

This is the first of several reports pertaining to flood characteristics of streams in selected areas in Puerto Rico. It presents hydrologic data to provide a technical basis for making sound decisions concerning the use of flood-plain lands. No recommendations or suggestions for land-use regulations are made and no solutions of flood problems are proposed.

The areas inundated by Río de Bayamón and its tributaries, Río Hondo and Quebrada Santa Catalina, in the vicinity of Bayamón and Cataño during the floods of August 4, 1945, and August 27, 1961, are shown on the topographic base map to record the flood hazard in graphical form. The flood of 1945 is the highest known since at least 1837. Although greater floods are possible, definition of their probable overflow limits was not undertaken in this report.

During moderate floods, low-lying areas in the municipality of Cataño and Fort Buchanan Military Reservation are inundated by Río de Bayamón floodwaters which cross Highway 869 at the eastern drainage divide north of Bayamón. Floodwaters also overflow Highway 866 north-east of Sabana Seca beyond the western drainage divide. In addition to the flow in Río de Bayamón, the depth of flooding in the Cataño area is affected by tides, by flow in local tributaries, and by the operation of drainage-canals. These factors vary independently and the extent of inundation in Cataño cannot be reliably predicted on the basis of only the flow in Río de Bayamón.

The flood limits shown on the map are dependent upon channel conditions that existed when the floods occurred and no attempt is made to appraise the effect of channel changes that may have been made later. Development of the flood plain, construction of highways, and canalization of Río de Bayamón may produce a different pattern of inundation for future floods equivalent in discharge to those in 1945 and 1961.

Cooperation and acknowledgment.--The preparation of this report is part of a flood-mapping program financed through a cooperative agreement between the Department of Public Works, Commonwealth of Puerto Rico, and the U.S. Geological Survey. The liaison officer for the Department of Public Works is Sixto Ramirez, Chief of Operations Division. Elevations of many floodmarks were obtained by the Flood Control Section, Ruben Nieves, Chief.

Acknowledgment is made to the U.S. Army Corps of Engineers, San Juan, for information obtained from its report on Ríos de Bayamón and Hondo. Additional data were obtained from personal interviews with municipal officials and many private citizens.

Río de Bayamón watershed.--Río de Bayamón flows north from the central uplands near Cidra to the Atlantic Ocean west of San Juan. The drainage area at Highway 167 in Bayamón is 72 square miles. Río Hondo and Quebrada Santa Catalina enter Río de Bayamón just below Highway 167 and add 10 square miles. Approximately 12 square miles is drained by Río de Bayamón between the confluence of Río Hondo and the Palo Seco mouth in San Juan Bay. A secondary mouth of Río de Bayamón opens into Boca Vieja Bay west of the Palo Seco thermoelectric powerplant during periods of storm runoff. This secondary mouth is enclosed by a sand bar, usually a few days after a flood.

Of the 72 square miles drainage area at Highway 167, 7 square miles in the headwaters area are above Cidra Reservoir. The reservoir, which has a storage capacity of 5,200 acre-feet, is operated for regulation of water delivered to the Aguas Buenas diversion dam downstream for water supply. Although the reservoir is not intended to control floods, the flow above Cidra was almost entirely contained during the 1960 and 1961 floods. The Aguas Buenas and Guaynabo water-supply diversion dams and the Santamaría Gases, Inc., dam have negligible storage capacity. Diversions at these dams cause moderate diurnal regulation, but floodflows are not affected.

Floods in Bayamón.--Elevations of floodmarks in Bayamón were obtained by survey parties for floods of 1899, 1928, 1944, 1945, 1956, 1959, 1960, and 1961. Newspaper accounts provided information that was used to determine the extent of other outstanding floods in Bayamón for the period 1900-58. During the period 1900-26, apparently only two floods occurred that were significant enough to be reported in the newspapers or to be remembered by local residents.

In the old commercial district of Bayamón, a flood that exceeds a 7-meter elevation causes damage. The Calle Dr. Betances bridge over Río Hondo, with a deck elevation of 7.2 meters, is the lowest bridge in Bayamón. Flood elevations of Río Hondo at Calle Dr. Betances are apparently the same as those just below Highway 167 bridge over Río de Bayamón.

Flood height.--The height of a flood at a gaging station usually is stated in terms of the stage elevation or stage, which is the elevation

of the water surface above a selected datum plane. Elevations shown on the map are in meters above mean sea level.

Gage elevation and year of occurrence of each annual flood (highest peak discharge each year) above 7 meters known to have occurred during the period 1899-1961 on Río de Bayamón at Highway 167 in Bayamón are shown in figure 1. The irregular occurrence of floods is evident.

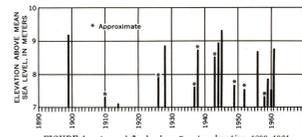


FIGURE 1.--Annual floods above 7-meter elevation, 1899-1961, Río de Bayamón, at Highway 167 in Bayamón.

Flood frequency.--Historical records and floodmark elevations obtained during this study were used to derive a flood-frequency relation on Río de Bayamón at Highway 167 in Bayamón. Extrapolation of flood-frequency curves is not recommended because of the possibility of large errors.

Discharge measurements of Río de Bayamón have been made since 1959 at the Geological Survey crest-stage gage located at Highway 2, and a stage-discharge relation there has been defined up to the elevation of the 1945 flood.

As applied to flood events, recurrence interval is the average interval of time within which a given flood height will be equaled or exceeded once. The recurrence interval is inversely related to the chance of a given flood being equaled or exceeded in any one year. Thus, the 20-year flood has a 5-percent (1 in 20) chance of being equaled or exceeded in any one year.

The general relation of recurrence interval to both flood height and flood discharge for Río de Bayamón at Highway 167 in Bayamón is shown in figure 2 and is tabulated below.

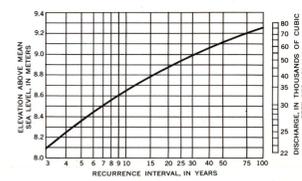


FIGURE 2.--Frequency of floods on Río de Bayamón at Highway 167 in Bayamón.

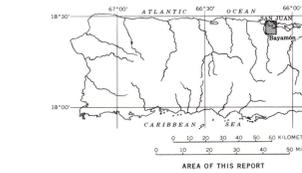
| Recurrence interval (year) | Elevation above mean sea level (meters) |
|----------------------------|---|
| 100 | 9.1 |
| 50 | 8.5 |
| 20 | 8.4 |
| 10 | 8.4 |
| 5 | 8.4 |
| 2 | 8.1 |

It is emphasized that recurrence intervals are average figures--the average interval within which floods of a given magnitude will be equaled or exceeded once. Thus, in Bayamón, a flood that reaches an elevation of 8.7 meters may be said to have a 13-year recurrence interval. However, because of the erratic nature of flood occurrence, the 8.7-meter elevation may be reached or exceeded more than once in 13 years, as in 1956 and 1961, or not at all in any one 13-year period.

Flood profiles.--Profiles of the water surface along Río de Bayamón, Río Hondo, and Quebrada Santa Catalina constructed primarily from marks left by floods and supplemented by information obtained from newspaper accounts and local residents, are shown in figures 3 and 4. Distances used for the profiles correspond to those marked along the streams on the flood map.

The profiles cover a range between the maximum known flood (1945) in 123 years and a flood that may be expected to occur on the average of once in 10 years.

In a river valley of uniform cross section and slope, flood profiles tend to be straight parallel lines. In the Río de Bayamón valley, however, sharp breaks occur in the profiles slopes because of both natural and manmade conditions. The most pronounced changes in the flood profiles have been observed at Highway 2 and Highway 167, where the waterway capacity of the channel and bridge openings changes abruptly.



The profile of a flood of specific recurrence interval may be plotted generally parallel to those shown. Its position may be estimated by interpolation between the known flood profiles. For example, the profile of a 50-year flood can be derived by first finding the elevation of the 50-year intercept (9.1 meters) in figure 2; then projecting throughout the length of the profile, the proportionate difference between 9.1 meters and the 1945 and 1961 flood elevations indicated at the flood frequency relation site at Highway 167 in Bayamón.

Depth of flooding.--The depth of flooding over the flood plains of Río de Bayamón and its tributaries, Río Hondo and Quebrada Santa Catalina can be estimated by subtracting the ground elevation from the water-surface elevation shown on the flood profiles of figures 3 and 4. The depth of flooding in the Cataño area for the floods of 1945 and 1961 can be estimated by subtracting the ground elevation from the water-surface elevation indicated on the map. Contours on the topographic map indicate approximate

elevations. If more exact elevations are required, ground elevations can be obtained by leveling to bench marks.

Tributary floods.--Río de Bayamón is the principal cause of flooding in Bayamón. Río Hondo and Quebrada Santa Catalina, which flow through the commercial district of Bayamón, are affected by backwater from Río de Bayamón at times. The backwater effect from Río de Bayamón is seen in the flattened profiles below Highway 2 (fig. 4). Intense local rains may cause minor flooding of these tributaries in Bayamón.

Additional data.--Additional information pertaining to floods at Bayamón, P. R., may be obtained at the office of the U.S. Geological Survey, 1209 Avenida Fernández Juncos, Santurce, Puerto Rico, or at Sección de Control de Inundaciones, Negociado de Operaciones, Departamento de Obras Públicas, Stop 22 1/2 Avenida Ponce de Leon, Santurce, Puerto Rico.

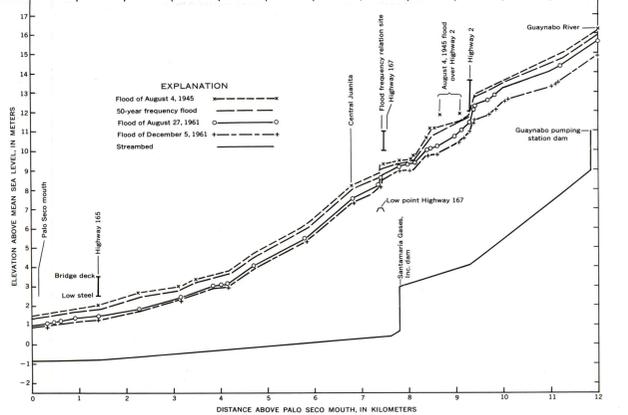


FIGURE 3.--Profiles of floods on Río de Bayamón.

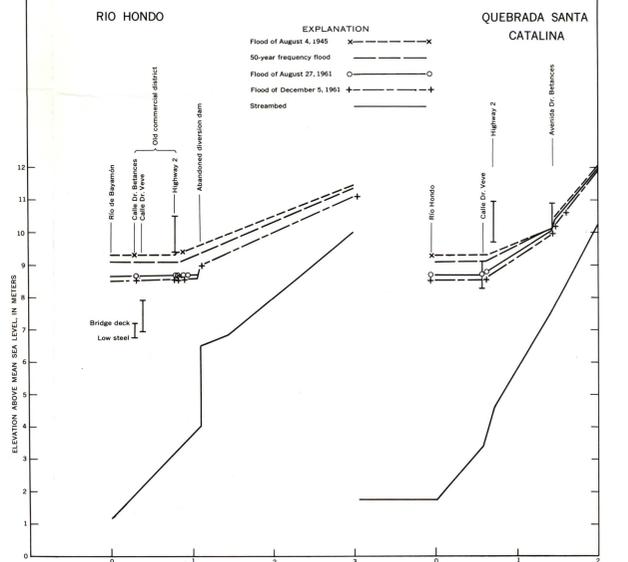


FIGURE 4.--Profiles of floods on Río Hondo and Quebrada Santa Catalina.

RIO DE BAYAMÓN FLOODS

Flood heights reached at Highway 167 in Bayamón. Overflow limits for only the 1945 and 1961 floods are shown on the map.

| Date of flood | Elevation above mean sea level (meters) | Discharge (cubic feet per second) |
|--------------------|---|-----------------------------------|
| August 4, 1945 | 9.3 | 80,000 |
| August 4, 1956 | 8.2 | 70,000 |
| August 16, 1944 | 8.9 | 45,000 |
| September 13, 1928 | 8.8 | 40,000 |
| August 11, 1956 | 8.7 | 36,000 |
| August 27, 1961 | 8.7 | 36,000 |

FLOODS AT BAYAMON AND CATAÑO, PUERTO RICO

By
Miguel A. Lopez
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