

# APACHE WASH FLOOD INSURANCE STUDY

PREPARED FOR  
FLOOD CONTROL DISTRICT OF  
MARICOPA COUNTY, ARIZONA

Contract FCD 89-66  
JJA/DEA Job No. MARI0001

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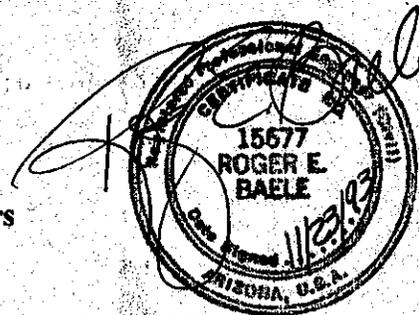


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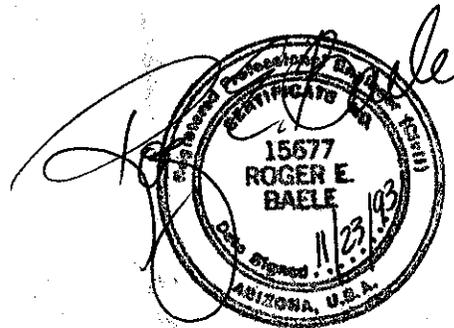
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### EXHIBITS

Exhibit 1 -Computer Models * HEC-2 HEC-1	
Exhibit 2 -Apache Wash Profiles *	
Exhibit 3 -Flood Boundary and Floodway Maps *	
Exhibit 4 -Apache Wash Hydrologic/Hydraulic Technical Data Notebook . . . . .	

### ADDENDUM

Apache Wash Hydrology Report \*  
\* Under Separate Cover



## 1.0 INTRODUCTION

### 1.1 Purpose of Study

This study investigates the existence and severity of flood hazards along Apache Wash and its tributaries in Maricopa County, Arizona. It aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data along Apache Wash and its tributaries that will be used in floodplain management and to establish actuarial flood insurance rates. Minimum floodplain management requirements for participation on the National Flood Insurance Program (NFIP) are set forth on the Code of Federal Regulations at 44 cfr, 60.3.

### 1.2 Authority and Acknowledgements

The original hydrologic analysis for this study was obtained from the City of Phoenix. The revised hydrologic analysis was performed by Jerry R. Jones & Associates, Inc. (JJA/DEA) for the Flood Control District of Maricopa County (FCDMC) under Contract No. 89-66 and was completed in June,, 1991.

The hydraulic analysis for this study was performed by JJA/DEA for the FCDMC under Contract No. 89-66. The work was completed in the summer of 1992.

### 1.3 Coordination

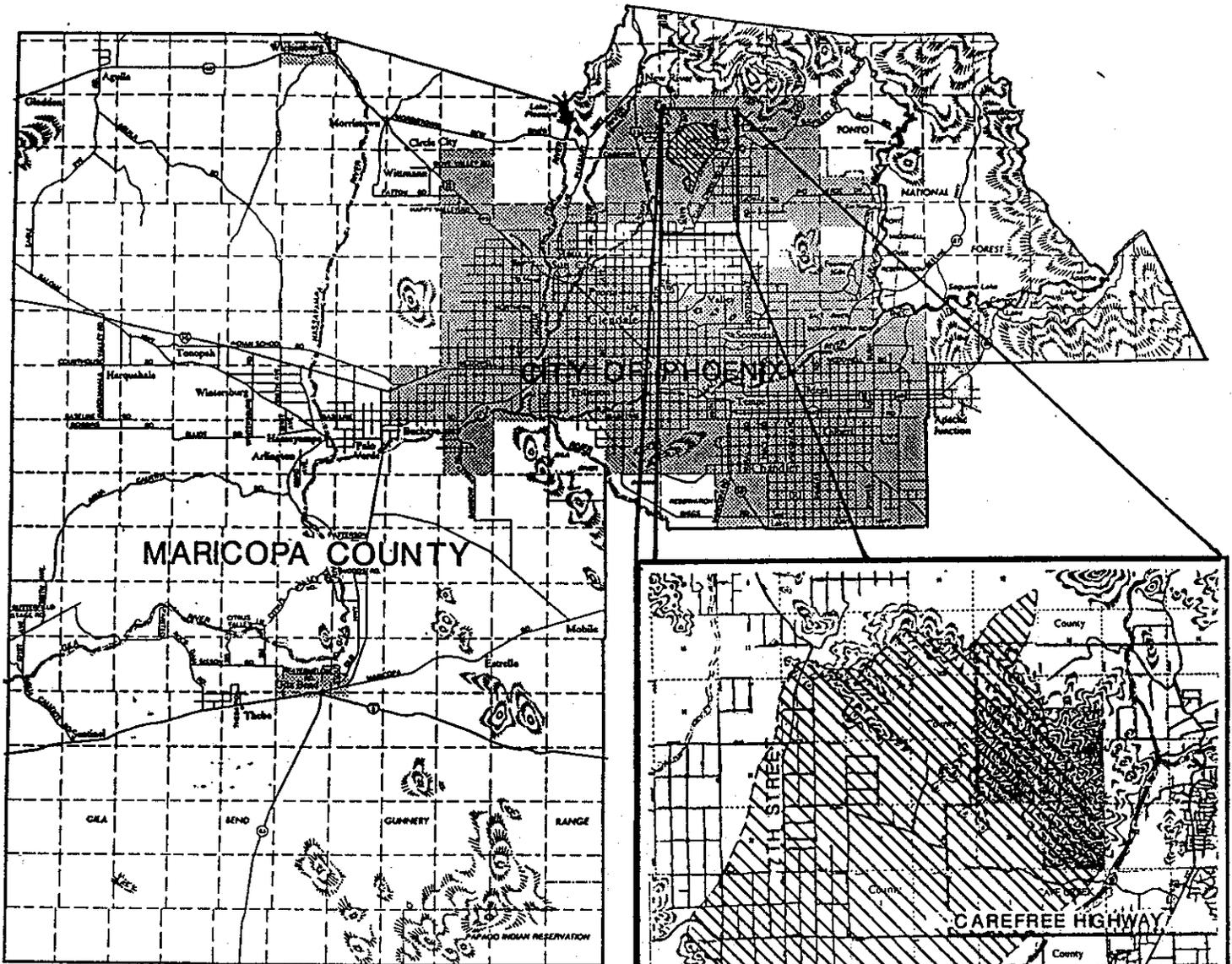
Written notice to proceed was received by JJA/DEA on April 4, 1990. Field inspection was conducted on April 18, 1990 and was attended by personnel from the Arizona Department of Water Resources (ADWR), the FCDMC, and JJA/DEA. The field trip served as the initial coordination meeting, and documented existing watershed conditions as well as channel roughness values. Public notice of this flood insurance study was published in the Arizona Republic/Phoenix Gazette on August 21, 1990.

Prior to the flood insurance study, JJA/DEA completed a master drainage study on the Apache Wash Basin for the City of Phoenix (Reference 10). A master drainage study was guided by a steering committee composed of representatives from: 1) City of Phoenix (COP) Parks, 2) COP Recreation and Library, 3) COP Water and Wastewater Department, 4) COP Long Range Planning, 5) COP Storm Drain Section, 6) COP Floodplain Management Section, 7) COP Deputy City Engineer, 8) COP Development Services, 9) Flood Control District of Maricopa County, 10) Arizona State Land Department, and 11) Landmark American Corporation. A public meeting on April 5, 1990 gathered public input for the study. Although not part of this flood insurance study, the master drainage study did generate information used in the flood insurance study.

## 2.0 AREA STUDIED

### 2.1 Scope of Study

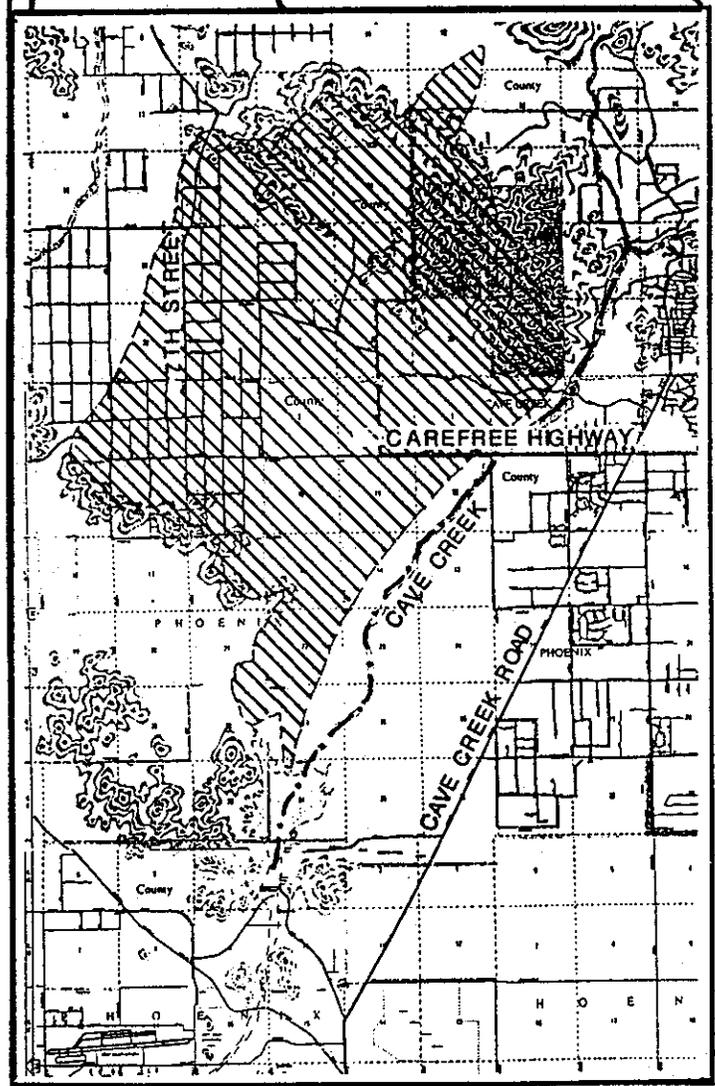
This Flood Insurance Study covers Apache Wash and its tributaries from the downstream limits of the northern boundary of the Cave Butte Recreation Area to the upstream limits where the 100-year discharge is less than 1,000 cfs. The watershed thus bounded covers an area of approximately 32 square miles. The Cave Creek Basin lies to the east and the Scatter Wash Basin is located to the west. The area of study is shown on the Location Map (Figure 1) and is detailed in Table 1, Description of Study Reaches. Total length of the various channels studied in this report is 24.9 miles.



LOCATION MAP

 APACHE WASH BASIN STUDY AREA

FIGURE 1.1



# APACHE WASH WATERSHED

## LOCATION MAP

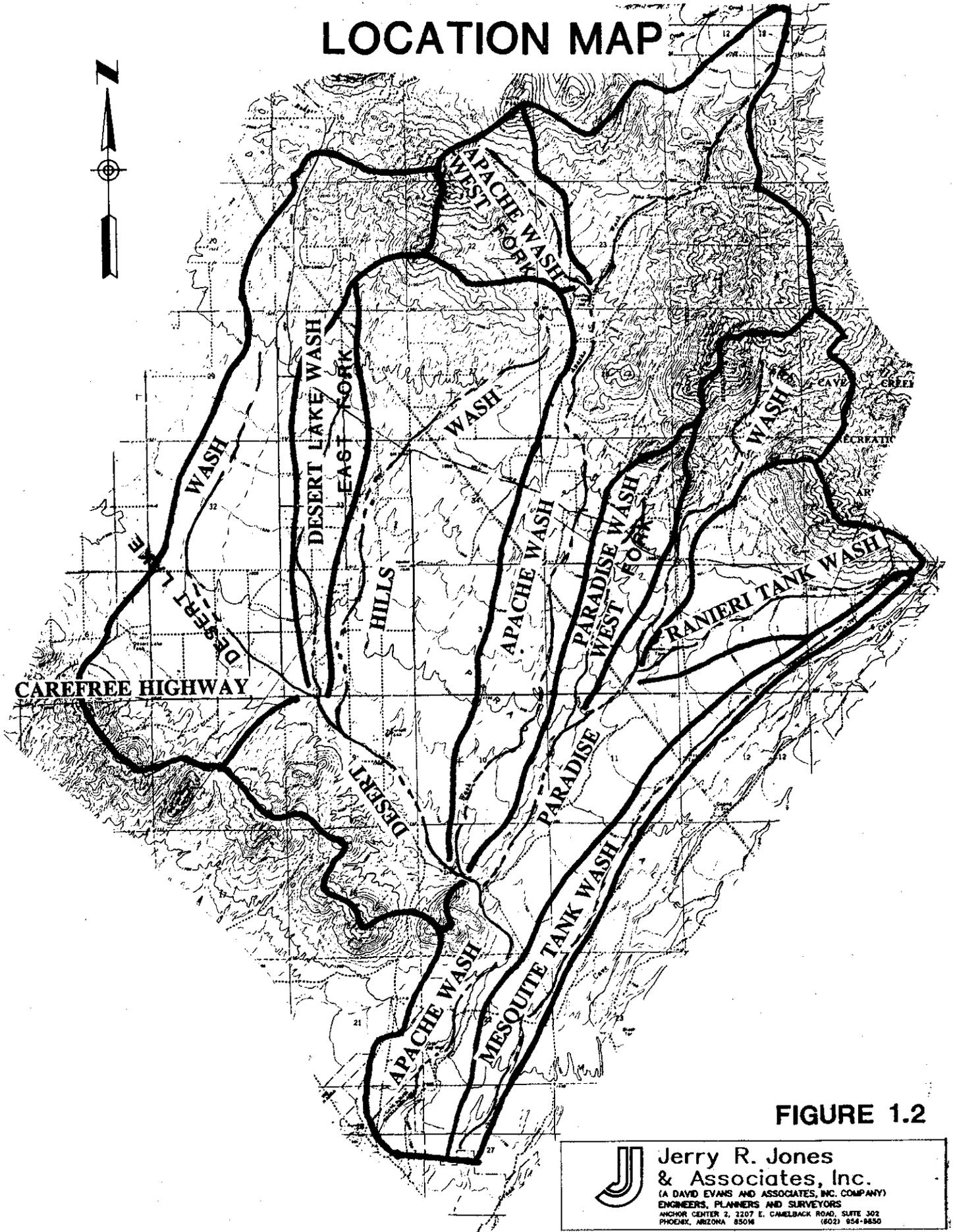


FIGURE 1.2



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## **2.2 Community Description**

The Apache Wash Basin is located in northern Maricopa County, Arizona, partially in the City of Phoenix and partially in Maricopa County. Approximately 9 of the 32 square miles of the basin are located in the City of Phoenix with Carefree Highway generally forming the boundary between the two jurisdictions. The City of Phoenix portion of the basin is located in Planning Areas C and D (Reference 8).

Land use is largely rural residential or undeveloped, although ranching occurs in some areas, such as Ranieri Wash. Vegetation is typical of the Sonoran Desert. Flow is generally from the north to south and most channels are incised. Sheetflow occurs in some western portions of the basin, particularly Desert Lake Wash. As is typical in the Sonoran Desert, flow is intermittent and channels are dry most of the time.

## **2.3 Principal Flood Problems**

The principal flood hazard arises from inadequately sized drainage structures under Carefree Highway. All existing crossings of Carefree Highway cannot convey the 100-year storm without overflowing the roadway. In addition, an August, 1988 flooding report by the FCDMC (Reference 9) identified three other problem areas: Central Avenue and Desert Lake, 10th Street and Cloud

Drive, and 14th Street and Cloud Drive. Sheet flooding occurs in the Desert Lake sub-basin.

Also in recent years construction of residences in the vicinity of the study limits has increased. In the absence of floodplain mapping, the potential for flooding of residences near washes may have increased.

#### **2.4 Flood Protection Measures**

Flood protection measures are limited to minor structures, such as berms and riprap, that are associated with culvert crossings. Other than these improvements, all channels are in a natural condition. The adoption of this F.I.S. will provide a tool to manage future development.

The FCDMC has recently designed two, 12'x10' CBC's at the intersection of Cloud Road and 32nd Street. These structures and the upstream and downstream channel improvements associated with these culverts will convey the 100-year storm. These improvements, although not built, have been incorporated in the HEC-2 data per request of the FCDMC.

TABLE 1 - DESCRIPTION OF STUDY REACHES

REACH	LIMIT OF STUDY
Apache Wash	From Cave Buttes Reservoir to the NE 1/4 of Section 23, T6N, R3E.
Apache Wash - West Fork	From the confluence with Apache Wash to the NW 1/4 of Section 23, T6N, R3E.
Paradise Wash	From the confluence with Apache Wash to approximately 6,800 feet upstream of New River Road.
Paradise Wash - West Fork	From the confluence with Paradise Wash for a distance of approximately 4,500 feet upstream to the SW 1/4 of Section 2, T5N, R3E.
Ranieri Wash	From the confluence with Paradise Wash for approximately 8,500 feet upstream to just south of New River Road.
Desert Hills Wash	From the confluence with Apache Wash to approximately 4,200 feet upstream of New River Road.
Desert Lake Wash - East Fork	From the confluence with Desert Lake Wash approximately 3,100 feet upstream of Carefree Highway.
Desert Lake	From the confluence with Desert Hills Wash to approximately 8,500 feet upstream of Carefree Highway.
Mesquite Tank Wash	From Cave Butte Reservoir for approximately 11,200 feet upstream to the NW 1/4 of Section 23, T5N, R3E.

### 3.0 ENGINEERING METHODS

#### 3.1 Hydrologic Analysis

Peak discharges were calculated using the U.S. Army Corps of Engineers HEC-1 program (Reference 2). Watershed boundaries were taken from a prior master drainage study for Apache Wash (Reference 10), and were modified or subdivided for this study. Runoff curve numbers were estimated using SCS TR-55 (Reference 14) based on SCS soils maps (Reference 12) and land use/vegetation parameters from aerial photos (Reference 7), and field investigation. The 24-hour, 100-year storm, the USBR lag time method per the FCDMC Hydrologic Design Manual (Reference 13), and the kinematic wave method were used to generate peak flows. Discharges were not reduced for transmission losses through the channel bed; only the 100-year discharge was estimated per the contract for this project.

All hydrologic calculations and information are included in a separate addendum titled Apache Wash Hydrology Report. Table 2, Summary of Discharges, compiles the 100-year discharges by wash and river mile.

### 3.2 Hydraulic Analysis

Topographic maps of the study area, at a scale of 1" = 200' and a contour interval of 2 feet, were generated from aerial photos flown from July to November, 1990 (Reference 6).

Water surface elevations were computed using the U.S. Army Corps of Engineers program HEC-2 (Reference 3). The following standard HEC-2 guidelines were used in the modeling.

- River mile stationing starts at 0.00 at the northern boundary of the Cave Butte Recreation Area and increases upstream. Tributary stationing starts at mile 0.00 at its confluence with the main channel or continues with main channel stationing, but with the miles carried out to the 1/1000 of a mile.
- Cross-sections were spaced every 500 feet along the channel centerline (thalweg) with a thalweg station of 10,000. Left and right orientation is facing downstream.
- Ineffective flow areas upstream and downstream of structures were modeled by a 1:1 contraction and 4:1 expansion, respectively. Contraction and expansion loss coefficients were 0.3 and 0.5, respectively.

- Channel and overbank roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgement and were based on field observations of the river channel and overbank areas. The channel "n" values ranged from 0.022 to 0.07, and the overbank "n" values ranged from 0.032 to 0.070. The dominant factor governing the choice of roughness factor was the degree of vegetation present in the channel or overbank. Areas with more vegetation had correspondingly higher "n" values than relatively barren areas.
  
- Starting water surface elevations for Mesquite Tank Wash and Apache Wash were the reservoir design flood pool elevation of 1,657.1 (actual 100-year flood elevation was calculated to be higher than that in the computer modeling). This information was obtained from Appendix 1A, Plate 1, of Reference 15.

TABLE 2 - SUMMARY OF DISCHARGES  
APACHE WASH AND TRIBUTARIES

FLOODING SOURCE	LOCATION	RIVER MILE	100-YEAR DISCHARGE (CFS)
Apache Wash	At Cave Butte Recreation Area	0.00 .	17,136
	Upstream of confluence with Paradise Wash	2.73	13,541
	Upstream of confluence with Desert Hills Wash	3.32	7,534
	Downstream of confluence with west overflow area into Desert Hills Wash	3.86	7,213
	Upstream of confluence with west overflow area	4.11	5,347
	Downstream of Carefree Highway	4.57	5,463
	Upstream of Carefree Highway	4.58	5,739
	Upstream of Carefree Highway (overflow area)	4.60	5,837
	Upstream of Carefree Highway (overflow area)	4.65	6,053
	Upstream of Carefree Highway (overflow area)	4.74	6,928
	Upstream of Carefree Highway (overflow area)	4.78	7,213
	New River Road	6.09	7,187
	Upstream of confluence with West Fork Apache Wash	8.12	3,853
Apache Wash (West Overflow Area)	Upstream of confluence with Apache Wash	4.055	1,866
	Upstream of Carefree Highway	4.655	1,250

TABLE 2 - SUMMARY OF DISCHARGES  
APACHE WASH AND TRIBUTARIES

FLOODING SOURCE	LOCATION	RIVER MILE	100-YEAR DISCHARGE (CFS)
	Upstream of Carefree Highway	4.722	723
	Upstream of Carefree Highway	4.744	285
Apache Wash - West Fork	Upstream of confluence with Apache Wash	0.09	2,191
Desert Hills Wash	Confluence with Apache Wash	0.02	13,541
	Upstream of confluence with Apache Wash (overflow from Apache Wash)	0.40	10,465
	Upstream of confluence with Apache Wash (overflow from Apache Wash)	0.48	10,453
	Upstream of confluence with Apache Wash (overflow from Apache Wash)	0.56	10,453
	Upstream of confluence with Apache Wash	0.40	10,259
	Downstream from 14th Street (overflow area)	1.10	9,657
	At 14th Street	1.29	9,560
	Confluence with Desert Lake Wash	1.81	8,890
	Upstream of confluence with Desert Lake Wash	2.00	4,143
	At Cloud Road	3.13	3,669
	Downstream of Joy Ranch Road and confluence with small unnamed wash	3.81	2,692
	At Joy Ranch Road	4.23	1,787

TABLE 2 - SUMMARY OF DISCHARGES  
APACHE WASH AND TRIBUTARIES

FLOODING SOURCE	LOCATION	RIVER MILE	100-YEAR DISCHARGE (CFS)
	Upstream of confluence with small, unnamed wash	5.02	1,000
Unnamed Wash	Small, unnamed wash tributary to Desert Hills Wash at Mi. 4.95	0.054	1,000
Desert Lake Wash - East Fork	Upstream of confluence with Desert Lake Wash	0.14	4,772
	Upstream of confluence with Desert Lake Wash	0.23	1,023
Mesquite Tanks Wash	At Cave Butte Recreation Area	0.38	1,000
Desert Lake Wash	Upstream of confluence with Desert Hills Wash	0.18	4,772
	Upstream of confluence with Desert Hills Wash	0.57	3,406
Paradise Wash	Upstream of confluence with Apache Wash	0.04	5,763
	Upstream of confluence with West Fork Paradise Wash	1.75	4,179
	Upstream of confluence with Ranieri Wash	2.37	1,701
	North of New River Road	3.40	1,590
Paradise Wash West Fork	Upstream of confluence with Paradise Wash	0.25	1,023
Ranieri Wash	Upstream of confluence with Paradise Wash	0.09	2,348

- Cross-sections were prepared by several methods. Some were prepared by an automatic cross-sectioning program using the digitized topographic information, while others were prepared by scaling from contour maps. All sections were reviewed for accuracy.
- Culverts were analyzed using the special culvert modeling or the normal bridge method. Data on these culverts was obtained through field reconnaissance methods.

Field reconnaissance was used to establish Manning's "n" values, and to verify information on structures. Additional elevations were obtained by field survey where necessary.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD).

### **3.2.2 Hydraulic Modeling at Structures**

Culverts at road crossings are the only hydraulic structures found in the Apache Wash Basin. Most of the culverts are along Carefree Highway; most are too small to convey 100-year discharge without overflowing the road. The HEC-2 culvert modeling method was used to model these structures. Typical coefficients were: Weir coefficient from 2.6 to 3.1, orifice flow loss coefficient of 1.6, and pier shape coefficient of 1.05. Table 3 summarizes the structures and modeling techniques.

TABLE 3 - SUMMARY OF STRUCTURES				
FLOODING SOURCE	LOCATION	STRUCTURE		HEC-2 BRIDGE METHOD
		No.	Description	
Apache Wash	Carefree Hwy	1	3-10'x5' RCBC	Special Culvert
	24th St.	2	2-66" HERCs	None
Desert Hills Wash	Carefree Hwy	3	3-10'x5' RCBCs	Special Culvert
	Joy Ranch Rd	4	2-48", 1-60" RCPs	Special Culvert
Desert Lake Wash	Carefree Hwy	5	4-12'x6' RCBCs	Special Culvert
Paradise Wash	Carefree Hwy	6	2-10'x5-1/2' RCBCs	None
Paradise Wash - West Fork	Carefree Hwy.	7	4-48" RCPs	Special Culvert

The existing box culvert at Carefree Highway (Structure No. 6) was not included in the hydraulic analysis of Paradise Wash because the structure has little or no effect on the hydraulics at high flows. The culvert is located within the primary flow channel along the extreme eastern side of the floodplain and is skewed to the roadway. During large (i.e., 100-year) flow most of the flow is in the west overbank and flows over the roadway, which, in places is no higher than the channel invert at the culvert. Thus, it was determined that the culvert analysis could be neglected for analysis of the 100-year flow event.

### 3.2.3 Split Flow Analyses

Split flow analyses were performed in two areas along Apache Wash: 1) The confluence of Desert Hills Wash and Apache Wash, and 2) the culvert crossing at Carefree Highway. The weir option was selected in the HEC-2 split flow model, with weir sections approximately perpendicular to the cross-sections and a weir coefficient of 2.6. Separate HEC-2 split flow runs in the immediate vicinity of the split flow areas were performed and the results were transferred as discharge changes (i.e., QT cards) into the complete HEC-2 run for Apache Wash. These separate short runs are also included under separate cover in Exhibit 1- Computer Models.

#### Confluence of Desert Hills Wash and Apache Wash

The confluence of these two washes is broad and long, extending from mile 2.73 (cross-section AE) on Apache Wash to mile 3.21 (cross-section AM) on Apache Wash and mile 0.56 (cross-section H) on Desert Hills Wash. The split flow occurs at three cross-sections at the upstream end of the confluence where the water surface elevations in Apache Wash are several feet higher than in Desert Hills Wash. Therefore, flow breaks out from Apache Wash over a low ridge into the adjacent Desert Hills Wash. Table 4 compiles data on this split flow area.

The area between the floodway and floodplain at the junction of these cross-sections is specified as a Zone A because base flood elevations and exact flow depths cannot be determined with accuracy in this split flow area; only maximum and minimum depths are known.

**TABLE 4**  
**SPLIT FLOW AT CONFLUENCE OF**  
**DESERT HILLS WASH AND APACHE WASH**

APACHE WASH				DESERT HILLS WASH		
STATION		DISCHARGE (CFS)		STATION	DISCHARGE (CFS)	
FROM	TO	SPLIT (CFS)	CHANGE (CFS)		$\Sigma$ SPLIT (CFS)	CHANGE (CFS)
3.32	-	-	7534	0.64	-	10259
3.21	3.32	5	7529	0.56	5	10264
3.13	3.21	189	7340	0.48	194	10453
3.07	3.13	12	7328	0.40	206	10465

Apache Wash at Carefree Highway

The culverts at Carefree Highway back up the 100-year flow in Apache Wash and cause it to break over a small ridge to an adjacent small watercourse to the west. This breakout area extends from Carefree Highway at river mile 4.57 (cross-section BE) for approximately one-third mile upstream to river mile 4.88 (cross-section BK). Once the breakout flow is in the adjacent watercourse, it crosses Carefree Highway and continues as a separate watercourse until it rejoins the main channel of Apache Wash at river mile 4.05 (cross-section AX). This adjacent watercourse was called the "west overflow area" and is covered by cross-sections 4.055 through 4.744; river miles were not assigned.

Tables 5A and 5B compile data on the split flow area.

**TABLE 5A  
APACHE WASH SPLIT FLOW BETWEEN STA. 4.49 AND 4.90**

STATION		DISCHARGE (CFS)		
FROM	TO	SPLIT	APACHE	Σ SPLIT
4.78	-	N/A	7213	N/A
4.74	4.78	285	6928	285
4.65	4.74	875	6053	1160
4.60	4.65	180	5873	1340
4.58	4.60	134	5739	1474
4.57	4.58	276	5463	1750
4.56	4.57	116	5347	1866
4.05	4.56	0	5347	1866

**TABLE 5B  
APACHE WASH SPLIT FLOW CHANNEL DISCHARGE**

STATION	DISCHARGE (CFS)
4.111	1866
4.499	1866
4.655	$(1160 + 1340)/2 = 1250$
4.722	$875/2 + 285 = 723$
4.744	285

The west overflow area between cross-sections 200 and 500 is specified as a Zone A because base flood elevations and depths cannot be estimated.

### 3.2.4 Modeling at Ranieri Tank

A cattle tank, or small dam, is located at mile 0.38 (cross-section F) on Ranieri Tank Wash. The topography (i.e., ground points) in the immediate vicinity of the tank were modified to model the blockage caused by the small dam.

## **4.0 FLOODPLAIN MANAGEMENT APPLICATIONS**

A prime purpose of the National Flood Insurance Program is to encourage State and local governments to adopt sound floodplain management programs. Each Flood Insurance Study, therefore, includes a flood boundary map designed to assist communities in developing sound floodplain management measures.

### **4.1 Flood Boundaries**

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the Federal Insurance Administration as the base flood for purposes of floodplain management measures. For each reach studied in detail, the boundaries of the 100-year flood have been delineated using the flood elevations determined at each cross-section; between cross-sections the boundaries were interpolated using topographic maps (Reference 7).

Flood boundaries for the 100-year flood are shown on the Flood Boundary and Floodway Map (Exhibit 3). Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding. However due to limitations of the map scale, such areas are not shown.

### **4.2 Floodways**

Encroachment on floodplains, such as artificial fill, reduces the flood-carrying capacity and increases flood heights, thus increasing flood hazards in areas

beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment in order that the 100-year flood is carried without substantial increases in flood heights and velocities. As minimum standards, the Federal Insurance Administration limits such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced.

The floodway presented in this study was computed by using both Method 4 and Method 1 in the HEC-2 model with a maximum allowable rise in water surface not exceeding 1.0 foot at any location. The principle of equal overbank conveyance reduction (i.e., Method 4) was utilized with a target of 1.0 foot of rise allowed. After initial runs, Method 1 was used to "smooth out" the floodway and assure that the 1.0 foot allowable rise criteria was adhered to. Where the floodway and floodplain boundaries are close together or coincident, only the floodway line is shown. Table 6 summarizes the floodway data for each cross-section.

TABLE 6  
APACHE WASH FLOODWAY DATE

FEDERAL EMERGENCY MANAGEMENT AGENCY  
MARICOPA COUNTY, ARIZONA

CROSS SECT.	STA.	----- FLOODWAY -----			WATER SURFACE ELEVATION		DIFFERENCE
		WIDTH (FEET)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (FPS)	WITH FLOODWAY (NGVD) <sup>1</sup>	WITHOUT FLOODWAY (NGVD)	
A	.200	590.	3006.	5.7	1659.7	1659.6	.1
B	.330	400.	2454.	7.0	1663.0	1662.8	.2
C	.430	468.	2666.	6.4	1666.0	1665.5	.5
D	.540	500.	2572.	6.7	1670.0	1669.0	1.0
E	.630	518.	2972.	5.8	1673.6	1672.9	.7
F	.710	420.	2494.	6.9	1675.7	1675.3	.4
G	.750	464.	2806.	6.1	1677.3	1677.0	.3
H	.840	395.	2602.	6.6	1680.0	1679.3	.7
I	.990	619.	3081.	5.6	1684.8	1684.1	.7
J	1.090	507.	2192.	7.8	1688.1	1687.5	.6
K	1.180	490.	2492.	6.9	1692.5	1691.5	1.0
L	1.270	410.	2995.	5.7	1695.5	1695.2	.3
M	1.370	492.	2644.	6.5	1697.8	1697.5	.3
N	1.470	490.	2812.	6.1	1701.2	1701.2	.0
O	1.560	447.	2459.	7.0	1704.1	1703.9	.2
P	1.600	439.	2833.	6.0	1705.5	1705.2	.3
Q	1.660	390.	2794.	6.1	1707.0	1706.6	.4
R	1.750	368.	2356.	7.3	1709.5	1709.3	.2
S	1.810	463.	3168.	5.4	1711.4	1711.2	.2
T	1.850	581.	3529.	4.9	1712.1	1711.9	.2
U	1.880	639.	3311.	5.2	1713.0	1712.8	.2
V	2.000	791.	3134.	5.5	1715.2	1715.1	.1
W	2.080	650.	2525.	6.8	1718.0	1717.9	.1
X	2.170	451.	2548.	6.7	1721.8	1721.6	.2
Y	2.240	305.	2083.	8.2	1724.5	1724.3	.2
Z	2.330	212.	1708.	10.0	1728.2	1728.0	.2

1 REGULATORY BASE FLOOD WATER SURFACE ELEVATION IS THE SAME AS THE FLOODWAY WATER SURFACE ELEVATION

TABLE 6

## APACHE WASH FLOODWAY DATA (CONTINUED)

CROSS SECT.	STA.	FLOODWAY		MEAN VELOCITY (FPS)	WATER SURFACE ELEVATION		ELEVATION DIFFERENCE
		WIDTH (FEET)	SECTION AREA (SQ. FT.)		WITH FLOODWAY (NGVD) <sup>1</sup>	WITHOUT FLOODWAY (NGVD)	
AA	2.400	247.	2298.	7.5	1731.3	1731.2	.1
AB	2.470	370.	3031.	5.7	1733.4	1733.4	.0
AC	2.520	535.	3744.	4.6	1734.4	1734.3	.1
AD	2.600	650.	3472.	4.9	1735.8	1735.7	.1
AE	2.730	293.	1755.	7.7	1738.9	1738.9	.0
AF	2.820	520.	3487.	3.9	1741.9	1741.7	.2
AG	2.870	640.	3802.	3.6	1742.6	1742.4	.2
AH	2.900	770.	3278.	4.1	1742.9	1742.6	.3
AI	2.920	840.	3288.	4.1	1743.6	1743.2	.4
AJ	2.970	372.	1179.	6.4	1745.3	1744.9	.4
AK	3.070	410.	1678.	4.5	1749.5	1749.4	.1
AL	3.130	468.	1569.	4.8	1750.8	1750.5	.3
AM	3.210	390.	1296.	5.8	1752.7	1752.3	.4
AN	3.320	375.	1324.	5.7	1757.1	1756.4	.7
AO	3.400	340.	1348.	5.6	1760.8	1760.0	.8
AP	3.480	270.	1141.	6.6	1764.1	1763.3	.8
AQ	3.520	241.	1123.	6.7	1765.8	1765.1	.7
AR	3.600	269.	1413.	5.3	1769.1	1768.4	.7
AS	3.650	290.	1587.	4.7	1770.5	1769.8	.7
AT	3.750	260.	1080.	7.0	1773.4	1773.0	.4
AU	3.780	276.	1216.	6.2	1775.2	1774.5	.7
AV	3.860	380.	1243.	5.8	1778.3	1778.2	.1
AW	3.960	556.	1257.	5.7	1782.6	1782.4	.2
AX	4.050	302.	1157.	4.6	1786.1	1786.0	.1
AY	4.110	314.	774.	6.9	1788.4	1788.5	-.1
AZ	4.220	302.	1225.	4.4	1792.7	1792.3	.4

TABLE 6

## APACHE WASH FLOODWAY DATA (CONTINUED)

CROSS SECT.	STA.	----- FLOODWAY -----		WATER SURFACE ELEVATION		DIFFERENCE	
		WIDTH (FEET)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (FPS)	WITH FLOODWAY (NGVD) <sup>1</sup>		WITHOUT FLOODWAY (NGVD)
BA	4.230	267.	1118.	4.8	1793.4	1792.8	.6
BB	4.310	194.	649.	8.2	1796.2	1796.1	.1
BC	4.400	311.	1189.	4.5	1800.9	1800.6	.3
BD	4.490	273.	773.	6.9	1803.1	1803.2	-.1
BD.1	4.560	272.	1034.	5.2	1806.1	1806.1	.0
BE	4.570	590.	1368.	4.0	1808.0	1808.0	.0
BF	4.580	600.	2306.	2.5	1809.0	1809.0	.0
BG	4.600	610.	2257.	2.6	1809.1	1809.1	.0
BH	4.650	538.	882.	6.9	1810.2	1810.2	.0
BI	4.740	867.	1990.	3.5	1816.6	1816.6	.0
BJ	4.780	634.	1554.	4.6	1817.3	1817.3	.0
BK	4.820	624.	1456.	5.0	1822.3	1822.3	.0
BL	4.900	515.	1122.	6.4	1824.5	1824.5	.0
BM	4.960	450.	1298.	5.6	1828.2	1827.8	.4
BN	5.030	450.	1418.	5.1	1832.2	1831.4	.8
BO	5.090	430.	1333.	5.4	1835.2	1834.4	.8
BP	5.150	368.	1333.	5.4	1838.3	1837.5	.8
BQ	5.210	325.	1107.	6.5	1841.0	1840.7	.3
BR	5.310	292.	1152.	6.3	1846.5	1845.5	1.0
BS	5.380	240.	1115.	6.5	1849.8	1848.9	.9
BT	5.480	260.	1043.	6.9	1854.1	1853.3	.8
BU	5.570	238.	1077.	6.7	1858.3	1857.9	.4
BU.1	5.640	310.	1431.	5.0	1860.6	1860.2	.4
BV	5.660	320.	908.	7.9	1862.2	1862.3	-.1
BW	5.760	395.	1442.	5.0	1868.5	1868.3	.2
BX	5.830	300.	946.	7.6	1871.6	1871.6	.0
BY	5.920	310.	1168.	6.2	1876.8	1876.3	.5
BZ	6.010	330.	1112.	6.5	1881.8	1881.7	.1

TABLE 6  
APACHE WASH FLOODWAY DATA (CONTINUED)

CROSS SECT.	STA.	----- FLOODWAY -----			WATER SURFACE ELEVATION		DIFFERENCE
		WIDTH (FEET)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (FPS)	WITH FLOODWAY (NGVD) <sup>1</sup>	WITHOUT FLOODWAY (NGVD)	
CA	6.090	310.	1277.	5.6	1885.7	1885.5	.2
CB	6.160	345.	954.	7.5	1889.4	1889.3	.1
CC	6.250	300.	1174.	6.1	1895.3	1895.0	.3
CD	6.320	283.	1007.	7.1	1898.9	1898.5	.4
CE	6.430	240.	1060.	6.8	1903.6	1903.4	.2
CF	6.500	222.	937.	7.7	1906.8	1906.1	.7
CG	6.580	174.	864.	8.3	1911.2	1910.9	.3
CH	6.630	158.	804.	8.9	1914.6	1914.1	.5
CI	6.710	185.	962.	7.5	1919.1	1919.0	.1
CJ	6.800	237.	1111.	6.5	1923.7	1923.3	.4
CK	6.900	204.	947.	7.6	1929.1	1928.2	.9
CL	6.980	175.	933.	7.7	1934.0	1933.3	.7
CM	7.080	140.	830.	8.7	1938.5	1937.9	.6
CN	7.170	143.	744.	9.7	1943.5	1943.8	-.3
CO	7.280	288.	1818.	4.0	1949.1	1949.0	.1
CP	7.360	215.	832.	8.6	1952.0	1952.0	.0
CQ	7.460	187.	1088.	6.6	1959.2	1959.0	.2
CR	7.550	238.	1140.	6.3	1964.2	1964.0	.2
CS	7.650	250.	1328.	5.4	1969.8	1969.7	.1
CT	7.740	281.	1142.	6.3	1975.6	1975.2	.4
CU	7.840	225.	1276.	5.6	1982.6	1982.0	.6
CV	7.890	280.	1218.	5.9	1985.4	1984.8	.6
CW	7.980	375.	1634.	4.4	1990.1	1989.7	.4
CX	8.020	285.	1031.	7.0	1992.3	1992.2	.1
CY	8.120	170.	930.	4.1	1998.7	1998.7	.0
CZ	8.210	96.	421.	9.2	2002.6	2002.5	.1
DA	8.310	87.	572.	6.7	2010.8	2009.9	.9
DB	8.400	123.	554.	7.0	2016.1	2015.5	.6
DC	8.500	123.	621.	6.2	2022.0	2021.6	.4

TABLE 6  
 APACHE WASH  
 (WEST OVERFLOW AREA)  
 FLOODWAY DATA

FEDERAL EMERGENCY MANAGEMENT AGENCY  
 MARICOPA COUNTY, ARIZONA

CROSS SECT.	STA. <sup>1</sup>	FLOODWAY			WATER SURFACE ELEVATION		DIFFERENCE
		WIDTH (FEET)	SECTION AREA (SQ.FT.)	MEAN VELOCITY (FPS)	WITH FLOODWAY (NGVD) <sup>2</sup>	WITHOUT FLOODWAY (NGVD)	
AW	-3.960 <sup>3</sup>	556.	1257.	5.7	1782.6	1782.4	.2
A	4.055	171.	424.	4.4	1785.7	1785.5	.2
B	4.111	258.	501.	3.7	1788.2	1787.6	.6
C	4.233	487.	682.	2.7	1791.9	1791.9	.0
D	4.311	448.	543.	3.4	1795.4	1795.2	.2
E	4.499	619.	710.	2.6	1800.3	1800.3	.0
F	4.655	434.	439.	2.8	1804.5	1804.4	.1
G	4.722	148.	170.	4.3	1809.2	1809.1	.1
H	4.744	117.	138.	2.1	1811.0	1811.0	.0

1 CORRESPONDS WITH STATIONING IN APACHE WASH MAIN CHANNEL.

2 REGULATORY BASE FLOOD WATER SURFACE ELEVATION IS THE SAME AS THE FLOODWAY WATER SURFACE ELEVATION.

3 STATION -3.96 IS SAME AS STATION 3.96 OF APACHE WASH.

TABLE 6  
 APACHE WASH FLOODWAY DATA (CONTINUED)

APACHE WASH-WEST FORK

CROSS SECT.	STA.	FLOODWAY			WATER SURFACE ELEVATION		DIFFERENCE
		WIDTH (FEET)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (FPS)	WITH FLOODWAY (NGVD) <sup>1</sup>	WITHOUT FLOODWAY (NGVD)	
CZ	-8.020 <sup>2</sup>	285.	1031.	7.0	1992.3	1992.2	.1
A	.090	150.	635.	3.4	1999.1	1999.1	.0
B	.130	101.	290.	7.6	2000.1	2000.1	.0
C	.210	121.	456.	4.8	2007.3	2006.9	.4
D	.280	103.	344.	6.4	2013.3	2012.4	.9
E	.340	102.	405.	5.4	2019.4	2018.7	.7
F	.400	125.	379.	5.8	2023.9	2023.4	.5
G	.470	127.	337.	6.5	2032.6	2032.7	-.1
H	.570	115.	399.	5.5	2044.1	2043.9	.2

1 REGULATORY BASE FLOOD WATER SURFACE ELEVATION IS THE SAME AS  
 THE FLOODWAY WATER SURFACE ELEVATION

2 STATION -8.02 IS SAME AS STATION 8.02 OF APACHE WASH

TABLE 6  
PARADISE WASH FLOODWAY DATA

FEDERAL EMERGENCY MANAGEMENT AGENCY  
MARICOPA COUNTY, ARIZONA

CROSS SECT.	STA. <sup>1</sup>	----- FLOODWAY -----			WATER SURFACE ELEVATION		DIFFERENCE
		WIDTH (FEET)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (FPS)	WITH FLOODWAY (NGVD) <sup>2</sup>	WITHOUT FLOODWAY (NGVD)	
AD	2.600 <sup>3</sup>	650.	3461.	5.0	1735.7	1735.7	.0
A	.040	545.	2491.	2.3	1737.0	1737.0	.0
B	.130	259.	887.	6.5	1738.0	1737.9	.1
C	.170	187.	904.	6.4	1740.2	1739.3	.9
D	.280	271.	1031.	5.6	1744.6	1743.8	.8
E	.340	422.	1378.	4.2	1748.4	1748.1	.3
F	.440	266.	1045.	5.5	1752.2	1751.6	.6
G	.530	228.	982.	5.9	1756.5	1755.7	.8
H	.620	270.	1017.	5.7	1760.3	1759.6	.7
I	.720	295.	1193.	4.8	1764.0	1763.0	1.0
J	.800	280.	989.	5.8	1767.5	1766.7	.8
K	.890	170.	862.	6.7	1772.2	1771.6	.6
L	.950	250.	1032.	5.6	1774.3	1773.4	.9
M	1.040	308.	1516.	3.8	1776.9	1776.2	.7
N	1.120	391.	730.	7.9	1779.2	1778.4	.8
O	1.210	381.	1540.	3.7	1783.9	1782.9	1.0
P	1.270	190.	837.	6.9	1785.7	1785.1	.6
Q	1.370	203.	1134.	5.1	1789.8	1789.4	.4
R	1.460	294.	1152.	5.0	1792.6	1792.0	.6
S	1.540	256.	993.	5.8	1795.1	1794.8	.3
T	1.650	503.	947.	6.1	1800.1	1800.0	.1
U	1.750	366.	895.	4.7	1805.7	1805.5	.2
V	1.830	222.	579.	7.2	1811.1	1810.7	.4
W	1.920	172.	723.	5.8	1816.2	1815.4	.8
X	2.000	214.	587.	7.1	1819.8	1820.0	-.2
Y	2.070	313.	904.	4.6	1824.7	1823.7	1.0
Z	2.140	254.	800.	5.2	1828.0	1827.2	.8

1 MILES ABOVE CONFLUENCE WITH APACHE WASH

2 REGULATORY BASE FLOOD WATER SURFACE ELEVATION IS THE SAME AS THE FLOODWAY WATER SURFACE ELEVATION

3 STATION 2.60 IS STATION 2.60 OF APACHE WASH

TABLE 3  
PARADISE WASH FLOODWAY DATA (CONTINUED)

CROSS SECT.	STA. <sup>1</sup>	FLOODWAY			WATER SURFACE ELEVATION		DIFFERENCE
		WIDTH (FEET)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (FPS)	WITH FLOODWAY (NGVD) <sup>2</sup>	WITHOUT FLOODWAY (NGVD)	
AA	2.230	213.	631.	6.6	1832.5	1832.4	.1
AB	2.370	120.	357.	4.8	1840.6	1840.0	.6
AC	2.450	102.	269.	6.3	1844.8	1844.7	.1
AD	2.530	101.	280.	6.1	1850.6	1850.4	.2
AE	2.620	98.	272.	6.2	1857.0	1856.6	.4
AF	2.710	84.	245.	7.0	1863.0	1862.3	.7
AG	2.790	84.	252.	6.8	1868.4	1868.1	.3
AH	2.880	61.	197.	8.6	1874.5	1874.3	.2
AI	2.970	95.	317.	5.4	1881.1	1880.3	.8
AJ	3.080	82.	250.	6.8	1885.7	1886.2	-.5
AK	3.111	67.	229.	7.4	1888.0	1887.9	.1
AL	3.120	72.	378.	4.5	1889.0	1888.6	.4
AM	3.130	70.	341.	5.0	1889.0	1888.6	.4
AN	3.140	68.	305.	5.6	1889.0	1888.6	.4
AQ	3.206	63.	181.	9.4	1892.8	1892.8	.0
AR	3.224	69.	191.	8.9	1895.6	1895.7	-.1
AS	3.244	89.	302.	5.6	1897.8	1897.6	.2
AT	3.263	57.	182.	9.3	1898.3	1898.2	.1
AU	3.300	75.	262.	6.5	1901.6	1901.6	.0
AV	3.400	61.	175.	9.1	1908.6	1908.6	.0
AW	3.490	53.	215.	7.4	1916.4	1916.4	.0
AX	3.580	63.	195.	8.2	1922.5	1922.5	.0
AY	3.670	58.	205.	7.8	1930.4	1930.4	.0
AZ	3.750	55.	208.	7.6	1935.5	1935.5	.0

TABLE 6  
PARADISE WASH FLOODWAY DATE (CONTINUED)

CROSS SECT.	STA. <sup>1</sup>	FLOODWAY			WATER SURFACE ELEVATION		DIFFERENCE
		WIDTH (FEET)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (FPS)	WITH FLOODWAY (NGVD) <sup>2</sup>	WITHOUT FLOODWAY (NGVD)	
BA	3.840	49.	166.	9.6	1943.8	1943.8	.0
BB	3.930	56.	190.	8.4	1951.6	1951.6	.0
BC	4.030	77.	194.	8.2	1963.5	1963.5	.0
BD	4.100	67.	248.	6.4	1969.6	1969.6	.0
BE	4.200	75.	211.	7.5	1976.0	1976.0	.0
BF	4.320	54.	167.	9.5	1990.7	1990.7	.0
BG	4.410	78.	215.	7.4	2001.7	2001.7	.0
BH	4.510	41.	152.	10.5	2015.4	2015.4	.0

TABLE 6  
PARADISE WASH - WEST FORK FLOODWAY DATE

FEDERAL EMERGENCY MANAGEMENT AGENCY  
MARICOPA COUNTY, ARIZONA

CROSS SECT.	STA. <sup>1</sup>	----- FLOODWAY -----			WATER SURFACE ELEVATION		
		WIDTH (FEET)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (FPS)	WITH FLOODWAY (NGVD) <sup>2</sup>	WITHOUT FLOODWAY	DIFFERENCE
A	.160 <sup>3</sup>	502.	909.	6.3	1800.0	1800.0	.0
B	.250	178.	477.	2.1	1805.2	1804.6	.6
C	.320	235.	322.	3.2	1806.2	1806.1	.1
D	.340	183.	267.	3.8	1807.1	1807.1	.0
E	.350	265.	720.	1.4	1810.4	1809.4	1.0
F	.360	250.	687.	1.5	1810.4	1809.5	.9
G	.410	73.	216.	4.7	1810.9	1810.3	.6
H	.490	69.	231.	4.4	1814.1	1814.0	.1
I	.590	88.	236.	4.3	1817.7	1817.3	.4
J	.680	78.	201.	5.1	1822.3	1821.5	.8
K	.750	130.	357.	2.9	1824.9	1824.0	.9
L	.840	165.	249.	4.1	1827.9	1827.9	.0
M	.920	110.	240.	4.3	1833.3	1832.8	.5
N	1.020	73.	217.	4.7	1837.5	1837.1	.4
O	1.110	75.	210.	4.9	1841.5	1841.4	.1
P	1.190	90.	240.	4.3	1844.8	1844.6	.2
Q	1.260	80.	213.	4.8	1848.4	1848.2	.2
R	1.330	58.	179.	5.7	1851.6	1851.4	.2

1 MILES ABOVE CONFLUENCE WITH PARADISE WASH

2 REGULATORY BASE FLOOD WATER SURFACE ELEVATION IS THE SAME AS  
THE FLOODWAY WATER SURFACE ELEVATION

3 STATION 0.16 IS SAME AS STATION 1.65 OF PARADISE WASH.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the floodplain that could be completely obstructed without increasing the water surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.

# TWO-DISTRICT FLOODPLAIN REGULATION

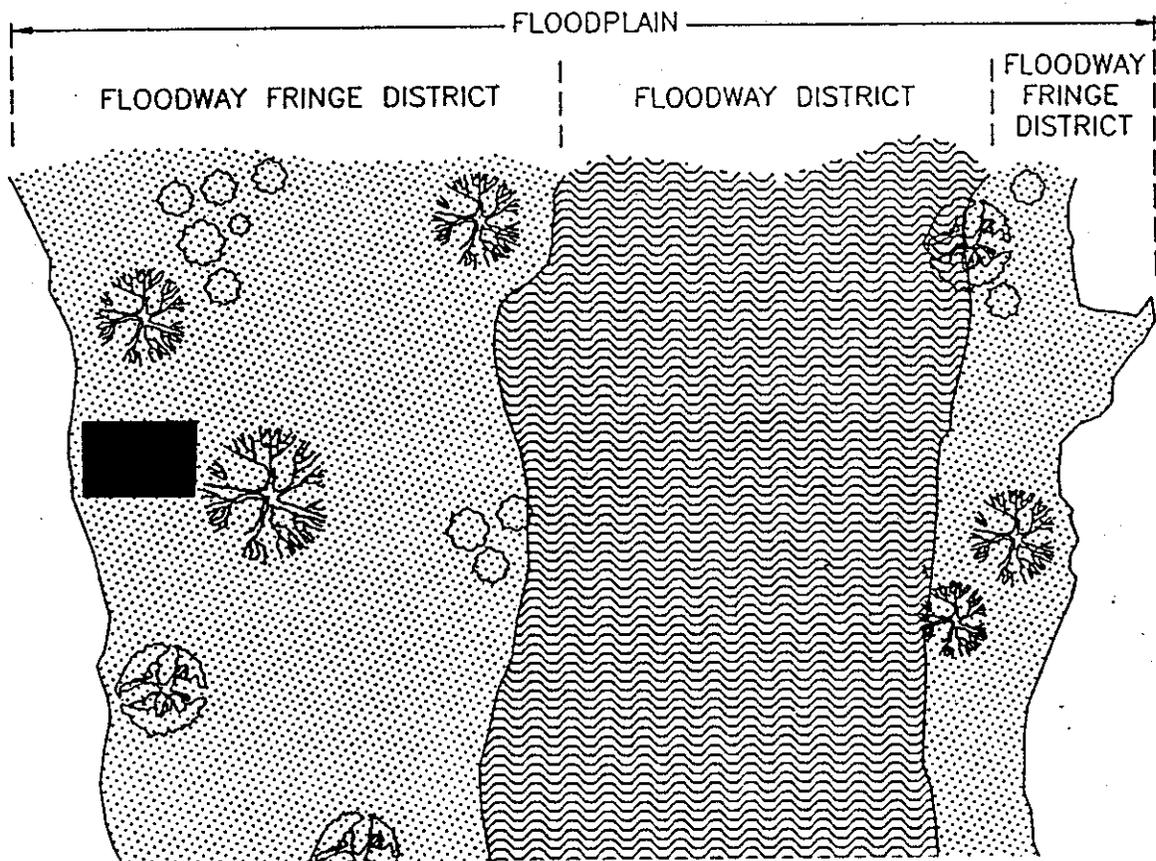
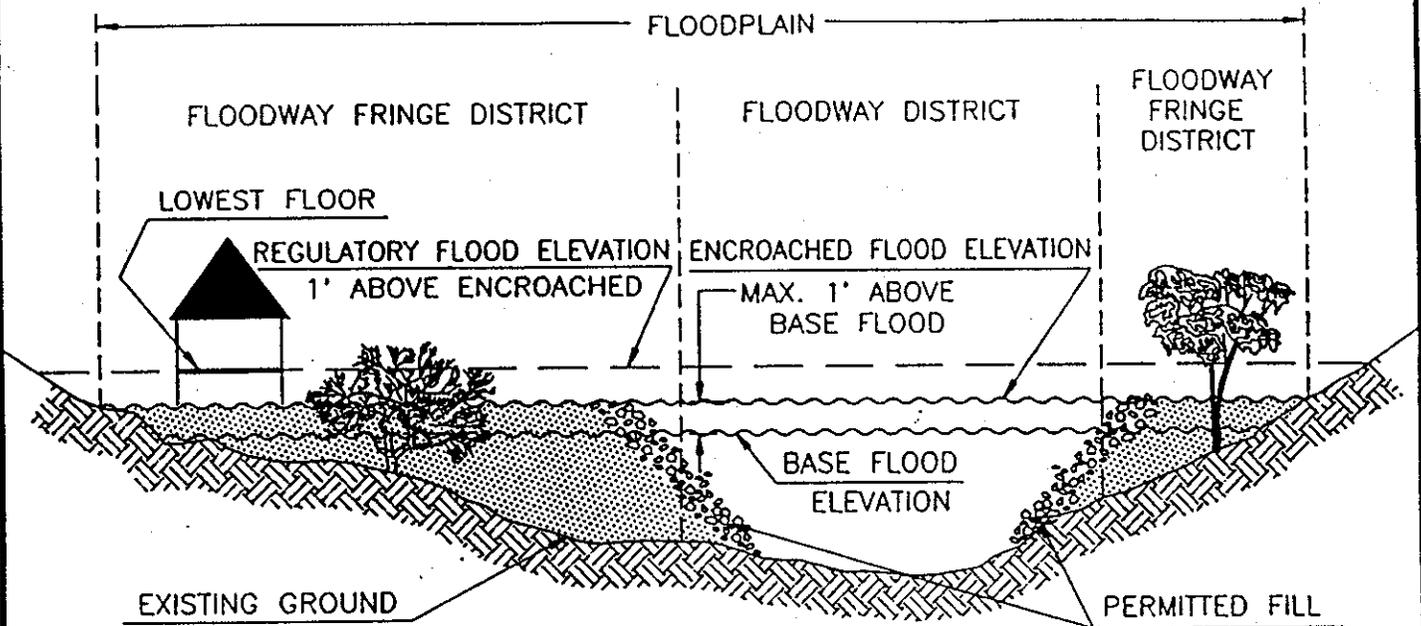


FIGURE 2: FLOODWAY SCHEMATIC

TABLE 6  
RANIERI TANK WASH FLOODWAY DATA

FEDERAL EMERGENCY MANAGEMENT AGENCY  
MARICOPA COUNTY, ARIZONA

CROSS SECT.	STA. <sup>1</sup>	----- FLOODWAY -----			WATER SURFACE ELEVATION		DIFFERENCE
		WIDTH (FEET)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (FPS)	WITH FLOODWAY (NGVD) <sup>2</sup>	WITHOUT FLOODWAY (NGVD)	
AA	2.230 <sup>3</sup>	182.	560.	7.5	1832.5	1832.4	.1
A	.090	190.	795.	3.0	1836.5	1835.6	.9
B	.170	102.	282.	8.3	1838.3	1838.4	-.1
C	.240	122.	516.	4.6	1842.7	1842.1	.6
D	.330	120.	352.	6.7	1846.0	1845.8	.2
E	.440	162.	516.	4.5	1852.2	1851.8	.4
F	.510	138.	408.	5.8	1855.6	1855.4	.2
G	.610	149.	405.	5.8	1861.1	1860.9	.2
H	.700	120.	455.	5.2	1865.7	1865.2	.5
I	.800	147.	472.	5.0	1869.2	1868.9	.3
J	.880	121.	353.	6.6	1872.7	1872.4	.3
K	.980	105.	364.	6.4	1878.8	1878.7	.1
L	1.050	152.	402.	5.8	1882.6	1882.4	.2
M	1.120	135.	419.	5.6	1887.1	1886.9	.2
N	1.200	213.	420.	5.6	1892.1	1891.6	.5

1 MILES ABOVE CONFLUENCE WITH PARADISE WASH

2 REGULATORY BASE FLOOD WATER SURFACE ELEVATION IS THE SAME AS  
THE FLOODWAY WATER SURFACE ELEVATION

3 STATION 2.23 IS STATION 2.23 OF PARADISE WASH

TABLE 6  
DESERT HILLS WASH FLOODWAY DATA

FEDERAL EMERGENCY MANAGEMENT AGENCY  
MARICOPA COUNTY, ARIZONA

CROSS SECT.	STA. <sup>1</sup>	----- FLOODWAY -----			WATER SURFACE ELEVATION		
		WIDTH (FEET)	SECTION AREA (SQ.FT.)	MEAN VELOCITY (FPS)	WITH FLOODWAY (NGVD) <sup>2</sup>	WITHOUT FLOODWAY (NGVD)	DIFFERENCE
D	.220 <sup>3</sup>	840.	3276.	4.1	1743.6	1743.2	.4
E	.310	488.	2239.	4.6	1745.0	1744.4	.6
F	.400	540.	2613.	3.9	1746.9	1746.4	.5
G	.480	556.	2899.	3.5	1748.0	1747.5	.5
H	.560	571.	2752.	3.7	1749.1	1748.5	.6
I	.640	490.	2229.	4.6	1750.4	1749.7	.7
J	.720	470.	2235.	4.6	1752.0	1751.3	.7
K	.810	600.	2490.	4.1	1754.1	1753.6	.5
L	.900	450.	2081.	4.9	1756.4	1755.9	.5
M	.990	425.	2380.	4.3	1758.5	1757.7	.8
N	1.100	394.	2234.	4.3	1760.4	1759.6	.8
O	1.190	370.	1935.	5.0	1762.2	1761.7	.5
P	1.290	430.	2308.	4.1	1764.1	1763.7	.4
Q	1.350	400.	2014.	4.6	1765.1	1764.7	.4
R	1.400	410.	1895.	4.8	1766.4	1765.6	.8
S	1.480	499.	2410.	3.8	1768.4	1767.5	.9
T	1.580	550.	2322.	3.9	1769.7	1769.0	.7
U	1.650	520.	2249.	4.1	1771.3	1770.5	.8
V	1.720	500.	2022.	4.5	1773.1	1772.3	.8
W	1.810	522.	2067.	4.3	1775.2	1774.3	.9
X	1.850	700.	2872.	3.1	1776.2	1775.3	.9
Y	1.950	500.	1458.	2.8	1777.3	1776.7	.6
Z	2.000	600.	1010.	4.1	1779.4	1779.2	.2

- 1 MILES ABOVE CONFLUENCE WITH APACHE WASH
- 2 REGULATORY BASE FLOOD WATER SURFACE ELEVATION IS THE SAME AS THE FLOODWAY WATER SURFACE ELEVATION
- 3 STATION 0.22 IS STATION 2.92 OF APACHE WASH

TABLE 6  
DESERT HILLS WASH (CONTINUED)

FLOODWAY DATA

CROSS SECT.	STA. <sup>1</sup>	----- FLOODWAY -----			WATER SURFACE ELEVATION		
		WIDTH (FEET)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (FPS)	WITH FLOODWAY (NGVD) <sup>2</sup>	WITHOUT FLOODWAY (NGVD)	DIFFERENCE
AA	2.010	600.	1522.	2.7	1780.8	1780.4	.4
AB	2.050	570.	3451.	1.2	1782.9	1781.9	1.0
AC	2.150	465.	1617.	2.6	1783.1	1782.2	.9
AD	2.240	310.	833.	5.0	1784.6	1784.3	.3
AE	2.340	300.	1109.	3.7	1788.2	1787.2	1.0
AF	2.430	325.	912.	4.5	1790.9	1790.3	.6
AG	2.530	250.	921.	4.5	1794.2	1793.6	.6
AH	2.610	309.	969.	4.3	1797.2	1796.6	.6
AI	2.710	280.	955.	4.3	1800.1	1799.4	.7
AJ	2.790	200.	826.	5.0	1802.4	1801.6	.8
AK	2.870	353.	1168.	3.5	1804.9	1804.4	.5
AL	2.960	329.	790.	5.2	1807.5	1807.1	.4
AM	3.040	388.	1177.	3.5	1810.9	1809.9	1.0
AN	3.130	277.	839.	4.4	1813.4	1812.8	.6
AO	3.200	204.	783.	4.7	1815.7	1815.3	.4
AP	3.260	171.	634.	5.8	1818.3	1817.8	.5
AQ	3.310	159.	657.	5.6	1820.5	1820.1	.4
AR	3.400	149.	646.	5.7	1823.7	1823.0	.7
AS	3.490	180.	717.	5.1	1826.5	1825.9	.6
AT	3.590	142.	593.	6.2	1829.8	1829.1	.7
AU	3.670	215.	761.	4.8	1833.0	1832.5	.5
AV	3.690	200.	654.	5.6	1833.7	1833.4	.3
AW	3.730	190.	725.	5.1	1835.6	1835.4	.2
AX	3.810	179.	664.	4.1	1837.6	1837.0	.6
AY	3.870	126.	481.	5.6	1839.4	1839.1	.3
AZ	3.960	291.	883.	3.0	1842.2	1841.8	.4

TABLE 6  
DESERT HILLS WASH (CONTINUED)  
FLOODWAY DATA

CROSS SECT.	STA. <sup>1</sup>	----- FLOODWAY -----			WATER SURFACE ELEVATION		ELEVATION DIFFERENCE
		WIDTH (FEET)	SECTION AREA (SQ.FT.)	MEAN VELOCITY (FPS)	WITH FLOODWAY (NGVD) <sup>2</sup>	WITHOUT FLOODWAY (NGVD)	
BA	4.030	111.	331.	8.1	1845.0	1844.3	.7
BB	4.140	317.	1216.	2.2	1848.9	1848.2	.7
BC	4.230	115.	257.	6.9	1851.7	1851.6	.1
BD	4.280	100.	346.	5.2	1854.8	1854.7	.1
BE	4.370	178.	368.	4.9	1858.1	1858.0	.1
BF	4.390	36.	153.	11.7	1858.8	1859.3	-.5
BG	4.410	190.	349.	5.1	1862.2	1862.2	.0
BH	4.480	140.	800.	2.2	1863.4	1862.9	.5
BI	4.530	127.	276.	6.5	1863.8	1863.6	.2
BJ	4.590	79.	338.	5.3	1867.6	1866.9	.7
BK	4.680	91.	305.	5.9	1871.0	1870.1	.9
BL	4.750	96.	335.	5.3	1874.5	1874.5	.0
BM	4.810	100.	339.	5.3	1877.4	1876.9	.5
BN	4.880	67.	251.	7.1	1881.1	1880.9	.2
BO	4.950	80.	308.	5.8	1885.3	1885.1	.2
BP	5.020	71.	172.	5.8	1888.2	1888.2	.0
BQ	5.110	63.	179.	5.6	1893.3	1893.3	.0
BR	5.180	56.	146.	6.9	1898.6	1898.4	.2

TABLE 6  
DESERT HILLS WASH - SMALL UNNAMED WASH  
FLOODWAY DATA

FEDERAL EMERGENCY MANAGEMENT AGENCY  
MARICOPA COUNTY, ARIZONA

CROSS SECT.	STA. <sup>1</sup>	----- FLOODWAY -----			WATER SURFACE ELEVATION		DIFFERENCE
		WIDTH (FEET)	SECTION AREA (SQ.FT.)	MEAN VELOCITY (FPS)	WITH FLOODWAY (NGVD) <sup>2</sup>	WITHOUT FLOODWAY (NGVD)	
BO	-4.950	79.	306.	5.8	1885.3	1885.1	.2
A	5.001	60.	160.	6.2	1887.7	1887.6	.1
B	5.081	40.	114.	8.8	1895.1	1895.1	.0
C	5.161	42.	142.	7.0	1902.5	1902.3	.2

1 MILES ABOVE CONFLUENCE WITH APACHE WASH

2 REGULATORY BASE FLOOD WATER SURFACE ELEVATION IS THE SAME AS  
THE FLOODWAY WATER SURFACE ELEVATION

3 STATION -4.95 IS THE SAME AS STATION 4.95 OF DESERT HILLS WASH

TABLE 6  
DESERT LAKE WASH - EAST FORK

FLOODWAY DATA

FEDERAL EMERGENCY MANAGEMENT AGENCY  
MARICOPA COUNTY, ARIZONA

CROSS SECT.	STA. <sup>1</sup>	FLOODWAY		MEAN VELOCITY (FPS)	WATER SURFACE ELEVATION		
		WIDTH (FEET)	SECTION AREA (SQ. FT.)		WITH FLOODWAY (NGVD) <sup>2</sup>	WITHOUT FLOODWAY (NGVD)	DIFFERENCE
C	.050 <sup>3</sup>	300.	1366.	.7	1781.9	1781.0	.9
D	.140	200.	456.	2.2	1782.1	1781.2	.9
E	.230	100.	221.	4.6	1784.6	1784.1	.5
F	.320	100.	319.	3.2	1788.1	1787.7	.4
G	.400	105.	262.	3.9	1790.3	1789.5	.8
H	.500	165.	278.	3.7	1794.1	1793.9	.2
I	.580	166.	309.	3.3	1796.8	1796.5	.3

1 MILES ABOVE CONFLUENCE WITH DESERT LAKE WASH

2 REGULATORY BASE FLOOD WATER SURFACE ELEVATION IS THE SAME AS  
THE FLOODWAY WATER SURFACE ELEVATION

3 STATION 0.05 AND 0.14 ARE THE SAME AS STATION 0.28 AND 0.38  
OF DESERT LAKE WASH, RESPECTIVELY.

TABLE 6  
DESERT LAKE WASH FLOODWAY DATE

FEDERAL EMERGENCY MANAGEMENT AGENCY  
MARICOPA COUNTY, ARIZONA

CROSS SECT.	STA. <sup>1</sup>	----- FLOODWAY -----			WATER SURFACE ELEVATION		DIFFERENCE
		WIDTH (FEET)	SECTION AREA (SQ.FT.)	MEAN VELOCITY (FPS)	WITH FLOODWAY (NGVD) <sup>2</sup>	WITHOUT FLOODWAY (NGVD)*	
A	.040 <sup>3</sup>	700.	2868.	3.1	1776.2	1775.3	.9
B	.120	304.	1096.	4.4	1777.4	1776.8	.6
C	.180	310.	1121.	4.3	1778.6	1778.2	.4
D	.200	350.	984.	4.9	1779.1	1778.8	.3
E	.220	530.	1126.	4.2	1780.9	1780.0	.9
F	.222	570.	1554.	3.1	1781.3	1780.5	.8
G	.280	413.	2129.	1.6	1782.0	1781.0	1.0
H	.380	341.	1667.	2.0	1782.0	1781.1	.9
I	.570	338.	1419.	2.4	1782.2	1781.3	.9
J	.660	253.	908.	3.8	1783.3	1782.5	.8
K	.770	248.	879.	3.9	1785.3	1784.5	.8
L	.850	178.	783.	4.4	1787.2	1786.2	1.0
M	.920	230.	980.	3.5	1788.7	1787.7	1.0
N	1.000	229.	893.	3.8	1790.0	1789.2	.8
O	1.090	310.	946.	3.6	1791.9	1791.2	.7
P	1.140	320.	911.	3.7	1793.3	1792.7	.6
Q	1.190	305.	1102.	3.1	1794.7	1793.8	.9
R	1.240	360.	1274.	2.7	1795.7	1794.7	1.0
S	1.330	370.	1552.	2.2	1796.6	1795.7	.9
T	1.420	370.	792.	4.3	1798.4	1797.6	.8

- 1 MILES ABOVE CONFLUENCE WITH DESERT HILLS WASH
- 2 REGULATORY BASE FLOOD WATER SURFACE ELEVATION IS THE SAME AS THE FLOODWAY WATER SURFACE ELEVATION
- 3 STATION 0.04 IS THE SAME AS STATION 1.85 OF DESERT HILLS WASH

TABLE 6  
MESQUITE TANK WASH FLOODWAY DATE

FEDERAL EMERGENCY MANAGEMENT AGENCY  
MARICOPA COUNTY, ARIZONA

CROSS SECT.	STA. <sup>1</sup>	FLOODWAY		MEAN VELOCITY (FPS)	WATER SURFACE ELEVATION		DIFFERENCE
		WIDTH (FEET)	SECTION AREA (SQ. FT.)		WITH FLOODWAY (NGVD) <sup>2</sup>	WITHOUT FLOODWAY (NGVD)	
A	.380	199.	525.	1.9	1657.1	1657.1	.0
B	.470	99.	206.	4.8	1658.9	1658.5	.4
C	.570	61.	230.	4.4	1663.9	1663.6	.3
D	.660	67.	220.	4.6	1667.5	1666.8	.7
E	.760	85.	209.	4.8	1672.5	1671.7	.8
F	.850	78.	286.	3.5	1675.9	1675.0	.9
G	.950	83.	289.	3.5	1677.9	1677.4	.5
H	1.040	80.	159.	6.3	1682.0	1681.6	.4
I	1.130	91.	287.	3.5	1687.1	1686.3	.8
J	1.230	46.	185.	5.4	1690.1	1689.2	.9
K	1.320	75.	214.	4.7	1694.8	1694.1	.7
L	1.420	83.	242.	4.1	1699.0	1698.3	.7
M	1.520	57.	225.	4.4	1702.2	1701.2	1.0
N	1.610	81.	199.	5.0	1706.4	1705.7	.7
O	1.700	72.	230.	4.3	1711.2	1710.4	.8
P	1.800	88.	237.	4.2	1715.0	1714.3	.7
Q	1.890	74.	226.	4.4	1718.8	1718.3	.5
R	1.990	84.	232.	4.3	1722.9	1722.3	.6

1 MILES ABOVE CAVE BUTTE RESERVOIR

2 REGULATORY BASE FLOOD WATER SURFACE ELEVATION IS THE SAME AS  
THE FLOODWAY WATER SURFACE ELEVATION

## 5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

### Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

### Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. In most instances, base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

### Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding with a constant water-surface elevation (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

### Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheetflow on sloping terrain) where average depths are between 1 and 3 feet. The depth should be averaged along the cross-section and then along the direction of flow to determine the extent of the zone. Average depths derived from the detailed hydraulic analyses are shown within this zone. A description of technical methods used to identify these areas is provided in Appendix 2. In addition, alluvial fan flood hazards are shown as Zone AO on the FIRM.

### Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone. The Study Contractor should distinguish between Zone X areas that are within the limits of the 500-year floodplain (shaded on the work map) and the Zone X areas outside the limits of the 500-year floodplain (unshaded on the work map).

### Zone B

Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood. (Medium shading)

### Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

### Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

### Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 100-year floodplain, and areas of 100-year sheetflow flooding where average depths are less than 1 foot, areas of 100-year stream flooding where the contributing drainage area is less than 1 square mile, or areas protected from the 100-year flood by levees. No base flood elevations are shown within this zone.

### Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

## 6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations for average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications the Flood Boundary and Floodway Maps show the 100-year floodplain, the floodways, and the locations of selected cross-sections used in the hydraulic analyses and floodway computations by tints, screens, and/or symbols.

## 7.0 OTHER STUDIES

One previous study titled Area Drainage Master Study, Apache Wash, Drainage/Storm Drain Master Plan was completed by JJA/DEA in July of 1990 (Reference 10). This study determined peak discharges and approximate floodplain for existing conditions, as well as preparing several alternatives and their costs for mitigation of flooding problems.

## 8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study may be obtained by contacting: the Flood Control District of Maricopa County, Hydrology Division, 2801 West Durango, Phoenix, AZ 85009; phone (602) 506-1501. The study was performed by Jerry R. Jones & Associates, Inc., 2207 East Camelback Road, Suite 302, Phoenix, AZ 85016.

Flood Control District  
of Maricopa County  
Hydrology Division  
2801 West Durango  
Phoenix, AZ 85009  
(602) 506-1501

Jerry R. Jones & Associates, Inc.  
(A David Evans and Associates, Inc. Company)  
2929 East Camelback Road  
Suite 240  
Phoenix, AZ 85016  
(602) 956-9850

## CERTIFICATION

This is to certify that all work accomplished in the conduct of this study was done in accordance with the Statement of Work and General Provisions of Contract FCD 89-66, and all amendments thereto, together with all such modifications, either written or oral, as the Project Officer and/or the Contracting Officer or their representatives have directed, as such modifications affect this contract, and that all such work has been accomplished in accordance with sound and accepted engineering practice within the contract provisions for respective phases of the work.



Roger E. Baele, P.E. 15677  
Senior Vice President  
Manager, Phoenix Office

## 9.0 REFERENCES

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12. Soil Conservation Service, U.S. Department of Agriculture,, Soil Survey of Maricopa County, September, 1977.
13. Flood Control District of Maricopa County, Hydrologic Design Manual for Maricopa County, Phoenix, Arizona, April, 1990.
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APACHE WASH  
ELEVATION REFERENCE MARKS  
DATA PROVIDED BY CITY OF PHOENIX

JJA JOB NO. MARI0001

I.D. NUMBER	ELEVATION (FEET)	DESCRIPTION/LOCATION	STATE PLANE COORDINATES	
			N	E
1	2,165.62	Top of G.L.O. brass cap, 1922, ¼ Secs. 23 & 24 T6N R3E	1,036,720.034	470,977.872
2	2,030.59	Top of 1" iron pipe possibly center ¼ Sec. 23 T6N R3E	1,036,729.134	468,315.714
4	2,242.31	Top of G.L.O. brass cap, 1922, N.E. Cor. Sec. 26 T6N R3E	1,034,086.542	470,972.561
5	1,996.35	Top of G.L.O. brass cap, 1922, ¼ Secs. 23 & 26 T6N R3E	1,034,091.490	468,312.395
6	2,176.33	Top of G.L.O. brass cap, 1922, ¼ Secs. 22 & 27 T6N R3E	1,034,098.679	463,016.795
7	1,982.14	Top of G.L.O. brass cap, 1922, N.E. Cor. Sec. 28 T6N R3E	1,034,100.655	460,369.367
9	1,910.74	Top of 1" iron pipe possibly center ¼ Sec. 27 T6N R3E	1,031,460.439	463,011.221
10	1,654.72	Top of Mar. Co. Hwy. Dept. brass cap in HH N.W. Cor. Sec. 33 T6N R3E	1,028,832.026	455,048.137
11	2,037.22	Top of G.L.O. brass cap, 1922, ¼ Secs. 25 & 36 T6N R3E	1,028,807.033	473,596.031
12	1,931.56	Top of G.L.O. brass cap, 1922, ¼ Secs. 26 & 35 T6N R3E	1,028,812.900	468,299.621
14	1,861.04	Chiseled "□" on West End Conc. Headwall @ N.W. Cor. 16th St. and Joy Ranch Rd.		
15	1,858.52	Top of 5/8" rebar w/tag PE 14187 @ centerline 12th St. and Joy Ranch Rd.		
16	2,308.05	Top of G.L.O. brass cap, 1922, East ¼ Sec. 36 T6N R3E	1,026,172.623	476,216.568

**APACHE WASH  
ELEVATION REFERENCE MARKS  
DATA PROVIDED BY CITY OF PHOENIX**

I.D. NUMBER	ELEVATION (FEET)	DESCRIPTION/LOCATION	STATE PLANE COORDINATES	
			N	E
18	1,906.10	Top of ½" iron rebar (flush) possibly center ¼ Sec. 35 T6N R3E	1,026,223.803	469,105.405
20	1,863.51	Top of ½" iron rebar - flush w/pav't. - centerline 16th St. in Aerial Panel	1,026,185.051	460,357.356
21	1,829.13	Top of Mar. Co. Hwy. Dept. brass cap flush w/pav't. @ centerline 7th St. and Maddock Rd. to East	1,026,236.252	455,096.731
22	1,921.55	Top of G.L.O. brass cap, 1922, ¼ Sec. 36 T6N R3E and Sec. 1 T5N R3E	1,023,546.732	473,591.707
23	1,901.85	Top of G.L.O. brass cap, 1922, Cor. Secs. 35 & 36 T6N R3E and Secs. 1 & 2 T5N R3E	1,023,555.246	470,940.073
24	1,862.46	PK Nail w/straddles @ centerline intersection 24th St. and Cloud Rd.	1,023,569.442	465,650.183
27	1,812.45	Top of Mar. Co. Hwy. Dept., brass cap in HH, Cor. Secs. 32 & 33 T6N R3E and Secs. 4 & 5 T5N R3E	1,023,565.578	455,051.772
28	1,912.72	Top of Stone East ¼ Sec. 1 T5N R3E	1,020,895.162	476,239.863
30	1,867.78	Top of ½" iron rebar possibly East ¼ Sec. 2 T5N R3E	1,020,917.221	470,942.138
33	1,814.64	Top of ¾" iron rebar - East ¼ Sec. 4 T5N R3E	1,020,915.181	460,310.672
35	1,797.59	Mar. Co. Hwy. Dept. brass cap, flush 7th St. and Galvin St.		
38	1,818.71	Mar. Co. Hwy. Dept. brass cap in HH North ¼ Sec. 11 T5N R3E	1,018,281.071	468,304.567

**APACHE WASH  
ELEVATION REFERENCE MARKS  
DATA PROVIDED BY CITY OF PHOENIX**

I.D. NUMBER	ELEVATION (FEET)	DESCRIPTION/LOCATION	STATE PLANE COORDINATES	
			N	E
39	1,807.60	Mar. Co. Hwy. Dept. BC/HH 24th St. and Carefree Hwy.		
40	1,798.98	Top of ¾" iron rebar in pothole 20th St. and Carefree Hwy.		
41	1,788.23	Top of R.R. Spike flush 16th St. @ North side Carefree Hwy.		
42	1,778.51	Mar. Co. Hwy. Dept. brass cap in HH 12th St. and Carefree Hwy.		
43	1,784.45	Top of R.R. Spike flush 7th St. and Carefree Hwy.		
46	1,789.60	Top of ½" iron rebar flush "near" East ¼ Sec. 10 T5N R3E	1,015,886.473	465,519.729
48	1,764.74	Top of Stone East ¼ Sec. 9 T5N R3E	1,015,612.288	460,314.294
52	1,785.12	Top of ½" iron rebar "near" N.E. Sec 15 T5N R3E, set 6/90 for Aerial Control, 18.0' East of N.E. Corner fence	1,012,991.152	465,652.555
53	1,769.13	Top of ½" iron rebar "near" North ¼ Sec. 15 T5N R3E, set 6/90 for Aerial Control, 9.4' North of barbed wire fence	1,012,984.85	463,022.678
54	1,746.73	Top of 2" brass cap "HORNOR LS 14187" N.W. Sec. 15 T5N R3E	1,012,982.260	460,321.68
55	1,771.23	Top of ½" iron rebar "near" East ¼ Sec. 15 T5N R3E, set 6/90 for Aerial Control, 9.0' West of barbed wire fence	1,010,210.023	465,636.604

**APACHE WASH  
ELEVATION REFERENCE MARKS  
DATA PROVIDED BY CITY OF PHOENIX**

I.D. NUMBER	ELEVATION (FEET)	DESCRIPTION/LOCATION	STATE PLANE COORDINATES	
			N	E
56	1,737.36	Top of ½" iron rebar "near" Center ¼ Sec. 15 T5N R3E, set 6/90 for Aerial Control	1,010,357.121	463,051.866
57	1,743.76	Top of ½" iron rebar "near" East ¼ Sec. 16 T5N R3E, set 6/90 for Aerial Control, 85' ± East of east edge of dirt road	1,011,029.626	460,656.771
59	1,713.66	Top of Stone South ¼ Sec. 15 T5N R3E	1,007,696.582	463,053.317
60	1,720.90	Top of 1" iron pipe w/cap "M. Wier LS 7247", 7' West of fence, East ¼ Sec. 22 T5N R3E	1,005,041.268	465,672.186
61	1,721.62	Top of ½" iron rebar, flush, "near" center ¼ Sec. 22 T5N R3E, set 6/90 for Aerial Control	1,005,027.136	462,936.059
62	1,690.81	Top of Stone West ¼ Sec. 22 T5N R3E	1,005,023.554	460,345.952
63	1,696.90	Top of Stone N.E. Sec. 27 T5N R3E, 18' West of fence	1,002,390.226	465,656.412
64	1,688.05	Top of Stone ¼ Secs. 22 & 27 T5N R3E	1,002,388.824	463,008.699
65	1,667.60	Top of Stone N.E. Cor. Sec. 28 T5N R3E	1,002,379.121	460,359.638
67	1,670.88	Top of ½" iron pipe East ¼ Sec. 27 T5N R3E, 72' West of fence N.W. & S.E.	999,739.462	465,656.128
68	1,668.82	Top of ½" iron rebar "near" East ¼ Sec. 28 T5N R3E, set 6/90 for Aerial Control	1,000,067.763	460,444.070
69	1,670.65	Top of ½" iron rebar "near" center ¼ Sec. 28 T5N R3E, set 6/90 for Aerial Control	999,585.084	457,696.302

**NOTES:**

1. Horizontal and vertical control for this mapping provided through the City of Phoenix. Contact Mike Miller (602) 495-2075 for additional information.
2. Coordinates are Arizona State Plane, Central Zone, NAD 1927.
3. Elevations are in reference to National Geodetic Vertical Datum 1929.