.

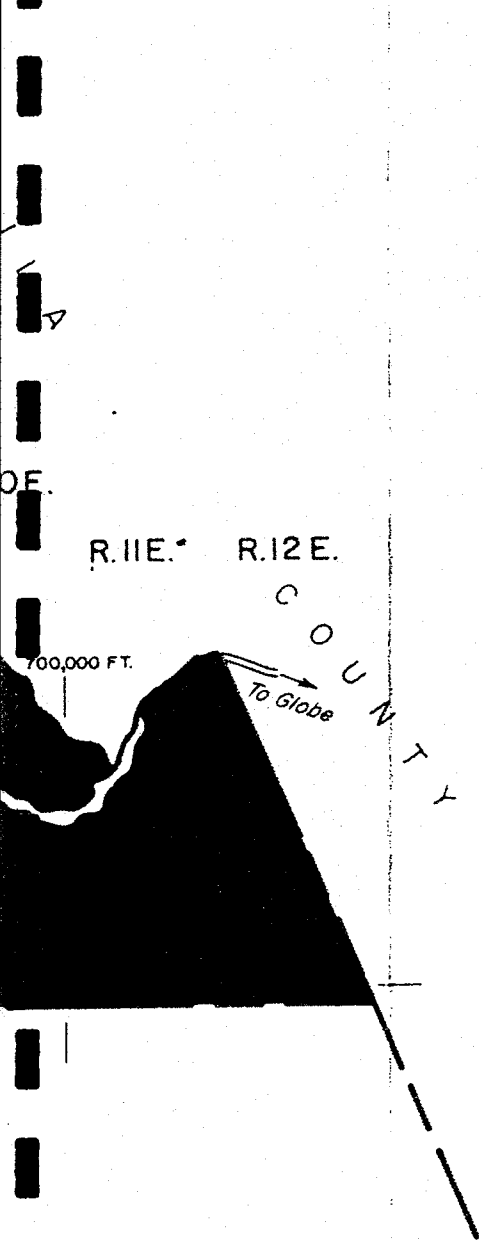
This map is intended for general planning use. On-site investigations must be made for detailed planning for a specific site or use.

NOVEMBER 1973

10 0 10 20 MILES

SCALE 1:500,000

M7-E-23123



LEGEND

I. Very hot, very dry soils.

A. Soils from recent alluvium.

[1] Gilman-Estrella-Avondale association. Nearly level loam soils on valley plains and flood plains.

[2] Antho-Valencia association. Nearly level to gently sloping sandy loam soils on alluvial fans and valley plains.

[3] Carrizo-Brios-Vint association. Nearly level sandy soils in stream channels.

B. Soils from old alluvium.

Rillito-Gunsight-Pinal association. Nearly level to gently sloping, gravelly to very gravelly limy soils on old alluvial fans and valley plains.

Mohall-Laveen association. Nearly level loam and clay loam soils on old valley plains and alluvial fans.

Laveen-Coolidge association. Nearly level, limy, sandy loam and loam soils on old alluvial fans and valley plains.

Ebon-Pinamt-Tremant association. Gently sloping to sloping, gravelly and very gravelly clay and clay loam soils on old alluvial fans at the base of mountains.

Casa Grande-Harqua association. Nearly level, saline-alkali, clay loam soils on old alluvial fans and valley plains.

Mohall-Contine association. Nearly level clay loam and clay soils on old alluvial fans and valley plains.

C. Soils of mountains and low hills.

Chirioni-Gachado-Rock Outcrop association. Moderately sloping to steep, shallow and very shallow soils on mountains and low hills.

II. Hot and dry soils.

A. Soils from old alluvium.

Continental-Pinaleno-Cave association. Gently sloping to moderately sloping clay to loam soils on old alluvial fans at the base of mountains.

Latene-Vekol-Anthony association. Nearly level to gently sloping, clay to sandy loam soils on valley plains and alluvial fans.

B. Soils of mountains and low hills.

Cellar-Lehman-Rock Outcrop association. Gently sloping to very steep, shallow to very shallow soils on mountains and low hills.

III. Warm, subhumid soils.

A. Soils of mountains and low hills.

Barkerville-Cabezon-Rock Outcrop association. Gently sloping to very steep, shallow to very shallow soils on mountains and low hills.

✓ - Rock outcrop areas of 200-400 acres
✓✓ - Rock outcrop areas of 400 acres or more

N

SOIL CONSERVATION SERVICE · U.S. DEPARTMENT of AGRICULTURE

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C. Cherioni - Gachado - Rock Outcrop

a. Cherioni D

b. Gachado D

c. Rock Outcrop D (Assumed)

3. Runoff Curve Number

A. Undeveloped Condition:

Assuming a 10% vegetation cover density for desert brush, the runoff curve numbers as determined by SCS for different hydrologic groups are as follows:

Hydrologic Group	Runoff Curve Number
B	83
C	89
D	92

B. Urbanized Condition:

Assuming 30% Impervious area and 70% natural desert landscaping development, according to SCS TR-55, the weighted runoff curve numbers are estimated as follows:

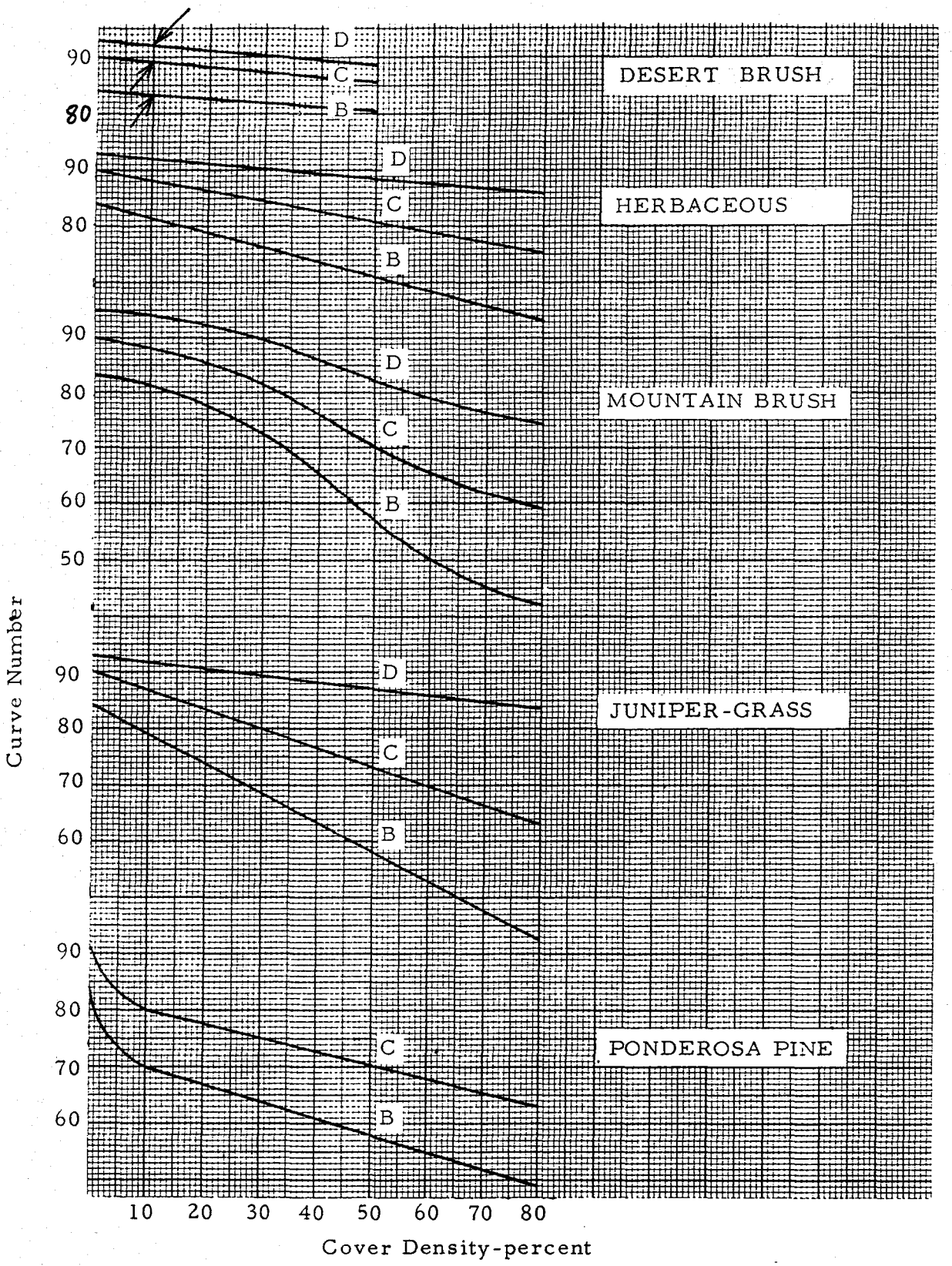

Fig. 2-3

HYDROLOGIC SOIL - COVER COMPLEXES
AND ASSOCIATED CURVE NUMBERS

Soil Conservation Service

Table 2-2a.—Runoff curve numbers for urban areas[1]

Cover description		Curve numbers for hydrologic soil group—			
Cover type and hydrologic condition	Average percent impervious area[2]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.)[3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only)[4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation)[5]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

[1]Average runoff condition, and $I_a = 0.2S$.
[2]The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.
[3]CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.
[4]Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.
[5]Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4, based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

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BY SK DATE 12/86

CHECK CH DATE 12/86

CLIENT FCDMC

JOB BUCHANAN WASH DELINEATION JOB NO. 310.40

Hydrologic Group	30% Impervious Area	70% Natural Landscaping	Weighted Curve Number
B	98	77	83
C	98	85	89
D	98	88	91

C. Since there is hardly any difference between the undeveloped condition and the future urbanized condition, we recommend that the undeveloped condition be used in this study.

4. Composite Curve Number

A. Rillito – Gunsight – Pinal Association

Soil Component	Hydrologic Group	Curve Number
Rillito	B	83
Gunsight	B	83
Pinal	D	92

Composite Curve Number $= 83 \times (1/3) + 83 \times (1/3) + 92 \times (1/3)$

$= 86$

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CHECK CH DATE 12/86

CLIENT FCDMC

JOB BUCHANAN WASH DELINEATION JOB NO. 310.40

B. Ebon - Pinamt - Tremant Association

Soil Component	Hydrologic Group	Curve Number
Ebon	C	89
Pinamt	B	83
Tremant	B	83

Composite Curve Number $= 89 \times (1/3) + 83 \times (1/3) \times 83 \times (1/3) = 85$

For practical purposes, use 86 (to be the same as Group A)

C. Cherioni - Gachado - Rock Outcrop Association

Since all soils in this association are Group D, the curve number is 92.

5. Summary

Soil Association	Composite Runoff Curve Number
Rillito-Gunsight-Pinal	86
Ebon - Pinamt - Tremant	86
Cherioni - Gachado - Rock Outcrop	92

TABLE A - Page 2

ESTIMATED PROPERTIES OF THE SOILS, OTHER FEATURES AND SOIL SUITABILITIES A/

Map Symbol and Major Soil Components	Estimated Properties of the Soils								Other Features	Suitability as a	
	Depth from Surface (in)	Texture	Permeability (in/hr)	Available Water Capacity (profile) (in)	Shrink-Swell Potential	Soil Reaction pH	Corrosivity: Uncoated Steel	Corrosivity: Concrete	Hydrologic Group	Roadfill	Sand &/or Gravel 1/
Vint loamy fine sand, 0-1% slopes, (15% of Unit)	0-60	lfs	6-20	3.5-5.0	Low	7.9-8.4	Moderate	Low	B	Good	Poor for sand, unsuited for gravel
4. Rillito-Gunsight-Pinal Association											
Rillito gravelly loam, 0-5% slopes (35% of Unit)	0-60	gl	.6-2	6.5-7.5	Low	7.9-8.4	High	Moderate	B	Good	Poor: grav excess fi
Gunsight gravelly loam, 0-10% slopes, (25% of Unit)	0-60	vgl,gl	.6-2	4.0-5.5	Low	7.9-8.4	High	Moderate	B	Good	Poor for gravel, unsuited for sand
Pinal gravelly loam, 0-5% slopes, (20% of Unit)	0-12 12	gl	.6-2	1.5-2.7 Indurated pan	Low	7.9-8.4	High	Moderate	D	Poor: thin layer	Unsuited
5. Mohall-Laveen Association											
Mohall clay loam 0-1% slopes (45% of Unit)	0-10 10-37 37-60	Cl cl gsl	2-6 .2-.6 2-6	7.5-9.0	Low Moderate Low	6.6-8.4 7.9-8.4 7.9-8.4	Moderate High High	Low Low Low	B	Fair: CL soil material	Poor for sand, unsuited for gravel

TABLE A - Page 3 ESTIMATED PROPERTIES OF THE SOILS, OTHER FEATURES AND SOIL SUITABILI

Map Symbol and Major Soil Components	Estimated Properties of the Soils: Depth from Surface (in)	Texture	Permeability (in/hr)	Available Water Capacity (profile) (in)	Shrink-Swell Potential	Soil Reaction pH	Corrosivity: Uncoated Steel	Corrosivity: Concrete	Other Features: Hydrologi Grou
6. Laveen-Coolidge Association									
Laveen loam 0-1% slopes (45% of Unit)	0-60	l	.6-2	8.5-9.5	Low	7.9-8.4	High	Moderate	B
Coolidge sandy loam, 0-1% slopes, (30% of Unit)	0-60	sl	2-6	6.0-7.5	Low	7.9-8.4	High	Low	B
7. Ebon-Pinamt-Tremant Association									
Ebon gravelly loam, 1-10% slopes, (35% of Unit)	0-38 38-60	gl,vkc vkscl	.06-.2 .2-.6	3.0-5.0	Moderate Low	7.9-8.4 7.9-8.4	High High	Low Low	C
Pinamt very cobbly loam, 1-10% slopes, (25% of Unit)	0-35 35-60	vkl vgscl vg sl	.2-.6 2-6	3.5-5.0	Moderate Low	7.9-8.4 7.9-8.4	High High	Low Low	B
Tremant very gravelly loam 1-5% slopes (20% of Unit)	0-36 36-60	vgcl,gl gl	.2-.6 .6-2	6.5-8.0	Moderate Low	7.9-8.4 7.9-8.4	High High	Moderate Low	B
8. Casa Grande-Harqua Association									
Casa Grande sandy loam, 0-1% slopes (35% of Unit)	0-23 23-60	sl,cl sl	.06-.2 .6-2	8.5-11.5	Moderate Low	8.5-9.6 8.5-9.6	High High	High High	C

TABLE A - Page 4

ESTIMATED PROPERTIES OF THE SOILS, OTHER FEATURES AND SOIL SUITABILITIES A/

Map Symbol and Major Soil Components	Estimated Properties of the Soils								Other Features	Suitability as a So	
	Depth from Surface (in)	Tex-ture	Perme-ability (in/hr)	Available Water Capacity (profile) (in)	Shrink-Swell Potential	Soil Reaction pH	Corrosivity: Uncoated Steel	Corrosivity: Concrete	Hydro-logic Group	Roadfill	Sand &/or Gravel 1/
Harqua very grav-elly clay loam 0-5% slopes (35% of Unit)	0-60	vgcl, gcl	.2-.6	5.0-6.5	Low	7.9-9.6	High	High	B	Fair: GC soil material	Unsuited
9. Mohall-Contine Association											
Mohall loam 0-1% slopes (55% of Unit)	0-10	l	2-6	7.5-9.0	Low	6.6-8.4	Moderate	Low	B	Fair: CL soil material	Poor for sand, un-suited for gravel
	10-37	cl	.2-.6		Moderate	7.9-8.4	High	Low			
	37-60	gsl	2-6		Low	7.9-8.4	High	Low			
Contine clay loam 0-1% slopes (35% of Unit)	0-12	cl	.06-.2	8.5-12.5	High	7.9-8.4	Moderate	Low	C	Poor: CH soil material, shrink-swell	Unsuited
	12-38	cl,c	.06-.2		High	7.9-8.4	High	Low			
	38-60	l,cl	.06-.2		High	7.9-8.4	High	Low			
10. Cherioni-Gachado-Rock Outcrop Association											
Cherioni gravelly very fine sandy loam, 10-40% slopes (35% of Unit)	0-9	gvfsl	.6-2	.9-2	Low	7.9-8.4	Moderate	Low	D	Poor: limited material	Unsuited
	9-12		Indurated pan over bedrock								
Gachado very cobbly loam 10-40% slopes (15% of Unit)	0-13	vkl,cl	.06-.2	1.5-2.1	Low	7.9-8.4	Moderate	Low	D	Poor: limited material	Unsuited
	13		Bedrock								
Rock Outcrop 10-80% slopes (35% of Unit)			Exposures of bedrock - no estimates can be made								

APPENDIX C

HEC-1 RESULTS

1

‡‡‡‡

FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985

U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616

‡‡‡‡

THIS HEC-1 VERSION CONTAINS ALL OPTIONS EXCEPT ECONOMICS, AND THE NUMBER OF PLANS ARE REDUCED TO 3

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  1           ID       BUCHANAN WASH  -  FLOOD PLAIN DELINATION   REV. 1 MAR., 1987
  2           ID       10 YR,  6 HOUR STORM EVENT
  3           IT      5                    60
  4           IO      5
              *DIAGRAM

  5           KK    SUB1
  6           KM       RUNOFF FROM SUBBASIN NO. 1
  7           BA    1.15
  8           LS            86                    92
  9           PB    2.09
 10           PC     0.0   0.003   0.007   0.011   0.014   0.018   0.022   0.026   0.031   0.035
 11           PC   0.039   0.044   0.048   0.053   0.057   0.062   0.068   0.073   0.079   0.086
 12           PC   0.093   0.100   0.108   0.117   0.125   0.135   0.145   0.155   0.167   0.180
 13           PC   0.192   0.241   0.290   0.339   0.469   0.599   0.729   0.750   0.770   0.791
 14           PC   0.804   0.825   0.830   0.841   0.851   0.862   0.870   0.879   0.887   0.894
 15           PC   0.901   0.908   0.914   0.920   0.926   0.931   0.937   0.942   0.947   0.951
 16           PC   0.956   0.960   0.965   0.969   0.973   0.977   0.980   0.983   0.987   0.990
 17           PC   0.993   0.997   1.000
 18           UK    1200   0.008   0.130      97
 19           UK     600   0.070   0.150       3
 20           RK    6000  0.0077   0.070    1.15    TRAP      10      10
 21           RK    2900  0.0066   0.050            TRAP      12       4

 22           KK    SUB2
 23           KM       RUNOFF FROM SUBBASIN NO. 2
 24           BA    1.89
 25           LS            86                    92
 26           UK    1100   0.008   0.130      99
 27           UK     600   0.070   0.150       1
 28           RK   15700  0.0075   0.070    1.37    TRAP      10      10
 29           RK    2100  0.0033   0.050            TRAP      13       4    YES

 30           KK    SUB3
 31           KM       RUNOFF FROM SUBBASIN NO. 3
 32           BA    1.72
 33           LS            86                    92
 34           UK     700   0.044   0.130      87
 35           UK     500   0.090   0.150      13
 36           RK    6300  0.0143   0.070    0.46    TRAP      10       3
 37           RK    3100  0.0029   0.050            TRAP      17       4    YES

 38           KK    SUB4
 39           KM       RUNOFF FROM SUBBASIN NO. 4
 40           BA    1.29
 41           LS            86                    92
 42           UK     650   0.015   0.130      94
 43           UK     500   0.080   0.150       6
 44           RK    4500   0.013   0.070    0.24    TRAP      10       5
 45           RK    4900  0.0062   0.050            TRAP      20       4    YES
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  46          KK   SUB9
  47          KM       RUNOFF FROM SUBBASIN NO. 9
  48          BA   3.12
  49          LS            86                    92
  50          UK    950  0.0087   0.130     95
  51          UK    500  0.0600   0.150      5
  52          RK  25100  0.0078   0.070   2.45   TRAP     10      5
  53          RK   2000  0.0020   0.050          TRAP     20      5

  54          KK   SUB5
  55          KM       COMBINATION OF RUNOFF ABOVE CAP CROSSING
  56          HC      2

  57          KK   RES5
  58          KM       RESERVOIR STORAGE AT SUBBASIN NO. 4
  59          RS      1    STOR     0.0
  60          SV      0    0.27    3.03   10.88   36.82  100.83  225.32  414.41  695.23
  61          SE   1493    1496    1500    1502    1504    1506    1508    1510    1512
  62          SQ      0     153     420     480     731     887    1019    1135    1241    1339
  63          SQ   1430
  64          SE   1493 1495.75  1498.0  1498.5  1500.0    1502    1504    1506    1508    1510
  65          SE   1512

  66          KK   SUB6
  67          KM       RUNOFF FROM SUBBASIN NO. 6
  68          BA   0.43
  69          LS            86                    92
  70          UK    800   0.010    0.13     37
  71          UK    550   0.04     0.15     63
  72          RK   4500   0.078   0.070   0.13   TRAP     10      3
  73          RK     10   0.008   0.050          TRAP     24      2

  74          KK   RES6
  75          KM       RESERVOIR STORAGE AT SUBBASIN NO. 6
  76          RS      1    STOR     0.0
  77          SV      0    2.98   10.59   23.57   41.57   70.00
  78          SE   1504    1506    1508    1510    1512    1514
  79          SQ      0       0    99.1   424.9  1118.7  2309.3
  80          SE   1504    1506    1508    1510    1512    1514

  81          KK  SUB6A
  82          KM       COMBINE HYDROGRAPHS AT CULVERT OUTLET
  83          HC      2

  84          KK   SUB7
  85          KM       RUNOFF FROM SUBBASIN NO. 7
  86          BA   0.39
  87          LS            86                    92
  88          UK    800   0.007   0.130     54
  89          UK    400   0.100   0.150     46
  90          RK   3000   0.117   0.070   0.06   TRAP     10      3
  91          RK   4100  0.0044   0.055          TRAP     25      2    YES
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  92          KK    SUB8
  93          KM        RUNOFF FROM SUBBASIN NO. 8
  94          BA     1.3
  95          LS              86                    92
  96          UK    1100   0.009    0.13      91
  97          UK     500   0.060    0.15       9
  98          RK    7700  0.0058   0.070    2.45   TRAP      10      10
  99          RK   10400  0.0035   0.055           TRAP      28       2    YES
 100          ZZ
```

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   5        SUB1
               V
               V
  22        SUB2 ***
               V
               V
  30        SUB3 ***
               V
               V
  38        SUB4 ***
               .
               .
  46           .        SUB9
               .          .
               .          .
  54        SUB5............
               V
               V
  57        RES5
               .
               .
  66           .        SUB6
               .          V
               .          V
  74           .        RES6
               .          .
               .          .
  81       SUB6A............
               V
               V
  84        SUB7 ***
               V
               V
  92        SUB8 ***
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

1

```
                                        ****
                    FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
          U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616
                                        ****


                         BUCHANAN WASH  -  FLOOD PLAIN DELINATION   REV. 1 MAR., 1987
                         10 YR,  6 HOUR STORM EVENT

  4 IO        OUTPUT CONTROL VARIABLES
                    IPRNT          5  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE

   IT         HYDROGRAPH TIME DATA
                     NMIN          5  MINUTES IN COMPUTATION INTERVAL
                    IDATE     1    0  STARTING DATE
                    ITIME       0000  STARTING TIME
                       NQ         60  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE     1    0  ENDING DATE
                   NDTIME       0455  ENDING TIME

             COMPUTATION INTERVAL     .08 HOURS
                  TOTAL TIME BASE    4.92 HOURS

       ENGLISH UNITS

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN       0. TO      183.
               THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
               THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)
```

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	SUB1	242.	4.25	65.	65.	65.	1.15		
+	HYDROGRAPH AT	SUB2	566.	4.58	131.	131.	131.	3.04		
+	HYDROGRAPH AT	SUB3	845.	3.50	267.	267.	267.	4.76		
+	HYDROGRAPH AT	SUB4	1331.	3.58	348.	348.	348.	6.05		
+	HYDROGRAPH AT	SUB9	548.	4.75	122.	122.	122.	3.12		
+	2 COMBINED AT	SUB5	1503.	4.58	470.	470.	470.	9.17		
+	ROUTED TO	RES5	1065.	4.92	317.	317.	317.	9.17		
+									1504.79	4.92
+	HYDROGRAPH AT	SUB6	318.	3.08	52.	52.	52.	.43		
+	ROUTED TO	RES6	100.	3.92	31.	31.	31.	.43		
+									1508.01	3.92
+	2 COMBINED AT	SUB6A	1138.	4.92	348.	348.	348.	9.60		
+	HYDROGRAPH AT	SUB7	1175.	4.92	355.	355.	355.	9.99		
+	HYDROGRAPH AT	SUB8	1422.	4.67	306.	306.	306.	11.29		

*** NORMAL END OF HEC-1 ***
^Z

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  1           ID       BUCHANAN WASH  -  FLOOD PLAIN DELINATION   REV. 1 MAR., 1987
  2           ID       50 YR,  6 HOUR STORM EVENT
  3           IT      5                    60
  4           IO      5
              *DIAGRAM

  5           KK    SUB1
  6           KM       RUNOFF FROM SUBBASIN NO. 1
  7           BA    1.15
  8           LS            86                    92
  9           PB    2.88
 10           PC     0.0   0.003   0.007   0.011   0.014   0.018   0.022   0.026   0.031   0.035
 11           PC   0.039   0.044   0.048   0.053   0.057   0.062   0.068   0.073   0.079   0.086
 12           PC   0.093   0.100   0.108   0.117   0.125   0.135   0.145   0.155   0.167   0.180
 13           PC   0.192   0.241   0.290   0.339   0.469   0.599   0.729   0.750   0.770   0.791
 14           PC   0.804   0.825   0.830   0.841   0.851   0.862   0.870   0.879   0.887   0.894
 15           PC   0.901   0.908   0.914   0.920   0.926   0.931   0.937   0.942   0.947   0.951
 16           PC   0.956   0.960   0.965   0.969   0.973   0.977   0.980   0.983   0.987   0.990
 17           PC   0.993   0.997   1.000
 18           UK    1200   0.008   0.130      97
 19           UK     600   0.070   0.150       3
 20           RK    6000  0.0077   0.070    1.15    TRAP      10      10
 21           RK    2900  0.0066   0.050            TRAP      12       4

 22           KK    SUB2
 23           KM       RUNOFF FROM SUBBASIN NO. 2
 24           BA    1.89
 25           LS            86                    92
 26           UK    1100   0.008   0.130      99
 27           UK     600   0.070   0.150       1
 28           RK   15700  0.0075   0.070    1.37    TRAP      10      10
 29           RK    2100  0.0033   0.050            TRAP      13       4     YES

 30           KK    SUB3
 31           KM       RUNOFF FROM SUBBASIN NO. 3
 32           BA    1.72
 33           LS            86                    92
 34           UK     700   0.044   0.130      87
 35           UK     500   0.090   0.150      13
 36           RK    6300  0.0143   0.070    0.46    TRAP      10       3
 37           RK    3100  0.0029   0.050            TRAP      17       4     YES

 38           KK    SUB4
 39           KM       RUNOFF FROM SUBBASIN NO. 4
 40           BA    1.29
 41           LS            86                    92
 42           UK     650   0.015   0.130      94
 43           UK     500   0.080   0.150       6
 44           RK    4500   0.013   0.070    0.24    TRAP      10       5
 45           RK    4900  0.0062   0.050            TRAP      20       4     YES
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  46          KK   SUB9
  47          KM       RUNOFF FROM SUBBASIN NO. 9
  48          BA   3.12
  49          LS            86                    92
  50          UK    950  0.0087   0.130     95
  51          UK    500  0.0600   0.150      5
  52          RK  25100  0.0078   0.070   2.45   TRAP     10      5
  53          RK   2000  0.0020   0.050          TRAP     20      5

  54          KK   SUB5
  55          KM       COMBINATION OF RUNOFF ABOVE CAP CROSSING
  56          HC      2

  57          KK   RES5
  58          KM       RESERVOIR STORAGE AT SUBBASIN NO. 4
  59          RS      1    STOR     0.0
  60          SV      0    0.27    3.03   10.88   36.82  100.83  225.32  414.41  695.23
  61          SE   1493    1496    1500    1502    1504    1506    1508    1510    1512
  62          SQ      0     153     420     480     731     887    1019    1135    1241    1339
  63          SQ   1430
  64          SE   1493 1495.75  1498.0  1498.5  1500.0    1502    1504    1506    1508    1510
  65          SE   1512

  66          KK   SUB6
  67          KM       RUNOFF FROM SUBBASIN NO. 6
  68          BA   0.43
  69          LS            86                    92
  70          UK    800   0.010    0.13     37
  71          UK    550   0.04     0.15     63
  72          RK   4500   0.078   0.070   0.13   TRAP     10      3
  73          RK     10   0.008   0.050          TRAP     24      2

  74          KK   RES6
  75          KM       RESERVOIR STORAGE AT SUBBASIN NO. 6
  76          RS      1    STOR     0.0
  77          SV      0    2.98   10.59   23.57   41.57   70.00
  78          SE   1504    1506    1508    1510    1512    1514
  79          SQ      0       0    99.1   424.9  1118.7  2309.3
  80          SE   1504    1506    1508    1510    1512    1514

  81          KK  SUB6A
  82          KM       COMBINE HYDROGRAPHS AT CULVERT OUTLET
  83          HC      2

  84          KK   SUB7
  85          KM       RUNOFF FROM SUBBASIN NO. 7
  86          BA   0.39
  87          LS            86                    92
  88          UK    800   0.007   0.130     54
  89          UK    400   0.100   0.150     46
  90          RK   3000   0.117   0.070   0.06   TRAP     10      3
  91          RK   4100  0.0044   0.055          TRAP     25      2    YES
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  92          KK   SUB8
  93          KM       RUNOFF FROM SUBBASIN NO. 8
  94          BA    1.3
  95          LS            86                    92
  96          UK   1100   0.009   0.13     91
  97          UK    500   0.060   0.15      9
  98          RK   7700  0.0058  0.070   2.45   TRAP     10      10
  99          RK  10400  0.0035  0.055          TRAP     28       2    YES
 100          ZZ
```

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   5        SUB1
              V
              V
  22        SUB2 ***
              V
              V
  30        SUB3 ***
              V
              V
  38        SUB4 ***
              .
              .
  46          .        SUB9
              .          .
              .          .
  54        SUB5............
              V
              V
  57        RES5
              .
              .
  66          .        SUB6
              .          V
              .          V
  74          .        RES6
              .          .
              .          .
  81       SUB6A............
              V
              V
  84        SUB7 ***
              V
              V
  92        SUB8 ***
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1                                                    ****
                    FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
          U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616
                                                    ****


                         BUCHANAN WASH  -  FLOOD PLAIN DELINATION   REV. 1 MAR., 1987
                         50 YR,  6 HOUR STORM EVENT

  4 IO        OUTPUT CONTROL VARIABLES
                   IPRNT          5  PRINT CONTROL
                   IPLOT          0  PLOT CONTROL
                   QSCAL         0.  HYDROGRAPH PLOT SCALE

    IT        HYDROGRAPH TIME DATA
                    NMIN          5  MINUTES IN COMPUTATION INTERVAL
                   IDATE      1   0  STARTING DATE
                   ITIME       0000  STARTING TIME
                      NQ         60  NUMBER OF HYDROGRAPH ORDINATES
                  NDDATE      1   0  ENDING DATE
                  NDTIME       0455  ENDING TIME

              COMPUTATION INTERVAL     .08 HOURS
                   TOTAL TIME BASE    4.92 HOURS

        ENGLISH UNITS

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN        0. TO      183.
               THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
               THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)
```

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	SUB1	541.	3.83	144.	144.	144.	1.15		
+	HYDROGRAPH AT	SUB2	1179.	4.17	314.	314.	314.	3.04		
+	HYDROGRAPH AT	SUB3	1647.	3.25	560.	560.	560.	4.76		
+	HYDROGRAPH AT	SUB4	2726.	3.42	728.	728.	728.	6.05		
+	HYDROGRAPH AT	SUB9	1083.	4.25	292.	292.	292.	3.12		
+	2 COMBINED AT	SUB5	3100.	3.50	1020.	1020.	1020.	9.17		
+	ROUTED TO	RES5	1253.	4.92	407.	407.	407.	9.17		
+									1508.25	4.92
+	HYDROGRAPH AT	SUB6	613.	3.08	88.	88.	88.	.43		
+	ROUTED TO	RES6	231.	3.50	63.	63.	63.	.43		
+									1508.81	3.50
+	2 COMBINED AT	SUB6A	1349.	4.67	470.	470.	470.	9.60		
+	HYDROGRAPH AT	SUB7	1467.	3.83	505.	505.	505.	9.99		
+	HYDROGRAPH AT	SUB8	2005.	4.17	523.	523.	523.	11.29		

*** NORMAL END OF HEC-1 ***
^Z

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  1           ID       BUCHANAN WASH  -  FLOOD PLAIN DELINATION   REV. 1 MAR., 1987
  2           ID       100 YR,  6 HOUR STORM EVENT
  3           IT      5                    60
  4           IO      5
              *DIAGRAM

  5           KK    SUB1
  6           KM       RUNOFF FROM SUBBASIN NO. 1
  7           BA    1.15
  8           LS            86                    92
  9           PB    3.25
 10           PC     0.0   0.003   0.007   0.011   0.014   0.018   0.022   0.026   0.031   0.035
 11           PC   0.039   0.044   0.048   0.053   0.057   0.062   0.068   0.073   0.079   0.086
 12           PC   0.093   0.100   0.108   0.117   0.125   0.135   0.145   0.155   0.167   0.180
 13           PC   0.192   0.241   0.290   0.339   0.469   0.599   0.729   0.750   0.770   0.791
 14           PC   0.804   0.825   0.830   0.841   0.851   0.862   0.870   0.879   0.887   0.894
 15           PC   0.901   0.908   0.914   0.920   0.926   0.931   0.937   0.942   0.947   0.951
 16           PC   0.956   0.960   0.965   0.969   0.973   0.977   0.980   0.983   0.987   0.990
 17           PC   0.993   0.997   1.000
 18           UK    1200   0.008   0.130      97
 19           UK     600   0.070   0.150       3
 20           RK    6000  0.0077   0.070    1.15   TRAP      10      10
 21           RK    2900  0.0066   0.050           TRAP      12       4

 22           KK    SUB2
 23           KM       RUNOFF FROM SUBBASIN NO. 2
 24           BA    1.89
 25           LS            86                    92
 26           UK    1100   0.008   0.130      99
 27           UK     600   0.070   0.150       1
 28           RK   15700  0.0075   0.070    1.37   TRAP      10      10
 29           RK    2100  0.0033   0.050           TRAP      13       4    YES

 30           KK    SUB3
 31           KM       RUNOFF FROM SUBBASIN NO. 3
 32           BA    1.72
 33           LS            86                    92
 34           UK     700   0.044   0.130      87
 35           UK     500   0.090   0.150      13
 36           RK    6300  0.0143   0.070    0.46   TRAP      10       3
 37           RK    3100  0.0029   0.050           TRAP      17       4    YES

 38           KK    SUB4
 39           KM       RUNOFF FROM SUBBASIN NO. 4
 40           BA    1.29
 41           LS            86                    92
 42           UK     650   0.015   0.130      94
 43           UK     500   0.080   0.150       6
 44           RK    4500   0.013   0.070    0.24   TRAP      10       5
 45           RK    4900  0.0062   0.050           TRAP      20       4    YES
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  46          KK   SUB9
  47          KM       RUNOFF FROM SUBBASIN NO. 9
  48          BA   3.12
  49          LS            86                    92
  50          UK    950  0.0087   0.130     95
  51          UK    500  0.0600   0.150      5
  52          RK  25100  0.0078   0.070   2.45   TRAP     10      5
  53          RK   2000  0.0020   0.050          TRAP     20      5

  54          KK   SUB5
  55          KM       COMBINATION OF RUNOFF ABOVE CAP CROSSING
  56          HC      2

  57          KK   RES5
  58          KM       RESERVOIR STORAGE AT SUBBASIN NO. 4
  59          RS      1    STOR     0.0
  60          SV      0    0.27    3.03   10.88   36.82  100.83  225.32  414.41  695.23
  61          SE   1493    1496    1500    1502    1504    1506    1508    1510    1512
  62          SQ      0     153     420     480     731     887    1019    1135    1241    1339
  63          SQ   1430
  64          SE   1493 1495.75  1498.0  1498.5  1500.0    1502    1504    1506    1508    1510
  65          SE   1512

  66          KK   SUB6
  67          KM       RUNOFF FROM SUBBASIN NO. 6
  68          BA   0.43
  69          LS            86                    92
  70          UK    800   0.010    0.13     37
  71          UK    550   0.04     0.15     63
  72          RK   4500   0.078   0.070   0.13   TRAP     10      3
  73          RK     10   0.008   0.050          TRAP     24      2

  74          KK   RES6
  75          KM       RESERVOIR STORAGE AT SUBBASIN NO. 6
  76          RS      1    STOR     0.0
  77          SV      0    2.98   10.59   23.57   41.57   70.00
  78          SE   1504    1506    1508    1510    1512    1514
  79          SQ      0       0    99.1   424.9  1118.7  2309.3
  80          SE   1504    1506    1508    1510    1512    1514

  81          KK  SUB6A
  82          KM       COMBINE HYDROGRAPHS AT CULVERT OUTLET
  83          HC      2

  84          KK   SUB7
  85          KM       RUNOFF FROM SUBBASIN NO. 7
  86          BA   0.39
  87          LS            86                    92
  88          UK    800   0.007   0.130     54
  89          UK    400   0.100   0.150     46
  90          RK   3000   0.117   0.070   0.06   TRAP     10      3
  91          RK   4100  0.0044   0.055          TRAP     25      2    YES
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  92          KK    SUB8
  93          KM        RUNOFF FROM SUBBASIN NO. 8
  94          BA     1.3
  95          LS              86                    92
  96          UK    1100   0.009    0.13      91
  97          UK     500   0.060    0.15       9
  98          RK    7700  0.0058   0.070    2.45    TRAP      10      10
  99          RK   10400  0.0035   0.055            TRAP      28       2     YES
 100          ZZ
```

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

    5       SUB1
               V
               V
   22       SUB2 ***
               V
               V
   30       SUB3 ***
               V
               V
   38       SUB4 ***
               .
               .
   46          .        SUB9
               .           .
               .           .
   54       SUB5............
               V
               V
   57       RES5
               .
               .
   66          .        SUB6
               .           V
               .           V
   74          .        RES6
               .           .
               .           .
   81      SUB6A............
               V
               V
   84       SUB7 ***
               V
               V
   92       SUB8 ***
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1                                        ****
                    FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
          U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616
                                         ****


                         BUCHANAN WASH  -  FLOOD PLAIN DELINATION   REV. 1 MAR., 1987
                         100 YR,  6 HOUR STORM EVENT

 4 IO         OUTPUT CONTROL VARIABLES
                    IPRNT          5  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE

  IT          HYDROGRAPH TIME DATA
                     NMIN          5  MINUTES IN COMPUTATION INTERVAL
                    IDATE      1   0  STARTING DATE
                    ITIME       0000  STARTING TIME
                       NQ         60  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE      1   0  ENDING DATE
                   NDTIME       0455  ENDING TIME

              COMPUTATION INTERVAL     .08 HOURS
                   TOTAL TIME BASE    4.92 HOURS

       ENGLISH UNITS

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN        0. TO      183.
            THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
            THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)
```

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	SUB1	724.	3.75	184.	184.	184.	1.15		
HYDROGRAPH AT	SUB2	1538.	4.00	411.	411.	411.	3.04		
HYDROGRAPH AT	SUB3	2221.	3.25	718.	718.	718.	4.76		
HYDROGRAPH AT	SUB4	3501.	3.42	925.	925.	925.	6.05		
HYDROGRAPH AT	SUB9	1389.	4.17	385.	385.	385.	3.12		
2 COMBINED AT	SUB5	4113.	3.42	1310.	1310.	1310.	9.17		
ROUTED TO	RES5	1308.	4.92	436.	436.	436.	9.17		
								1509.37	4.92
HYDROGRAPH AT	SUB6	743.	3.08	106.	106.	106.	.43		
ROUTED TO	RES6	301.	3.50	80.	80.	80.	.43		
								1509.24	3.50
2 COMBINED AT	SUB6A	1433.	4.17	515.	515.	515.	9.60		
HYDROGRAPH AT	SUB7	1609.	3.67	564.	564.	564.	9.99		
HYDROGRAPH AT	SUB8	2304.	4.00	622.	622.	622.	11.29		

NORMAL END OF HEC-1 ***

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  1           ID       BUCHANAN WASH  -  FLOOD PLAIN DELINATION   REV. 1 MAR., 1987
  2           ID       500 YR,  6 HOUR STORM EVENT
  3           IT      5                    60
  4           IO      5
              *DIAGRAM

  5           KK    SUB1
  6           KM        RUNOFF FROM SUBBASIN NO. 1
  7           BA    1.15
  8           LS            86                    92
  9           PB    4.10
 10           PC     0.0   0.003   0.007   0.011   0.014   0.018   0.022   0.026   0.031   0.035
 11           PC   0.039   0.044   0.048   0.053   0.057   0.062   0.068   0.073   0.079   0.086
 12           PC   0.093   0.100   0.108   0.117   0.125   0.135   0.145   0.155   0.167   0.180
 13           PC   0.192   0.241   0.290   0.339   0.469   0.599   0.729   0.750   0.770   0.791
 14           PC   0.804   0.825   0.830   0.841   0.851   0.862   0.870   0.879   0.887   0.894
 15           PC   0.901   0.908   0.914   0.920   0.926   0.931   0.937   0.942   0.947   0.951
 16           PC   0.956   0.960   0.965   0.969   0.973   0.977   0.980   0.983   0.987   0.990
 17           PC   0.993   0.997   1.000
 18           UK    1200   0.008   0.130      97
 19           UK     600   0.070   0.150       3
 20           RK    6000  0.0077   0.070    1.15    TRAP      10      10
 21           RK    2900  0.0066   0.050            TRAP      12       4

 22           KK    SUB2
 23           KM        RUNOFF FROM SUBBASIN NO. 2
 24           BA    1.89
 25           LS            86                    92
 26           UK    1100   0.008   0.130      99
 27           UK     600   0.070   0.150       1
 28           RK   15700  0.0075   0.070    1.37    TRAP      10      10
 29           RK    2100  0.0033   0.050            TRAP      13       4     YES

 30           KK    SUB3
 31           KM        RUNOFF FROM SUBBASIN NO. 3
 32           BA    1.72
 33           LS            86                    92
 34           UK     700   0.044   0.130      87
 35           UK     500   0.090   0.150      13
 36           RK    6300  0.0143   0.070    0.46    TRAP      10       3
 37           RK    3100  0.0029   0.050            TRAP      17       4     YES

 38           KK    SUB4
 39           KM        RUNOFF FROM SUBBASIN NO. 4
 40           BA    1.29
 41           LS            86                    92
 42           UK     650   0.015   0.130      94
 43           UK     500   0.080   0.150       6
 44           RK    4500   0.013   0.070    0.24    TRAP      10       5
 45           RK    4900  0.0062   0.050            TRAP      20       4     YES
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  46          KK   SUB9
  47          KM       RUNOFF FROM SUBBASIN NO. 9
  48          BA   3.12
  49          LS            86                    92
  50          UK    950  0.0087   0.130     95
  51          UK    500  0.0600   0.150      5
  52          RK  25100  0.0078   0.070   2.45   TRAP     10      5
  53          RK   2000  0.0020   0.050          TRAP     20      5

  54          KK   SUB5
  55          KM       COMBINATION OF RUNOFF ABOVE CAP CROSSING
  56          HC      2

  57          KK   RES5
  58          KM       RESERVOIR STORAGE AT SUBBASIN NO. 4
  59          RS      1    STOR     0.0
  60          SV      0    0.27    3.03   10.88   36.82  100.83  225.32  414.41  695.23
  61          SE   1493    1496    1500    1502    1504    1506    1508    1510    1512
  62          SQ      0     153     420     480     731     887    1019    1135    1241    1339
  63          SQ   1430
  64          SE   1493 1495.75  1498.0  1498.5  1500.0    1502    1504    1506    1508    1510
  65          SE   1512

  66          KK   SUB6
  67          KM       RUNOFF FROM SUBBASIN NO. 6
  68          BA   0.43
  69          LS            86                    92
  70          UK    800   0.010    0.13     37
  71          UK    550   0.04     0.15     63
  72          RK   4500   0.078   0.070   0.13   TRAP     10      3
  73          RK     10   0.008   0.050          TRAP     24      2

  74          KK   RES6
  75          KM       RESERVOIR STORAGE AT SUBBASIN NO. 6
  76          RS      1    STOR     0.0
  77          SV      0    2.98   10.59   23.57   41.57   70.00
  78          SE   1504    1506    1508    1510    1512    1514
  79          SQ      0       0    99.1   424.9  1118.7  2309.3
  80          SE   1504    1506    1508    1510    1512    1514

  81          KK  SUB6A
  82          KM       COMBINE HYDROGRAPHS AT CULVERT OUTLET
  83          HC      2

  84          KK   SUB7
  85          KM       RUNOFF FROM SUBBASIN NO. 7
  86          BA   0.39
  87          LS            86                    92
  88          UK    800   0.007   0.130     54
  89          UK    400   0.100   0.150     46
  90          RK   3000   0.117   0.070   0.06   TRAP     10      3
  91          RK   4100  0.0044   0.055          TRAP     25      2    YES
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  92          KK   SUB8
  93          KM       RUNOFF FROM SUBBASIN NO. 8
  94          BA    1.3
  95          LS            86                    92
  96          UK   1100   0.009    0.13     91
  97          UK    500   0.060    0.15      9
  98          RK   7700  0.0058   0.070    2.45   TRAP     10      10
  99          RK  10400  0.0035   0.055           TRAP     28       2     YES
 100          ZZ
```

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   5        SUB1
               V
               V
  22        SUB2 ***
               V
               V
  30        SUB3 ***
               V
               V
  38        SUB4 ***
               .
               .
  46           .        SUB9
               .          .
               .          .
  54        SUB5............
               V
               V
  57        RES5
               .
               .
  66           .        SUB6
               .          V
               .          V
  74           .        RES6
               .          .
               .          .
  81       SUB6A............
               V
               V
  84        SUB7 ***
               V
               V
  92        SUB8 ***
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1                                        ****
                    FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
          U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616
                                        ****


                         BUCHANAN WASH  -  FLOOD PLAIN DELINATION   REV. 1 MAR., 1987
                         500 YR,  6 HOUR STORM EVENT

 4 IO         OUTPUT CONTROL VARIABLES
                    IPRNT          5  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE

  IT          HYDROGRAPH TIME DATA
                     NMIN          5  MINUTES IN COMPUTATION INTERVAL
                    IDATE     1    0  STARTING DATE
                    ITIME       0000  STARTING TIME
                       NQ         60  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE     1    0  ENDING DATE
                   NDTIME       0455  ENDING TIME

              COMPUTATION INTERVAL     .08 HOURS
                   TOTAL TIME BASE    4.92 HOURS

       ENGLISH UNITS

** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN        0. TO      183.
             THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
             THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)
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RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	SUB1	1204.	3.58	281.	281.	281.	1.15		
HYDROGRAPH AT	SUB2	2481.	3.83	654.	654.	654.	3.04		
HYDROGRAPH AT	SUB3	3608.	3.17	1104.	1104.	1104.	4.76		
HYDROGRAPH AT	SUB4	5751.	3.33	1415.	1415.	1415.	6.05		
HYDROGRAPH AT	SUB9	2132.	3.92	609.	609.	609.	3.12		
2 COMBINED AT	SUB5	6808.	3.33	2024.	2024.	2024.	9.17		
ROUTED TO	RES5	1407.	4.92	490.	490.	490.	9.17	1511.49	4.92
HYDROGRAPH AT	SUB6	1027.	3.00	146.	146.	146.	.43		
ROUTED TO	RES6	467.	3.42	117.	117.	117.	.43	1510.12	3.42
2 COMBINED AT	SUB6A	1647.	3.67	606.	606.	606.	9.60		
HYDROGRAPH AT	SUB7	1958.	3.50	679.	679.	679.	9.99		
HYDROGRAPH AT	SUB8	3067.	3.75	836.	836.	836.	11.29		

*** NORMAL END OF HEC-1 ***