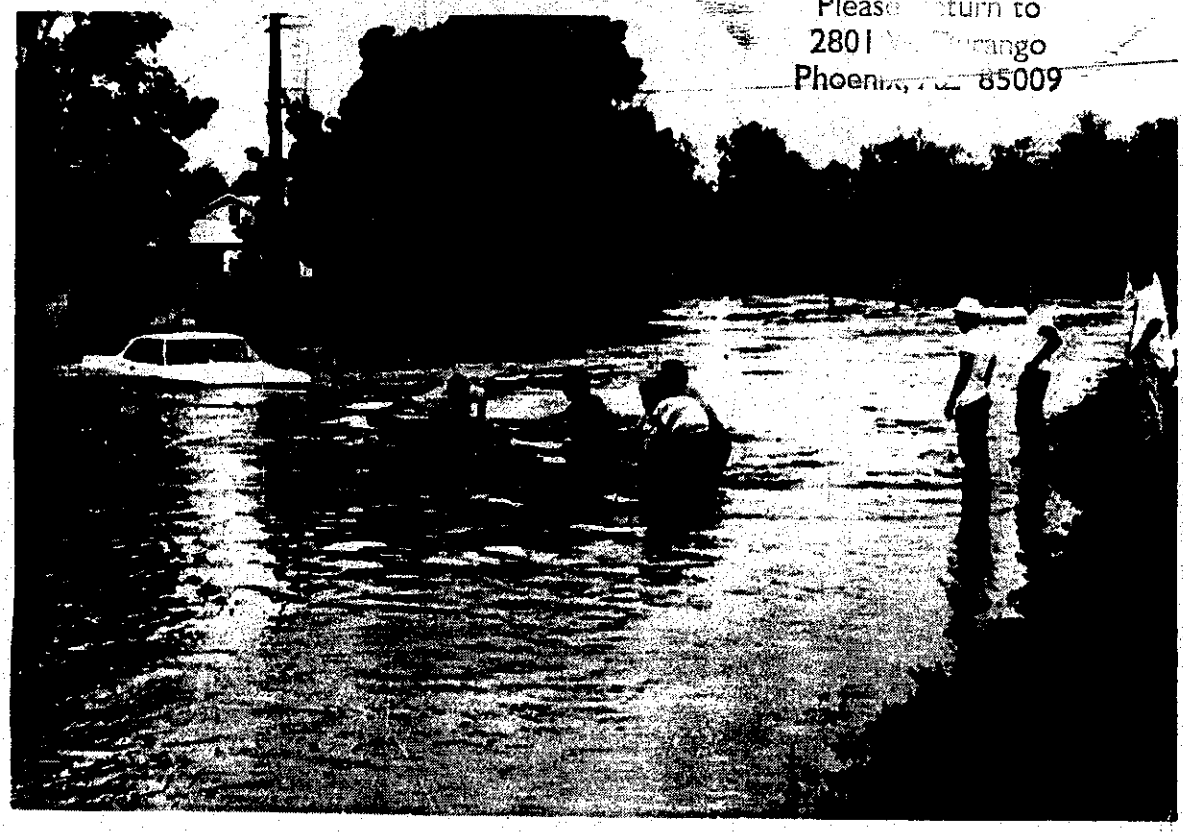
FLOOD PLAIN INFORMATION

HASSAYAMPA RIVER

VICINITY OF WICKENBURG
ARIZONA



PREPARED FOR
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY, ARIZONA
BY
CORPS OF ENGINEERS, U. S. ARMY
LOS ANGELES DISTRICT, CALIFORNIA
APRIL 1972

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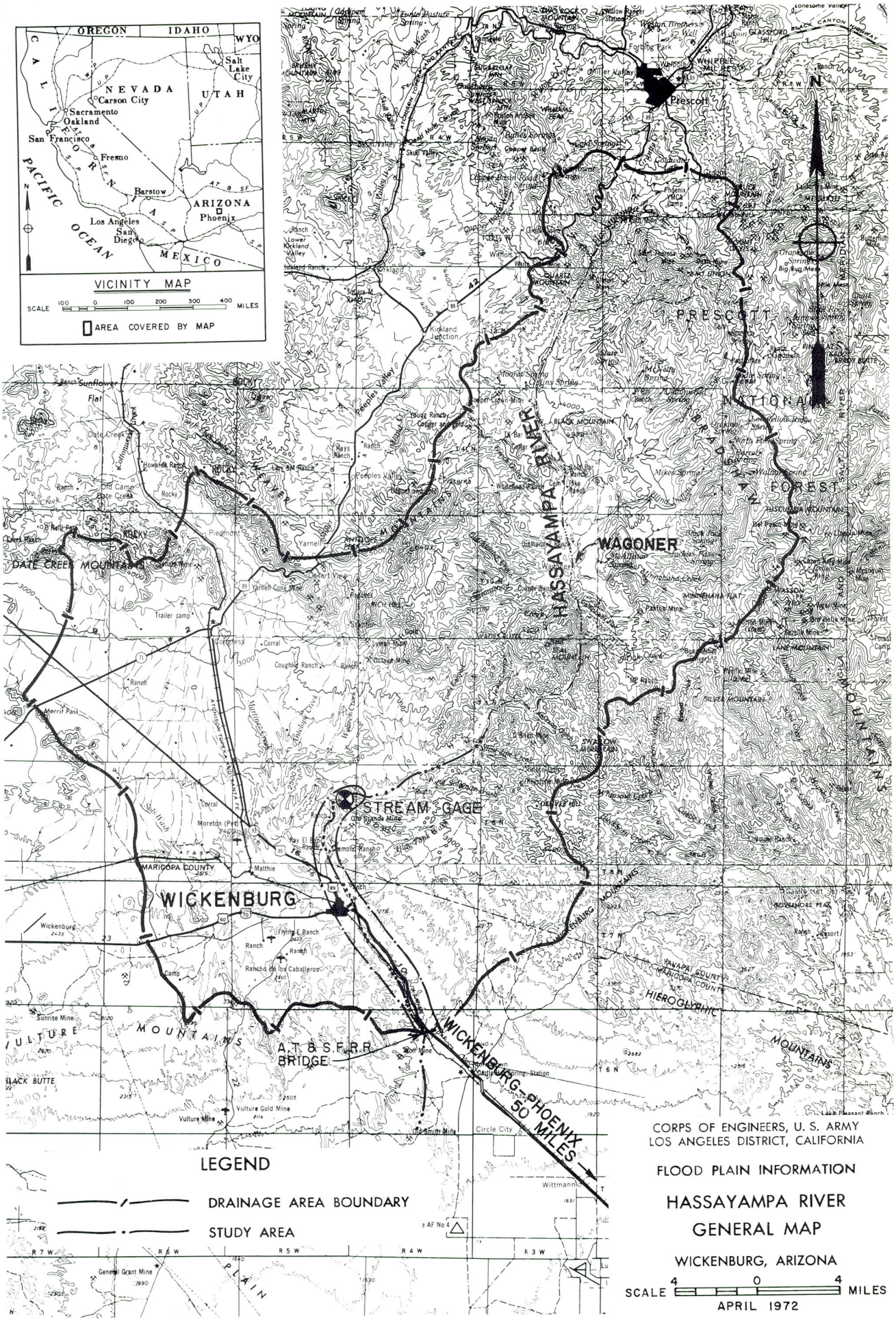
OREGON
IDAHO
WYO
NEVADA
Carson City
Sacramento
Oakland
San Francisco
Fresno
Salt Lake City
UTAH
ARIZONA
Phoenix
Barstow
Los Angeles
San Diego
MEXICO
PACIFIC OCEAN
VICINITY MAP
SCALE 100 0 100 200 300 400 MILES
AREA COVERED BY MAP
Prescott
PRESCOTT NATIONAL FOREST
HASSAYAMPA RIVER
WAGONER
DATE CREEK MOUNTAINS
WICKENBURG
STREAM GAGE
WICKENBURG-PHOENIX 50 MILES
A.T.&S.F.R.R. BRIDGE
VULTURE MOUNTAINS
HIEROGLYPHIC MOUNTAINS
MARICOPA COUNTY
YAVAPAI COUNTY
LEGEND
DRAINAGE AREA BOUNDARY
STUDY AREA
CORPS OF ENGINEERS, U. S. ARMY
LOS ANGELES DISTRICT, CALIFORNIA
FLOOD PLAIN INFORMATION
HASSAYAMPA RIVER
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WICKENBURG, ARIZONA
SCALE 4 0 4 MILES
APRIL 1972

PLATE 1

PREFACE

The purpose of this report is to present information on the flood hazard along the Hassayampa River in Wickenburg, Arizona and the surrounding area. Plate 1 shows the study limits of this report. Land use in the flood plain has been primarily agricultural in the past, but increased residential development is anticipated in the future by local officials. Studies made for this report show that floods larger than those of the past could occur in the future in the study area. This report contains information on past floods, and maps, profiles, and cross sections that indicate the approximate extent and depth of inundation from large floods that can reasonably be expected to occur in the future. For this report, these floods have been designated as the Intermediate Regional and Standard Project Floods.

This report was prepared at the request of the Flood Control District of Maricopa County, Arizona, under the continuing authority provided the Corps of Engineers in section 206 of the 1960 Flood Control Act (Public Law 86-645), as amended.

It is intended that this report be used by local agencies and other flood plain users in developing and using flood plain areas in such a way that flood hazards and future flood damages are minimized. The report also provides the communities concerned a basis for further study and planning toward the optimum use and development of flood prone areas through zoning and subdivision regulations, construction of flood control projects, or a combination of these and other approaches to reducing flood hazards and flood damage. Recommendations or plans for solution of flood problems in the study area are not included in this report. Neither does this report extend any Federal authority over zoning or other regulation of flood plain use. Methods to minimize flood damage in flood prone areas, but still permit their optimum use and development, are introduced in a Corps of Engineers publication entitled "Guidelines for Reducing Flood Damage." Copies of which are available on request.

This report is based upon all available information bearing on the occurrence and size of floods in the Wickenburg area. Limited official records from past major floods exist. An analysis of rainfall and runoff characteristics in conjunction with the existing streamgaging data was the primary basis for determining the size of the future floods discussed in this report.

The assistance and cooperation of the Flood Control District of Maricopa County, the Arizona State Highway Department, the Santa Fe Railroad, the Arizona Republic and Wickenburg Sun newspapers, the City of Wickenburg, the Wickenburg Chamber of Commerce, photographer Vern Kendrick, and individuals who directly or indirectly aided in the preparation of this report are gratefully acknowledged

Maricopa County, through the office of the Flood Control District, will make the information in this report available to all interested agencies and individuals. Copies of the report and information on its use are available in that office. The Los Angeles District of the Corps of Engineers will, upon request, provide technical assistance to Federal, State, and local agencies in the interpretation and use of data presented and will provide other related flood data.

BACKGROUND INFORMATION

Settlement

The Wickenburg area lies in the northeast section of Maricopa County and is about 50 miles northwest of the City of Phoenix. Inhabited lands in the study area include the City of Wickenburg and its immediate surroundings. The remainder of the study area is sparsely inhabited by ranchers. Wickenburg was named for Henry Wickenburg, an Austrian immigrant born in 1820. He arrived in Arizona in 1862 and discovered the Vulture Gold Mine in 1863 about 10 miles south of the present town. This mine became one of the richest in Arizona's territorial history. With his profits from the Vulture Mine, Henry Wickenburg established a ranch near the site of the future town of Wickenburg. The present name of Wickenburg was first used by a James Moore while writing Governor John N. Goodwin; Moore dated his letters, "Wickenburg Ranch," and that name was used thereafter for the locality. As the Vulture Mine developed, so did Wickenburg which reached population of about 500 in 1870. The population of the Wickenburg area was about 1000 in 1940 and about 3000 in 1970.

Today, the Wickenburg area is famous as a retirement and dude ranch center. The region is served by the Wickenburg Airport, 3 U.S. Highway routes, the Santa Fe railroad, and bus service. New developments in the community have been built on the flood plain of the Hassayampa River in the past since flat developable land is scarce. Undeveloped flood plain land will come under increasing demand for use with increasing population and tourism.

The Stream and Its Valley

The word "Hassayampa" comes from a combination of Mojave Indian words meaning "place of big rocks and water." The Hassayampa River, which drains an area in northwestern Maricopa County and southern Yavapai County, originates in the Bradshaw Mountains south of Prescott and empties into the Gila River about 40 miles west of the center of Phoenix. Major tributaries entering the Hassayampa River in the vicinity of Wickenburg were studied in a previous Flood Plain Information Report, "The Wickenburg Report," dated December 1965.

The entire drainage area affecting the study reach (see plate 1) ranges in elevation from about 1,830 feet to about 7,700 feet above mean sea level. The terrain consists of mountains with heavy forest cover in the northern third of the basin, rolling hills in the central third, and typically desert valley in the southern third. The stream gradient of the Hassayampa River ranges from an average of about 20 feet per mile near the downstream study limit to about 400 feet per mile near the upstream study limit.

The climate in the basin varies with latitude and elevation. Wickenburg is in an arid, sub-tropical climatic zone characterized by hot summers, mild winters, and infrequent rainfall. Extremes in temperature readings recorded in Wickenburg are 10 and 117 degrees. Summer highs frequently exceed 100 degrees; winter lows occasionally dip below freezing. The mean annual precipitation for the drainage area ranges from 10 inches in the lower desert to about 30 inches in the higher mountains, and averages about 18 inches over the total drainage area. The mean summer seasonal precipitation (May to September) ranges from 4 inches in the lower desert to 12 inches in the higher mountains. Snow is not considered an important factor contributing to runoff from the summer storms.

Drainage areas upstream from several points along the Hassayampa River are shown in table 1.

TABLE 1

DRAINAGE AREAS

Location	Drainage area sq. miles
Below San Domingo Wash	813
Below Monarch Wash	780
Below Turtleback Wash	751
Below Calamity & Cemetery Washes	742
Below Sols Wash	724
Above Sols Wash	565
At Box Canyon	421

(See Plate 2 for locations)

Developments on the Flood Plain

Most of the land on the Hassayampa River flood plain has been developed. At present, the bulk of the development is limited to agricultural uses, such as grazing and thoroughbred horse breeding. Highway 60, 70, 89, and 93 parallels the river on the east bank south of Wickenburg then crosses the flood plain in Wickenburg. The Santa Fe Railroad crosses the river near the downstream study limit then parallels the flood plain on the west bank up to Wickenburg. A few commercial and light industrial structures in Wickenburg as well as several residences are in the flood plain.

Other developments existing on the flood plain include: a roadside park, a sewage treatment plant and main outfall sewer, a high school, several trailer parks, apartments, motels, dude ranches, the recently completed Wickenburg Community Center, streets, public utilities, and a privately owned airstrip. Planned uses for the flood plain include recreational, industrial, commercial, civic, and agricultural. As population and tourism increase in the study area, much of the flood plain currently utilized for agricultural purposes will come under increasing pressure to be developed with permanent structures of all types.

FLOOD SITUATION

Sources of Data and Records

The U.S. Geological Survey stream gage located in Box Canyon (See Plates 1 and 2) yielded data for the report. Other hydrologic and meteorologic data were obtained from the U.S. Soil Conservation Service, the Bureau of Reclamation, the National Weather Service, and the Geological Survey. Information on past floods was provided by the above mentioned sources and from newspaper accounts and accounts of local residents.

Maps, tables and other data prepared for this report are based on topographic maps that were supplied by the Flood Control District of Maricopa County. These topographic maps were produced from 1971 aerial photographs. Structural details of the two bridges in the study area were supplied by the Arizona State Highway Department and the Santa Fe Railroad.

Flood Season and Flood Characteristics

Three types of storms produce precipitation in the area: general storms, general summer storms, and thunderstorms.

General storms can occur at any time of the year and are caused by weather fronts passing through the area usually from the west coast or pacific northwest. They affect large areas, sometimes for several days. Because these fronts must first pass over the coastal mountains, much of their moisture is lost by the time they reach the study area.

General summer storms usually occur in late summer or early fall. Tropical storms originating along the Mexican Pacific Coast or the Gulf of Mexico can reach the Wickenburg area, producing the general summer storm that is characterized by heavy precipitation over large areas.

Thunderstorms commonly occur in the months of July through October, although they could occur at anytime of the year. This type of storm covers comparatively small areas and usually is of high intensity rainfall. The duration is usually short, about 3 hours or less.

Springs and occasional precipitation produce some continuous streamflow in the mountainous sections of the area. Little streamflow occurs in most of the area except during and immediately following rains because climatic and drainage area characteristics are not conducive to continuous runoff. Streamflow increases rapidly in response to effective rainfall.

Factors Affecting Flooding and Its Impact

Obstructions to floodflows – Natural obstructions to floodflow include brush, large trees, and other vegetation growing along the streambanks in floodway areas. Man-made obstructions include the two bridges listed in table 4. During floods, brush growing in floodways impedes floodflows, thus creating backwater and increased flood heights. Brush may be washed out and carried downstream to collect on bridges and on other obstructions to flow, creating a damming effect and a raised water surface. As floodflow increases, masses of debris break loose and a wall of water and debris surges downstream until another obstruction is encountered. Debris may collect against a bridge creating a damming effect until the hydrostatic load exceeds its structural capability and the bridge is destroyed.

In general, obstructions restrict floodflows and cause overbank flows, unpredictable areas of flooding, destruction of, or damage to, bridges and culverts, and increased velocity of flow immediately downstream. The two major obstructions to floodflows are shown in figures 1 and 2.

Flood damage reduction measures – At present, there are no Federal flood control projects in the study area. Furthermore, there are no state, county, city or local agency or private interest flood control projects existing in the study area. A dam in Box Canyon in conjunction with an irrigation district downstream was proposed in a 1945 Bureau of Reclamation study. This dam has not been constructed as of the date of this report.

Other factors and their impact – The general summer storm was determined to be the critical storm since it would cause higher peak discharges and more damage than the other types of storms which could occur in the study area. Flooding and threats of flooding promote action by local officials in flood warning and flood fighting activities. Materials stored on the flood plain pose another hazard during large floods.

Flood warnings and forecasting – The National Oceanic and Atmospheric Administration(NOAA) maintains year-round surveillance of weather conditions. Storm forecasts, made by the National Weather Service, NOAA, are supplied to the Weather Service district offices for distribution to federal, state, and local agencies and to the public. The intensity and duration of storm activity can be estimated from radar and satellite reports, and, if conditions warrant, flood warnings can be issued. Local news media and law enforcement agencies disseminate these warnings to the public.

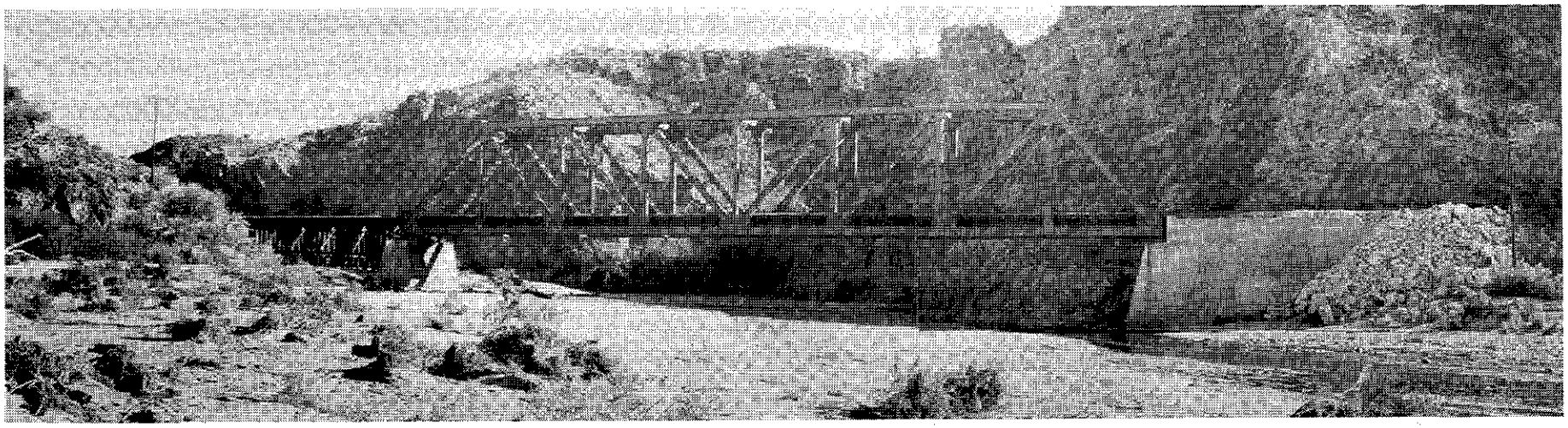


Figure 1 — AT & SF railroad bridge over Hassayampa River (looking upstream at river mile 40.04).

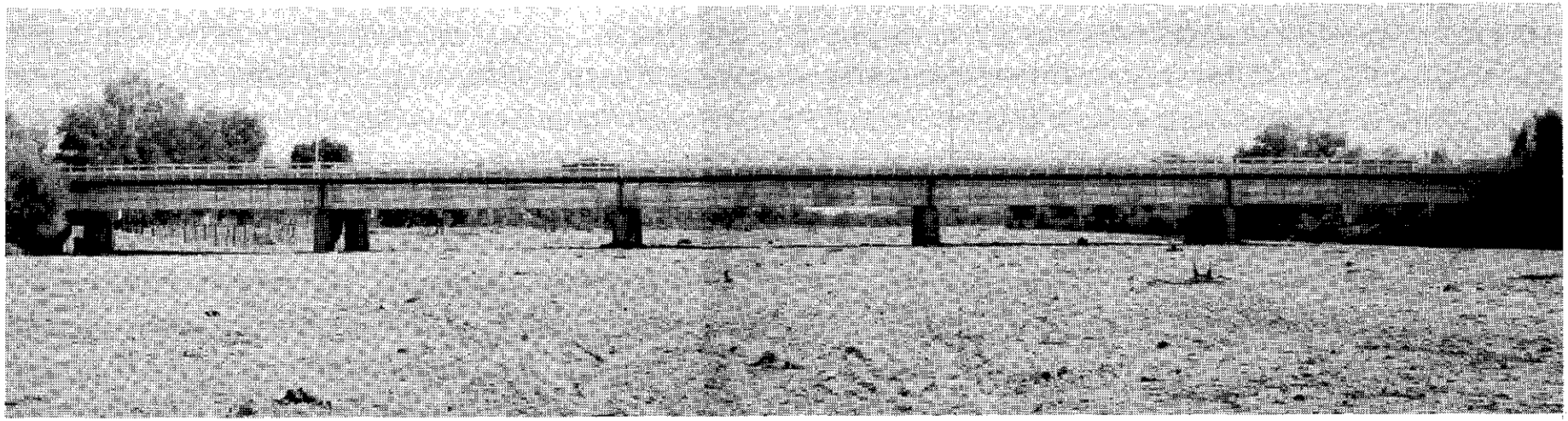


Figure 2 — Highway 60, 70, 89, 93 bridge over Hassayampa River (looking downstream at river mile 47.63).

Flood fighting and emergency evacuation plans — In the event of a major flood, emergency procedures would be activited by the county, the State and upon request, by the Federal government. State and local law enforcement agencies, county flood control districts, local fire departments, street and highway maintenance crews, and civil defense groups could assist in the rescue of stranded persons and perform other flood fighting activities. The Federal government, through the Corps of Engineers, will also, upon request, aid in flood fighting, evacuation, and restoration work. Services of the Corps can be requested by the State Office of Emergency Service or, in the event that the area is designated as a disaster area by the President of the United States, by the Office of Emergency Preparedness (OEP).

Floatable materials stored on the flood plain — During a major flood on the Hassayampa River, floatable materials unconfined on the flood plain would be transported downstream. However, due to the sparse industrial development on the flood plain, there is very little floatable material being stored there. The amount of unrestrained floatable objects (such as empty tanks, large containers, crates, and piles of lumber) which would be carried by the peak of a major flood would be small in relation to the probable amount of natural debris.

PAST FLOODS

Summary of Historical Floods

Damaging floods on the Hassayampa River are known to have occurred in Wickenburg and vicinity as early as 1890. Peak flood discharges were recorded as early as 1916. Major floods (those having a peak discharge greater than 10,000 cubic feet per second) have occurred in 1916, 1919, 1921, 1923, 1925, 1927, 1935, 1937, 1938, 1951, 1958, 1968, and 1970. The flood of September 1970 had the largest recorded peak discharge (estimated to be 58,000 cubic feet per second) since records were instituted in 1916; however, the flood of 1890 was a worse disaster in terms of loss of life.

Flood Records

The U.S.G.S. stream gage at Box Canyon on the Hassayampa River was established in 1938; however, the U.S.G.S. record of peak flows extends back to 1916. Information on floods prior to 1916 was obtained from accounts in newspapers, almanacs, and history texts. Estimated maximum peak discharges at Box Canyon during major floods from 1916 through 1970 are shown in table 2.

TABLE 2

HISTORICAL PEAK FLOWS

Date		Estimated Peak at Box Canyon
Month	Year	c.f.s.
September	1970	58,000
August	1935	30,000
February	1927	27,100
August	1951	27,000
September	1925	25,500
February	1937	22,000
November	1919	20,000
October	1916	18,000
July	1921	13,000
December	1968	11,200
September	1958	10,600
December	1923	10,200
March	1938	10,050

Flood Descriptions

Flood of February 1890. A few miles downstream of the town currently known as Wagoner (See Plate 1), the Walnut Grove Water Storage Company, organized in 1886, began construction of a dam to fill the needs for water and power at the placer mines nearby. This dam, a rockfill structure 110 feet high, formed a reservoir of 10,000 acre-feet capacity. In February 1890, before the spillway was completed, an extremely high runoff caused failure of the dam. The resulting wall of water tore its way down the Hassayampa River causing substantial damages and claiming the lives of 76 people trapped in its path. This flood ranks as one of the worst disasters in Arizona history, as well as United States history, in terms of loss of life.

Flood of September 1970. The largest recorded flood on the Hassayampa River and also the most recent major flood occurred in September 1970. Figures 3 through 9 and the cover photograph illustrate the extent of this flood, the danger it posed to the lives of several residents, and some of the damage it caused. This flood reached a peak discharge estimated to be 58,000 cubic feet per second at Box Canyon. The following descriptions of the September 1970 flood appeared in the Wickenburg Sun and Arizona Republic newspapers:

EXCERPTS FROM THE ARIZONA REPUBLIC, 6 SEPTEMBER 1970 [a]

But the heaviest rains fell in the Bradshaw Mountains northwest of Phoenix, at Payson and in Oak Creek Canyon. The runoff from these rains filled the Hassayampa, New and Agua Fria rivers and resulted in heavy runoff into Cave Creek and the Verde and Salt Rivers northeast of the Valley.

Crown King in the Bradshaw Mountains received more than 7 inches of rain, while the rainfall measured about 6½ inches at Payson and more than 5 inches in Oak Creek Canyon. Sedona received about 4½ inches.

The Hassayampa River caused some of the worst trouble as it rolled across the countryside flooding ranches and sweeping away livestock and buildings. It reportedly flowed about two city blocks out of its banks into Wickenburg, flooding houses and driving animals to higher ground.

EXCERPTS FROM THE WICKENBURG SUN, 10 SEPTEMBER 1970 [a]

HURRICANE NORMA LASHES AREA

LOSS HERE ENORMOUS AS HASSAYAMPA FLOODS

Hurricane Norma, roaring inland from off the coast of Southern California, lashed at sections of Western and Central Arizona with torrential rains which resulted in the worst calamity of modern times in this area. More than seven inches of rain at one time over the headwaters of the Hassayampa River in the high Bradshaws early last Saturday morning sent a tremendous volume of water down the meandering river bed with all the power that a drop from the 7,000 feet at Crown King to Wickenburg's 2,000 feet or less created.

The flood waters struck in this area before noon and by late afternoon had swept away homes, motor vehicles, animals, outbuildings, trees, foundations and walls from above the Rincon district in Yavapai County to more than five miles below Wickenburg.

Fortunately, no lives were lost and no one was injured, as far as the SUN could learn Tuesday.

The serious damage to the Town of Wickenburg's sewage disposal plant southeast of town was probably the most severe blow of the entire catastrophe. The plant, built just a few short years ago, was under more than two feet of water and it is feared the heavy motors and pumps may be damaged beyond repair. Officials said Monday the damage to the entire plant may run between $50,000 and $100,000. It is also reported that it may take a minimum of three weeks to get the plant back in operation. In the meantime, raw sewage is being dumped into the river because a quarter of a mile of sewer line from the town to the sewage plant was washed away.

WELL OWNERS WARNED

As soon as Town Manager Delbert Kirby notified the Maricopa County Health Department of the situation here, four representatives of that department came here Monday. After surveying the damage to the sewage disposal system, they issued a warning to all owners and users of private wells in the flooded areas to boil their drinking water and bring samples of their well water to Town Hall for testing. They first tested the town's three deep wells and pronounced them free of contamination.

The county officials are chlorinating the raw sewage and also spraying along the broken sewer line.

Whether it was the most destructive flood ever to hit this community is debatable. Certainly it caused more widespread damage than the flood of August, 1951, but there has been considerable more development along the river since then and subject to destruction.

Mrs. Charlotte Long, who has lived for years in the Rincon district, told us Monday it was the worst flood she has seen since 1891. She escaped damage at her home but told us of the loss suffered by her brother Otto Baker, nephew Jerry Baker and other residents in the Rincon area.

All along the town side of the river from above the bridge was hard hit but the area south and east in the vicinity of Bob's Coffee Shop was desolated and homes, trailer houses, sheds and other out-

(a) Simulated from actual newspaper articles

buildings swept away, or turned over, or shattered as the rampaging river swept everything ahead of it. There were many instances of the rescue of human beings from their homes in the area and it was a near miracle that no lives were lost.

RED CROSS AIDS STRICKEN FAMILIES

Pinch-hitting for vacationing Beverly O'Leary, local Red Cross chapter chairman, Anna Jane Roller put in long hours Sunday, Monday, Tuesday and Wednesday, offering assistance in the way of lodging and food to flood-ravished families. Two families were lodged in local motels and food was supplied to five families. The American Legion, the churches and many individuals furnished food and clothing too.

THE BEAUTIFUL and popular roadside park on the Phoenix Highway is a shambles, only the building housing the rest rooms and a scattering of the heavier picnic tables and benches left behind by the flooding river. The surfaced roads are gone, trees and shrubs uprooted and fireplaces demolished.

RINCON SCHOOL HOUSE WASHED AWAY

Severe damage resulted in the Rincon area northwest of town in Yavapai County. Roach Roberts, a rancher residing there, told us the Rincon School House, no longer in use, washed away. Sunday morning Roberts was in town trying to learn what to do for a voting place in Tuesday's primary election, voters in the Rincon precinct having used the schoolhouse for that purpose for years. Roberts said that many residents of Rincon suffered heavy damage, including the Otto and Jerry Bakers, the Stanley C. Ginthers and the Jerry Andersons, the latter losing their car but saving their pickup. The Phil MacDonalds had all of their possessions packed ready to move out of the Rincon Road house owned by Mrs. Marjorie Bodfish when the flood hit. Mrs. Bodfish reported from two to three feet of water got into the house.

TWO ARE RESCUED BY CABLE

Tom Thomas told of the good work of Earl Herber and Dave Underdown, and probably others too, in rescuing two men on flooded Chestnut Street. Clarence (Hap) Stegman, who has been ill, was taken from his home at 266 Chestnut by piggy-back and cable across the street to high ground in Sols Wash Park and is not believed to have suffered any ill effects. Further along on Chestnut Street Henry Johnson was trying to get a line on the Ray Bybees' Cadillac to tow it to safety but his efforts failed when the rushing waters carried the car away and left Johnson stranded on the roof of the Bybee residence. Again Herber and Underdown came to the rescue with their cable and saved his life. Among those who helped in the rescue operations was an unidentified motorist who was having his car fixed at Herber's Earl's Auto Repair. When Herber closed up to rush to the flooded area, the out-of-towner put his wife and daughter in a motel and went along to help out.

MAYOR BROWN SUFFERS HEAVY LOSS

Mayor Garth Brown suffered heavy damage when the flooding river struck his warehouse. He lost his Wickenburg Plumbing pickup truck, the apartment occupied by Mr & Mrs. Henry Eihler and daughter and many plumbing supplies. The Eihlers escaped uninjured but Mr Eihler had a narrow escape when he was trapped in the apartment with water up to his armpits and he could not get the door open. He managed to lower the upper half of a window and got out that way.

SANTA FE TRACKS UNDER WATER

Santa Fe railroad tracks in the vicinity of San Domingo Wash were under several feet of water late Saturday afternoon and evening and the railroad yards here saw many diesel engines and freight trains stranded here over the weekend. Track crews worked day and night to repair the roadbed and trains started moving again late Monday afternoon.

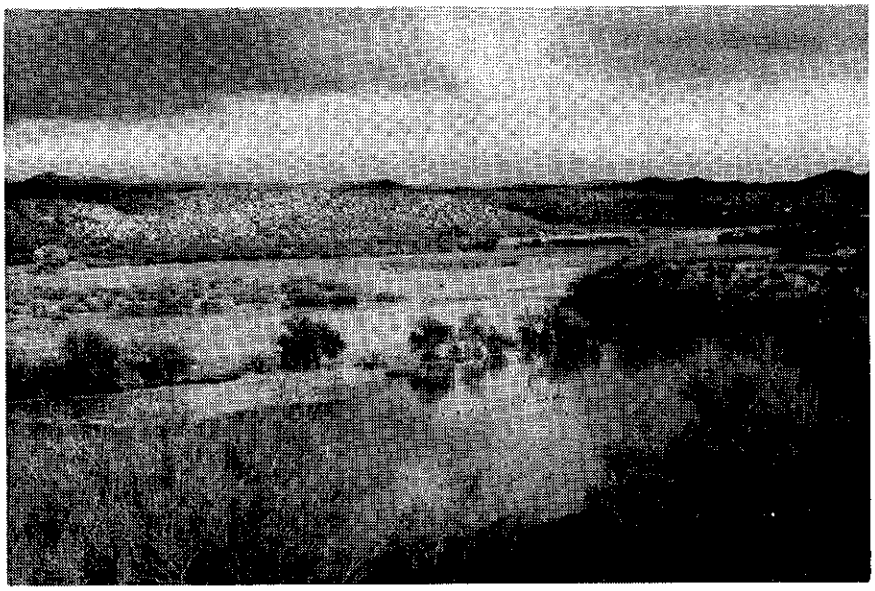


Figure 3 — Hassayampa River flood plain at river mile 49.00 during September 1970 flood.

Figure 4 — Hassayampa River at confluence of Sols Wash during September 1970 flood.

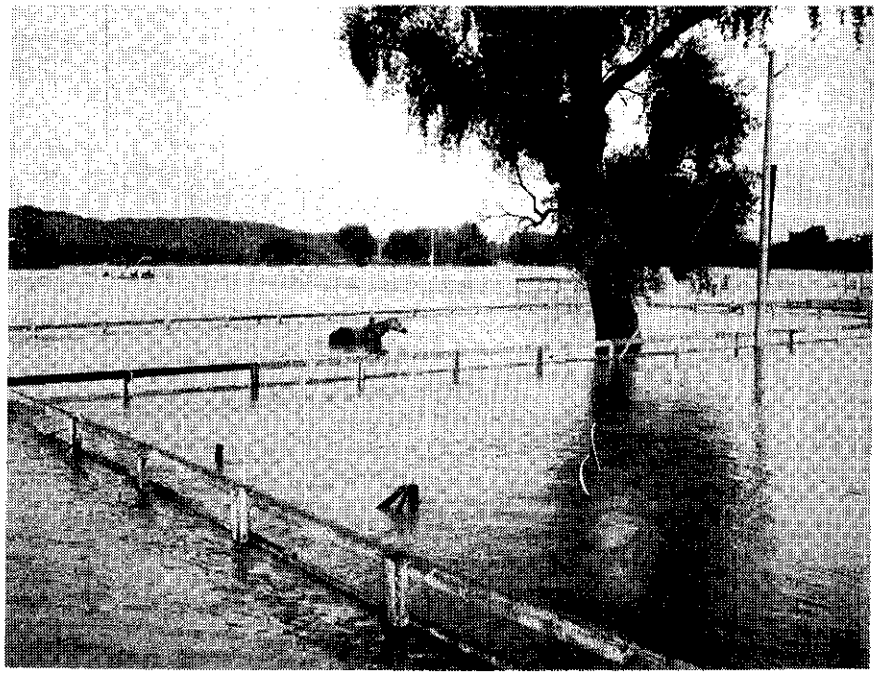


Figure 5 – Horse ranch on west bank of Hassayampa River upstream from Sols Wash during September 1970 flood.

Figure 6 – Flows in Chestnut Street from September 1970 flood on Hassayampa River.

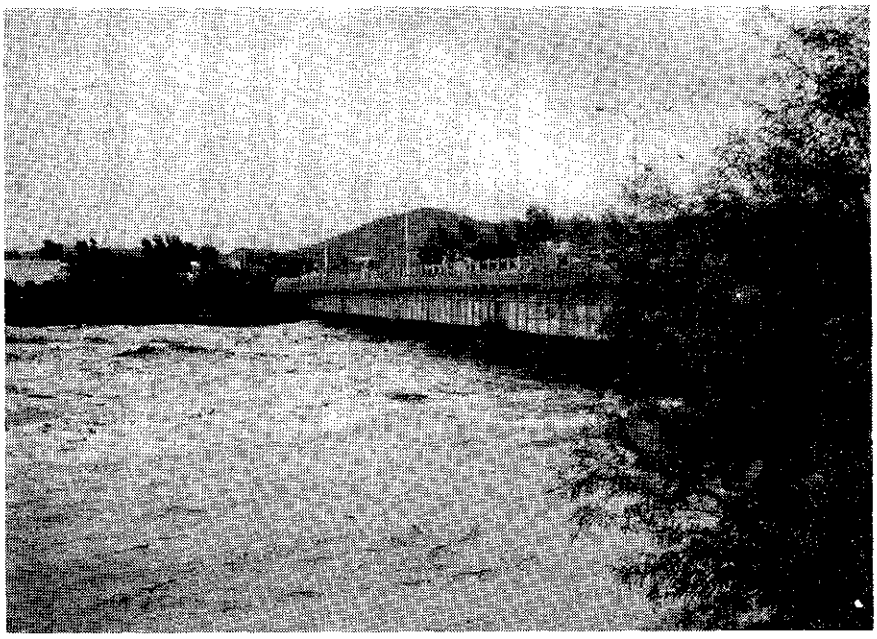


Figure 7 — Upstream side of Highway 60, 70, 89, 93 bridge near time of crest of September 1970 flood.

Figure 8 — Vehicles being swept down Chestnut Street during September 1970 flood.

Figure 9 — Damage to residence on Chestnut Street caused by September 1970 flood.

FUTURE FLOODS

Although floods of the same magnitude as those that have occurred in the past could recur in the future, discussion of the future floods in the report is limited primarily to those that have been designated as the Intermediate Regional and Standard Project Floods. The Standard Project Flood would be larger and would occur less frequently than the Intermediate Regional Flood, and both of these floods would be greater than any recorded flood that occurred in the past. A Standard Project Flood would be a rare event, but could reasonably be expected to occur in the future.

Selection of the Intermediate Regional and Standard Project Floods was based on hydrologic computations (correlation of records of similar drainage basins) and consideration of pertinent meteorologic and physiographic conditions. As previously indicated, floods in the study area caused by general summer storms can affect large areas of the flood plain, result in greater flood damage, and create greater hazards to people than other types of storms. Therefore, the future floods discussed herein would probably be caused by a general summer storm.

Intermediate Regional Flood

The Intermediate Regional Flood is one that could occur about once in 100 years on the average, although it may occur in any year or more than once in one year. Usually the peak flow of such a flood is developed from statistical analyses of streamflow and precipitation records and the runoff characteristics of the stream basin. Since gaging records in the Hassayampa River basin are limited, other basins in the general region were analyzed and correlated to the study area, with adjustments for differences in hydrologic, meteorologic, and physiographic characteristics. Peak flows thus developed for the Intermediate Regional Flood at selected points in the study area are shown in table 3.

Standard Project Flood

For the purpose of determining peak flows of the Standard Project Flood, a standard project storm was derived for the Hassayampa River basin from statistical analyses of the Hassayampa River basin and other stream basins having similar meteorologic characteristics.

A standard project storm is the most severe combination of meteorologic conditions reasonably characteristic of the geographic region, excluding extremely rare combinations. Studies were made to transpose storm data to the Hassayampa River basin and compute peak flows for the Standard Project Flood. Peak flows thus developed for the Standard Project Flood at selected points in the study area are shown in table 3.

TABLE 3

PEAK FLOWS FOR INTERMEDIATE REGIONAL AND STANDARD PROJECT FLOODS

Location	Miles upstream from mouth	Drainage area sq. mi.	Intermediate Regional Flood cfs	Standard Project Flood cfs
Below San Domingo Wash	40.34	813	65,000	121,000
Below Monarch Wash	42.71	780	67,000	125,000
Below Turtleback Wash	45.15	751	68,000	128 000
Below Calamity & Cemetery Washes	46.76	742	70,000	131 000
Below Sols Wash	47.65	724	71,000	133,000
Above Sols Wash	47.80	565	71,000	133,000
At Box Canyon	54.80	421	77,000	140,000

(See Plate 2 for locations)

Frequency

In terms of the frequency of occurrence of major floods on the Hassayampa River, a relatively short period of recorded history exists. Geological evidence in sections of the canyon walls indicates that floods of greater magnitude than the Standard Project Flood have occurred in the geologically recent past. Although the occurrence of the Intermediate Regional and Standard Project Floods would probably be infrequent, an even greater flood such as the Probable Maximum Flood (see Glossary for definition) could occur in the study reach of the Hassayampa River.

Hazards of Large Floods

The amount and extent of damage caused by any flood depends on the topography of the area flooded, depth and duration of flooding, velocity of flow, and developments on the flood plain. An Intermediate Regional or Standard Project Flood on the Hassayampa River would result in inundation of residential, commercial, agricultural, recreational, and industrial lands on the Hassayampa River flood plain.

Deep floodwater flowing at a high velocity and carrying floating debris would create conditions hazardous to persons and vehicles attempting to cross flooded areas. In general, floodwater 3 or more feet deep and flowing at a velocity of 3 or more feet per second (about 2 miles per hour) could sweep a person off his feet, thus creating definite dangers of injury or drowning. Rapidly rising and swiftly flowing floodwater may trap persons in homes that are ultimately destroyed or in vehicles that are ultimately submerged. Decaying flood-deposited garbage or other organic materials could create health hazards. Isolation of areas by floodwater could create hazards in terms of medical, fire, or law enforcement emergencies.

Flooded areas and flood damage – The areas along the Hassayampa River that would be flooded by a Standard Project Flood are shown on plate 2, which is also an index map to plates 3 through 11. Areas that would be flooded by the Intermediate Regional and Standard Project Floods are shown in detail on plates 3 through 11. These areas include civic, recreational, industrial, agricultural, and residential sections and the associated streets, roads, and public utilities in the study reach.

Because of the wider flood plain, a greater depth of flooding, a higher velocity flow, and a longer duration of flooding during a Standard Project Flood, damage would be more severe than during an Intermediate Regional Flood. Extensive deposits of silt and debris would occur in many parts of the flooded areas. Plates 12 through 21 show water surface profiles of the Intermediate Regional and Standard Project Floods. Depth of flow in the channel can be estimated from these illustrations. Typical cross sections of the flood plain at selected locations, together with the water surface elevation and lateral extent of the Intermediate Regional and Standard Project Floods, are shown on plate 22.

Limits of overflow indicated on plates 3 through 11 may vary from actual locations on the ground due to map scale, deposition, erosion, or inaccuracy of original topographic maps.

Obstructions – As shown in table 4, the two major man-made obstructions to flow in the study reach are the AT & SF railroad bridge, and the State Highway bridge at Wickenburg. The Intermediate Regional Flood would pass under both bridges; however, the Standard

Project Flood would overtop both bridges and render them impassable during the height of the disaster. The effects of these obstructions to flow are shown on profile plates 12 through 21.

TABLE 4

ELEVATION DATA (FLOOD AND OBSTRUCTION ELEVATIONS)

Obstruction Identification	Location (a)	Elevation (b) Streambed	Low Chord (c)	Roadway (d)	IRF* (e)	SPF** (e)
Atchison, Topeka, and Santa Fe railroad bridge	40.04	1829.5	1851.0	1856.0	1845.0	1862.0
U.S. Highway 60, 70 and 89 and State Highway 93 bridge	47.63	2033.0	2047.0	2049.0	2046.8	2052.0

(a) Miles above mouth.
(b) All elevations are in feet, mean sea level datum.
(c) Elevation of bottom of bridge structure.
(d) Average elevation.
(e) Computed water surface elevation based on estimated flow and existing channel and structures.
* Intermediate Regional Flood
** Standard Project Flood.

Velocities of flow – Occurrence of the Intermediate Regional or Standard Project Flood would result in the flows shown in table 3. During an Intermediate Regional Flood, the average velocity of main channel flow would range from 6 to 20 feet per second (about 4 to 14 miles per hour). Water flowing at this rate is capable of causing erosion to streambanks and transporting large rocks. In the steep canyon sections, velocities could exceed 20 feet per second; this force would cause severe erosion and would dislodge and move larger rocks. In the broad flood plain areas, the average velocity of flow in the overbanks would range from 1 to 10 feet per second (about 1 to 7 miles per hour).

The range of average velocities of flows during a Standard Project Flood would be 1 to 5 feet per second greater than the range of average velocities during an Intermediate Regional Flood. Water flowing at about 2 feet per second (about 1.4 miles per hour) or less would deposit debris and silt. Table 5 shows average velocities of flow in feet per second at several points along the Hassayampa River in the Study area.

TABLE 5

VELOCITIES OF FLOW

Location	Miles upstream from mouth	Intermediate Regional Flood		Standard Project Flood	
		Channel fps	Overbank fps	Channel fps	Overbank fps
Cross section No. 1	41.98	13	3	14	6
Cross section No. 2	47.49	12	1	14	3
Cross section No. 3	47.79	6	1	6	1
Cross section No. 4	48.68	8	1	9	1
At Box Canyon	54.80	21	4	25	6

Rates of rise and duration of flooding — Intense rainfall from general summer storms centered over the upper reaches of the basin collects rapidly as surface runoff and reaches the vicinity of Wickenburg within a short time after the beginning of the storm. The peak stages for both the Standard Project and Intermediate Regional Floods would occur near the 32nd hour after the beginning of the storm.

For the Intermediate Regional and Standard Project Floods near river mile 48.0, table 6 gives the maximum rate of rise, height of rise (from critical stage level to maximum floodflow level), time of rise (time period corresponding to height of rise), and duration of critical stage (period of time during which flooding is above critical stage level). The stage hydrographs of these two future floods near mile 48.0 are shown on plate 23.

TABLE 6

RATES OF RISE AND DURATION
(at river mile 48.0)

Flood	Maximum Rate of Rise ft/hr	Height of rise ft	Time of rise hrs	Duration of critical stage days
Intermediate Regional	1.0	5.2	9.0	2.0
Standard Project	1.8	10.3	10.4	2.1

Photographs, future flood heights — The levels that the Intermediate Regional and Standard Project Floods would be expected to reach at various locations on the Hassayampa River flood plain are indicated in figures 10 through 13.

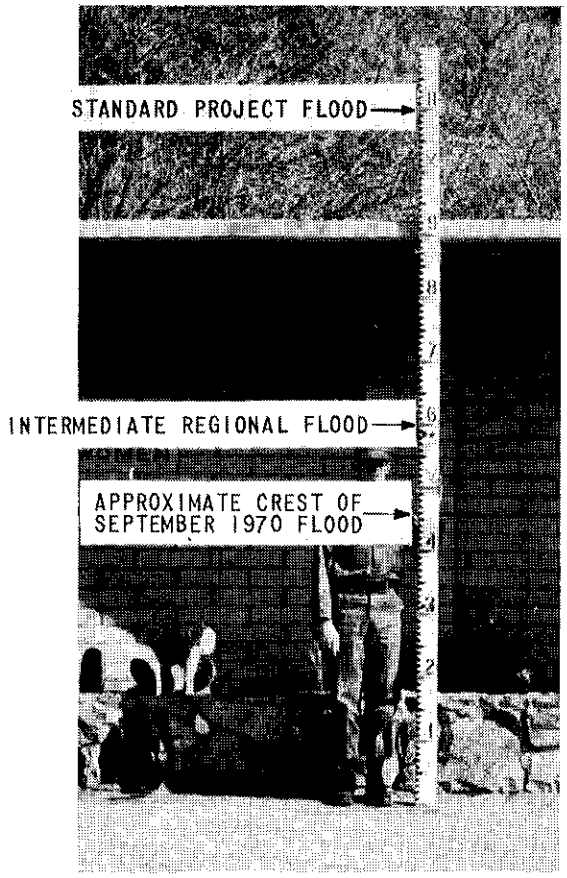


Figure 10 — Future flood heights at the public restrooms in the roadside park on Highway 60, 70, 89, and 93 (near river mile 42.00).

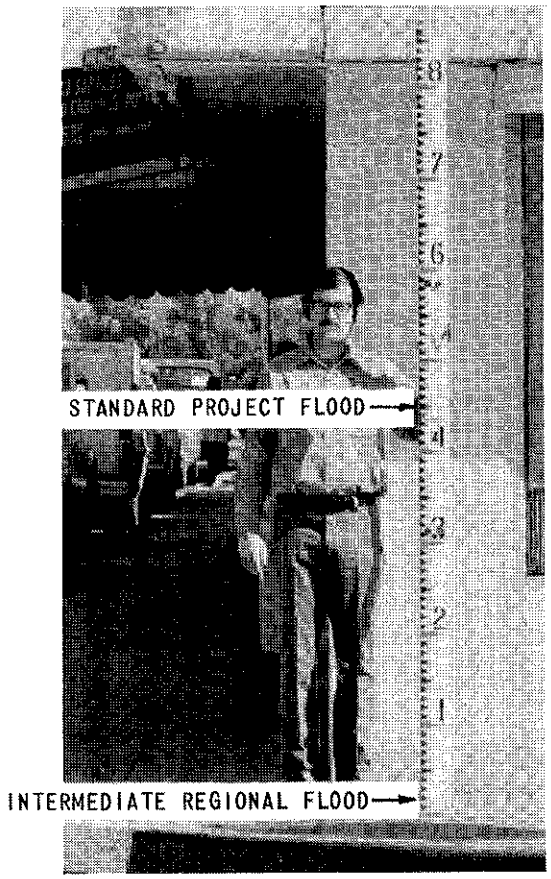
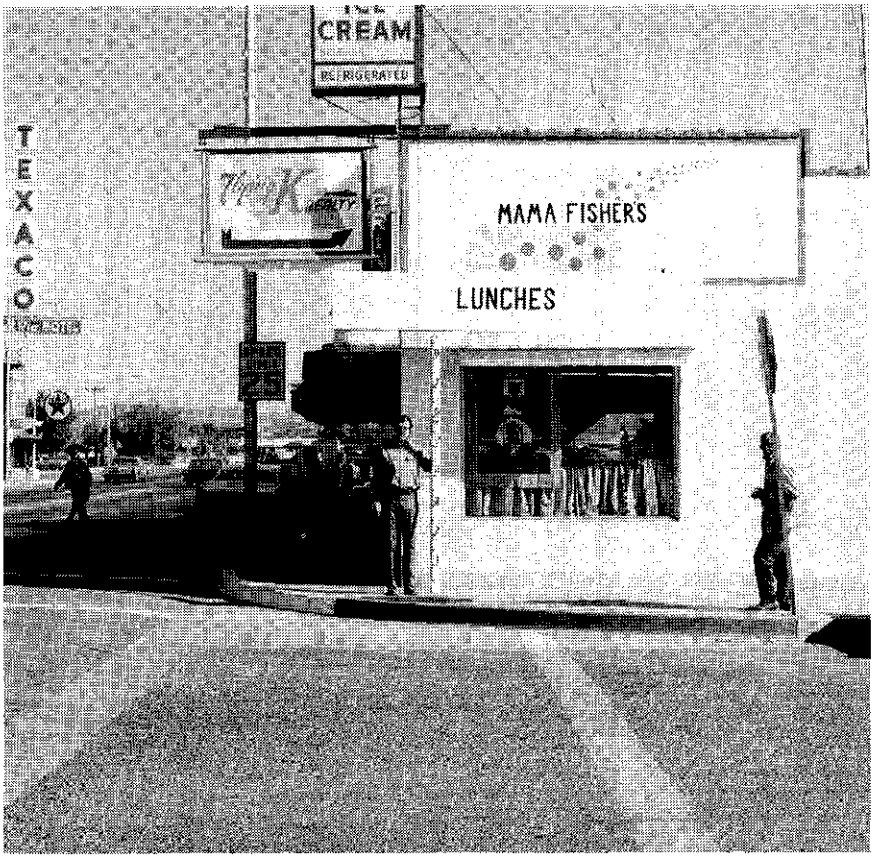


Figure 11 — Future flood heights at the southeast corner of the intersection of Valentine and Center Streets in Wickenburg.



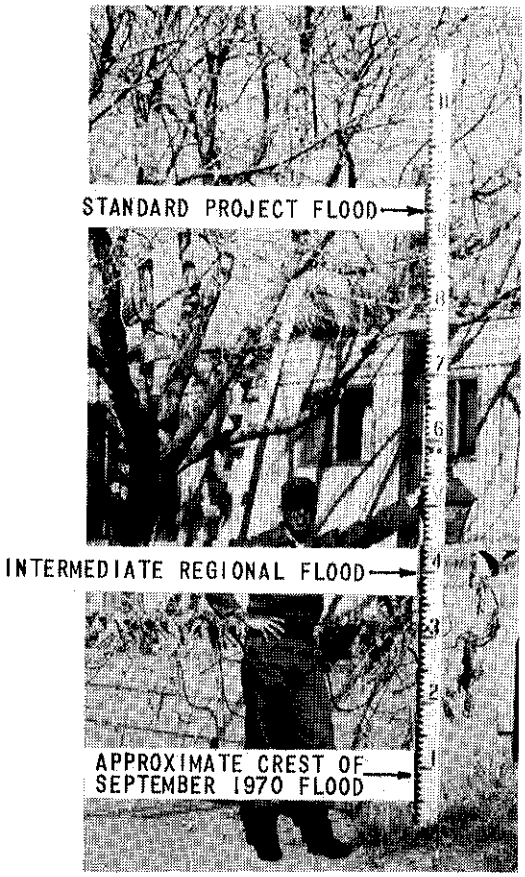
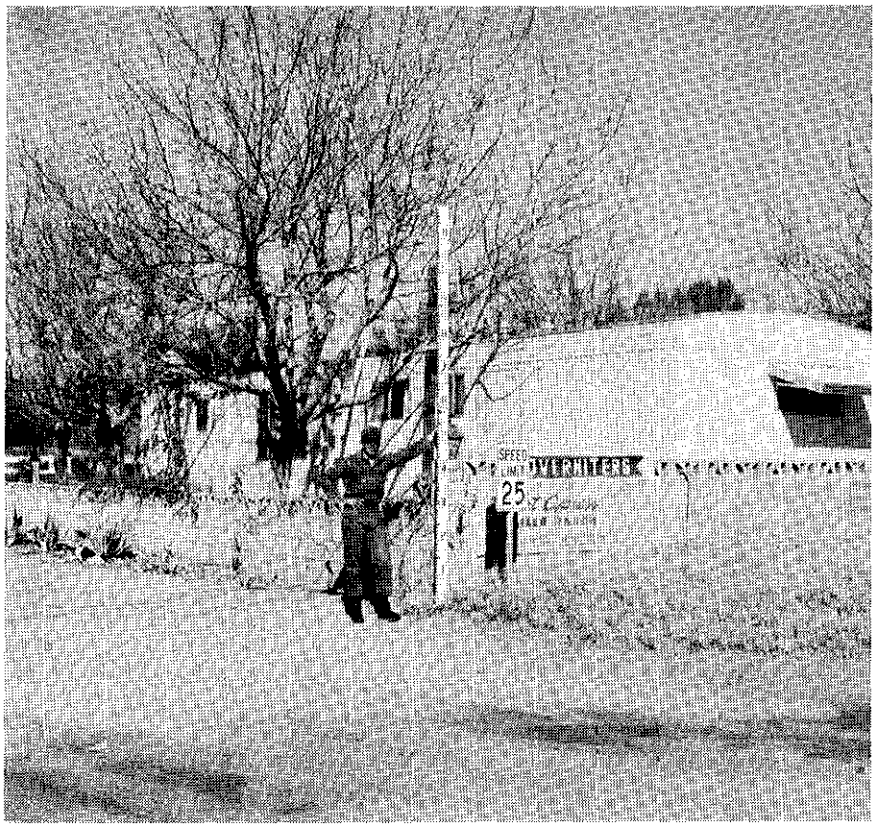


Figure 12 – Future flood heights at the northeast corner of intersection of Constellation and Burton Roads in Wickenburg.



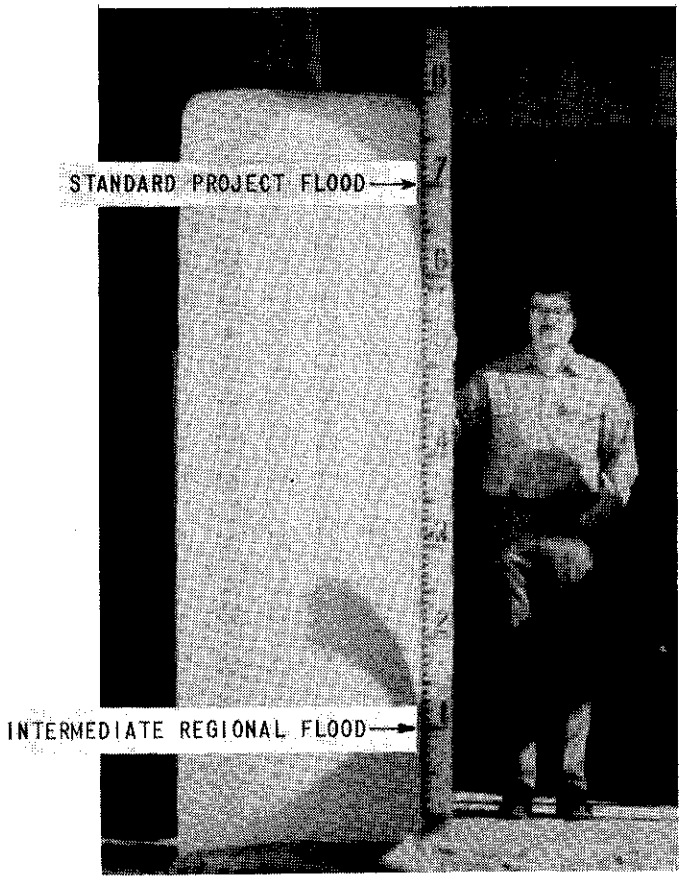
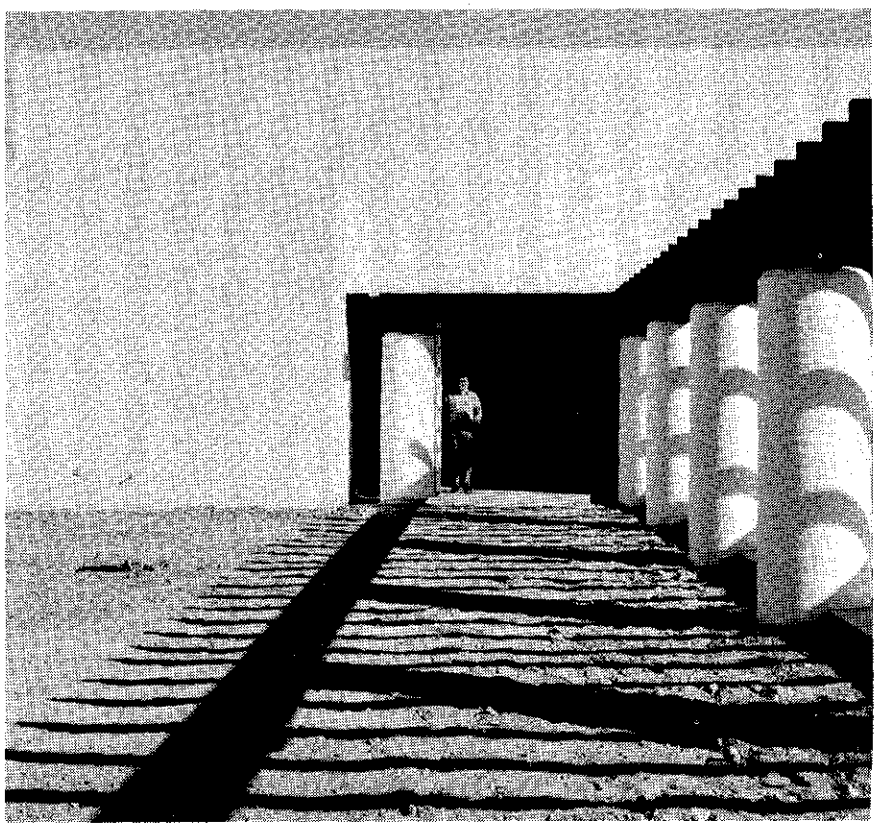


Figure 13 – Future flood heights at the front entrance of the new Wickenburg Community Center.



GLOSSARY

Critical Stage. The point at which floodflows overtop the natural or artificial banks along any reach of a stream.

Critical Stage Level. The elevation that corresponds to critical stage.

Flood. An overflow of lands not normally covered by water and that are used or usable by man. Floods have two essential characteristics: the inundation of land is temporary; and the land is adjacent to and inundated by overflow from a river, a stream, or other watercourse, an ocean, a lake, or other body of standing water.

Normally, a "flood" is considered to be any temporary rise in streamflow or stage (not the ponding of surface water) that results in significant adverse effects in the vicinity. Adverse effects may include damages from overflow of land areas, temporary backwater effects in sewers and local drainage channels, creation of unsanitary conditions or other unfavorable situations by deposition of materials during flood recessions, rise of ground water coincident with increased streamflow, and other problems.

Flood Crest. The maximum stage or elevation reached by the waters of a flood at a given location.

Flood Peak. The maximum instantaneous discharge of a flood at a given location. It usually occurs at or near the time of the flood crest.

Flood Plain. The relatively flat area or lowlands adjoining the channel of a river, a stream, or other watercourse, or adjoining an ocean, a lake, or other body of standing water that have been or may be inundated by a flood.

Flood Profile. A graph showing the relationship of water surface elevation to location, the latter generally expressed as distance above mouth for a stream of water flowing in an open channel. It is generally drawn to show water surface elevations for the crest of a specific flood, but may be prepared for conditions at any given time or stage.

Flood Stage. The elevation at which overflow of the natural banks of a stream or body of water begins in the reach or area in which the elevation is measured.

Floodway. The channel of the stream and that part of the flood plain that would be used to carry floodflows.

General Summer Storm. In late summer or early fall, tropical storms originating along the Mexican Pacific Coast or the Gulf of Mexico can reach the study area, producing the general summer storm that is characterized by heavy precipitation over large areas.

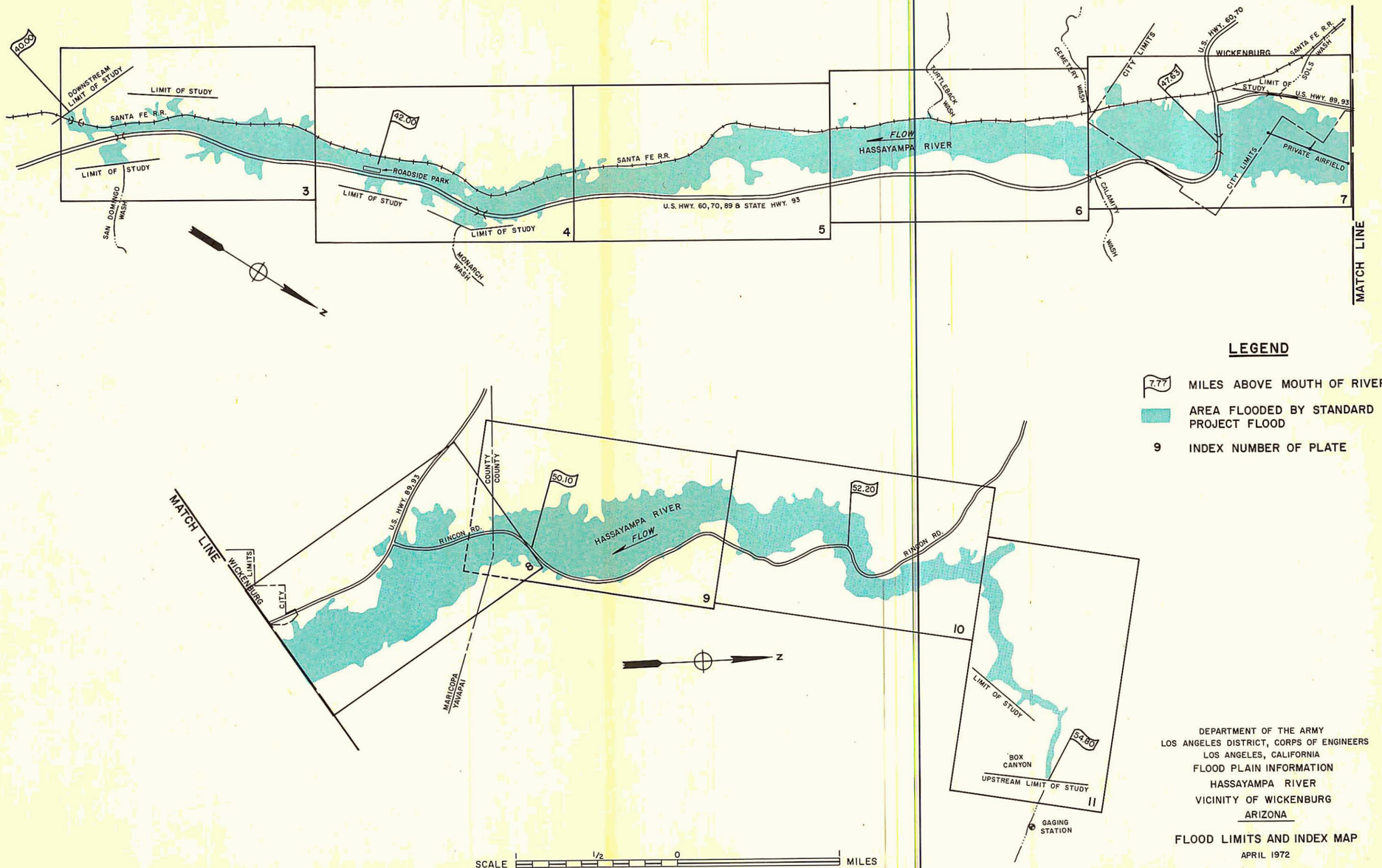
General Storm. Results from weather fronts passing through the study area usually in the winter months. It may last several days but is usually of low intensity. Because these fronts must first pass over the coastal mountains most of their moisture is lost by the time they reach the study area.

Thunderstorm. Commonly occurs in the months of July through October, although it could occur at any time of year. This type of storm covers comparatively small areas and usually is of high intensity rainfall. The duration is short, usually 3 hours or less.

Intermediate Regional Flood. A flood having an average frequency of occurrence of once in 100 years, although the flood may occur in any year or more than once in one year. It is based on statistical analyses of streamflow records available for the watershed and analyses of rainfall and runoff characteristics in the general region of the watershed.

Standard Project Flood. The flood that may be expected from the most severe combination of meteorologic and hydrologic conditions that is considered reasonably characteristic of the geographic area in which the drainage basin is located, excluding extremely rare combinations. Peak discharges for these floods are generally about 40 to 60 percent of the Probable Maximum Floods for the same basins. As used by the Corps of Engineers, Standard Project Floods are intended as practicable expressions of the degree of protection that should be sought in the design of flood control works, the failure of which might be disastrous.

Probable Maximum Flood. A hypothetical flood representing the most severe flood with respect to volume, concentration of runoff, and peak discharge that may be expected from a combination of the most severe meteorologic and hydrologic conditions in the region.



LEGEND

- 7.77 — MILES ABOVE MOUTH OF RIVER
- AREA FLOODED BY STANDARD PROJECT FLOOD
- 9 — INDEX NUMBER OF PLATE

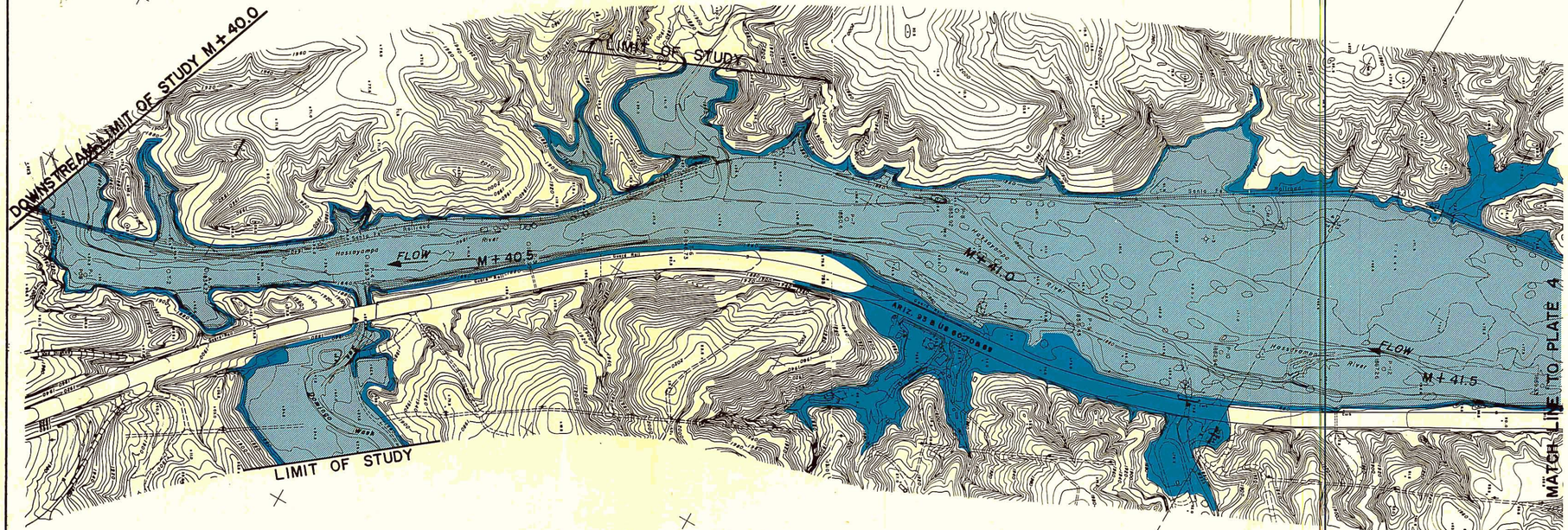
DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, CORPS OF ENGINEERS
LOS ANGELES, CALIFORNIA

FLOOD PLAIN INFORMATION
HASSAYAMPA RIVER
VICINITY OF WICKENBURG
ARIZONA

FLOOD LIMITS AND INDEX MAP

APRIL 1972

PLATE 2



LEGEND:

OVERFLOW LIMITS

INTERMEDIATE REGIONAL FLOOD

STANDARD PROJECT FLOOD

M+2.50 ____ MILES ABOVE MOUTH

2 ——— CROSS SECTION

400 _____ GROUND ELEVATION IN FEET ABOVE MEAN SEA LEVEL

CONTOUR INTERVAL 4 FEET

NOTES:

LIMITS OF OVERFLOW INDICATED MAY VARY FROM ACTUAL LOCATIONS ON GROUND, AS EXPLAINED IN THE REPORT.

DATE OF TOPOGRAPHY 1971

BASE TOPOGRAPHIC MAPS FURNISHED BY

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY, ARIZONA.

FLOOD LIMITS SHOWN DO NOT INCLUDE AREAS FLOODED BY TRIBUTARIES.

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CORPS OF ENGINEERS, U. S. ARMY

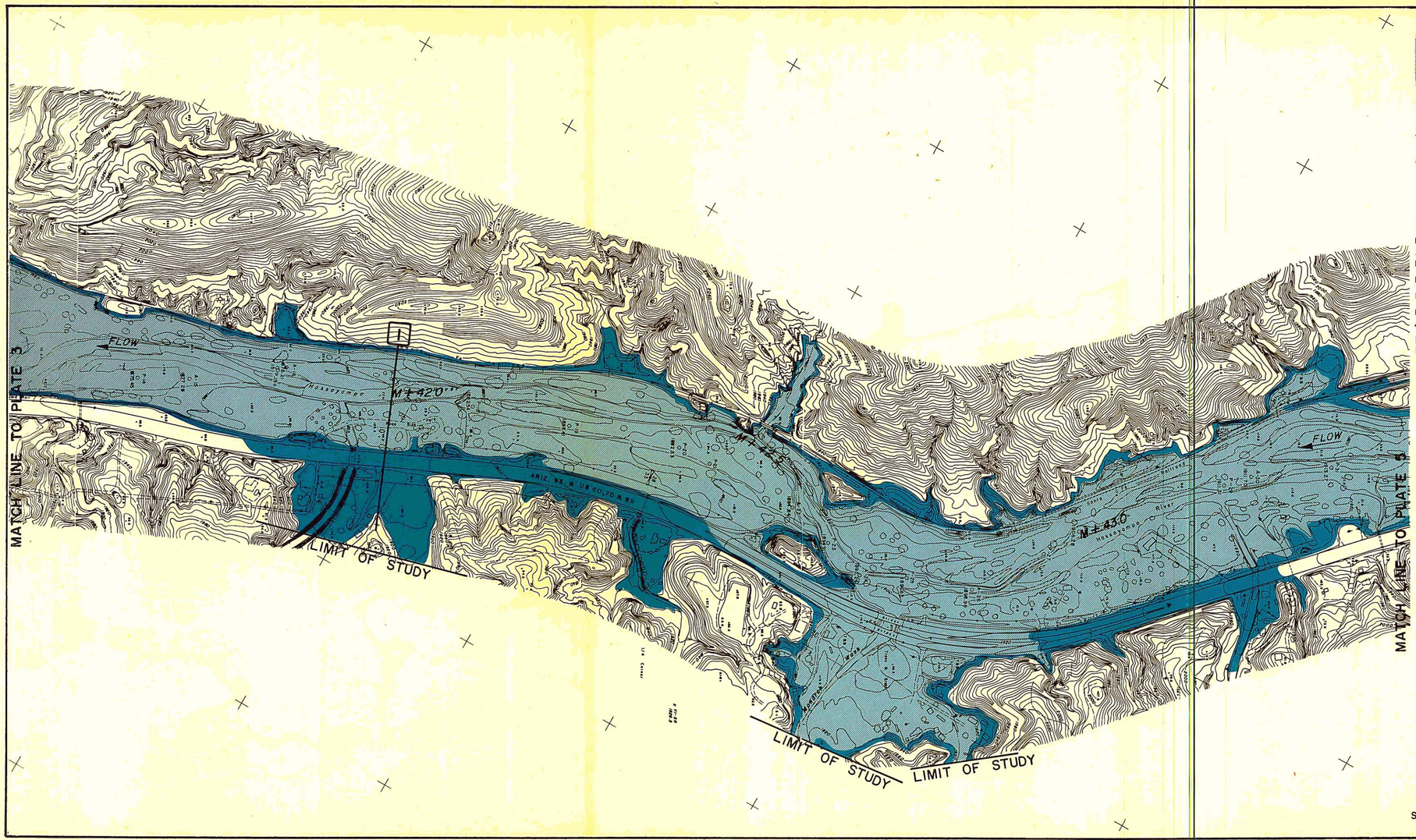
LOS ANGELES DISTRICT, CALIFORNIA

FLOODED AREAS
HASSAYAMPA RIVER
VICINITY OF WICKENBURG, ARIZONA

SCALE 500 0 500 FEET

APRIL 1972

PLATE 3



LEGEND:

OVERFLOW LIMITS

INTERMEDIATE REGIONAL FLOOD — STANDARD PROJECT FLOOD

M+2.50 ---- MILES ABOVE MOUTH

2 ——— CROSS SECTION

400 ---------- GROUND ELEVATION IN FEET ABOVE MEAN SEA LEVEL

CONTOUR INTERVAL 4 FEET

NOTES:

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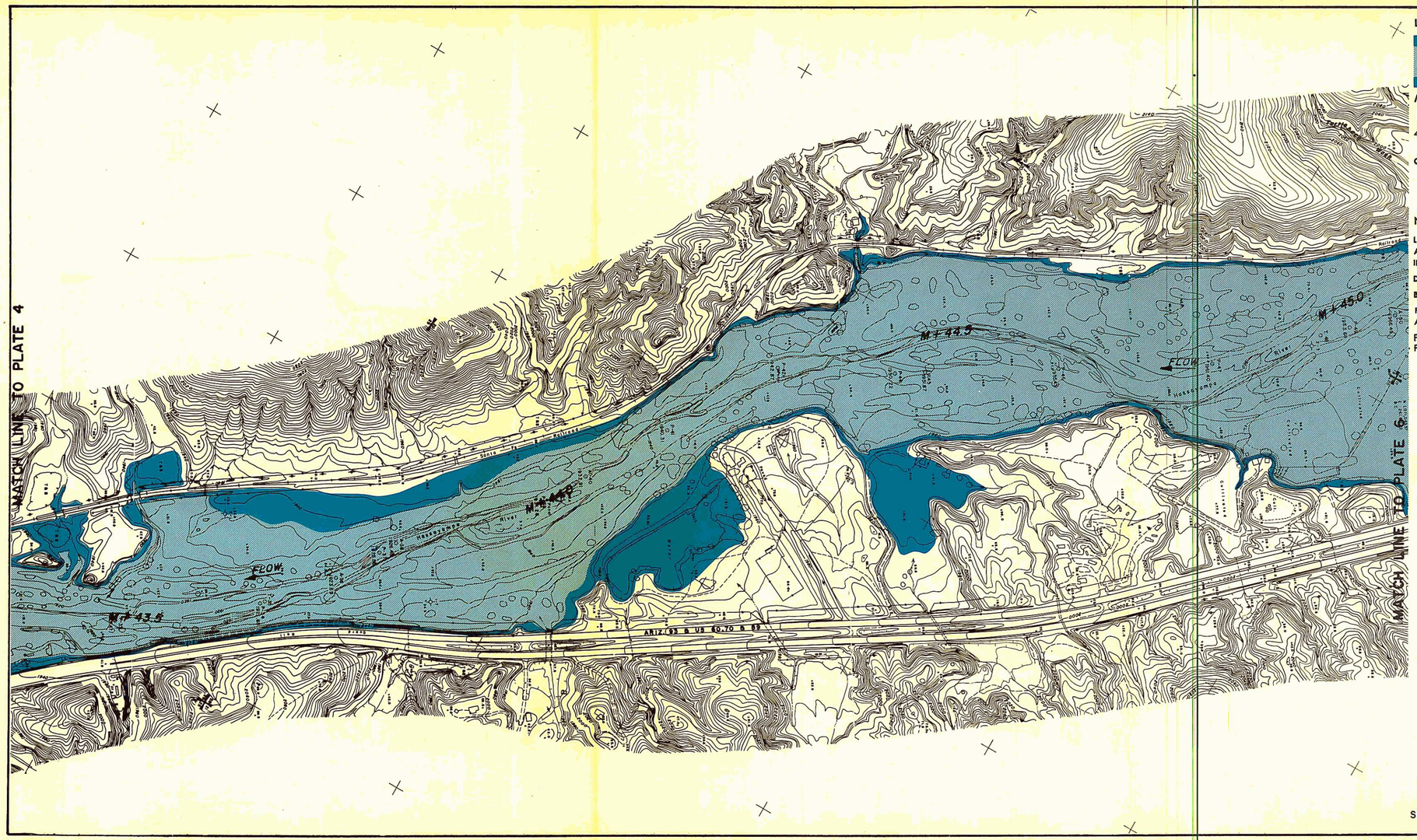
LOS ANGELES DISTRICT, CALIFORNIA

FLOODED AREAS HASSAYAMPA RIVER VICINITY OF WICKENBURG, ARIZONA

SCALE 500 0 500 FEET

APRIL 1972

PLATE 4



LEGEND:

OVERFLOW LIMITS

INTERMEDIATE REGIONAL FLOOD — STANDARD PROJECT FLOOD

M+ 2.50 ---- MILES ABOVE MOUTH

2 ——— CROSS SECTION

400 ——— GROUND ELEVATION IN FEET ABOVE MEAN SEA LEVEL

CONTOUR INTERVAL 4 FEET

NOTES:

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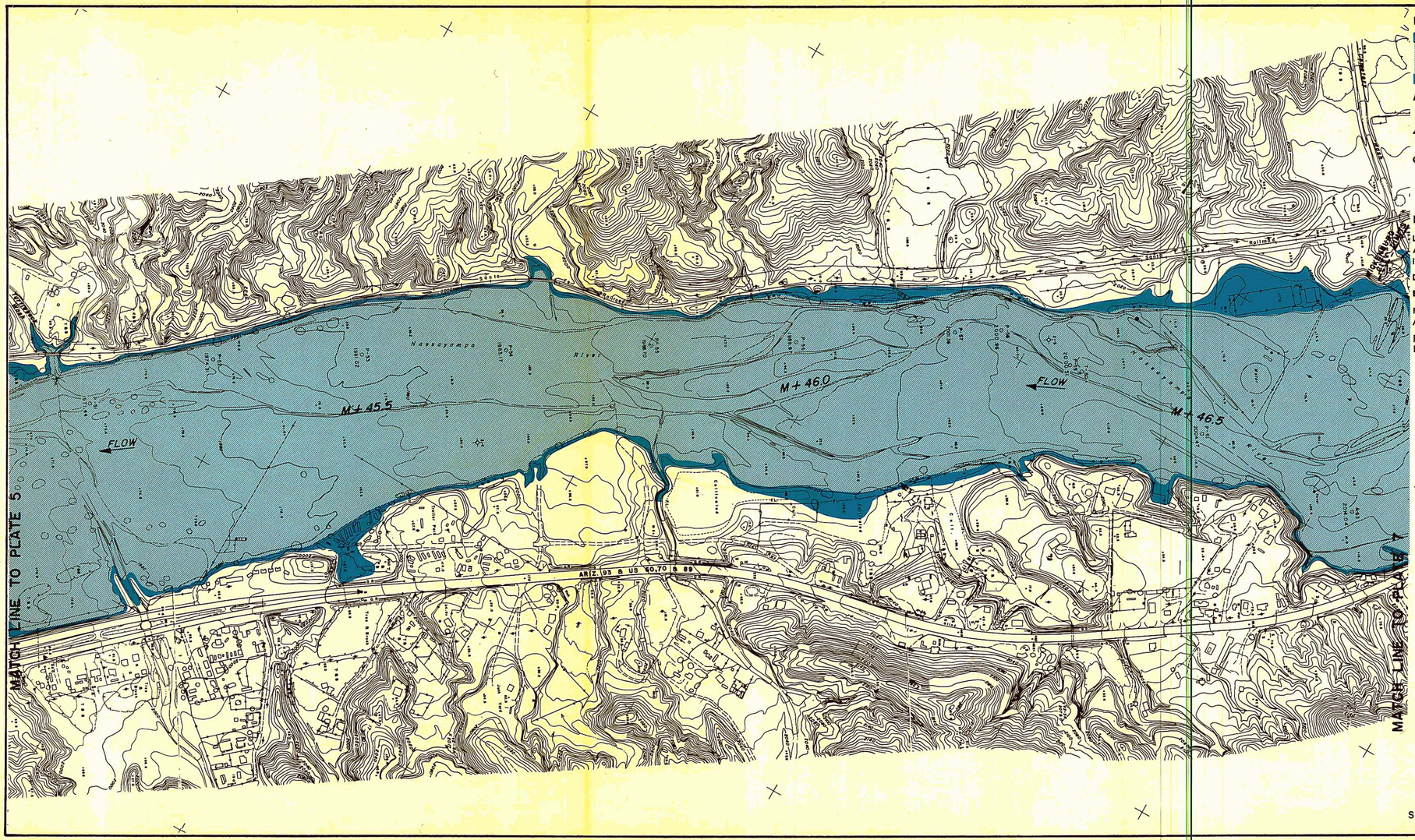
LOS ANGELES DISTRICT, CALIFORNIA

FLOODED AREAS HASSAYAMPA RIVER VICINITY OF WICKENBURG, ARIZONA

SCALE 500 0 500 FEET

APRIL 1972

PLATE 5



LEGEND:

OVERFLOW LIMITS

INTERMEDIATE REGIONAL FLOOD

STANDARD PROJECT FLOOD

M+2.50 ---- MILES ABOVE MOUTH

2 CROSS SECTION

400 GROUND ELEVATION IN FEET ABOVE MEAN SEA LEVEL

CONTOUR INTERVAL 4 FEET

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LOS ANGELES DISTRICT, CALIFORNIA

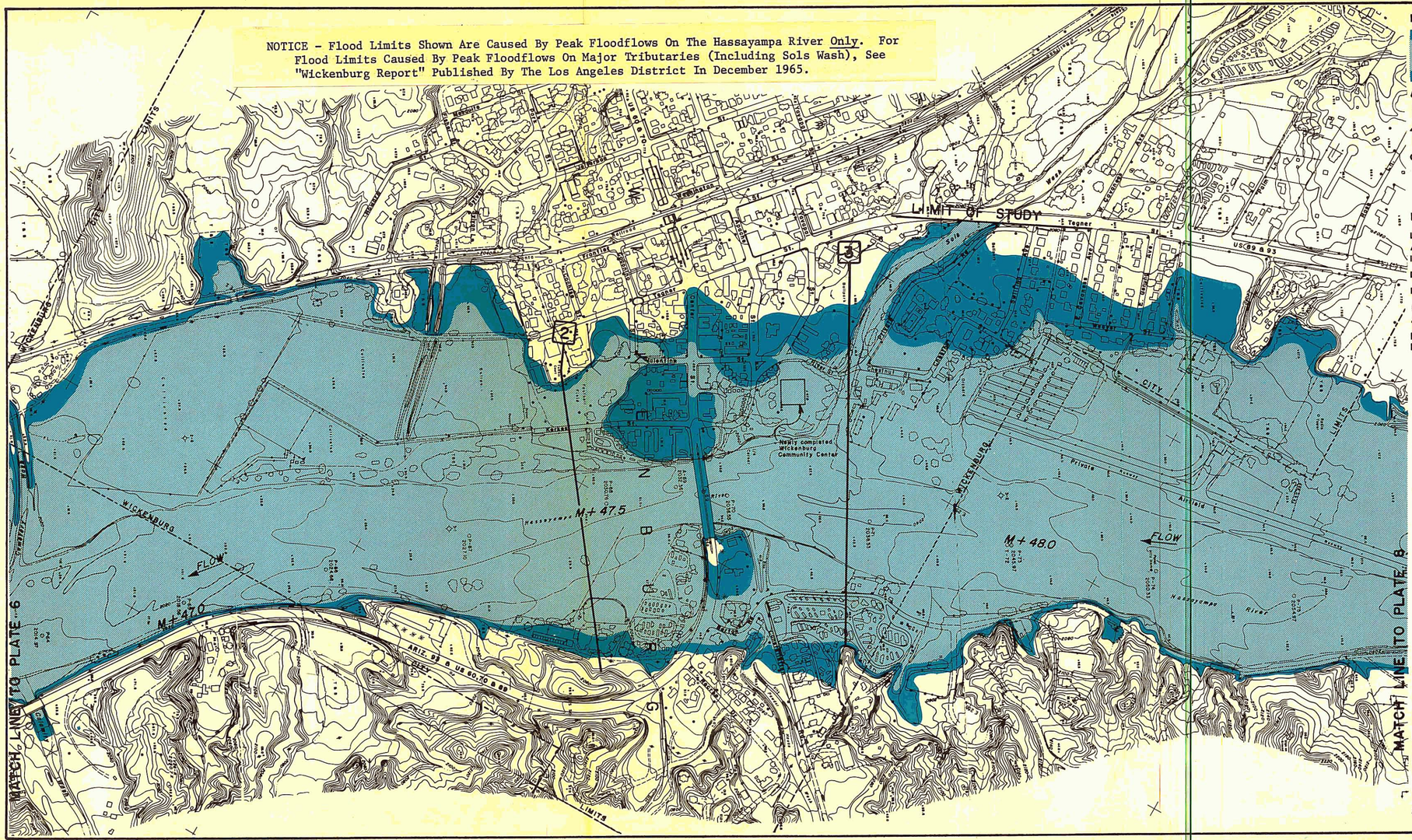
FLOODED AREAS HASSAYAMPA RIVER VICINITY OF WICKENBURG, ARIZONA

SCALE 500 0 500 FEET

APRIL 1972

PLATE 6

NOTICE - Flood Limits Shown Are Caused By Peak Floodflows On The Hassayampa River Only. For Flood Limits Caused By Peak Floodflows On Major Tributaries (Including Sols Wash), See "Wickenburg Report" Published By The Los Angeles District In December 1965.



LEGEND:

OVERFLOW LIMITS
- INTERMEDIATE REGIONAL FLOOD
- STANDARD PROJECT FLOOD

M+ 2.50 ---- MILES ABOVE MOUTH

2 —— CROSS SECTION

400 ———— GROUND ELEVATION IN FEET ABOVE MEAN SEA LEVEL

CONTOUR INTERVAL 4 FEET

NOTES:

LIMITS OF OVERFLOW INDICATED MAY VARY FROM ACTUAL LOCATIONS ON GROUND, AS EXPLAINED IN THE REPORT.

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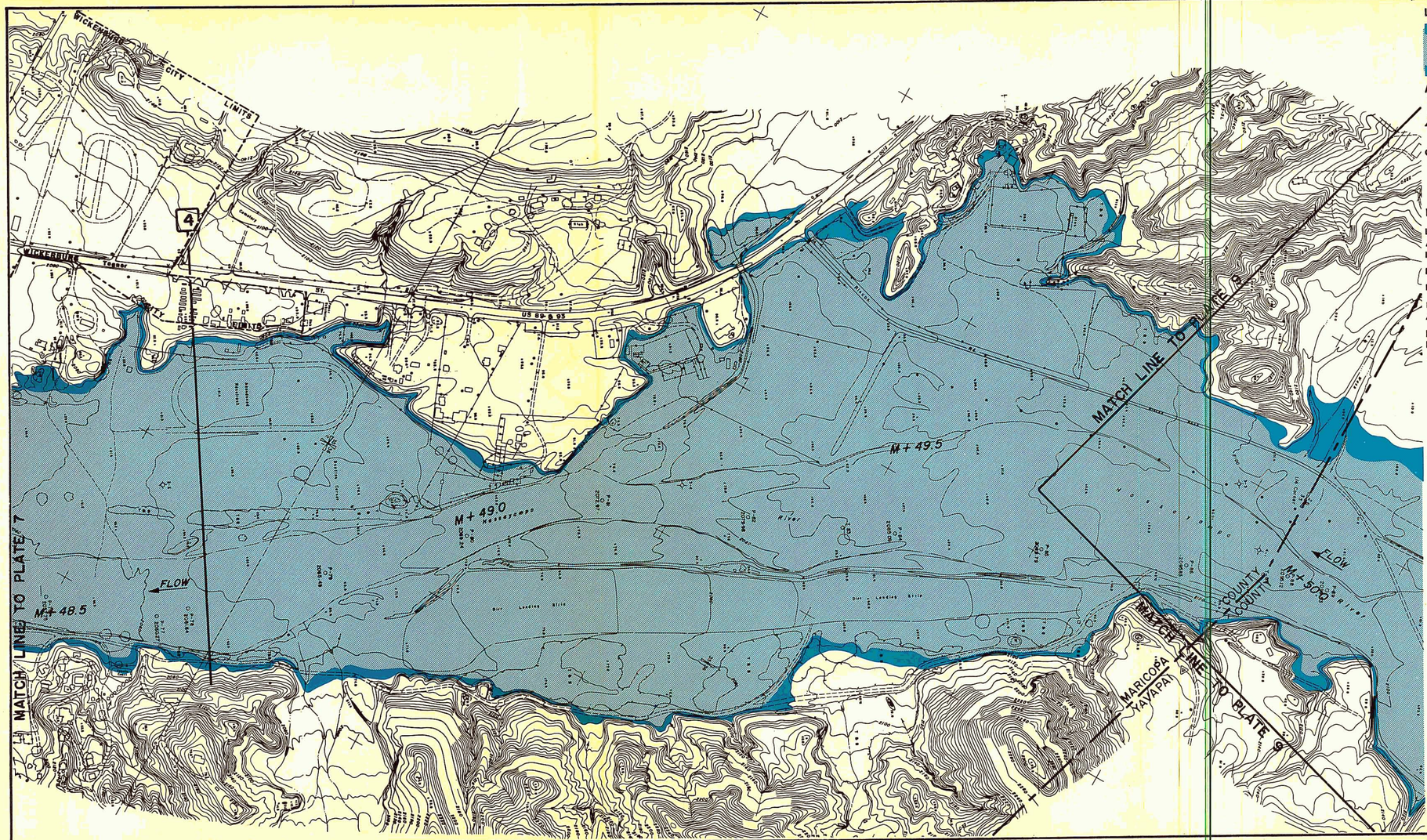
LOS ANGELES DISTRICT, CALIFORNIA

FLOODED AREAS HASSAYAMPA RIVER VICINITY OF WICKENBURG, ARIZONA

SCALE 500 0 500 FEET

APRIL 1972

PLATE 7



LEGEND:

OVERFLOW LIMITS

INTERMEDIATE REGIONAL FLOOD — STANDARD PROJECT FLOOD

M+2.50 ---- MILES ABOVE MOUTH

2 ——— CROSS SECTION

400 ---------- GROUND ELEVATION IN FEET ABOVE MEAN SEA LEVEL

CONTOUR INTERVAL 4 FEET

NOTES:

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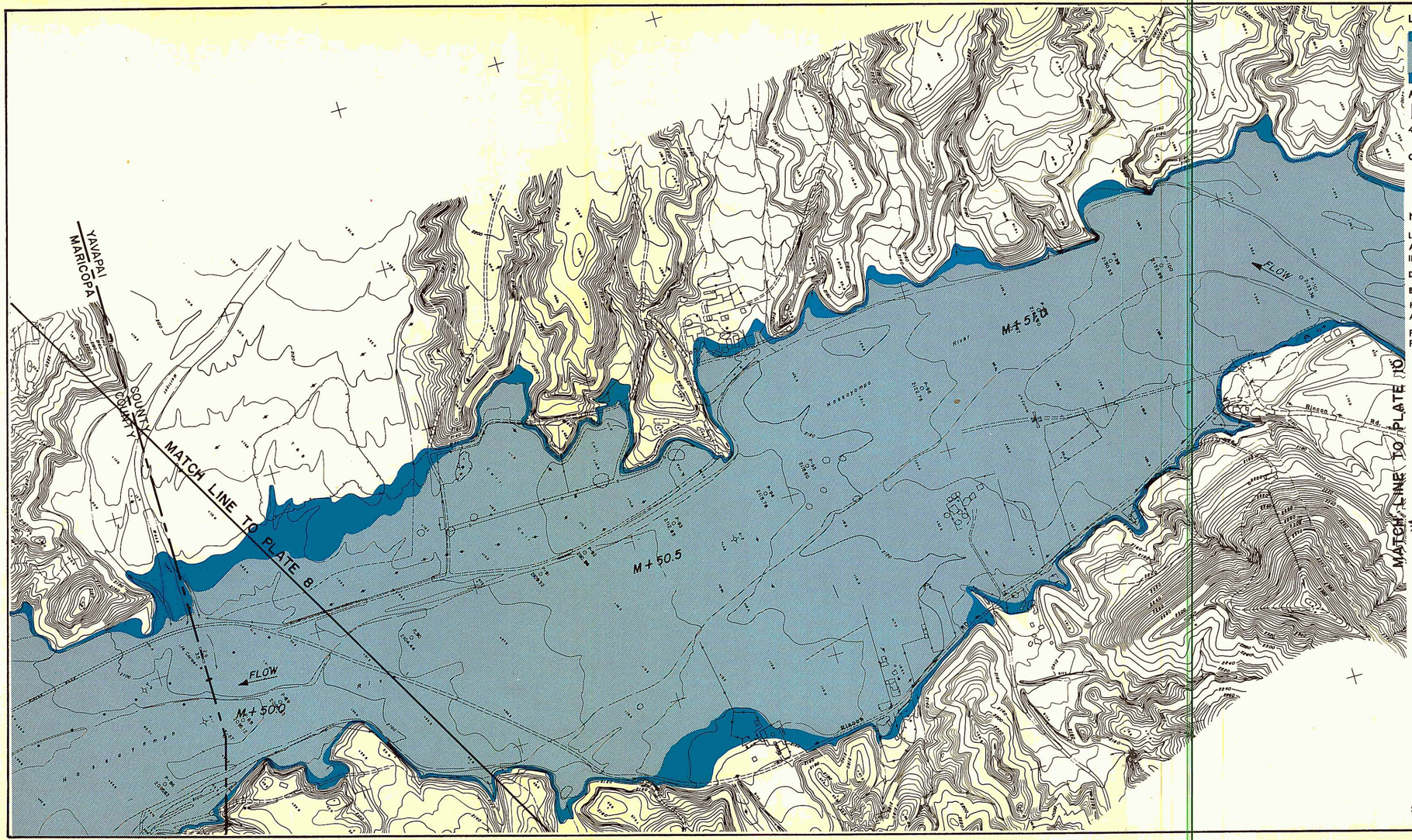
LOS ANGELES DISTRICT, CALIFORNIA

FLOODED AREAS HASSAYAMPA RIVER VICINITY OF WICKENBURG, ARIZONA

SCALE 500 0 500 FEET

APRIL 1972

PLATE 8



LEGEND:

OVERFLOW LIMITS

INTERMEDIATE REGIONAL FLOOD

STANDARD PROJECT FLOOD

M+2.50 ---- MILES ABOVE MOUTH

2 ——— CROSS SECTION

400 ---------- GROUND ELEVATION IN FEET ABOVE MEAN SEA LEVEL

CONTOUR INTERVAL 4 FEET

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LOS ANGELES DISTRICT, CALIFORNIA

FLOODED AREAS HASSAYAMPA RIVER

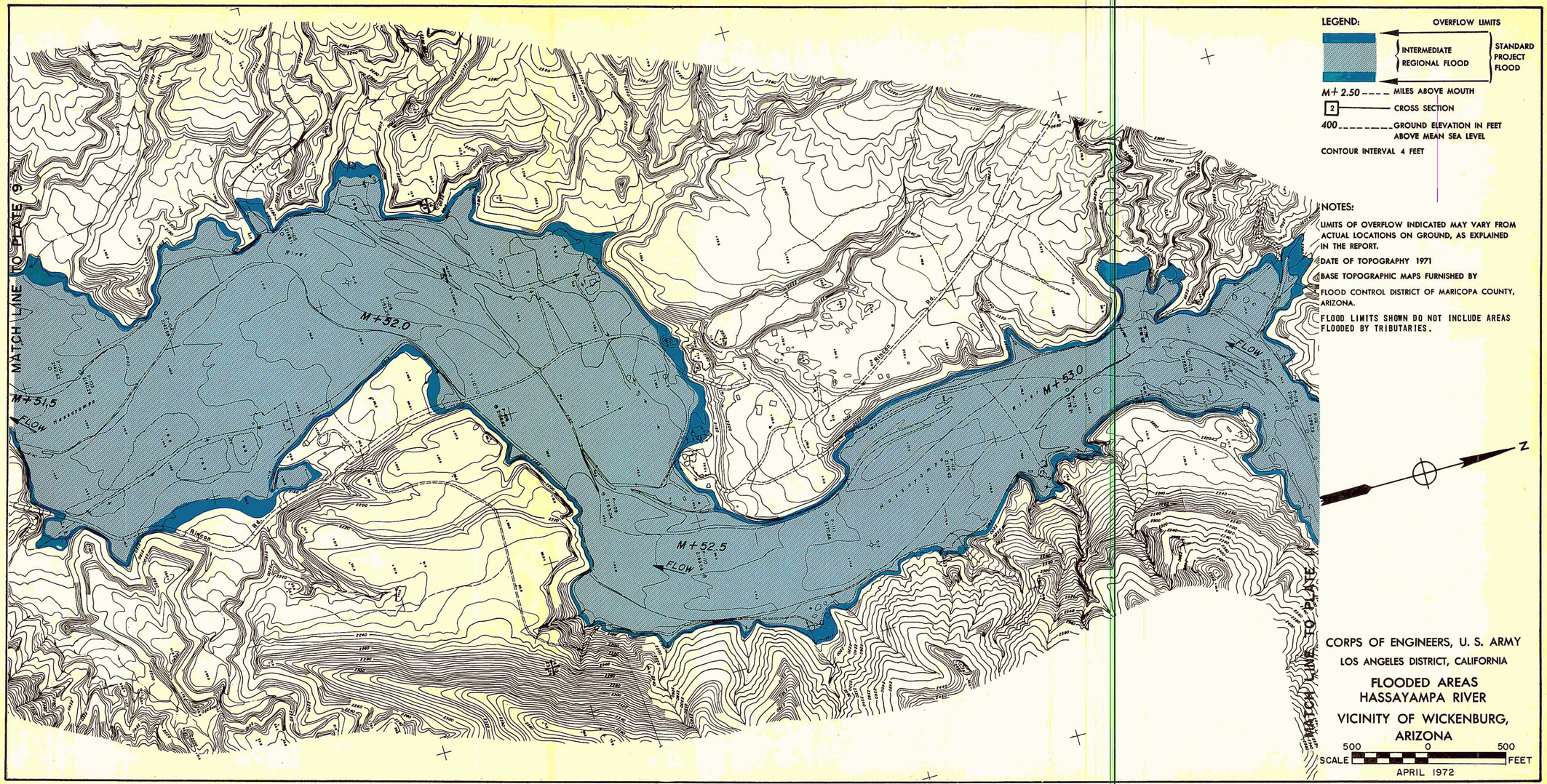
VICINITY OF WICKENBURG, ARIZONA

500 0 500

SCALE FEET

APRIL 1972

PLATE 9



LEGEND:

OVERFLOW LIMITS

INTERMEDIATE REGIONAL FLOOD

STANDARD PROJECT FLOOD

M+ 2.50 ---- MILES ABOVE MOUTH

2 ---- CROSS SECTION

400 ---- GROUND ELEVATION IN FEET ABOVE MEAN SEA LEVEL

CONTOUR INTERVAL 4 FEET

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LOS ANGELES DISTRICT, CALIFORNIA

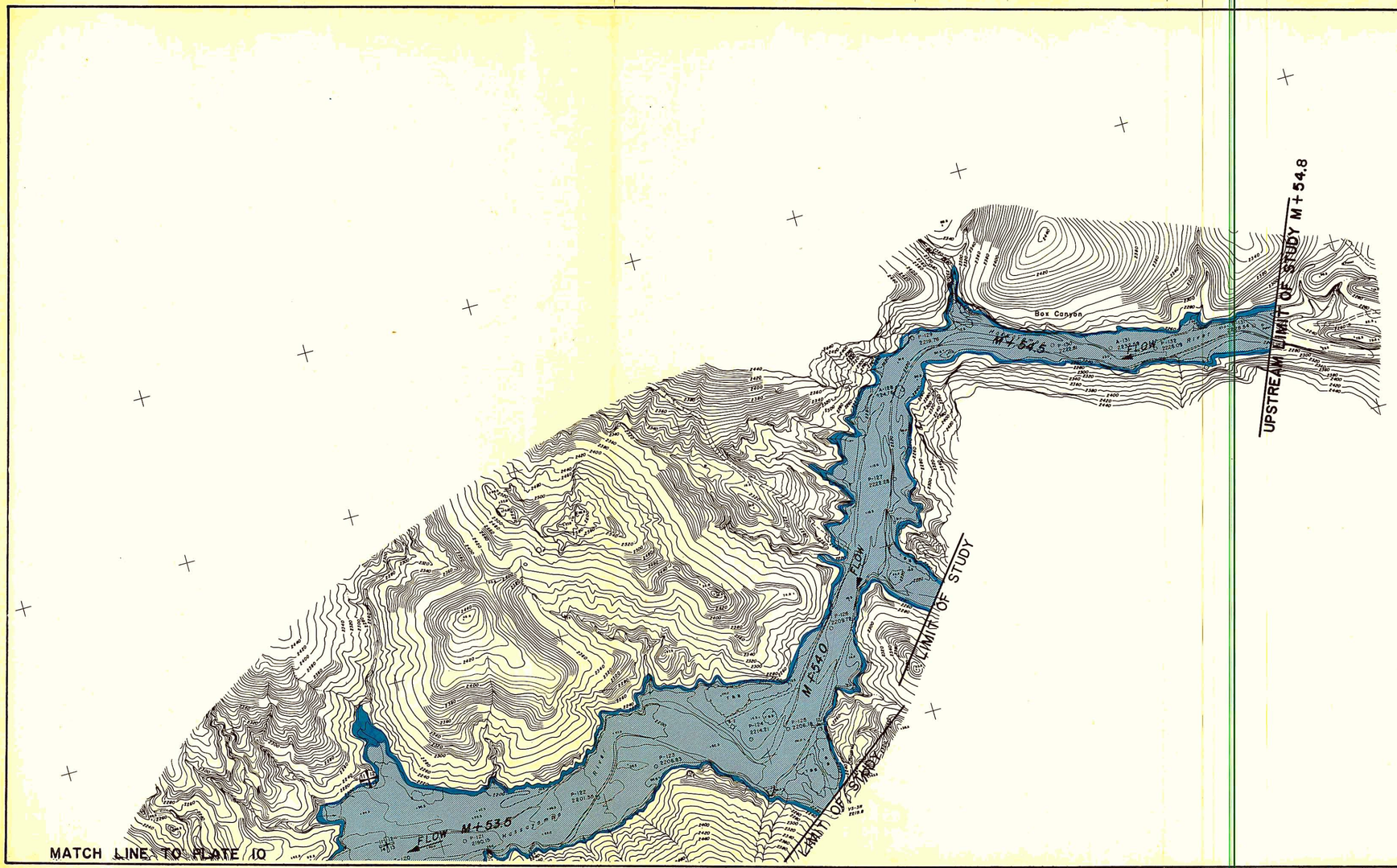
FLOODED AREAS HASSAYAMPA RIVER VICINITY OF WICKENBURG, ARIZONA

500 0 500

SCALE FEET

APRIL 1972

PLATE 10



LEGEND:

OVERFLOW LIMITS

INTERMEDIATE REGIONAL FLOOD

STANDARD PROJECT FLOOD

M+ 2.50 ---- MILES ABOVE MOUTH

2 ——— CROSS SECTION

400 ---------- GROUND ELEVATION IN FEET ABOVE MEAN SEA LEVEL

CONTOUR INTERVAL 4 FEET

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LOS ANGELES DISTRICT, CALIFORNIA

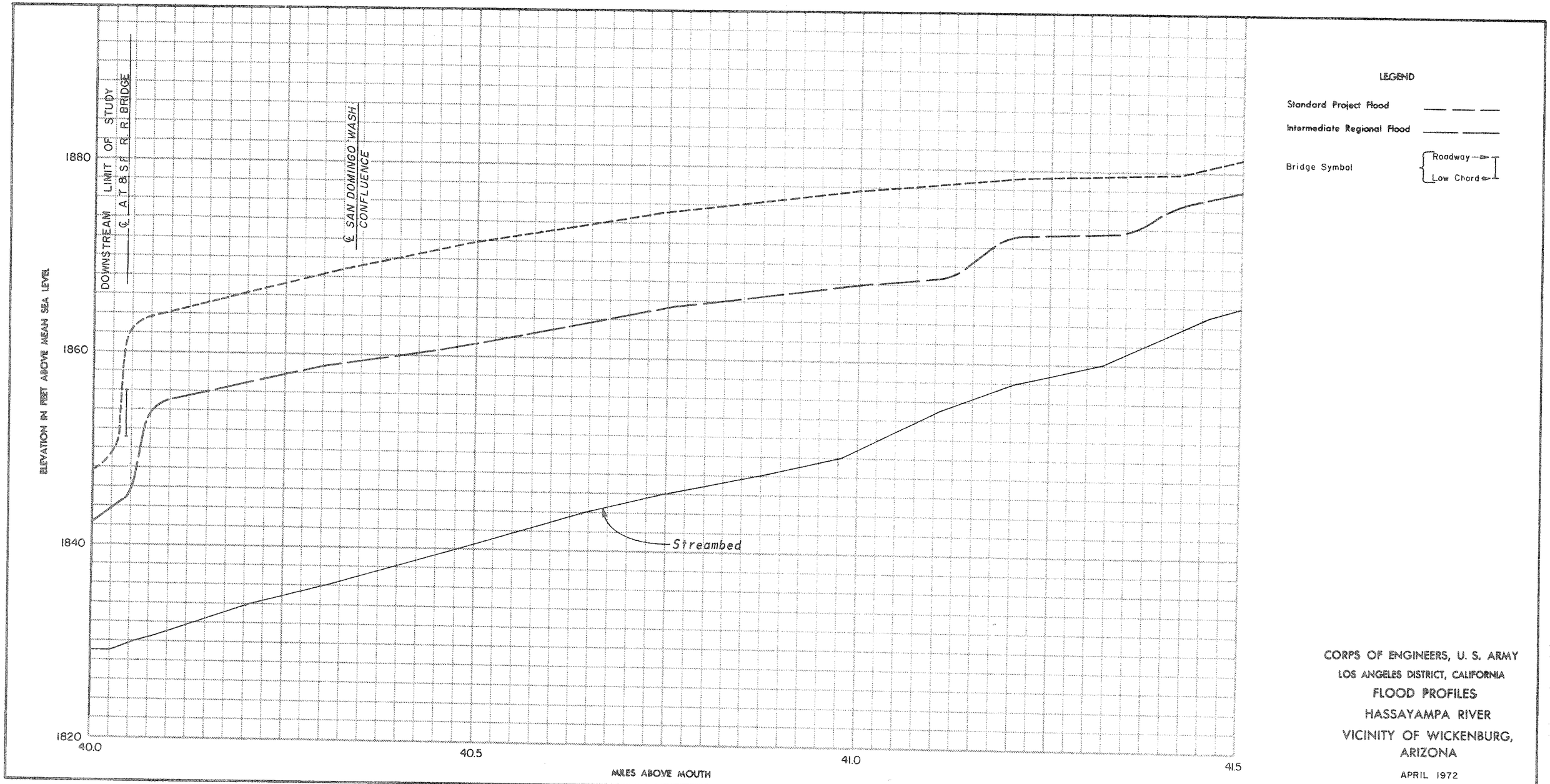
FLOODED AREAS HASSAYAMPA RIVER

VICINITY OF WICKENBURG, ARIZONA

SCALE 500 0 500 FEET

APRIL 1972

PLATE 11



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LOS ANGELES DISTRICT, CALIFORNIA
FLOOD PROFILES
HASSAYAMPA RIVER
VICINITY OF WICKENBURG, ARIZONA
APRIL 1972

PLATE 12

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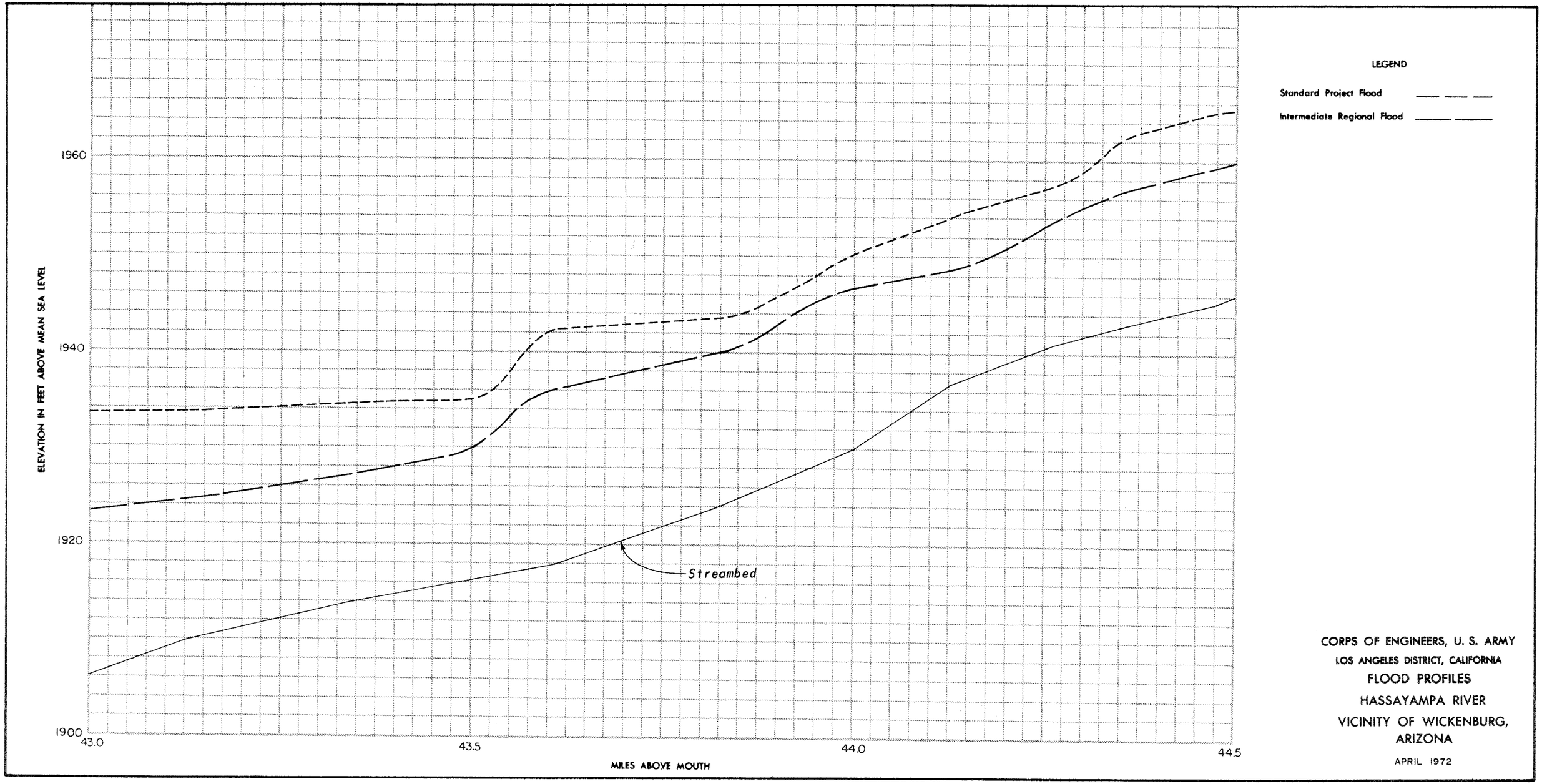
LOS ANGELES DISTRICT, CALIFORNIA
FLOOD PROFILES
HASSAYAMPA RIVER
VICINITY OF WICKENBURG, ARIZONA
APRIL 1972

PLATE 13



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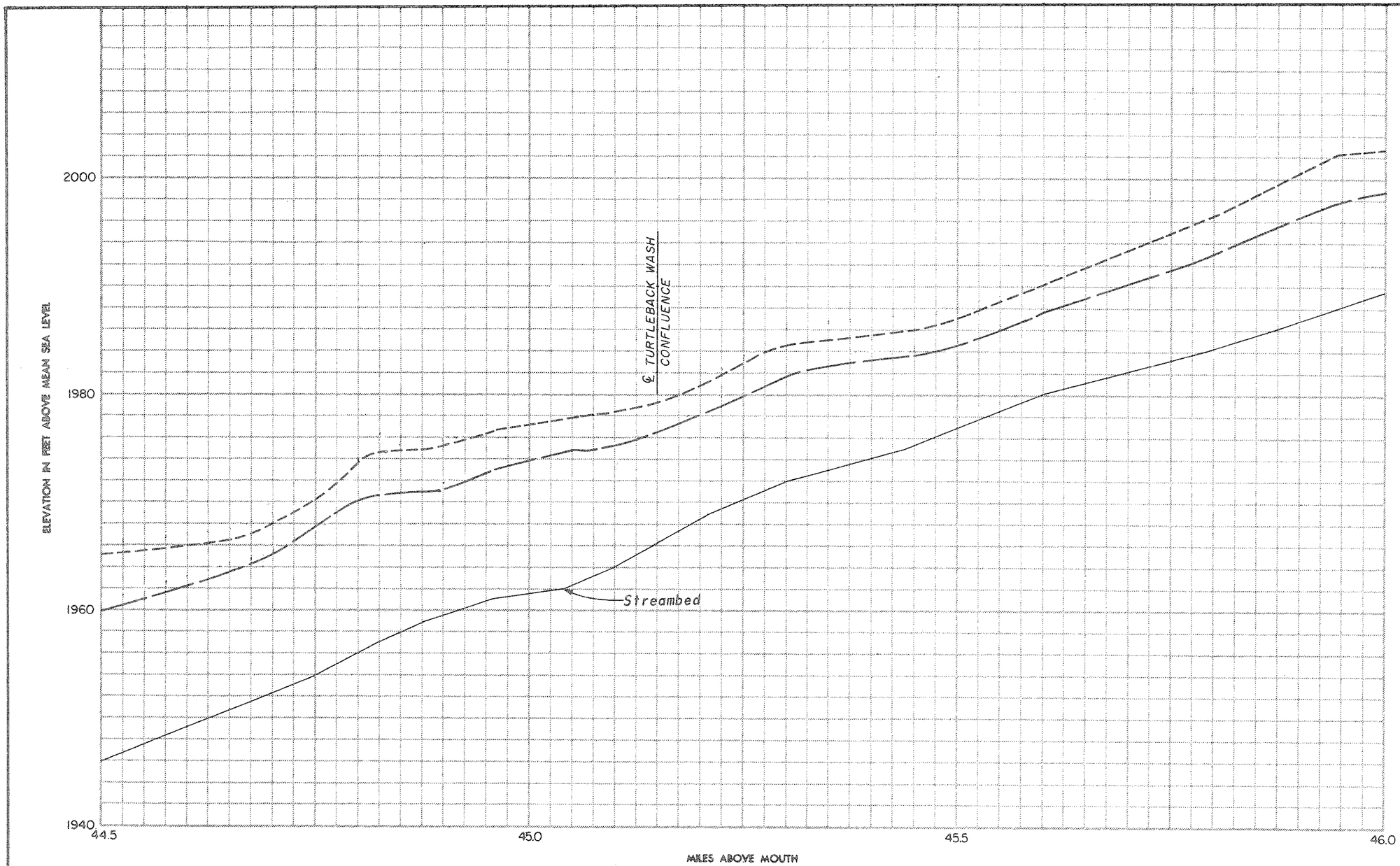
LOS ANGELES DISTRICT, CALIFORNIA
FLOOD PROFILES
HASSAYAMPA RIVER
VICINITY OF WICKENBURG, ARIZONA
APRIL 1972

PLATE 14



LEGEND

Standard Project Flood ——— — ———

Intermediate Regional Flood ——— ———

CORPS OF ENGINEERS, U. S. ARMY

LOS ANGELES DISTRICT, CALIFORNIA

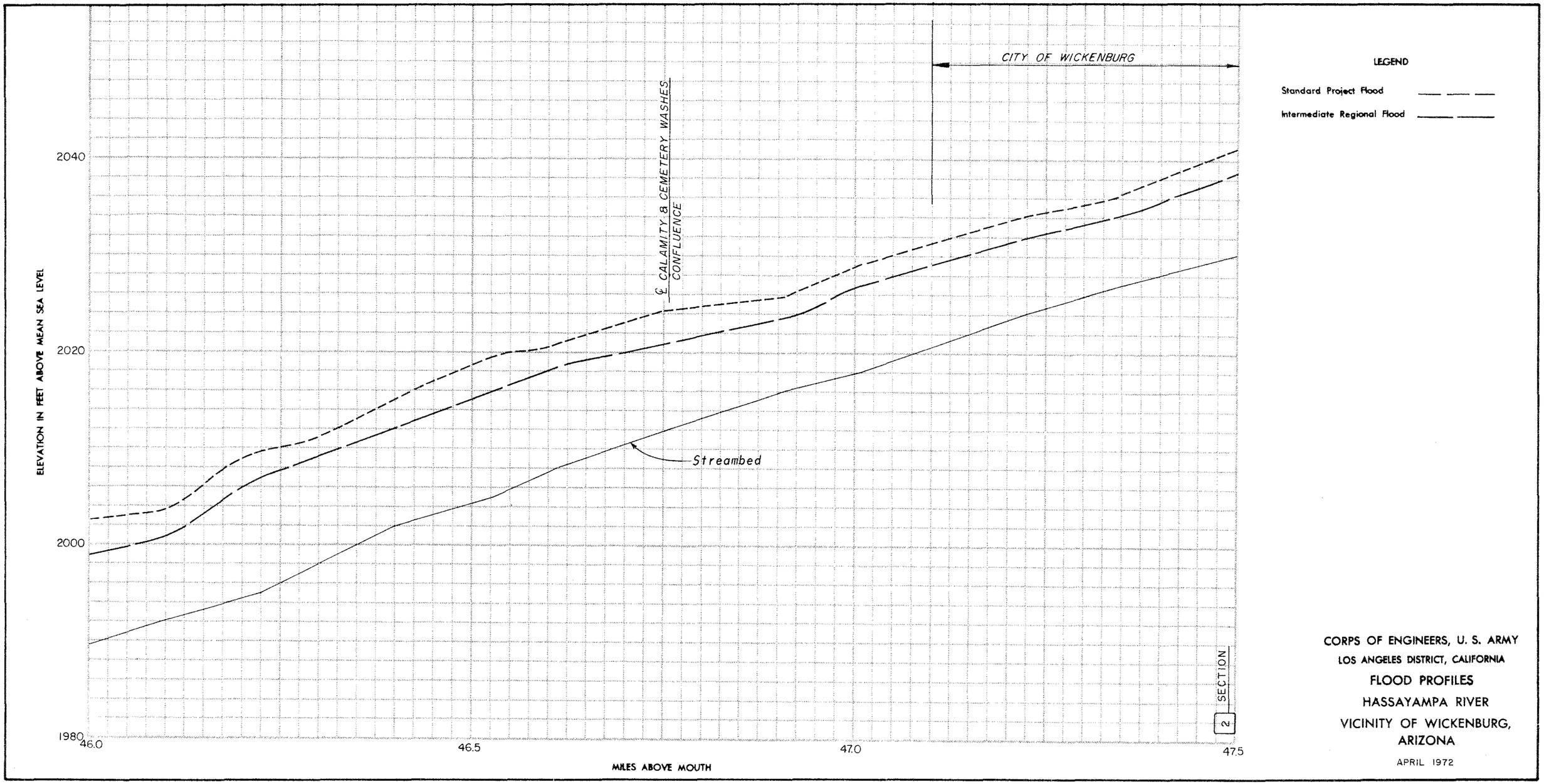
FLOOD PROFILES

HASSAYAMPA RIVER

VICINITY OF WICKENBURG, ARIZONA

APRIL 1972

PLATE 15



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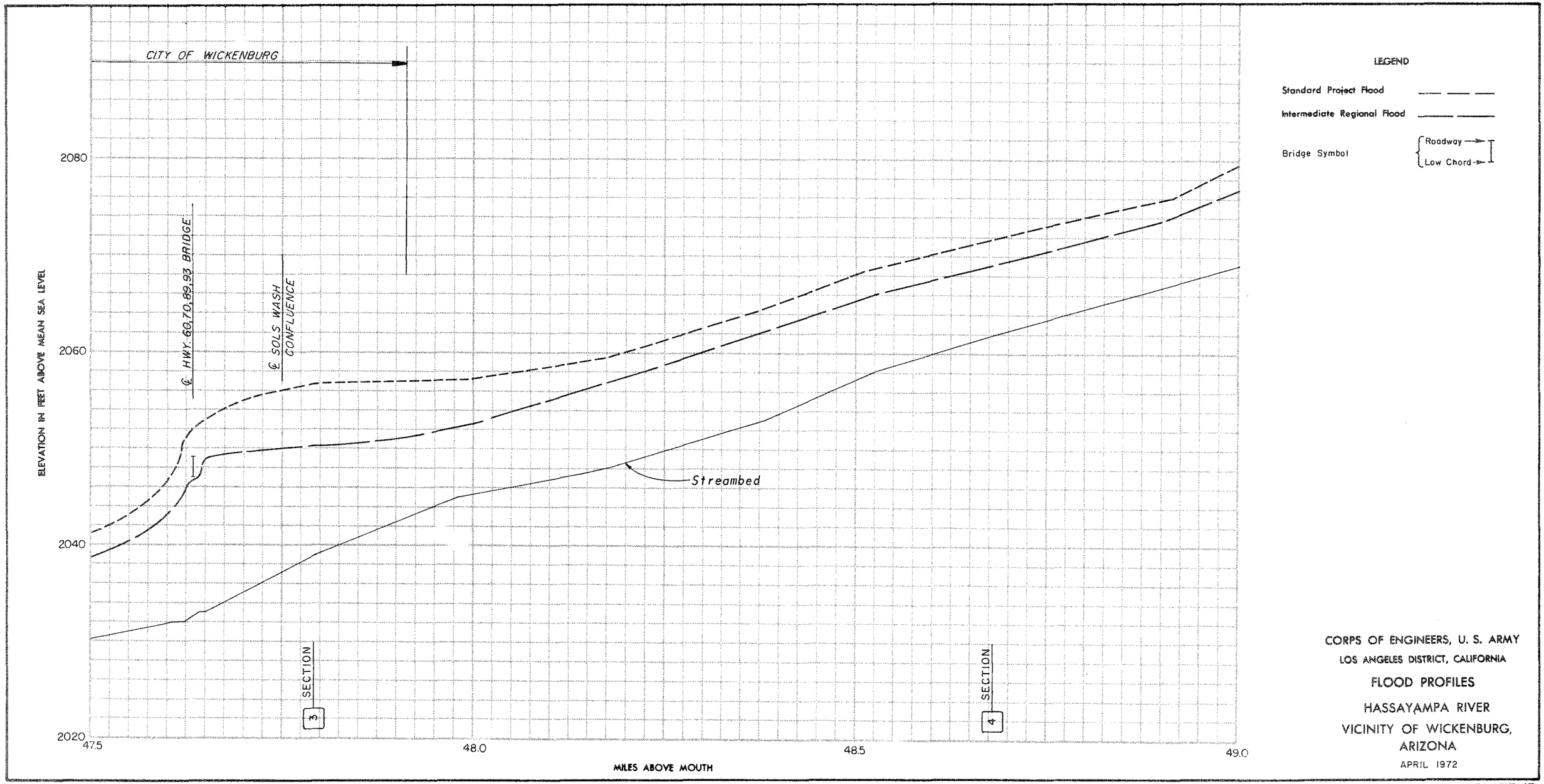
LOS ANGELES DISTRICT, CALIFORNIA

FLOOD PROFILES
HASSAYAMPA RIVER
VICINITY OF WICKENBURG, ARIZONA

APRIL 1972

PLATE 16

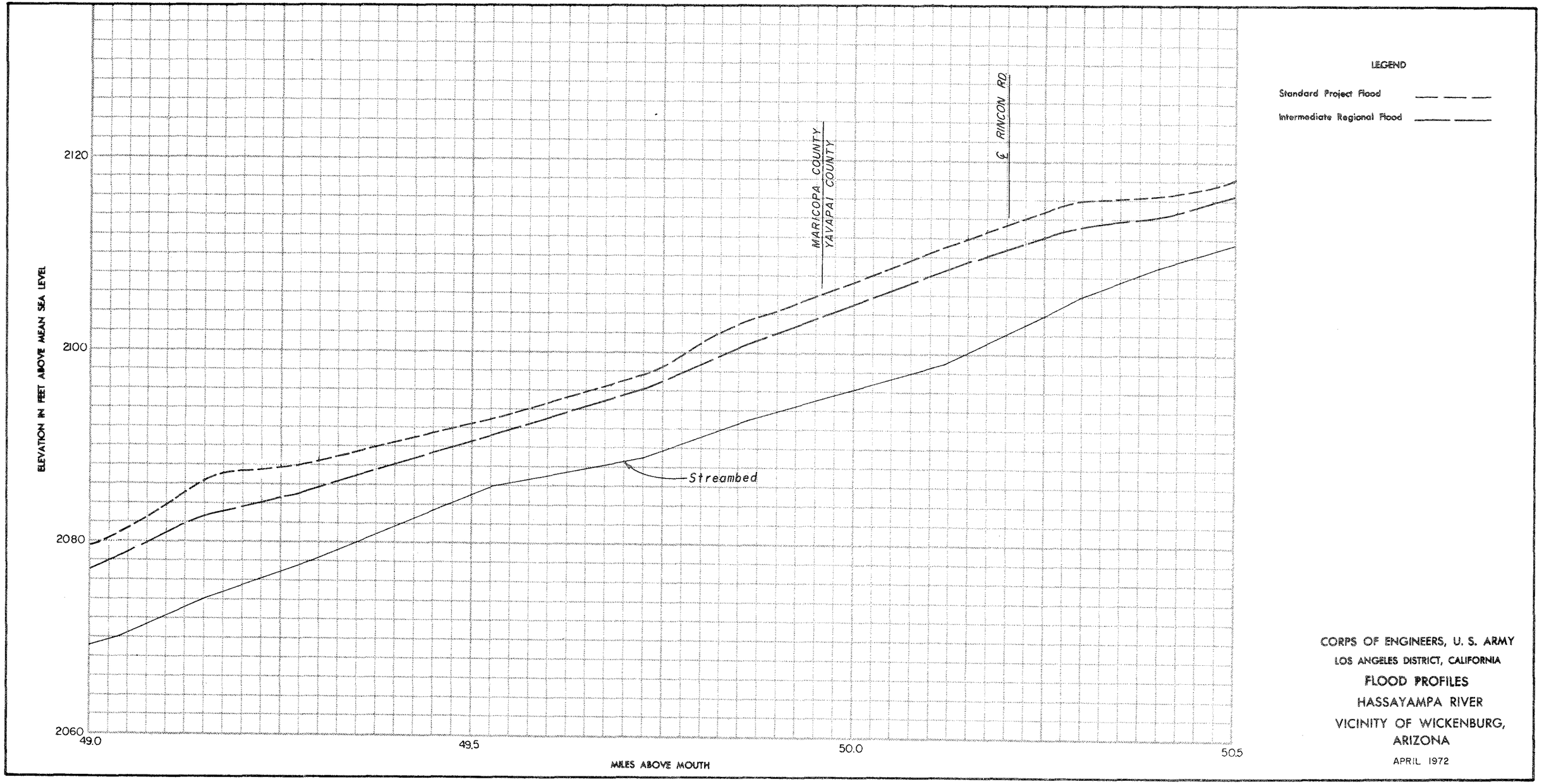


CORPS OF ENGINEERS, U. S. ARMY
LOS ANGELES DISTRICT, CALIFORNIA

FLOOD PROFILES

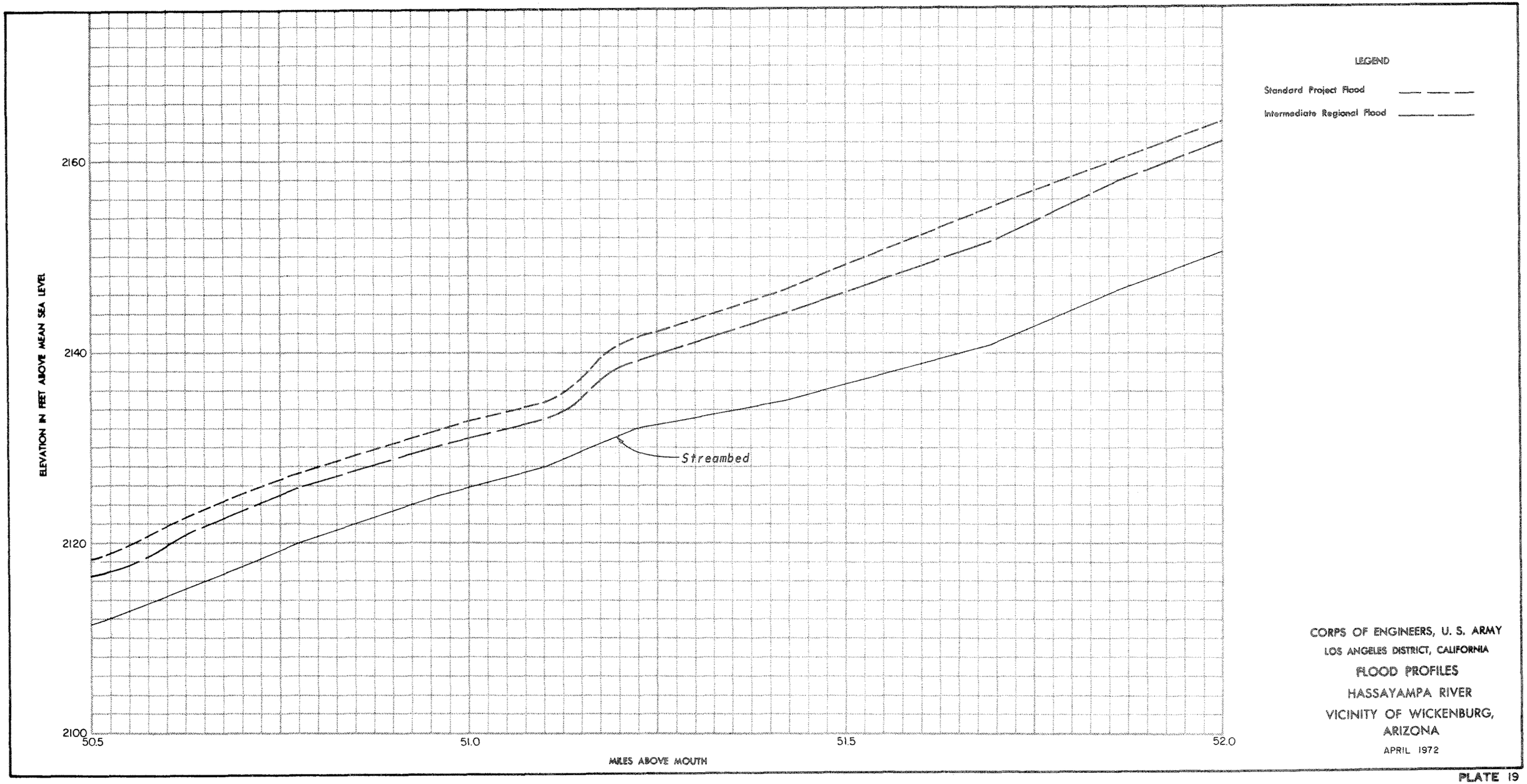
HASSAYAMPA RIVER
VICINITY OF WICKENBURG, ARIZONA
APRIL 1972

PLATE 17



CORPS OF ENGINEERS, U. S. ARMY
LOS ANGELES DISTRICT, CALIFORNIA
FLOOD PROFILES
HASSAYAMPA RIVER
VICINITY OF WICKENBURG, ARIZONA
APRIL 1972

PLATE 18



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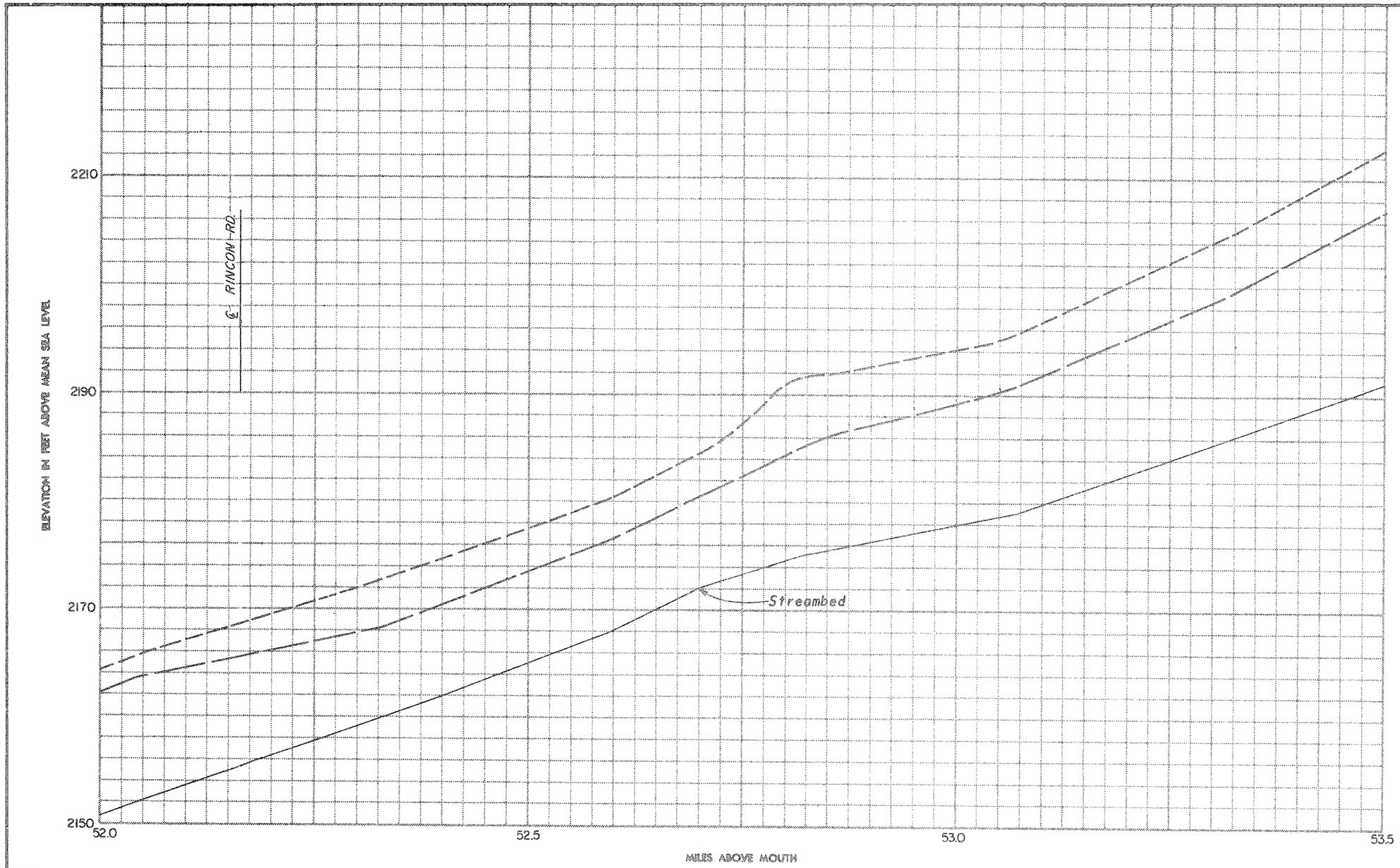
LOS ANGELES DISTRICT, CALIFORNIA
FLOOD PROFILES
HASSAYAMPA RIVER
VICINITY OF WICKENBURG, ARIZONA
APRIL 1972

PLATE 19



LEGEND

Standard Project Flood

Intermediate Regional Flood

CORPS OF ENGINEERS, U. S. ARMY

LOS ANGELES DISTRICT, CALIFORNIA

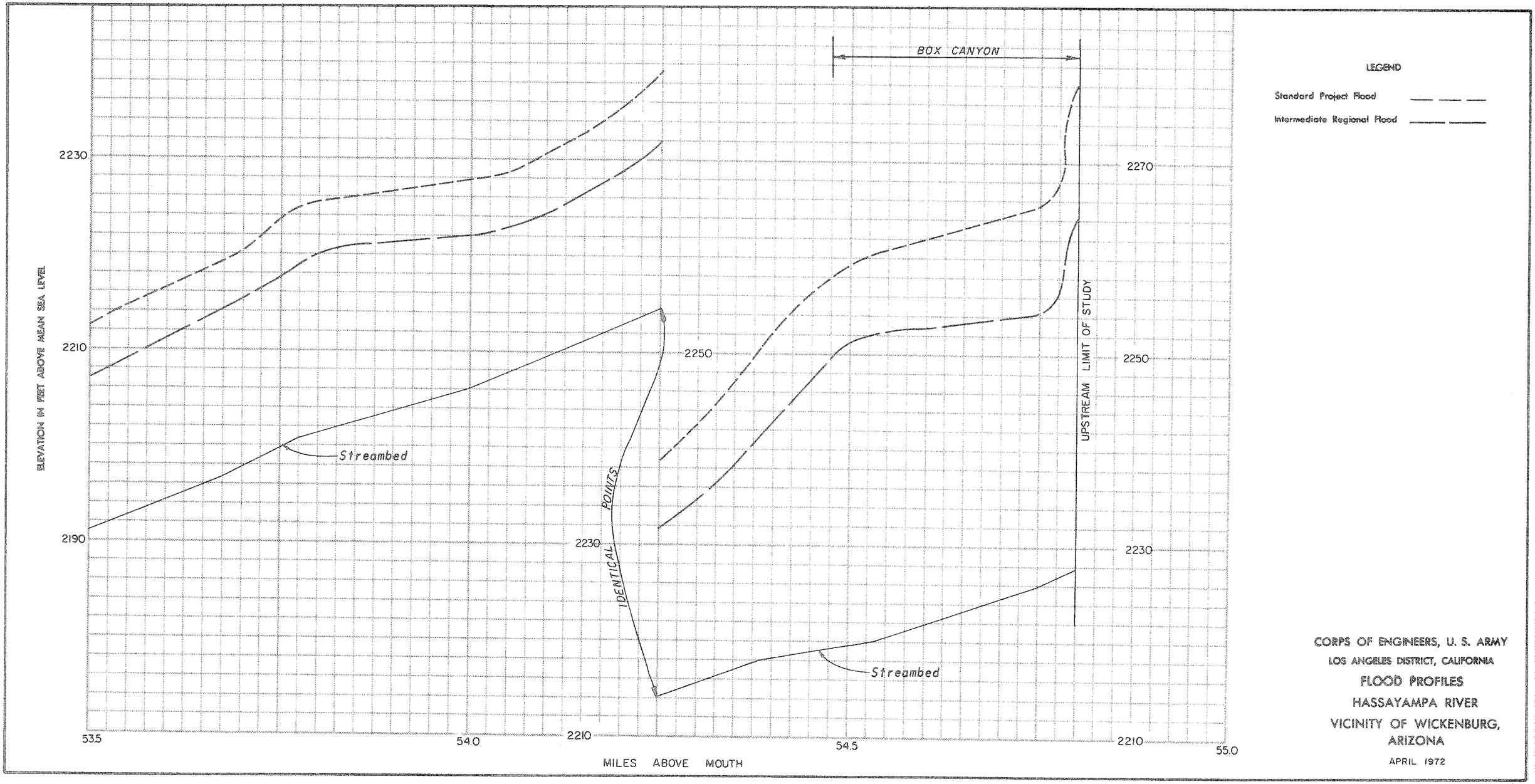
FLOOD PROFILES

HASSAYAMPA RIVER

VICINITY OF WICKENBURG, ARIZONA

APRIL 1972

PLATE 20



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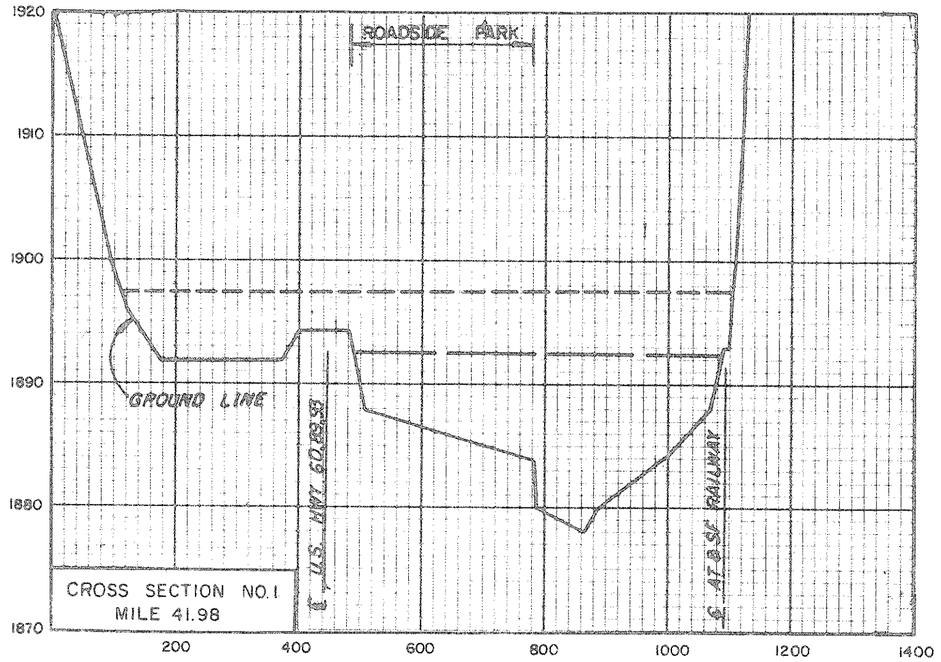
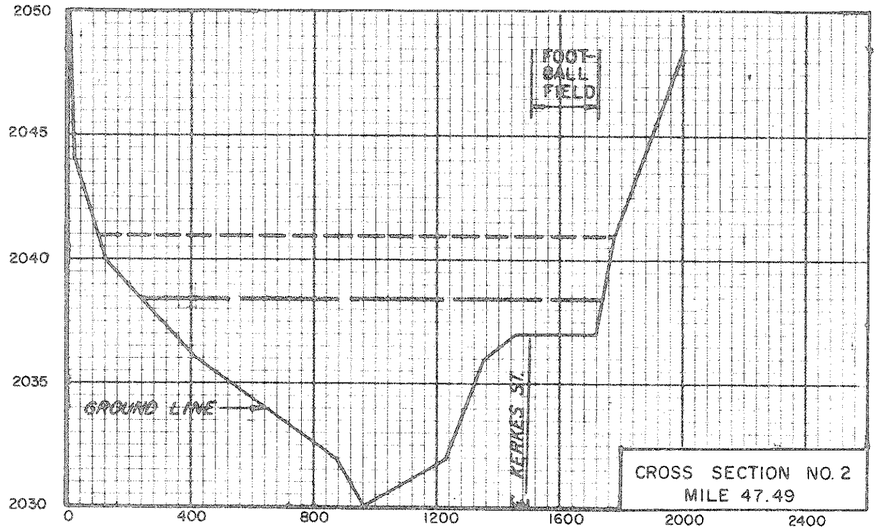
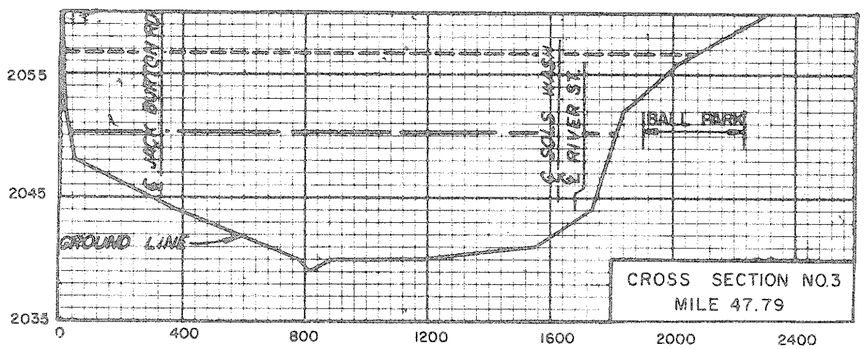
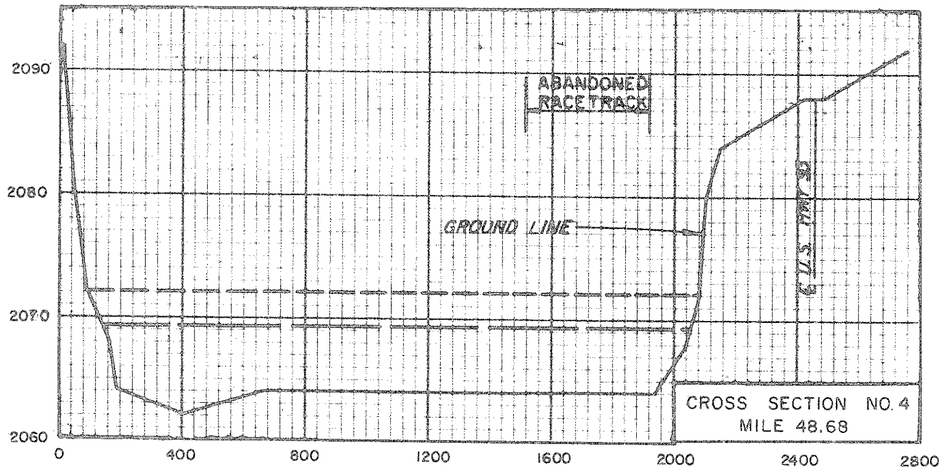
LOS ANGELES DISTRICT, CALIFORNIA
FLOOD PROFILES
HASSAYAMPA RIVER
VICINITY OF WICKENBURG, ARIZONA
APRIL 1972

PLATE 21









LEGEND

Standard Project Flood. – – – – – –

Intermediate Regional Flood. ——— ———

NOTES:

1. Horizontal distance in feet.
2. Sections taken looking downstream.

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LOS ANGELES DISTRICT, CALIFORNIA

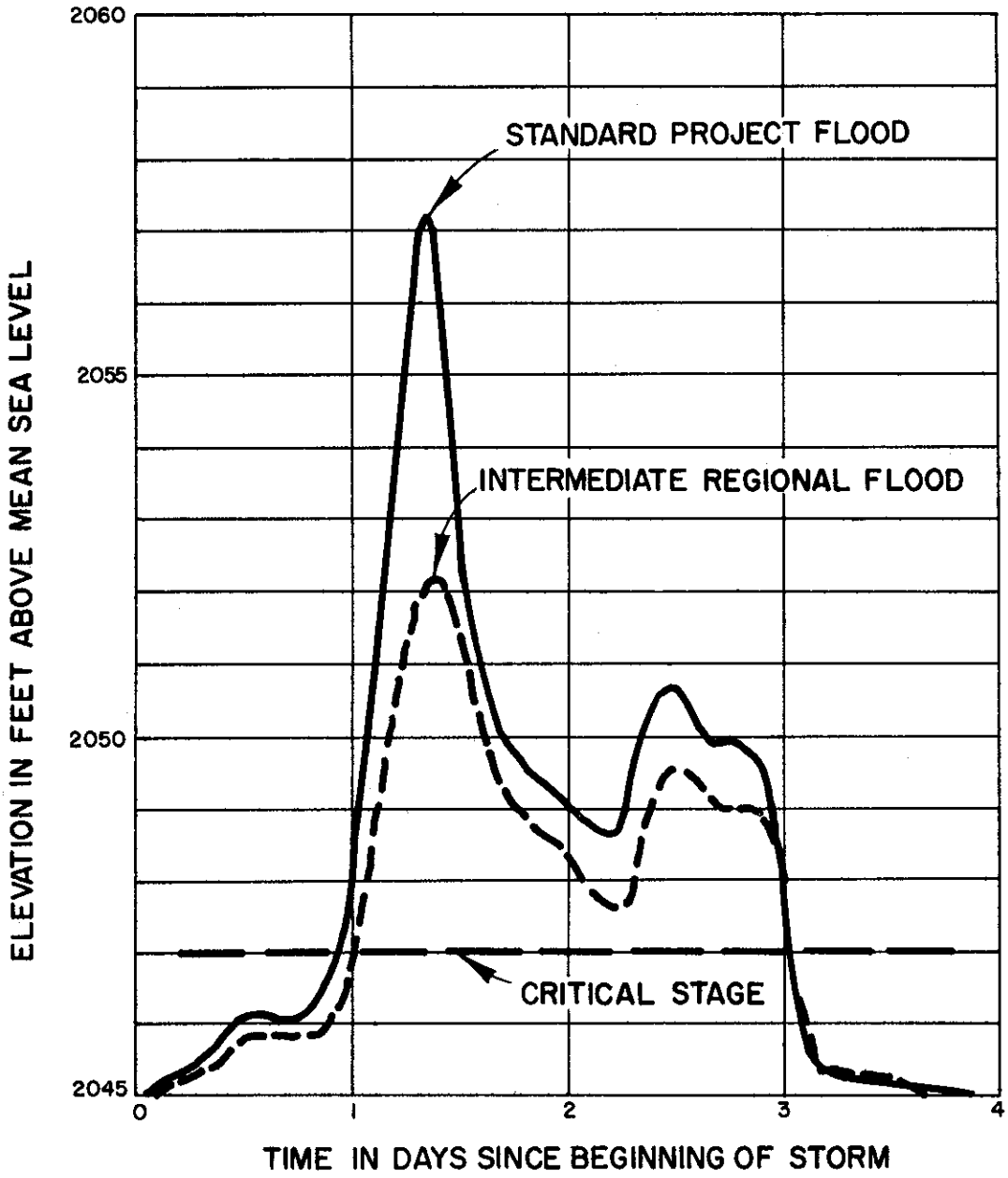
CROSS SECTIONS

HASSAYAMPA RIVER

VICINITY OF WICKENBURG, ARIZONA

APRIL 1972

PLATE 22



NOTES:

1. STAGE HYDROGRAPH AT RIVER MILE 48.0

FLOOD PLAIN INFORMATION

STAGE HYDROGRAPH

HASSAYAMPA RIVER

WICKENBURG, ARIZONA

CORPS OF ENGINEERS, U. S. ARMY
LOS ANGELES DISTRICT, CALIFORNIA

APRIL 1972

PLATE 23