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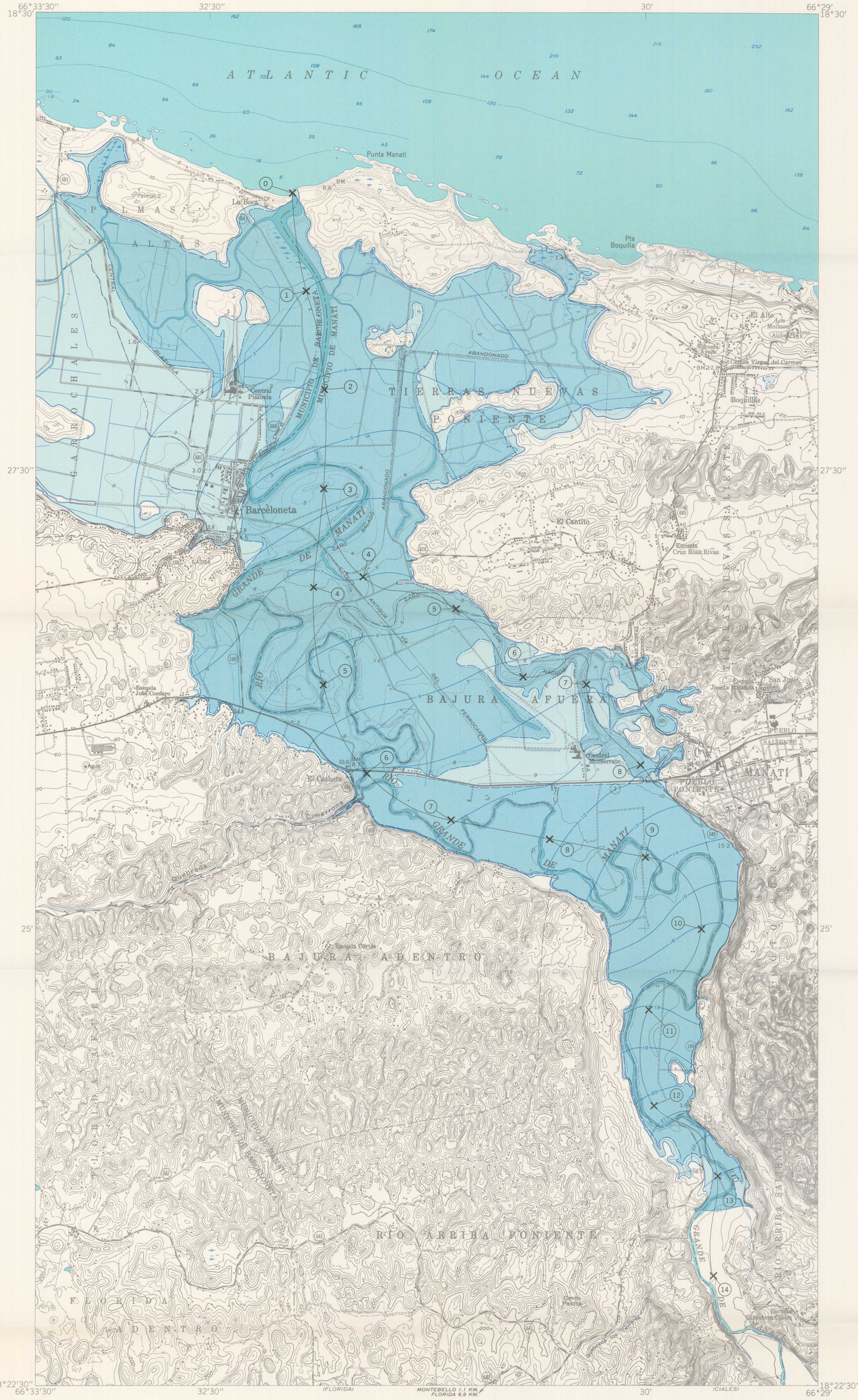
HYDROLOGIC INVESTIGATIONS
ATLAS HA-262



FLOODS AT BARCELONETA AND MANATÍ PUERTO RICO

This report provides a record of flood events and interpretive hydrologic information to form a basis for more rational decisions regarding land use in the flood plains of the lower reaches of Río Grande de Manatí. Flood data are tabulated, areas of inundation are delineated, and flood profiles are shown for flood events. Analyses of flood data are given to indicate the magnitude and probability of future flood events.

Floods on Río Grande de Manatí inundate large areas of the municipalities of Barceloneta and Manatí. Areas inundated by the floods of September 13, 1928, and of December 11, 1965, are delineated on the topographic base map, on the basis of floodmarks. The 1928 flood was the earliest and the greatest flood for which sufficient data were available to delineate the inundated areas. The 1965 flood, although not a great flood, was one for which a greater quantity of accurate data were available.

In the study area, Río Grande de Manatí is crossed by Highway 642, Highway 2, and an abandoned railroad. Highway 642 is at or below valley level and has one low-level bridge. Highway 2 is a little above natural ground level for most of the distance across the valley, and waterway openings are located at the extreme ends of the crossing. The railroad, having a more uniform grade than the highways, varies in its relation to natural ground and has three waterway openings, one of which is for local drainage. Great floods inundate both the highway crossings and railroad lines except in the vicinity of the main channel of the river.

The areas inundated and the flood profiles shown in this report are for valley conditions that existed at the time of the floods. If the channel or flood plains in the study area are substantially altered, the recurrence of floods of equal magnitude would result in altered patterns of inundation and altered flood profiles. All elevations are given in meters above mean sea level datum.

Drainage basin.— Río Grande de Manatí drains a roughly rectangular interior basin situated on the northern slopes of the Cordillera Central and flows northward through a deep, narrow valley to reach the coastal area at the city of Barceloneta. The locations of the drainage basin and of the study area are shown on figure 1. The drainage area of the interior basin is 134 square miles and the drainage area at the Highway 2 bridge is 165 square miles. Part of the runoff from about 6 square miles in the upper reaches of the river is diverted by Guineo and Matrullas dams for use outside of the basin. The combined capacity of the two reservoirs at crest elevations is 4,743 acre-feet. Because regulation by the two dams is not complete and because the area affected by diversion is less than 4 percent of the drainage area at Highway 2, the effect of the reservoirs on floods in the study area is not considered significant.

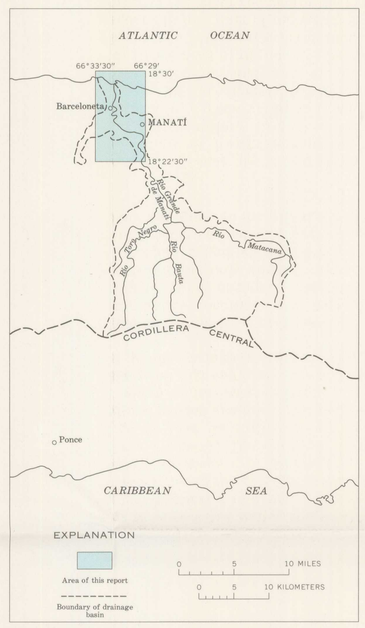


FIGURE 1.—*Location of drainage basin and study area.*

Flood occurrence.— The earliest flood known on Río Grande de Manatí occurred on August 8, 1899. A flood that occurred on July 14, 1916, was lower than the 1899 flood, but the elevations that these two floods reached at Highway 2 have not been determined. The earliest flood for which elevations have been determined at Highway 2 occurred on September 13, 1928. Inconclusive and apparently contradictory evidence indicates that the 1899 flood probably was greater than the 1928 flood. The elevations of the major floods since 1928 have been determined. Data for known floods are tabulated below.

Date	Elevation above mean sea level at main channel, Highway 2 (meters)	Recurrence interval (years)
Aug. 8, 1899		
July 14, 1916		
Sept. 13, 1928	10.06	39
Sept. 27, 1932	9.98	34
Aug. 4, 1945	9.36	14
Aug. 12, 1956	8.18	3.0
May 3, 1959	8.78	6.5
Sept. 6, 1960	8.63	5.3
Aug. 27, 1961	8.56	4.8
Dec. 11, 1965	8.81	6.8

Flood frequency.— The long-time average interval between the recurrence of floods of selected magnitude can be estimated from a sufficiently long record of flood events. The recurrence interval or frequency of a flood of specific magnitude is the number of years on the average during which the flood will be equaled or exceeded once. Frequency of floods can be stated in terms of probability of occurrence in a year, which is virtually the reciprocal of the recurrence interval for floods having recurrence intervals greater than 10 years. For example, a 20-year flood will be equaled or exceeded on the average once in 20 years and has one chance in 20 (5 percent) of occurring in any year.

A stage-frequency relation, based on the elevations of floodmarks, has been developed for the west end of the crossing of Highway 2 at the main-channel bridge at El Cachete (profile base line kilometer 5.96) and is shown by the curve in figure 2.

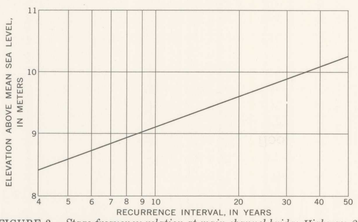


FIGURE 2.—*Stage-frequency relation at main channel bridge, Highway 2.*

Flood profiles.— Water-surface profiles for the floods of September 13, 1928, and December 11, 1965, and for the 50-year and 25-year floods are shown for Río Grande de Manatí in figure 3. The profiles are referenced to arbitrarily chosen base lines shown on the map. The flood of December 11, 1965, was not large enough to pass over Highway 2 and therefore the flow downstream from Highway 2 was divided by the higher area around Central Monserrate and to some extent by the embankment of the abandoned railroad. The profile for the 1965 flood on the east side of the valley north of Highway 2 is referenced to an auxiliary base line that begins at kilometer 3 and extends along Caño de los Nachos to the Highway 2 relief bridge. The profiles represent the elevations of the water surface along the base lines.

Water-surface contours.— Water-surface contours for the flood of September 13, 1928, based on the elevations of floodmarks, have been drawn on the map. Contours for the 50-year flood can be estimated by adding the difference between the elevations of that flood and the 1928 flood, shown by the flood profiles, to the elevation of the 1928 contours. For example, the 10-meter contour shown for the 1928 flood represents the 50-year flood contour of 10.20 meters at base line kilometer 6.0 and the 20-meter contour represents the 50-year flood contour of 20.4 meters at base line kilometer 11.8.

Depth of flooding.— Maximum depth of flooding during the 1928 flood at any point in the inundated area can be estimated by subtracting the ground elevation, shown on the map by ground contours, from the elevation of the water surface, shown by the water-surface contours. Maximum depth of flooding for the same point during a 50-year flood can be estimated by adding the incremental difference in elevation between the 50-year flood and the 1928 flood (from the flood profiles) to the 1928 flood depth. At most points in the inundated area the ground elevation can be found by interpolation between ground contours or by levels run from bench marks. The water-surface elevation usually can be estimated by interpolation between water-surface contours.

Additional information.— Additional information relating to floods on Río Grande de Manatí can be obtained from the U.S. Geological Survey, San Juan, Puerto Rico, or from the Sección de Control de Inundaciones, Puerto Rico Department of Public Works, Stop 22½, Ponce de León Avenue, Santurce, Puerto Rico.

Cooperation and acknowledgment.— This report was prepared as part of a flood-mapping project under a floods investigation program by authority of a cooperative agreement between the Puerto Rico Department of Public Works and the U.S. Geological Survey.

Much of the flood data were provided by the Puerto Rico Department of Public Works. Historical flood information was obtained from documents made available by the General Archives of the Institute of Puerto Rican Culture and from many residents of the study area.

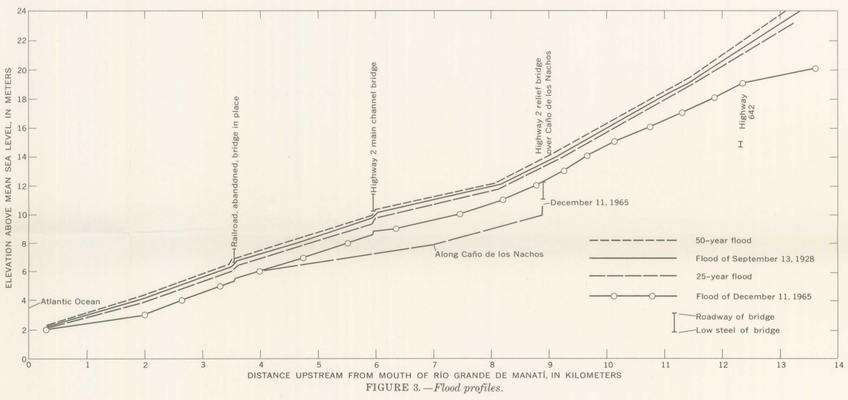


FIGURE 3.—*Flood profiles.*

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