FLOOD INSURANCE STUDY

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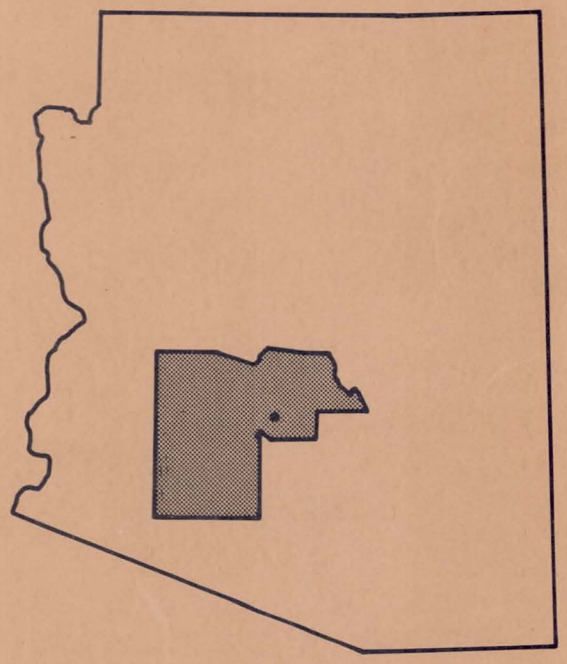
CITY OF PHOENIX, ARIZONA
MARICOPA COUNTY



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U.S. DEPARTMENT of HOUSING & URBAN DEVELOPMENT
INSURANCE ADMINISTRATION

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PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index

Flood Insurance Rate Map

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FLOOD INSURANCE STUDY
CITY OF PHOENIX, ARIZONA

1.0 INTRODUCTION

1.1 Purpose of Study

The purpose of this Flood Insurance Study is to investigate the existence and severity of flood hazards in the City of Phoenix, Maricopa County, Arizona, and to aid in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Initial use of this information will be to convert Phoenix to the regular program of flood insurance by the Federal Insurance Administration (FIA). Further use of the information will be made by local and regional planners in their efforts to promote sound land use and flood plain development.

1.2 Coordination

This Flood Insurance Study was coordinated with the City Engineer, Phoenix, Arizona, and the FIA. Southwest Computing Service, a local engineering firm, was contacted to obtain topographic data for Salt River between 7th Street and 51st Avenue. Coordination between this study and the Maricopa County Flood Insurance Study was achieved at a meeting held on October 13, 1976 in Phoenix. This meeting was attended by the representatives of Dames and Moore (D&M), Dewberry, Nealon & Davis (DND), Harris Toups Corporation, Maricopa County Flood Control District and the FIA. D&M has reviewed and revised the Maricopa County Flood Insurance Study and Harris Toups Corporation has been contracted to study other areas in Maricopa County.

On March 3, 1977, a meeting was held between DND, D&M, and FIA to further coordinate the Maricopa County, Phoenix, Mesa, Scottsdale, and Wickenburg, Arizona Flood Insurance Studies prior to final community coordination meetings for those communities.

A final Consultation and Coordination Officer's (CCO) meeting was held on November 16, 1977. This meeting was attended by representatives from the FIA, DND, Harris Toups Corporation, Maricopa County Flood Control District, City of Phoenix and residents of Phoenix.

1.3 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968, as amended.

The hydrologic and hydraulic analyses for this study were conducted by the Los Angeles District of the U. S. Army Corps of Engineers (COE) for the Federal Insurance Administration, under Inter Agency Agreement No. IAA-H-15-72, Project Order No. 18 and Inter Agency Agreement No. IAA-H-15-73, Project Order No. 3. This work was completed in September 1973.

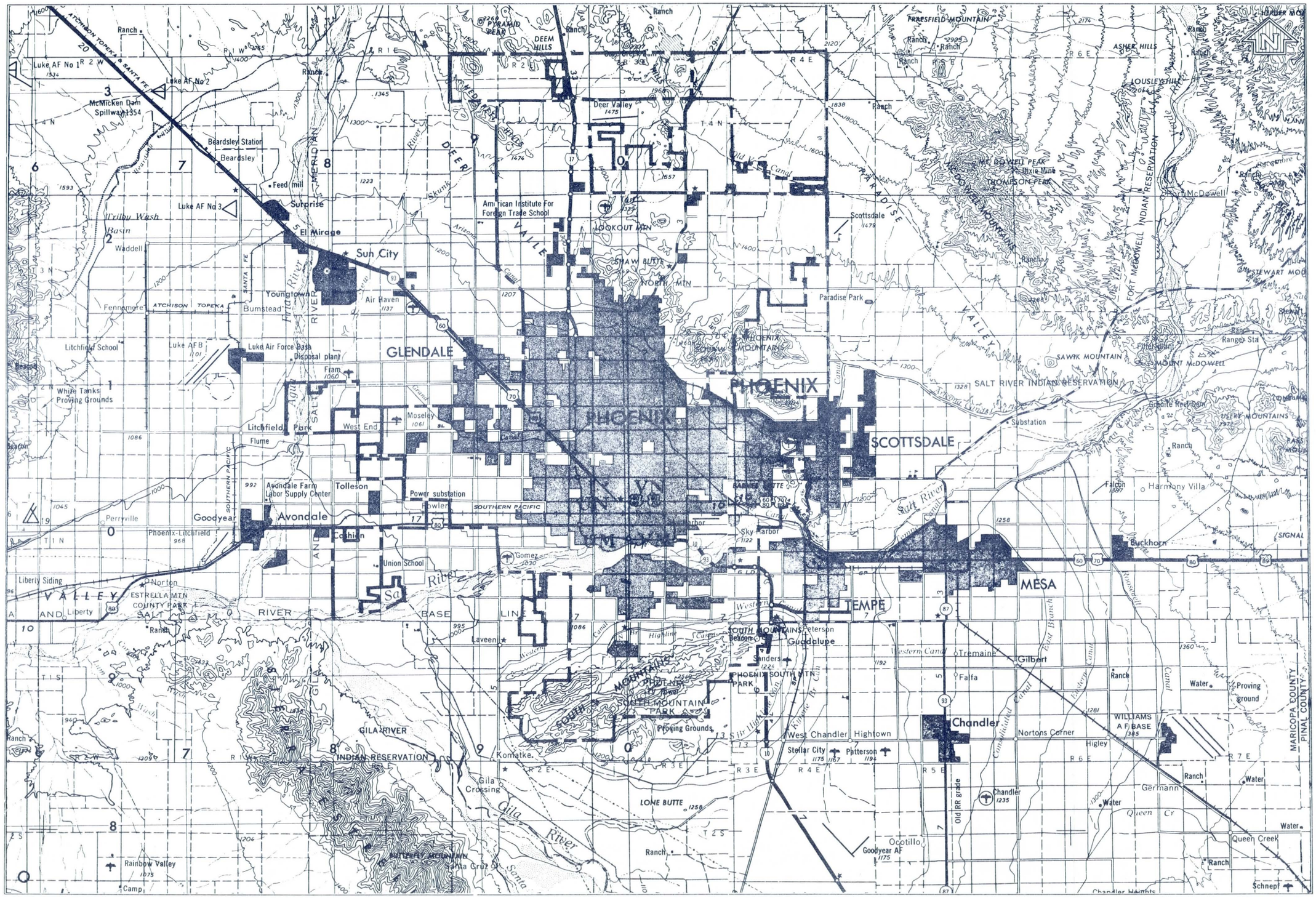
100-year flood profiles for upper Cave Creek and Tenth Street Wash were revised by the City of Phoenix in April and July 1975. 10- and 500-year flood profiles and floodways for upper Cave Creek and Tenth Street Wash were revised by Dewberry, Nealon & Davis in November 1976. Flood profiles and floodways for East Fork Cave Creek and West Branch East Fork Cave Creek were also revised by Dewberry, Nealon & Davis in November 1976. Flood boundaries were curvilinearized by Dewberry, Nealon & Davis from the blocked off maps in the 1973 Flood Insurance Study. Flood boundaries in areas recently annexed by the City of Phoenix, which include flooding from the Agua Fria and New Rivers, were taken from the Maricopa County Flood Insurance Study, revised in 1976 by Dames and Moore. Flood boundaries above Thunderbird Road on Moon Valley Wash were revised in November 1976 by the City of Phoenix. Flood profiles and floodways for Salt River were revised by Harris Toups Associates in October 1977.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Phoenix, Maricopa County, Arizona. Not included in the study area is Phoenix South Mountain Park, located in the southern portion of the city. The area of study is shown on the Vicinity Map (Figure 1).

Cave Creek, which flows from north to south through Phoenix, and the Salt River, which flows from east to west through the southern portion of Phoenix, are the major watercourses affecting the city. Indian Bend Wash has its source in the northwestern corner of Phoenix and within three miles flows into Paradise Valley to the east. Small reaches of the Aqua Fria and New Rivers flow from north to south through the western portion of Phoenix. In addition to these major channels, the following tributaries and mountain washes flow through the City of Phoenix: Moon Valley Wash, East Fork Cave Creek, West Branch East Fork Cave Creek, Cave Creek Tributary at Deer Valley Drive, Scatter Wash, East Branch Scatter Wash, Tenth Street Wash, Northern Avenue Wash, Dreamy Draw Wash, Dreamy Draw Wash East, Myrtle



APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

FIGURE 1

Avenue Wash, Flynn Lane Wash, Echo Canyon Wash, and Skunk Creek. In addition, a system of major irrigation canals, including the Arizona, Grand, Roosevelt, Western, and Highline Canals, crosses the city from east to west.

Flooding on all the mentioned watercourses, excluding Indian Bend Wash, Northern Avenue Wash, Dreamy Draw Wash, and the irrigation canals, was studied in detail. Flooding caused by overflow and breakage of canals and ponding behind their elevated banks was also studied by approximate methods because of the difficulty of analysis. Indian Bend Wash was studied by detailed methods in 1973. The hydrology in the Indian Bend Wash drainage area has changed significantly due to the completion of the central Arizona aqueduct and flood protection dike. The flood boundaries determined in 1973 have, therefore, been considered to be approximate in this study. The upper reaches of Cave Creek, Cave Creek Tributary at Deer Valley Drive, Scatter Wash, and Skunk Creek were also studied by approximate methods.

The areas studied by detailed methods were selected with priority given to all known flood hazard areas, and areas of projected development or proposed construction for the next five years, through October 1982. Approximate methods of analysis were used to study those areas having low development potential and/or minimal flood hazards as identified at the initiation of the study. The scope and methods of study were proposed to and agreed upon by FIA.

2.2 Community Description

The City of Phoenix, located in south central Arizona in the eastern portion of Maricopa County, is the capital and largest city in the state. In 1974 the estimated population of the city was 780,000. This represents a 34 percent increase over the 1970 population of 582,500 (Reference 1). Metropolitan Phoenix, which includes the satellite communities of Scottsdale, Tempe, Mesa, Paradise Valley, Sun City, Carefree, Buckeye, Chandler and Glendale, plus the rest of the county, contained 1,173,000 residents in 1974 (estimated). A steady growth is anticipated with a projected 1980 metropolitan area population of 1,600,000.

Incorporated on February 11, 1881, Phoenix is governed by a mayor-council form of government with a city manager as administrative officer. Phoenix's incorporated area has increased from 17.1 square miles in 1950 to 276.4 square miles in 1977.

Flood plains within the city abound with residential, commercial, and industrial development. Little streamflow occurs except during and immediately following heavy precipitation because climatic

and drainage characteristics are not conducive to continuous runoff. None of the watercourses in the Phoenix study area flow perennially. Even the major rivers which flowed year round in their pristine states have been dried up by dams and diversions. Stream channels are distinct and well defined in the mountain ranges but upon reaching the valley transition they become braided and poorly defined, carrying most large flood discharges in their wide, flat flood plains. Urban areas are generally densely built up in a manner that tends to impede this type of flow. Streets provide the best avenue for runoff. There is a good rectilinear grid of arterial and collector streets. Interior streets have been laid out to facilitate local drainage, but capacity to contain excess floodwater is limited. An underground storm drainage system exists in much of the city; however, its capacity is limited to 1- or 2-year runoff rates.

There is a system of major irrigation canals crossing the city from east to west nearly parallel to ground contours which includes the Arizona, Grand, Roosevelt, Western, and Highline Canals. The Arizona and Grand Canals were generally built high relative to the ground so they could irrigate adjacent fields by gravity. Because the canals are drained during severe storm conditions, they have been useful in the disposal of runoff. In many places, residential and other development has been carried up to the canal right-of-ways.

Most of the city lies at elevations between 1,000 and 1,500 feet. Scattered mountainous areas within the city rise to elevations of about 2,600 feet. Mountain areas are characterized by thin soils or exposed rock, sparse vegetation, and a terrain with many narrow canyons. Where streams leave the mountain canyons and enter the valley floor, they encounter deep and porous soils on mild slopes.

The climate of the Phoenix area is typically desert in character with short, mild winters and long, hot summers. Wide diurnal temperature variations are characteristic. Temperatures generally range between 35 degrees and 105 degrees Fahrenheit, with an annual average of 71 degrees. The prevailing winds are from the east and are usually light, although severe windstorms occur at rare intervals. The annual precipitation for the study area averages about 7.4 inches; however, this figure increases to about 24 inches in the headwater areas of the streams.

There are two separate rainfall seasons. The first occurs during the winter months from November to March when the area is subject to storms from the Pacific Ocean. While this is classified as a rainfall season, there can be periods of a month or more in this or any other season when practically no precipitation falls. Snowfall

Figure 4 - Flooding at the Central Avenue bridge over Salt River on January 7, 1966. Note how one pier has fallen four feet. Flow is from left to right.

Figure 5 - Flooding at the Central Avenue bridge over Salt River on January 3, 1966. Flow is from left to right.

Buttes Dam (construction to begin in April 1977), and the Arizona Canal Diversion Channel (proposed only) all of which would retain flows caused by the standard project storm (approximately the 350-year storm in Arizona).

The City of Phoenix has completed five flood detention basins capable of providing protection against the 100-year flood near 7th and Peoria Avenues, near 7th Street and Thunderbird Road, and Cave Creek Road's approximate intersection with 16th Street.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Floods having recurrence intervals of 10, 50, 100, and 500 years have been selected as having special significance for flood plain management and for flood insurance premium rates. The analyses reported here reflect current conditions in the watersheds of the flooding sources.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail in the community.

Discharge-frequency relationships for streams in the study area were developed using a flood frequency regression analysis of stream-flow records for 43 gages in south central Arizona in conjunction with a determination of the flood in excess of the 350-year flood. The drainage areas at the gaging stations in the analysis ranged from 0.13 to 417 square miles; lengths of record ranged from 4 to 42 years. Graphical frequency curves were drawn for each of these gages using the procedures outlined in Beard's Statistical Methods in Hydrology (Reference 2). Zero flows were ranked along with the positive flows; hence, the entire period of record was utilized for each stream gage. The 100-, 50-, 25-, 10-, 5-, and 2-year peak discharges were then used as the dependent variables in the regression analysis.

The regression analysis was performed using the Hydrologic Engineering Center Program 704-G9-L2020 Multiple Regression Package (Reference 3). Regression equations were derived for streams with drainage

areas of less than 30 square miles in size and for drainage areas between 30 and 417 square miles in size. Independent variables found to be the most closely related to peak-flood discharges in the Phoenix area were drainage area, basin slope, and 5-year and 24-hour rainfall.

The standard project flood was computed using the local standard project storm and precipitation-runoff relationships. The standard project flood is a hypothetical flood which would be the result of a combination of the most severe meteorological and hydrologic conditions that are considered reasonably characteristic of the geographical region involved. The August 19, 1954 thunderstorm that was centered generally in the Queen Creek drainage area was selected as the standard project ~~flood~~ storm for the central portion of Arizona. This storm was transposed to the Phoenix area on the basis of 10-year, 6-hour precipitation. Reconstitutions of observed flood events in the Phoenix area provided the basis for the rainfall runoff relationships used in this study. Runoff was computed using synthetic unit hydrographs. (what about losses?)

The discharges for the 2-, 5-, 10-, 25-, 50-, and 100-year floods were computed at various points along each stream covered by the analysis and plotted on log-probability paper. At points where the standard project flood had less than a 500-year recurrence interval, the curve was extrapolated to obtain a 500-year peak discharge.

The construction of a detention basin in the headwaters of the Tenth Street Wash necessitated a further evaluation of peak discharges along this flooding source. Discharges were first computed without the detention basin in place by the modified rational method (Reference 4) and adjusted to agree with the values determined in the regression analysis. Discharges were then determined assuming a metered flow from the detention basin.

The 100-year peak discharges for the Moon Valley Wash were determined at selected locations by use of the Soil Conservation Service's TR-20 Hydrology Program (Reference 5). This method used drainage basin characteristics to develop 100-year conditions which were substantially lower than those originally computed. Those flows have been used for this study.

For larger magnitude floods on Cave Creek and all floods on the Salt River, discharges tend to decrease proceeding downstream due to ground infiltration and overbank storage.

Peak discharges for the 10-, 50-, 100-, and 500-year floods of the streams studied in detail are shown in Table 1, "Summary of Discharges." No data were available for East Branch Scatter Wash and Skunk Creek.

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
CAVE CREEK					
Deer Valley Drive	194.56	700	17,500	36,000	88,000
Utopia Road	215.00	1,000	14,000	32,000	76,000
Greenway Road	234.59	1,200	12,000	24,000	68,000
Upstream of Arizona Canal	252.00	2,100	12,000	21,000	55,000
Grand Canal	264.41	3,700	17,000	25,000	49,000
Confluence with Salt River	310.56	6,200	22,000	32,000	59,000
EAST FORK CAVE CREEK					
500 feet downstream of 7th Street	32.67	2,150	7,000	10,500	23,800
Confluence with Cave Creek	34.67	3,100	9,000	13,300	33,000
CAVE CREEK TRIBUTARY AT DEER VALLEY DRIVE					
At mouth	0.80	600	1,400	1,750	2,600
WEST BRANCH EAST FORK CAVE CREEK					
At mouth	0.67	500	800	1,000	2,300
Cudia City Wash					
ECHO CANYON WASH					
200 feet East of 40th Street	4.30	1,900	4,200	5,900	14,000
Arizona Canal	5.13	2,000	4,600	6,600	18,000
MOON VALLEY WASH					
Confluence with Cave Creek	6.52	2,000	5,000	7,300	21,000
SCATTER WASH					
At mouth	1.25	1,000	2,400	3,000	3,700
MYRTLE AVENUE WASH					
At mouth	0.87	600	1,000	1,300	2,800
FLYNN LANE WASH					
Flynn Lane and Lincoln Drive	0.63	400	800	1,100	2,300
Ocotillo Road	0.98	700	1,300	1,700	3,300

TABLE 1 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
TENTH STREET WASH					
Cheryl Drive	0.81	385	*	1,440	3,650
Hatcher Road	1.59	910	*	3,400	8,600
Alice Avenue	2.25	1,170	*	4,390	11,110
Griswold Road	2.69	1,265	*	4,740	12,000
DREAMY DRAW WASH EAST					
At mouth	0.38	300	750	1,000	1,700
SALT RIVER					
Mill Avenue bridge	13,260	47,000	130,000	178,500	368,000
Confluence with Gila River	13,700	37,000	104,000	145,000	290,000

*Data not available

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the flooding sources studied in detail were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of these flooding sources.

Cross section data were obtained from topographic maps at a scale of 1:1,200 with a contour interval of two feet (Reference 6). Cross sections were located at close intervals above and below bridges and culverts in order to compute the significant backwater effects of these structures. Only two bridge structures on the Salt River were modeled because these were considered to be the bridges which could adequately pass the higher discharges. Although the remaining bridges were not modeled, their approach geometry generated fairly large head losses. Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross-section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 3). Cross sections used on the Agua Fria and New Rivers were taken outside the corporate limits and are thus not shown.

Roughness coefficients (Manning's "n" values) were established on the basis of field investigations. Values of the roughness coefficients for all streams ranged from 0.015 to 0.050 for the channel and from 0.015 to 0.07 for the overbank areas.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals. Water-surface elevations of floods of the selected recurrence intervals were computed through use of the COE HEC-2 step-backwater computer program (Reference 7). Starting water-surface elevations for all streams except the Salt River were determined by the slope/area method. For the Salt River, starting elevations were taken at the confluence with the Gila River (Reference 8). All elevations used in this study are referenced to National Geodetic Vertical Datum of 1929 (NGVD), formerly referred to as Sea Level Datum of 1929. Locations of the elevation reference marks used in the study are shown on the maps.

The 100-year flood elevation for Indian Bend Wash has also been determined through use of the HEC-2 computer program; however, this flooding source has been designated as an area of approximate study due to the effects of the central Arizona aqueduct and dikes on Indian Bend Wash.

The approximate 100-year flood elevations of ponding areas adjacent to irrigation canals are assumed to be one foot above the top elevations of levees bordering the canals to account for variations in levee elevations.

The hydraulic analyses for this study are based only on the effects of unobstructed flow. The flood elevations as shown on the profiles are thus considered valid only if hydraulic structures in general remain unobstructed.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

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

base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100- and 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:1,200 with a contour interval of two feet (Reference 6). In cases where the 100- and 500-year flood boundaries are close together, only the 100-year boundary has been shown.

For Indian Bend Wash, which has been designated as an area of approximate study, the same procedure was used as outlined for streams studied in detail; however, only the 100-year flood boundary has been delineated. Areas adjacent to irrigation canals which would be inundated by 100-year ponding levels were delineated by extending an elevation one foot higher than the top of the levees outward to the point where it intersects the natural ground surface.

Boundaries of flooding due to inadequate drainage in Moon Valley above Thunderbird Road were drawn based on experience and judgment using the topographic maps mentioned previously. Boundaries in areas recently annexed by the city were obtained from the Flood Insurance Study for Maricopa County, Arizona as revised by Dames and Moore (Reference 9). These include a Zone A4 on the Agua Fria and New Rivers near their confluence and a Zone B from sheet flooding due to inadequate drainage in western portions of Phoenix. Due to the flatness of the land, the 100-year flood will produce shallow flooding less than one foot in depth over most of the area. For this reason, most of Phoenix has been designated as moderate flood hazard areas (Zone B).

The boundaries of the 100- and 500-year floods 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 may not be subject to flooding. Owing to limitations of the map scale, or lack of detailed topographic information, such areas are not shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases flood heights, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard.

For purposes of the Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain 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 flood plain areas, that must be kept free of encroachment in order that the 100-year flood may be carried without substantial increases in flood heights. Minimum standards of the FIA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. The City of Phoenix's Floodplain Ordinance restricts the velocity at floodway encroachments to be less than or equal to 5.0 feet per second. FIA criteria were used to delineate the floodways in this study; thus, floodways delineated under Phoenix's Floodplain Ordinance may be more restrictive.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 2).

As shown on the Flood Boundary and Floodway Map (Exhibit 3), the floodway widths were determined at cross sections; between cross sections, the boundaries were interpolated. On East Branch Scatter Wash, a floodway was not determined. Cross sections on the Agua Fria and New Rivers were not shown on the Flood Boundary and Floodway Map because they were outside the corporate limits. In cases where the boundaries of the 100-year flood are either close together or collinear, only the floodway boundary has been shown.

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 flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 6.

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHFs), and flood insurance zone designations for each flooding source studied in detail affecting the City of Phoenix.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE (FT.)
Cave Creek[2]							
AO	9.62	2,600	*	*	1198.7	1197.9	0.8
AP	9.88	2,800	*	*	1205.1	1204.4	0.7
AQ	10.17	2,750	*	*	1212.1	1211.4	0.7
AR	10.45	2,900	*	*	1219.9	1218.9	1.0
AS	10.71	2,600	*	*	1225.1	1224.3	0.8
AT	10.98	3,320	*	*	1232.3	1231.5	0.8
AU	11.25	1,830	*	*	1238.5	1237.5	1.0
AV	11.52	1,720	*	*	1244.3	1243.3	1.0
AW	11.67	1,500	*	*	1247.9	1247.1	0.8
AX	11.90	1,350	*	*	1255.4	1254.4	1.0
AY	12.12	1,150	*	*	1260.8	1260.4	0.4
AZ	12.62	1,820	*	*	1272.0	1271.1	0.9
BA	12.87	680	*	*	1279.1	1278.1	1.0
BB	13.08	1,850	*	*	1281.5	1280.7	0.8
BC	13.20	2,650	*	*	1282.8	1281.8	1.0
BD	13.52	350	*	*	1289.2	1289.2	0.0
BE	13.71	450	*	*	1293.1	1293.1	0.0
BF	14.06	300	*	*	1302.1	1302.1	0.0
BG	14.30	500	*	*	1304.9	1304.9	0.0
BH	14.79	280	*	*	1311.3	1311.3	0.0

[1]MILES ABOVE MOUTH
[2]NO FLOODWAY COMPUTED FOR CROSS SECTIONS A THROUGH AN
*DATA NOT AVAILABLE

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

FLOODWAY DATA

CAVE CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE (FT.)
Cave Creek (continued)							
BI	15.05	300	*	*	1324.0	1324.0	0.0
BJ	15.23	186	*	*	1328.0	1327.8	0.2
BK	15.33	910	*	*	1337.4	1337.1	0.3
BL	15.49	1,335[2]	*	*	1339.5	1338.5	1.0
BM	15.71	1,434[2]	*	*	1342.9	1342.3	0.6
BN	15.80	1,664[2]	*	*	1345.1	1344.1	1.0
BO	15.92	2,250[2]	*	*	1348.5	1348.3	0.2
BP	16.04	2,897[2]	*	*	1351.2	1350.2	1.0
BQ	16.29	713	*	*	1360.9	1359.9	1.0
BR	16.45	634	*	*	1365.5	1364.5	1.0
BS	18.41	670	*	*	1424.1	1423.1	1.0
BT	18.80	553[2]	*	*	1435.9	1434.9	1.0
East Fork Cave Creek							
A	1.04	305	1,168	9.0	1350.5	1350.5	0.0
B	1.20	280	1,656	6.3	1355.3	1354.9	0.4
C	1.36	481	1,637	6.2	1357.9	1357.1	0.8

[1] MILES ABOVE MOUTH
[2] DOES NOT INCLUDE COMBINED FLOODWAY FROM EAST FORK CAVE CREEK
*DATA NOT AVAILABLE

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

FLOODWAY DATA

CAVE CREEK, EAST FORK CAVE CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE (FT.)
East Fork Cave Creek (continued)							
D	1.54	363	1,262	8.3	1362.2	1361.2	1.0
E	1.80	770	2,096	5.0	1369.9	1369.5	0.4
F	2.00	820	1,770	5.9	1374.9	1374.8	0.1
G	2.18	558	1,473	4.9	1380.1	1379.3	0.8
H	2.37	870	1,924	3.8	1383.5	1382.8	0.7
I	2.56	550	973	7.4	1389.5	1388.6	0.9
J	2.79	1,110	2,046	3.5	1396.1	1395.7	0.4
K	2.95	503	926	7.8	1401.2	1400.8	0.4
Cave Creek Tributary at Deer Valley Drive							
A	0.63	380	*	*	1496.2	1496.2	0.0
B	0.86	200	*	*	1503.4	1503.4	0.0
C	1.17	360	*	*	1515.7	1515.7	0.0

[1] MILES ABOVE MOUTH

*DATA NOT AVAILABLE

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

FLOODWAY DATA

EAST FORK CAVE CREEK,
CAVE CREEK TRIBUTARY AT DEER VALLEY DRIVE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE [1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE (FT.)
West Branch East Fork Cave Creek							
A	0.53	160	163	6.2	1364.6	1364.4	0.2
B	0.73	320	414	2.4	1370.3	1370.3	0.0
Echo Canyon Wash							
A	0.51	150	1,432	4.1	1272.7	1271.7	1.0
B	0.71	180	1,466	4.0	1278.8	1278.0	0.8
C	1.04	210	1,501	3.9	1293.5	1293.1	0.4
D	1.19	180	1,169	5.0	1298.3	1298.0	0.3
Moon Valley Wash							
A	0.47	1,120	*	*	1294.7	1293.7	1.0
B	0.74	1,000	*	*	1300.9	1300.0	0.9
C	0.88	1,000	*	*	1307.2	1306.9	0.3

[1] MILES ABOVE MOUTH
*DATA NOT AVAILABLE

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

FLOODWAY DATA

WEST BRANCH EAST FORK CAVE CREEK,
ECHO CANYON WASH, MOON VALLEY WASH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE (FT.)
Scatter Wash							
A	0.40	620	*	4.6	1334.0	1333.2	0.8
B	0.80	560	*	4.5	1344.4	1343.7	0.7
C	1.30	470	*	5.4	1358.5	1357.7	0.8
D	1.80	270	*	2.6	1367.5	1366.8	0.7
E	2.30	120	*	4.5	1381.0	1380.9	0.1
F	2.80	200	*	4.5	1397.0	1396.2	0.8
G	3.00	185	*	2.8	1402.8	1402.5	0.3
H	3.38	520	*	*	1416.0	1416.0	0.0
I	3.55	320	*	*	1417.0	1417.0	0.0
J	3.92	980	*	*	1430.5	1430.5	0.0
K	4.40	1,800	*	*	1445.1	1445.0	0.1
L	4.67	770[2]	*	*	1455.7	1455.7	0.0
M	5.04	780[2]	*	*	1471.5	1471.4	0.1
Myrtle Avenue Wash							
A	0.04	250	*	*	1242.9	1242.0	0.9
B	0.22	250	*	*	1260.8	1260.2	0.6

[1]Miles above mouth
[2]Part of floodway located outside of corporate limits
*Data unavailable

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

FLOODWAY DATA

SCATTER WASH AND MYRTLE AVENUE WASH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE (FT.)
Flynn Lane Wash							
A	0.05	350	*	*	1244.7	1244.3	0.4
B	0.21	250	*	*	1259.9	1259.8	0.1
C	0.34	200	*	*	1273.0	1272.5	0.5
D	0.53	400	*	*	1291.1	1290.1	1.0
Tenth Street Wash							
A	0.09	1,590	*	*	1242.8	1241.8	1.0
B	0.31	370	*	*	1247.4	1246.5	0.9
C	0.54	530	*	*	1258.6	1257.6	1.0
D	0.74	400	*	*	1268.7	1267.7	1.0
E	0.92	140	*	*	1279.6	1278.6	1.0
F	1.12	260	*	*	1288.5	1287.5	1.0
G	1.37	80	*	*	1298.3	1297.3	1.0
H	1.50	250	*	*	1306.0	1306.0	0.0
I	1.75	80	*	*	1315.1	1314.4	0.7
J	1.91	60	*	*	1323.4	1323.2	0.2
K	2.13	315	*	*	1337.5	1337.5	0.0
L	2.28	100	*	*	1350.4	1350.4	0.0
Dreamy Draw Wash East							
A	0.04	250	*	*	1242.9	1242.0	0.9

[1]Miles above mouth
*Data not available

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

FLOODWAY DATA

FLYNN LANE WASH, TENTH STREET WASH, DREAMY DRAW WASH EAST

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE [1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE (FT.)
Salt River							
A-C [2]							
D	2.90	3302/1470 [3]	26,536	5.6	966.4	965.5	0.9
E	3.11	3489/1350 [3]	27,041	5.6	967.4	966.6	0.8
F	3.30	3198/1460 [3]	26,825	5.6	968.7	968.1	0.6
G	3.56	2911/1740 [3]	23,580	6.4	970.4	970.0	0.4
H	3.76	2856/1990 [3]	26,870	5.6	972.6	971.9	0.7
I-R [2]							
S	8.80	3121/600 [3]	20,499	7.9	1,016.2	1,015.7	0.5
T	9.00	3875/1280 [3]	21,832	7.5	1,017.3	1,016.7	0.6
U	9.20	3917/1690 [3]	24,665	6.6	1,020.1	1,019.8	0.3
V	9.60	3780/2220 [3]	29,325	5.6	1,023.6	1,023.1	0.5
W	10.18	3260/2280 [3]	19,409	8.5	1,028.1	1,027.9	0.2
X	10.57	2,660	23,445	7.0	1,032.7	1,032.3	0.4
Y	10.96	3,150	19,878	8.3	1,035.8	1,035.3	0.5
Z	11.22	2,700	18,912	8.8	1,037.4	1,036.4	1.0
AA	11.39	2,725	21,649	7.7	1,040.2	1,039.8	0.4
AB	11.58	2,660	38,378	4.4	1,041.7	1,041.2	0.5
AC	11.98	2,830	23,367	7.1	1,042.4	1,041.9	0.5
AD	12.20	2,750	17,390	9.7	1,044.4	1,044.0	0.4

[1] Miles from 115th Avenue
[2] Cross sections located outside corporate limits
3 Width/Width within corporate limits

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

FLOODWAY DATA

SALT RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE (FT.)
Salt River (continued)							
AE	12.40	2,625	21,596	7.8	1,047.3	1,047.3	0.0
AF	12.85	2,091	16,694	10.1	1,049.9	1,049.9	0.0
AG	13.06	2,072	10,865	15.6	1,052.9	1,052.9	0.0
AH	13.20	1,830	26,980	6.3	1,057.4	1,056.9	0.5
AI	13.93	1,830	21,919	7.7	1,059.4	1,058.7	0.7
AJ	14.51	1,483	28,480	6.0	1,064.6	1,064.3	0.3
AK	14.95	968	19,473	8.8	1,065.4	1,065.1	0.3
AL	15.22	930	10,094	17.0	1,069.3	1,068.4	0.9
AM	15.50	1,302	21,802	7.9	1,081.7	1,081.7	0.0
AN	15.85	1,795	37,449	4.6	1,083.1	1,083.0	0.1
AO	16.37	1,700	14,433	12.0	1,084.7	1,084.5	0.2
AP	16.65	2,047	23,140	7.5	1,091.6	1,091.2	0.4
AQ	16.77	2,051	19,930	8.7	1,092.2	1,091.8	0.4
AR	17.26	2,879	23,749	7.3	1,097.1	1,096.4	0.7
AS	17.74	3,394	26,168	6.6	1,104.1	1,103.6	0.5
AT	18.14	2,742	25,852	6.8	1,108.5	1,108.4	0.1
AU	18.44	2,993	23,492	7.4	1,111.2	1,111.2	0.0
AV	19.07	3,050	24,032	7.3	1,113.8	1,113.8	0.0

[1] Miles from 115th Avenue

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

FLOODWAY DATA

SALT RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE (FT.)
Salt River (continued)							
AW	19.68[1]	4,268	28,580	6.2	1,121.2	1,121.2	0.0
AX	19.96[1]	4,320	18,301	9.6	1,123.0	1,123.0	0.0
AY	20.25[1]	4,400	29,117	6.1	1,127.6	1,127.0	0.6
AZ	20.50[1]	4,750	25,228	7.0	1,129.3	1,128.5	0.8
BA	21.05[1]	3,755	22,554	7.9	1,135.5	1,134.6	0.9
BB	21.16[1]	3300/1200[3]	23,337	7.6	1,137.4	1,136.5	0.9
BC	21.35[1]	2888/1400[3]	20,933	8.5	1,139.5	1,138.5	1.0
BD	21.72[1]	3470/1160[3]	26,746	6.7	1,143.5	1,142.5	1.0
Skunk Creek							
A	5.90[2]	1,110	*	5.0	1,305.9	1,305.4	0.5
B	6.50[2]	1,755	*	5.1	1,319.8	1,319.5	0.3
C	6.84[2]	2,010 [4]	*	4.8	1,329.6	1,328.9	0.7
D	7.00[2]	790	*	7.8	1,336.0	1,335.2	0.8
E	7.50[2]	920	*	5.3	1,348.4	1,347.6	0.8
F	8.00[2]	870	*	6.0	1,360.8	1,359.9	0.9
G	8.80[2]	1,220	*	5.3	1,384.1	1,383.5	0.6
H	9.10[2]	1,550	*	4.5	1,394.5	1,393.5	1.0

[1] Miles from 115th Avenue
[2] Miles above mouth
[3] Width/width within corporate limits
[4] Combined floodway for Skunk Creek and Scatter Wash
*Not computed

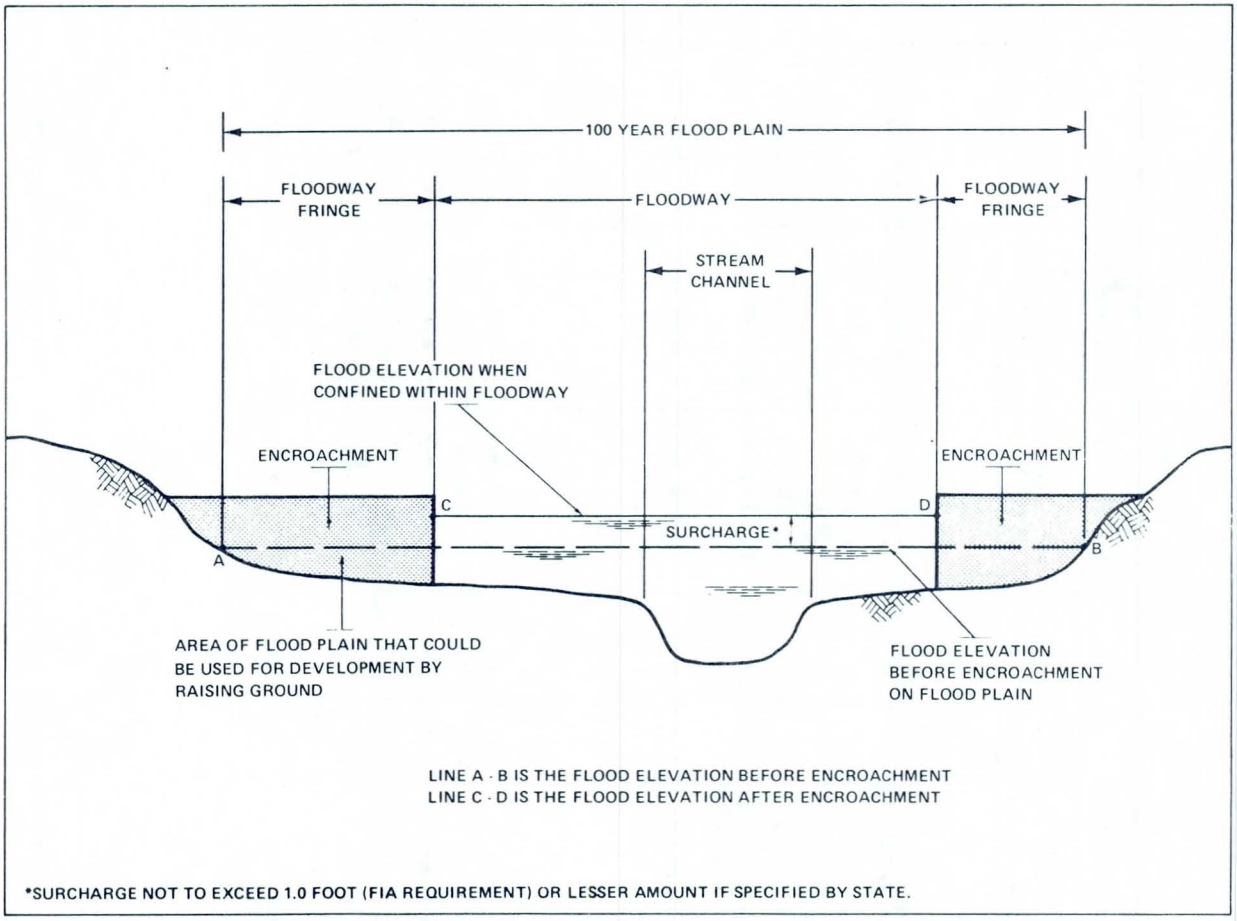
TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

FLOODWAY DATA

SALT RIVER AND SKUNK CREEK



FLOODWAY SCHEMATIC Figure 6

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

Thirty-six reaches meeting the above criteria were required for the flooding sources of Phoenix. These included ten on Cave Creek, three each on East Fork Cave Creek, Echo Canyon Wash, Scatter Wash, and the Salt River, two each on Flynn Lane Wash, Dreamy Draw Wash East, and West Branch East Fork Cave Creek, and one each on the Agua Fria River, New River, Cave Creek Tributary at Deer Valley Drive, East Branch Scatter Wash, Myrtle Avenue Wash, Tenth Street Wash, Moon Valley Wash and Skunk Creek. The locations of the reaches are shown on the Flood Profiles (Exhibit 1). The reaches on the Agua Fria and New Rivers were taken from the Flood Insurance Study for Maricopa County (Reference 9).

5.2 Flood Hazard Factors

The FHF is the FIA device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.5 foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of Phoenix was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.
Zone AO:	Special Flood Hazard Areas inundated by types of 100-year shallow flooding where depths are between 1.0 and 3.0 feet; depths are shown, but no FHFs are determined.

Zones A1, A2, A4, A5, A7, A8, A9, A10, A12, A13, A15, A16, A17, A20, A22:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones assigned according to FHFs.
Zone B:	Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; also, areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of Minimal Flooding; including areas that are protected from 100- and 500-year floods by dike, levee, or other water control structure; not subdivided.

Table 3, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations foreach flooding source studied in detail in the community.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Phoenix is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

6.0 OTHER STUDIES

The 1973 Flood Insurance Study for the City of Phoenix has been revised using data from several drainage studies done later to reflect changing conditions in a rapidly developing area. The upper reaches of Cave Creek were revised in April 1975 in a report done for the city by Yost and Gardner

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3]
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Cave Creek							
Reach 1	50,75,95,115	-2.6	*	+2.3	025	A5	Varies
Reach 2	50	-5.9	*	+5.7	060	A12	Varies
Reach 3	50	-9.8	*	+7.8	100	A20	Varies
Reach 4	50	-11.7	*	+1.8	120	A22	Varies
Reach 5	50	-7.7	*	+2.8	075	A15	Varies
Reach 6	30,50	-4.2	*	+1.9	040	A8	Varies
Reach 7	30	-6.6	*	+2.3	065	A13	Varies
Reach 8	30	-4.8	*	+5.2	050	A10	Varies
Reach 9	30	-8.2	*	+11.0	080	A16	Varies
Reach 10	30	-5.2	*	+7.1	050	A10	Varies
East Fork Cave Creek							
Reach 1	50	-3.4	*	+2.5	035	A7	Varies
Reach 2	50	-2.6	*	+2.9	025	A5	Varies
Reach 3	50	-1.1	*	+0.9	010	A2	Varies

[1] FLOOD INSURANCE RATE MAP PANEL
[2] WEIGHTED AVERAGE
[3] ROUNDED TO NEAREST FOOT

*DATA NOT AVAILABLE

TABLE 3

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

FLOOD INSURANCE ZONE DATA

CAVE CREEK, EAST FORK CAVE CREEK

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Cave Creek Tributary at Deer Valley Drive							
Reach 1	30	-1.2	*	+0.8	010	A2	Varies
West Branch East Fork Cave Creek							
Reach 1	50	-2.5	*	+2.8	025	A5	Varies
Reach 2	50	-0.9	*	+1.2	010	A2	Varies
Echo Canyon Wash							
Reach 1	80	-2.2	*	+2.1	020	A4	Varies
Reach 2	80	-4.4	*	+2.8	045	A9	Varies
Reach 3	80	-2.4	*	+2.2	025	A5	Varies

[1] FLOOD INSURANCE RATE MAP PANEL
[2] WEIGHTED AVERAGE
[3] ROUNDED TO THE NEAREST FOOT—SEE MAP
*DATA NOT AVAILABLE

TABLE 3

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

FLOOD INSURANCE ZONE DATA

CAVE CREEK TRIBUTARY AT DEER VALLEY DRIVE,
WEST BRANCH EAST FORK CAVE CREEK, ECHO CANYON WASH

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Moon Valley Wash							
Reach 1	50	-2.1	*	+1.9	020	A4	Varies
Scatter Wash							
Reach 1	25	-2.0	*	*	020	A4	Varies
Reach 2	25,30	-3.3	*	*	035	A7	Varies
Reach 3	30	-0.8	*	+0.3	010	A2	Varies
East Branch Scatter Wash							
Reach 1	30	-2.1	*	*	020	A4	Varies
Myrtle Avenue Wash							
Reach 1	75	-1.0	*	+1.3	010	A2	Varies
Flynn Lane Wash							
Reach 1	75	-0.5	*	+0.5	005	A1	Varies
Reach 2	75	-1.2	*	+1.0	010	A2	Varies

[1] FLOOD INSURANCE RATE MAP PANEL
[2] WEIGHTED AVERAGE
[3] ROUNDED TO THE NEAREST FOOT—SEE MAP
*DATA NOT AVAILABLE

TABLE 3

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

FLOOD INSURANCE ZONE DATA

MOON VALLEY WASH, SCATTER WASH, EAST BRANCH SCATTER WASH, MYRTLE AVENUE WASH, FLYNN LANE WASH

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Tenth Street Wash							
Reach 1	50,75	-2.2	*	+2.1	020	A4	Varies
Dreamy Draw Wash East							
Reach 1	75	-1.0	*	+0.8	010	A2	Varies
Reach 2	75	-2.1	*	+1.2	020	A4	Varies
Agua Fria River							
Reach 1	65,85	-2.2	*	+1.4	020	A4	Varies
New River							
Reach 1	65,85	-2.2	*	*	020	A4	Varies
Salt River							
Reach 1	105,110,115	-5.1	-1.3	+2.2	050	A10	Varies
Reach 2	100,115,120	-8.6	-2.2	+3.5	085	A17	Varies
Reach 3	100,120	-5.2	-1.3	+2.0	050	A10	Varies

[1] FLOOD INSURANCE RATE MAP PANEL
[2] WEIGHTED AVERAGE
[3] ROUNDED TO THE NEAREST FOOT—SEE MAP
*DATA NOT AVAILABLE

TABLE 3

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

FLOOD INSURANCE ZONE DATA

TENTH STREET WASH, DREAMY DRAW WASH EAST, AGUA FRIA RIVER, NEW RIVER, SALT RIVER

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Skunk Creek Reach 1	25,30	-2.0	*	*	020	A4	Varies
Shallow Flooding	115		Depth 1.0 foot			A0	Varies
Shallow Flooding	110,115,120 50		Depth 2.0 feet			A0	Varies

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO THE NEAREST FOOT—SEE MAP
*DATA NOT AVAILABLE

TABLE 3

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

FLOOD INSURANCE ZONE DATA

SKUNK CREEK, SHALLOW FLOODING

Engineers (Reference 10) and these revisions were incorporated into this report. A drainage study (Reference 4) done by Yost and Gardner Engineers for the City of Phoenix on the Tenth Street Wash dated July 1975 was used to revise the profiles on that flooding source. Flood boundaries on Moon Valley Wash were revised by the city in November 1976 and appropriate changes made to the maps.

The as-yet unpublished Flood Insurance Study for unincorporated areas of Maricopa County, Arizona, was coordinated with this study and boundaries were obtained for areas of the county recently annexed by the City of Phoenix (Reference 9).

This study is authoritative for purposes of the Flood Insurance Program, and the data presented here either supersede or are compatible with previous determinations.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study can be obtained by contacting the office of the Federal Insurance Administration, Regional Director, 450 Golden Gate Avenue, P. O. Box 36003, San Francisco, California 94102.

8.0 BIBLIOGRAPHY AND REFERENCES

1. Phoenix Metropolitan Chamber of Commerce, Community Profile, Phoenix, Arizona, 1975.

2. Leo R. Beard, Statistical Methods in Hydrology, Sacramento, California, U. S. Army Corps of Engineers, January 1962.

3. U. S. Army Corps of Engineers, Hydrologic Engineering Center, Program 704-G9-L2020, Multiple Regression Package, R. G. Wiley and H. E. Kubic, Davis, California, 1970.

4. Yost and Gardner Engineers, Drainage Study, Tenth Street Wash, F. Robert Stevens, Phoenix, Arizona, July 1975.

5. U. S. Department of Agriculture, Soil Conservation Service, SCS-TR-20 Project Formulation Computer Program, Champaign, Illinois, February 1974.

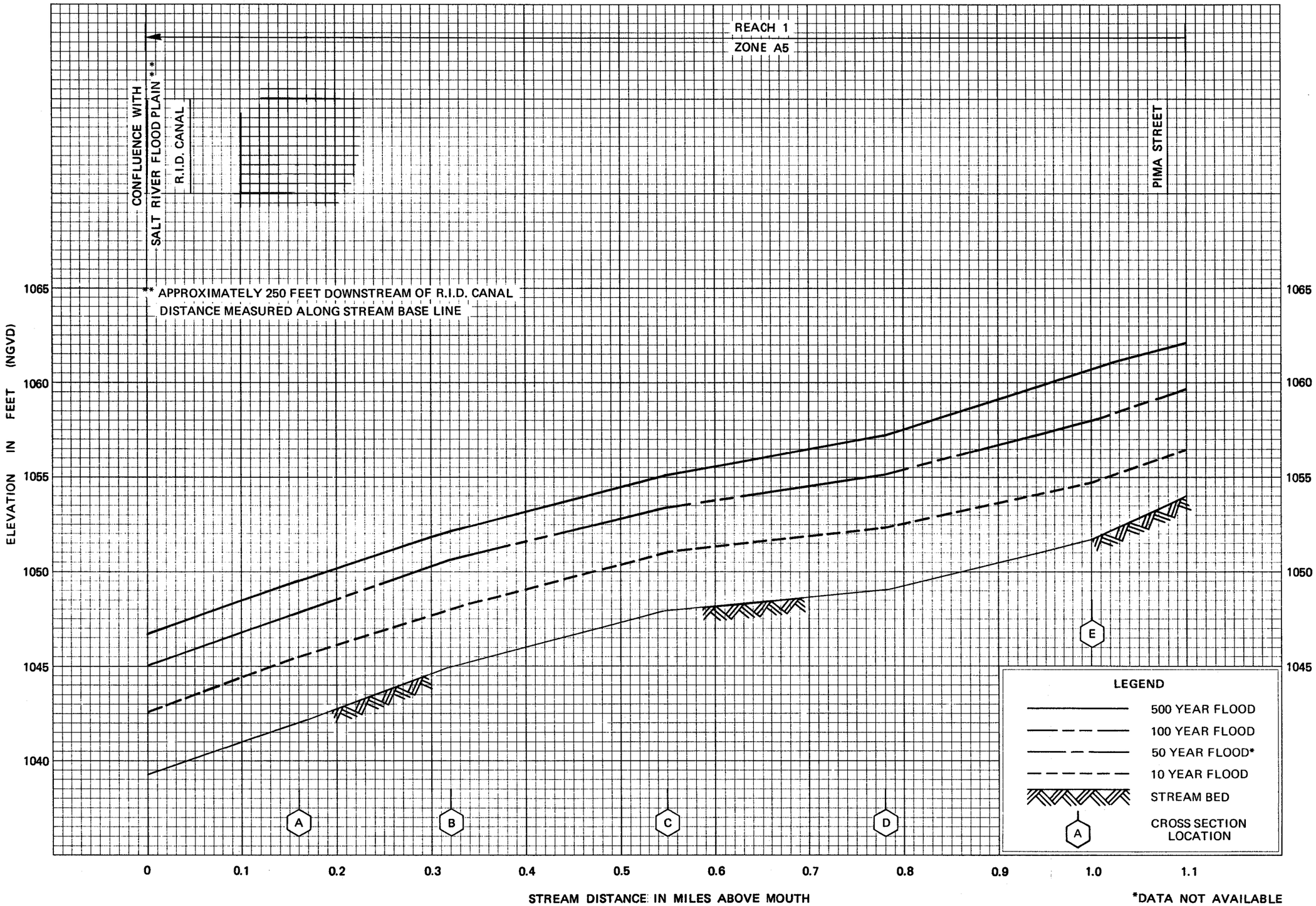
6. City of Phoenix, Topographic Maps, Scale 1:1,200, Contour Interval 2 feet, 1967.

7. U. S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles, Generalized Computer Program, Davis, California, October 1973.

8. Harris Toups Associates, Flood Study for Salt River, City of Phoenix, Maricopa County, Arizona, Phoenix, October 1977.

9. U. S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study, Maricopa County, Arizona (Unpublished).

10. Yost and Gardner Engineers, Cave Creek Flood Maps, F. Robert Stevens, Phoenix, Arizona, April 1975.



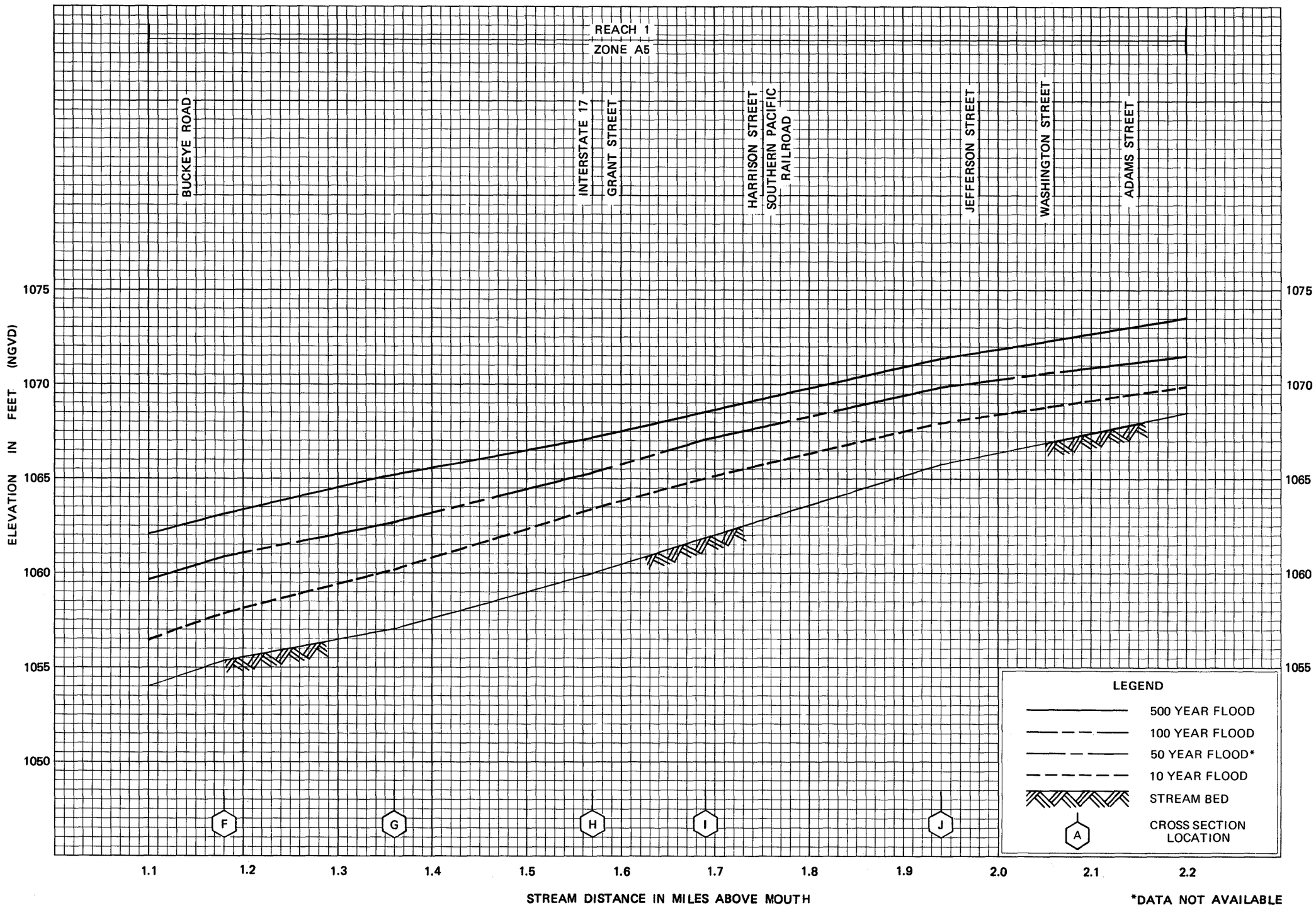
FLOOD PROFILES

CAVE CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

01P



FLOOD PROFILES

CAVE CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

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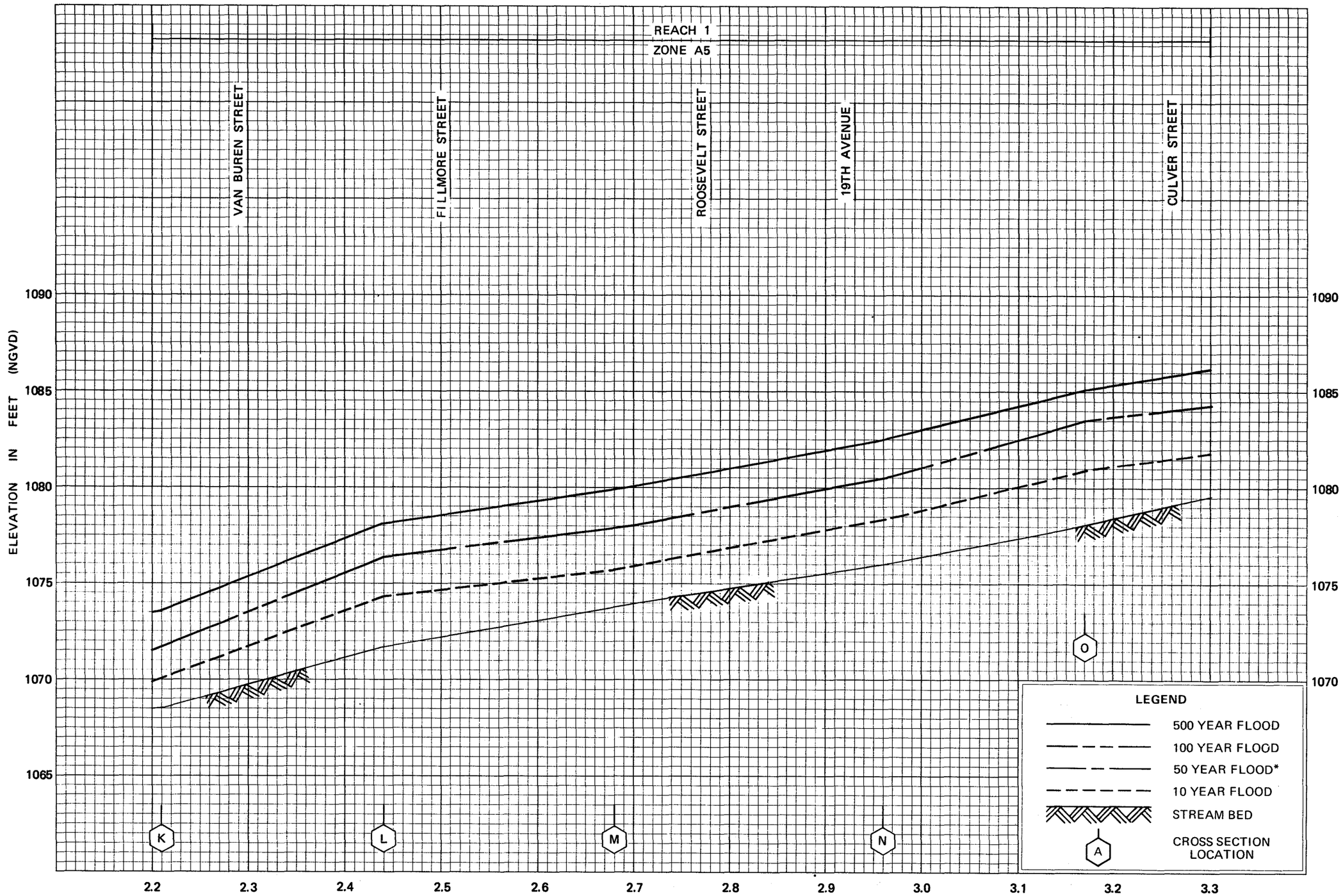


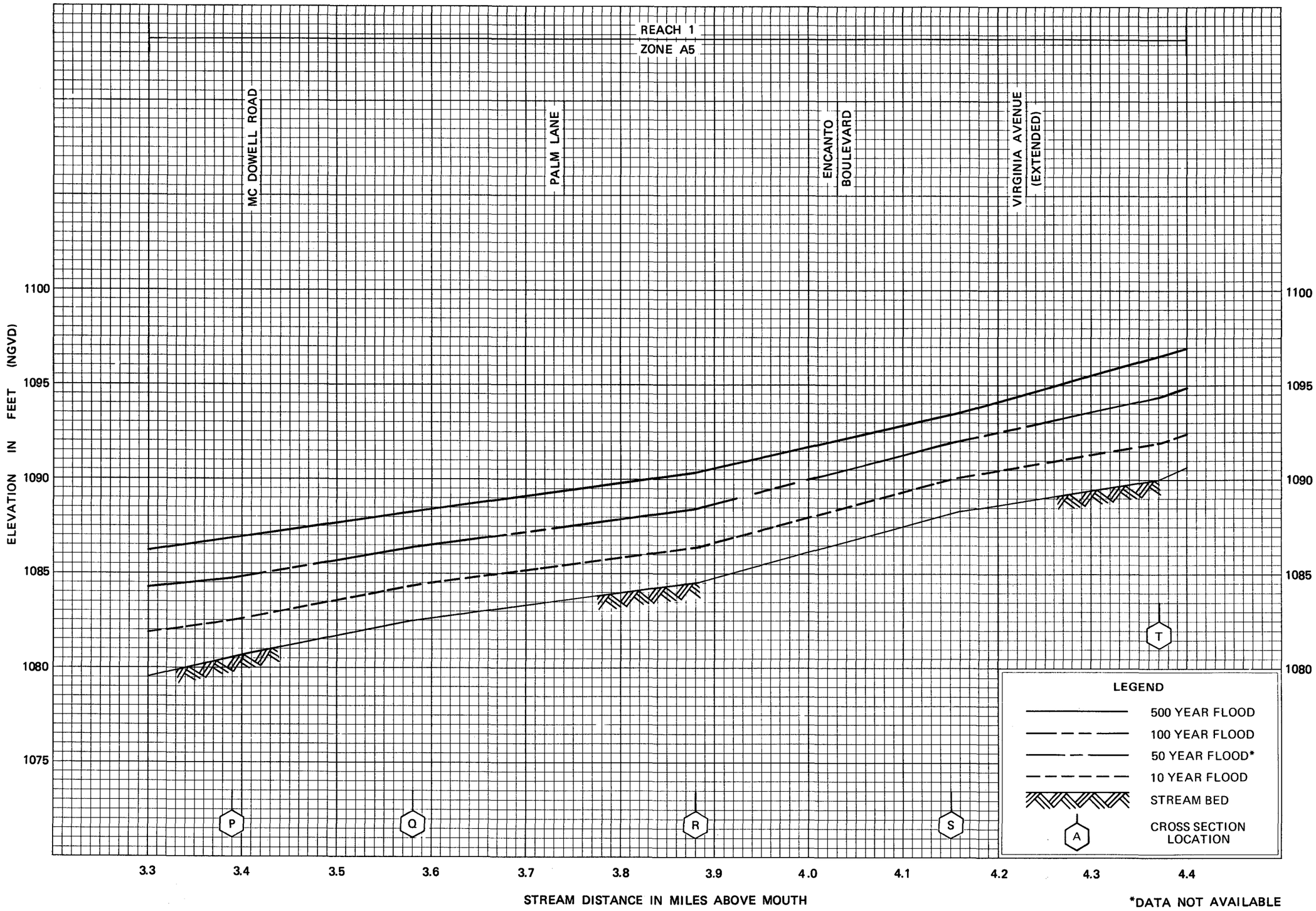
FLOOD PROFILES

CAVE CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

03P



*DATA NOT AVAILABLE

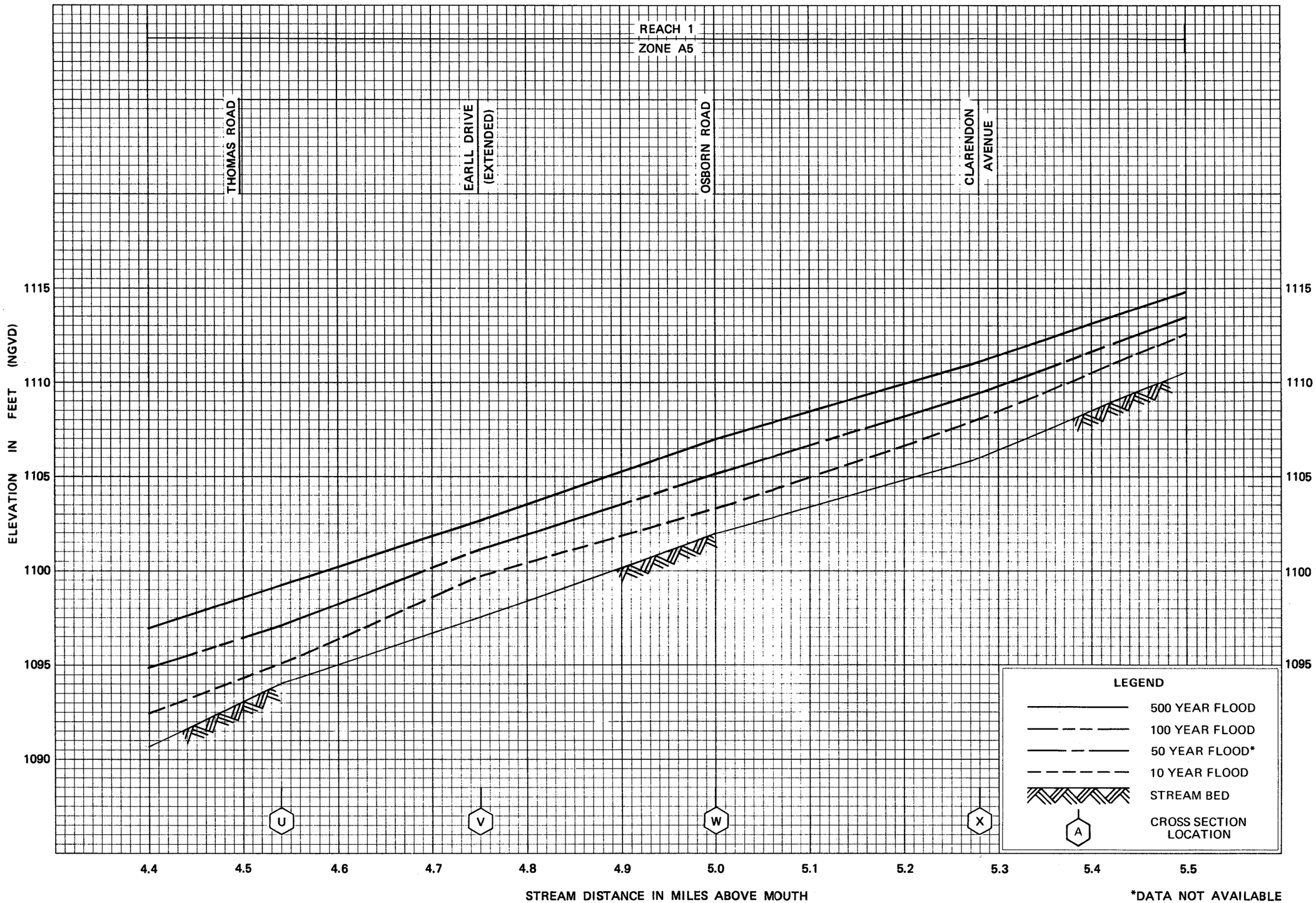
FLOOD PROFILES

CAVE CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

04P



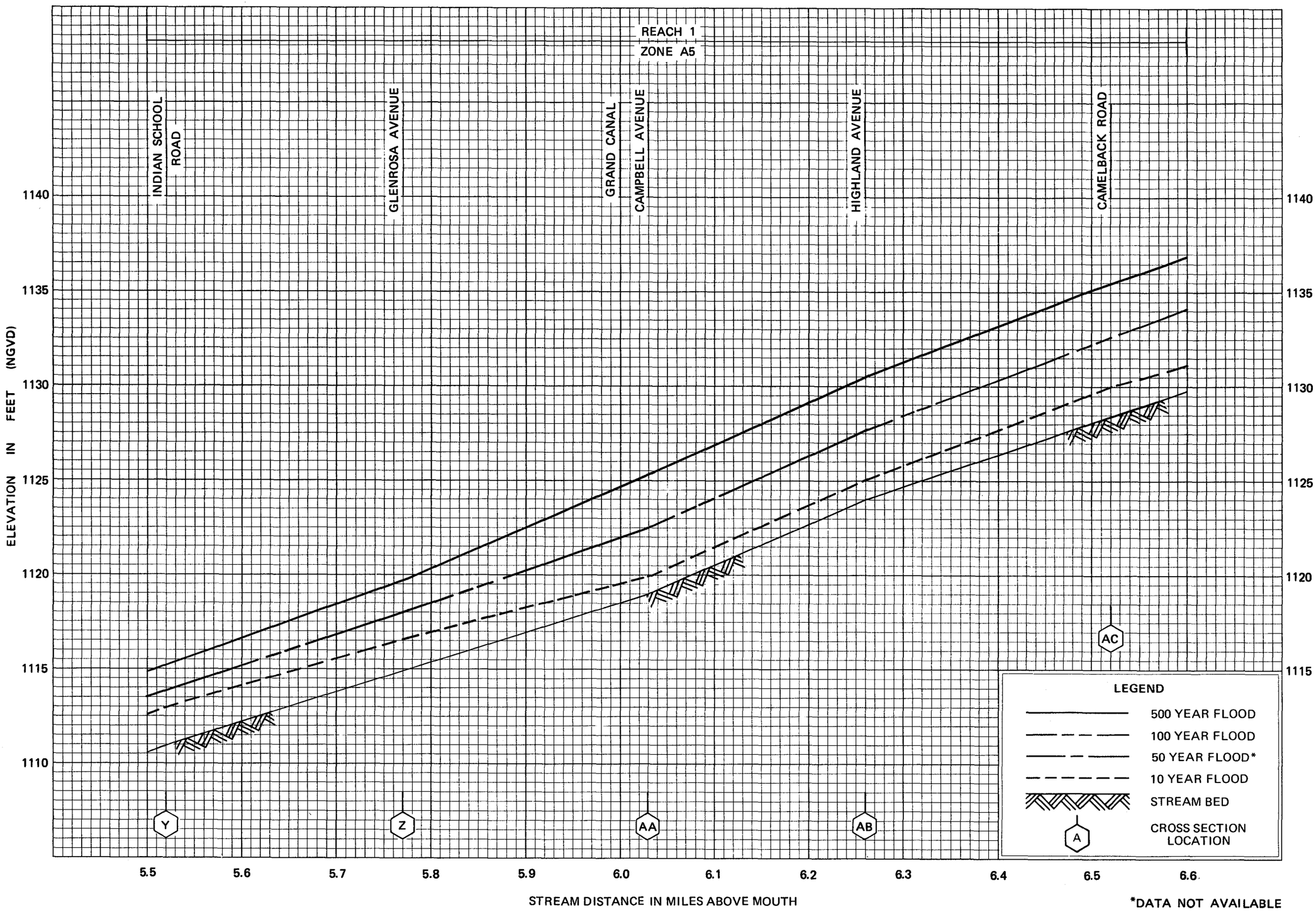
FLOOD PROFILES

CAVE CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

05P



*DATA NOT AVAILABLE

FLOOD PROFILES

CAVE CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

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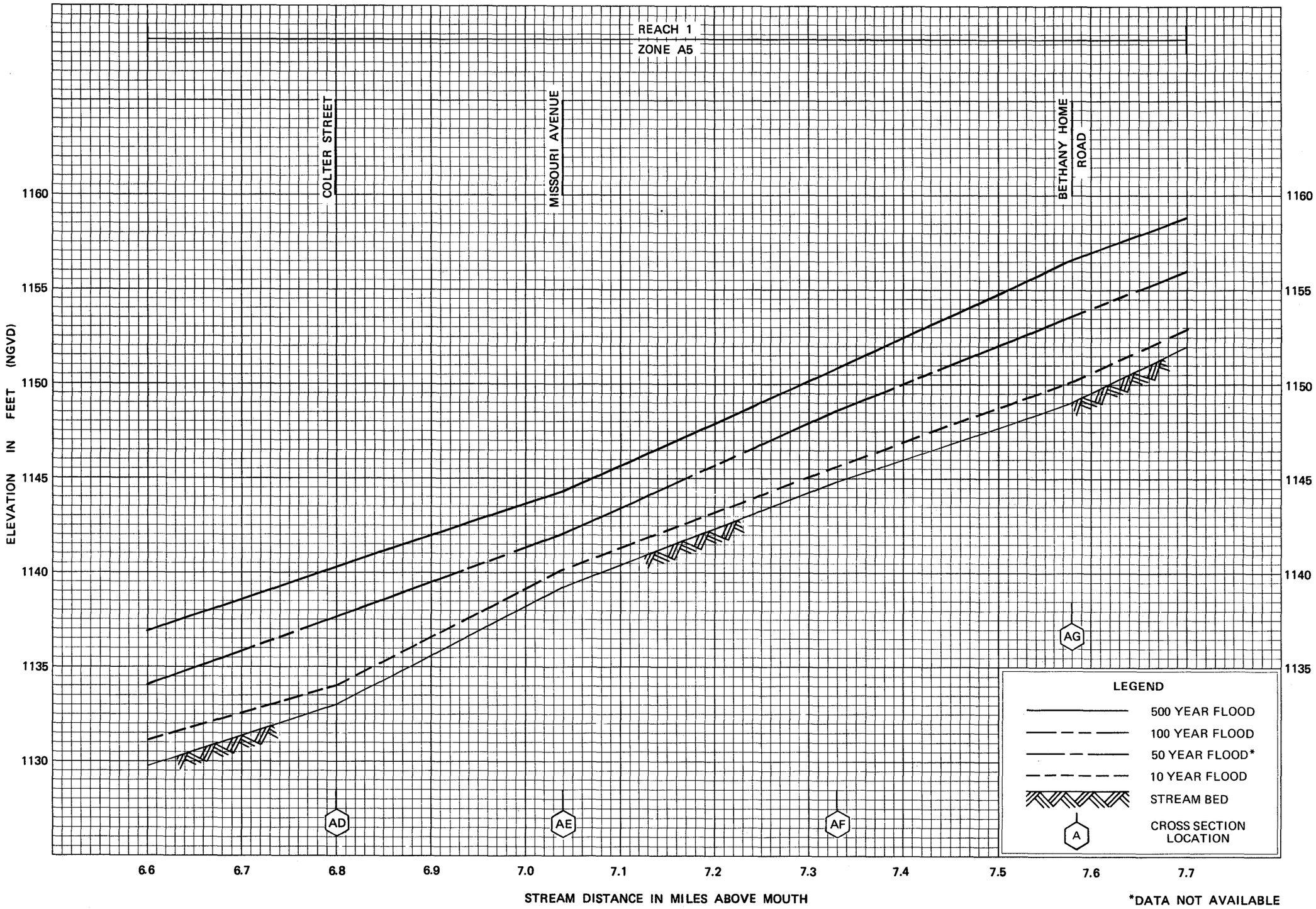


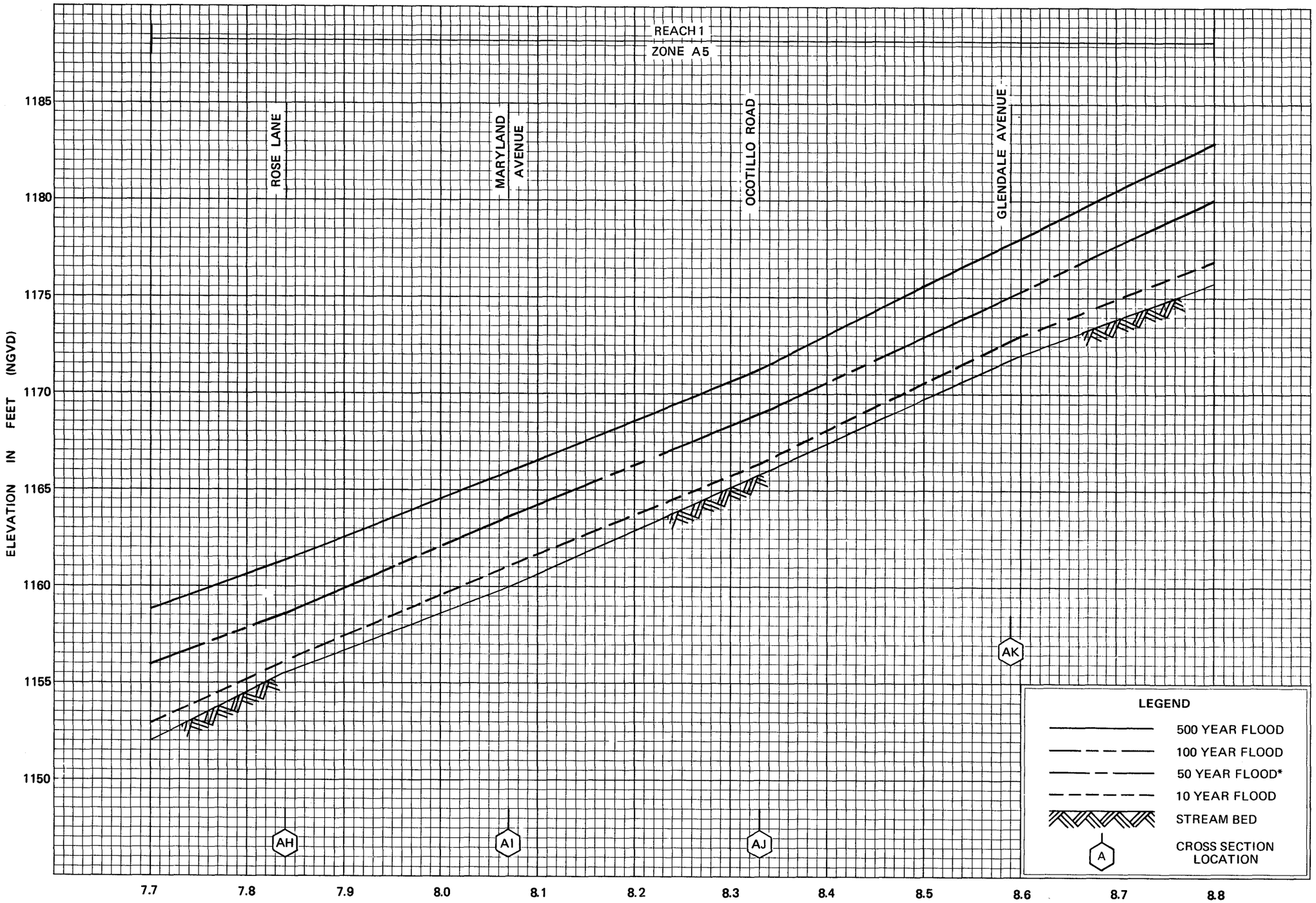
FLOOD PROFILES

CAVE CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

07P



*DATA NOT AVAILABLE

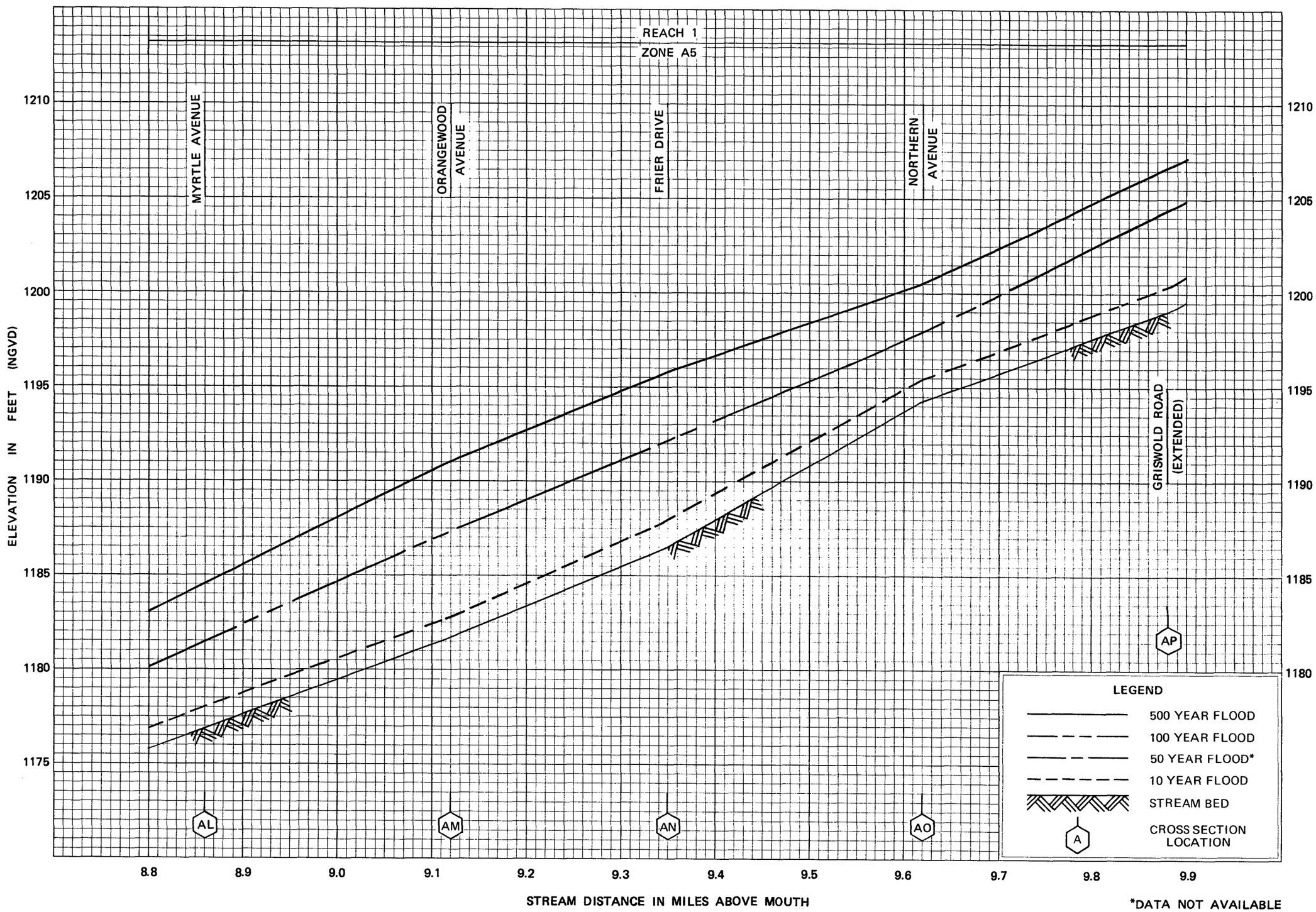
FLOOD PROFILES

CAVE CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

08P



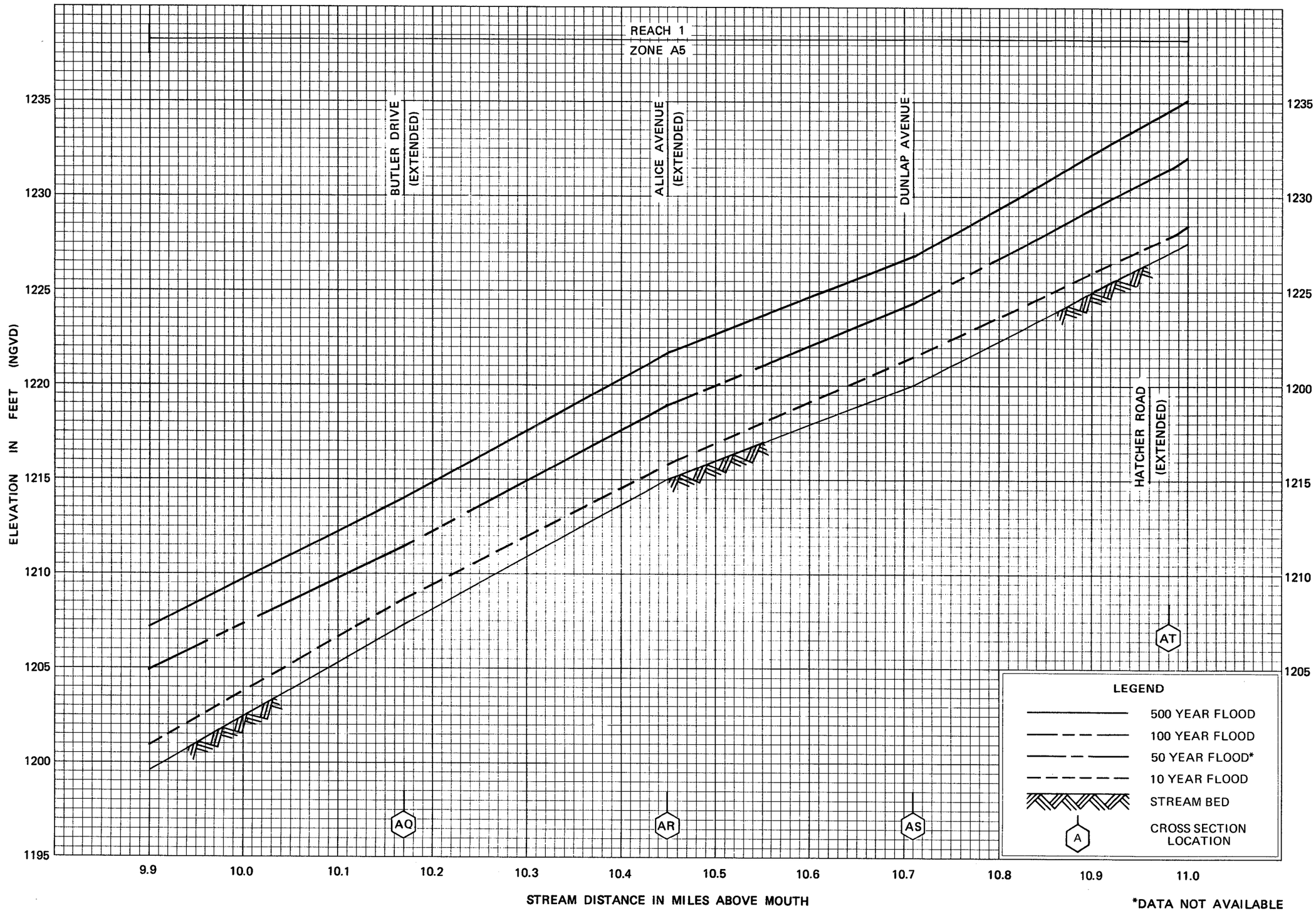
FLOOD PROFILES

CAVE CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

09P



FLOOD PROFILES

CAVE CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

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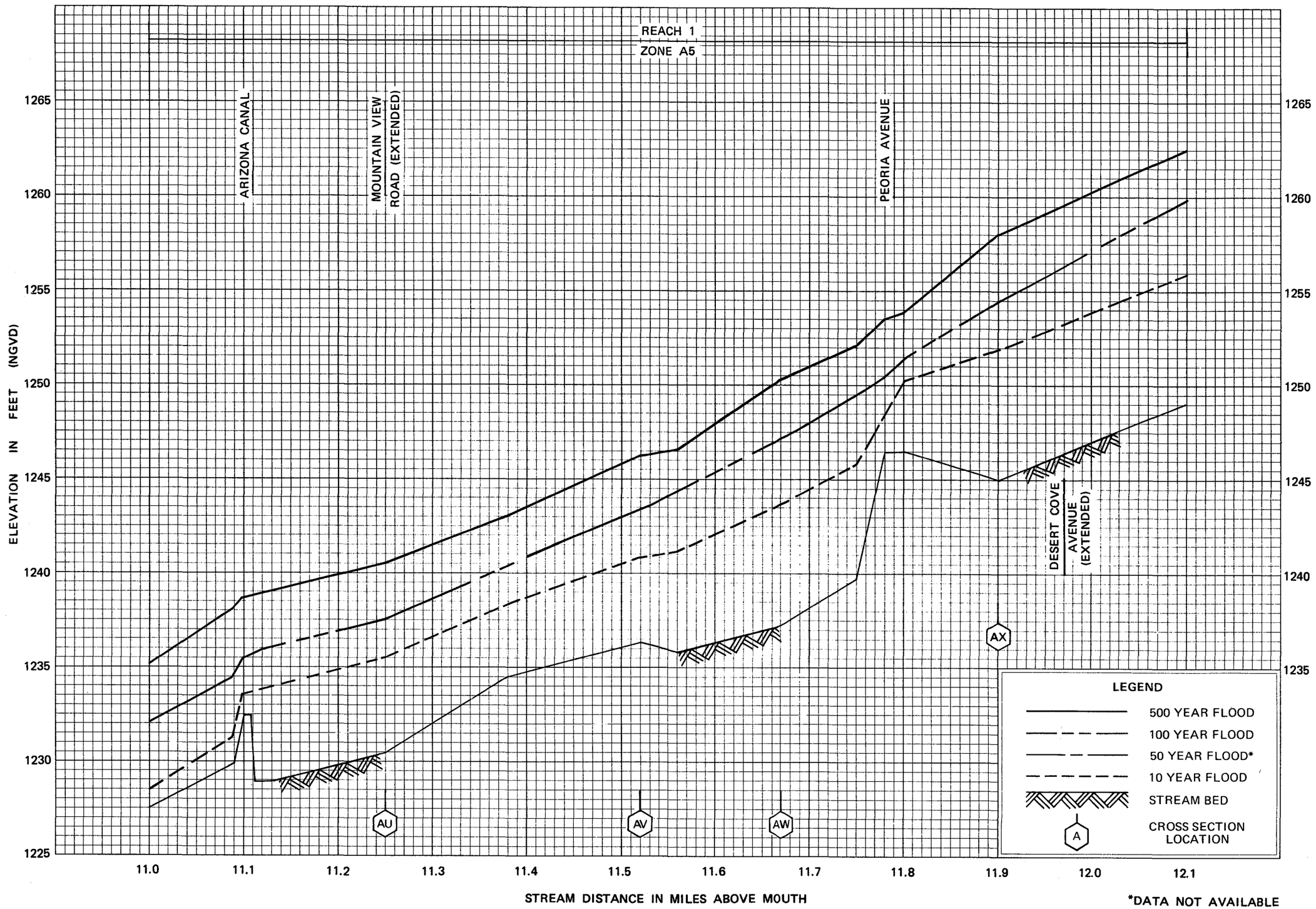

FLOOD PROFILES

CAVE CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
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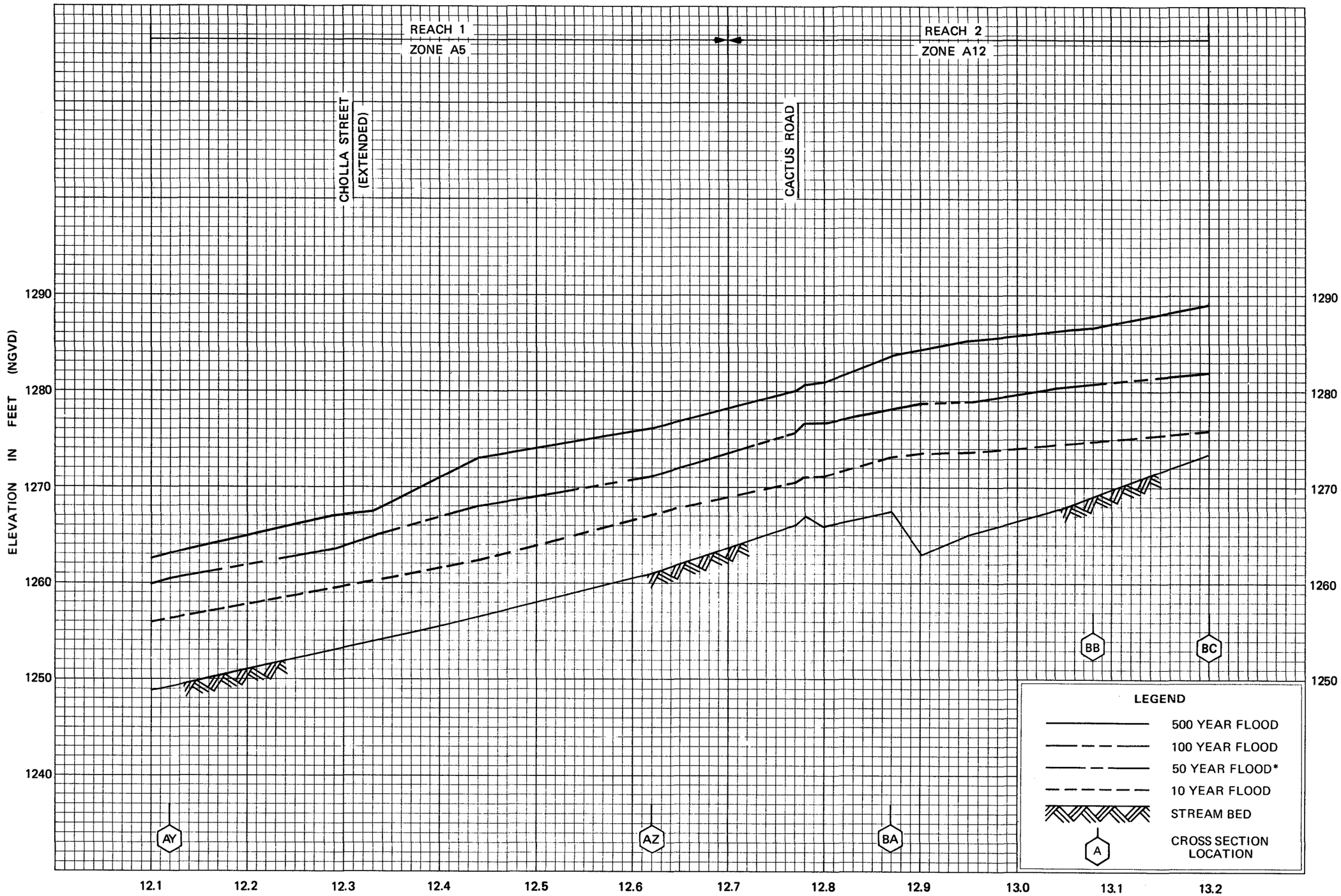

FLOOD PROFILES

CAVE CREEK

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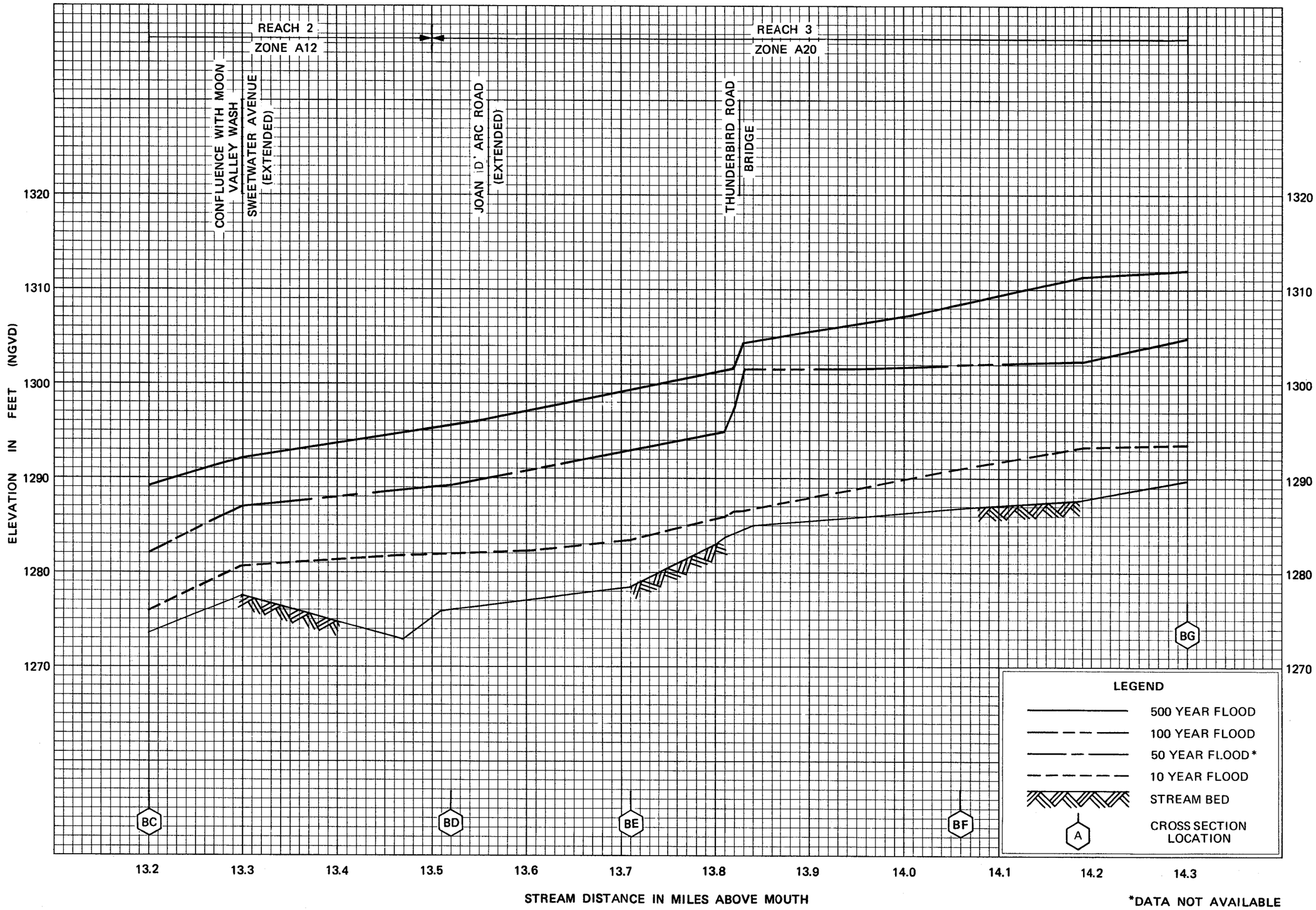
12P



FLOOD PROFILES

CAVE CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
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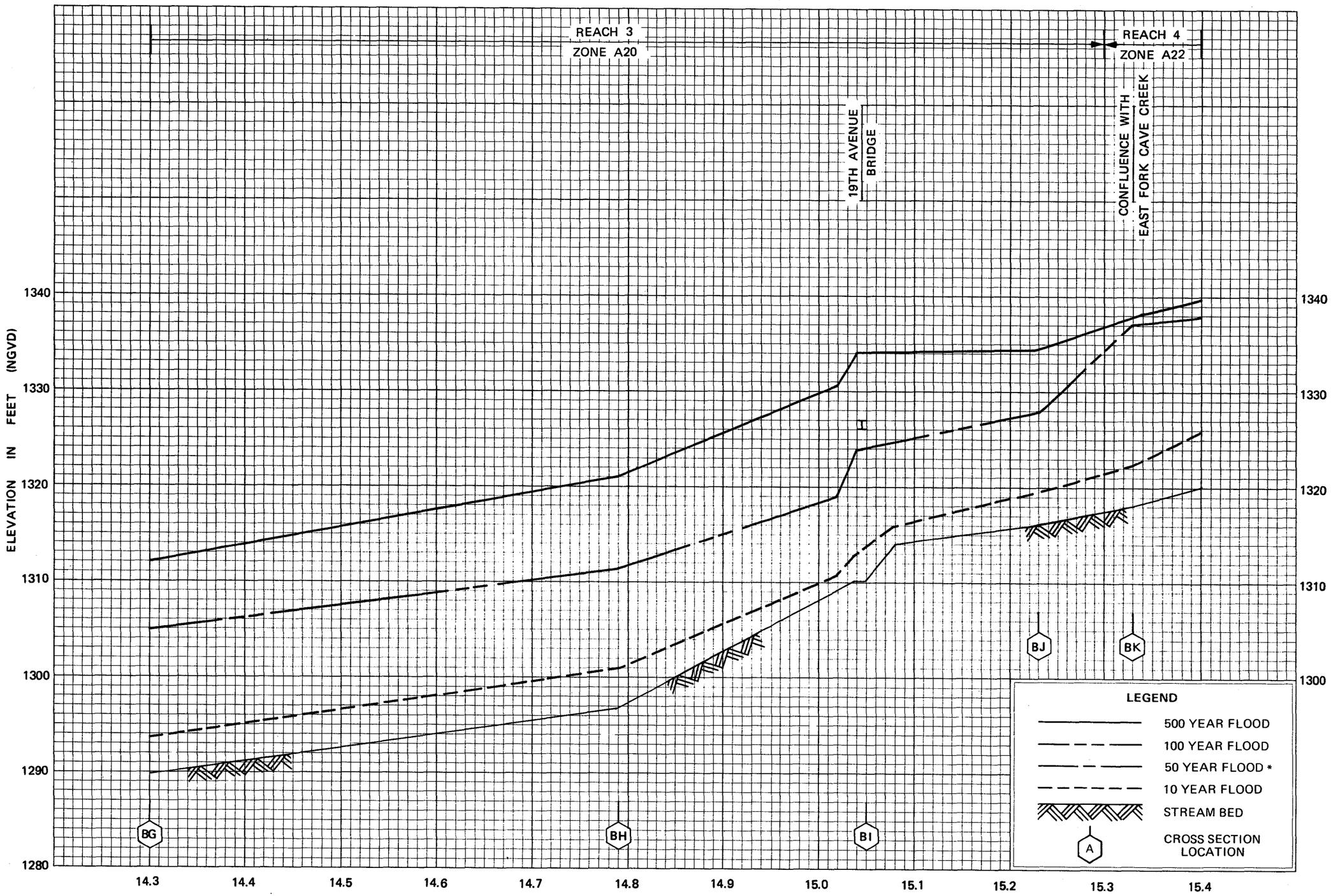
13P



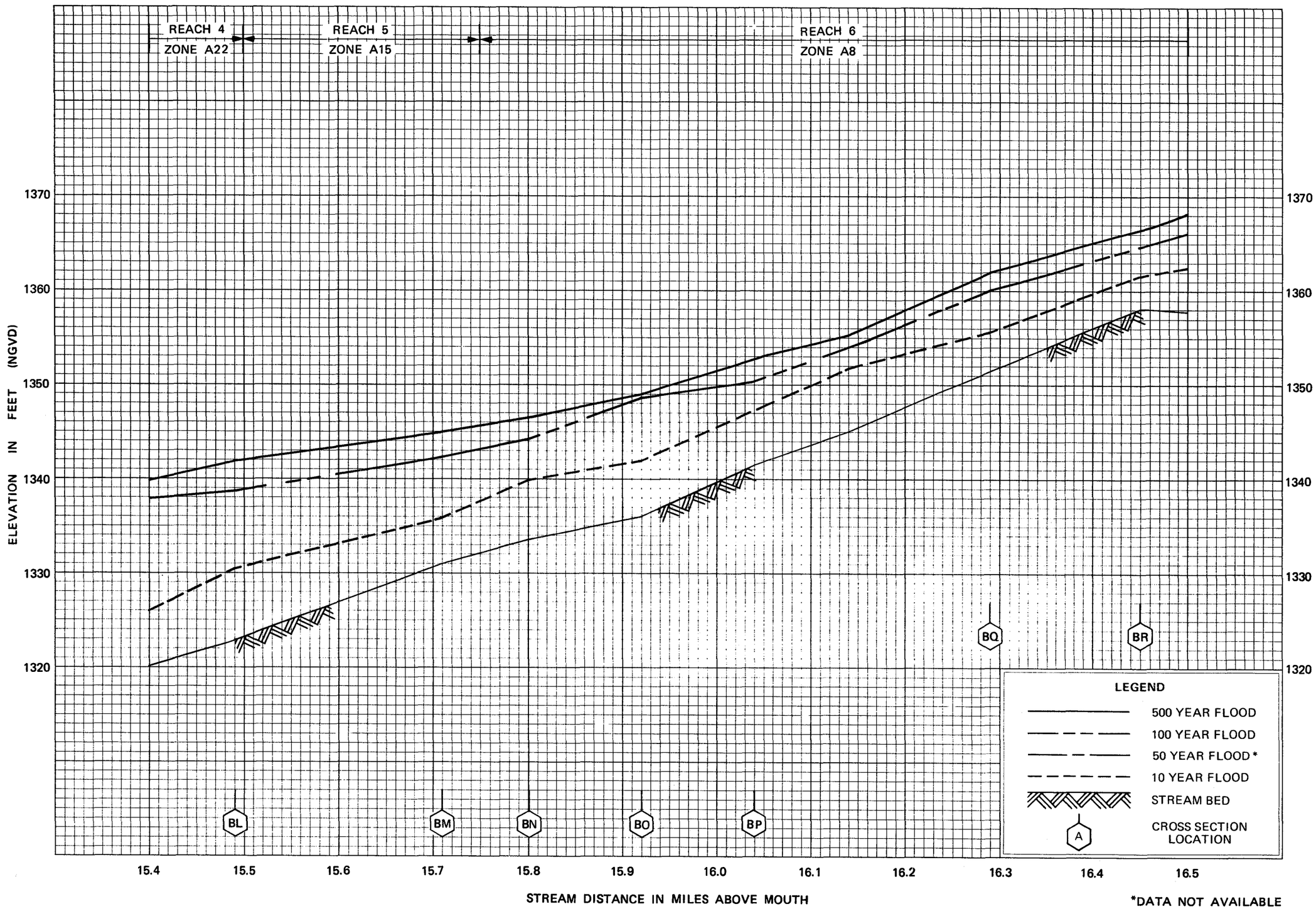
FLOOD PROFILES

CAVE CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

14P



FLOOD PROFILES

CAVE CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
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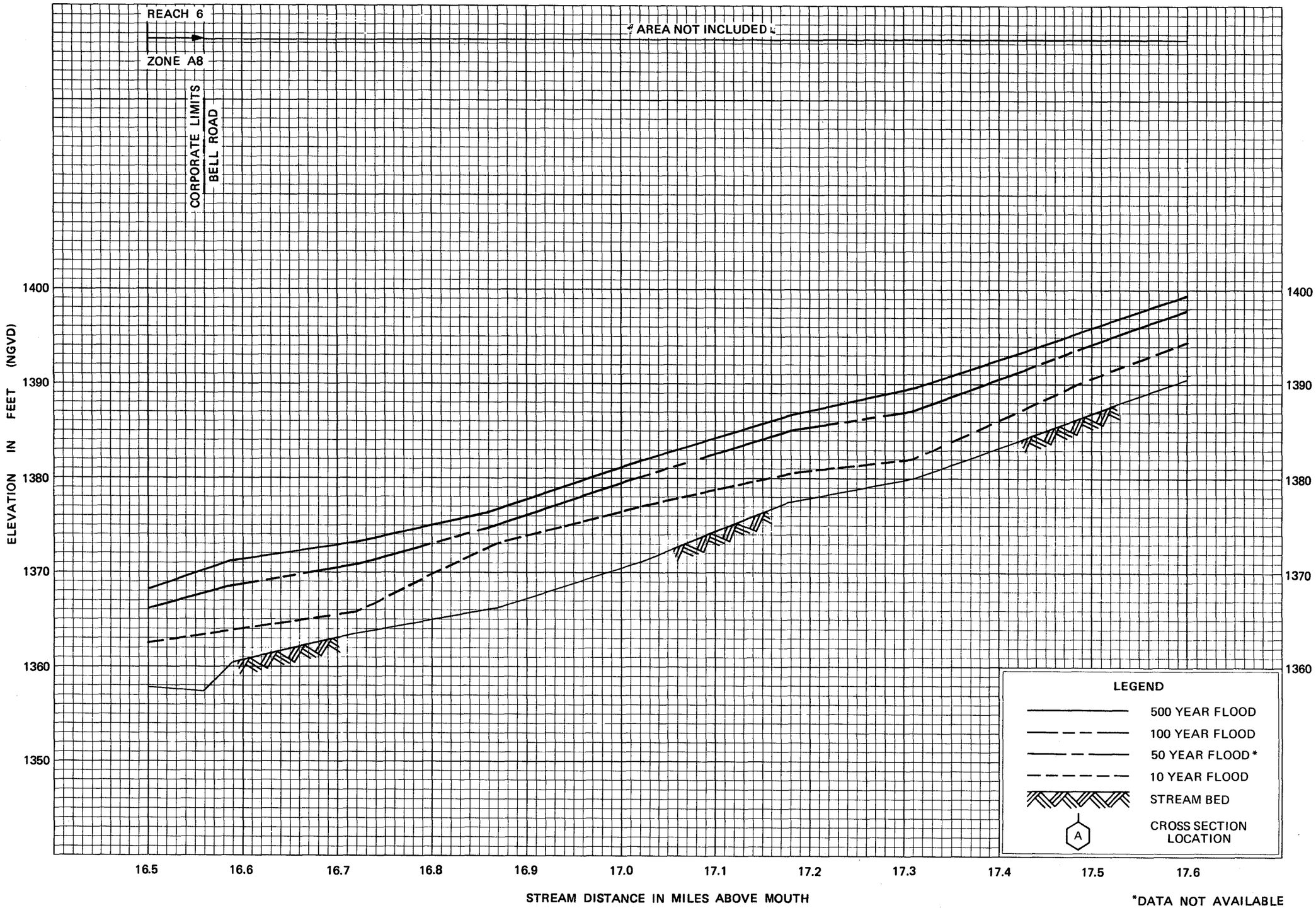
CITY OF PHOENIX, AZ
(MARICOPA CO.)



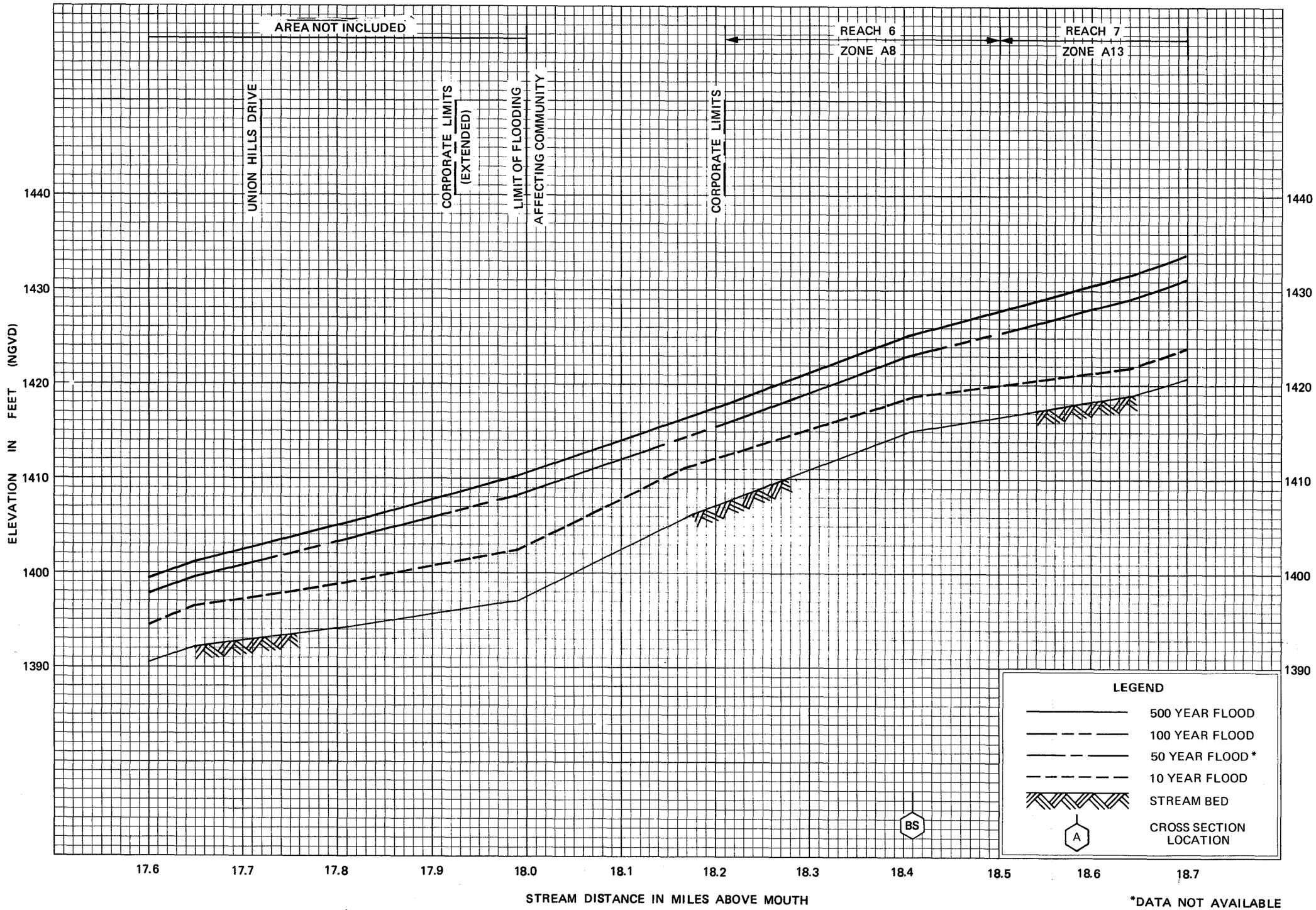
FLOOD PROFILES

CAVE CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

16P



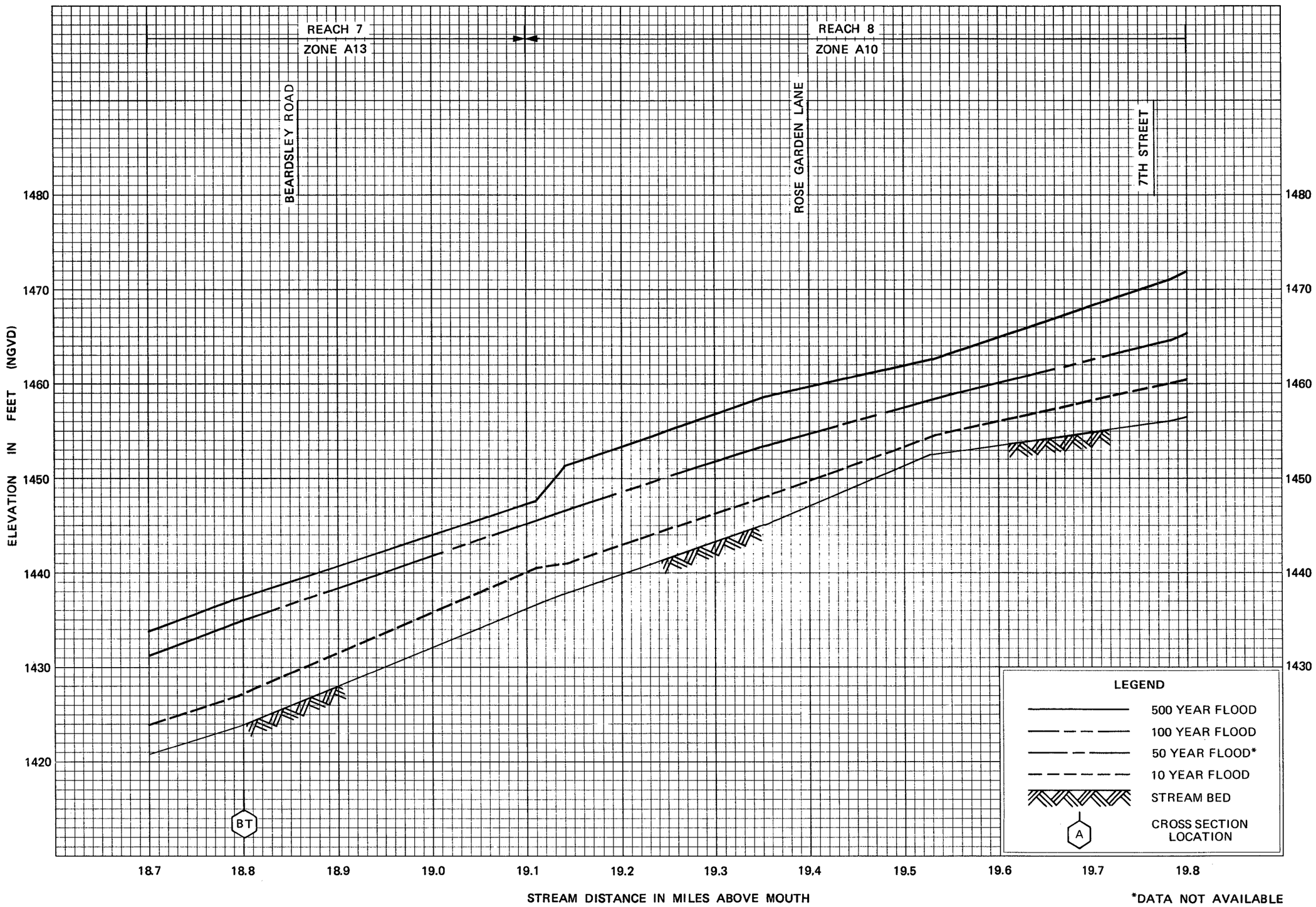
FLOOD PROFILES

CAVE CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

17P

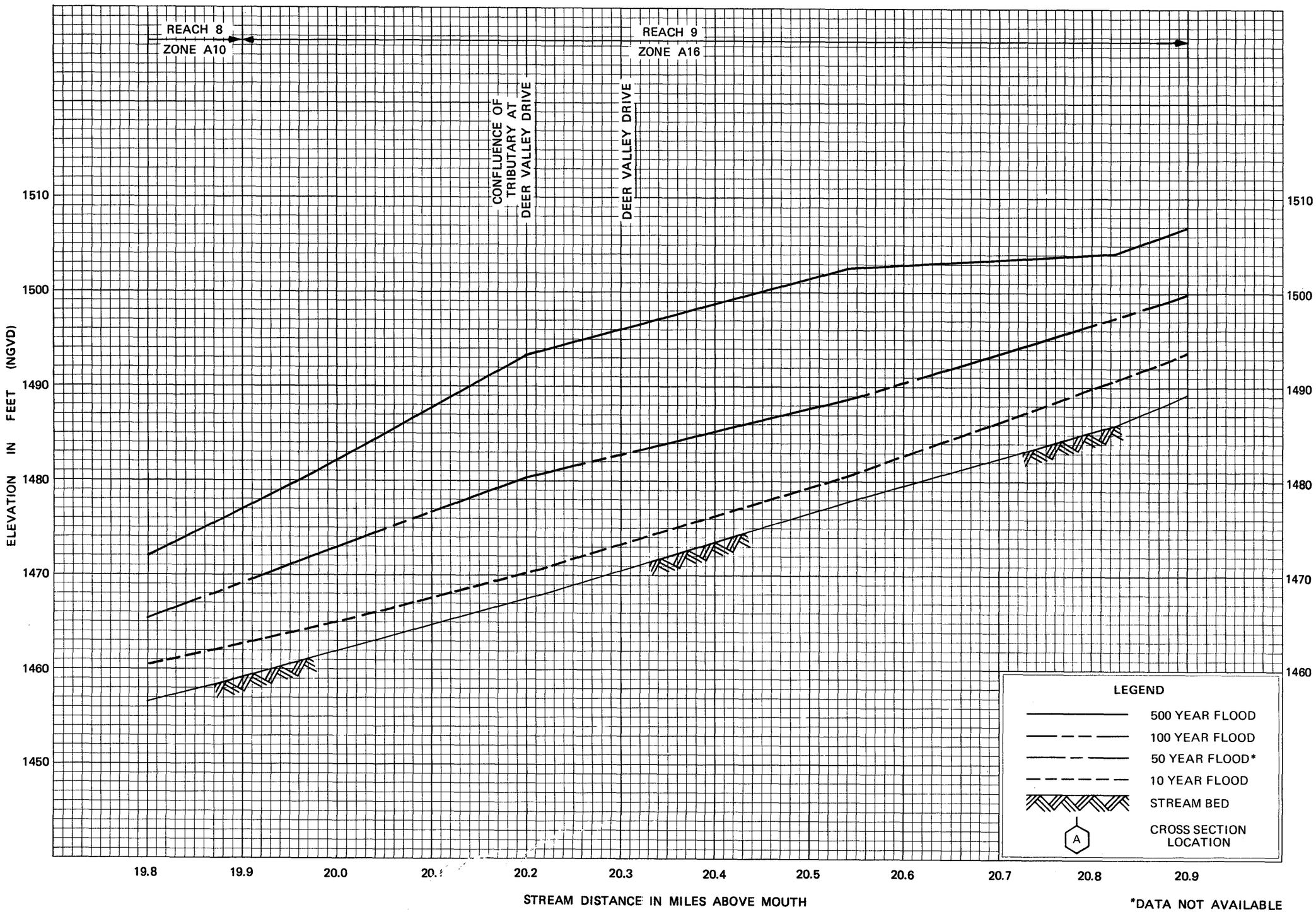


FLOOD PROFILES

CAVE CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

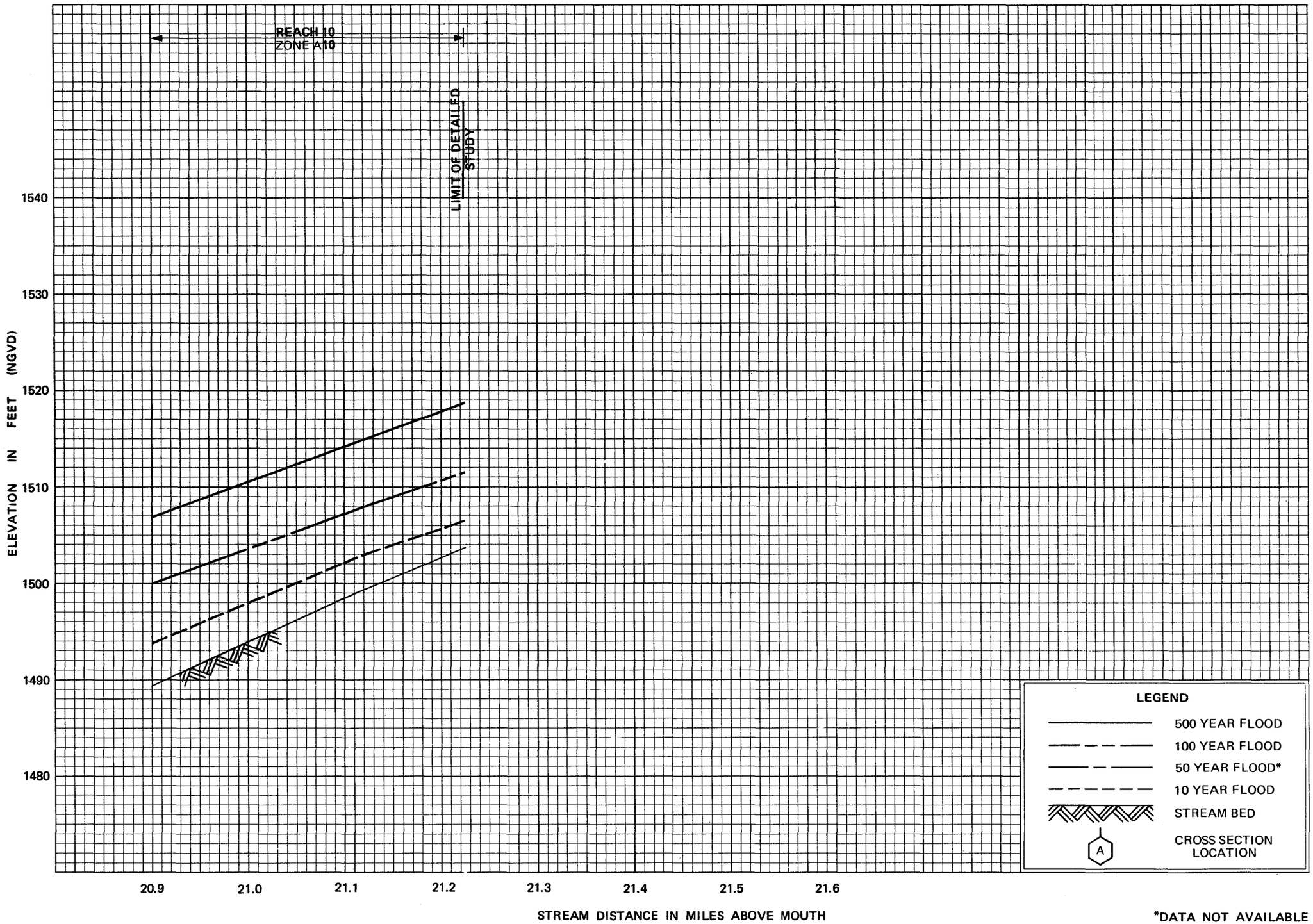


FLOOD PROFILES

CAVE CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)



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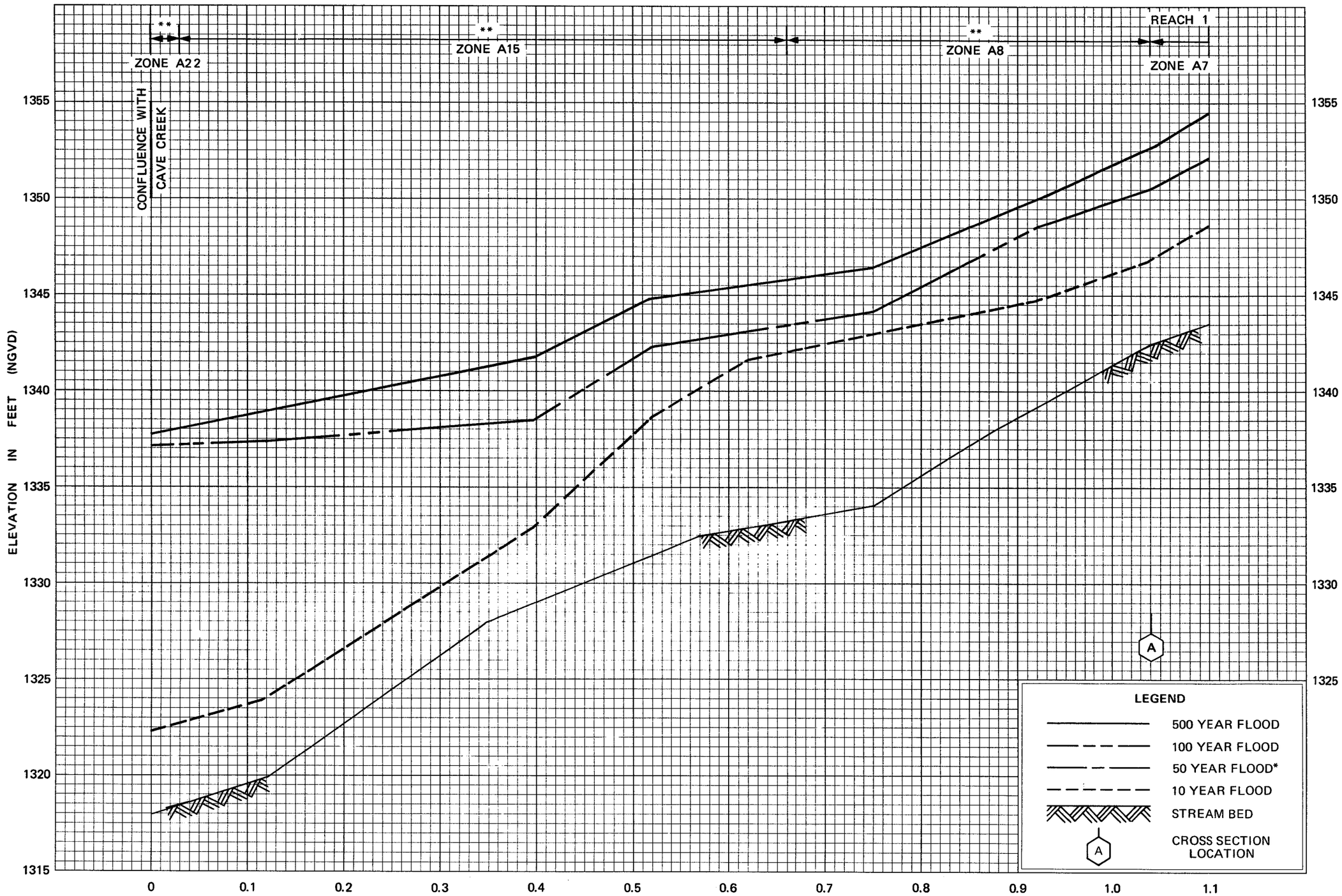
FLOOD PROFILES

CAVE CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)



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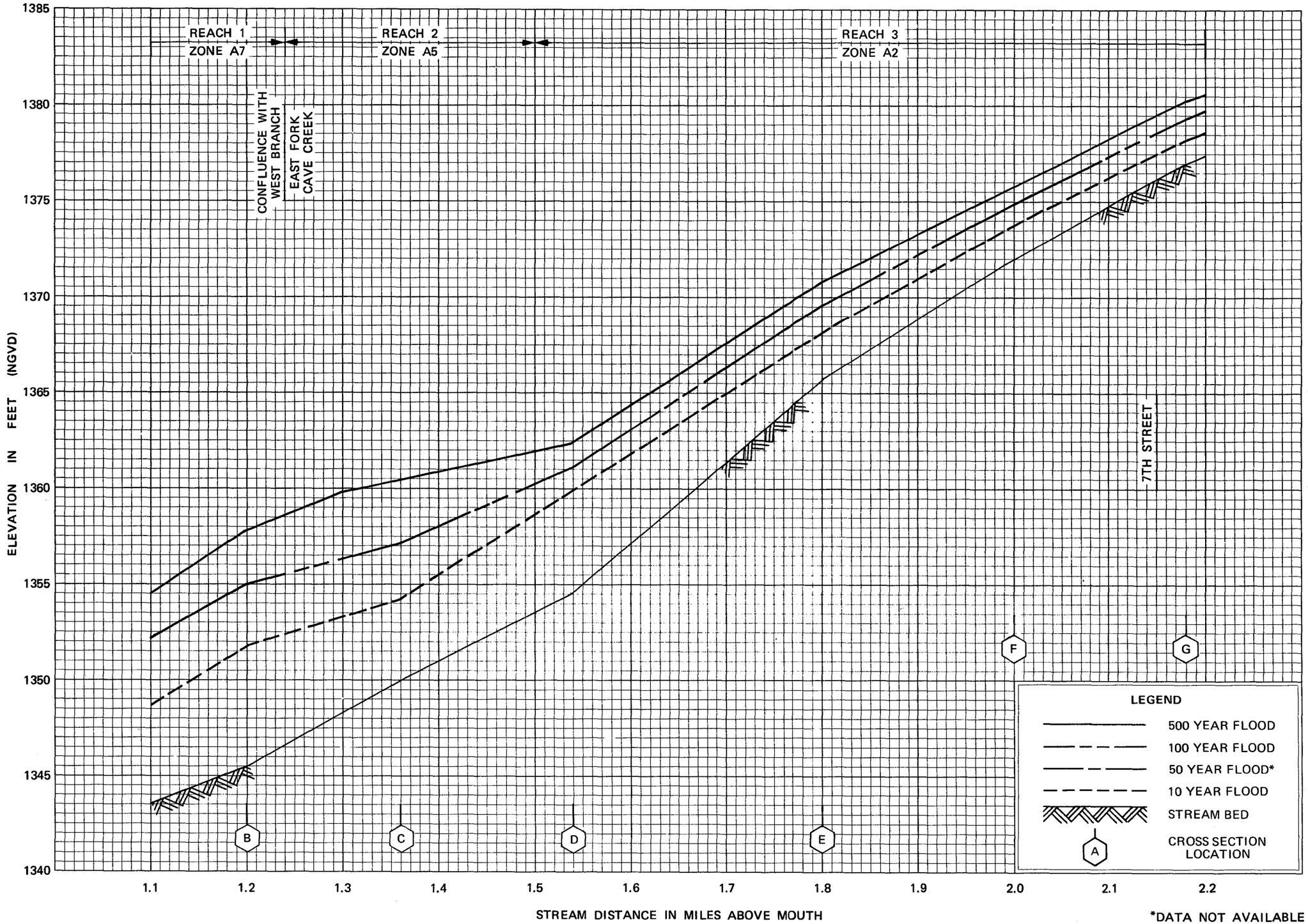
**FLOODING CONTROLLED BY CAVE CREEK

FLOOD PROFILES

EAST FORK CAVE CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

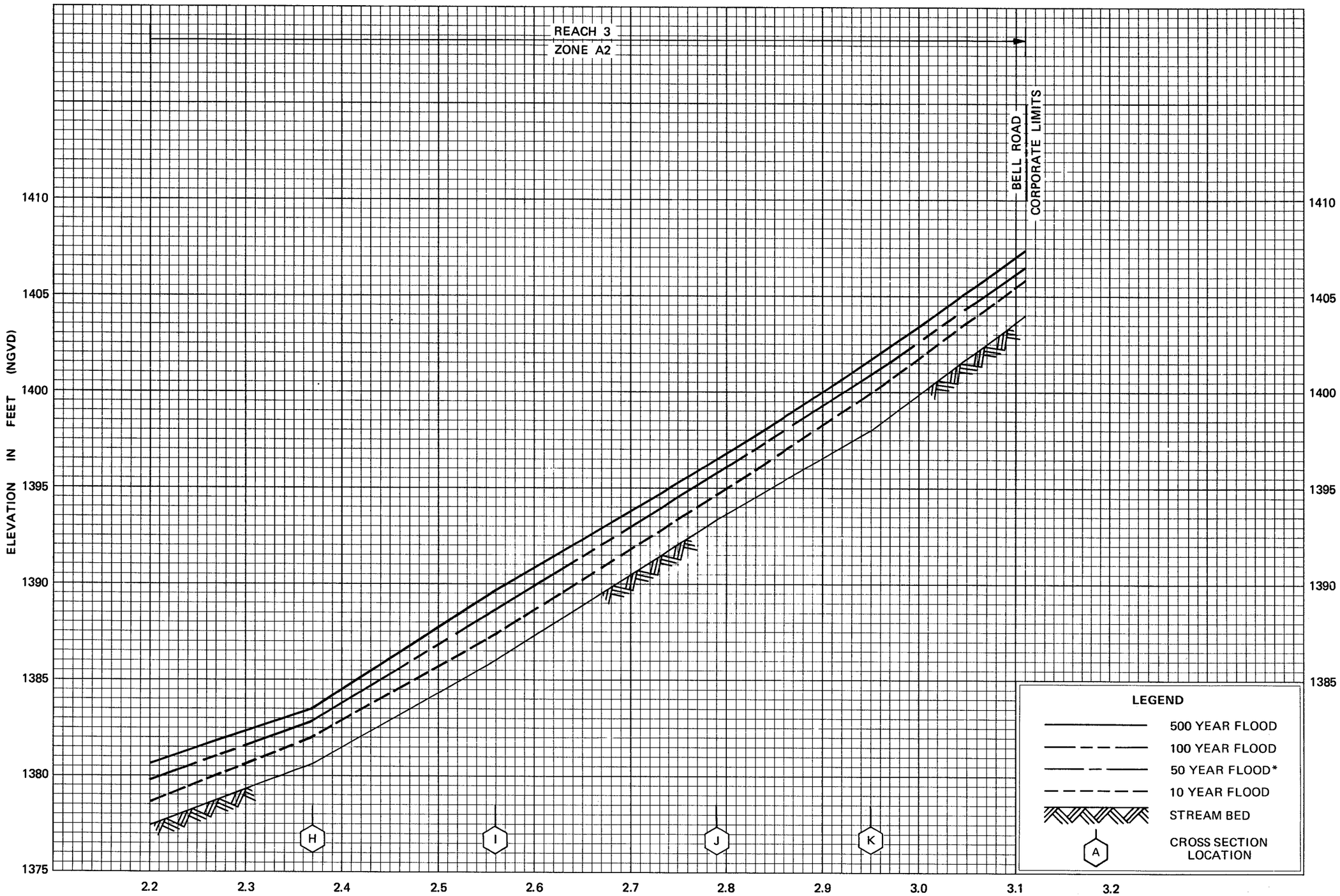


FLOOD PROFILES

EAST FORK CAVE CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)



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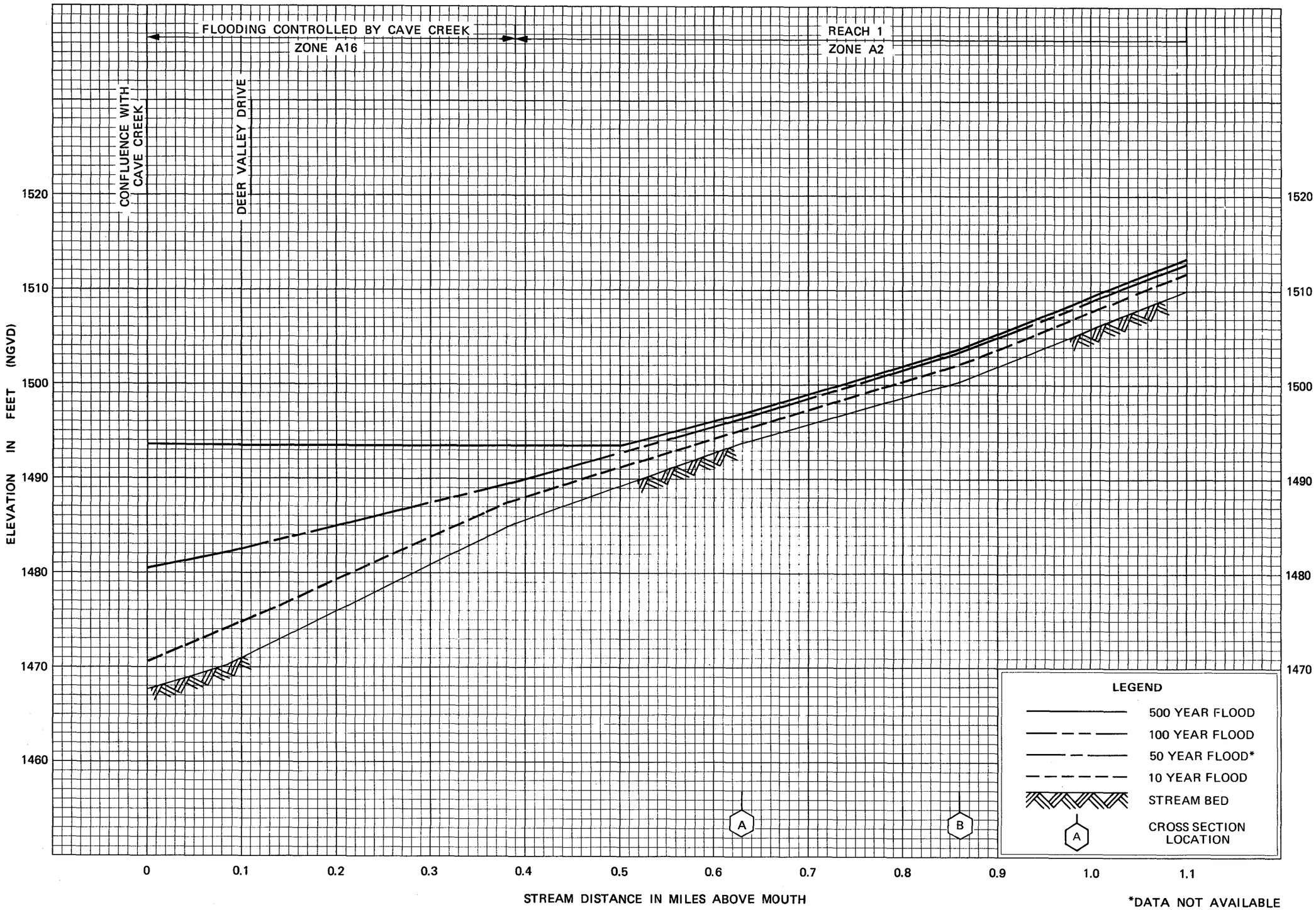
FLOOD PROFILES

EAST FORK CAVE CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

23P



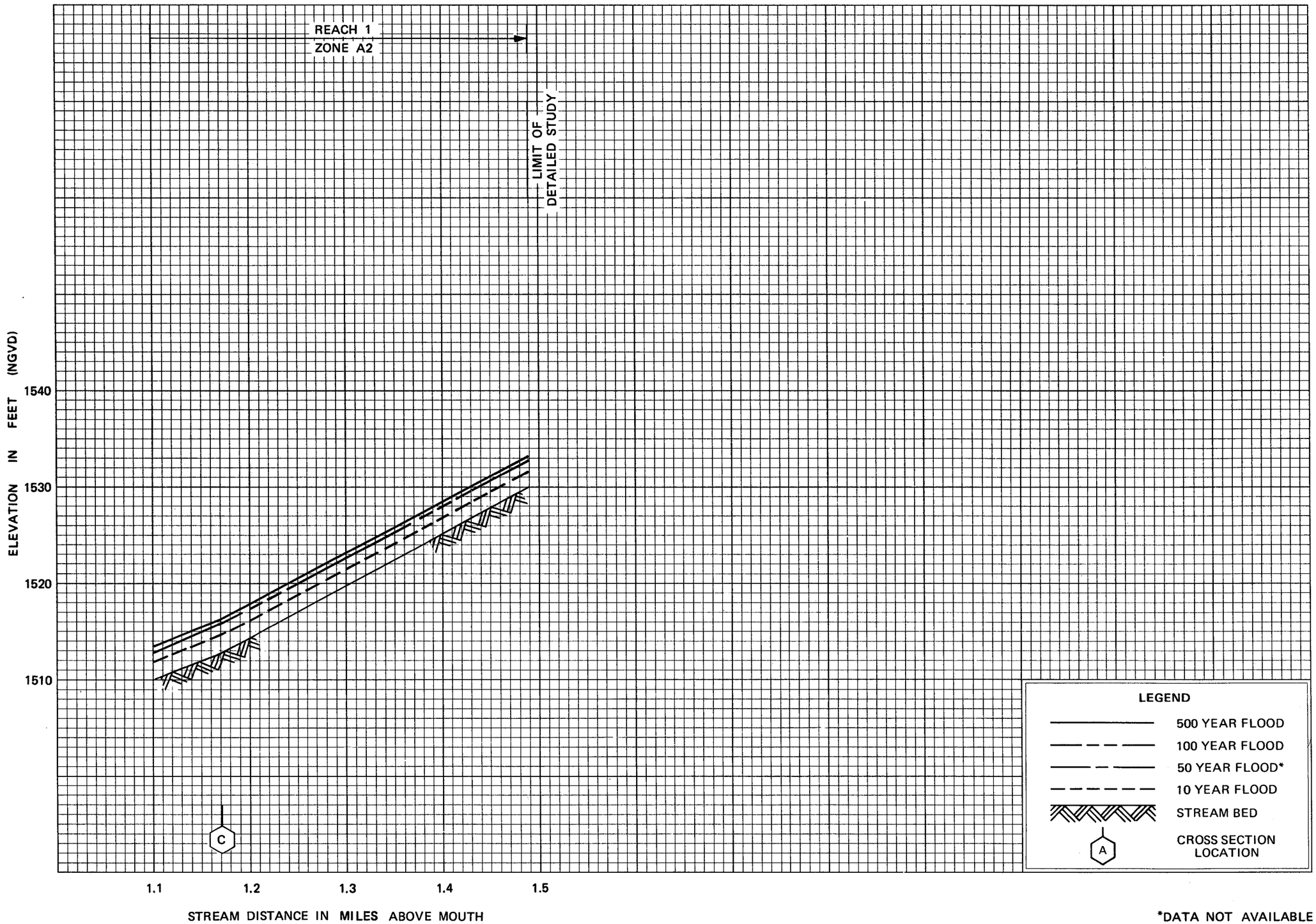
FLOOD PROFILES

CAVE CREEK TRIBUTARY AT DEER VALLEY DRIVE

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

24P



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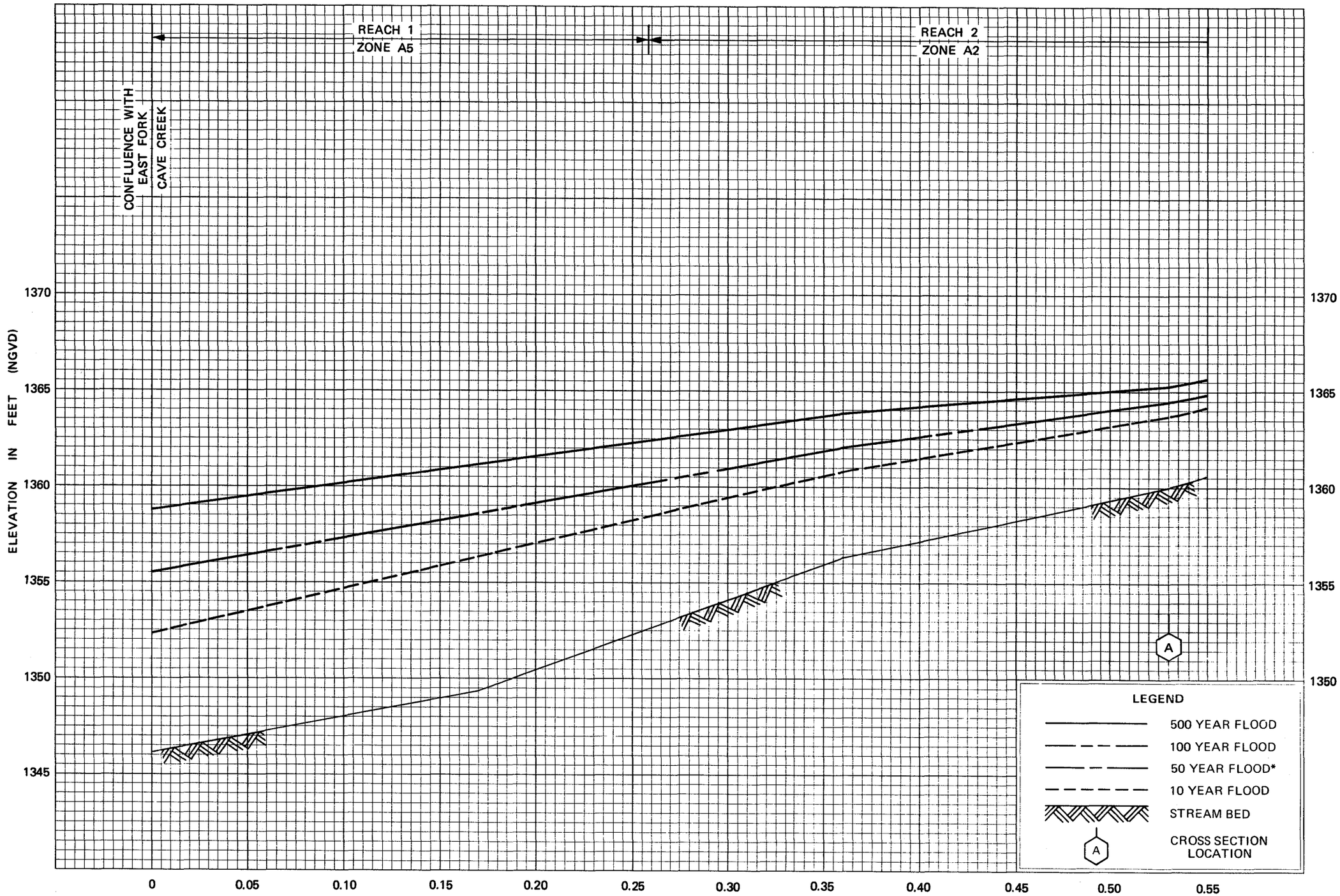
FLOOD PROFILES

CAVE CREEK TRIBUTARY AT DEER VALLEY DRIVE

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)



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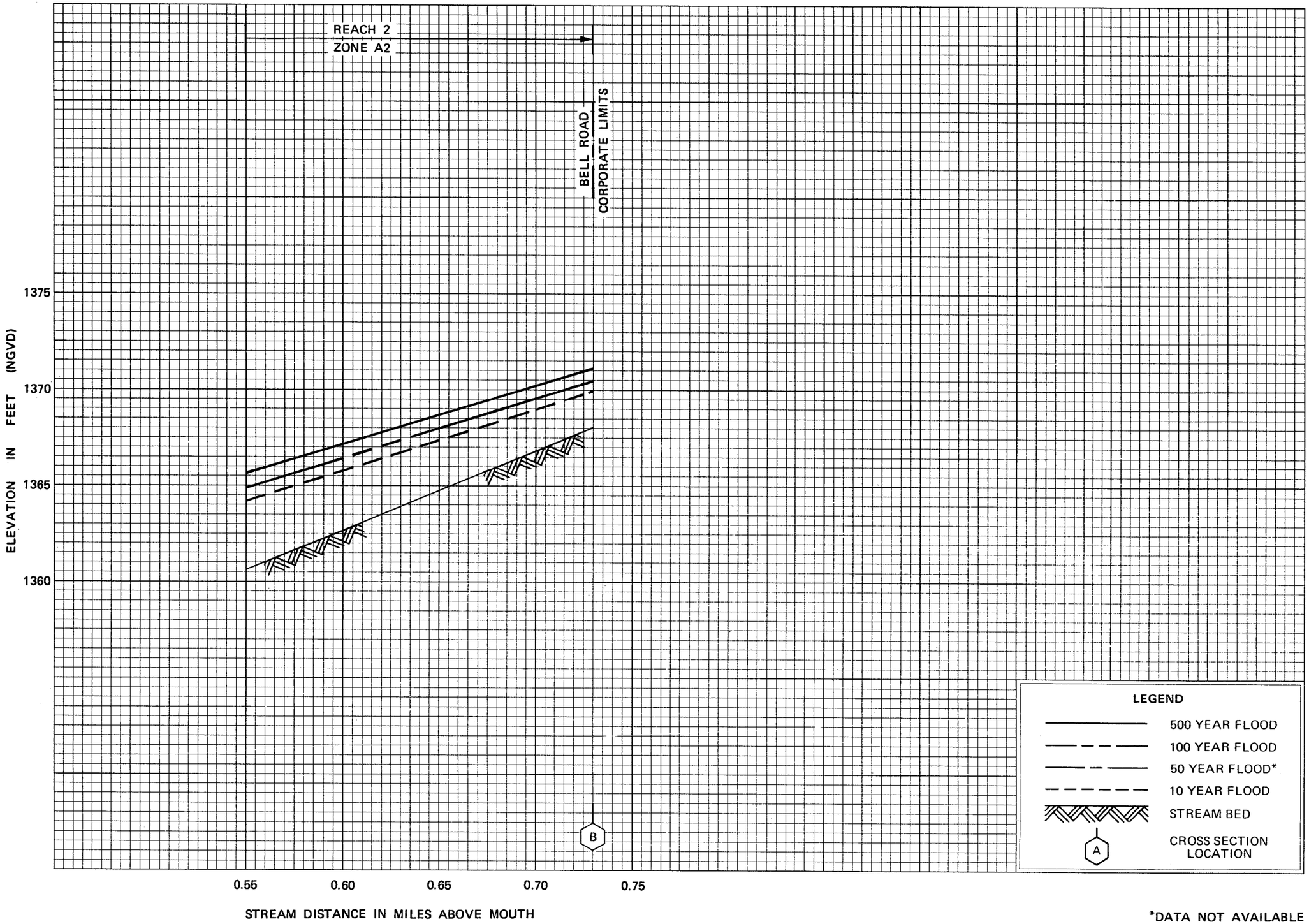
FLOOD PROFILES

WEST BRANCH EAST FORK CAVE CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)



*DATA NOT AVAILABLE

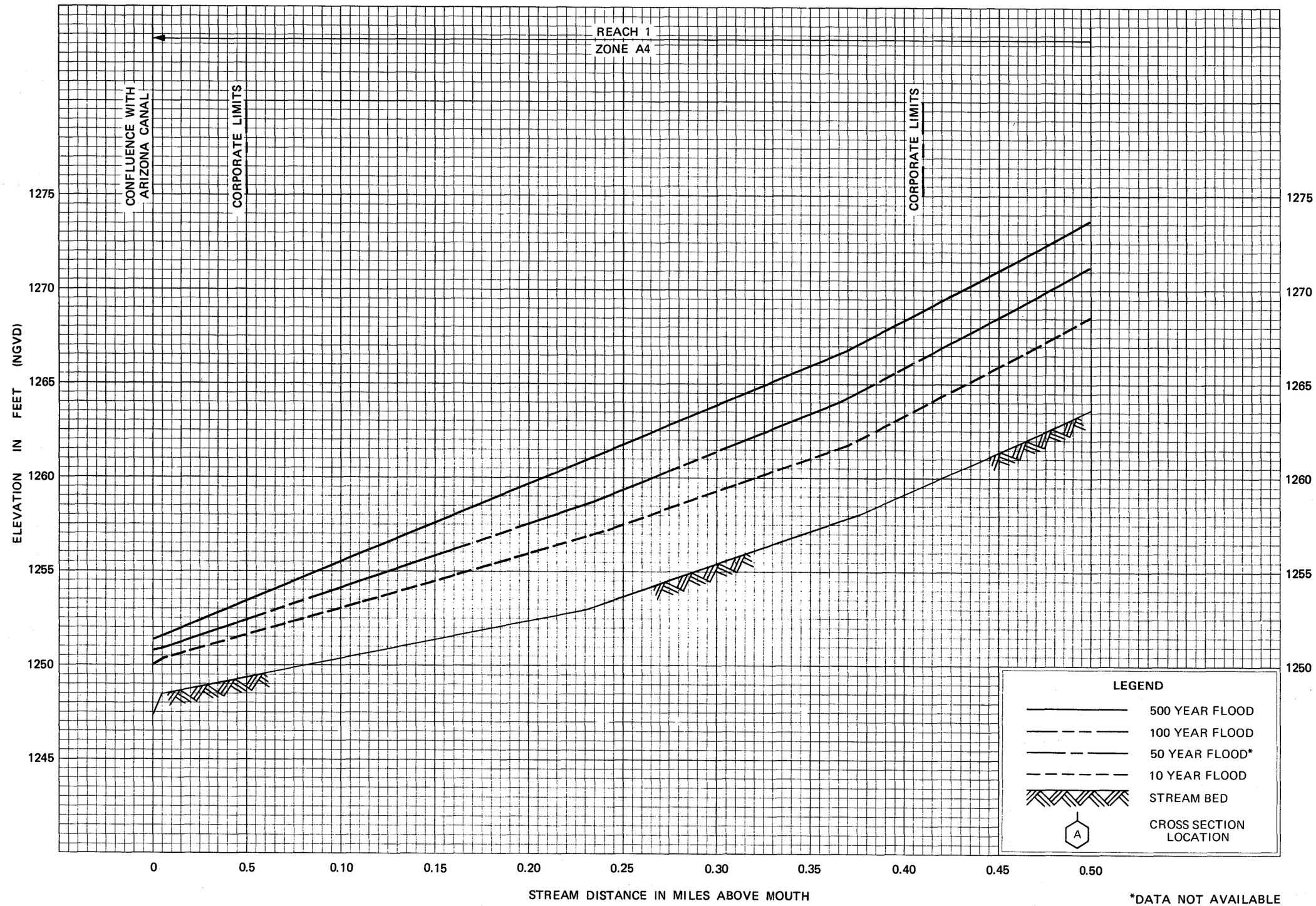
FLOOD PROFILES

WEST BRANCH EAST FORK CAVE CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

27P



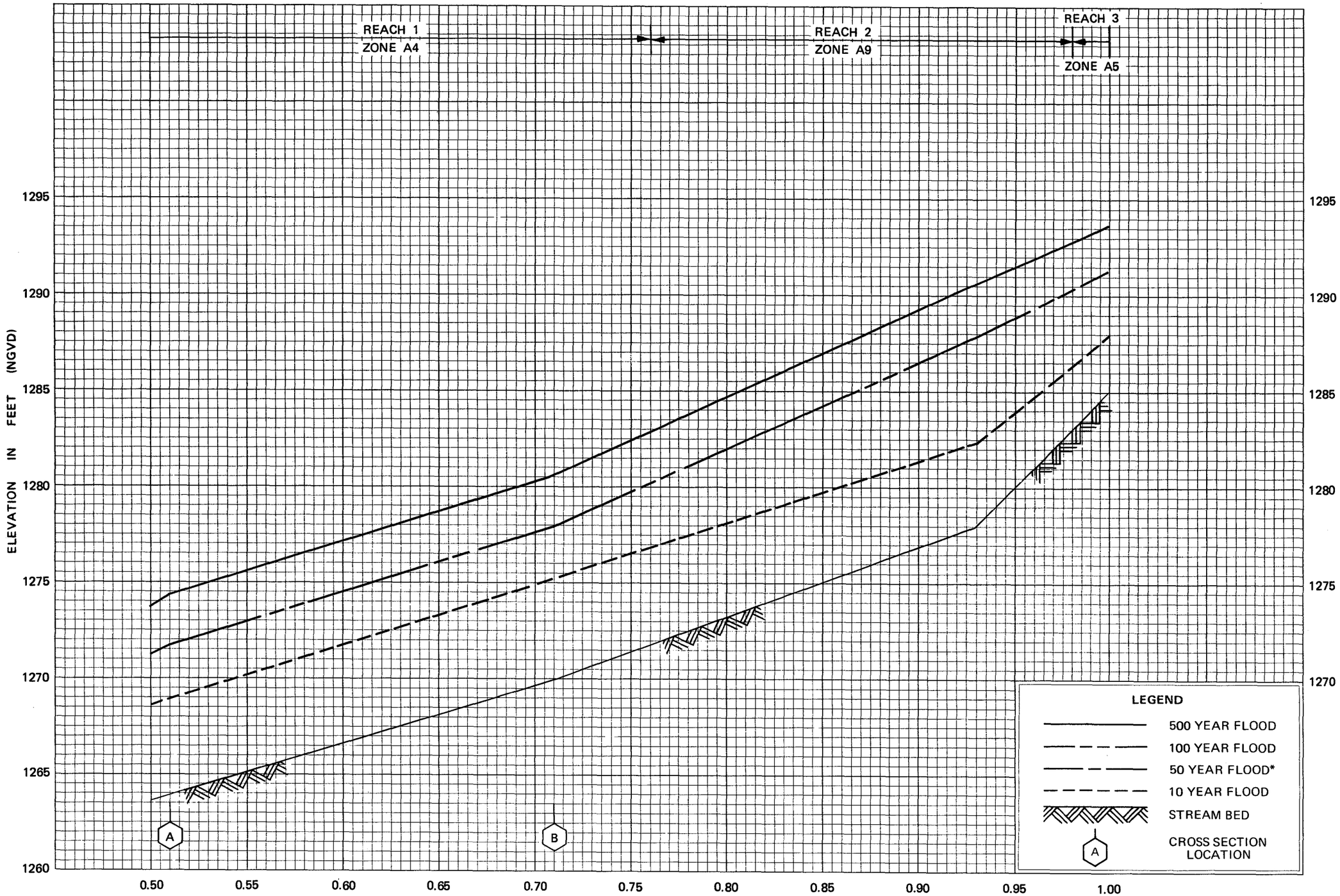
*DATA NOT AVAILABLE

FLOOD PROFILES

ECHO CANYON WASH

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)



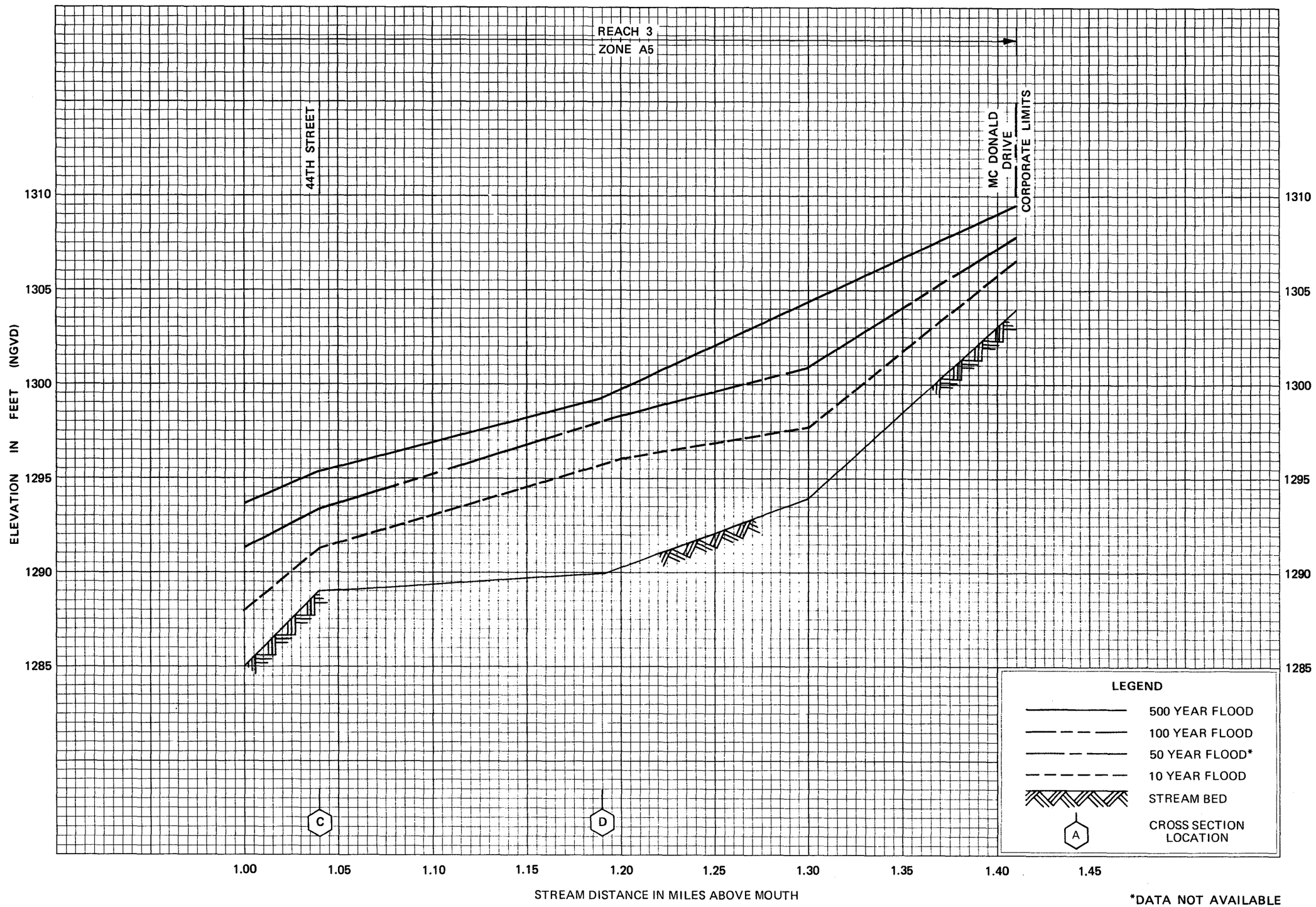
FLOOD PROFILES

ECHO CANYON WASH

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

29P



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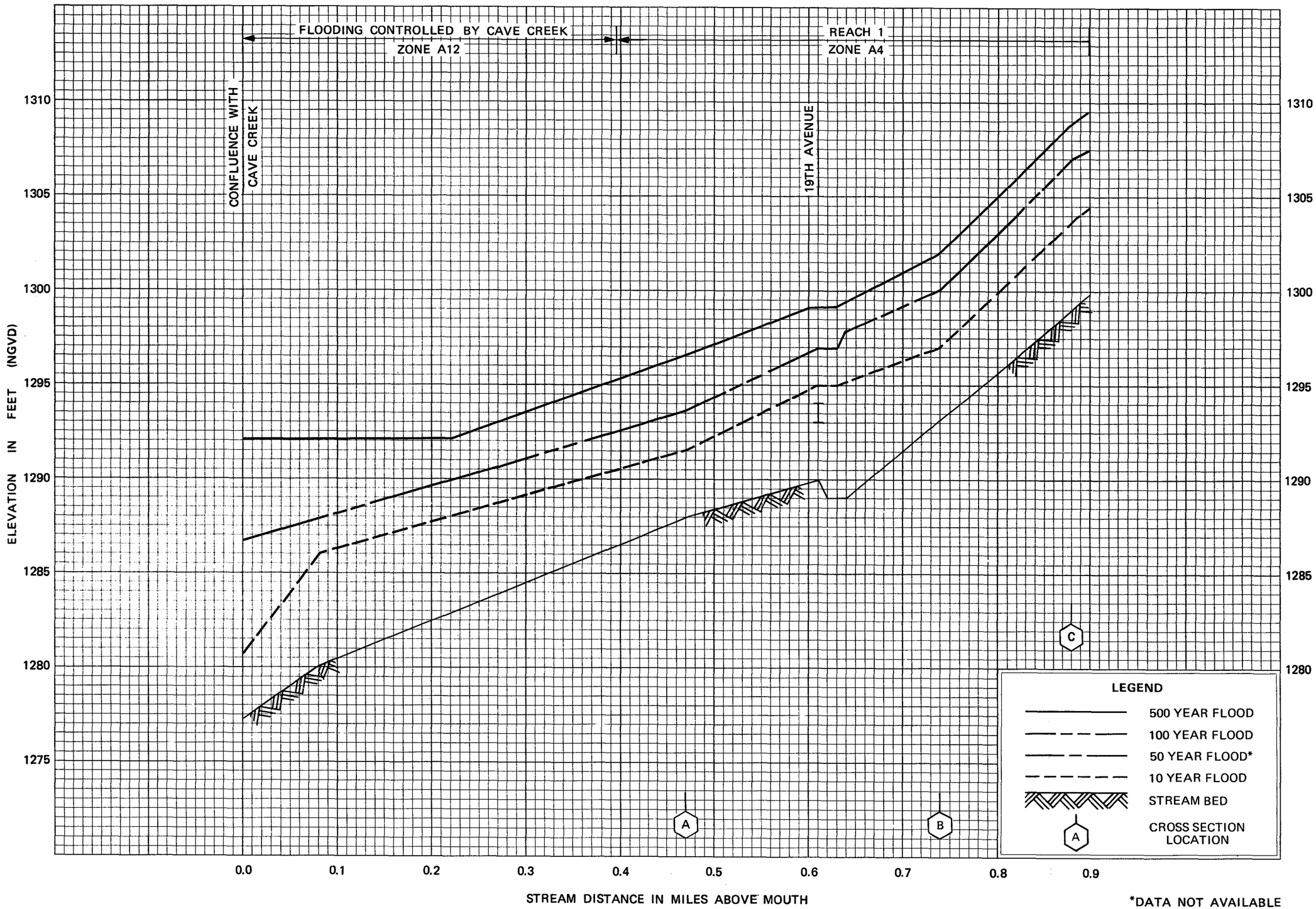
FLOOD PROFILES

ECHO CANYON WASH

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

30P



*DATA NOT AVAILABLE

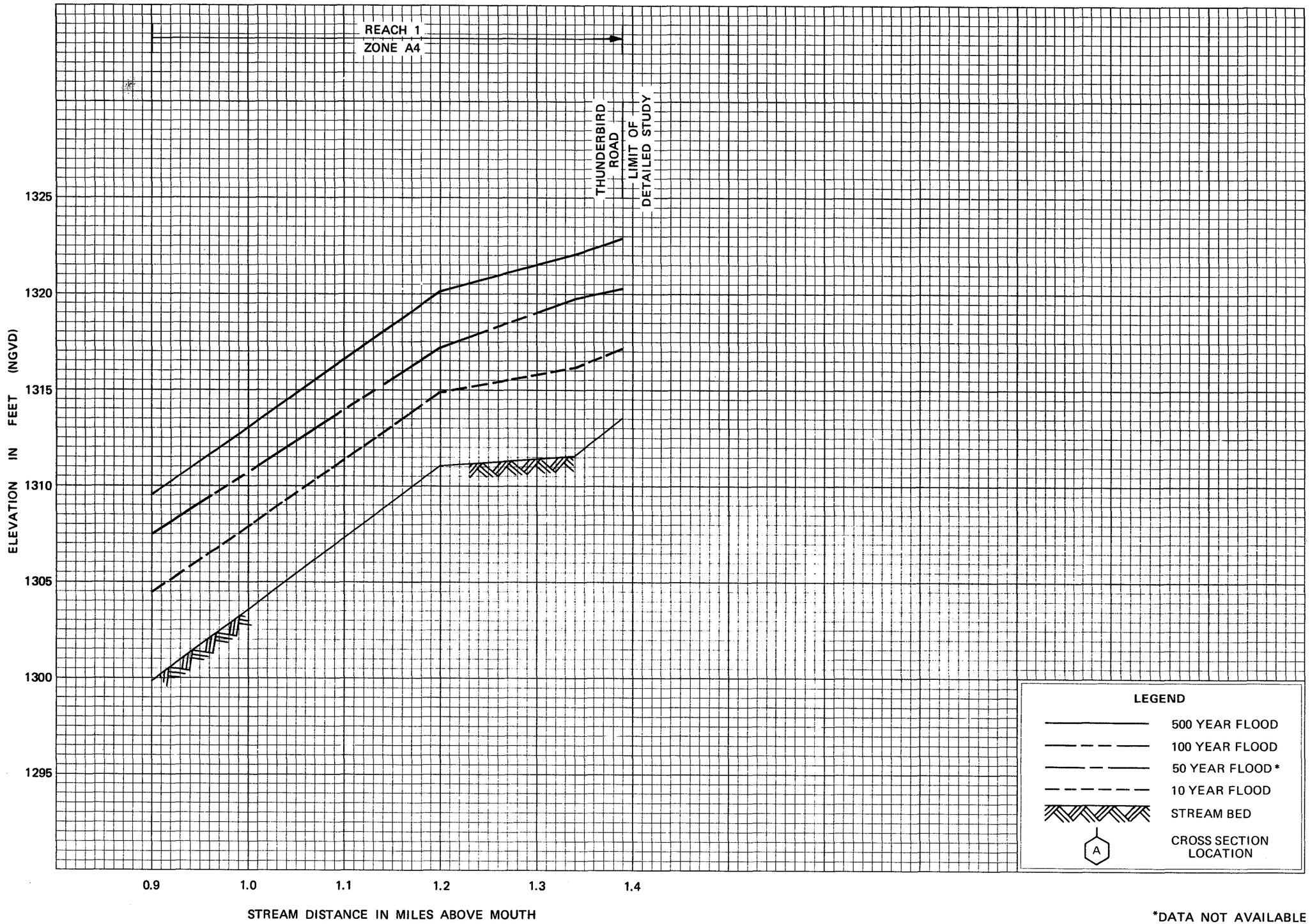
FLOOD PROFILES

MOON VALLEY WASH

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

31P



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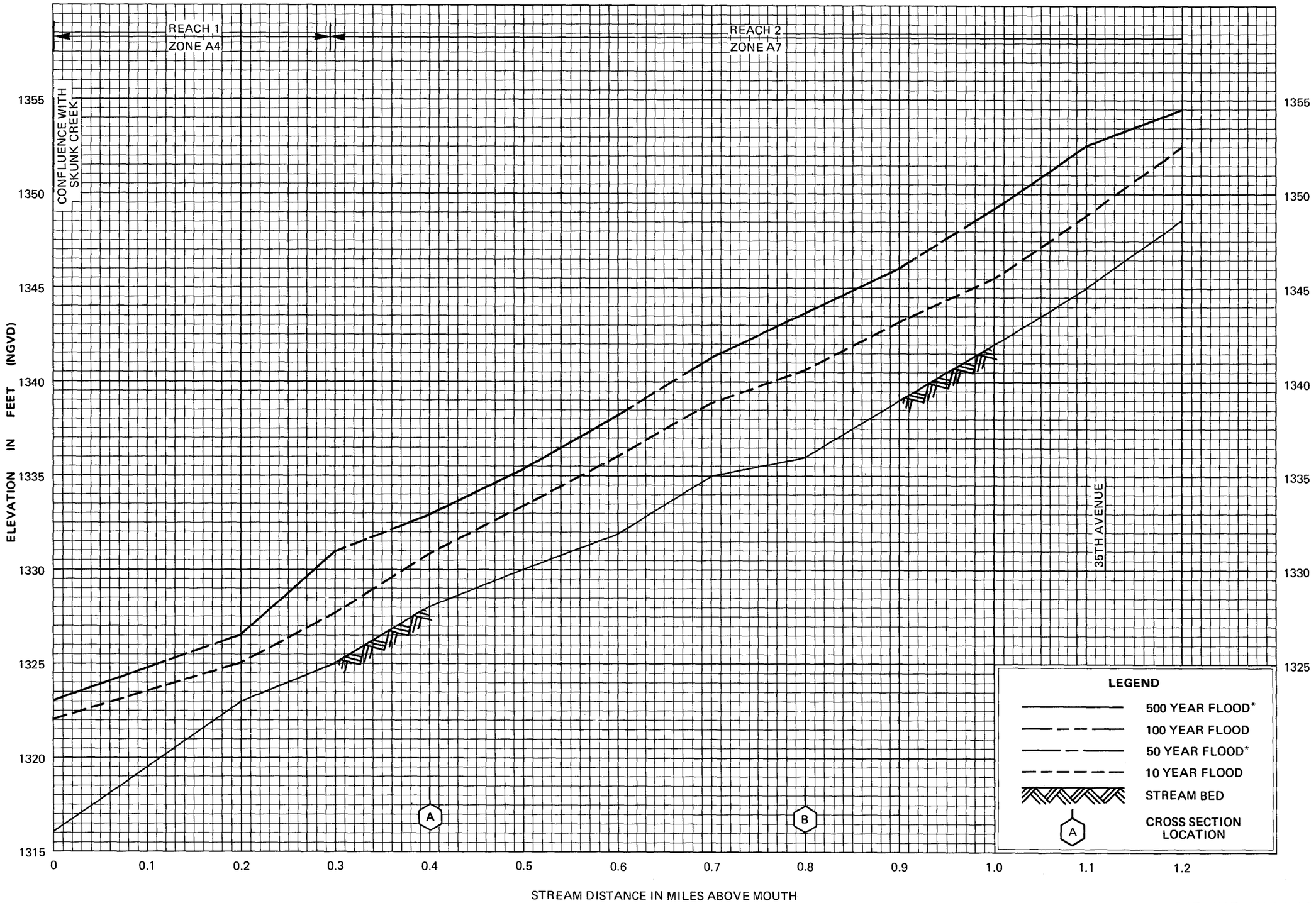
FLOOD PROFILES

MOON VALLEY WASH

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)



*DATA NOT AVAILABLE

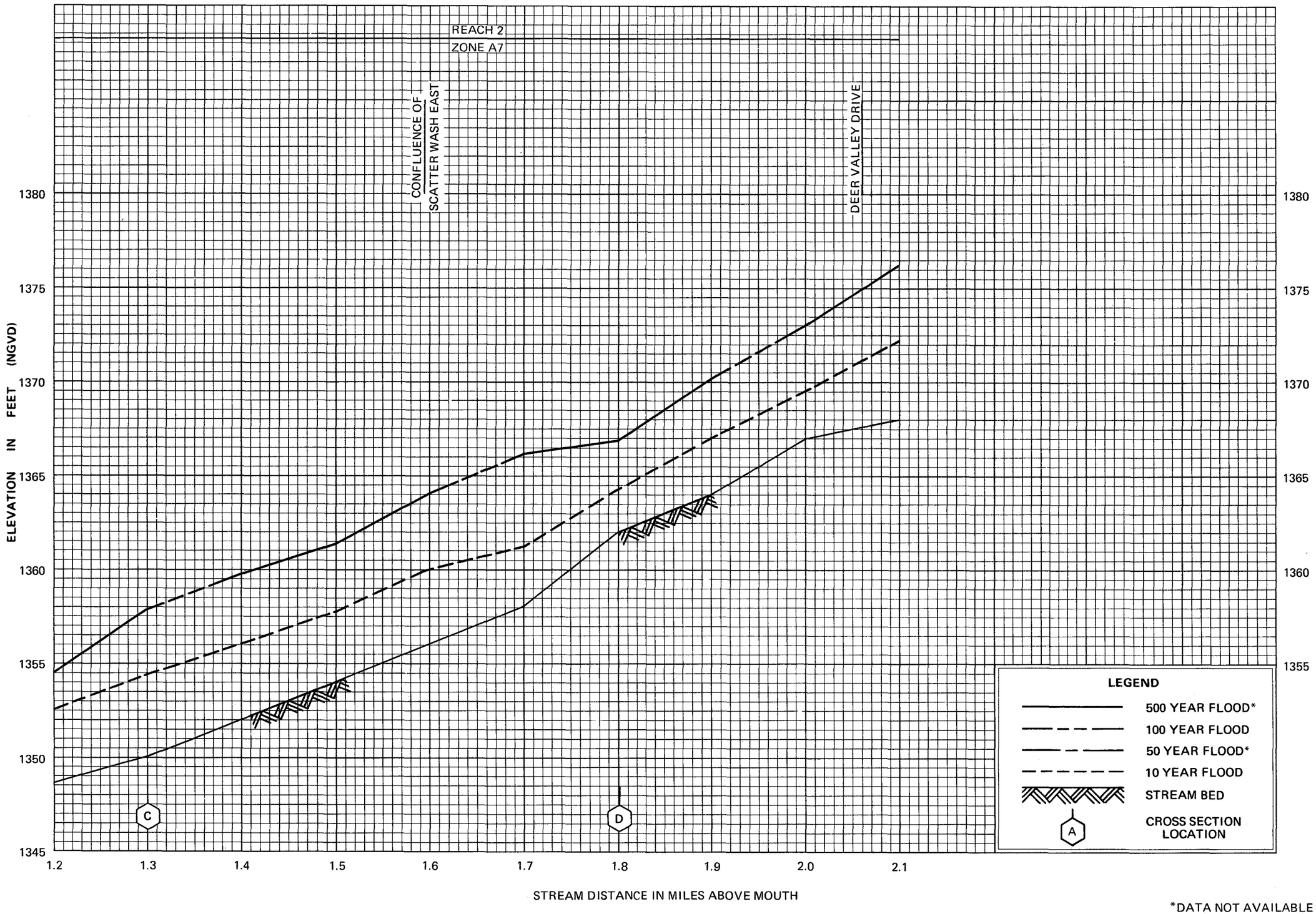
FLOOD PROFILES

SCATTER WASH

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

33P



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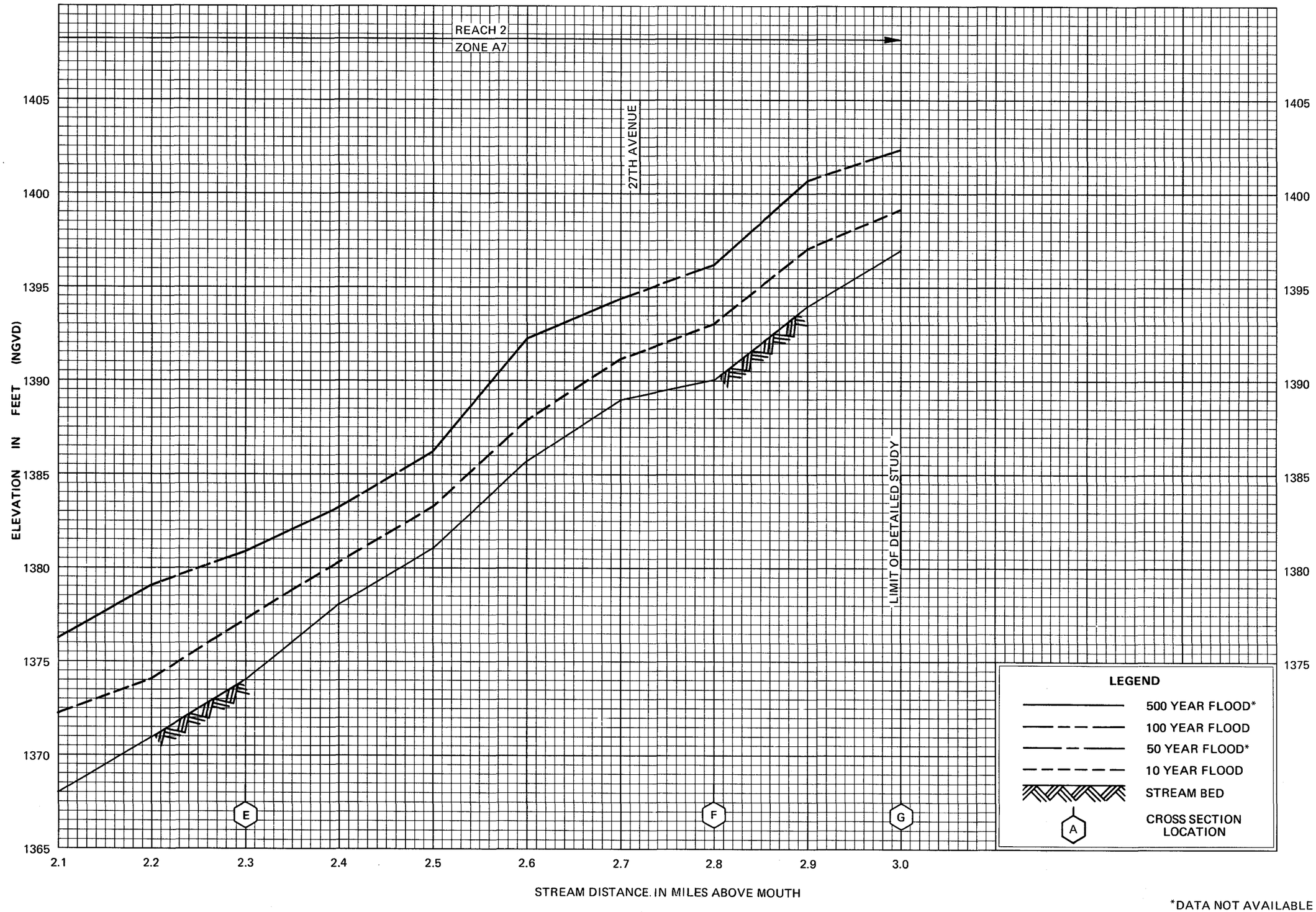
FLOOD PROFILES

SCATTER WASH

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)



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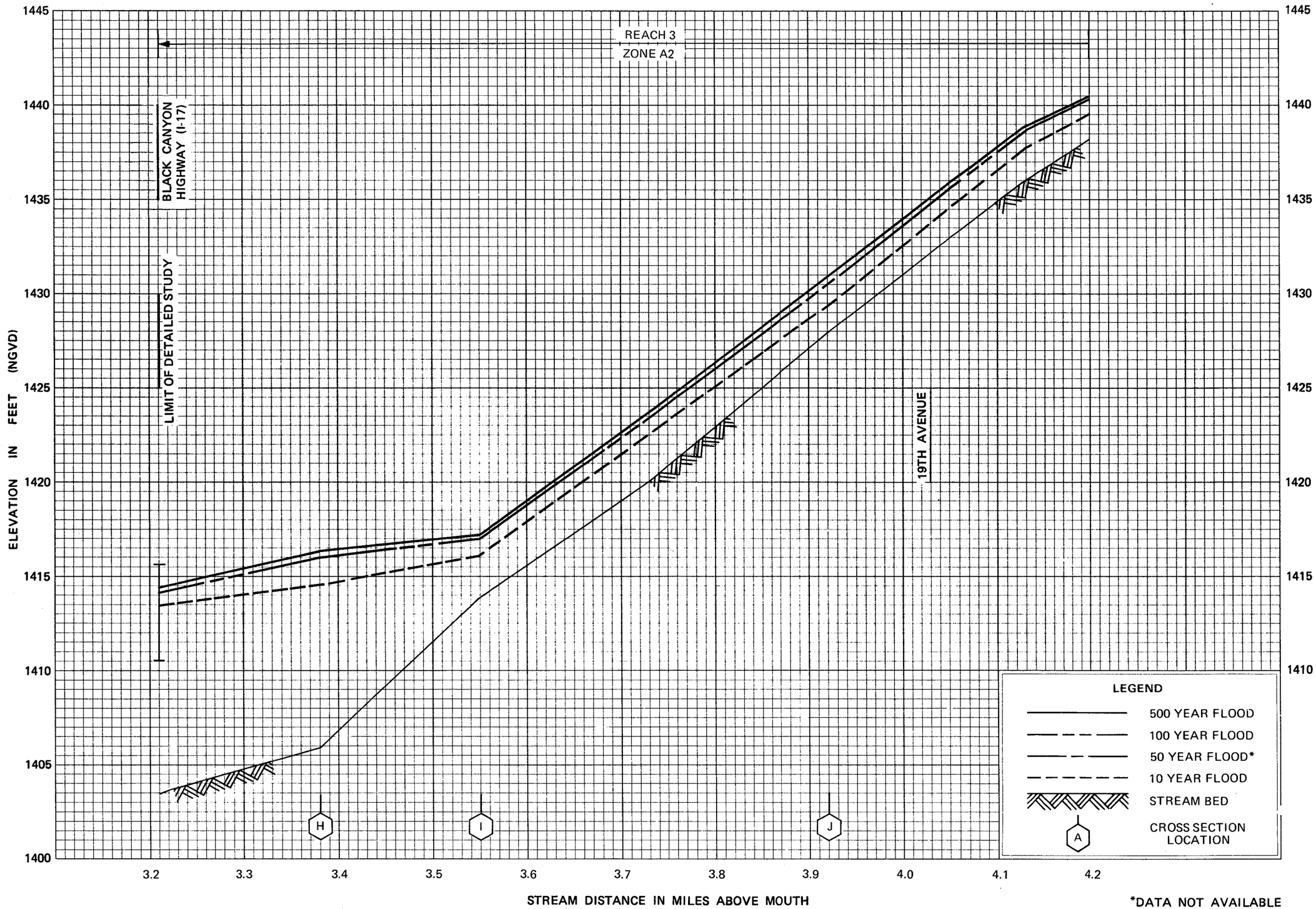
FLOOD PROFILES

SCATTER WASH

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)



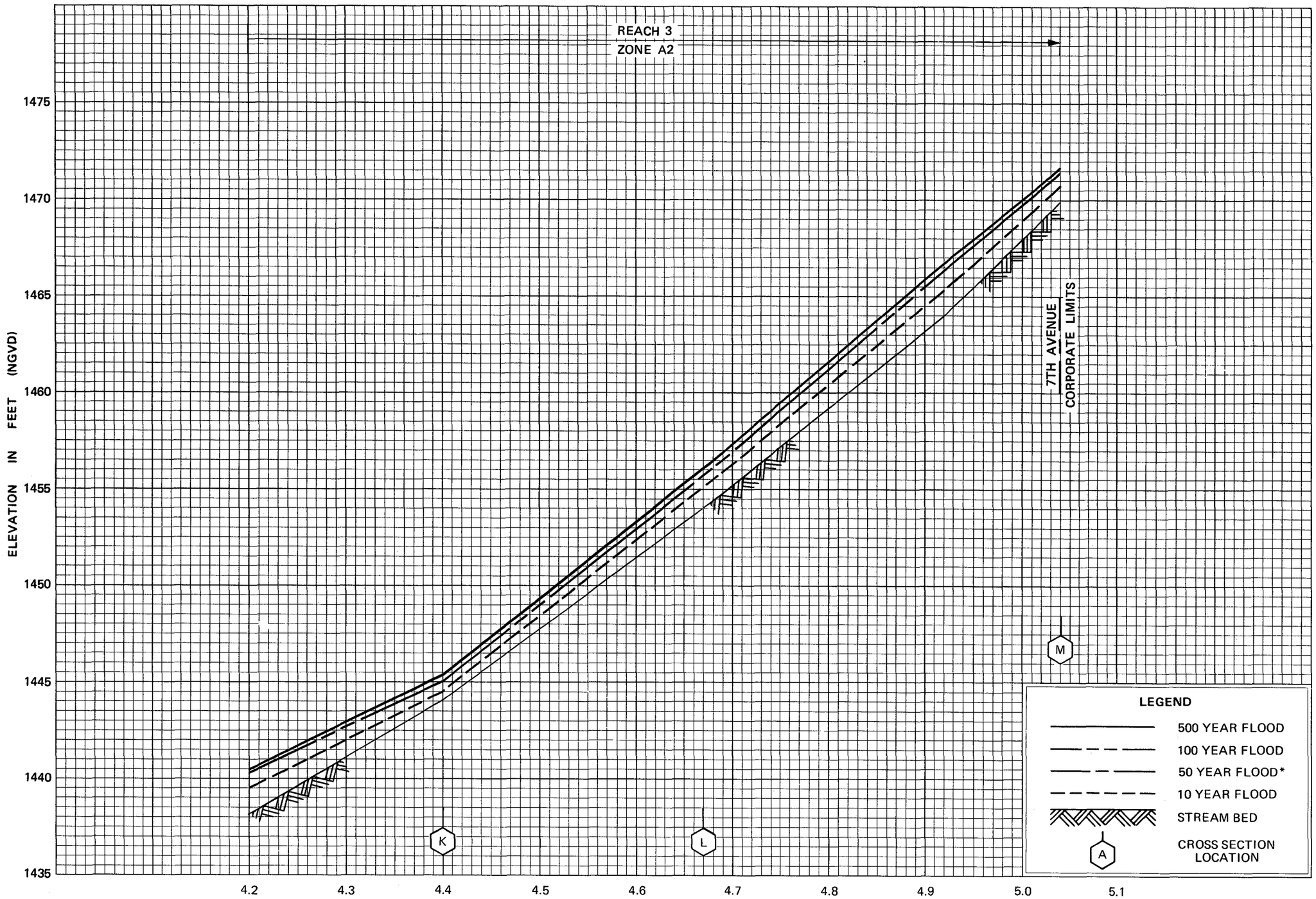
FLOOD PROFILES

SCATTER WASH

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

36P



*DATA NOT AVAILABLE

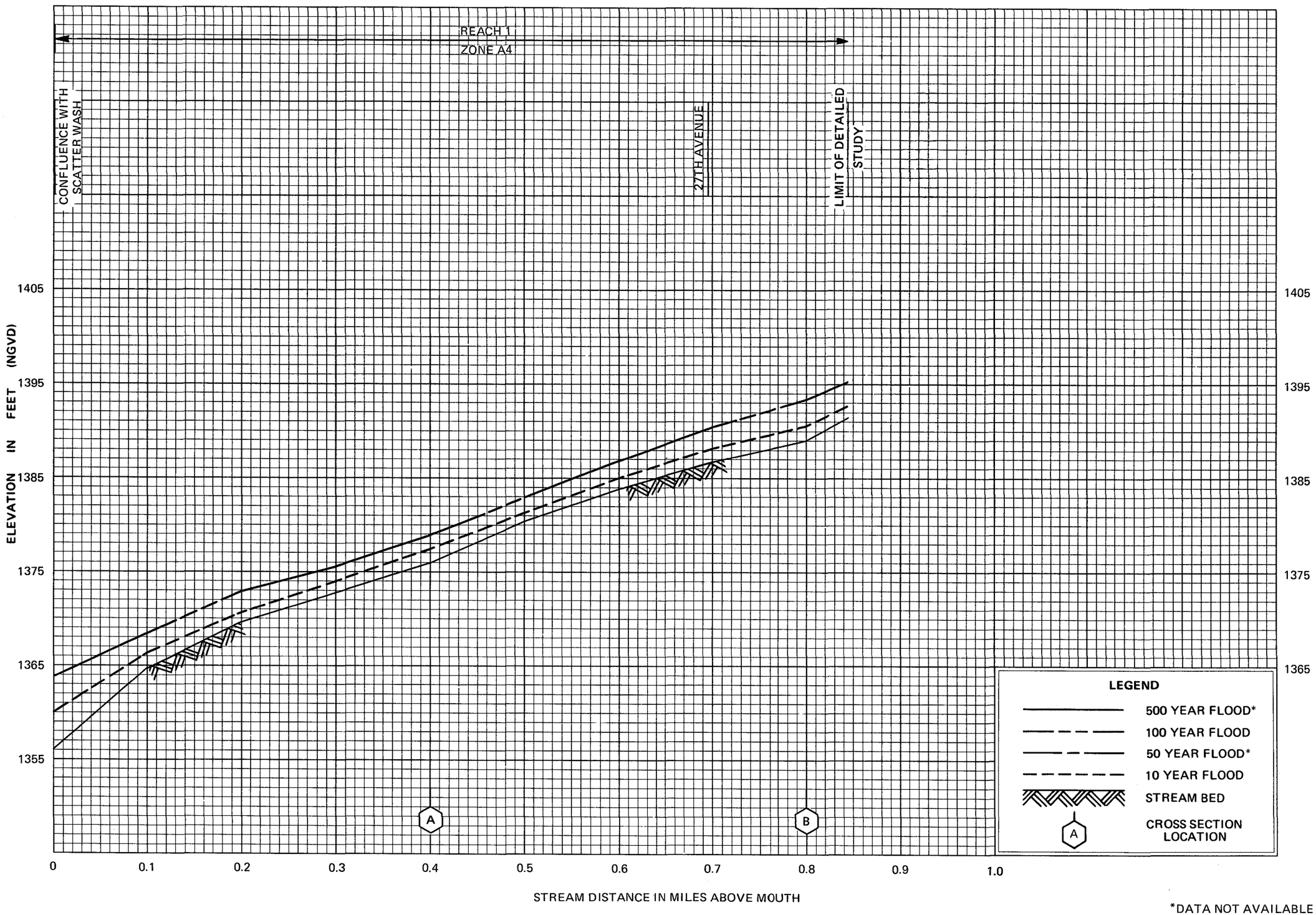
FLOOD PROFILES

SCATTER WASH

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

37P



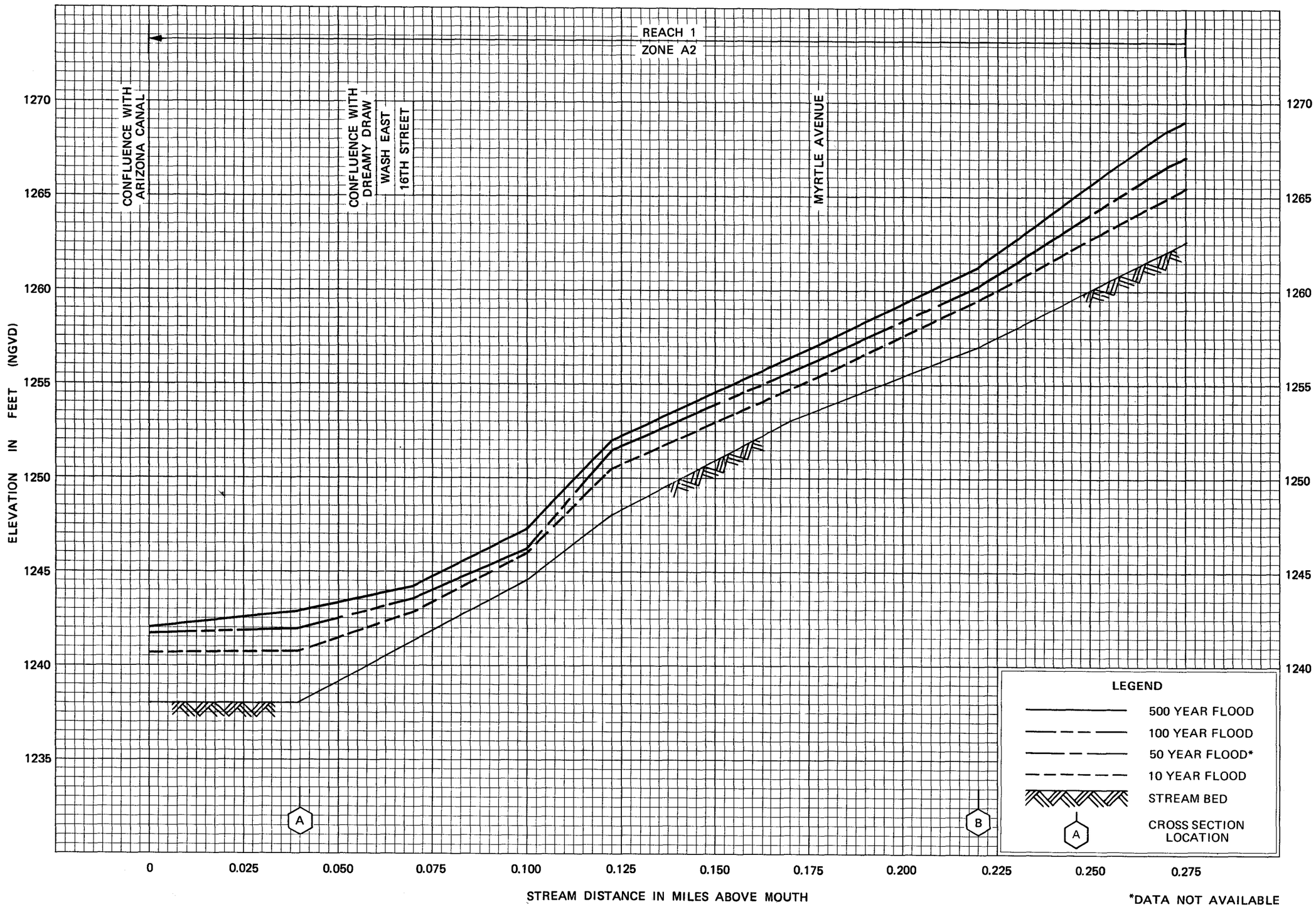
*DATA NOT AVAILABLE

FLOOD PROFILES

EAST BRANCH SCATTER WASH

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

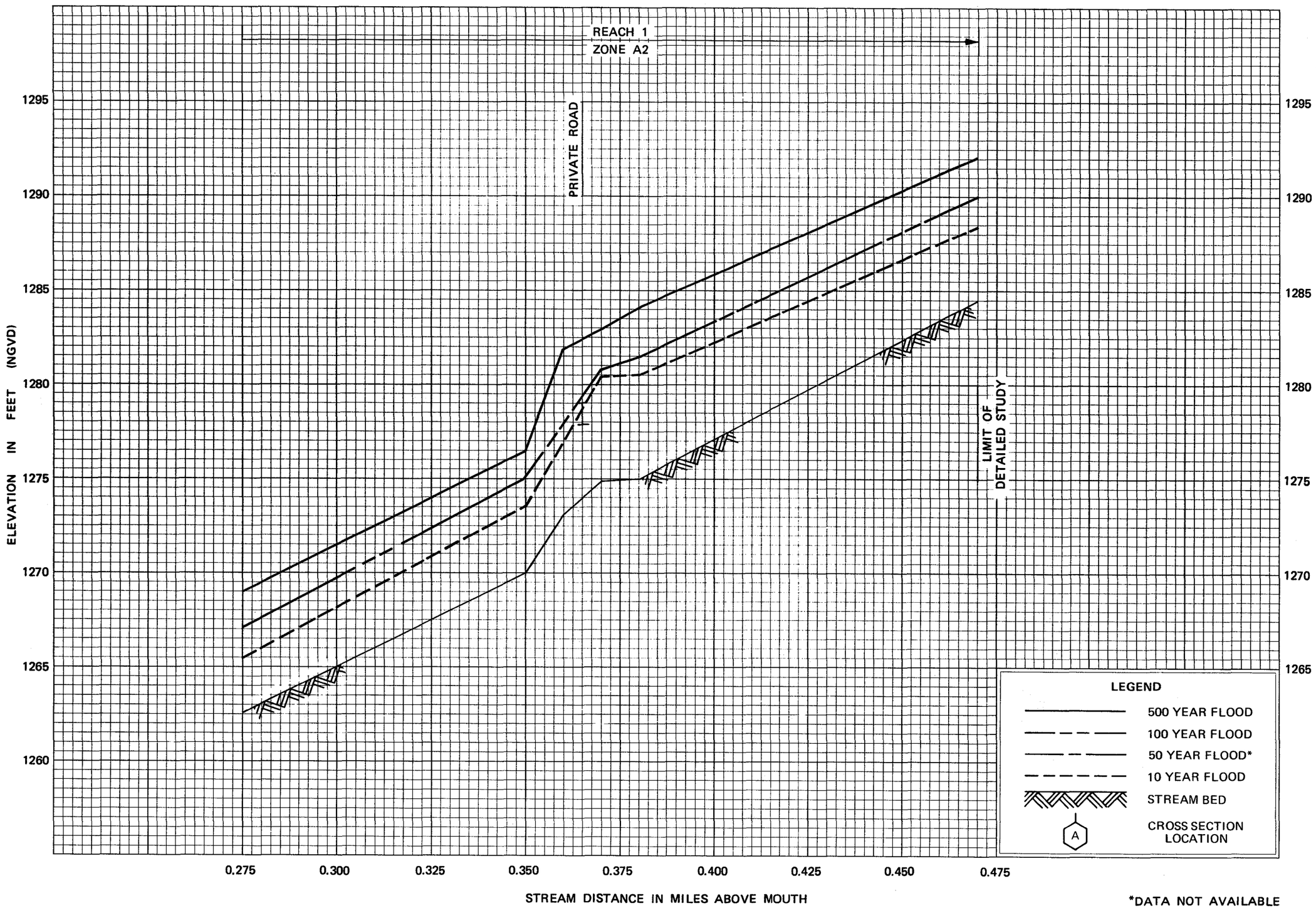


FLOOD PROFILES

MYRTLE AVENUE WASH

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

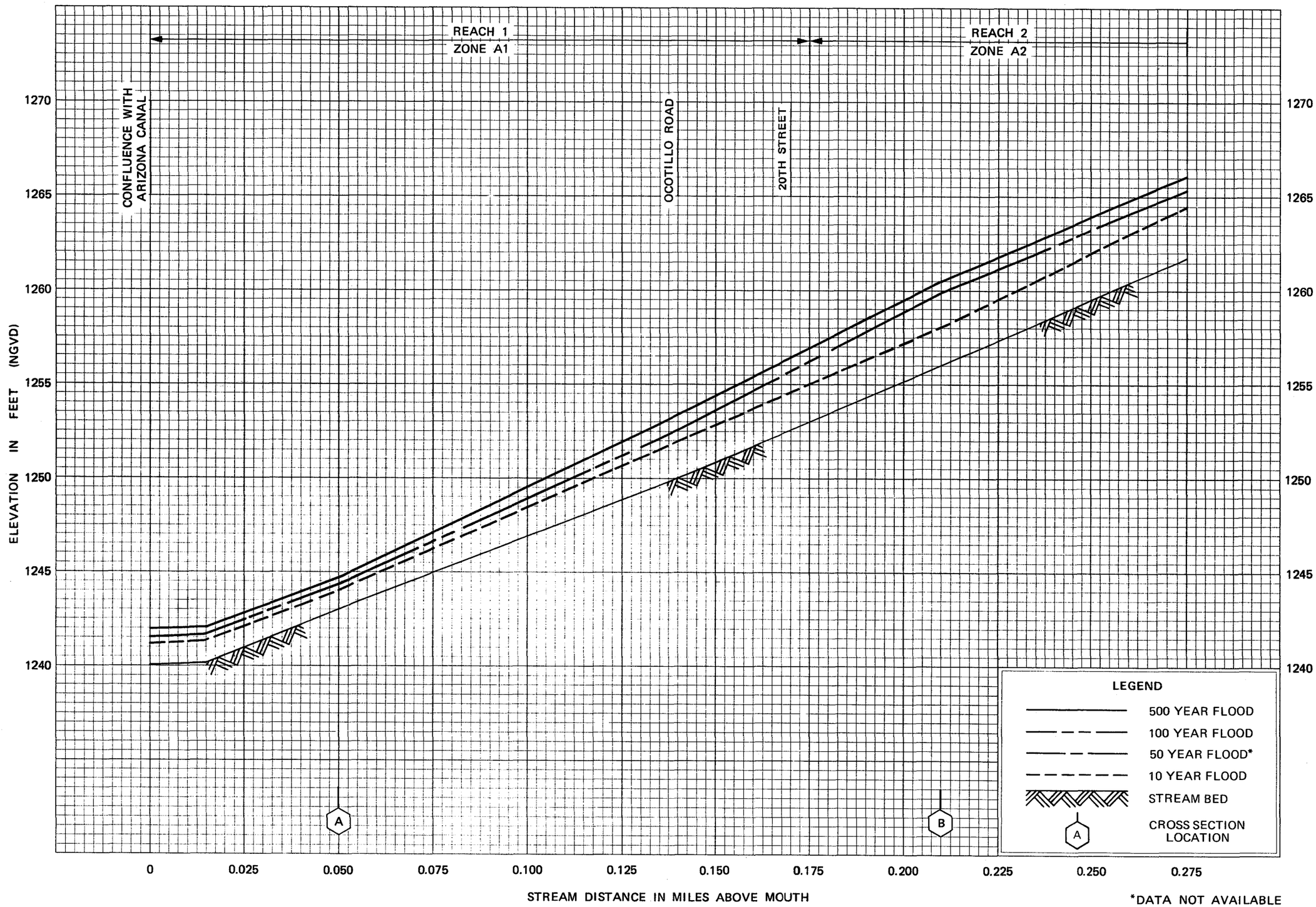


FLOOD PROFILES

MYRTLE AVENUE WASH

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)



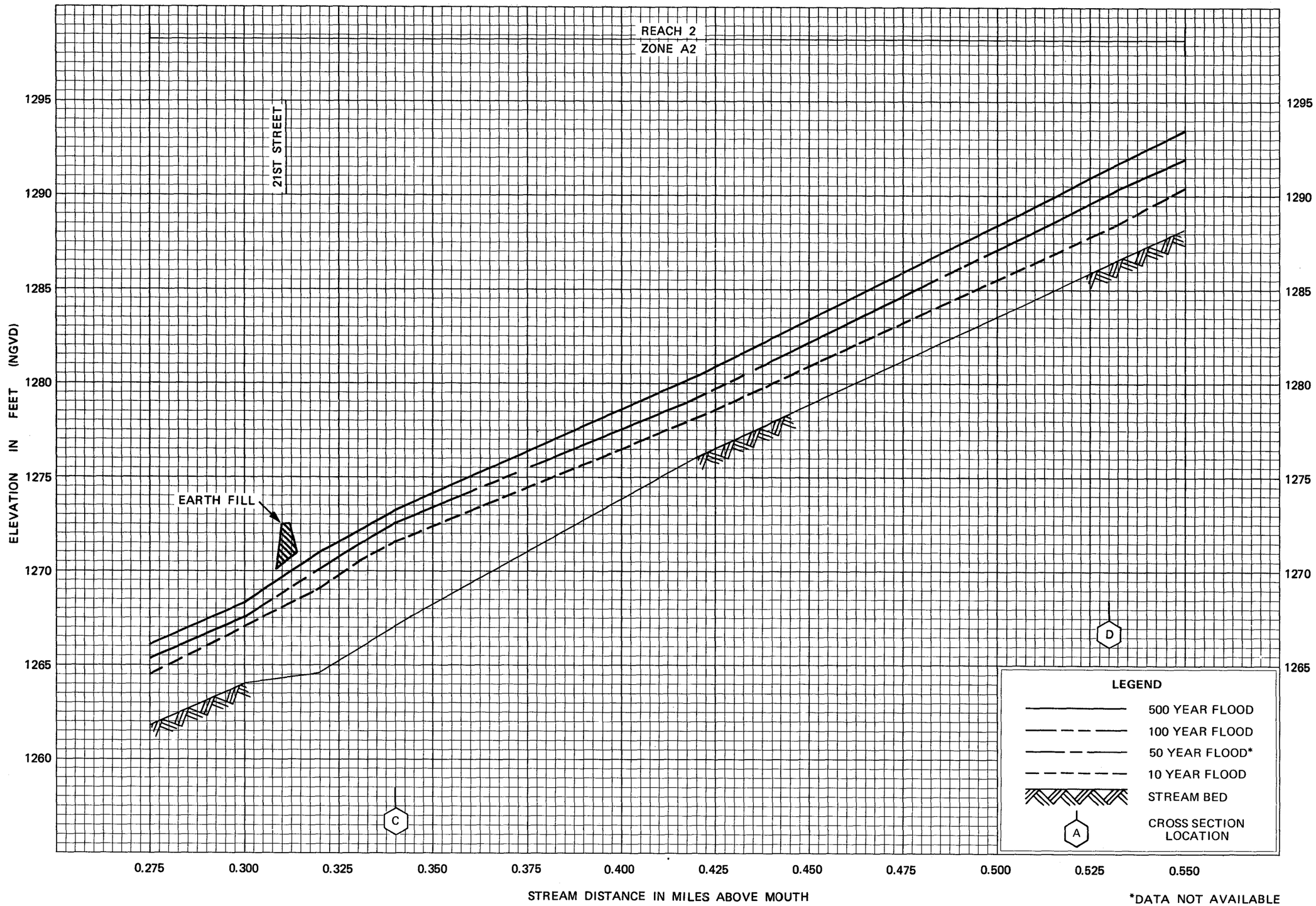
FLOOD PROFILES

FLYNN LANE WASH

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

41P



*DATA NOT AVAILABLE

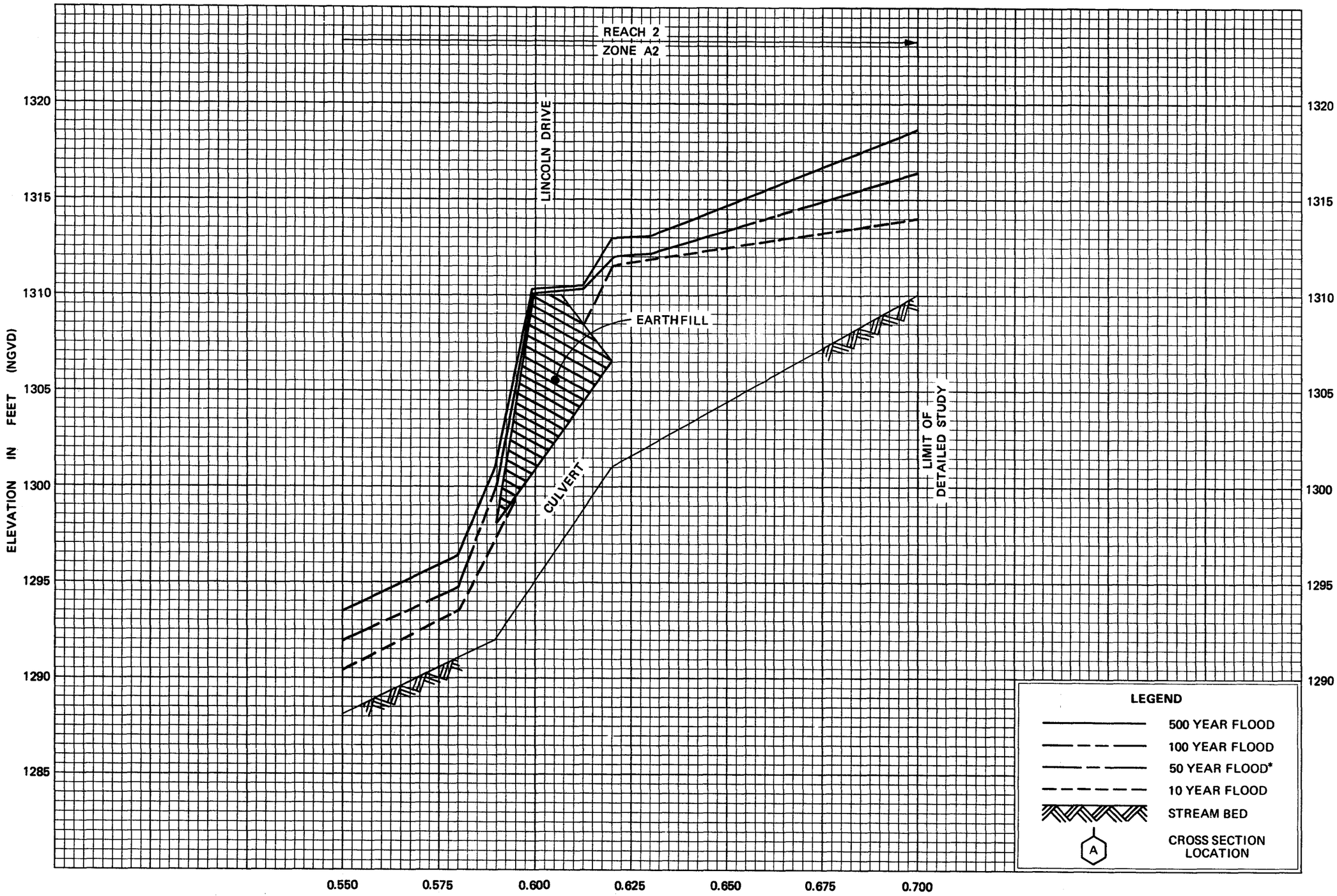
FLOOD PROFILES

FLYNN LANE WASH

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

42P



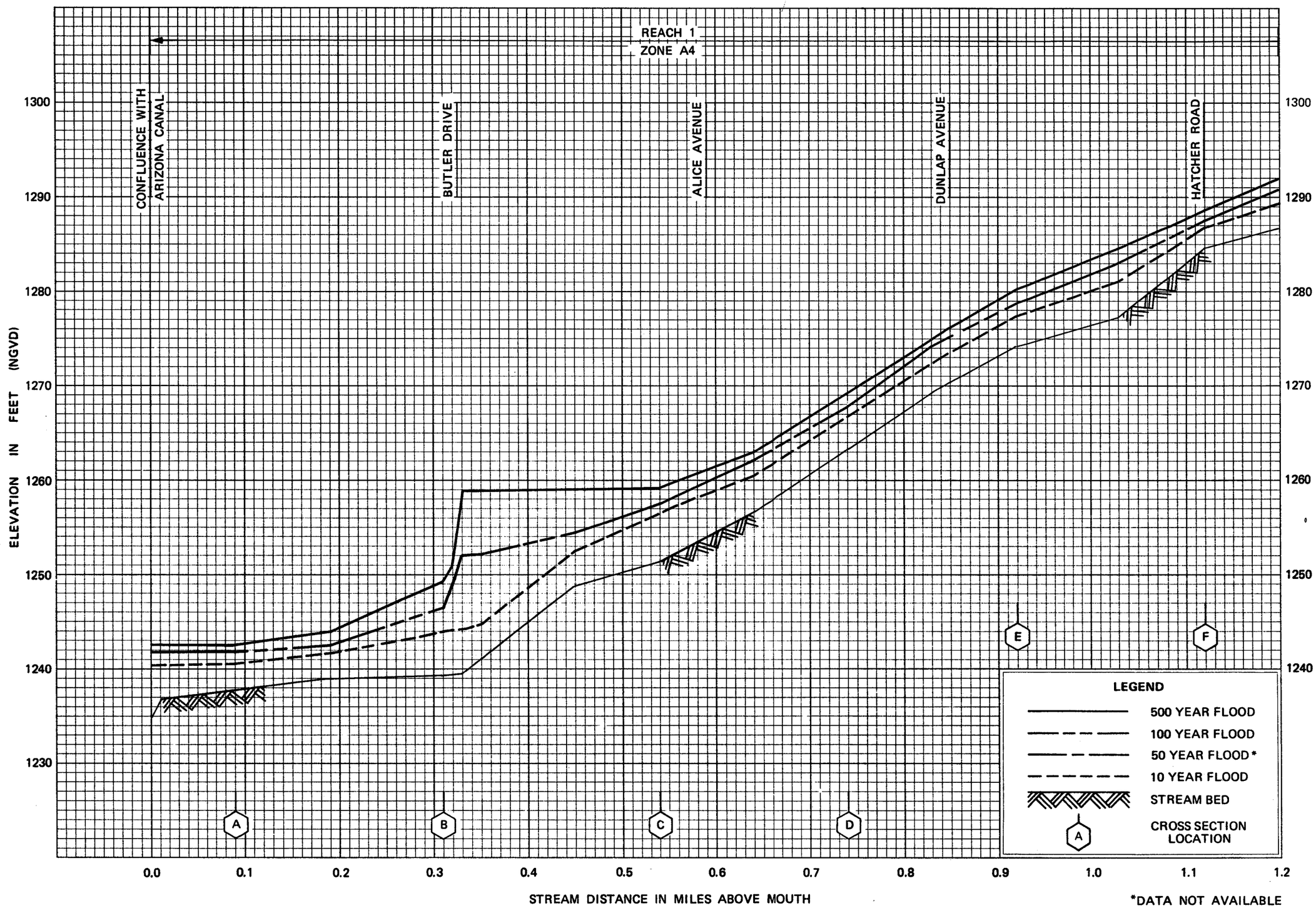
FLOOD PROFILES

FLYNN LANE WASH

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

43P

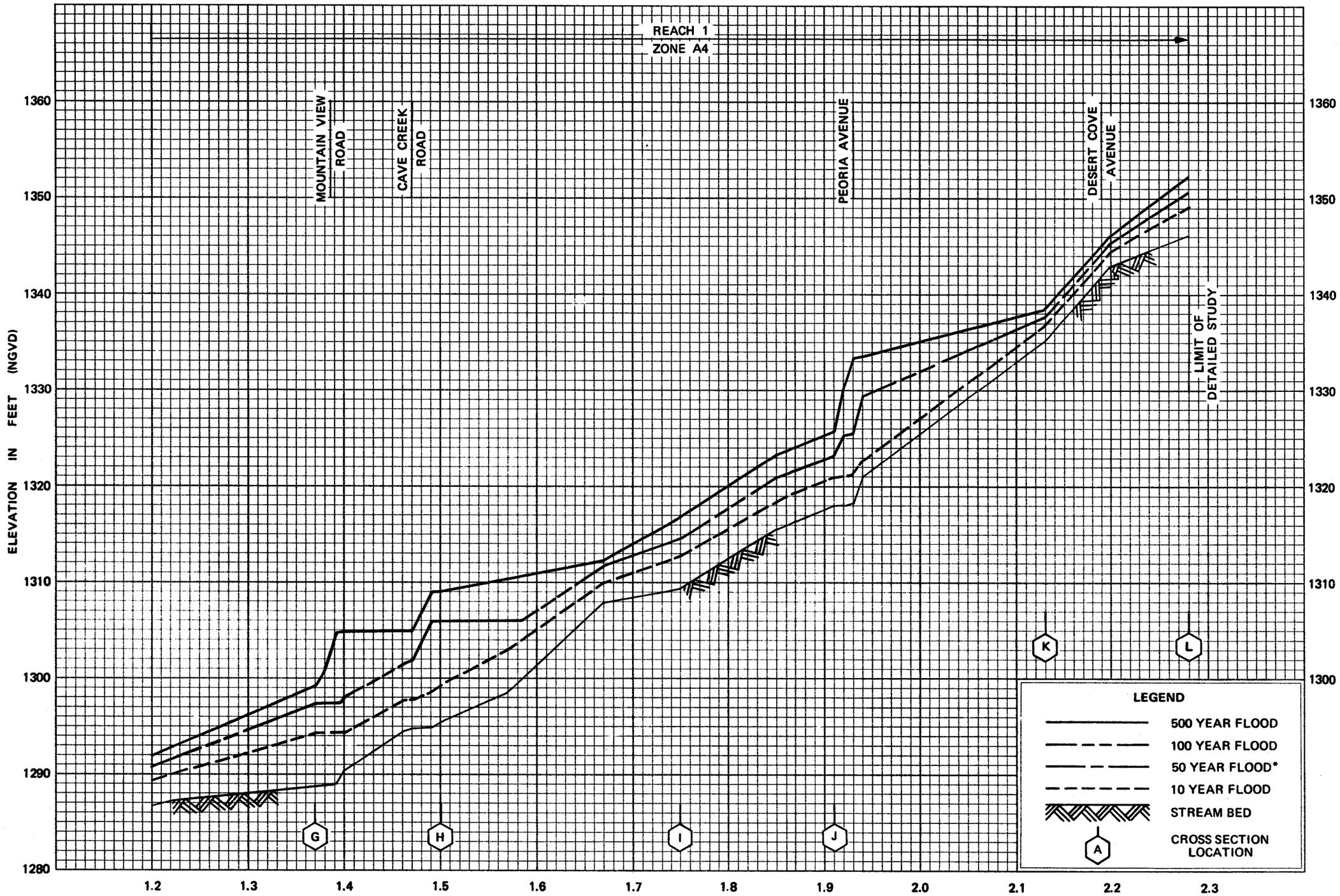


FLOOD PROFILES

TENTH STREET WASH

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

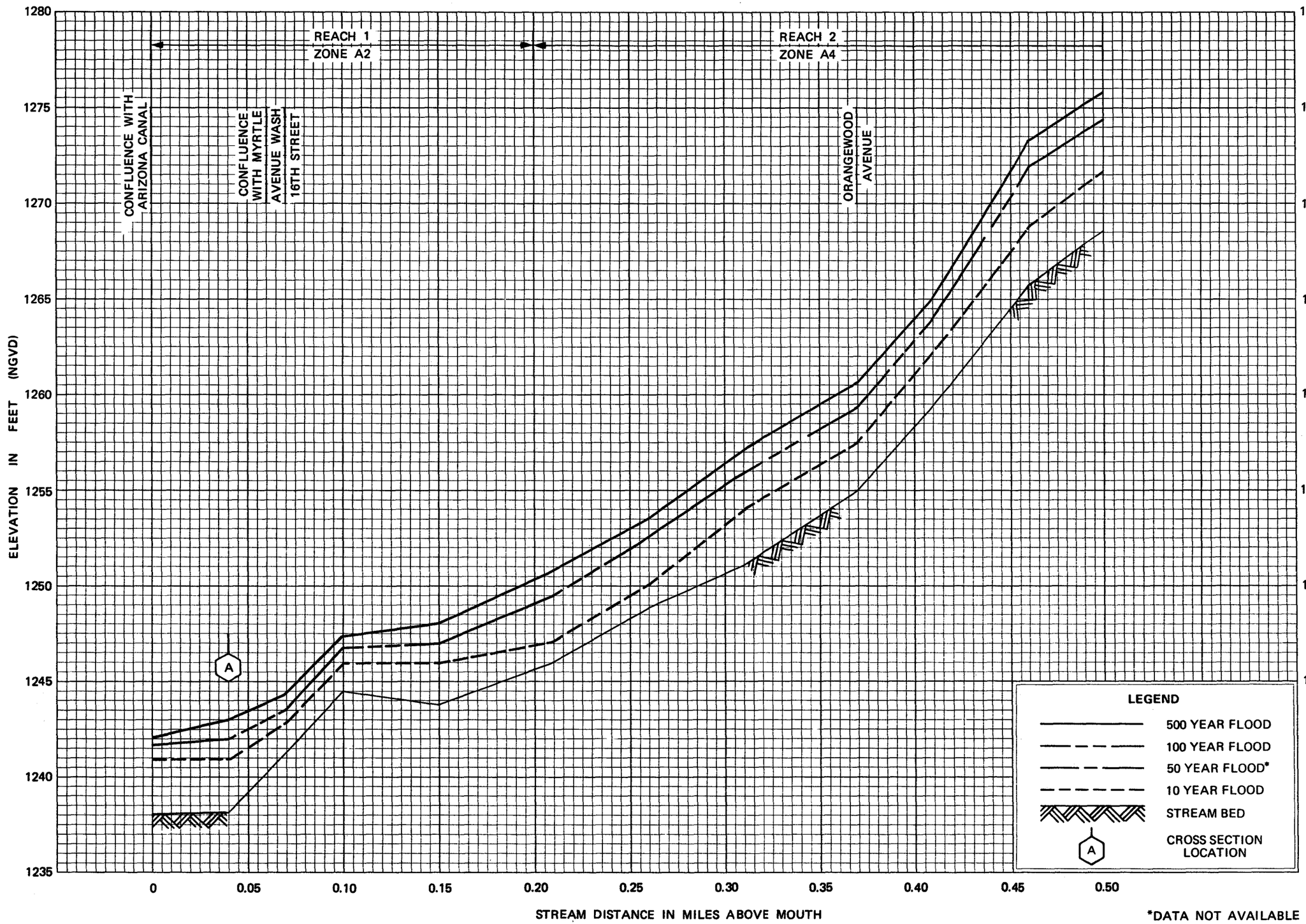


FLOOD PROFILES

TENTH STREET WASH

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

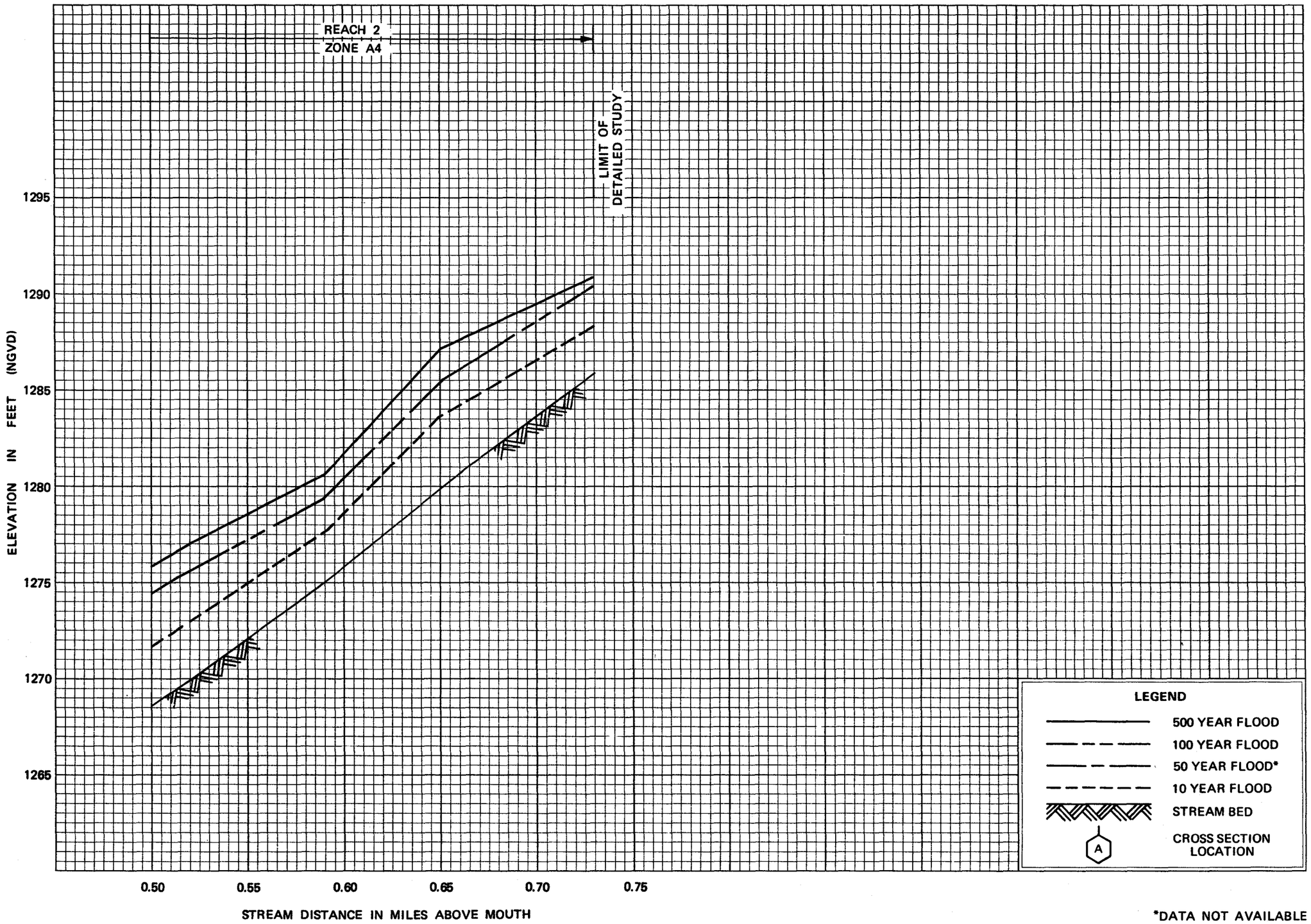


FLOOD PROFILES

DREAMY DRAW WASH EAST

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)



*DATA NOT AVAILABLE

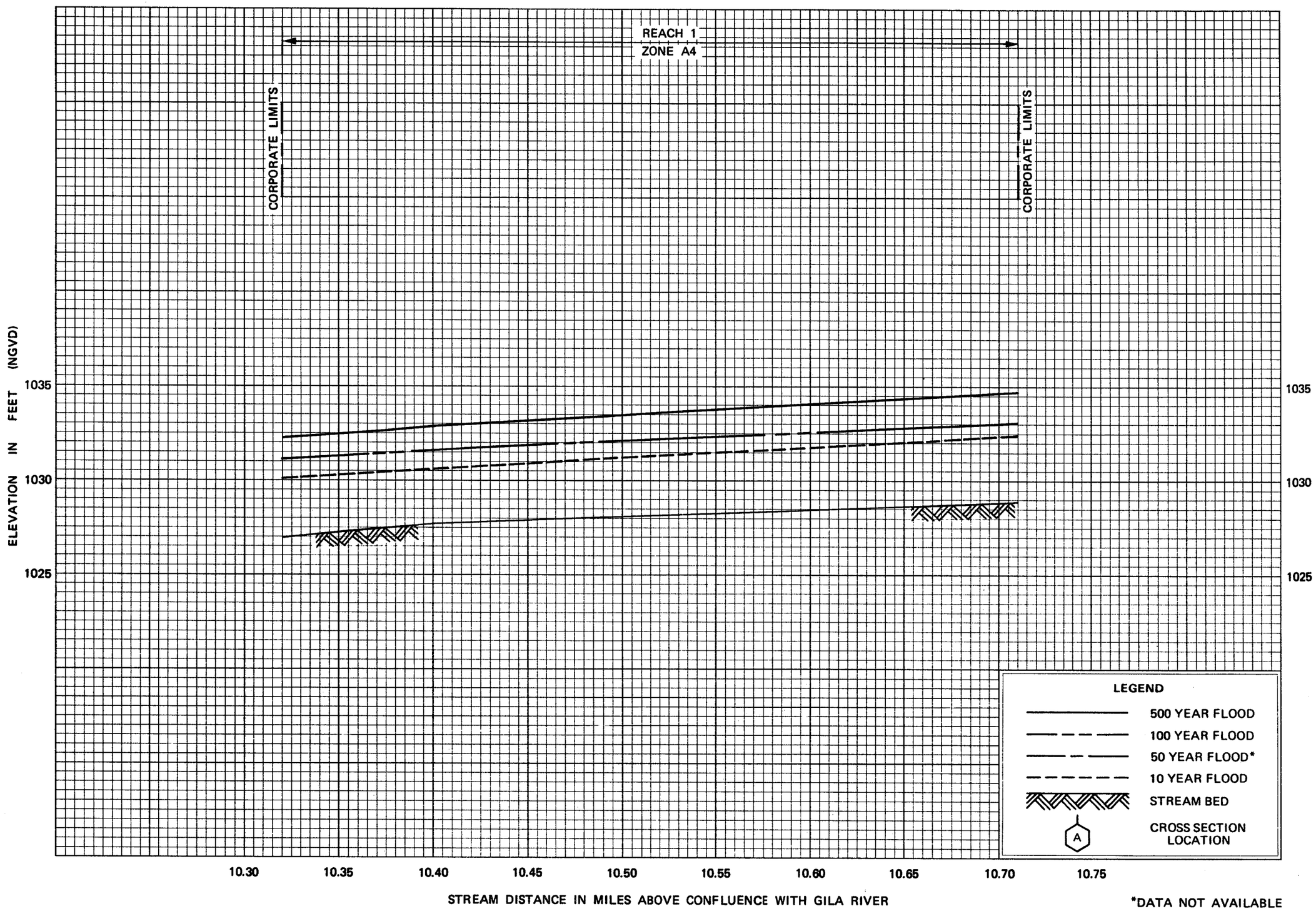
FLOOD PROFILES

DREAMY DRAW WASH EAST

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

47P

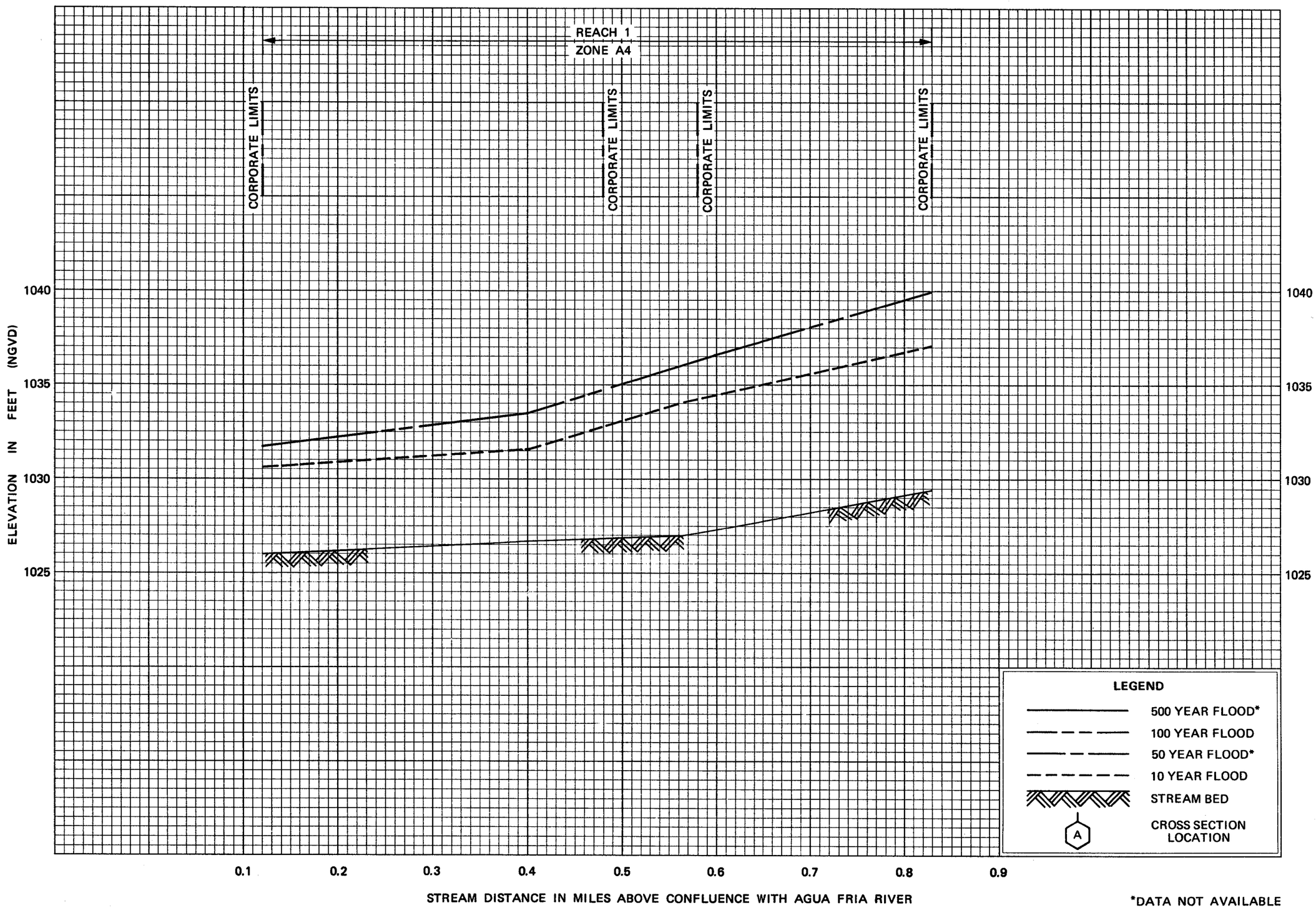


FLOOD PROFILES

AGUA FRIA RIVER

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)



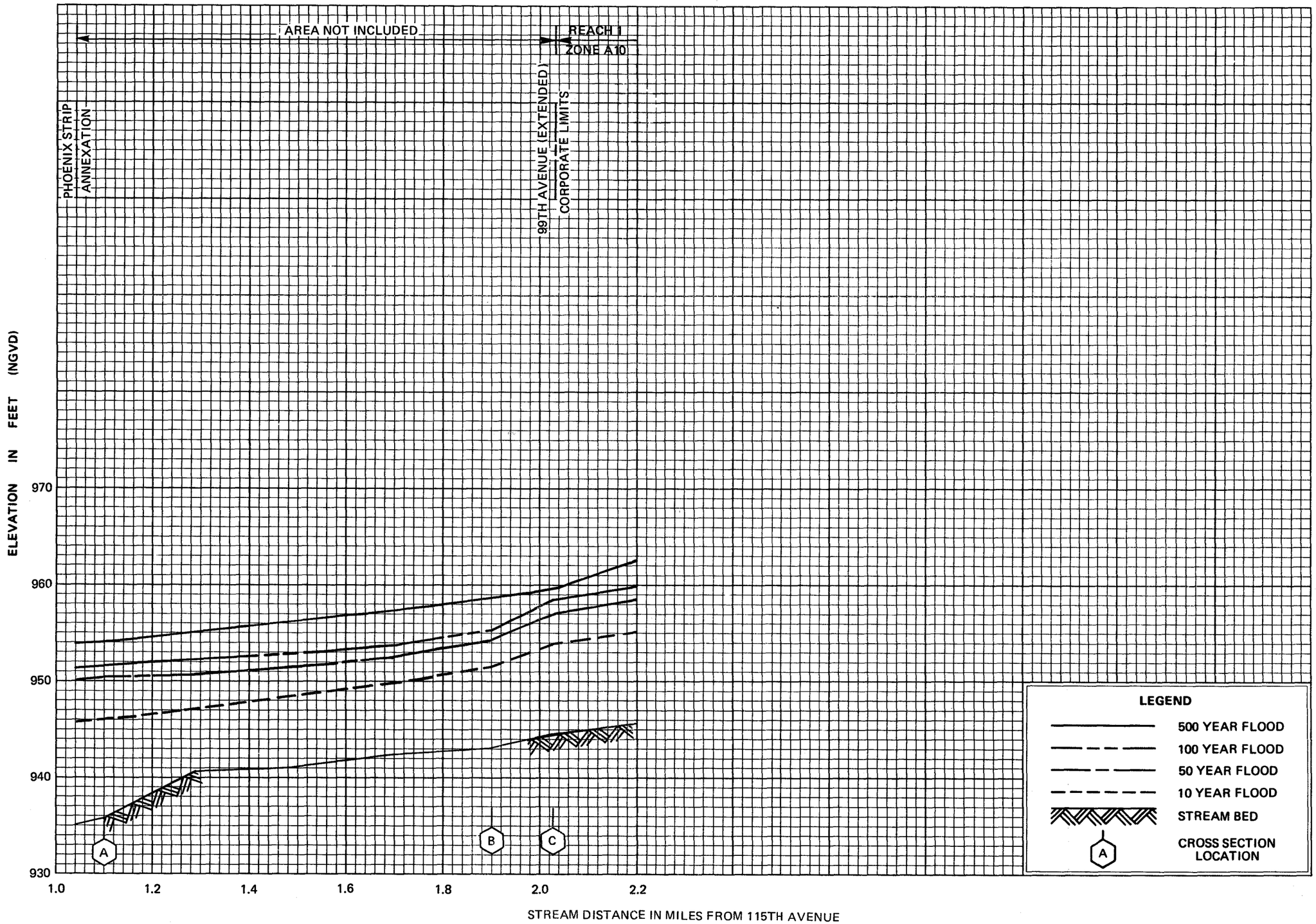
*DATA NOT AVAILABLE

FLOOD PROFILES

NEW RIVER

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)



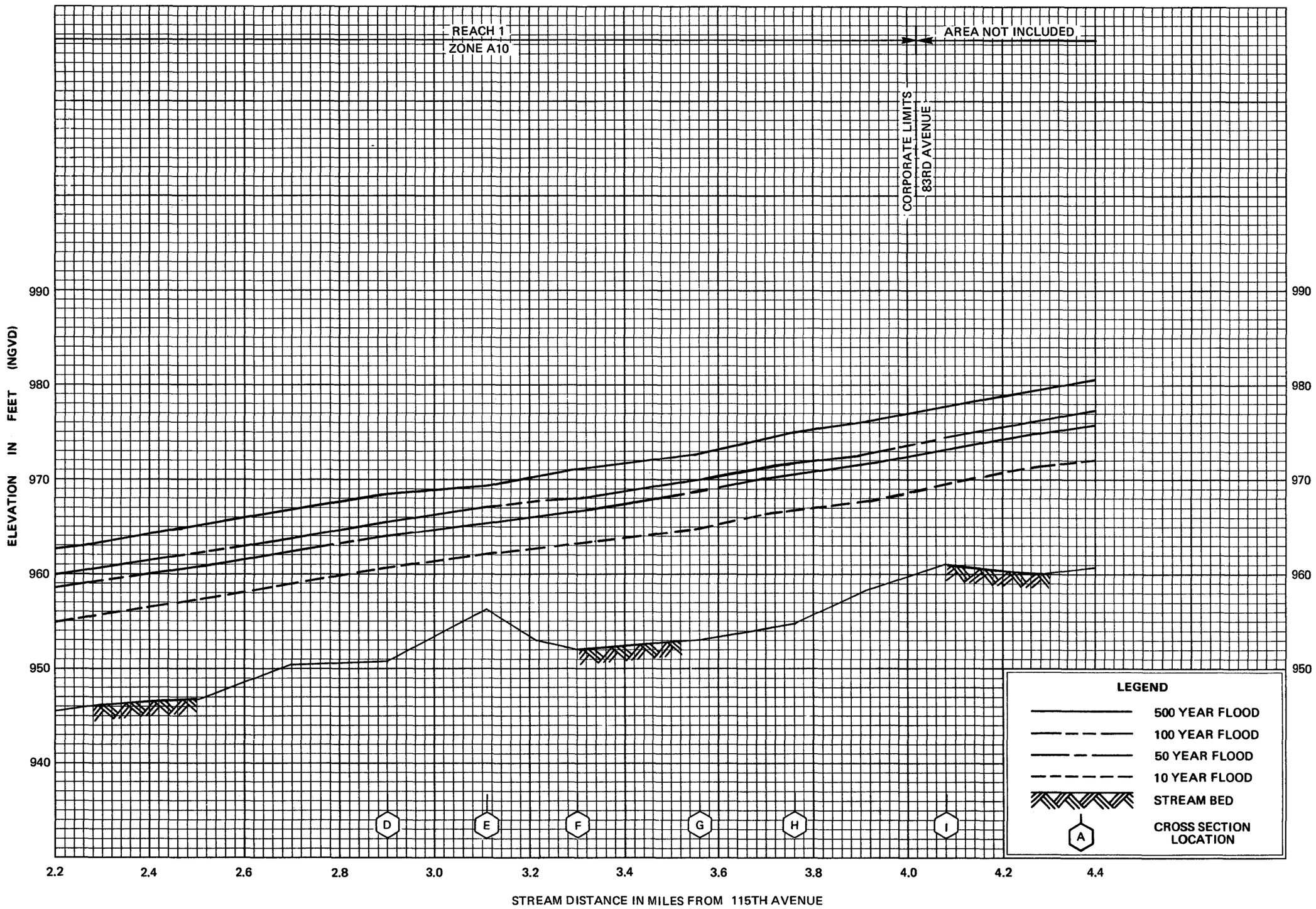
FLOOD PROFILES

SALT RIVER

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

50P



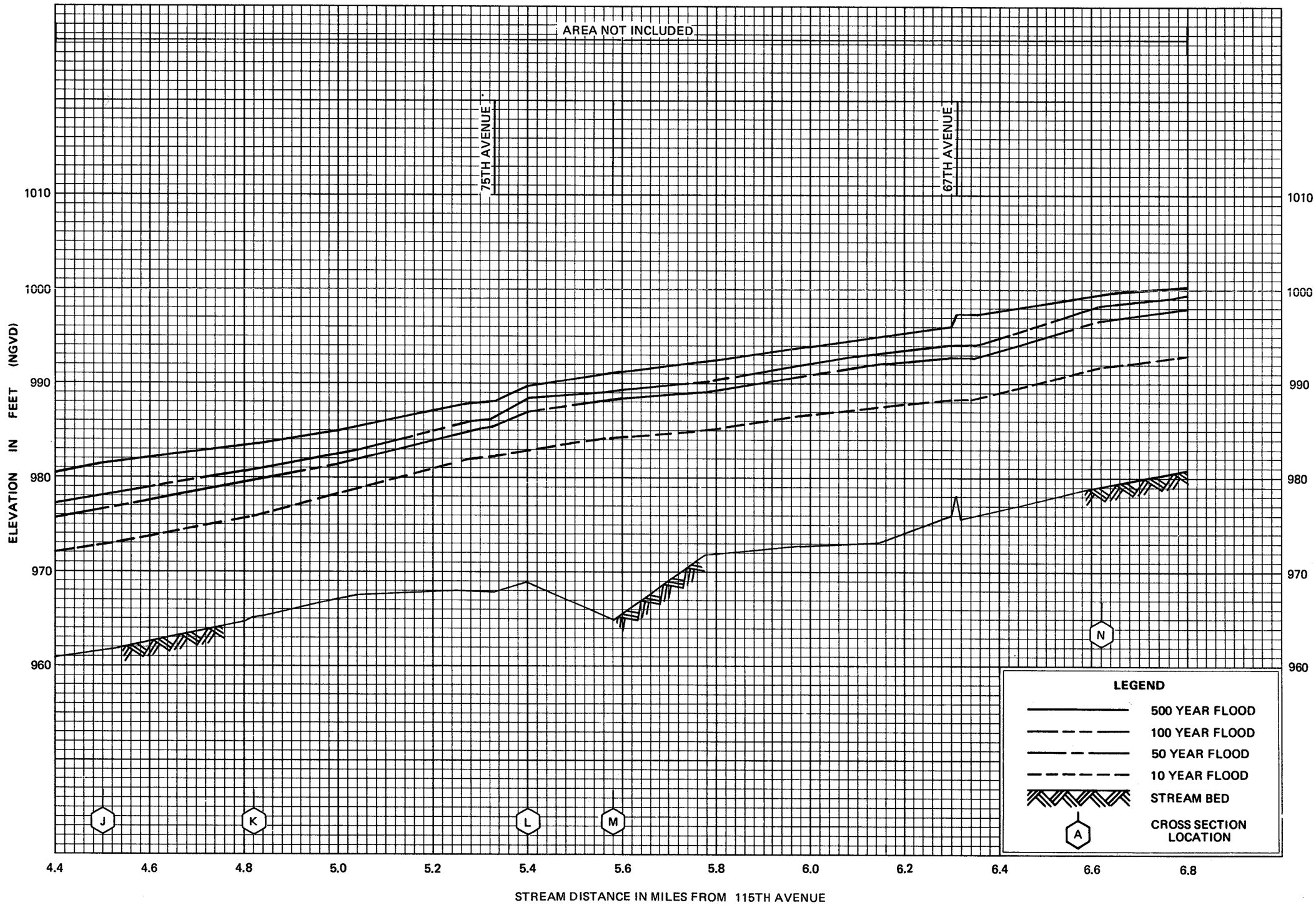
FLOOD PROFILES

SALT RIVER

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

51P



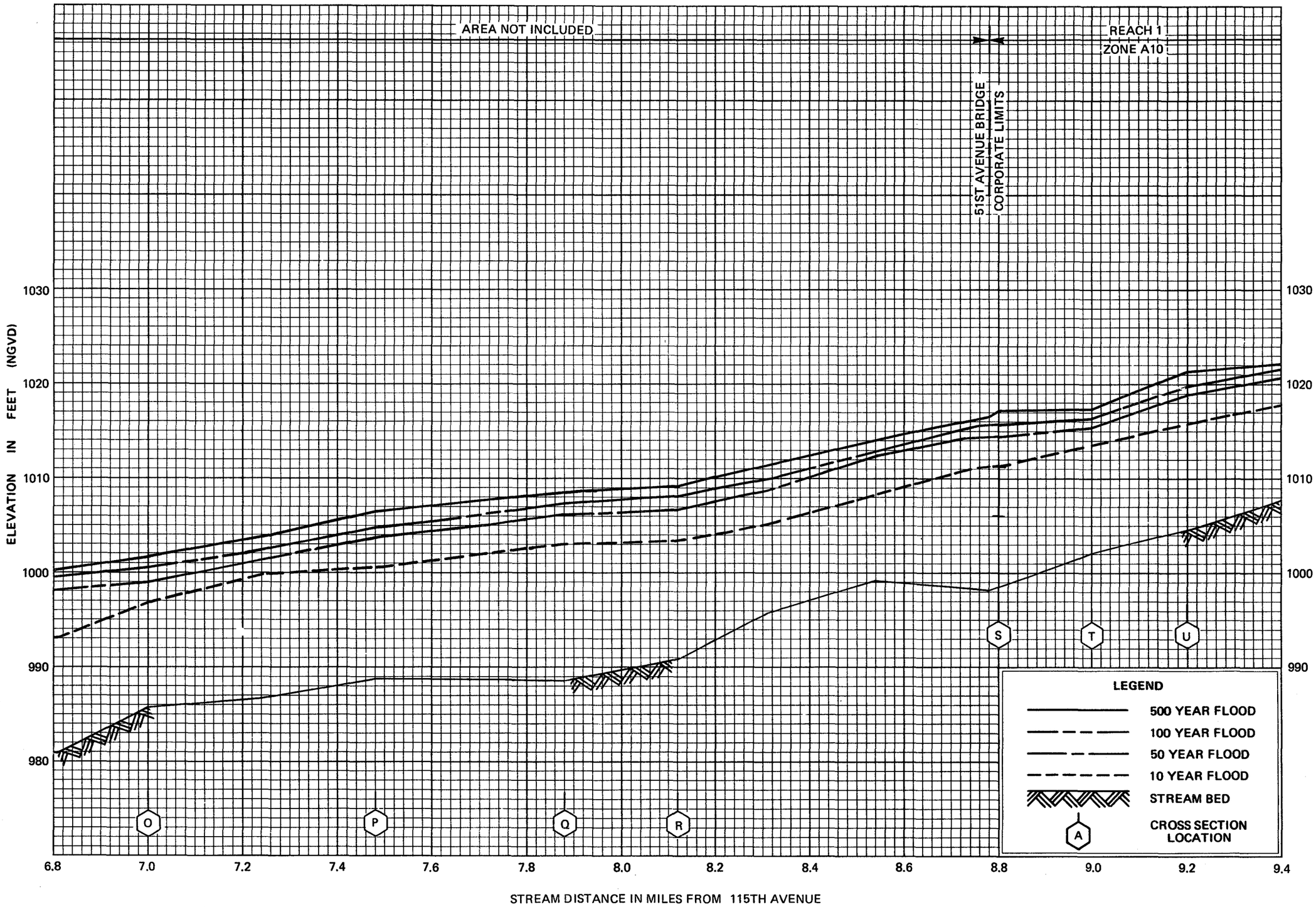
FLOOD PROFILES

SALT RIVER

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

52P

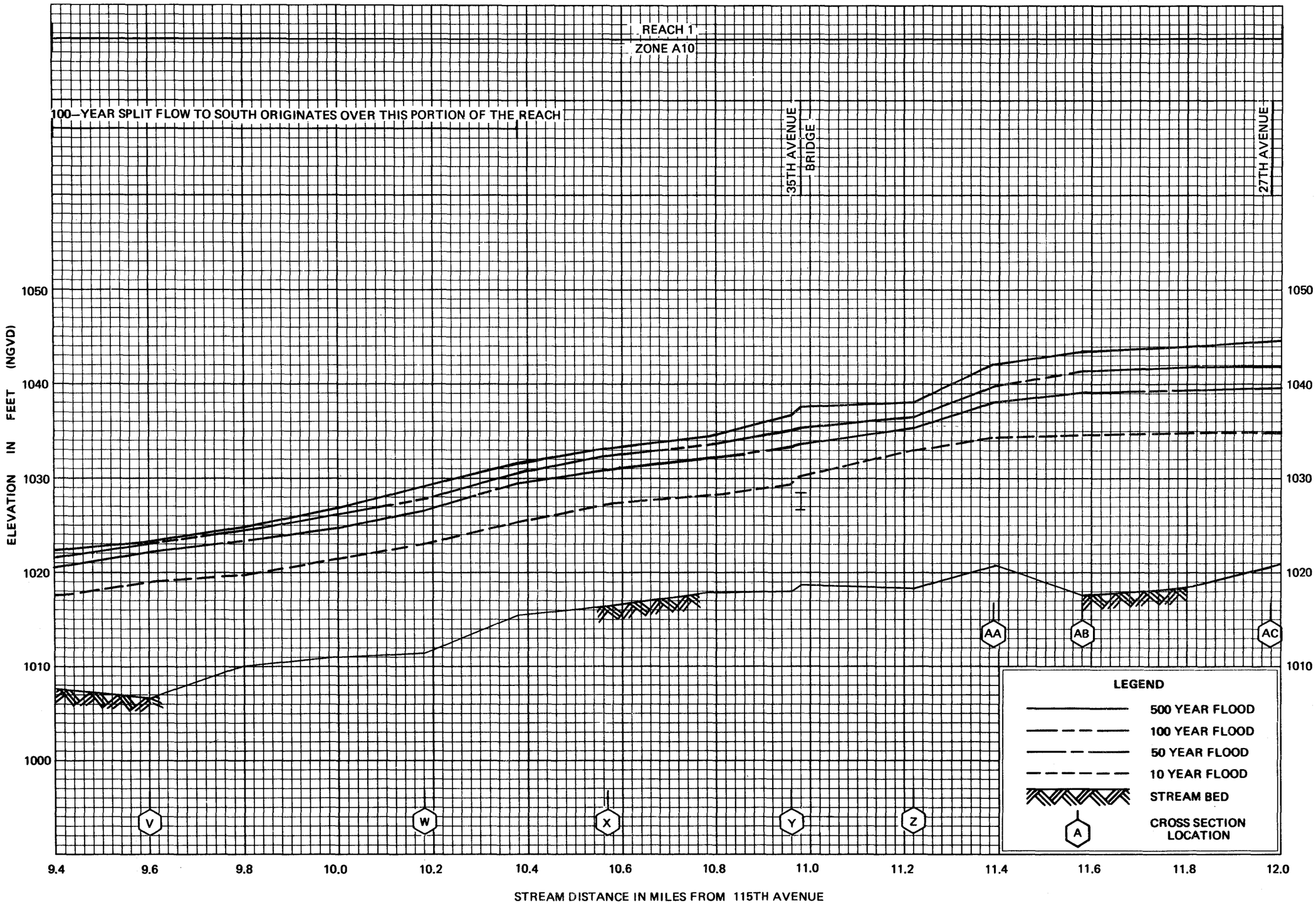


FLOOD PROFILES

SALT RIVER

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

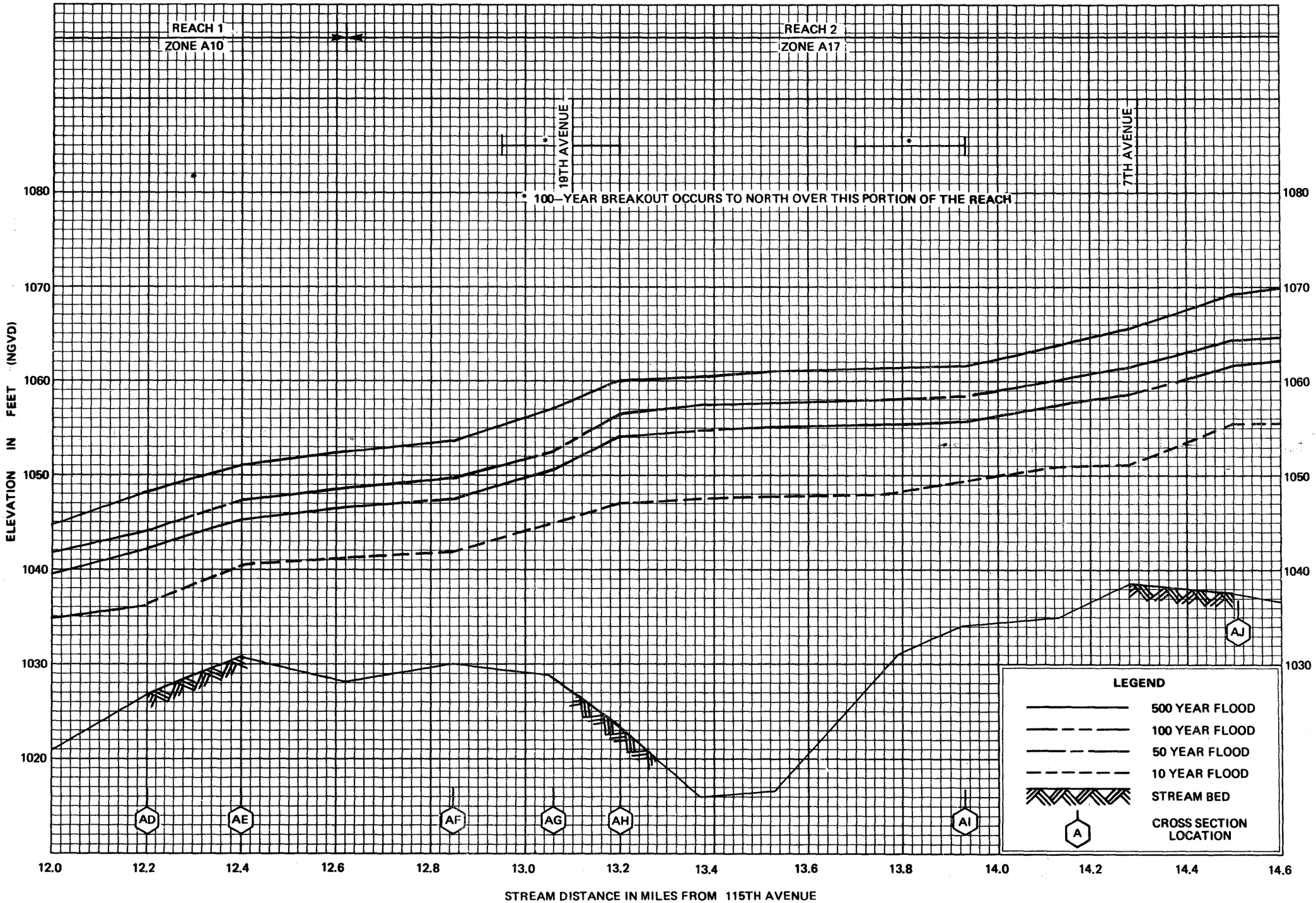


FLOOD PROFILES

SALT RIVER

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)



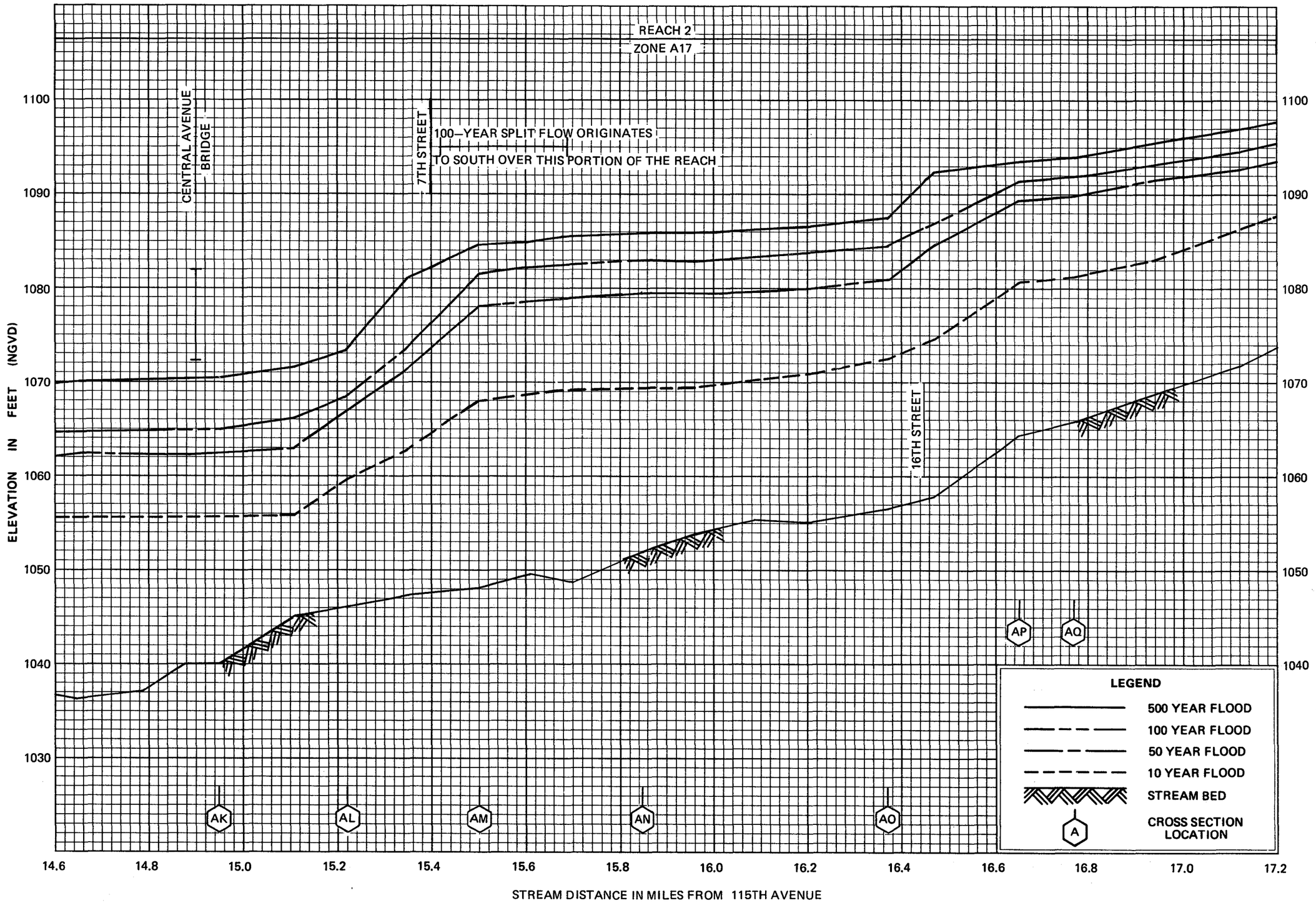
FLOOD PROFILES

SALT RIVER

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

55P



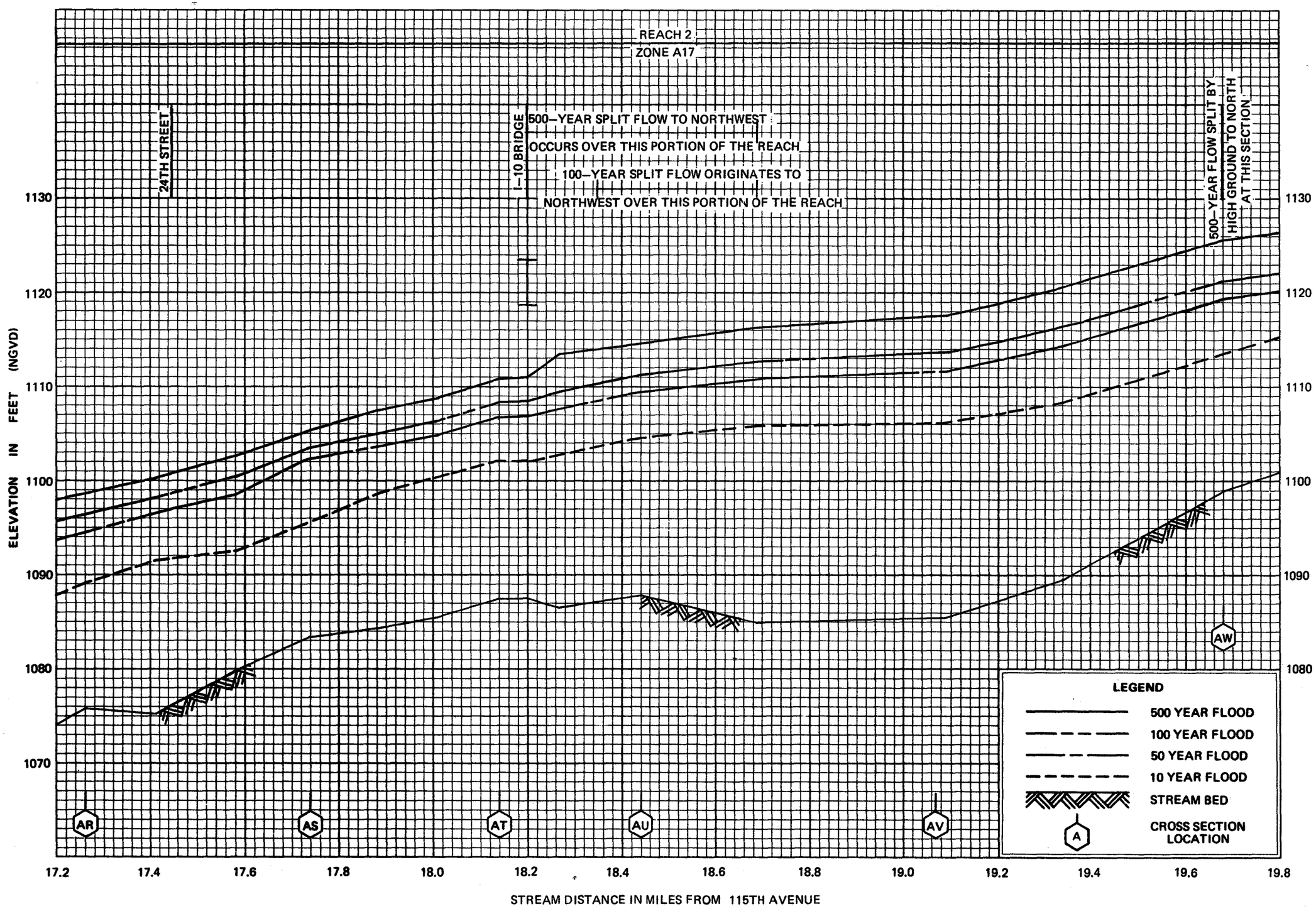
FLOOD PROFILES

SALT RIVER

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

56P



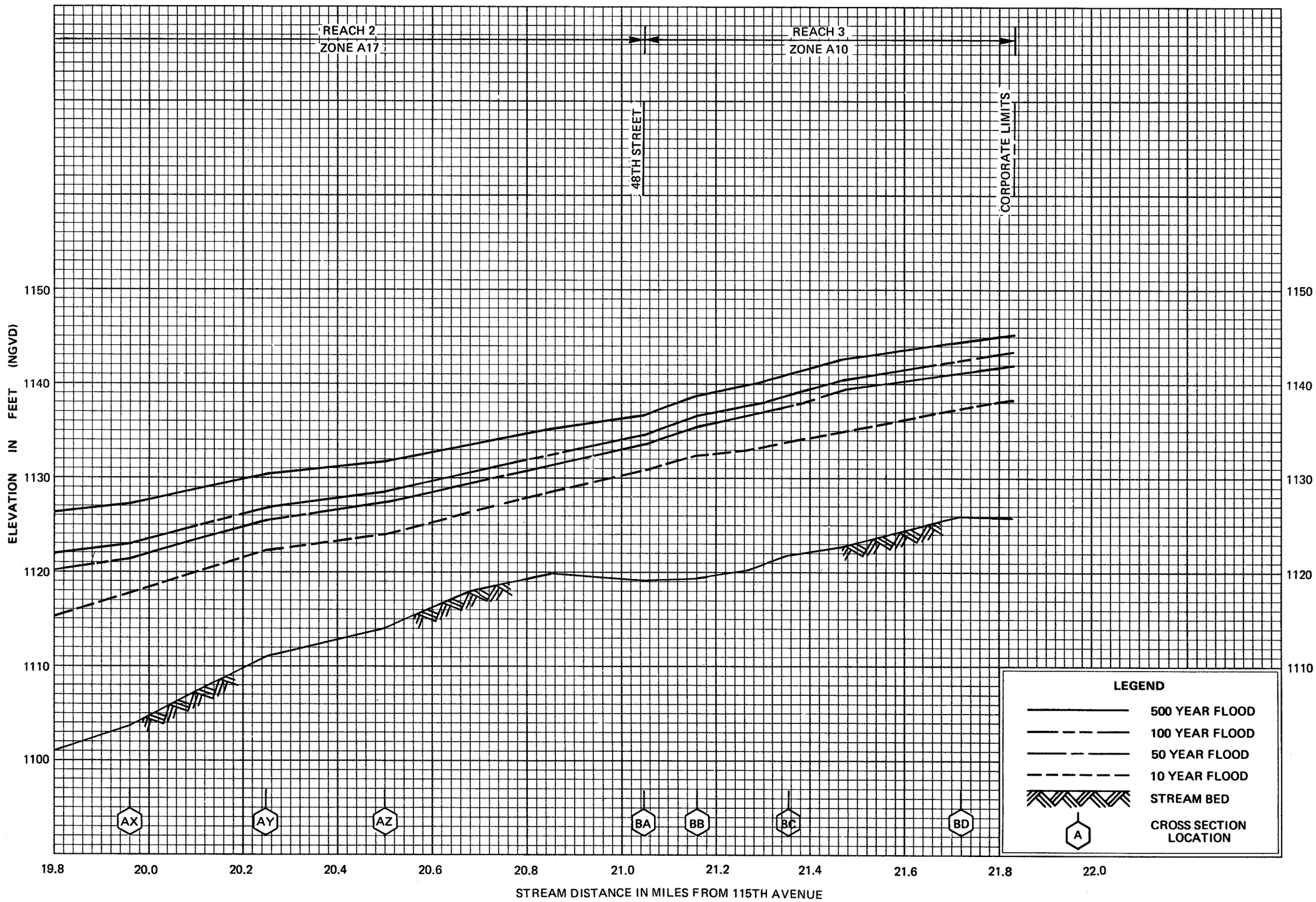
FLOOD PROFILES

SALT RIVER

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

57P



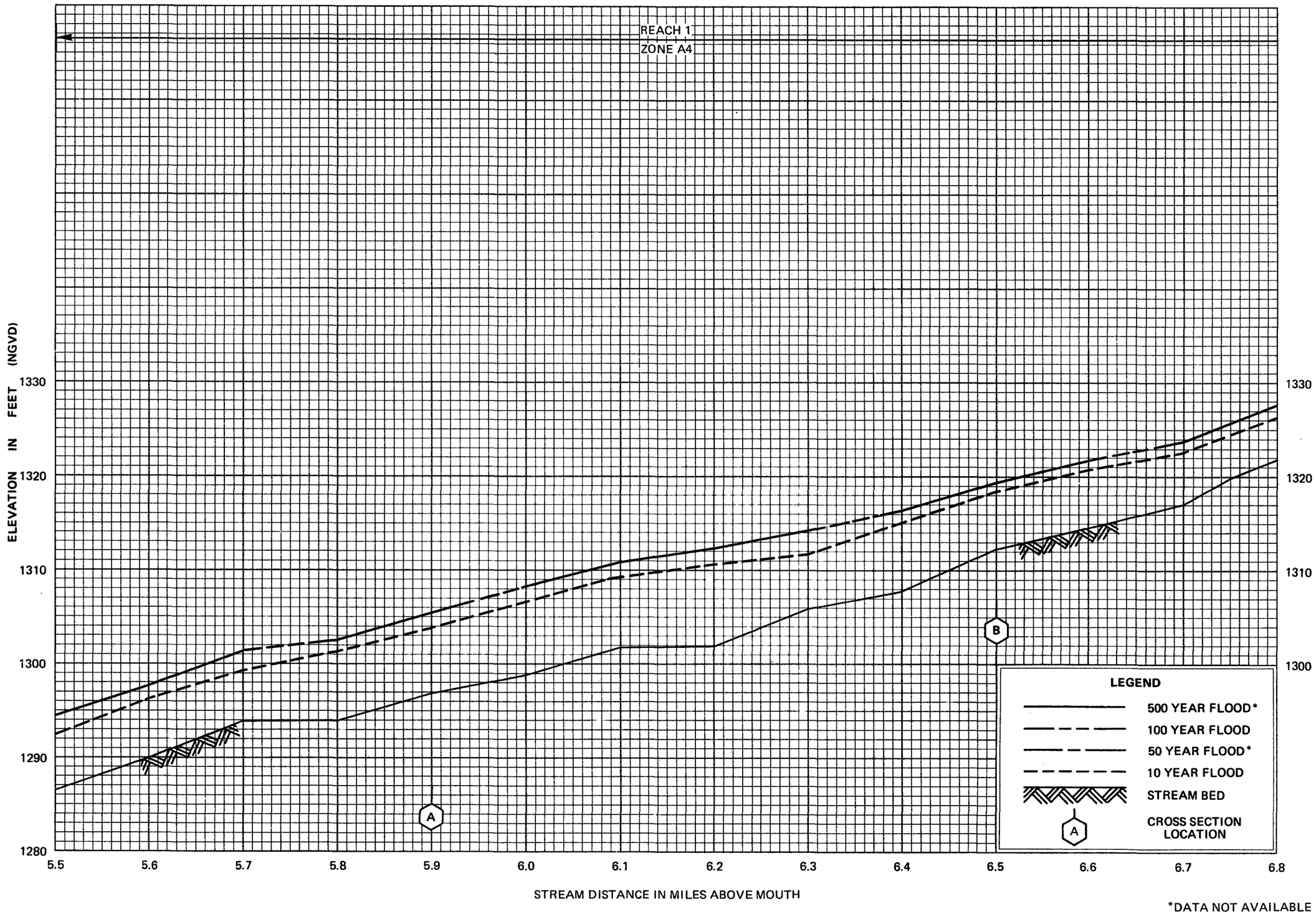
FLOOD PROFILES

SALT RIVER

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

58P



*DATA NOT AVAILABLE

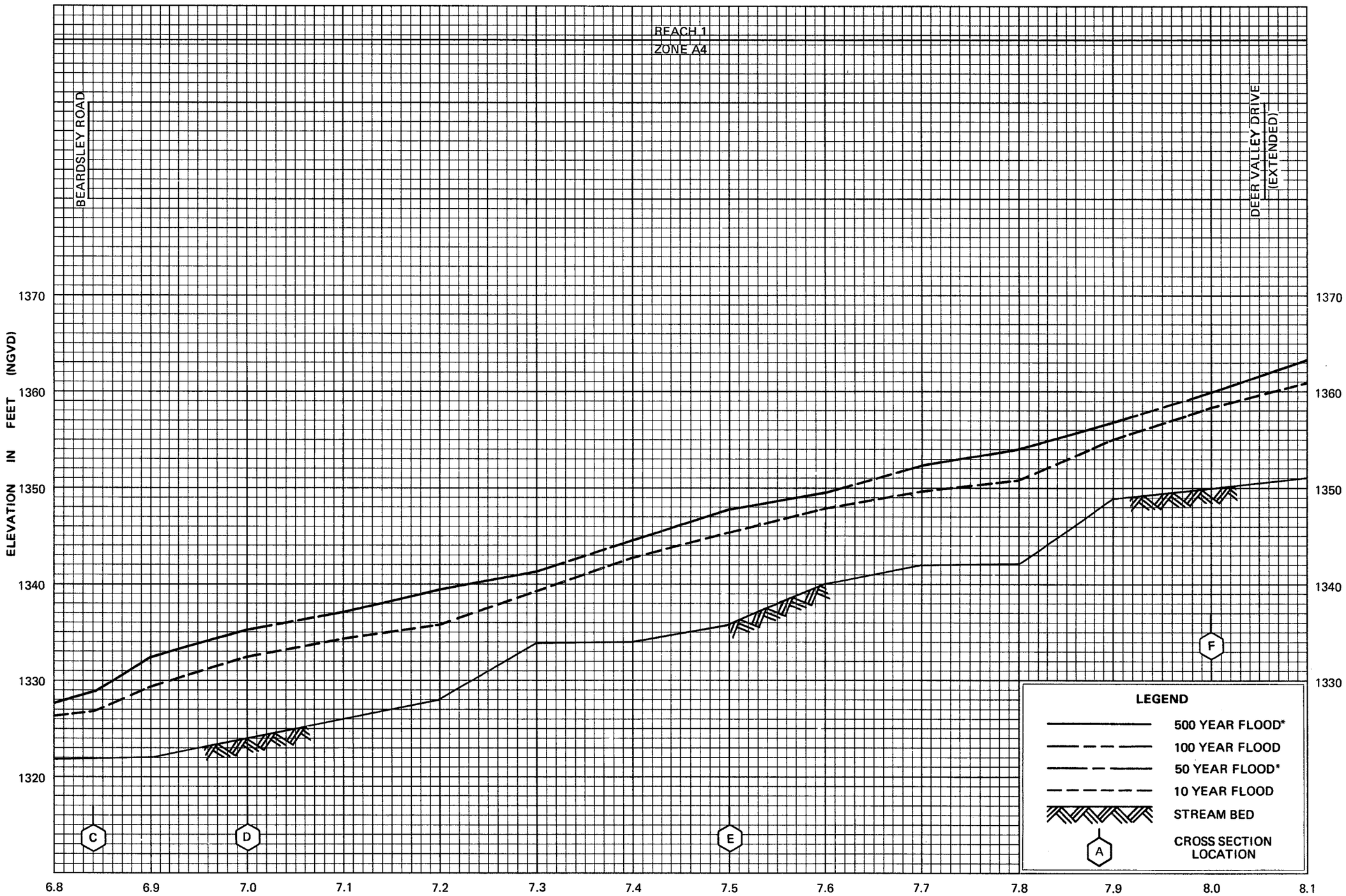
FLOOD PROFILES

SKUNK CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

59P



*DATA NOT AVAILABLE

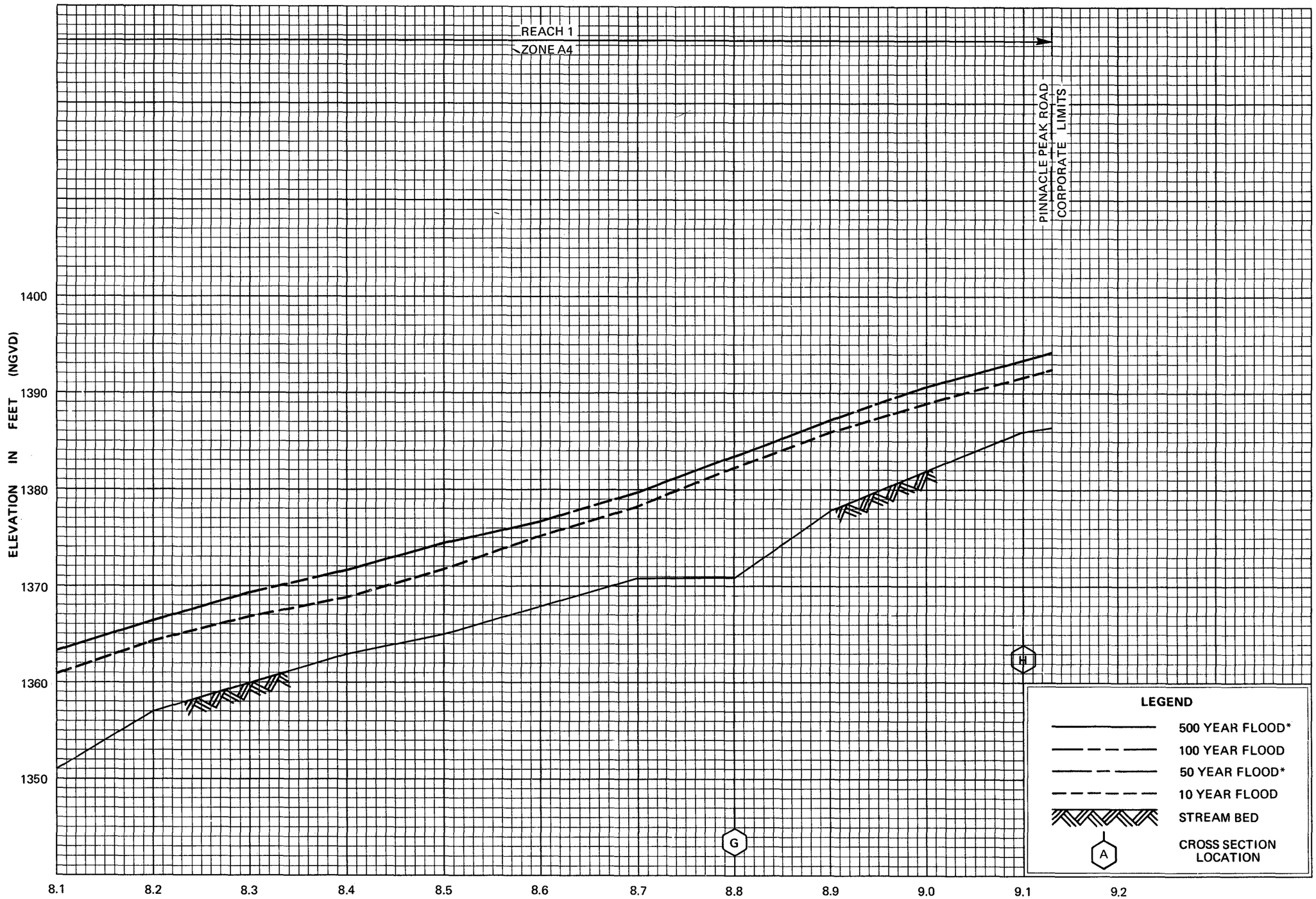
FLOOD PROFILES

SKUNK CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

60P



*DATA NOT AVAILABLE

FLOOD PROFILES

SKUNK CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF PHOENIX, AZ
(MARICOPA CO.)

61P