DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
THOMAS B. NOLAN, DIRECTOR

PREPARED IN COOPERATION WITH
THE STATE OF NEW JERSEY
DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT
H. MAT ADAMS, COMMISSIONER

HYDROLOGIC INVESTIGATIONS
ATLAS HA-104

FLOODS ON RARITAN AND MILLSTONE RIVERS IN SOMERSET COUNTY, NEW JERSEY

The extent and depth of flooding that may be expected along the Raritan River and along the Millstone River in Somerset County, New Jersey, are evaluated in this atlas. The approximate boundaries of inundation by a flood having a recurrence interval of 1 1/2-years, and also by a flood having a recurrence interval of 35 years, are shown on the map. Greater floods than those shown have occurred in the past and undoubtedly will recur, but no attempt has been made to define their probable overflow limits. Depths of inundation and limits of overflow of floods of various sizes can be estimated by using the methods and relations presented.

The atlas has been prepared to aid individuals, organizations, and governmental agencies who make decisions for the safe and economic use of flood-plain lands along the Raritan and Millstone Rivers. Only flood data are presented. No recommendations for land-use regulations are made and no solution of flood problems are proposed. However, the map and flood data provide a technical basis for making decisions leading to land uses compatible with the degree and frequency of flooding expected.

This atlas was prepared as part of an investigative program financed through a cooperative agreement between the U.S. Geological Survey and the New Jersey Department of Conservation and Economic Development, Division of Water Policy and Supply. The cooperative program is administered on behalf of the Department of Conservation and Economic Development by H. Mat Adams, Commissioner, and is directly coordinated by George R. Shanklin, Chief Engineer and Acting Director of the Division of Water Policy and Supply.

Flood history --The history of flood events on the Raritan and Millstone Rivers was used to estimate the probable frequency of future floods. Streamflow records obtained at two gaging stations on Raritan River and two gaging stations on Millstone River are the primary sources of flood data used. The records are published in Water-Supply Papers of the U.S. Geological Survey and in Special Reports of the New Jersey Department of Conservation and Economic Development. Flood height at a gaging station--the elevation reached by the water surface above an arbitrarily selected datum plane--usually is stated in terms of gage height or stage. Flood heights shown in this atlas are elevations above mean sea level, datum of 1929, which is equivalent to the New Jersey Geodetic Control Survey datum. Gage heights or stages at gaging stations on the Raritan and Millstone Rivers can be converted to elevations above mean sea level by adding the gage height to the appropriate datum of gage listed below. Location of gaging station, measured along the river channel, and period of flood record also are shown.

Gaging station	Distance along channel (feet)	Datum of gage above mean sea level (feet)	Period of record
Raritan River at Manville	28,400	20.61	July 1903 to March 1907
	28,400	20.61	August 1921 to date
at Bound Brook	8,200	——	September 1903 to March 1909
	15,800	18.06	January 1945 to date
Millstone River near Kingston	79,100	38.00	May 1933 to September 1949
at Blackwells Mills	32,600	26.97	August 1921 to date

Data on some large floods that occurred outside the period of record at the gaging stations were obtained from published reports, from interviews with long-time residents, and from other sources. These data indicate that the flood of February 6, 1896, on Raritan River, and the flood of September 24, 1882, on Millstone River were probably the largest floods on these rivers since 1800. The Annual Report of the State Geologist of New Jersey for 1896 indicates that the 1896 Raritan River flood may have exceeded the largest recent flood, that of August 19, 1955, by as much as 3 feet at the confluence of the North and South Branches, by 4 feet at Bound Brook, and by 6 feet at Fieldville Dam. Between 1800 and the time gaging stations were established, outstanding floods occurred November 24, 1810, and July 17, 1865, but available data are insufficient to compare their magnitudes with floods recorded later at the gaging stations.

Flood occurrence --The irregular distribution of flood events is illustrated by the pattern of flood occurrence at the gaging station on Millstone River at Blackwells Mills during the period 1929-60 (fig. 1). Floods above 36.5-foot elevation (which corresponds to the smaller flood limits shown on the map) occurred 21 times in the 32-year period, an average of about one flood each 1 1/2 - years. No such flood occurred in 17, or about half, of the years, and none occurred during the 3-year period 1929-32, although three occurred in the single year 1955. Records for other gaging stations, and for other time periods also show an erratic distribution of flood occurrences.

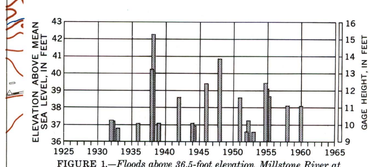

FIGURE 1.—*Floods above 36.5-foot elevation, Millstone River at Blackwells Mills, New Jersey, 1929-60*

Recurrence intervals --Although the distribution of flood occurrences is recognized as erratic, the concept of "recurrence intervals" is used in evaluating the probable frequency of future flooding. 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. For example, about 50 floods of at least the magnitude of a 2-year flood may be expected to occur in a 100-year period, and about 4 floods of at least the magnitude of a 25-year flood may be expected to occur in a 100-year period. Because of the irregular nature of flood events, recurrence intervals cannot be used to predict the time of flood occurrence. They can, however, be used to evaluate the probability of occurrence in any future year. A 20-year flood has 1 chance in 20 of being equaled or exceeded in any one year, and the 35-year flood shown on the map has 1 chance in 35 of being equaled or exceeded in any one year.

Flood-frequency --The relation between recurrence interval and flood elevation at four gaging station sites is tabulated below, and is shown graphically in figure 2. The flood-frequency relations were derived from a statistical evaluation of flood records.

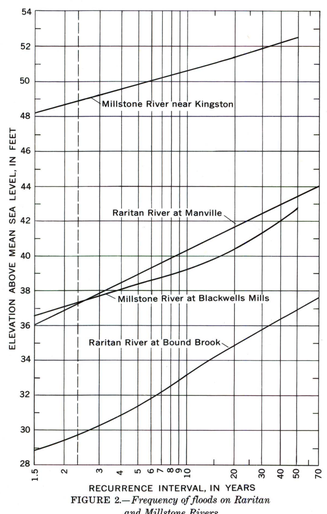

FIGURE 2.—*Frequency of floods on Raritan and Millstone Rivers*

A long period of flood record is considered more reliable than a shorter record for estimating future flood probabilities. Therefore, before defining the flood-frequency relations, the gaging station flood records were extended, where practical, on the basis of longer flood records at some nearby gaging stations. The Raritan River frequency relations are based on flood records extended to cover the 1904-58 period, and the Millstone River relations are based on records for the 1922-60 period.

Confidence in the accuracy of flood-frequency relations declines as the recurrence interval becomes longer. Extrapolation of the frequency curves beyond the limits shown is not advised.

Recurrence interval (years)	Elevations above mean sea level (feet)			
	Raritan River at Manville	Raritan River at Bound Brook	Millstone River near Kingston	Millstone River at Blackwells Mills
70	44.1	37.6	——	
50	43.4	36.9	52.5	42.8
35	42.7	36.1	52.0	41.8
25	42.1	35.4	51.6	41.0
10	40.3	33.2	50.6	39.2
5	38.9	31.4	49.9	38.3
1½	36.0	28.8	48.2	36.5

It is emphasized that recurrence intervals are average values--the average number of years that will elapse between floods that equal or exceed a specific elevation. Thus, a flood elevation of 35.4 feet at Bound Brook gage is said to have a 25-year recurrence interval. However, because of the nature of flood occurrences, the 35.4-foot elevation may not be exceeded in any given 25-year period, or it may be exceeded more than once.

Flood profiles --The flood-frequency relations evaluate the flood likelihood at the gaging station sites only. The flood profiles shown in figures 3 and 4 extend this information to all sites along the Raritan and Millstone Rivers in the study area. The profiles are based on the gaging station frequency curves and observations of the maximum water-surface elevations of several floods at many sites. Distances along the channel used to define the profiles were established by the Works Progress Administration, New Jersey Riparian and Stream Survey in 1935-37, and correspond to those shown on the map. The zero point of the Raritan River channel distances is located at an arbitrary point about 1 1/2-miles downstream from Bound Brook near Fieldville Dam. The zero point of the Millstone River channel distances is at a small dam near the mouth of the river.

Extent of flooding --The boundaries of inundation shown on the map were determined by locating the ground position of the water-surface elevations indicated by the 35-year and 1 1/2 - year flood profiles shown in figures 3 and 4. Similarly, the boundaries of inundation for a flood of any size up to that with a 50-year recurrence interval can be determined. The difference in areal extent between relatively large and small floods is not great, and boundaries of floods of recurrence intervals up to 50 years can be satisfactorily estimated for many practical uses.

Along tributary streams the areas shown on the map as subject to inundation are those that would be flooded by backwater from the Raritan and Millstone Rivers. No attempt is made to define limits of inundation by floods originating on the tributaries. The areas along tributaries subject to inundation by tributary flow (particularly at a distance upstream from the mouth) may be greater than the areas inundated by backwater from the Raritan and Millstone Rivers.

There is no particular significance associated with the flood of 35-year recurrence-interval size. It is shown as an example of a rather infrequent flood because the reach of Raritan River upstream from Manville experienced such a flood August 19, 1955, and because the limits of inundation by a flood of 35-year recurrence-interval size could be determined for the remainder of the Raritan and Millstone Rivers with reasonable accuracy. The smaller flood limits are shown for comparison.

Depth of flooding --Depth of flooding by a 35-year and a 1 1/2- year flood at several selected cross sections is shown in figures 5 and 6. Depth of flooding at other points by floods of several sizes can be estimated by subtracting ground elevations from the water-surface elevations indicated in figures 3 and 4. The flood-plain elevations indicated by the profiles are average values, and at any given point on the flood plain the actual elevation may be considerably different from that shown. Accurate ground elevations can be determined by leveling to nearby bench marks.

Future conditions --The flood-evaluation data in this atlas are applicable for flood-control and river-channel conditions existing prior to 1962. Operation of Round Valley and Spruce Run water-supply reservoirs and of Millstone River tributary desilting basins is not expected to affect significantly floodflows on the Raritan and Millstone Rivers in Somerset County. Flood-control reservoirs that may be built after 1962 may reduce the frequency of flooding but will not necessarily eliminate all future flooding. Changes which affect the water-carrying capacity of the river channels, such as dikes, highway fills, or channel dredging and straightening, may affect the inundation pattern of future floods.

Additional information --Additional information pertaining to floods and flood problems on the Raritan and Millstone Rivers may be obtained at the office of the U.S. Geological Survey, Trenton, New Jersey, and from the following reports:

Dola, Steven, 1961, Flood damage alleviation in New Jersey: New Jersey Dept. Conserv. and Econ. Devel., Water Resources Circ. 3.
McCall, J. E., and Lendo, A. C., 1960, Surface Water Supply of New Jersey: New Jersey Dept. Conserv. and Econ. Devel., Spec. Rept. 16.
U.S. Geological Survey, 1961, Surface Water Records of New Jersey: Trenton, New Jersey.

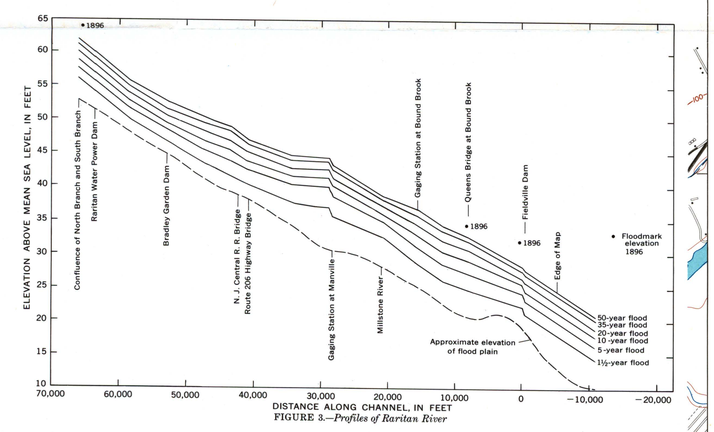

FIGURE 3.—*Profiles of Raritan River*

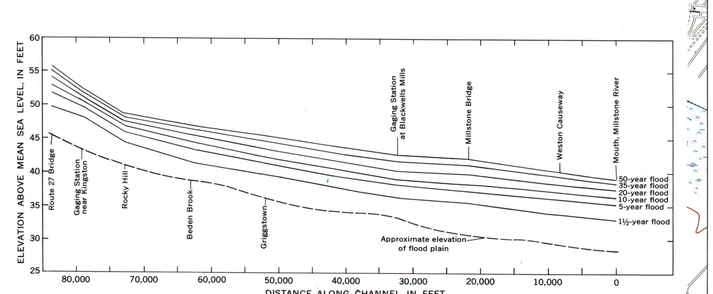

FIGURE 4.—*Profiles of Millstone River*

Major floods recorded at U.S. Geological Survey gaging stations on the Raritan and Millstone Rivers

Date of flood	Raritan River						Millstone River					
	at Manville			at Bound Brook			near Kingston			at Blackwells Mills		
	Stage (feet)	Elevation above mean sea level (feet)	Discharge (cubic feet per second)	Stage (feet)	Elevation above mean sea level (feet)	Discharge (cubic feet per second)	Stage (feet)	Elevation above mean sea level (feet)	Discharge (cubic feet per second)	Stage (feet)	Elevation above mean sea level (feet)	Discharge (cubic feet per second)
Aug. 19, 1955	22.1	42.7	34,600	16.20	34.26	30,800	——	——	——	12.12	39.09	——
Dec. 30–31, 1948	19.8	40.4	22,100	16.14	34.20	30,600	12.86	50.86	7,230	13.84	40.81	14,000
Aug. 9, 1942	19.7	40.3	33,200	14.2	32.3	26,200	10.10	48.10	4,730	11.57	38.54	8,940
Sept. 21–22, 1938	20.42	41.03	36,100	16.3	34.4	31,000	14.12	52.12	9,820	15.29	42.26	18,300
Oct. 10, 1903	18.5	39.1	28,600	——	——	32,100	——	——	——	——	——	——

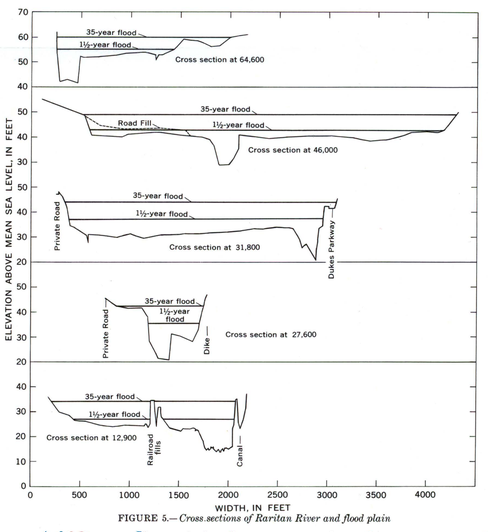

FIGURE 5.—*Cross sections of Raritan River and flood plain*

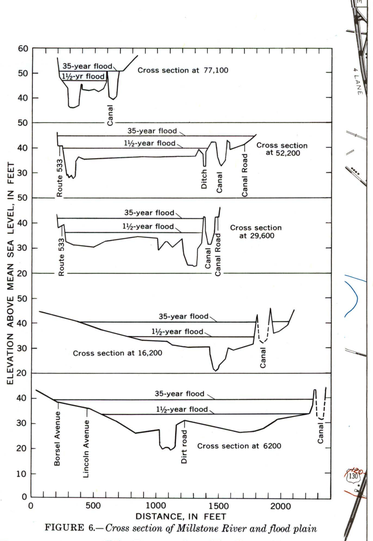

FIGURE 6.—*Cross section of Millstone River and flood plain*

EXPLANATION

- Estimated area inundated by hypothetical 1½-year flood
- Estimated area inundated by hypothetical 35-year flood
- Cross section location
- Distance along channel measured in feet (×—80,000)
- Boundary of 1½-year flood
- Boundary of 35-year flood

APPROXIMATE MEAN DECLINATION, 1964

SCALE 1:24 000

1 0 1 MILE

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

INDEX MAP OF NEW JERSEY

Base from U.S. Geological Survey topographic quadrangles; Raritan, 7½', 1955, Bound Brook, 7½', 1955, Rocky Hill, 7½', 1954, Monmouth Junction, 7½', 1954, Princeton, 7½', 1954, and Hightstown, 7½', 1954

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FLOODS ON RARITAN AND MILLSTONE RIVERS IN SOMERSET COUNTY, NEW JERSEY

By
D. M. Thomas and R. H. Tice

1964

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C.—1964—W63413

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