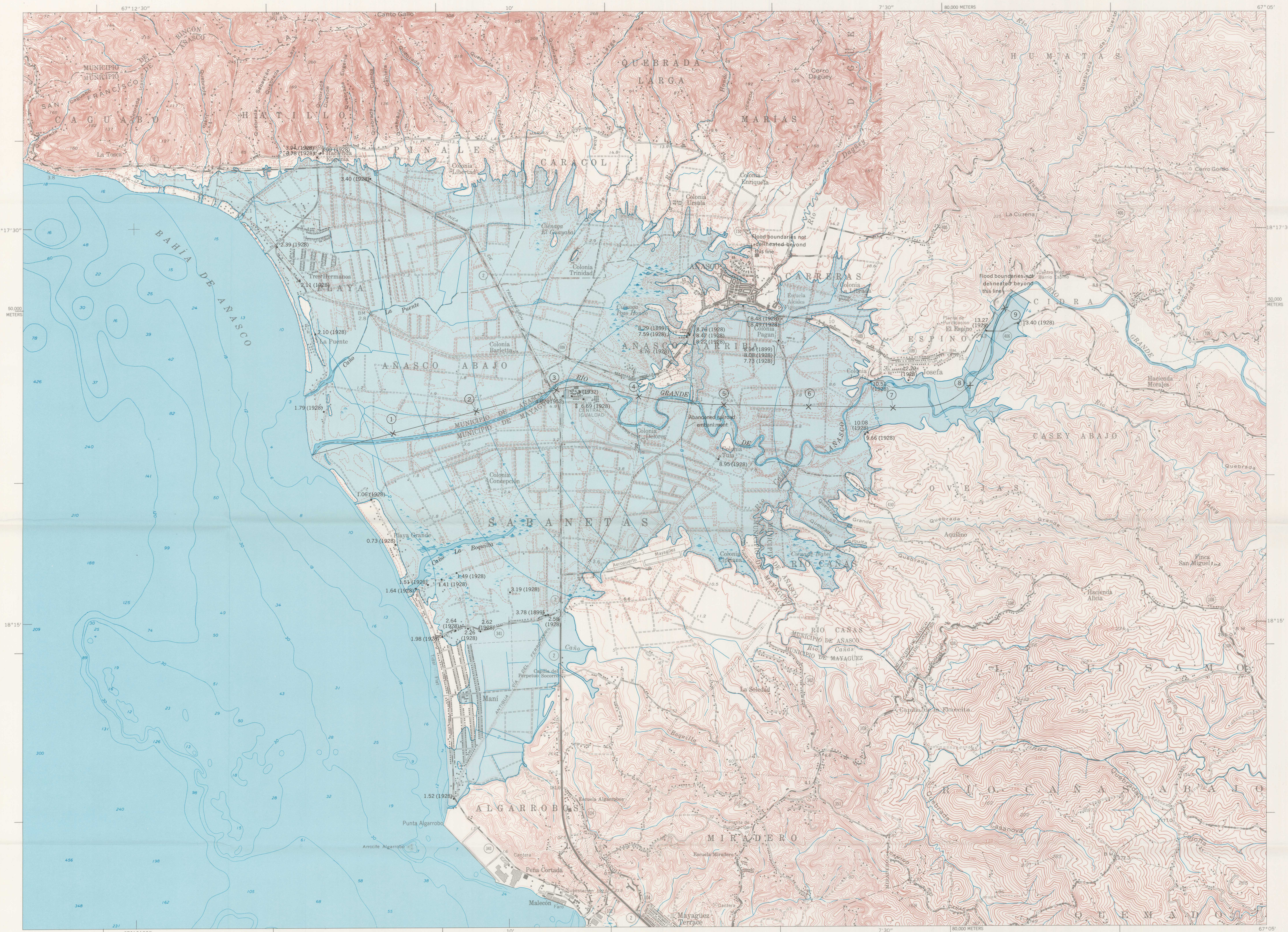
PREPARED IN COOPERATION WITH THE
COMMONWEALTH OF PUERTO RICO
DEPARTMENT OF PUBLIC WORKS

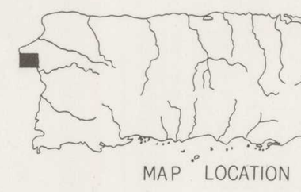


Base from U.S. Geological Survey; Rincón, Rosario, 1955; Central La Plata, Mayagüez, 1964

APPROXIMATE MEAN DECLINATION, 1971

SCALE 1:20 000

CONTOUR INTERVAL 5 AND 10 METERS
DOTTED LINES REPRESENT 1-METER CONTOURS
DATUM IS MEAN SEA LEVEL
DEPTH CURVES AND SOUNDINGS IN FEET—DATUM IS MEAN LOW WATER
SHORELINE SHOWN REPRESENTS THE APPROXIMATE LINE OF MEAN HIGH WATER
THE MEAN RANGE OF TIDE IS APPROXIMATELY 0.2 METERS


MAP LOCATION

EXPLANATION

Flood of September 13, 1928

Boundary of 1928 flood

Kilometers upstream from mouth measured along profile base line

Approximate water-surface contour for 1928 flood. Contour interval, 1 meter (above 2-meter line)

Floodmark elevation in meters above mean sea level and year of flood • 1.64 (1928)

FLOODS IN THE AÑASCO AREA, PUERTO RICO

This hydrologic atlas provides factual and interpretive hydrologic information. The information can be used by the planner, designer, or any interested person, to reach more rational decisions related to land use in the flood plain of the lower reaches of Río Grande de Añasco. Among the data presented are tabulations of flood stages, stream-flood profiles, and area of inundation for the flood of September 13, 1928, on Río Grande de Añasco, and the area inundated in the vicinity of Añasco by floodwaters of Río Dagüey on August 12, 1956. Stage-frequency curves are presented from which the magnitude of future floods of selected recurrence interval can be estimated. Areas of inundation and flood profiles are specifically for valley conditions that existed at the time of the floods. Some of the information is based on that obtained from interviews with residents in the study area. All elevations are in meters above mean sea level datum.

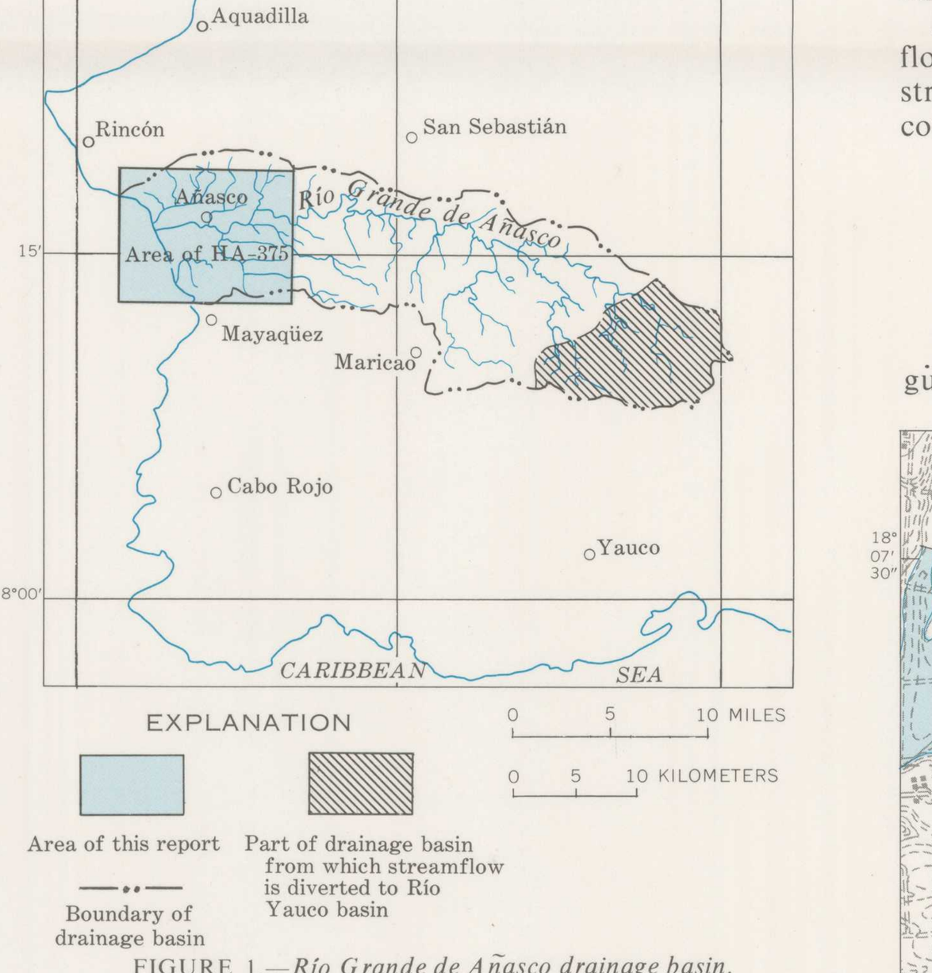


FIGURE 1.—*Río Grande de Añasco drainage basin.*

Drainage basin.—The Río Grande de Añasco basin lies in the central part of western Puerto Rico, as shown in figure 1. The stream flows west from the rugged Cordillera Central and empties into Bahiá de Añasco, on Pasaje de Mona. The drainage area of the basin is 201 square miles, which includes 39 square miles above Lagos Yahuecas, Guayo, Prieto, and Toro. Flow from the interconnected 4-reservoir system is diverted from the Río Grande de Añasco basin to Lagos Yauco and Loco for power production and then to Valle de Lajas for irrigation. A schematic diagram of the system is shown in figure 2. The four reservoirs in the Río Grande de Añasco basin, which have a combined storage capacity of 20,000 acre-feet, were constructed during the period 1955–56.

The flood plain of the lower Río Grande de Añasco has been highly developed for agricultural use. The principal crop in the area is sugarcane.

Flood history.—The flood plain of the lower Río Grande de Añasco has been inundated extensively at least four times during the period 1899–1967. The greatest flood known occurred August 8, 1899. The second greatest flood was that of September 13, 1928. Other major floods occurred on September 26, 1932, and September 23, 1952.

A railroad embankment in the vicinity of the river crossing 4.6 kilometers upstream from the mouth of Río Grande de Añasco and 1.3 kilometers south of Añasco, which was increased in height after it was overtopped by the 1899 flood, was a pronounced obstruction to flow during the 1928 flood. According to an 1892 engineering report on the railroad bridge design, during a river discharge of 30,000 cfs (cubic feet per second) the bridge opening and adjacent culvert would accommodate 20,000 cfs. The remaining flow was intended to spill northwest across Highway PR-109 and pass through another structure on Caño La Puente. Although the railroad bridge has been removed, the abutments and the embankment remain to affect high-magnitude streamflow.

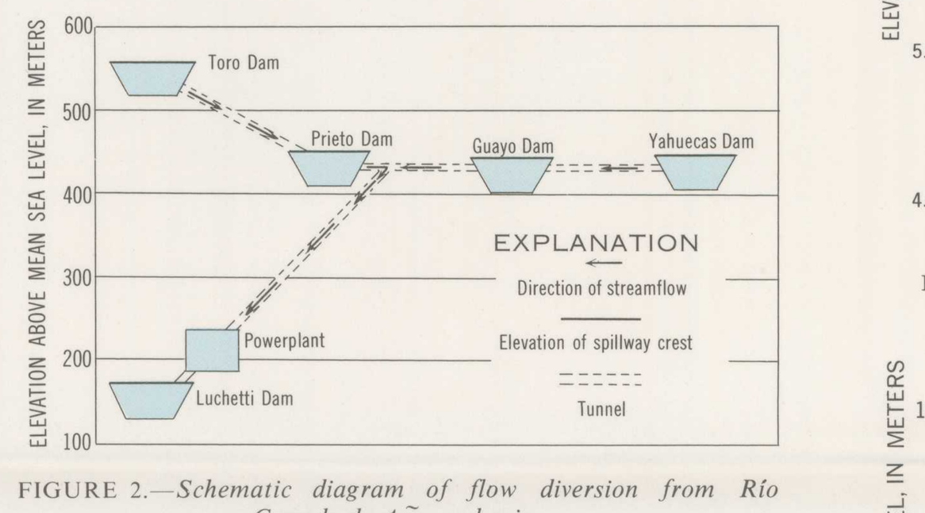


FIGURE 2.—*Schematic diagram of flow diversion from Río Grande de Añasco basin.*

The Highway PR-2 bridge near Central Igualdad was destroyed during the 1928 flood. At least one wooden bridge at this site, built after the 1928 flood, was destroyed by a flood prior to the construction of the present bridge in 1944.

The tributary inflow to the lower basin from Río Dagüey, Río Cañas, and numerous small streams causes local flooding. The floodwaters of Río Dagüey have inundated parts of Añasco on several occasions, flooding the northern and eastern outskirts. The southern and western edges of Añasco have been inundated by the floodwaters of Río Grande de Añasco.

Flood discharge.—The peak discharge of the 1928 flood on Río Grande de Añasco was computed as 35,000 cfs on the basis of the high-water profile and the channel geometry in the vicinity of El Espino. The drainage area at El Espino is 109 square miles, excluding the 39 square miles above the reservoirs. There are insufficient data to compute the peak discharge of the 1899, 1932, and 1952 floods. Flood discharge of the tributary into the lower basin is undetermined.

Flood stage.—The most complete tabulation of flood elevations on Río Grande de Añasco was collected at Central Igualdad. The central is about 200 meters upstream from the Highway PR-2 bridge. These elevations, which have been transferred to a common point on the basis of the indicated water-surface slope, are tabulated below.

Date of flood	Elevation above mean sea level (meters)
September 13, 1928	6.5
September 27, 1932	5.5
September 23, 1952	4.9

The Puerto Rico Department of Public Works has obtained information pertaining to three floods on Río Dagüey at Añasco.

Escuela Alcides Figueroa is situated on the west flood plain of Río Dagüey about 100 meters upstream from Highway PR-109. Flood elevations recovered at the school are given below.

Date of flood	Elevation above mean sea level (meters)
August 12, 1956	9.6
August 20, 1960	8.7
July 23, 1966	8.0

The area inundated by the 1956 flood in Río Dagüey is shown in figure 3.

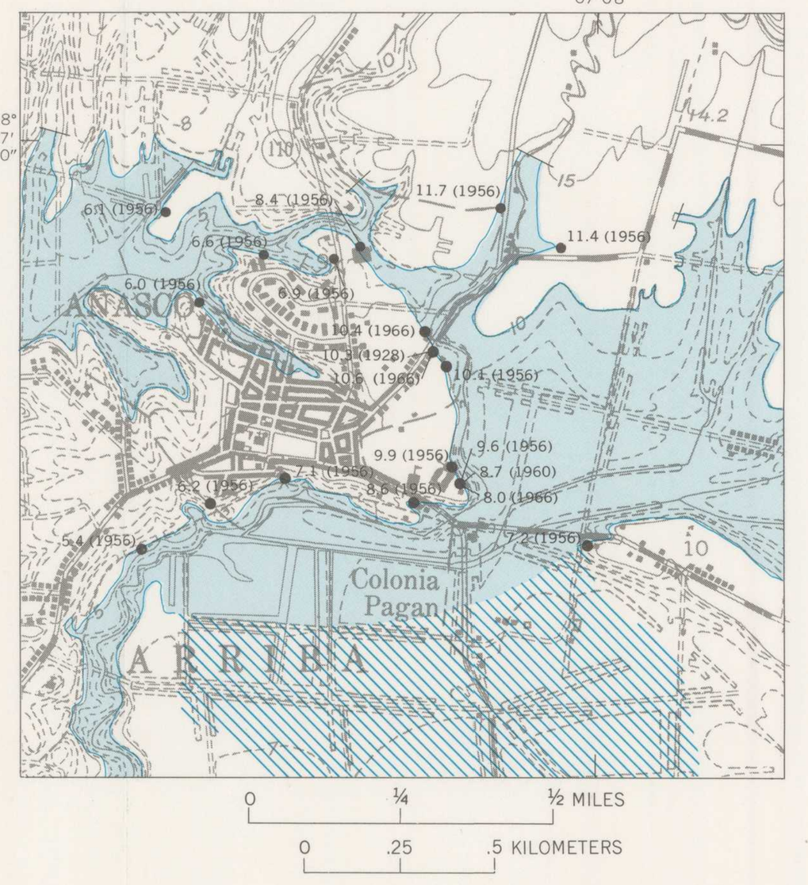


FIGURE 3.—*Area inundated by Río Dagüey in the vicinity of Añasco on August 12, 1956.*

Flood frequency.—There are no means of predicting the date when a flood of a given magnitude will occur. If a long record of floods is available, however, the average recurrence interval of a given flood and the chance of its occurrence in any year can be computed. The recurrence interval, or frequency, of a flood of specific magnitude is the average length of time during which that flood will be equaled or exceeded once. For floods greater than the 10-year flood, the reciprocal of the recurrence interval is virtually the chance of occurrence in a given year; thus a 20-year flood will have a 5-percent chance of occurring in any year, and a 50-year flood will have a 2-percent chance.

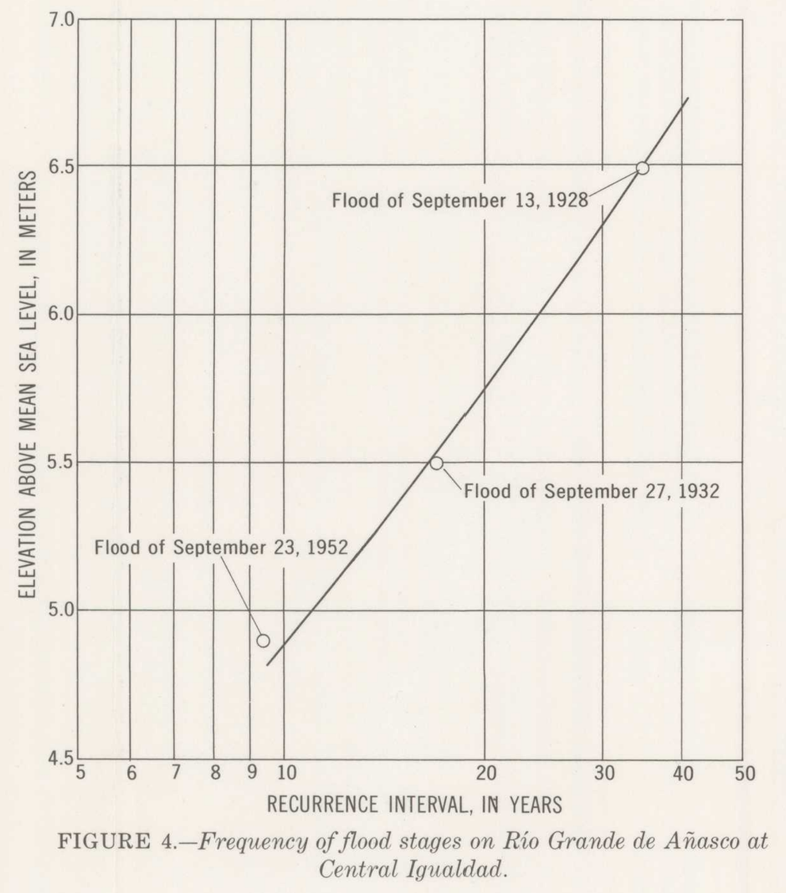


FIGURE 4.—*Frequency of flood stages on Río Grande de Añasco at Central Igualdad.*

The stage-frequency relation at Central Igualdad and at Escuela Alcides Figueroa, based upon the tabulations given under "Flood stage," is shown in figures 4 and 5, respectively.

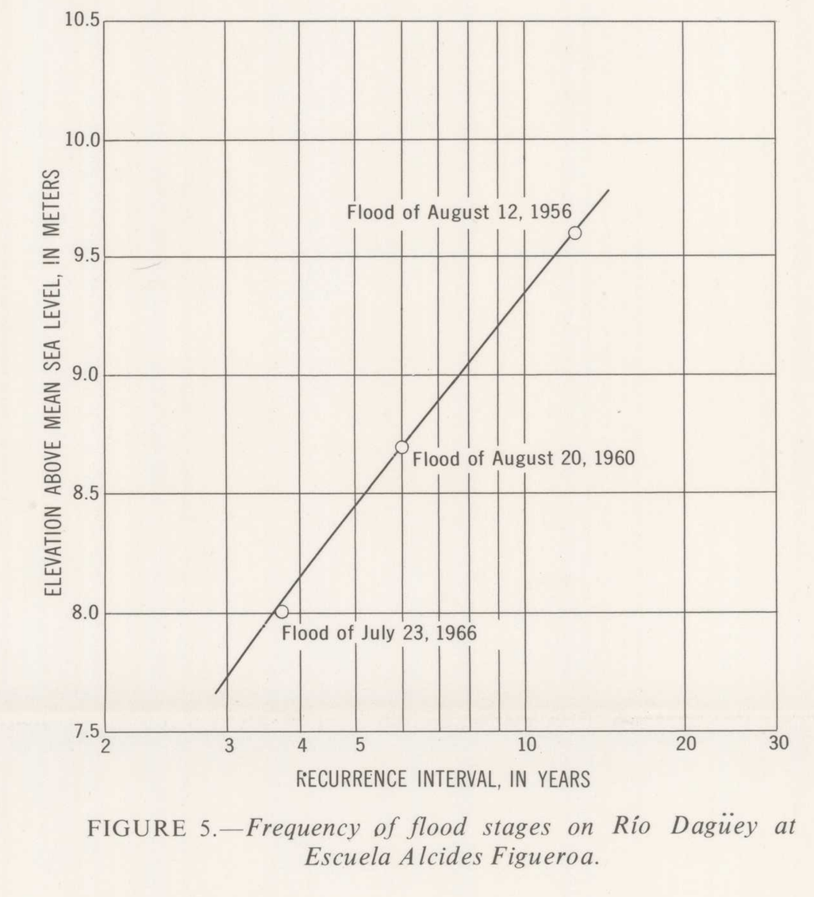


FIGURE 5.—*Frequency of flood stages on Río Dagüey at Escuela Alcides Figueroa.*

High-water mark information.—The inundated area has been defined on the basis of flood-stage information furnished by local residents. Field surveys were conducted to determine the elevation of flood stages provided by personal accounts. The delineated area is determined from water-surface profiles which represent an average of the individual high-water elevations. Floodmark elevations and locations are shown on the topographic maps. Flood stages are well defined in the vicinity of El Espino, Añasco, Central Igualdad, and the mouth of Río Grande de Añasco; they are poorly defined elsewhere.

The flood boundaries delineated on the topographic maps provide a record of historic facts that reflect channel and flood-plain conditions existing when the 1928 flood occurred. The effect of more recent or future changes in the channel and flood plain, the possible change in runoff characteristics resulting from increased urbanization, and the effect of the four dams in the upper part of the drainage basin are unknown. The Highway PR-2 embankment has been raised and the highway has been relocated east of the indicated position on the north side of the flood plain. The inundation pattern of floods may be affected by Highway PR-2, the possible relocation and improvement of the stream channel, the removal of the railroad embankment, and other cultural changes. The dams may reduce the frequency of flooding, but will not eliminate floods.

Water-surface profile.—The approximate water-surface profile of the flood of Río Grande de Añasco on September 13, 1928, is shown in figure 6. The profile is referenced to an arbitrarily chosen base line indicated on the topographic map. Flood elevations along each edge of the flood plain and midstream are included. The profile represents an average of the flood elevations.

Water-surface contours.—The estimated water-surface contours for the flood of September 13, 1928, are shown on the topographic map.

Depth of flooding.—Depth of flooding during the 1928 flood can be estimated by subtracting the ground elevation from the water-surface elevation, each shown by contours on the map. Intermediate estimates of depth can be determined by interpolation.

Cooperation and acknowledgment.—This report was prepared as part of the floods investigation authorized by a cooperative agreement between the Department of Public Works, Commonwealth of Puerto Rico, and the United States Geological Survey. Many of the flood data were provided by the Department of Public Works. Historical flood information was made available by the Instituto de Cultura Puertorriqueña, the U.S. Soil Conservation Service, and many residents of the municipality of Añasco.

Additional information.—Additional information relating to floods on Río Grande de Añasco can be obtained from the U.S. Geological Survey, San Juan, Puerto Rico, or from the Area de Prevención de Inundaciones, Puerto Rico Departamento de Obras Públicas, Santurce, Puerto Rico.

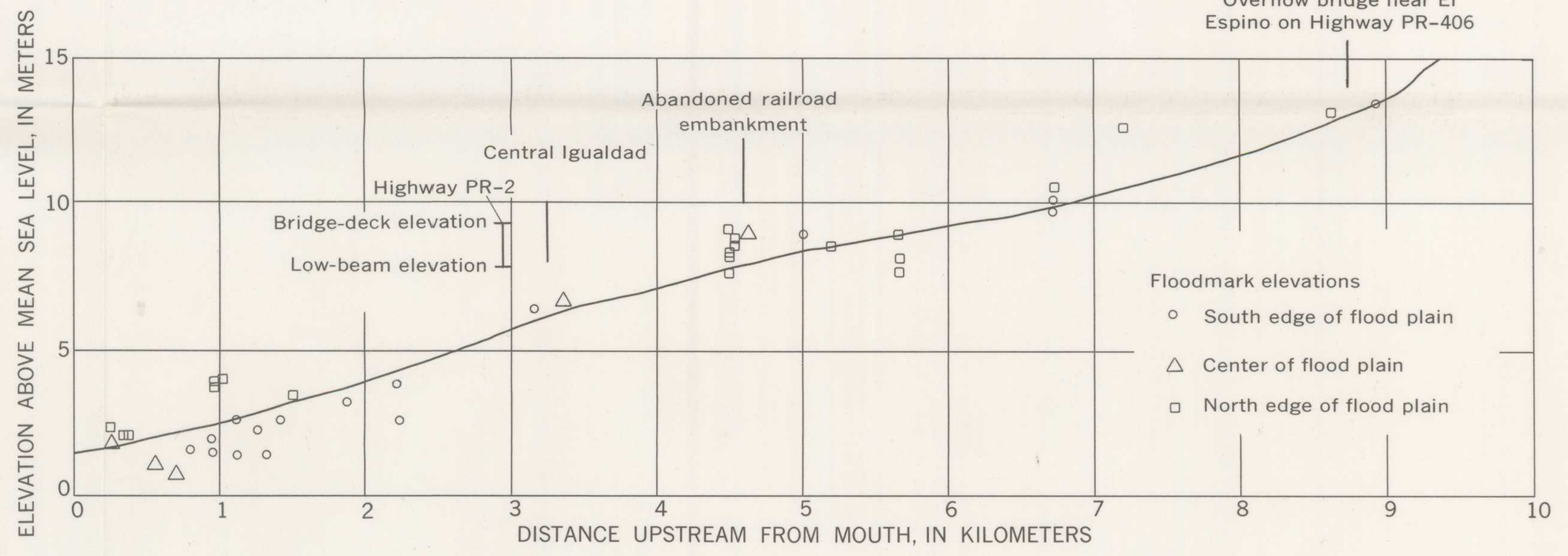


FIGURE 6.—*Profile of Río Grande de Añasco, flood of September 13, 1928.*

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D.C.—1971—W69516

FLOODS IN THE AÑASCO AREA, PUERTO RICO

By
Fred K. Fields
1971