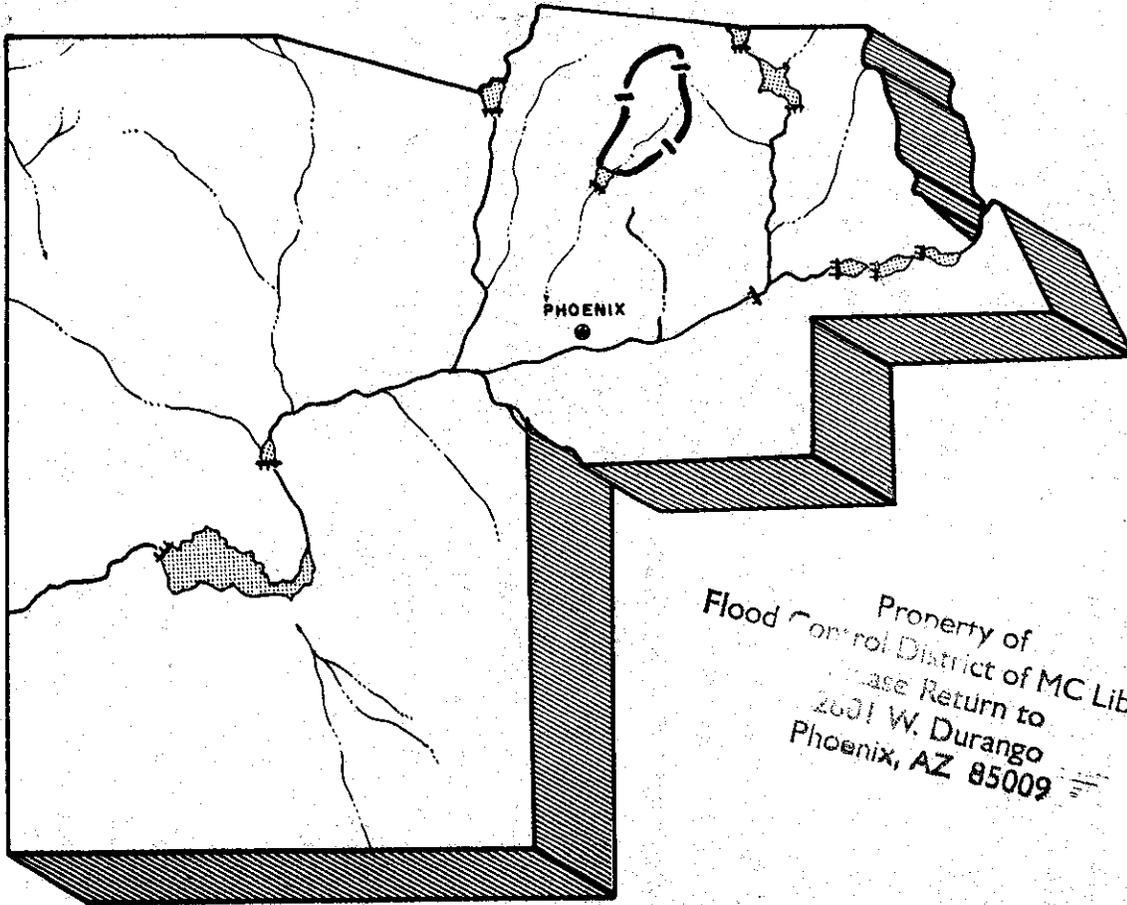


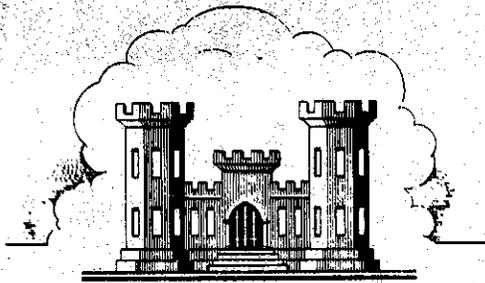
(Relineation)

FLOOD-PLAIN INFORMATION STUDY FOR MARICOPA COUNTY, ARIZONA

221



VOLUME II CAVE CREEK REPORT



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VOLUME II

CAVE CREEK REPORT

CONTENTS

	<u>Page</u>
Summary.....	1
General.....	1
Authorization.....	1
Purpose of study.....	2
Scope.....	3
Use of the report.....	4
Acknowledgement.....	4
Glossary of selected terms.....	5
Bibliography.....	5
Description of problem.....	6
General description of problem area.....	6
Prospective developments affecting the flood plain....	7
Nature and extent of flood problem.....	7
Rainfall and floods.....	11
General.....	11
Types of storms.....	11
Past storms and floods.....	11
Standard project flood.....	12
Flood frequency.....	12
Flood limits delineated in this report.....	13
General.....	13
Standard project flood.....	13
100-year flood.....	14
50- and 25-year floods.....	14
Flood profiles and cross sections.....	14
Guidelines for reducing future flood damages.....	16
General.....	16
Corrective measures.....	17
Flood control.....	17
Other corrective measures.....	18
Preventive measures.....	18
General.....	18
Flood-plain regulations.....	19
Zoning ordinances.....	19
Subdivision regulations.....	22
Building codes.....	22

CONTENTS--Continued

	<u>Page</u>
Guidelines for reducing future flood damages (continued):	
Other preventive measures.....	22
Need for continuing observation.....	23
Continuing assistance of the Corps of Engineers.....	23
Conclusions.....	24

PLATES

<u>No.</u>	<u>Title</u>
1.	Index map of study areas in Maricopa County.
2.	Study area location.
3.	Hydrologic map.
4.	Flood magnitudes and frequencies, points of concentration.
5.	Aerial map.
6.	Aerial map.
7.	Aerial map.
8.	Aerial map.
9.	Flood area.
10.	Flood area.
11.	Flood area.
12.	Flood area.
13.	Flood profile.
14.	Flood profile.
15.	Flood profile.

APPENDIXES

1. Authorization.
2. Glossary of selected terms.
3. Bibliography.

FLOOD-PLAIN INFORMATION STUDY
FOR
MARICOPA COUNTY, ARIZONA

VOLUME II

CAVE CREEK REPORT

SUMMARY

General

1. The Flood Control District of Maricopa County requested the U.S. Army Corps of Engineers to provide information about the flood hazards in flood plains along several streams in the county. An index map of the study areas is shown on plate 1. This report, the second in the series on Maricopa County, presents the results of the study made on a reach of the Cave Creek flood plain.

Authorization

2. This report was prepared under the authority granted in section 206, Public Law 86-645, approved 14 July 1960. That section is quoted in appendix 1.

3. The authority of the Flood Control District of Maricopa County to participate in flood-control planning is derived from article 5, sections 45-2351 to 45-2370, inclusive, title 45, chapter 10, Arizona Revised Statutes - and from a resolution of the Board of Supervisors of Maricopa County dated 3 August 1959, which established the flood-control district pursuant to the cited statutes.

4. Furthermore, Arizona has adopted State statutes enabling counties and cities to zone through the use of properly adopted

resolutions and ordinances. Such zoning laws must be in the interest of promoting health, safety, morals, or general welfare, and are generally placed on referendum in a public election. Maricopa County has adopted zoning laws, but not in regard to flood hazards. However, flood-plain zoning could be adopted by the county, because it would be in the interest of promoting health, safety, and general welfare.

5. On 26 September 1960 and 11 December 1961, the Board of Supervisors of Maricopa County and the Board of Directors of the Food Control District of Maricopa County adopted resolutions requesting the U.S. Army Corps of Engineers to make a flood-plain information study for Maricopa County - and giving assurances that the information in this report would be made available to all interested persons and organizations, and that the availability of the report would be adequately publicized. Those resolutions are quoted in appendix 1. On 14 April 1961 the Chief of Engineers, U.S. Army Engineers, Washington, D.C. approved the request for these Maricopa County studies.

6. The Arizona State Land Commissioner has been designated by the Governor of Arizona to coordinate and to assign priority to applications for flood-plain information studies. Upon approval for release of this report by the Arizona State Land Commissioner on 28 September 1964, the Chief of Engineers, U.S. Army Engineers, Washington, D.C., approved release of this report for publication on 2 October 1964.

Purpose of Study

7. The purpose of the study presented in this report is to provide information on flood hazards in the flood plain on a reach of

Cave Creek for the guidance of the State of Arizona and the Flood Control District of Maricopa County in (a) advising county and city planning organizations and private land developers about those hazards and (b) setting up appropriate controls to insure optimum and prudent use of the flood plain. The purpose of this report is not to discourage the use of the flood plain - but rather to encourage development that will insure an optimum balance between the needs of man for use of the flood plain and the needs of nature for the discharge of floodwaters.

Scope

8. The original request for the study from the Flood Control District of Maricopa County indicated an interest in flood-plain information along Cave Creek from Skull Mesa downstream past Cave Creek Reservoir to the mouth and along Rowler Wash for about 4 miles upstream from the confluence with Cave Creek. Subsequently, some flood-plain information for Cave Creek downstream from Cave Creek Reservoir was included in the interim flood-control survey report for Phoenix, Arizona, and vicinity (including New River) being prepared by the U.S. Army Corps of Engineers for submittal to Congress.

9. The flood plain that local interests finally selected for this study extends upstream along Cave Creek from Cave Creek Reservoir to the mouth of Rowler Wash, upstream along Rowler Wash from Cave Creek to a point just downstream from the community of Carefree, and along Mexican Wash for about 3,800 feet upstream from its

confluence with Rowler Wash. (See pls. 2 and 3.)

10. The study included consideration of past floods and of future floods in whose overflow areas methods of regulating development or construction of flood-control facilities might be warranted.

Use of the Report

11. The information in this report is presented for consideration and use by the State of Arizona, Maricopa County, and other local agencies for planning the use and regulation of selected flood-plain areas in the Cave Creek drainage area upstream from Cave Creek Reservoir. The State and county will make this information available to any responsible local interest. Further information on the use or availability of this report should be requested from the Flood Control District of Maricopa County, in Phoenix, Arizona.

12. Any regulation for flood-plain use resulting from this report would be undertaken by the State, the county, or some other local agency. This report is not intended to extend any Federal authority over zoning or other regulation of flood-plain use, and the information study and report are not to be construed as committing the Federal Government to investigating, planning, designing, constructing, operating, or maintaining any facilities discussed, or to imply any intent to undertake such activities unless specifically authorized by Congress.

Acknowledgement

13. The cooperation of the Flood Control District of Maricopa County and individuals who directly or indirectly aided in the

preparation of this report is gratefully acknowledged. Topographic maps prepared by Yost and Gardner, Engineers, were the basic maps used for the study (see pls. 9, 10, 11, and 12). A mosaic, prepared from an aerial survey flown by Whitehorse Aerial Surveys, was used for the delineation of flood areas (see pls. 5, 6, 7, and 8). General highway maps prepared by the Arizona Highway Department were used in preparing a map of the report area along Cave Creek (see pl. 2).

Glossary of Selected Terms

14. A glossary of selected terms used in this report is included as appendix 2.

Bibliography

15. A bibliography of references used in preparing this report is included as appendix 3.

DESCRIPTION OF PROBLEM

General Description of Problem Area

16. The report area, which comprises the flood plain along parts of upper Cave Creek and two tributaries, is a part of the Cave Creek drainage area, which in turn is tributary to the Salt River at Phoenix. This report area extends upstream along Cave Creek for about 9-3/4 miles to Rowler Wash (near the town of Cave Creek) and thence upstream along Rowler wash and its tributary, Mexican Wash, for a total of about 3-1/4 miles. That part of the drainage area that contributes to floodflows in this flood plain comprises about 138 square miles. The area is bounded on the north by the drainage area of the New River, on the west by the drainage area of Skunk Creek, and on the east by the drainage areas of the Verde River and Indian Bend Wash. The location of the upper Cave Creek drainage area is shown on the hydrologic map on plate 3.

17. The total length of Cave Creek from the headwaters to the reservoir is about 25 miles. Elevations in the area range from about 4,950 feet above mean sea level at Skunk Ridge to 1,650 feet above mean sea level at Cave Creek Reservoir. The terrain and climate in the vicinity of Cave Creek are typically desert in character. The winters are short and relatively mild and the summers are long and hot. At the town of Cave Creek, temperatures range from a high of 115° in summer to a low of 19° in winter.

18. Cave Creek flows generally southwestward. Near the town of Cave Creek the discharge from three tributaries enters Cave Creek. Two of these tributaries are Rowler Wash and Mexican Wash. Because

Cave Creek and tributaries in the area upstream from Cave Creek Reservoir generally have well-defined channels with relatively steep banks, the width of the flood plain generally coincides with the width of the channel. The flood-plain width of Cave Creek in the report area ranges from an average of about 1,800 feet in the lower reach to a minimum of approximately 350 feet near the confluence of Cave Creek and Rowler Wash.

Prospective Developments Affecting the Flood Plain

19. Although present development of the area adjacent to Cave Creek is limited, the presence of street signs at some points along Cave Creek Road in the vicinity of New River road indicates the existence of plans for future residential subdivisions. The town of Cave Creek, which is adjacent to Rowler Wash upstream from the confluence with Cave Creek, has a population of more than 500 persons and occupies a considerable area on both sides of Cave Creek Road. The town of Carefree, Arizona, which is being built upstream from the report area, is east of the intersection of Cave Creek Road with Scottsdale Road. Although Carefree is high enough not to be exposed to flood hazard, the development serves to illustrate the potential of the area.

Nature and Extent of Flood Problem

20. Maricopa County (including the drainage area of Cave Creek) is experiencing a rapid increase in population and in urban development, particularly in the farmlands and desertlands around Phoenix. This increase has sometimes led to development on the flood plains of

streams without due regard to the existence of flood hazards. The hazard that exists in the flood plain of Cave Creek and tributaries upstream from Cave Creek Reservoir is not always apparent to the layman because the land is semiarid and because recent urban developments have not as yet experienced damaging floods. However, storms in this area have caused - and will continue to cause - floods resulting in the inundation of wide flood plains. (See pictures on following pages for typical views of flood plain, Rowler Wash near confluence with Mexican Wash.)

21. Because Cave Creek from the mouth of Rowler Wash to Cave Creek Reservoir has a well-defined channel with generally steep banks, most flood damage from future floods in the flood plain would occur if development were to occur within the channel area, which ranges from a minimum width of about 350 feet at Rowler Wash to an average width of about 1,800 feet at Cave Creek Reservoir.

22. Similarly, most flood damage from future floods in the flood plains of Rowler Wash and its tributary, Mexican Wash, would occur if development were to occur within the channel area. However, the left bank of Rowler Wash near the trailer park (see pictures on page 9) has been overtopped several times in recent years with resultant damage to the town of Cave Creek. (The location along the wash where overtopping is known to have occurred is shown on plates 8 and 12.) The Flood Control District of Maricopa County has completed plans for approximately 800 feet of dike with revetment (1962 cost estimate, \$15,000). However, at the time this report was prepared, construction funds had not been made available.

23. No flood-control works are in the area, and no flood-plain zoning regulations are in existence.



Concrete protection wall being constructed by owner of trailer court between Cave Creek Rd. and Rowler Wash at station 99+00. This is at low point on south bank where overflow occurred in Sept. 1959 and caused damage in town of Cave Creek.



Looking westward from south bank of Rowler Wash at low point in bank where overflow occurred in Sept. 1959. Path of overflow was toward left side of picture and thence across Cave Creek Rd.



Looking northwestward (downstream) from south bank of Rowler Wash near confluence with Mexican Wash.



Looking eastward (upstream) from south bank of Rowler Wash near confluence with Mexican Wash.

RAINFALL AND FLOODS

General

24. Types of storms.--Three types of storms produce precipitation in the Cave Creek basin: general winter storms, general summer storms, and local thunderstorms. Pertinent information on these storms is given in the following subparagraphs.

(a) General winter storms, usually occurring during the months of December to March, originate over the Pacific Ocean as a result of the interaction between cool polar Pacific and warm tropical Pacific airmasses and move eastward over the basin. These storms often last for several days and are accompanied by widespread rainfall.

(b) General summer storms, which occur during the months of July to September, are associated with the influx of moist tropical air originating over the Gulf of Mexico or the South Pacific Ocean, and are often accompanied by relatively heavy rainfall over large areas for periods up to 24 hours, with light showers continuing for as long as 3 days.

(c) Local thunderstorms can occur at any time of the year, even during a general storm. However, they are most common from July to September, covering relatively small areas and resulting in high-intensity rainfall for durations of 3 hours or less.

25. Past storms and floods.--Severe local storms and floods have occurred in the Phoenix area in the following years: 1921, 1935, 1936, 1939, 1943, 1951, 1954, 1956, 1957, and 1963. The most severe storm of record occurred over the Queen Creek drainage area on 19 August 1954. That storm was a thunderstorm with high rainfall

intensities during the first 3 hours of the storm and light rainfall during the next 3 hours. An estimated area of 100 square miles had over 5 inches of rain, and about 1,000 square miles had over 1 inch of rainfall. The peak discharge at Whitlow Ranch damsite (in the Queen Creek drainage area) was estimated at 42,000 cubic feet per second. The drainage area upstream from the damsite is about 143 square miles.

26. Standard project flood.—A flood resulting from a thunderstorm of the magnitude described in the preceding paragraph would have a high peak discharge and a relatively short duration. If such a storm were centered over the Cave Creek drainage area upstream from Cave Creek Reservoir, the peak discharge of the resulting flood at the reservoir would be 62,000 cubic feet per second from the tributary drainage area of 138 square miles. That flood was selected as the standard project flood (see definition in appendix 2).

Flood Frequency

27. Information on the frequency of floods of various magnitudes is essential in planning for optimum use of the flood plain. The development of such information depends on rainfall and streamflow data. Of the six precipitation stations in and near the Cave Creek drainage area, only one has a record for more than 25 years - and only four are still in operation. The only streamflow gage in the area is about 5 miles upstream from Cave Creek Reservoir. This gage has been in operation since only 1958. The location of the streamflow and precipitation stations is shown on plate 3.

28. Fortunately, sufficient rainfall and streamflow data are available for areas in and near the Cave Creek drainage area to permit reasonable estimates of the frequency of occurrence of floods of various magnitudes at eight concentration points in the drainage area upstream from Cave Creek Reservoir. A table giving the size of the standard project flood for those eight concentration points, together with the size of the 25-, 50-, and 100-year floods at those points, is shown on plate 4.

Flood Limits Delineated in This Report

29. General.--Actual areas inundated by past major floods in the report area are unavailable because no records of streamflow in the area are in existence. Sufficient information is available to determine that in general the steep and well-defined banks of Cave Creek and tributaries within the report area would confine the standard project flood and all floods having smaller discharges. The extent of the areas inundated by various floods would be the bank limits. However, the depths of flow would vary and bank caving can occur. Estimates of depth and extent of overflow areas were made of the following future floods:

(a) Standard project flood.--For this study, the limits of the overflow area of the standard project flood were selected as the upper limits of the flood plain. The limits of that overflow area are shown on flood-area plates 9, 10, 11, and 12 and - so that present conditions of development can be shown - are also shown on aerial maps (pls. 5, 6, 7, and 8).

(b) 100-year flood.--In general, the overflow area of the 100-year flood is the same as for the standard project flood. However, the depth of flow is less and in some areas benches exist which limit the overflow area of the 100-year flood to less than the natural bank area. Although the overflow area of the 100-year flood was selected by local interests as the upper limit to be used in flood-plain planning and regulation, these benches can be cut away by shifts in floodflows so that for this report area the floodway encroachment lines (see chart of Suggested Flood Zones under "Preventive Measures") would be the standard project flood limits with an additional 100-foot width allowance for bank caving on each side. Therefore, the encroachment lines would reserve a floodway having a width 200 feet greater than the overflow area shown for the standard project flood. The overflow area for the 100-year flood is the same area shown for the standard project flood except for the bench areas shown on plates 5, 6, 7, 8, 9, 10, 11, and 12.

(c) 50- and 25-year floods.--Because of the relatively steep and well-defined banks of Cave Creek and tributaries in the report area, the flood limits of the smaller 50- and 25-year floods are so close to the flood limits of the 100-year flood that no purpose would be served by showing the limits of those floods on the flood-area maps.

30. Flood profiles and cross sections.--Flood profiles showing the water-surface elevations for both the standard project flood and the 100-year flood, as well as typical cross sections showing the shape of the floodway and the depth of flow for both those floods,

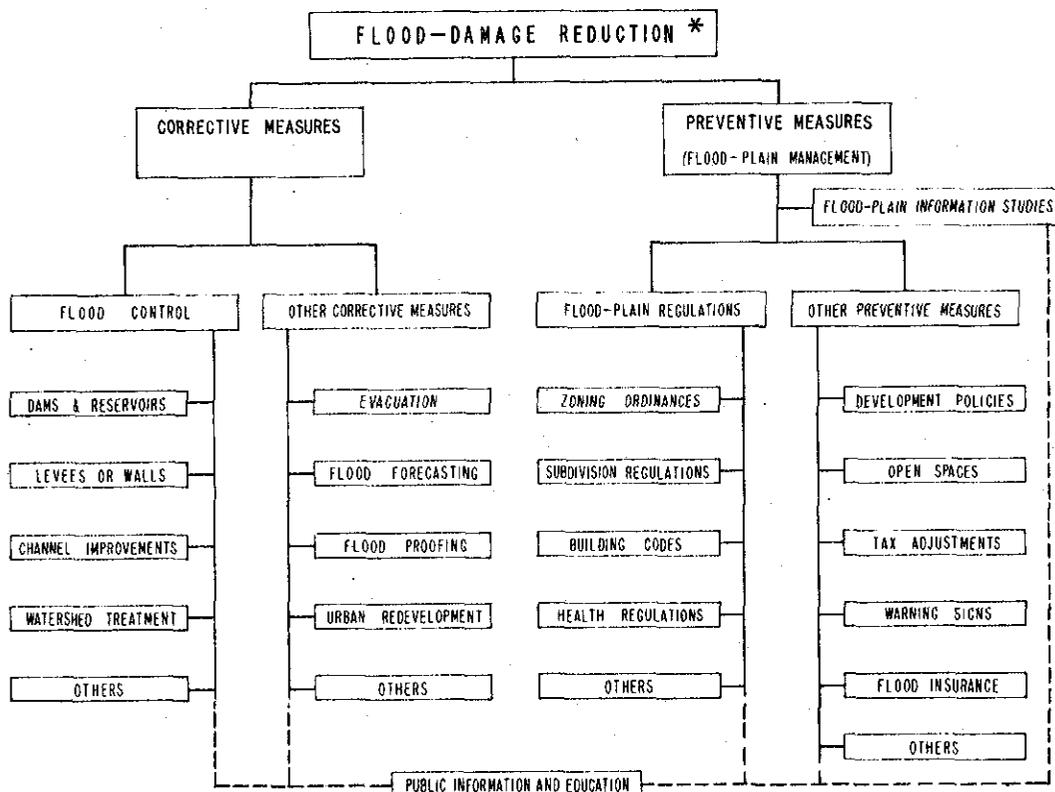
were used in determining the flood limits. For convenience in reference, the locations of the cross sections are indicated by capital letters in a circle on the aerial mosaics and the flood-area maps. The flood profiles are shown on plates 13, 14, and 15.

GUIDELINES FOR REDUCING FUTURE FLOOD DAMAGES

General

31. The two broad categories of methods to reduce flood damages are corrective measures and preventive measures. Corrective measures are primarily the construction of dams and channel improvements. By comparison, preventive measures are primarily flood-plain management methods, such as zoning ordinances which will preserve or establish floodways and therefore provide protection. Also, flood-plain management is necessary after completion of corrective measures to preclude developments which would decrease the flood carrying capacity of channels and floodways as well as to permit the development of these areas to the highest uses compatible with floodway needs.

32. In general, flood-plain information studies such as those discussed in this report, are concerned with developing a basis for preventive measures. A chart indicating the relationship of flood-plain information studies to both preventive and corrective measures follows:



* Adapted from chart shown in bibliography item No. 2 (see appendix 3).

Corrective Measures

33. Flood control.--Flood-control works, one of the means of reducing flood damage, include dams, channel improvements, levees and floodwalls, and upstream watershed treatment. Dams and reservoirs store floodwaters and release them at rates that will not cause damage. Channel improvements include deepening, widening, or straightening existing stream channels, and constructing new channels to carry floodwaters without damage. Levees and floodwalls restrain floodwaters so that they do not overflow onto land outside their boundaries. Upstream watershed treatment reduces flooding by permitting more of the rainfall to soak into the ground.

34. With the limited development at the present time along most of the study reach of Cave Creek, flood-control works are not considered economically feasible, and none are presently contemplated with the exception of a levee at one location on the south side of Rowler Wash near the trailer park. That location, which is about 2,650 feet upstream from the confluence of Rowler Wash with Mexican Wash (see pls. 8 and 12 for "Point of Known Overflow"), is at a point where the low bank on the south (left) side of the wash has resulted in several overflows during floods over the past few years, with resultant damage in the town of Cave Creek. Maricopa County has plans for a protective levee here, but funds have not yet been made available for construction.

35. Provision for future flood-control works should be given consideration at this time. For example, if an improved channel is expected, the land required for rights-of-way should be reserved or

acquired as soon as practicable. The early establishment of the alignment, rights-of-way limits, and required grades permits a better sequence of development. Rights-of-way requirements for any future channel for the study reach are not shown on the flood-area plates 9, 10, 11, and 12. However, a reference line has been established that would closely approximate the existing flow line of the stream. Once the type of channel improvement is determined, channel bank stabilization could be undertaken to reduce the hazard from small floods. The earth excavated from this channel could be used as land fill where it is required to raise the ground level in areas otherwise suitable for building.

36. Other corrective measures.--Among the other corrective measures that can be taken are permanent evacuation, flood forecasting, and flood proofing. Corrective measures may also be possible in connection with programs for urban redevelopment.

Preventive Measures

37. General.--Preventive measures for reducing flood damages require management of the flood plain. Flood-plain management involves controlling the use of the flood plain by legal and logical measures. Such management should be the means of realizing maximum community benefits, taking into account the most profitable use to which the flood plain can be put and the flood damages to which these uses would be subject. Some uses would be subject to very little damage; for example, recreational use for parks and playgrounds. Pertinent information on flood-plain regulations and other preventive measures is given in the following paragraphs.

38. Flood-plain regulations.--When plans have been developed for use of the flood plain, the establishment of flood-plain regulations may be necessary to accomplish the desired results. Flood-plain regulations are established by State statutes, county resolutions, and city ordinances. Such regulations include zoning ordinances (including those setting up floodway-encroachment lines), subdivision regulations, building and housing codes, and other similar regulations. The type of measures necessary to regulate use of the flood plain depends on the nature of the hazard. The more restrictive measures would be used where the flood hazard might include loss of life, property damage, or excessive floodway obstruction. Information on the relationship of some of those regulations to flood-plain zoning along upper Cave Creek and tributaries is given in following subparagraphs.

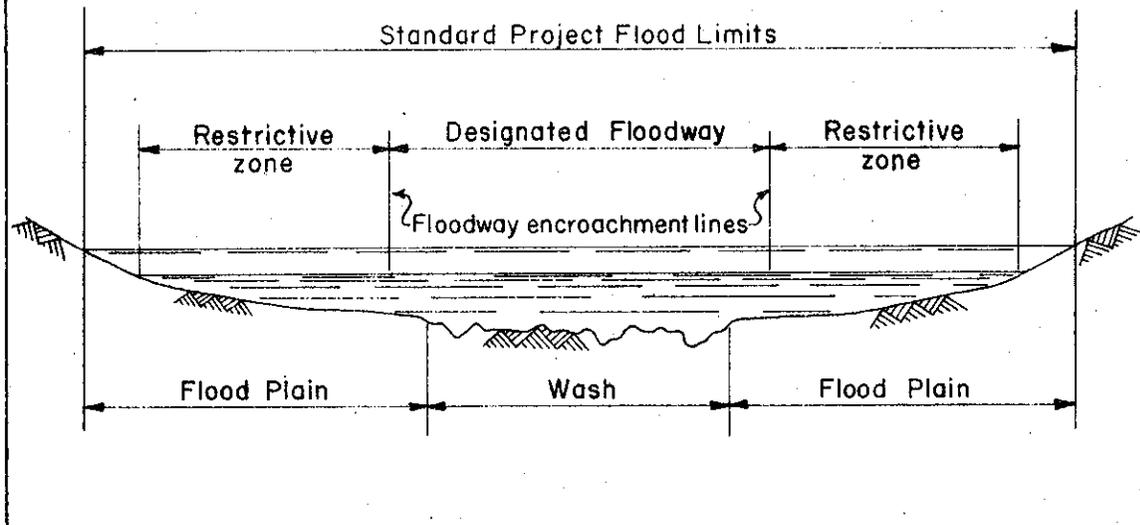
(a) Zoning ordinances.--The most universally accepted tool used by States, counties, and municipalities to regulate the use and development of land within their boundaries would be zoning ordinances. Zoning ordinances may provide for the establishment of designated floodway limits but usually go beyond to establish zones of different degrees of restriction, depending on the flood hazard. Within these restrictive zones (see sketch on page titled "Suggested Flood Zones"), the elevation of floors, landfill, and other improvements could be controlled so as to permit the most effective use of the land without undue risk of damage from flooding. The storage of large quantities of floatable materials should be prohibited, because they could cause damage to downstream

improvements and could cause obstruction to floodflows.

(b) Arizona has adopted State statutes enabling counties and cities to zone through the use of properly adopted resolutions and ordinances. Such zoning laws must be in the interest of promoting health, safety, morals, or general welfare, and are customarily placed on referendum in a public election. Maricopa County has adopted zoning laws, but not in regard to flood hazards. Flood-plain zoning could be adopted by the county, because it would be in the interest of promoting health, safety, and general welfare.

(c) By establishing floodway-encroachment lines (see sketch on next page), a local zoning or regulatory agency could prohibit the building of permanent structures that would obstruct the natural flow of floodwaters within a designated floodway on the flood plain. That agency would determine the criteria for specifying the flood magnitude and the maximum rise in flood level that would be allowed. The floodway width required for passage of the designated flood can then be determined, and the encroachment lines established.

SUGGESTED FLOOD ZONES



(d) Effective reduction of flood damage to properties in the flood plain can result only if the flood magnitude considered in determining the size of the designated floodway is of infrequent occurrence and does not result in raising the flood level in the restrictive zones sufficiently to cause major damage. For the Cave Creek study area, the Flood Control District of Maricopa County determined that the designated floodway should be of sufficient size to accommodate a flood with an occurrence frequency of about once in a hundred years with a flood-level rise of less than 6 inches in any restrictive zones.

(e) Floodway-encroachment lines are not shown on the overflow-area maps in this report. The streams in the report area are well entrenched within easily definable banks that, in general, coincide

with the limits of both the designated floodway and the natural floodway. Furthermore, the area of restrictive zones, which are outside the designated floodway and within the 100-year flood limits, is negligible; and the area between the limits of the 100-year flood and the limits of the standard project flood is limited to a few locations where protection could be provided by small levees or fills.

(f) Subdivision regulations.--The regulation of subdivisions provides one of the most immediately effective means of reducing flood damages in generally undeveloped areas. Cities and counties should proceed early and rapidly to establish regulations because of the opportunity of producing ideal developments not hampered by nonconforming existing uses. Floodways and restrictive zones can be established by subdivision regulations in the same manner as with zoning ordinances.

(g) Building codes.--Building codes could be developed to provide for the safety of buildings by requiring minimum elevations for floors and installed equipment, such as furnaces, in the restrictive zones of flood plain.

39. Other preventive measures.--Reduction of future flood damage could also be accomplished by the relocation of existing structures, and the setting aside of flood-plain land for parks and recreational areas on the basis of the future needs of the city and county for these uses. Tax adjustments could be used to discourage flood-plain use that would add a burden on the community by increasing the need for flood fighting, relief, and expenditures for repair of flood damages to service facilities. Other preventive measures include warning signs placed in flood-plain areas to alert potential builders to the threat of damage.

Need for Continuing Observation

40. Because no quantitative records of precipitation and no quantitative information on streamflow characteristics were available for the upper Cave Creek drainage area, the flood-magnitude estimates used in this report were based on available information on precipitation and streamflow for nearby drainage areas. Additional precipitation and stream-gaging stations properly located would provide information for the engineer to improve the evaluation of present conditions and the prediction of future conditions.

Continuing Assistance of the Corps of Engineers

41. The technical assistance of the Corps of Engineers will be available, upon request of the State and local governmental agencies concerned, to interpret and explain information in this report and to provide any other flood data that becomes available for the use of the local planning agencies.

CONCLUSIONS

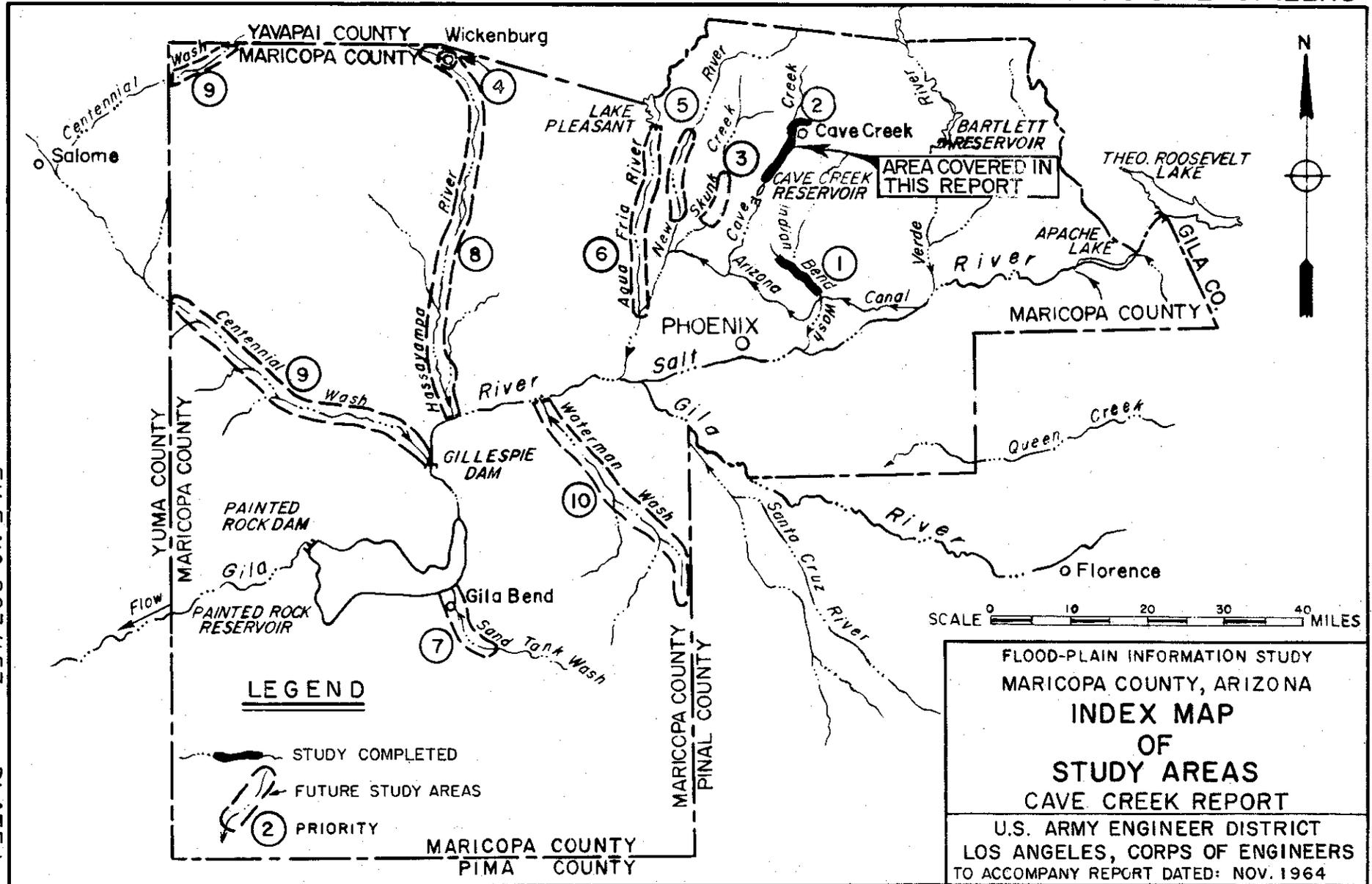
42. A potential flood hazard exists in the flood plain of Cave Creek upstream from the Cave Creek Reservoir to the confluence with Rowler Wash and upstream along Rowler Wash and its tributary, Mexican Wash, to the limits of this study, just downstream from the town of Carefree. The hazard presents an especial problem along Rowler Wash near the town of Cave Creek, where overflows have caused damage to the town.

43. Although the encroachment of development on the flood plain has not yet presented an acute problem, the need for increased development will grow with the population and preventive measures should be taken as soon as possible to forestall any encroachment in the floodway that might lessen its flood-carrying capacity.

44. The information in this report is intended to provide a factual basis for local governmental agencies in formulating appropriate regulations, measures to control development in the flood plain of upper Cave Creek and its tributaries - and to provide information for the guidance of real estate developers or private individuals in acquiring or developing land in the flood plain covered in this report.



EARL G. PEACOCK
Colonel, Corps of Engineers
District Engineer



LEGEND

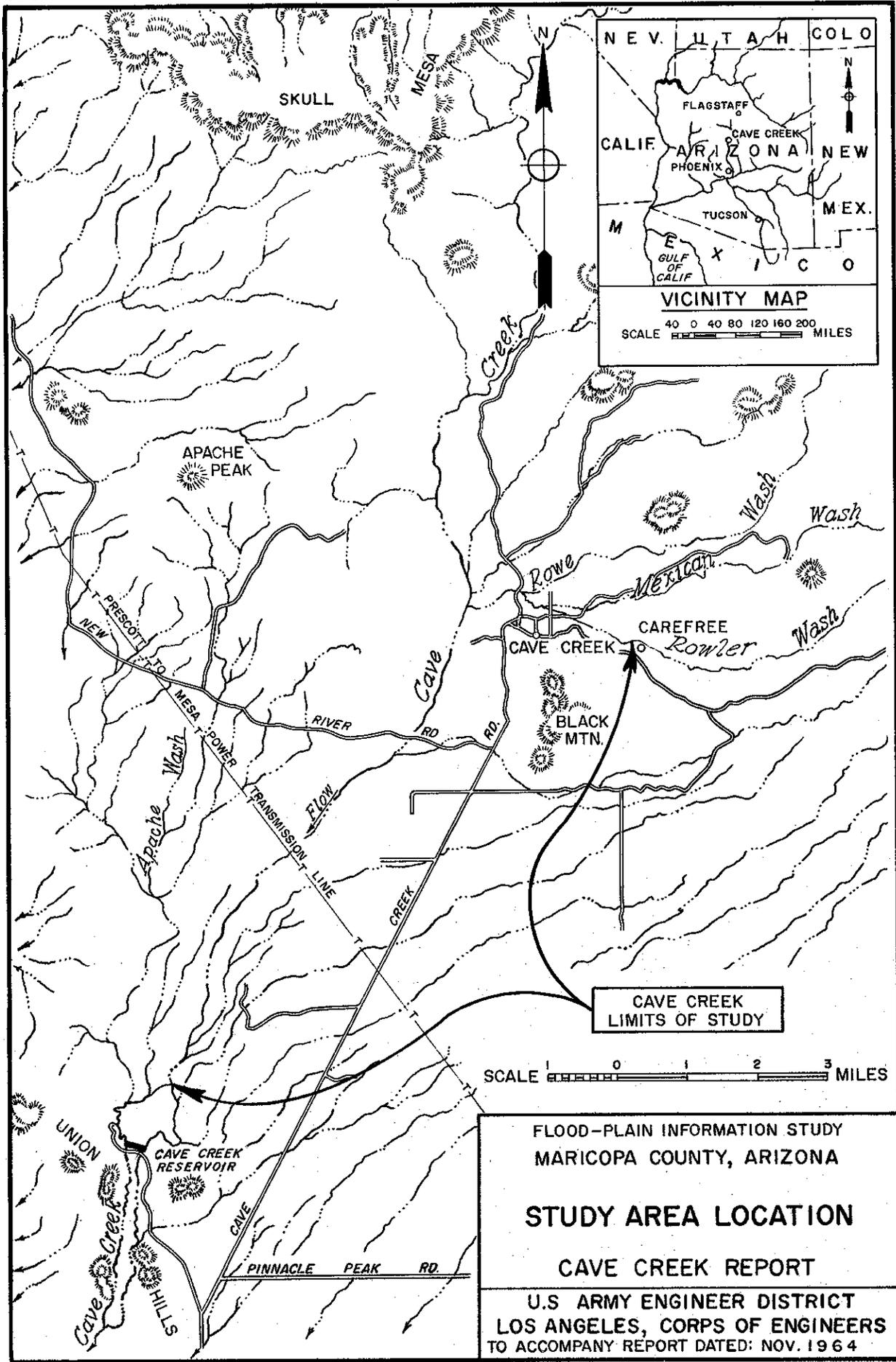
-  STUDY COMPLETED
-  FUTURE STUDY AREAS
-  PRIORITY

SCALE 0 10 20 30 40 MILES

FLOOD-PLAIN INFORMATION STUDY
 MARICOPA COUNTY, ARIZONA
INDEX MAP
 OF
STUDY AREAS
 CAVE CREEK REPORT
 U.S. ARMY ENGINEER DISTRICT
 LOS ANGELES, CORPS OF ENGINEERS
 TO ACCOMPANY REPORT DATED: NOV. 1964

FILE NO. 203/153

PLATE I

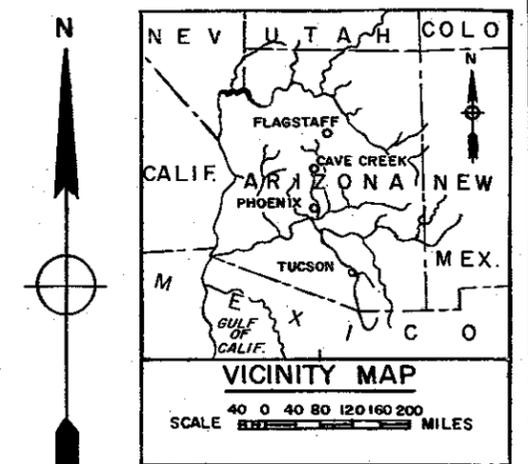
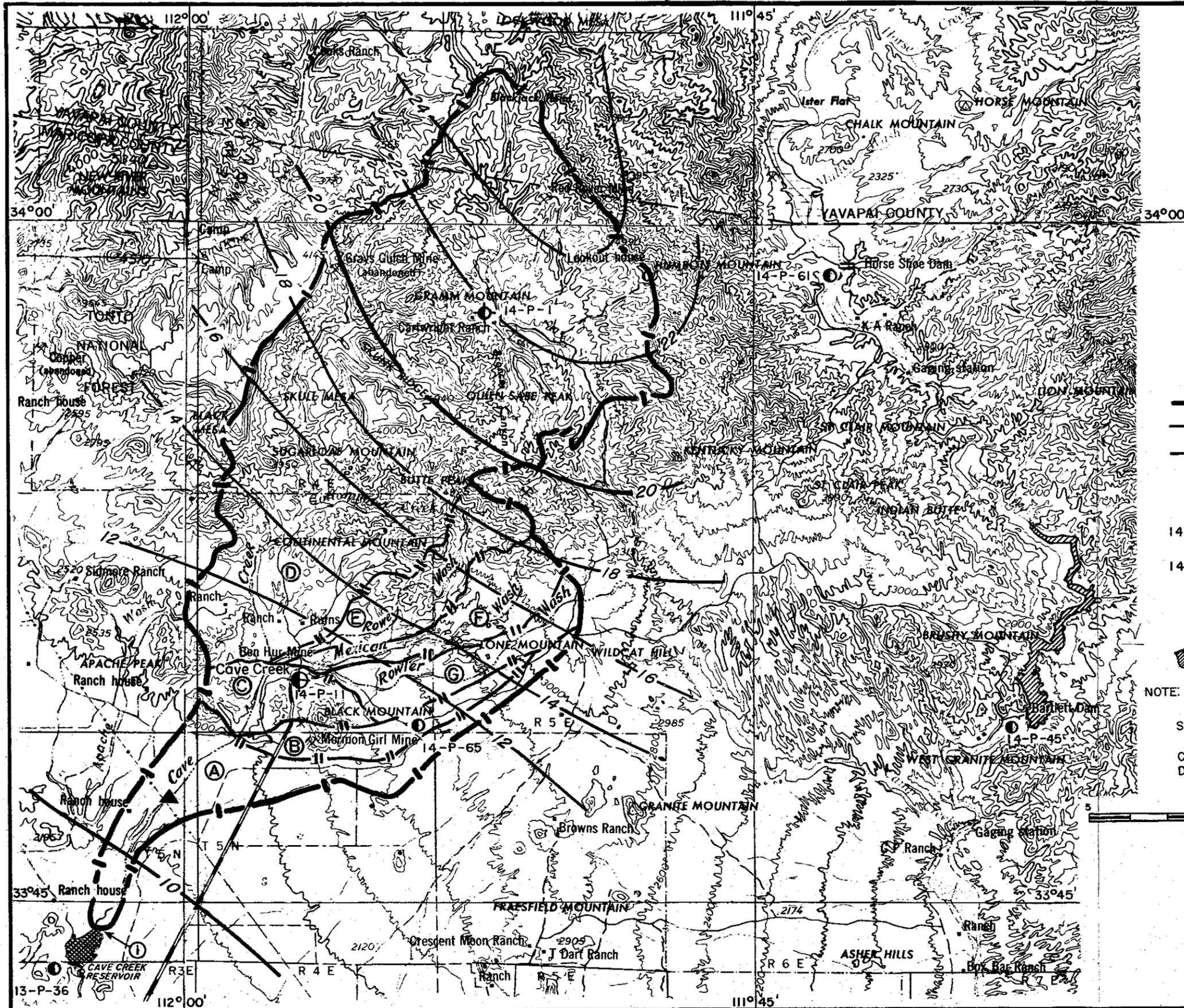


FLOOD-PLAIN INFORMATION STUDY
 MARICOPA COUNTY, ARIZONA

STUDY AREA LOCATION

CAVE CREEK REPORT

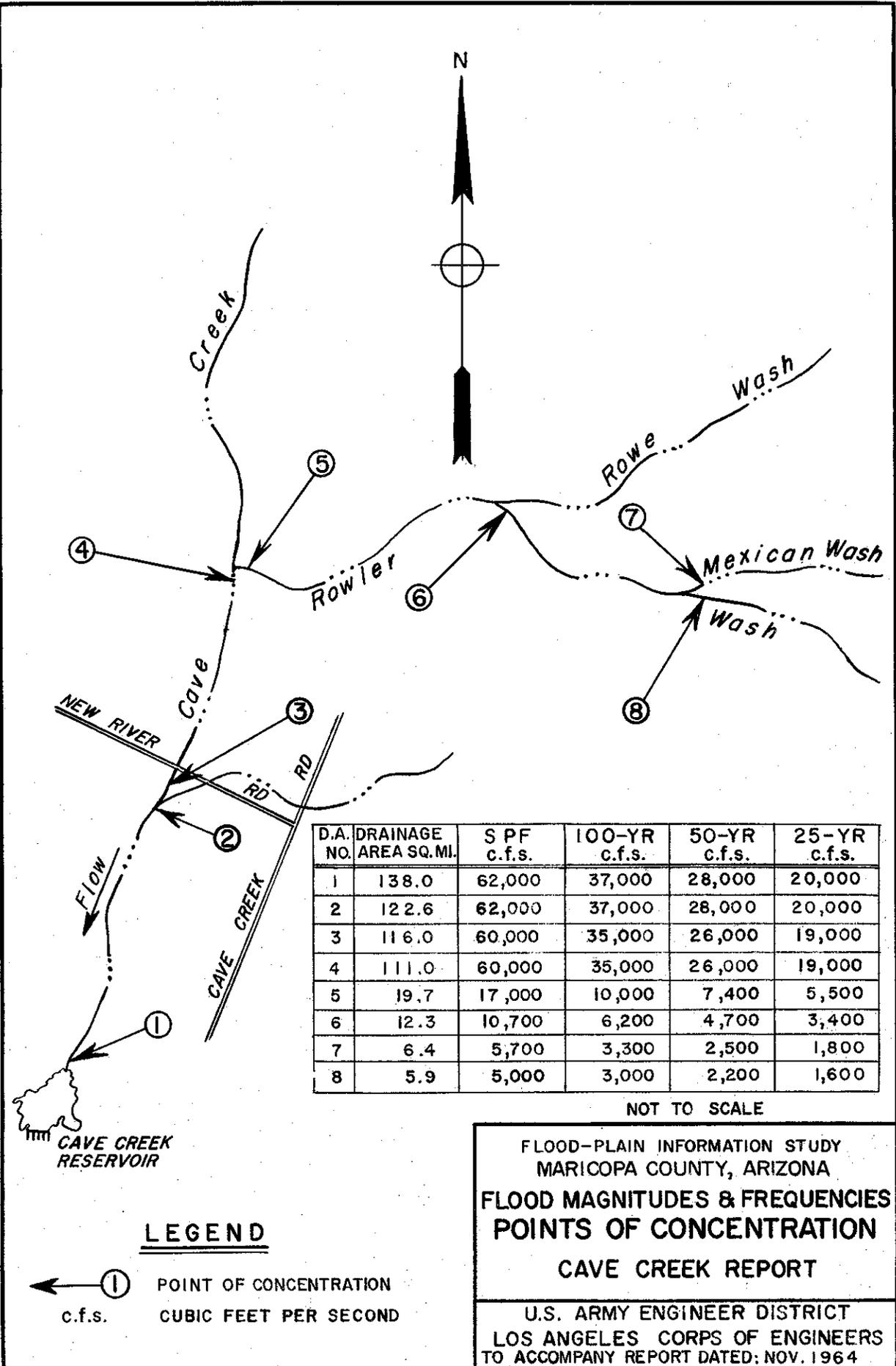
U.S. ARMY ENGINEER DISTRICT
 LOS ANGELES, CORPS OF ENGINEERS
 TO ACCOMPANY REPORT DATED: NOV. 1964



- LEGEND**
- I — BOUNDARY OF DRAINAGE AREA
 - II — BOUNDARY OF DRAINAGE SUBAREA
 - 20 — LINE OF EQUAL 90-YEAR MEAN ANNUAL PRECIPITATION IN INCHES
 - Ⓐ SUBAREA DESIGNATION
 - 14-P-11 PRECIPITATION STATION AND NUMBER (NON-RECORDING).
 - 14-P-1 PRECIPITATION STATION AND NUMBER (NON-RECORDING, DISCONTINUED).
 - ▲ STREAM-GAGING STATION
 - ◼ EXISTING FLOOD-CONTROL RESERVOIR
 - ◼ EXISTING WATER-CONSERVATION RESERVOIR

NOTE:
 MAP REPRODUCED FROM WESTERN UNITED STATES SERIES QUADRANGLES, SCALE 1:250,000.
 COUNTOUR INTERVAL 200 FEET
 DATUM IS MEAN SEA LEVEL
 SCALE IN MILES

FLOOD-PLAIN INFORMATION STUDY
 MARICOPA COUNTY, ARIZONA
HYDROLOGIC MAP
 CAVE CREEK REPORT
 U.S. ARMY ENGINEER DISTRICT
 LOS ANGELES, CORPS OF ENGINEERS
 TO ACCOMPANY REPORT DATED: NOV. 1964



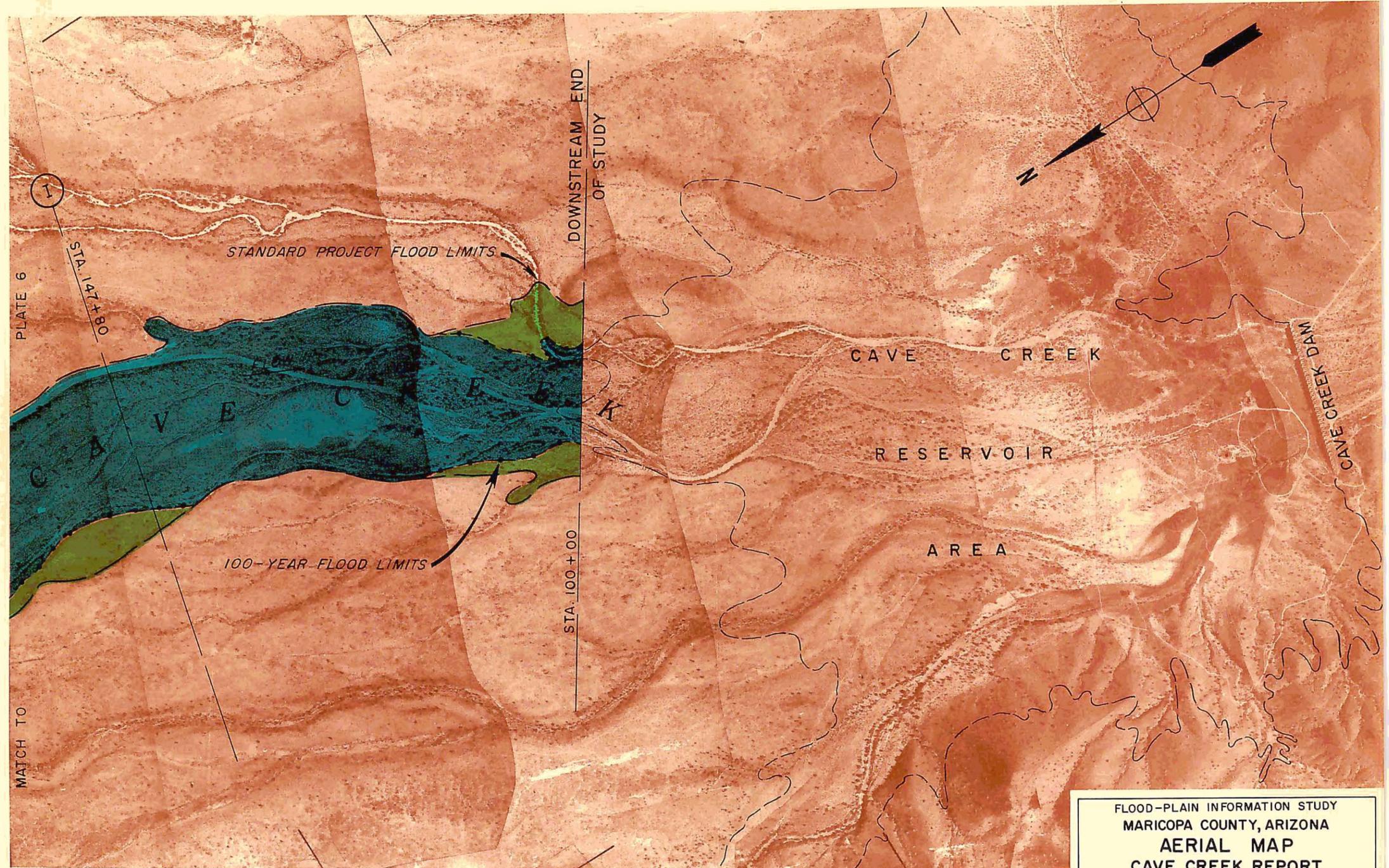
NOT TO SCALE

FLOOD-PLAIN INFORMATION STUDY
 MARICOPA COUNTY, ARIZONA
**FLOOD MAGNITUDES & FREQUENCIES
 POINTS OF CONCENTRATION**
CAVE CREEK REPORT

U.S. ARMY ENGINEER DISTRICT
 LOS ANGELES CORPS OF ENGINEERS
 TO ACCOMPANY REPORT DATED: NOV. 1964

LEGEND

① ← POINT OF CONCENTRATION
 c.f.s. CUBIC FEET PER SECOND

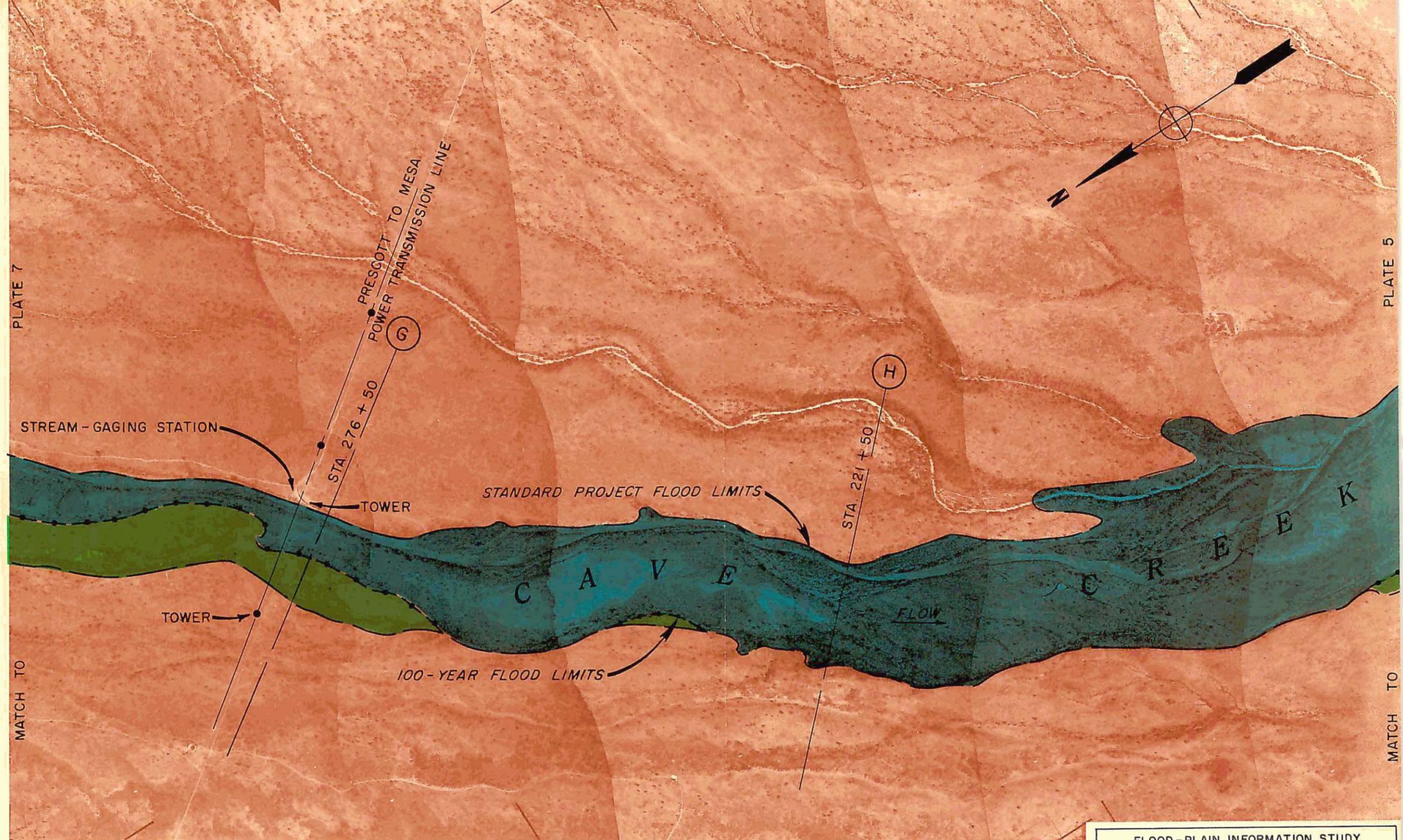


NOTE:
SEE PLATE 8 FOR GENERAL NOTES

FLOOD-PLAIN INFORMATION STUDY
 MARICOPA COUNTY, ARIZONA
AERIAL MAP
CAVE CREEK REPORT

1000 0 1000
 SCALE FEET

U.S. ARMY ENGINEER DISTRICT
 LOS ANGELES, CORPS OF ENGINEERS
 TO ACCOMPANY REPORT DATED: NOV 1964



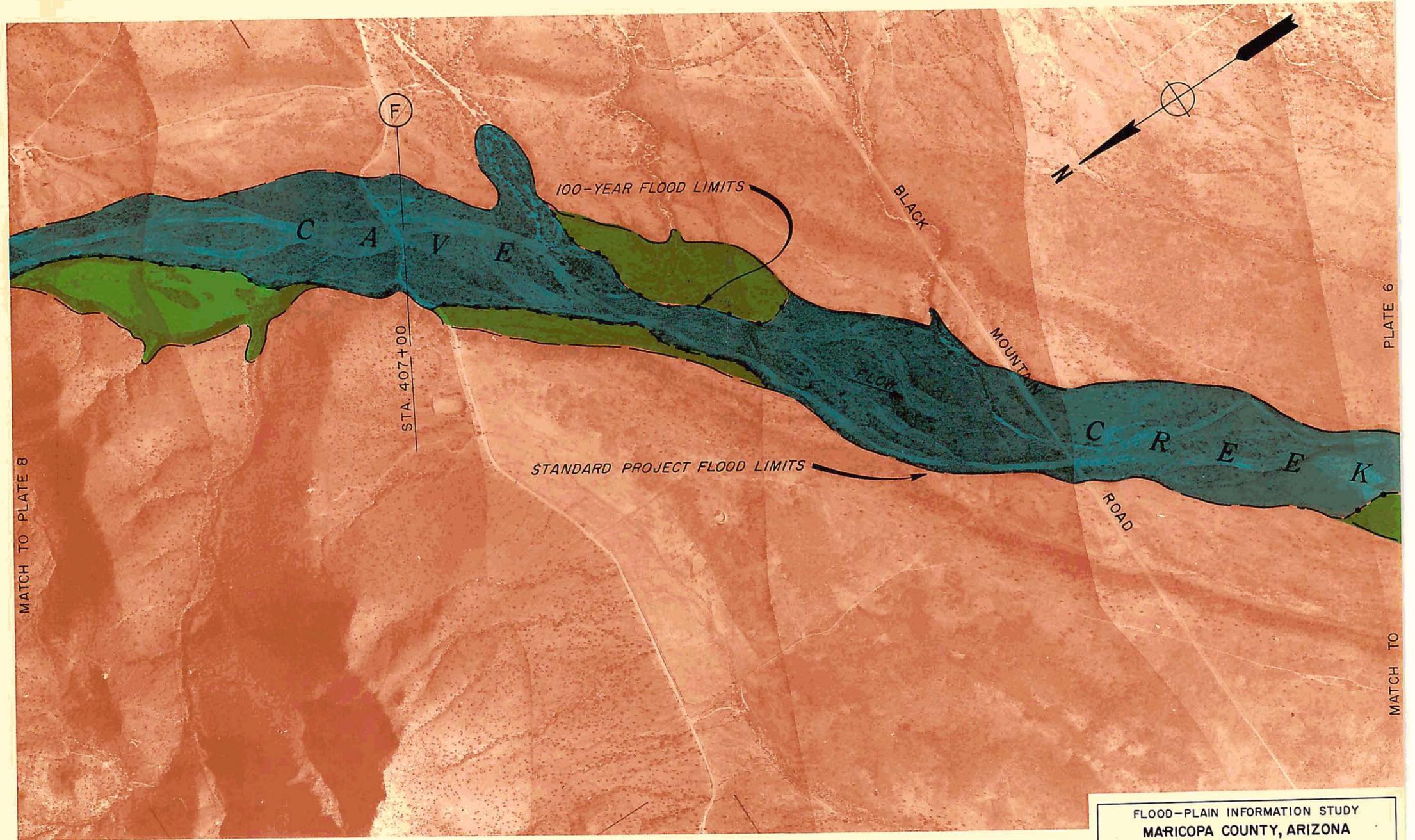
NOTE:
SEE PLATE 8 FOR GENERAL NOTES

FLOOD-PLAIN INFORMATION STUDY
MARICOPA COUNTY, ARIZONA
AERIAL MAP
CAVE CREEK REPORT

1000 0 1000
SCALE FEET

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED: NOV 1964

FILE NO. 203/158 PLATE 6

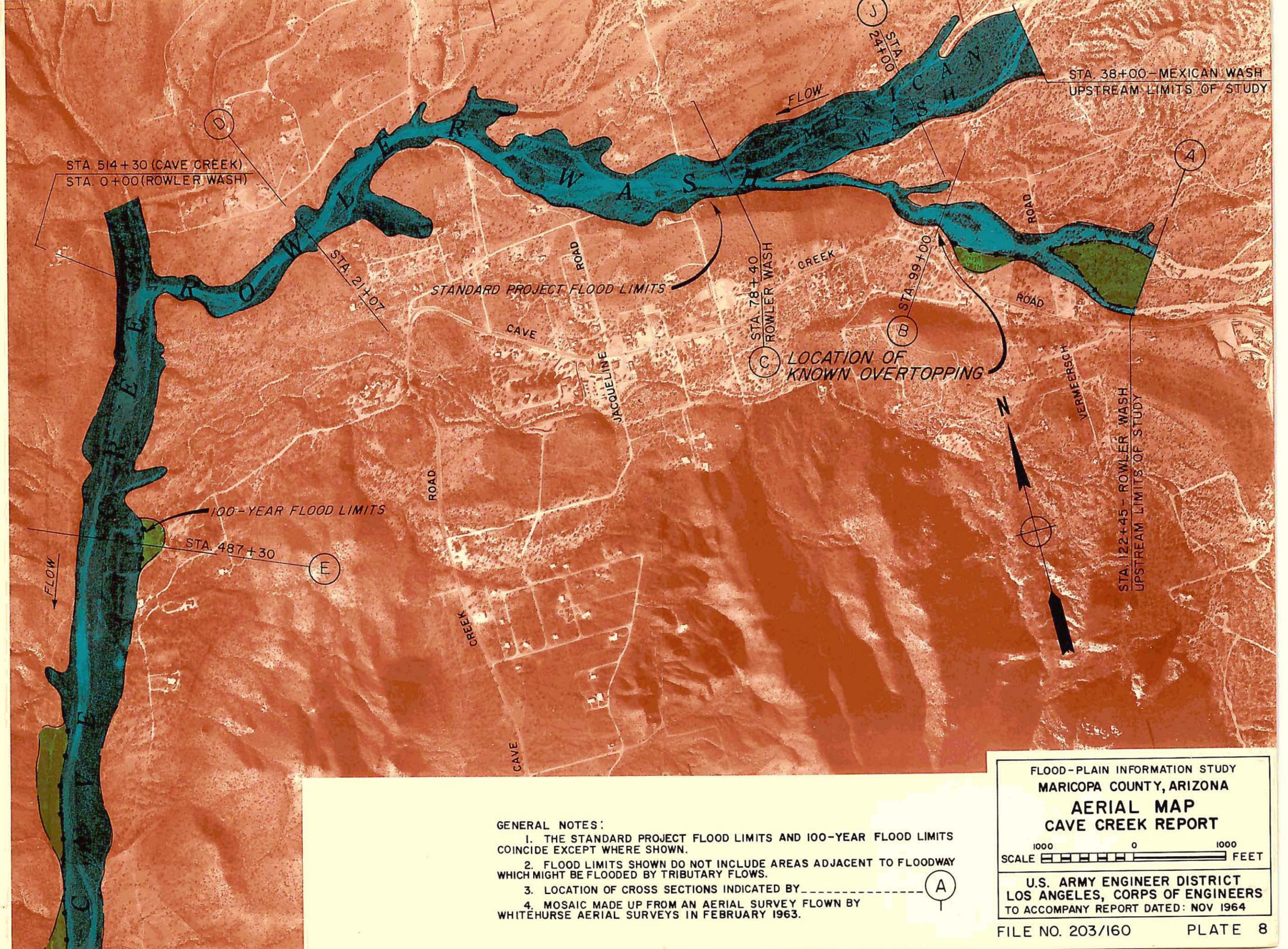


NOTE:
SEE PLATE 8 FOR GENERAL NOTES

FLOOD-PLAIN INFORMATION STUDY
 MARICOPA COUNTY, ARIZONA
 AERIAL MAP
 CAVE CREEK REPORT

SCALE FEET

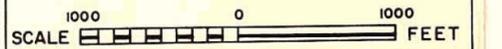
U.S. ARMY ENGINEER DISTRICT
 LOS ANGELES, CORPS OF ENGINEERS
 TO ACCOMPANY REPORT DATED: NOV 1964



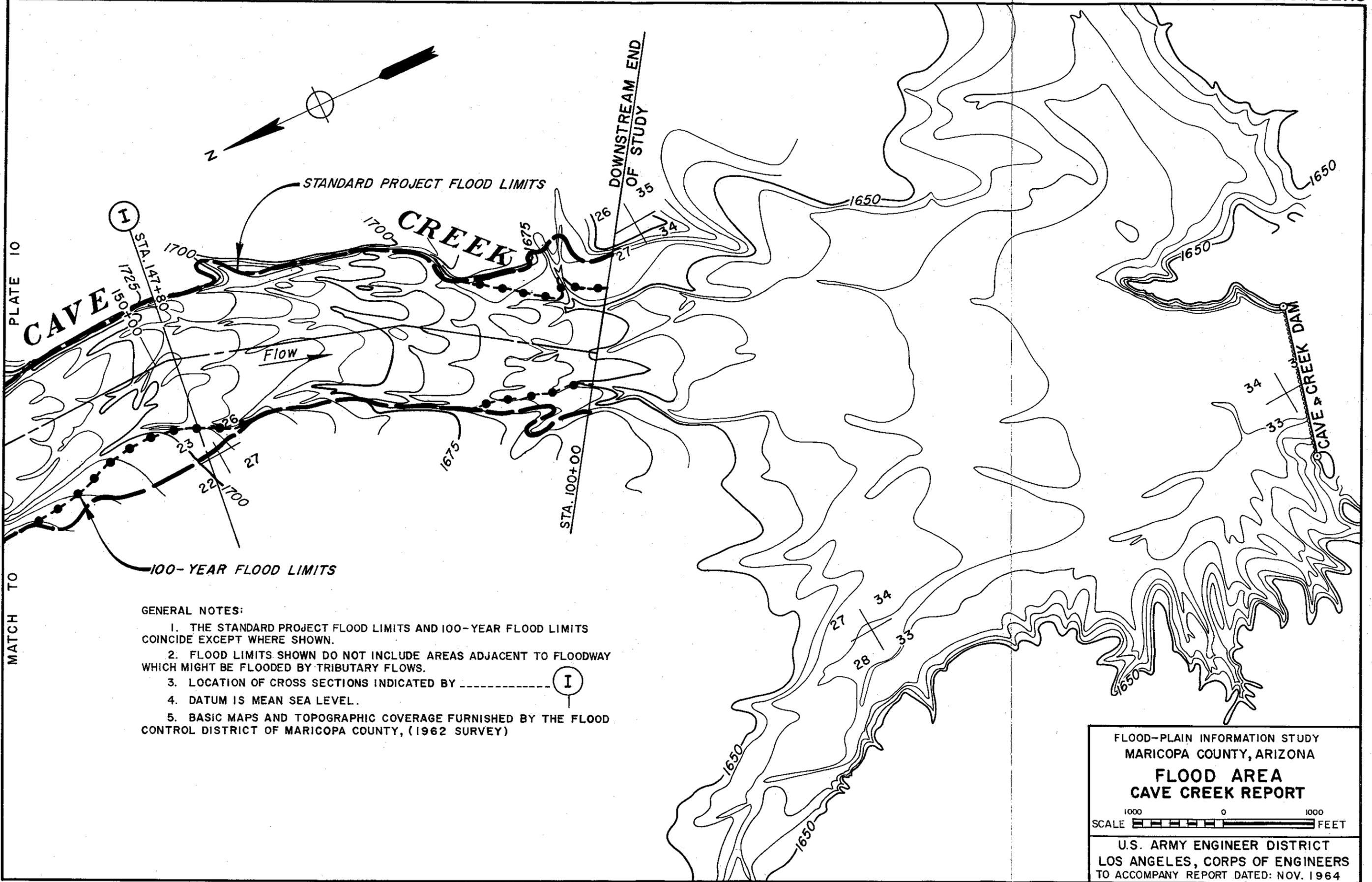
GENERAL NOTES:

1. THE STANDARD PROJECT FLOOD LIMITS AND 100-YEAR FLOOD LIMITS COINCIDE EXCEPT WHERE SHOWN.
2. FLOOD LIMITS SHOWN DO NOT INCLUDE AREAS ADJACENT TO FLOODWAY WHICH MIGHT BE FLOODED BY TRIBUTARY FLOWS.
3. LOCATION OF CROSS SECTIONS INDICATED BY _____ (A)
4. MOSAIC MADE UP FROM AN AERIAL SURVEY FLOWN BY WHITEHURSE AERIAL SURVEYS IN FEBRUARY 1963.

FLOOD-PLAIN INFORMATION STUDY
 MARICOPA COUNTY, ARIZONA
AERIAL MAP
CAVE CREEK REPORT



U.S. ARMY ENGINEER DISTRICT
 LOS ANGELES, CORPS OF ENGINEERS
 TO ACCOMPANY REPORT DATED: NOV 1964



GENERAL NOTES:

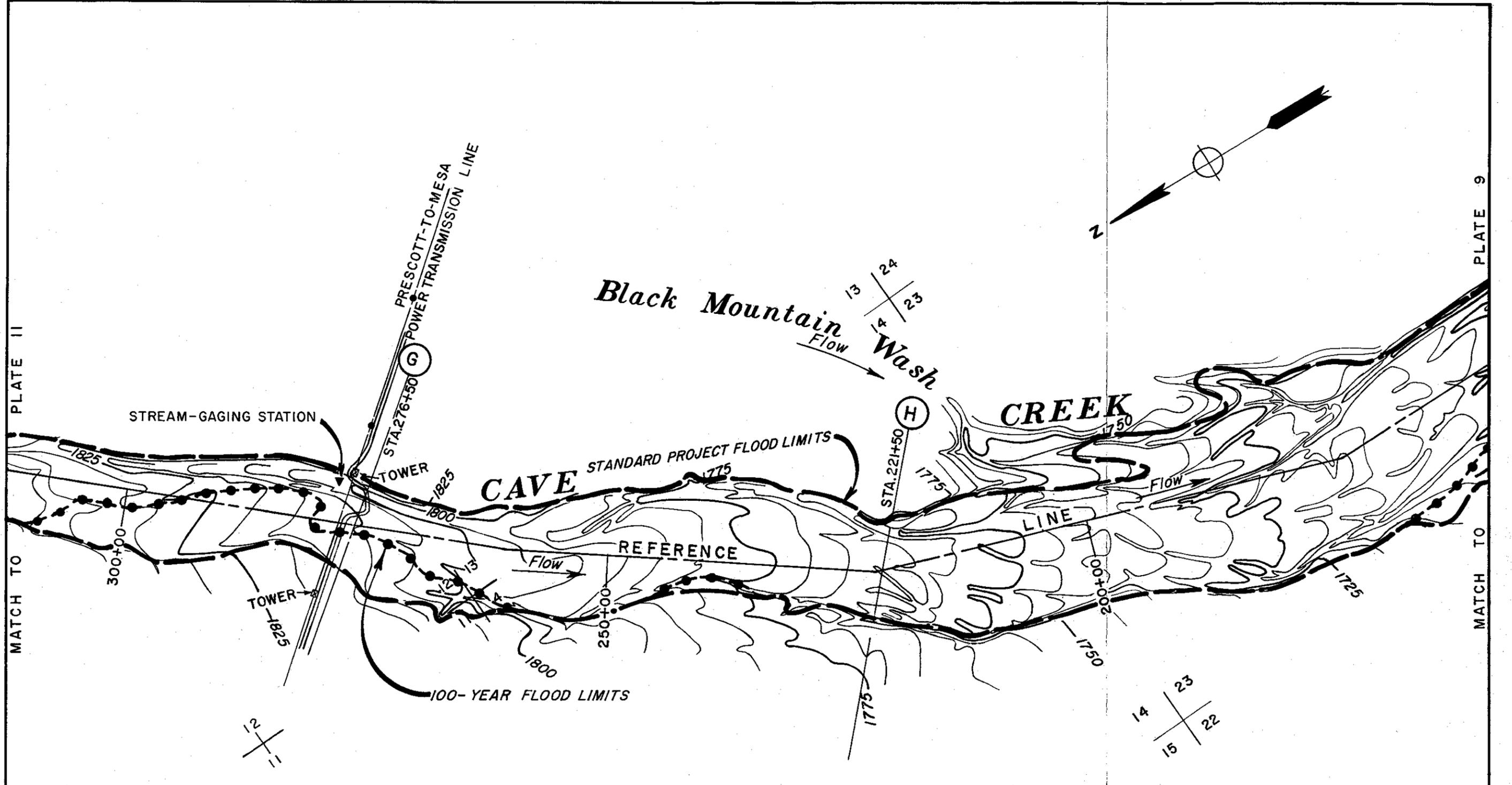
1. THE STANDARD PROJECT FLOOD LIMITS AND 100-YEAR FLOOD LIMITS COINCIDE EXCEPT WHERE SHOWN.
2. FLOOD LIMITS SHOWN DO NOT INCLUDE AREAS ADJACENT TO FLOODWAY WHICH MIGHT BE FLOODED BY TRIBUTARY FLOWS.
3. LOCATION OF CROSS SECTIONS INDICATED BY I
4. DATUM IS MEAN SEA LEVEL.
5. BASIC MAPS AND TOPOGRAPHIC COVERAGE FURNISHED BY THE FLOOD CONTROL DISTRICT OF MARICOPA COUNTY, (1962 SURVEY)

FLOOD-PLAIN INFORMATION STUDY
MARICOPA COUNTY, ARIZONA

**FLOOD AREA
CAVE CREEK REPORT**

1000 0 1000
SCALE FEET

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED: NOV. 1964

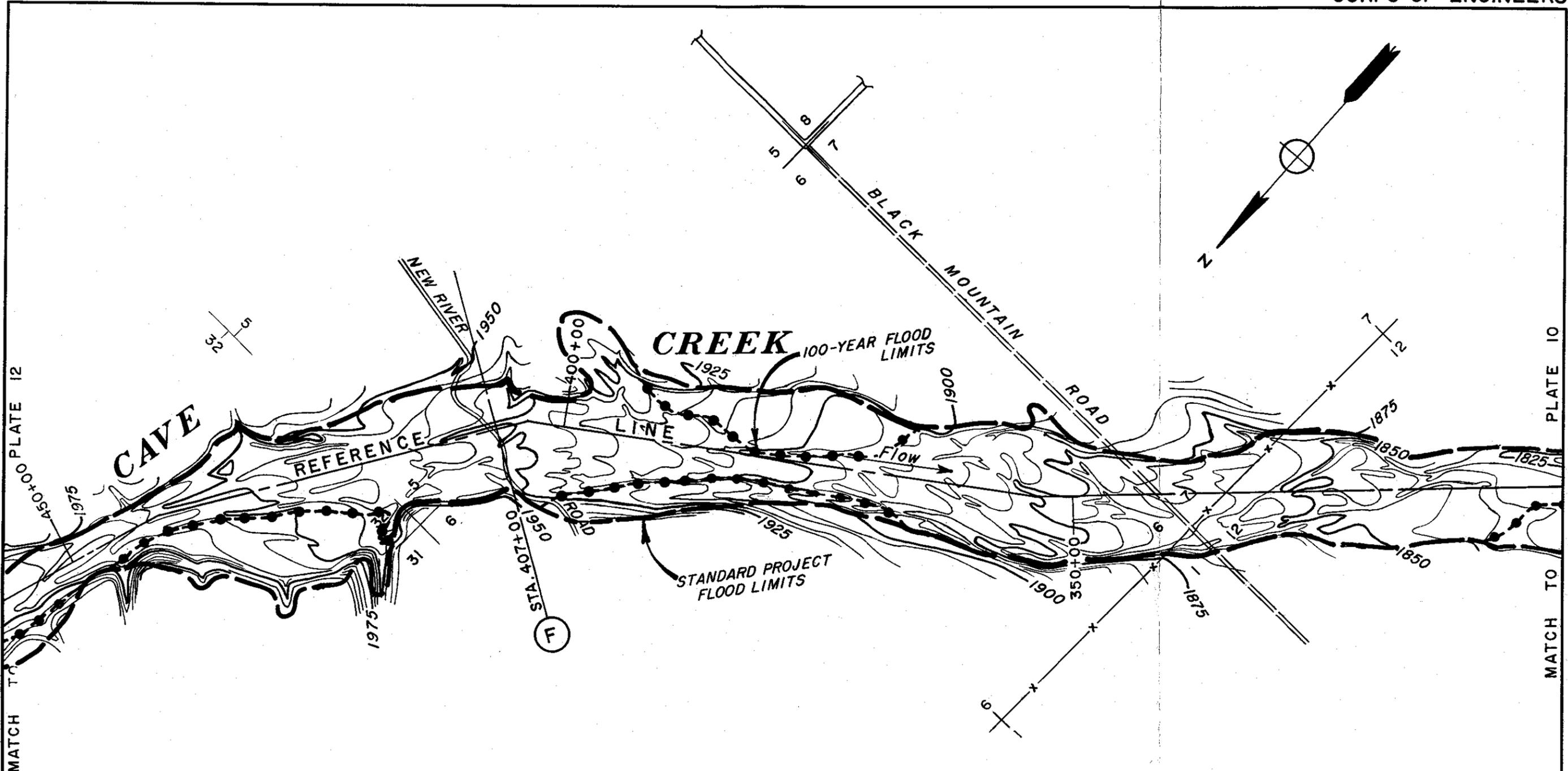


NOTE:
FOR GENERAL NOTES SEE PLATE 9

FLOOD-PLAIN INFORMATION STUDY
 MARICOPA COUNTY, ARIZONA
**FLOOD AREA
 CAVE CREEK REPORT**

1000 0 1000
 SCALE FEET

U.S. ARMY ENGINEER DISTRICT
 LOS ANGELES, CORPS OF ENGINEERS
 TO ACCOMPANY REPORT DATED: NOV. 1964

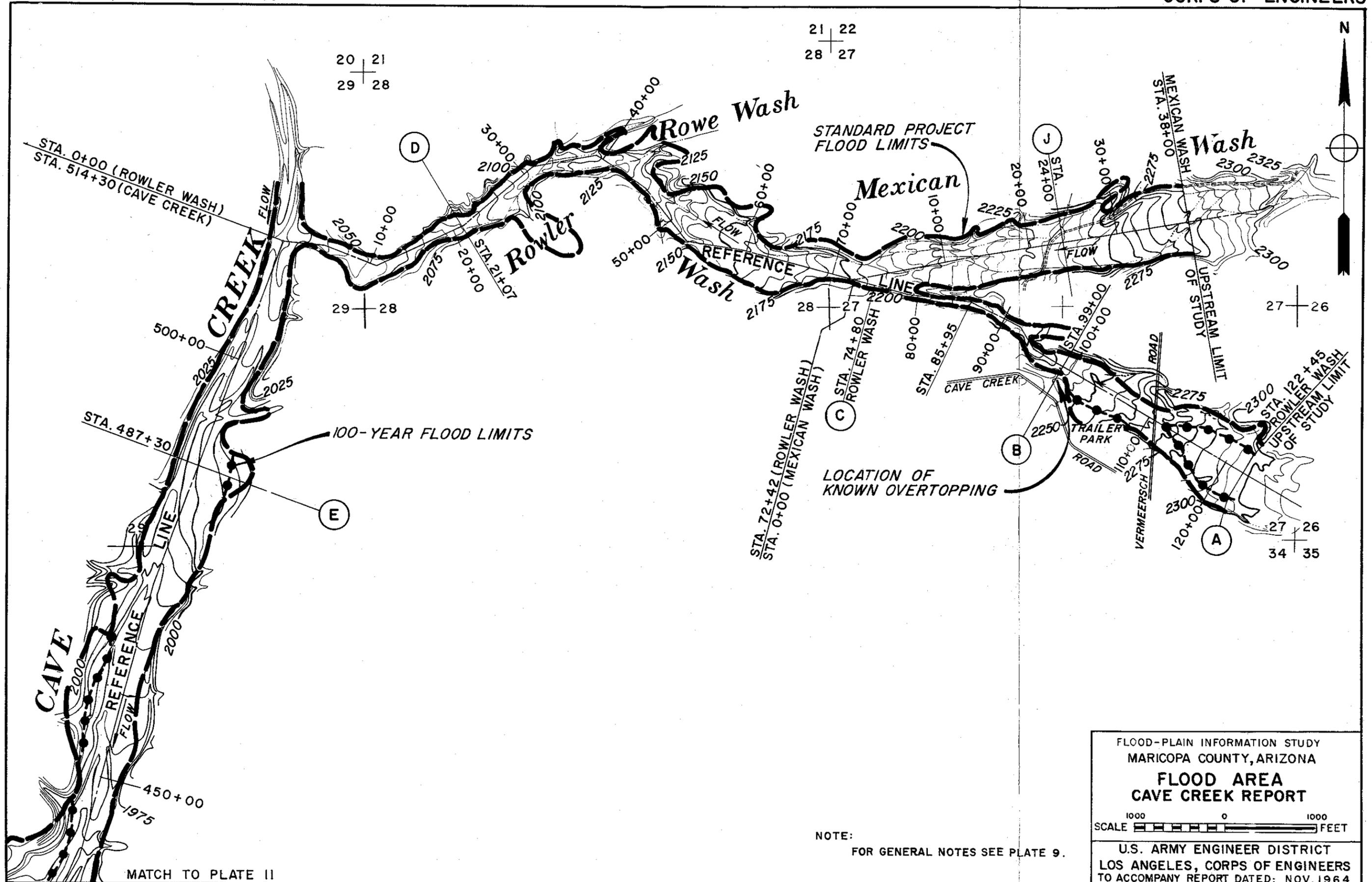


NOTE:
FOR GENERAL NOTES SEE PLATE 9

FLOOD-PLAIN INFORMATION STUDY
 MARICOPA COUNTY, ARIZONA
**FLOOD AREA
 CAVE CREEK REPORT**

1000 0 1000
 SCALE FEET

U.S. ARMY ENGINEER DISTRICT
 LOS ANGELES, CORPS OF ENGINEERS
 TO ACCOMPANY REPORT DATED: NOV. 1964



FLOOD-PLAIN INFORMATION STUDY
 MARICOPA COUNTY, ARIZONA
**FLOOD AREA
 CAVE CREEK REPORT**

1000 0 1000
 SCALE FEET

U.S. ARMY ENGINEER DISTRICT
 LOS ANGELES, CORPS OF ENGINEERS
 TO ACCOMPANY REPORT DATED: NOV. 1964

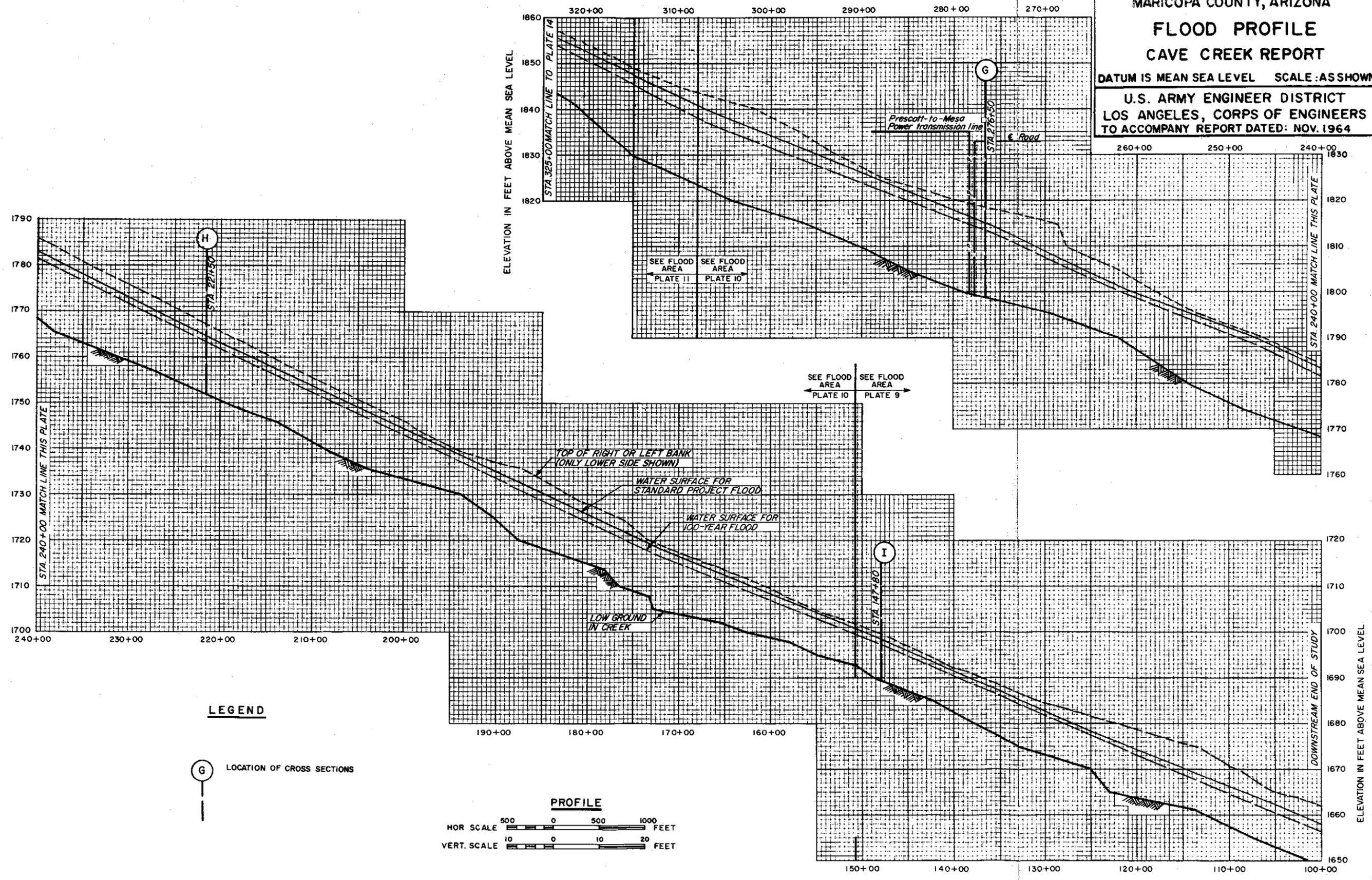
NOTE:
 FOR GENERAL NOTES SEE PLATE 9.

FLOOD-PLAIN INFORMATION STUDY
MARICOPA COUNTY, ARIZONA

FLOOD PROFILE
CAVE CREEK REPORT

DATUM IS MEAN SEA LEVEL SCALE: AS SHOWN

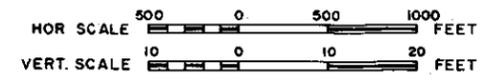
U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED: NOV. 1964



LEGEND

G LOCATION OF CROSS SECTIONS

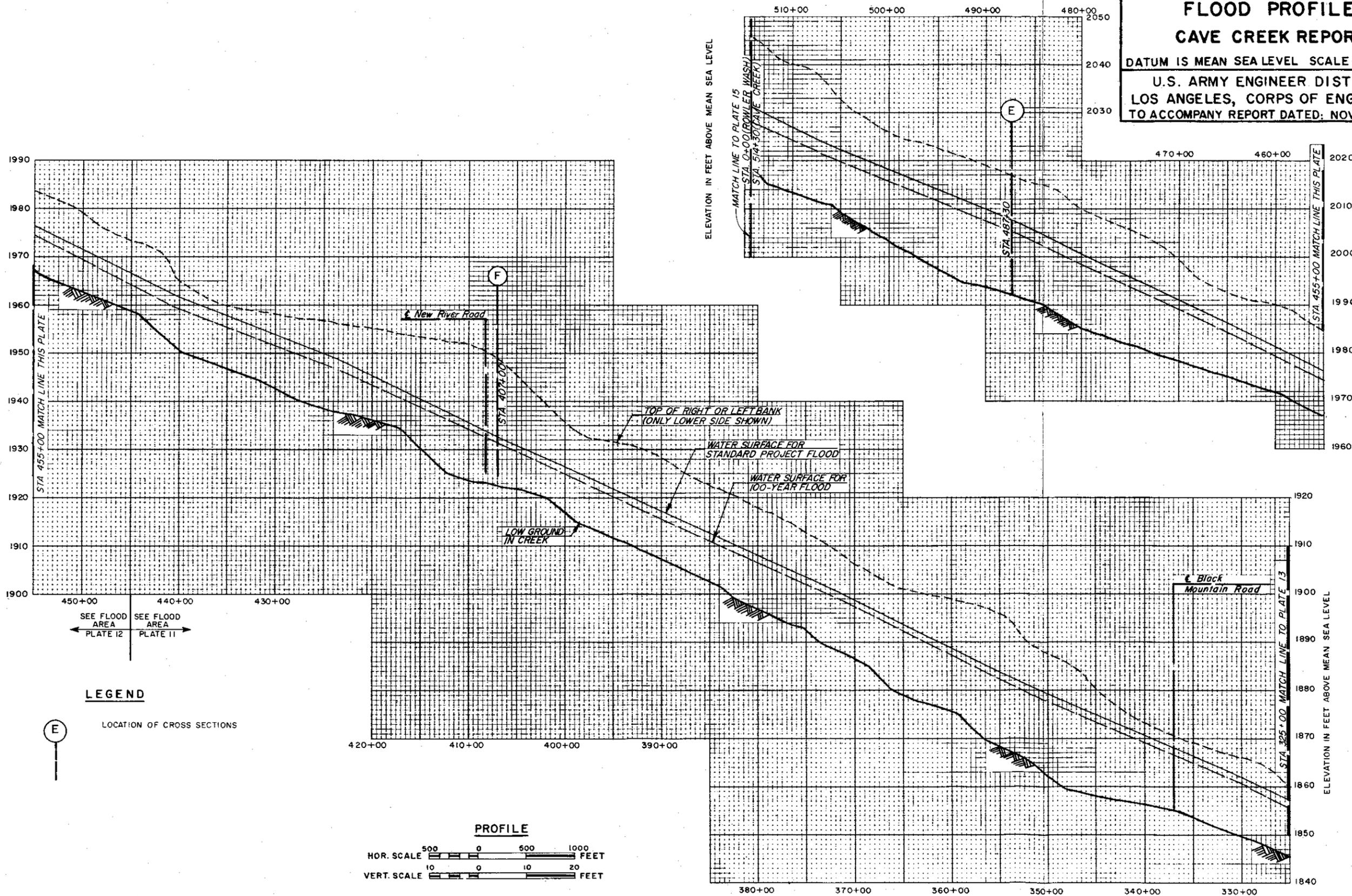
PROFILE



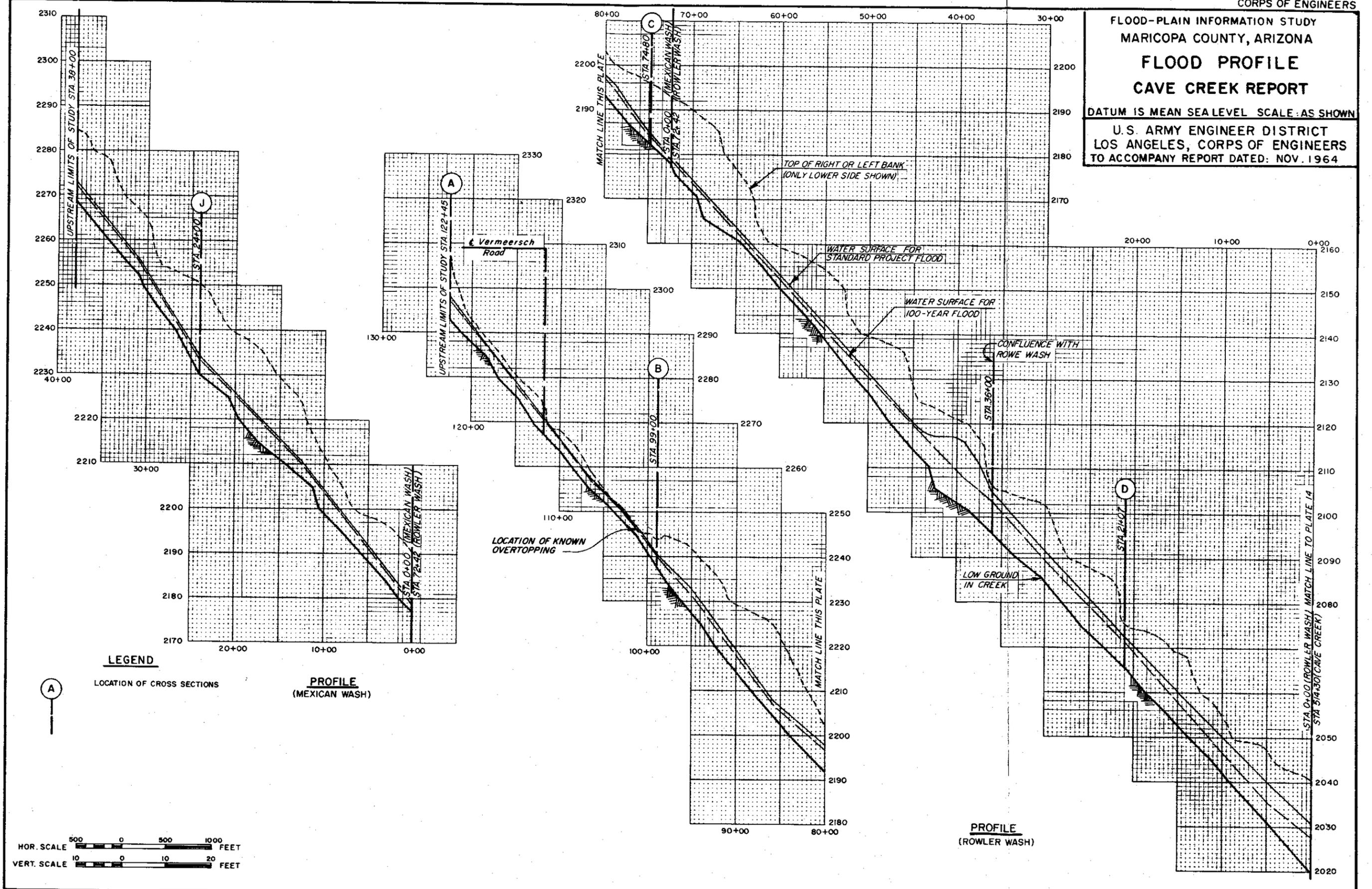
FLOOD-PLAIN INFORMATION STUDY
MARICOPA COUNTY, ARIZONA
FLOOD PROFILE
CAVE CREEK REPORT

DATUM IS MEAN SEA LEVEL SCALE AS SHOWN

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED: NOV. 1964



FLOOD-PLAIN INFORMATION STUDY
 MARICOPA COUNTY, ARIZONA
FLOOD PROFILE
CAVE CREEK REPORT
 DATUM IS MEAN SEA LEVEL SCALE AS SHOWN
 U.S. ARMY ENGINEER DISTRICT
 LOS ANGELES, CORPS OF ENGINEERS
 TO ACCOMPANY REPORT DATED: NOV. 1964



APPENDIX I - AUTHORIZATION
FLOOD-PLAIN INFORMATION STUDY
FOR
MARICOPA COUNTY, ARIZONA

VOLUME II

CAVE CREEK REPORT

1. Scope.--This appendix presents supplemental material on (a) the congressional authorization providing authority for the U.S. Army Corps of Engineers to conduct flood-plain information studies and (b) the Maricopa County resolutions requesting the Corps to make such studies in Maricopa County and providing assurances that information in the completed report will be disseminated and publicized.

2. Congressional authorization.--This report is prepared pursuant to act of Congress, Public Law 86-645, Eighty-sixth Congress, approved 14 July 1960, which reads in part as follows:

SEC. 206. (a) That, in recognition of the increasing use and development of the flood plains of the rivers of the United States and of the need for information on flood hazards to serve as a guide to such development, and as a basis for avoiding future flood hazards by regulation of use by States and municipalities, the Secretary of the Army, through the Chief of Engineers, Department of the Army, is hereby authorized to compile and disseminate information on floods and flood damages, including identification of areas subject to inundation by floods of various magnitudes and frequencies, and general criteria for guidance in the use of flood plain areas; and to provide engineering advice to local interests for their use in planning to ameliorate the flood hazard: Provided, That the necessary surveys and studies will be made and such information and advice will be provided for specific localities only upon the request of a State or a responsible local governmental agency and upon approval by the Chief of Engineers.

(b) The Secretary of the Army is hereby authorized to allot, from any appropriations hereafter made for flood control, sums not to exceed \$1,000,000 in any one fiscal year for the compilation and dissemination of such information.

* * * * *

3. Maricopa County resolutions.--The Board of Supervisors of Maricopa County and the Board of Directors of the Flood Control District of Maricopa County adopted resolutions on 26 September 1960 and 11 December 1961.

4. In the resolution of 26 September 1960, Maricopa County requested that the U.S. Army Corps of Engineers make a flood-plain information study for Maricopa County. The resolutions reads as follows:

R E S O L U T I O N

WHEREAS, the Flood Control District of Maricopa County is charged with responsibility for preparation of a comprehensive program of flood control within the county, and

WHEREAS, information on floods and flood damages, including identification of areas subject to inundation by floods of various frequencies, criteria for guidance in the use of flood plain areas and engineering advice for use in planning to ameliorate flood hazard are essential to the preparation of a comprehensive program of flood control, and

WHEREAS, the United States Army Corps of Engineers is authorized under Section 206 of the Flood Control Act of 1960 to furnish such information and advice

NOW, THEREFORE, BE IT RESOLVED by the Board of Supervisors of Maricopa County and the Board of Directors of the Flood Control District of Maricopa County that the Corps of Engineers is requested to provide the assistance which it is authorized to furnish by the above cited Act, and

BE IT FURTHERMORE RESOLVED that the Flood Control District of Maricopa County will assist the Corps of Engineers in obtaining basic hydrologic and topographic data required for its studies and

BE IT FURTHERMORE RESOLVED that the County of Maricopa and the Flood Control District of Maricopa County intend to use the information provided for the purpose of developing flood plain zoning plans and a comprehensive program of flood control and

BE IT FURTHERMORE RESOLVED that information and assistance will be furnished municipalities within the county for their use in implementing such flood plain zoning plans as may be recommended within their boundaries.

BE IT FURTHERMORE RESOLVED, that this resolution be entered on the minutes of the Board of Supervisors of Maricopa County and the Board of Directors of the Flood Control District of Maricopa County.

Passed and approved this 26 day of Sept., 1960.

/s/ Ruth A. O'Neil
Chairman of the Board
of Supervisors of
Maricopa County
ATTEST:
/s/ Rhea Averill
Clerk of the Board

/s/ Ruth A. O'Neil
Chairman of the Board
of Directors of the
Flood Control District
of Maricopa County

5. In the resolution of 11 December 1961, Maricopa County added more specific assurances that the flood-plain information report will be made available to all interested organizations and individuals and that the availability of the report will be adequately publicized.

The resolution reads as follows:

R E S O L U T I O N

WHEREAS, the Flood Control District of Maricopa County is charged with responsibility for preparation of a comprehensive program of flood control within the county, and

WHEREAS, information on floods and flood damages, including identification of areas subject to inundation by floods of various frequencies, criteria for guidance in the use of flood plain areas and engineering advice for use in planning to ameliorate flood hazard are essential to the preparation of a comprehensive program of flood control, and

WHEREAS, the United States Army Corps of Engineers is authorized under Section 206 of the Flood Control Act of 1960 to furnish such information and advice, and

WHEREAS, the United States Army Corps of Engineers has authorized a flood plain information study of Maricopa County, Arizona, in accordance with the application of the Maricopa County Flood Control District dated July 26, 1960; project allocations covering Indian Bend Wash, Cave Creek, Skunk Creek, New River, Agua Fria River and Wickenburg area, and

WHEREAS, the United States Army Corps of Engineers require certain assurances from the Maricopa County Flood Control District before work can be initiated

NOW, THEREFORE, BE IT RESOLVED by the Board of Supervisors of Maricopa County and the Board of Directors of the Flood Control District of Maricopa County that the applicant will publicize the information report in the community and area concerned, and make copies available for use or inspection by responsible interested parties and individuals, and

BE IT FURTHERMORE RESOLVED that zoning and other regulatory, development and planning agencies, and public information media, will be provided with the flood plain information for their guidance and appropriate action, and

BE IT FURTHERMORE RESOLVED that survey markers, monuments, etc., established in any Federal surveys undertaken for Sec. 206 studies, or in regular surveys in the area concerned will be preserved and safeguarded, and

BE IT FURTHERMORE RESOLVED, that this resolution be entered on the minutes of the Board of Supervisors of Maricopa County and the Board of Directors of the Flood Control District of Maricopa County, and that the Chief Engineer and General Manager of said Flood Control District be and he is hereby directed to forward a certified copy of this resolution to the District Engineer, U. S. Army Engineer District, Los Angeles, Corps of Engineers, P. O. Box 17277 Foy Station, Los Angeles 17, California.

PASSED AND APPROVED this 11 day of December, 1961.

/s/ B.W. Burns
Chairman of the Board of Supervisors of Maricopa County

ATTEST:

/s/ Rhea Averill
Clerk of the Board

/s/ B.W. Burns
Chairman of the Board of Directors of the Flood Control District of Maricopa County
APPROVED:
Board of Supervisors

by /s/ Charles W. Miller
Charles W. Miller
County Manager

APPENDIX 2 - GLOSSARY OF SELECTED TERMS

FLOOD-PLAIN INFORMATION STUDY
FOR
MARICOPA COUNTY, ARIZONA

VOLUME II

CAVE CREEK REPORT

The definitions in this appendix are provided for consistency of use in flood-plain information studies and for clarification of terms for nontechnical readers. The definitions are based on definitions of terms in general technical usage.

BASIN - The region drained by a stream and its tributaries. A basin is separated from adjacent basins by ridges or mountain ranges.

CUBIC FEET PER SECOND (C.F.S.) - A measure of the magnitude of streamflow (i.e., the number of cubic feet of water passing a point each second).

DESIGNATED FLOODWAY - The channel of a stream and that part of the adjoining flood plain designated by a regulatory agency to reasonably provide for passage of a selected flood. (See also definition of "floodway.")

FLOOD - As used in this report, any temporary rise in streamflow or water-surface level that results in significant adverse effects in the area under study. Adverse effects of floods may include damages from overflow of land areas, effects of temporary backwater on sewers and local drainage channels, bank erosion or channel shifts, unsanitary conditions or other unfavorable conditions resulting from deposition of materials in stream channels during flood recessions, rise of ground water coincident with increased streamflow, and interruption of traffic at bridge crossings.

FLOOD FREQUENCY - The frequency of occurrence of a flood of some stated magnitude in terms of years. Based on statistical analysis of past flood records, a determination may be made of the probable number of times that a flood of some stated magnitude will be equaled or exceeded during some future period of time, say 100 years. A 25-year flood with a magnitude of 8,000 cubic feet per second is a flood that during a 100-year period probably will be equaled or exceeded four times. The term "25-year flood" does not mean that such a flood can occur only once in 25 years and that once it occurs the flood will not happen again for another 25 years. Because floods occur randomly, they may be grouped or spread out unevenly with respect to time.

FLOOD PEAK - The maximum instantaneous discharge of a flood at a given location. The discharge generally is expressed in cubic feet per second.

FLOOD PLAIN - The relatively flat area or lowlands adjoining the channel of a stream or watercourse and subject to overflow by floodwaters.

FLOOD-PLAIN REGULATIONS - A general term applied to the full range of codes, ordinances, and other regulations pertaining to land use and to construction within the channel and flood-plain areas. The term encompasses zoning ordinances, subdivision regulations, building and housing codes, floodway-encroachment laws, open-area regulations, and similar controls affecting the use and development of the flood-plain areas.

FLOOD PROFILE - A graph showing the relationship of water-surface elevation to location for a stream of water flowing in an open channel. The location generally is expressed as the distance upstream from the channel mouth. The graph generally is drawn to show the water-surface elevation for the crest of a specific flood, but may be prepared for conditions at any given time or stage.

FLOODPROOFING - A combination of measures taken to render structures, property, and lands less vulnerable to flood losses.

FLOODWAY - The channel of a stream and that part of the flood plain inundated by a flood and, therefore, used to carry floodflow. (See also definitions of "designated floodway.")

FLOODWAY-ENCROACHMENT LINES - Those lateral lines along streams that mark the limits of the designated floodway. (See also definition of "designated floodway.") No structure or fill may be placed in the area between these lines without reducing the flood-carrying capacity of that floodway. The locations of the lines should be such that the floodway between the lines will accommodate a designated floodflow except for minor overflow into the restrictive zone.

GAGING STATION - A facility on a stream or reservoir where systematic observations of stage (water-surface level) or discharge are made.

PRECIPITATION STATION - A facility where systematic observations of the depth of rainfall are made.

RESTRICTIVE ZONE - That part of the floodway within the overflow limits of a selected flood and outside the designated floodway. (See also definitions of "floodway" and "designated floodway.") The restrictive zone is established by a zoning ordinance for the

purpose of reducing the flood hazard to life and property by regulating development within the zone. (See also definition of "zoning ordinance.")

STANDARD PROJECT FLOOD - A flood that would result from a storm with the most severe flood-producing rainfall pattern of any storm that is considered reasonably characteristic of the region in which the drainage area is located, giving consideration to the runoff characteristics of the drainage area and excluding extremely rare combinations of meteorologic and hydrologic conditions. Such a flood provides a reasonable upper limit to be considered in designing flood-control improvements.

ZONING ORDINANCE - An ordinance adopted by a local governing body, with authority from a State zoning enabling law, which under the police power divides an entire local governmental area into districts and - within each district - regulates the use of land; the height, bulk, type, and use of buildings or other structures; and the density of population.

APPENDIX 3 - BIBLIOGRAPHY

FLOOD-PLAIN INFORMATION STUDY
FOR
MARICOPA COUNTY, ARIZONA

VOLUME II

CAVE CREEK REPORT

The following is a sampling of published work, mostly recent, on flood-plain regulations and flood-plain development problems.

1. Dunham, Allison, Flood control via the police power*: University of Pennsylvania Law Review, Philadelphia, Pa., vol. 107, No. 8, June 1959, pp. 1098-1132.
2. Goddard, James E., Flood plain management improves man's environment*: Journal of the Waterways and Harbors Division, Proceedings of the American Society of Civil Engineers, vol. 89, No. WW4, Ann Arbor, Mich., November 1963, pp. 67-84.
3. Kates, Robert William, Hazard and choice perception in flood plain management*: University of Chicago Department of Geography Research Paper No. 78, Chicago, Ill., 1962.
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5. Morse, Henry F., Role of the states in guiding land use in flood plains*: Special Report No. 38 of Engineering Experiment Station, Georgia Institute of Technology, Atlanta, Ga., June 1962.
6. Murphy, Francis C., Regulating flood-plain development*: University of Chicago Department of Geography Research Paper No. 56, Chicago, Ill., November 1958.
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8. Task Force on Flood Plain Regulations established by Flood Control Committee of Hydraulics Division of American Society of Civil Engineers, Guide for the development of flood plain regulations*: Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, vol. 88, No. HY5, part 1, Ann Arbor, Mich., September 1962, pp. 73-119.
9. White, Gilbert F., and others, Papers on flood problems*: University of Chicago Department of Geography Research Paper No. 70, Chicago, Ill., 1961.
10. Wiitala, Sulo W., and others, Hydraulic and hydrologic aspects of flood-plain planning*: U.S. Geological Survey Water-Supply Paper 1526, 1961.

* Includes bibliographies and references useful for more extensive reading on the subject of flood-plain studies and related studies.