

Figure 1.--Area of report (shaded).

#### INTRODUCTION

Avra Valley is about 15 mi west of Tucson, Ariz. (fig. 1), and extends from near Three Points at the upstream end to the Pima-Pinal County line at the downstream end. At the present time (1977) the land is used mainly for agriculture and cattle grazing. Although the valley is sparsely populated and has no incorporated towns, its proximity to Tucson makes it highly desirable for future urban development. The purpose of this map is to show the administrators and planners concerned with future land development the approximate areas that are subject to inundation by the 100-year flood. The study was requested by the Pima County Engineer and was made by the U.S. Geological Survey in cooperation with the Pima County Board of Supervisors.

Avra Valley is a wide plain bounded by low mountains on the east and west and is drained mainly by Brawley Wash. Brawley Wash becomes Los Robles Wash 10 mi upstream from its mouth. Brawley Wash heads near the international boundary about 40 mi south of Three Points and joins the Santa Cruz River as Los Robles Wash 3 mi north of the Pima-Pinal County line. Blanco Wash drains the west side of Avra Valley and joins Los Robles Wash at Silver Bell Road about 2 mi south of the county line.

The channel of Brawley Wash is well defined from its entry into the study area to a stock tank in sec. 1, T. 15 S., R. 10 E., about 5 mi downstream from Three Points. Most of the natural drainage system consists of small braided channels bordered by narrow bands of dense vegetation, which cause floodwater to spread over wide areas at shallow depths. In some places the natural channels have been aligned and enlarged, and dikes and ditches have been built around irrigated fields in an attempt to prevent inundation by floodwater. The drainage divide between Brawley and Blanco Washes is not well defined, and during the 100-year flood the areas inundated by the washes may join in several places.

The flood profiles and the approximate areas that would be inundated by the 100-year flood are based on the alignment and capacity of the channels and the location of fields and dikes in 1976. The information given for areas that would be inundated by the 100-year floods along Brawley, Los Robles, and Blanco Washes is a refinement of similar information given in the 1970 flood-prone maps of the Silver Bell Peak, Cocoraque Butte, San Xavier Mission, Avra, and Marana quadrangles.

#### FLOOD HISTORY

The flood of September 26, 1962, is the largest known in Avra Valley and is comparable to the 100-year flood in much of the valley. The peak discharge increased from 13,000 ft<sup>3</sup>/s at crest-stage gage 09487000 on Brawley Wash near Three Points to 36,000 ft<sup>3</sup>/s at Mile Wide Road and then decreased to 32,000 ft<sup>3</sup>/s at crest-stage gage 09487250 on Los Robles Wash at Trico Road (see table 1). The flood mainly was the result of inflow between Three Points and Mile Wide Road. The 1962 peak discharge on Little Brawley Wash—a tributary that enters Brawley Wash 3 mi downstream from Three Points—was 13,800 ft<sup>3</sup>/s from a drainage area of 11.9 mi<sup>2</sup>. The flood of September 5, 1970, was of about the same magnitude as the flood of 1962 at crest-stage gage 09487000 near Three Points, but the flood discharge in 1970 decreased sharply as it moved downstream (see table 1).

Table 1.--Peak discharges for the floods of September 1962, September 1970, and the 100-year flood

[Estimates for the 100-year flood determined from methods described by S. N. Aldridge and Alberto Condes de la Torre (written comm. 1970)]				
Location	River miles upstream from mouth	Drainage area in square miles	Peak discharge, in cubic feet per second Flood of September 1962	100-year flood Flood of September 1970
BRAWLEY-LOS ROBLES WASH				
Brawley Wash near Three Points (at State Highway 86) crest-stage gage 09487000	38.6	776	13,000	13,700
Brawley Wash at Mile wide Road	24.4	1,077	36,800	6,140
Brawley Wash (east branch)	10.0 to 19.2	-----	-----	21,000
Brawley Wash (west branch)	10.0 to 38.3	-----	-----	14,000
Los Robles Wash near Marana (at Trico Road) crest-stage gage 09487250	9.1	1,170	32,000	4,490
Los Robles Wash at Silver Bell Road	6.2	1,349	32,600	35,000
BLANCO WASH				
Blanco Wash 1 mile north of Marville Road	11.5	64	-----	6,000
Blanco Wash at Avra Valley Road	6.2	115	-----	8,800
Blanco Wash at mouth	0	165	-----	11,000
LITTLE BRAWLEY WASH				
Little Brawley Wash near Three Points; crest-stage gage 09487100	----	11.9	13,800	2,300

#### DETERMINATION OF THE 100-YEAR FLOOD

The peak discharges for the 100-year floods on Brawley, Los Robles, and Blanco Washes were determined from regional flood-frequency relations developed by B. N. Aldridge and Alberto Condes de la Torre (written commun., 1970) and were coordinated with the U.S. Army Corps of Engineers, Arizona Water Commission, Arizona State Land Department, and U.S. Soil Conservation Service (see table 1). The relation between the 100-year flood and size of drainage area in Avra Valley is shown in figure 2. The 100-year flood is defined as the discharge that will be exceeded on the average of once in 100 years. The chance of the 100-year flood occurring in any year is 1 in 100 or 1 percent.

#### FLOOD PROFILES

Profiles of the elevation of the water surface of the 100-year floods on Brawley, Los Robles, and Blanco Washes are shown in figures 3-9. The lines along which the profiles were developed are shown on the topographic map. The river miles upstream from the mouth shown in the profiles and table 1 correspond to those shown along the streams on the topographic map. Preliminary flood profiles were developed using step-backwater computations, and the limits of inundation were plotted on topographic maps. The preliminary flood profiles then were adjusted to match the elevations on the topographic maps where flood boundaries cross topographic contours, streambed profiles, and high-water marks for the floods of 1962 and 1970. High-water information was obtained from residents, field surveys, and aerial photographs of the floods of 1962 and 1970. The step-backwater computations were made using U.S. Geological Survey computer program E 431 (Shearman, 1976) and channel cross-section data furnished by the Pima County Engineer. Data for 70 cross sections at 3,700-ft average intervals were used in the program. The roughness values were selected and the hydraulic computations were made by the author and were reviewed by personnel of the U.S. Geological Survey.

A flood profile was not developed from mile 27.8 to mile 34.8 along Brawley Wash because the 100-year flood would spread over a wide area as flow in the many small channels and as overflow at an average depth of less than 3 ft between the channels. From mile 22.1 to mile 27.8, the flood profile is applicable only along the east edge of the inundated area.

#### AREAS SUBJECT TO INUNDATION

The approximate areas subject to inundation by the 100-year flood are shown on the map and were determined on the basis of the 100-year flood profiles, areas inundated by the floods of 1962 and 1970, contour maps, and stereo-aerial photographs. In most of the area between Three Points and Ryan Field the boundary of inundation is indefinite because of the wide areas that are subject to sheetflow. In this report sheetflow is defined as flow that averages less than 1 ft deep.

The approximate areas that would be inundated by the 100-year flood are based on the alignment and capacity of the channels and location of fields and dikes in 1976. Changes made in the dikes, ditches, or pattern of agricultural development and the channel changes that occur during floods in the desert washes may affect the boundaries of inundation. Where small braided channels are present, new channels are cut when the existing channels become clogged either by the deposition of sediment as the floodwater recedes or by the vegetation that grows in the channels between floods. Along the defined channels, erosion and deposition cause channel migration and changes in channel shape. Therefore, the boundaries of the areas subject to inundation probably would not be the same for any two floods of the same magnitude, even if there were no changes made by man.

#### SELECTED REFERENCES

- Aldridge, B. N., and Burkham, D. E., 1974, Delineation of flood hazards in the Marana quadrangle, Pima County, Arizona: U.S. Geol. Survey Misc. Inv. Ser. Map I-846-B, 1 sheet.
- Lewis, D. D., 1963, Desert floods—a report on southern Arizona floods of September 1962: Arizona State Land Dept. Water-Resources Rept. 13, 30 p.
- Patterson, J. L., and Somers, W. P., 1966, Magnitude and frequency of floods in the United States, Part 9, Colorado River basin: U.S. Geol. Survey Water-Supply Paper 1683, 475 p.
- Roeske, R. H., Cooley, M. E., and Aldridge, B. N., 1977, Floods of September 1970 in Arizona, Utah, Colorado, and New Mexico: U.S. Geol. Survey Water-Supply Paper 2052. [In press]
- Shearman, J. O., 1976, Computer applications for step-backwater and floodway analyses—Computer program E 431 user's manual: U.S. Geol. Survey Open-File Rept. 76-499, 103 p.
- U.S. Army Corps of Engineers, 1963, Flood-damage report on storm and flood of 26-30 September 1962—Santa Cruz River and Santa Rosa Wash, southern Arizona: Corps of Engineers, U.S. Army Engineer District, Los Angeles, 32 p.

Other information pertaining to floods in Avra Valley can be obtained at the Office of the U.S. Geological Survey, Tucson, Ariz.

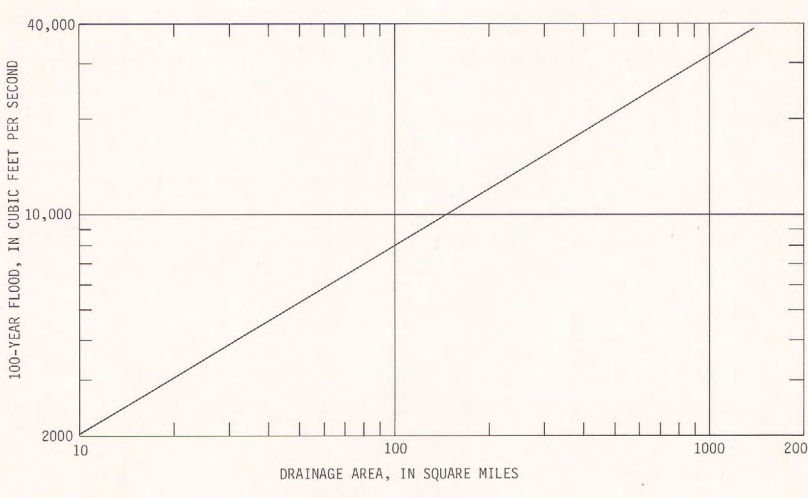
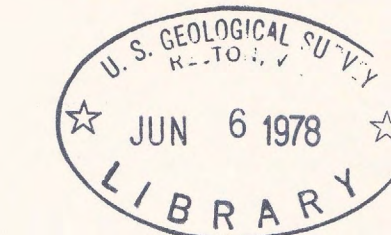


Figure 2.—Relation of 100-year flood size to drainage area in Avra Valley, Arizona.

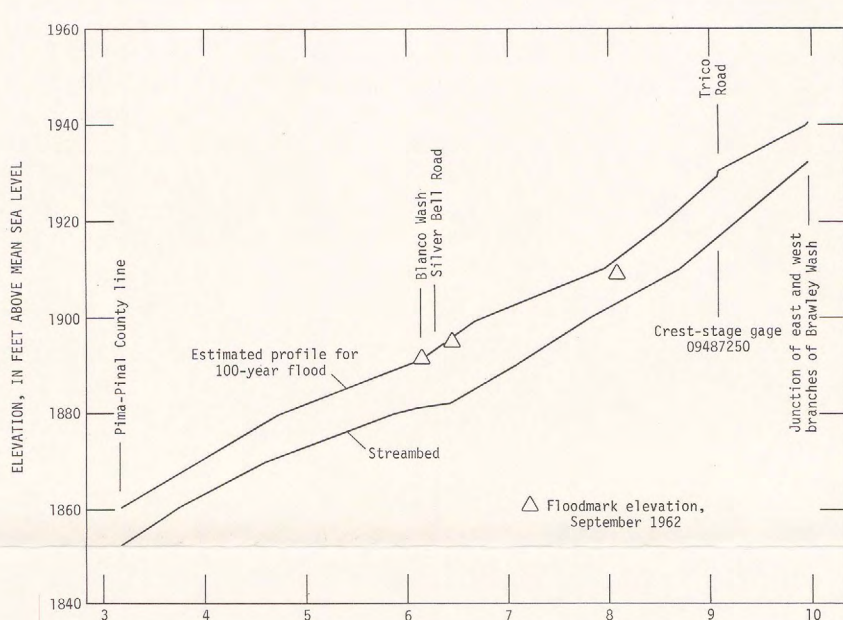


Figure 3.—Flood profile for Los Robles Wash.

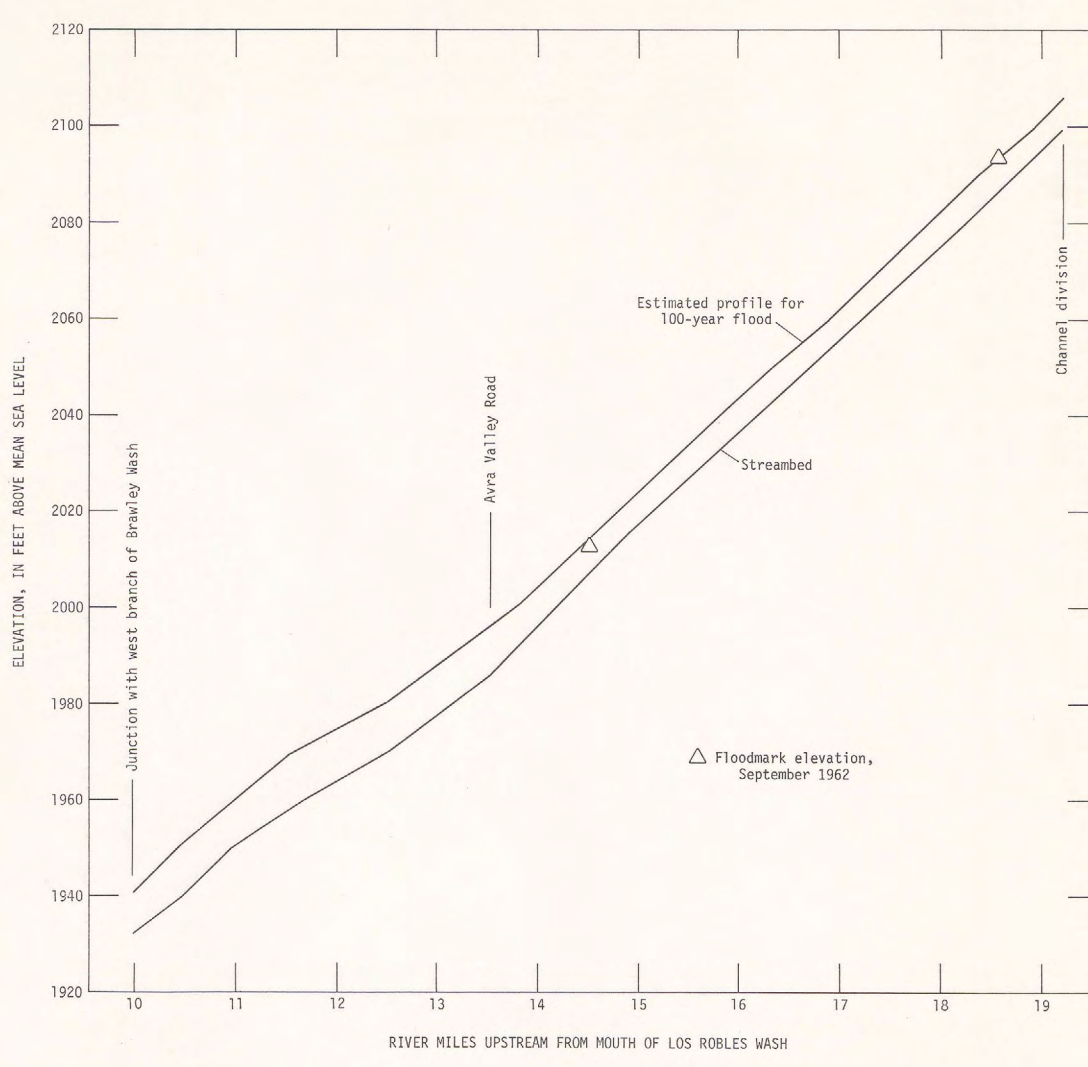


Figure 4.—Flood profile for west branch of Brawley Wash.

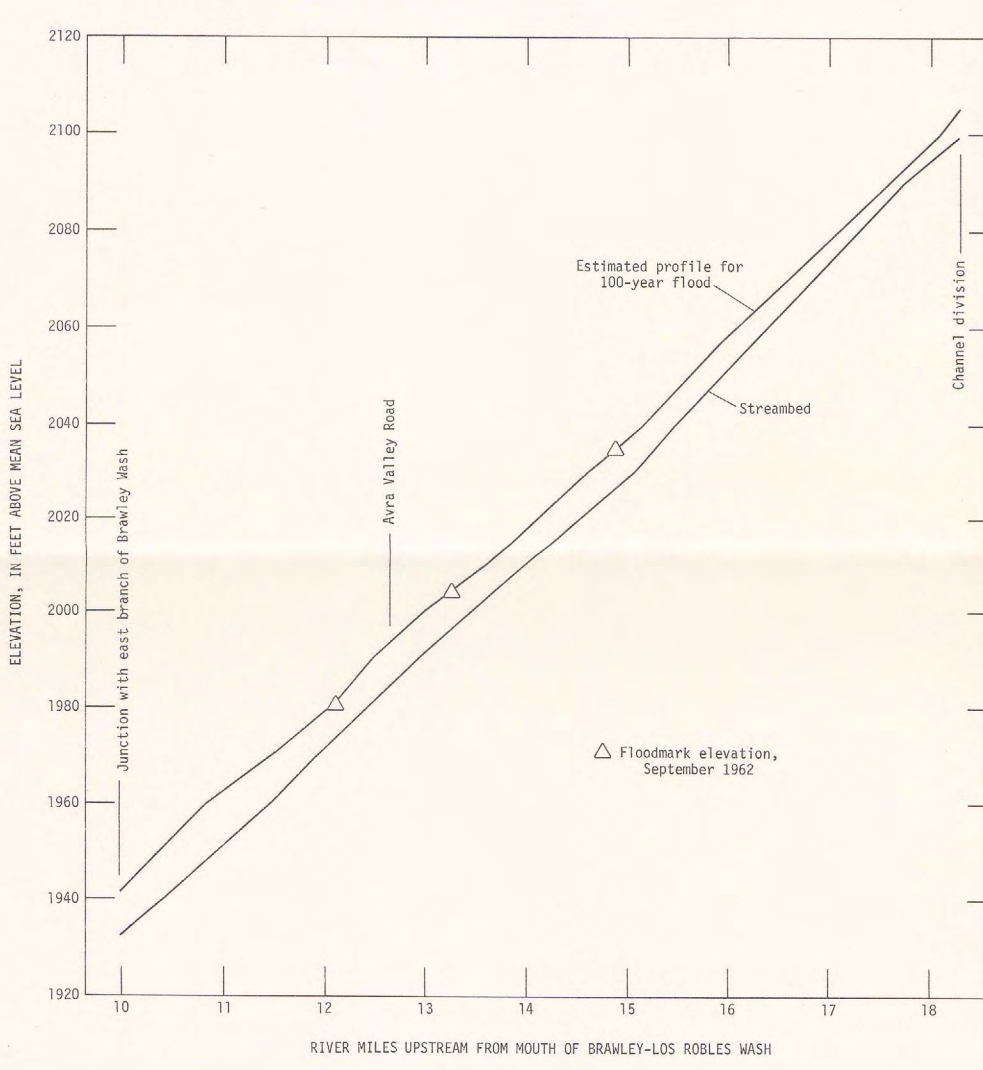


Figure 5.—Flood profile for west branch of Brawley Wash.

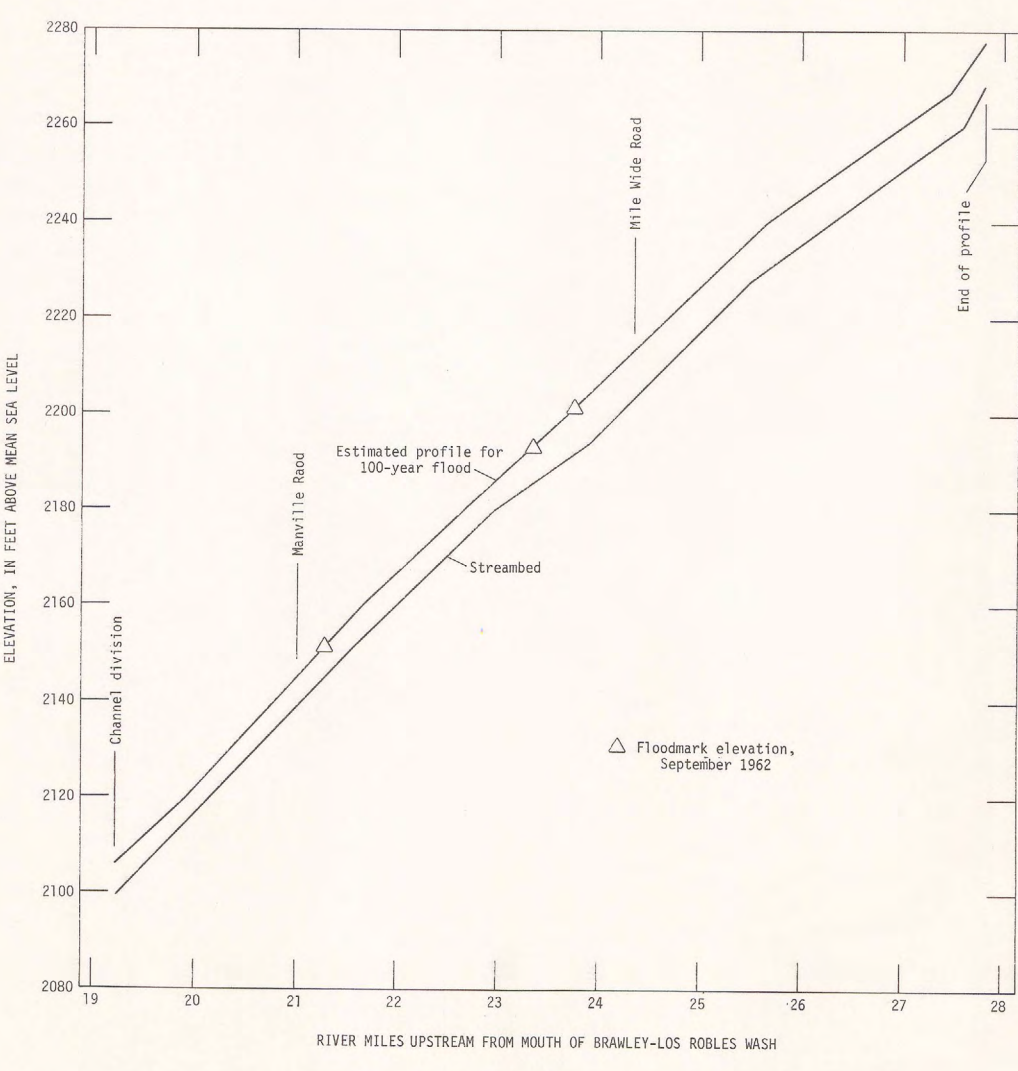


Figure 6.—Flood profile for Brawley Wash from river mile 10.2 to river mile 27.8.

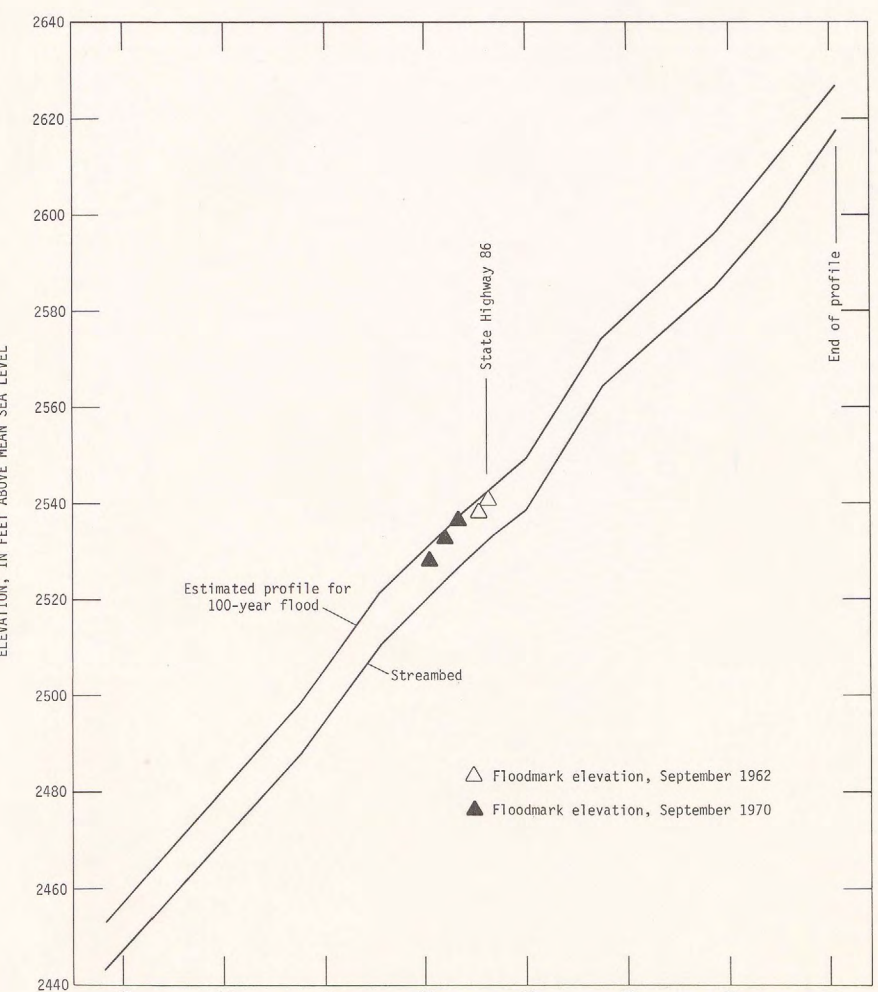


Figure 7.—Flood profile for Brawley Wash from river mile 34.8 to river mile 42.

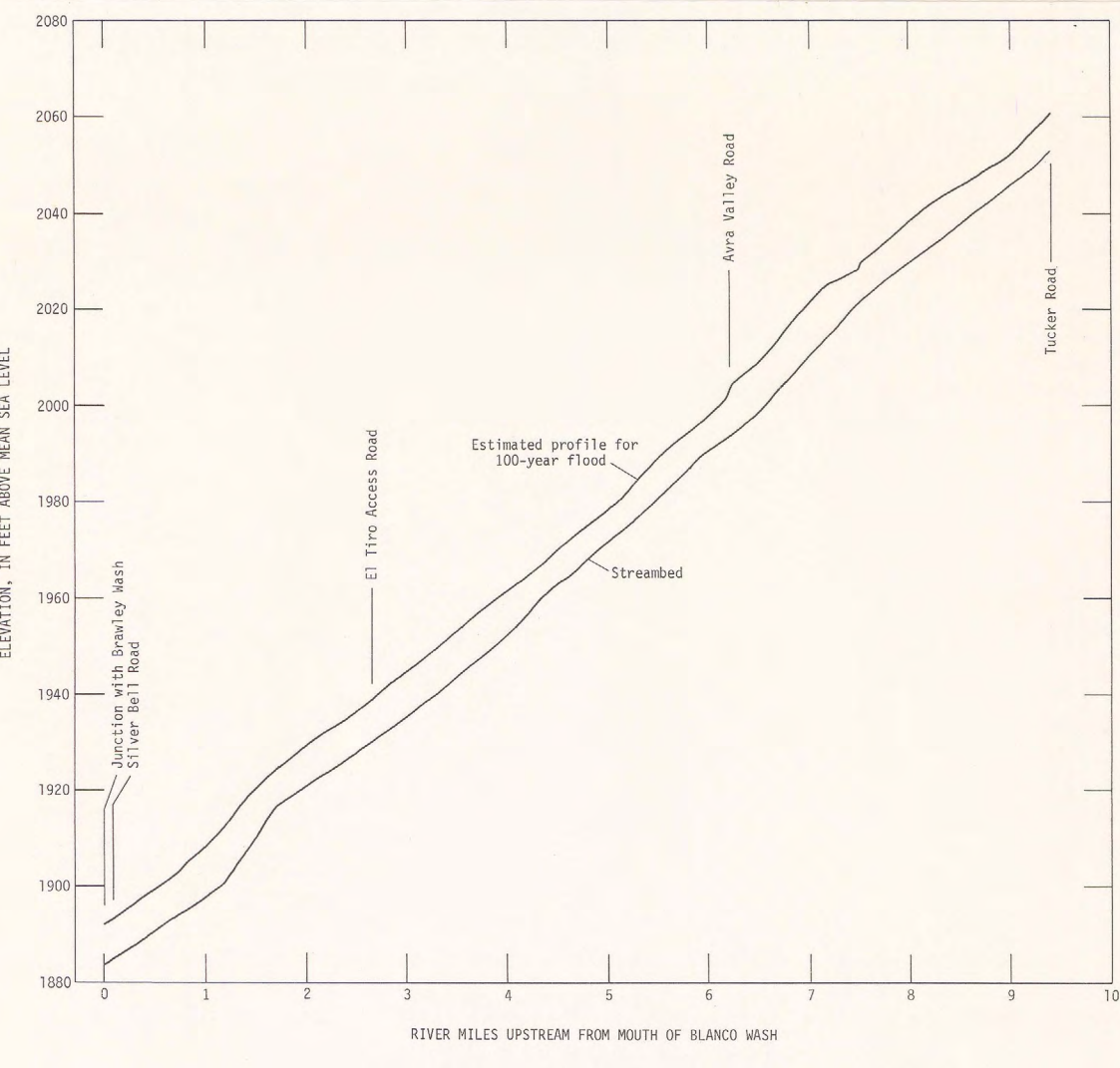


Figure 8.—Flood profile for Blanco Wash from mouth to Tucson Road.

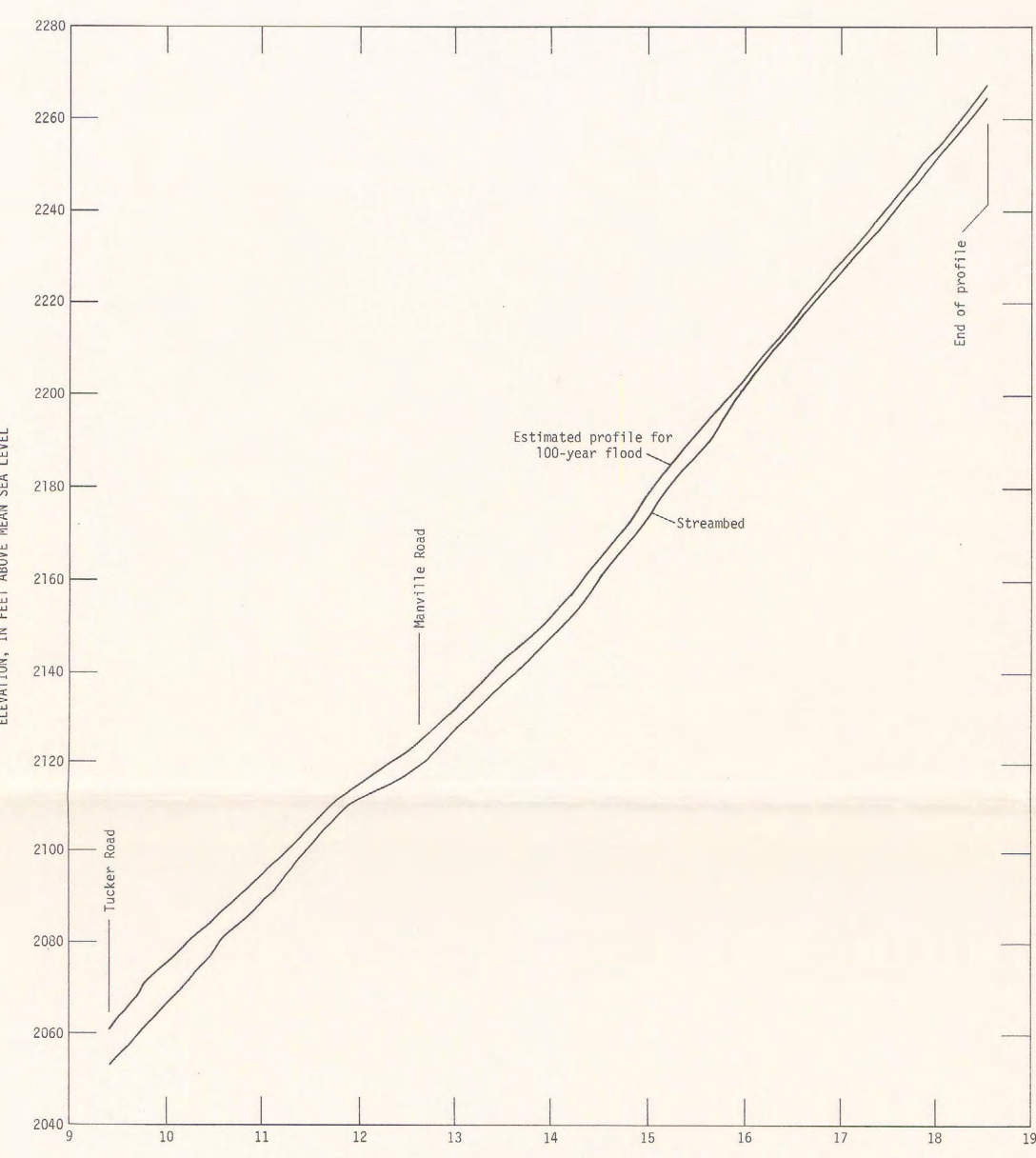


Figure 9.—Flood profile for Blanco Wash from Tucson Road to river mile 16.5.

#### CONVERSION FACTORS

Multiply U.S. customary units	By	To obtain metric units
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometers (km)
square mile (mi <sup>2</sup> )	2.590	square kilometers (km <sup>2</sup> )
cubic foot per second (ft <sup>3</sup> /s)	.02832	cubic meter per second (m <sup>3</sup> /s)