REPORT OF

THE RIVER MASTER

OF THE DELAWARE RIVER

For the period
December 1, 1987 - November 30, 1988

by Stanley P. Sauer, William E. Harkness, and Bruce E. Krejmas
with a section on water quality by Kirk E. White

U.S. GEOLOGICAL SURVEY

Open-File Report 89-585

Reston, Virginia

1989

DEPARTMENT OF THE INTERIOR

MANUEL LUJAN, JR., Secretary

U.S. GEOLOGICAL SURVEY

Dallas L. Peck, Director

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Denver, CO 80225

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FACTORS FOR CONVERTING INCH-POUND UNITS TO METRIC (INTERNATIONAL SYSTEM) UNITS

Multiply Inch-Pound unit	By	To Obtain Metric unit
	Length	
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
square mile (mi^2)	2.590	square kilometer (km^2)
	Volume	
million gallons (Mgal)	3,785	cubic meter (m^3)
billion gallons (Bgal)	3.785	cubic hectometer (m^3)
cubic foot per second-day (ft^3/s)·d	0.002447	cubic hectometer (hm^3)
	Flow	
million gallons per day (Mgal/d)	0.04381	cubic meter per second (m^3/s)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)

ADDITIONAL CONVERSION FACTORS AND DEFINITIONS

Multiply	By	To Obtain
Million gallons per day (Mgal/d)	1.547	cubic foot per second (ft^3/s)
Billion gallons per day (Bgal/d)	1547	cubic foot per second (ft^3/s)
Million gallons (Mgal)	1.547	cubic foot per second-day (ft^3/s)·d

Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called "Mean Sea Level of 1929."

Section I

RIVER MASTER LETTER OF TRANSMITTAL

and

SPECIAL REPORT

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page 3 follows

OFFICE OF THE DELAWARE RIVER MASTER
United States Geological Survey
433 National Center, Reston, Virginia 22092

November 17, 1989

The Honorable
William H. Rehnquist
Chief Justice of the Supreme Court
of the United States

The Honorable
Michael N. Castle
Governor of Delaware

The Honorable
Thomas H. Kean
Governor of New Jersey

The Honorable
Mario M. Cuomo
Governor of New York

The Honorable
Robert P. Casey
Governor of Pennsylvania

The Honorable
Edward I. Koch
Mayor of the City of New York

New Jersey v. New York et al
No. 5 Original, October Term 1950

Dear Sirs:

For the record and in compliance with the provisions of the Amended Decree of the Supreme Court of the United States entered June 7, 1954, I am transmitting herewith the thirty-fifth Annual Report of the River Master of the Delaware River for the year December 1, 1987 to November 30, 1988.

Precipitation in the upper Delaware River basin during the 1988 River Master report year ranged from 18 percent of the long-term average during June to 149 percent during July (See table 1). Total precipitation during the year was about 6.41 inches below average. Precipitation during the December to May period, when reservoirs typically refill, was 4.21 inches below normal. However, due to the wet conditions at the end of the 1987 report year, the reservoirs were much above normal on December 1, 1987. Because the reservoirs were above normal and much of the precipitation occurred during several short wet periods, the runoff was sufficient to fill the reservoirs to capacity by the end of May.

On December 1, 1987, when this report year began, combined storage in the New York City reservoirs in the upper Delaware River basin was 233 billion gallons, 86 percent of the 270.837 billion gallons combined capacity. Normal storage on December 1, based on 20 years of data, is 158 billion gallons. Cannonsville Reservoir began spilling on December 1 and spilled periodically throughout the winter and spring. Pepacton Reservoir filled to capacity on May 30, and spilled from May 30 to June 3. Neversink Reservoir filled to within 0.5 feet of spillway level, 99.3 percent of capacity, on May 30 but did not spill.

The reservoirs reached a maximum combined storage for the report year of 272.209 billion gallons, on May 31, 1988. On June 1, 1988, the start of the water operations year, storage was 271.951 billion gallons and Pepacton and Cannonsville reservoirs were spilling. Median storage for June 1st is 269.951 billion gallons, 99.7 percent. The minimum combined storage during the year was 111.208 billion gallons, 41.1 percent of capacity on November 5, 1988.

Throughout the year, diversions for water supply for New York City and releases designed to maintain the flow of the Delaware River at Montague were made as directed by this office and as provided in the Decree. Diversions by New York City from the Delaware River basin reservoirs did not exceed the limit specified by the Decree.

The Delaware River Master Advisory Committee met at Port Jervis, New York on May 11, 1988 to discuss hydrologic conditions in the basin and operational procedures during the 1988 release season. The River Master informed the committee that on the basis of information provided by New York City, the excess quantity that would be released beginning June 15 was 8.763 billion gallons. This water would be released at rates designed to maintain the Montague target flow at 110 ft^3/s above the normal 1,750 ft^3/s specified by the Decree.

Also discussed at the meeting were the problems that have occurred with the new gaging station on the Delaware & Raritan Canal. At that time, the acoustic velocity meter and remote transmission equipment that was designed to meet the need for improved information had been installed, but because some of the equipment was damaged in shipment, the gage was not yet operating satisfactorily.

Precipitation during June and early July was much below normal, which caused below normal streamflow in the basin. Because of the low streamflow and concern that the basin was approaching drought conditions, particularly in the Pennsylvania part of the basin downstream from the gaging station at Montague, New Jersey on July 15, 1988, Pennsylvania requested that the remainder of the excess quantity be set aside for use as needed to maintain the streamflow objective at the Delaware River at Trenton, New Jersey. That request was based on an operating procedure contained in a lower basin drought management plan that was nearing completion but had not yet been approved by the Parties to the Decree.

Since the lower basin drought-management plan had not received unanimous approval of the Parties to the Decree, a meeting of the Advisory Committee was convened in New York City on July 20 to discuss the proposal and to work out a procedure for its administration if it was approved. An agreement and a procedure for implementing it was worked out at the meeting and verbal approval was given by the Parties to begin implementation as soon as possible. However, because heavy rains occurred in the lower basin on July 20-21, it was decided to delay implementation of the plan until unanimous written approval was obtained. Due to heavy rainfall during the next several days and subsequent improved streamflow in the lower basin, Pennsylvania and New Jersey determined that implementation of the plan was unnecessary and did not sign the agreement. Therefore, lacking unanimous agreement by the Parties to the Decree, the plan was not implemented.

On September 28, 1988, the Delaware River Basin Commission, with the unanimous approval of the Parties to the Decree and this office, adopted criteria and operations formulae for emergency operations during a lower basin drought warning and drought (DRBC Resolution No. 88-22, Revised). That resolution, referred to as the "Lower Basin Drought Plan," provides guidelines for operations in the basin in the event of a drought warning or drought condition in the basin area downstream from the Montague, New Jersey streamflow gaging station when conditions in the upper basin are in a normal or above normal status. The development of the plan was suggested in the Interstate Water Management Recommendations of the Parties to the U.S. Supreme Court Amended Decree of 1954, which was transmitted to the Clerk of the Court by letter dated April 8, 1983.

The Interstate Water Management Recommendations, commonly referred to as the "Good Faith Agreement", was unanimously approved by the Governors of the four basin States and the Mayor of New York City. This lower basin drought-management plan has also been unanimously approved by representatives of the Governors and the Mayor. Certain provisions of the Good Faith Agreement resulted in significant changes in the application of the diversion and release requirements administered by this office under the terms of the 1954 Amended Decree.

Some of the provisions of this lower basin drought-management plan provide for additional changes to those requirements. The most significant provisions call for: (1) setting aside the excess release quantity, defined in the Amended Decree, for use as needed to maintain the Delaware River Basin Commission streamflow objective at Trenton, New Jersey; and (2) the use of additional quantitites of water from New York City reservoirs for drought assistance in the lower basin provided storage in those reservoirs remains above specified levels. These quantities of water would by necessity have to pass the Montague gaging station in addition to the water required to meet the Montague formula specified in the Amended Decree. The plan describes a coordinated effort by the Parties to the Decree to share the limited water supplies of the basin during periods of drought warning and drought and is the result of negotiations among the four basin states, New York City and this office under the auspices of the Delaware River Basin Commission, Flow Management Technical Advisory Committee.

During the report year, the River Master and staff participated in meetings of the Delaware River Basin Commission to assess water-supply conditions. Upon invitation of the representatives of Parties to the Decree, the Deputy River Master met periodically with those representatives as a member of the Flow Management Technical Advisory Committee. Discussions primarily centered on proposals for the management of releases from reservoirs in the basin and other measures designed to cope with streamflow deficiences whenever they occur.

The U.S. Geological Survey continued the operation of its field office of the Delaware River Master at Milford, Pennsylvania. William E. Harkness, Deputy Delaware River Master, continued in charge of the office, assisted by Bruce E. Krejmas and Beverly A. Roberts.

During the report year, the Milford office continued the weekly distribution of summary river data. These weekly reports contained preliminary data on releases from the New York City reservoirs to the Delaware River, diversions to the New York City water-supply system, reservoir contents, daily segregation of flow of the Delaware River at Montague gaging station, and diversions by New Jersey. The reports were made available to the State and City representatives on the Delaware River Master Advisory Committee and to other parties interested in the Delaware River operations. A special monthly summary of past hydrologic conditions, supplemented by an "outlook" of the river flow for the forthcoming month, was made available to the representatives on the Advisory Committee.

Section II of the report describes in detail Delaware River operations during the report year. As shown on page 18 the City of New York diverted a total of 266.249 billion gallons from the basin during the report year ending November 30, 1988 and released 103.263 billion gallons from Pepacton, Cannonsville, and Neversink Reservoirs to the Delaware River during the same period. The River Master directed releases to the Delaware River from these reservoirs totaling 77.491 billion gallons.

Section III of the report describes water quality at various sites in the Delaware River Estuary. It was prepared by Kirk E. White, U.S. Geological Survey, Malvern, Pennsylvania and contains data showing the extent of salinity encroachment and other water-quality characteristics in the estuary.

During the report year, the following individuals functioned as members of the River Master Advisory Committee:

Delaware	Dr. Robert R. Jordan
New Jersey	Dirk C. Hofman, P.E.
New York	William H. Lee Russell C. Mt. Pleasant
New York City	Harvey W. Schultz
Pennsylvania	John E. McSparran

The appreciation of the River Master and staff is expressed for the continued excellent cooperation of all the representatives of the parties to the Decree. Also, appreciation is extended to the Pennsylvania Power & Light Company and the Orange and Rockland Utilities, Inc. for their cooperation in keeping us informed of their plans for power generation and resulting releases as requested by this office. As usual, it is gratifying to report that New York City complied willingly with the terms of the Decree and with the directives of the River Master.

A draft of this report was furnished to the Advisory Committee members for comment.

Sincerely yours,

Stanley P. Sauer

Stanley P. Sauer, P.E.
Delaware River Master

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Section II

REPORT OF DELAWARE RIVER OPERATIONS

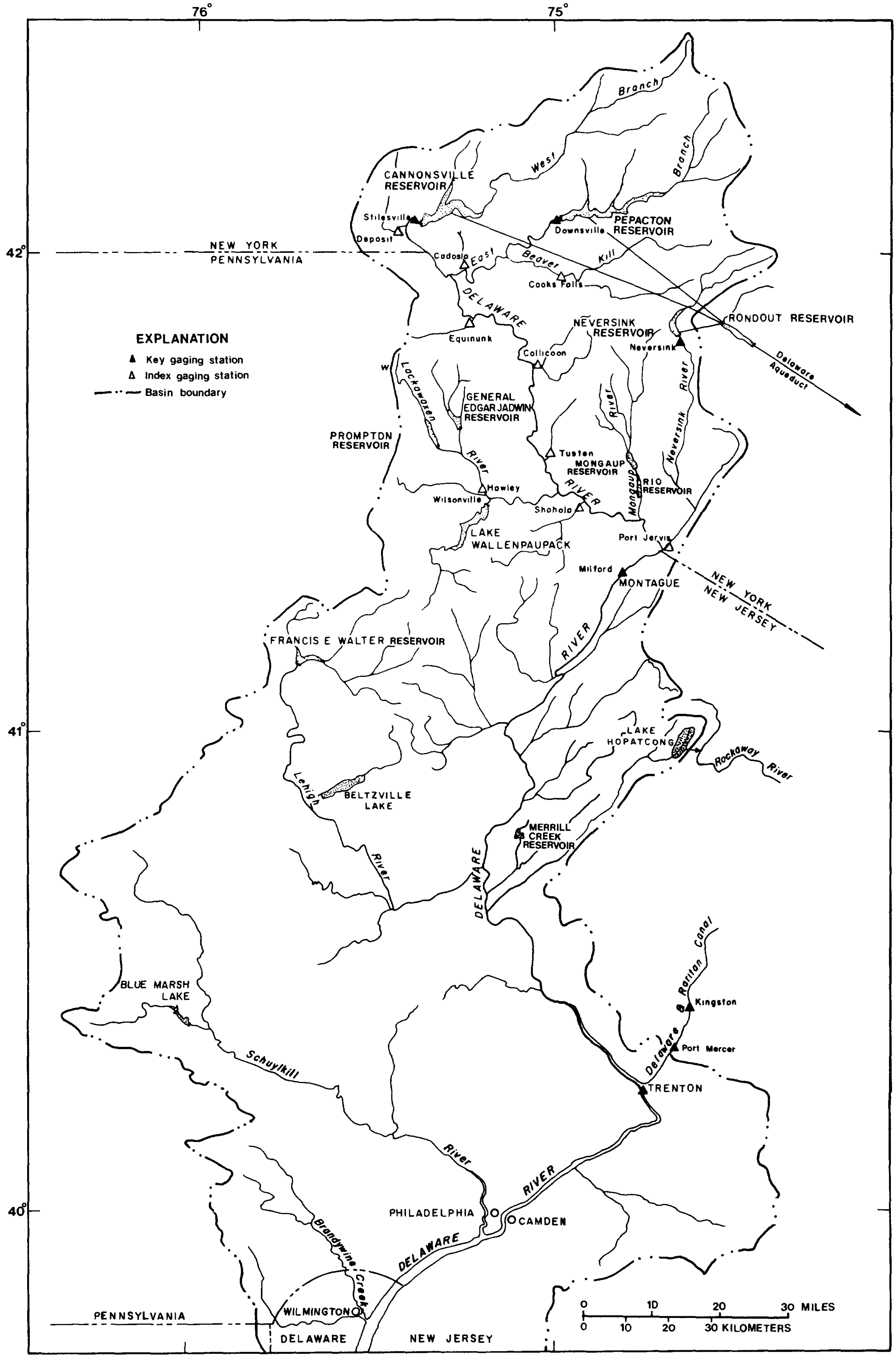

Figure 1. - Delaware River Basin upstream from Wilmington, Delaware.

Section II

REPORT OF DELAWARE RIVER OPERATIONS

by William E. Harkness and Bruce E. Krejmas

ABSTRACT

A Decree of the Supreme Court of the United States in 1954 established the position of Delaware River Master. The Decree authorizes diversions of water from the Delaware River basin (Figure 1) and requires compensating releases from certain New York City owned reservoirs to be made under the supervision and direction of the River Master. Reports to the Court, not less frequently than annually, were stipulated.

During the 1988 report year, December 1, 1987, to November 30, 1988, precipitation and runoff ranged from above average to below average in the Delaware River basin. For the year as a whole, precipitation was 6.41 inches below average. Reservoir storage in the basin remained in the normal zone of the operation curves for the reservoirs throughout the year and operations were conducted as prescribed by the Decree for the entire report year. On December 1, 1987, combined storage in New York City Delaware River Basin reservoirs was 86 percent of capacity. During the winter and spring, storage increased to capacity by the beginning of the water operations year, June 1, 1988.

Diversions from the Delaware River basin by New York City and New Jersey did not exceed those authorized by the terms of the Amended Decree. Releases were made as directed by the River Master at rates designed to meet the Montague flow objective on 127 days during the year. Releases were made at augmented conservation rates or at rates designed to relieve thermal stress in the streams downstream from the reservoirs at other times. The excess release quantity as defined by the Decree was expended on October 28, 1988 and the Montague design rate was reduced from 1,860 ft^3/s to 1,750 ft^3/s.

New York City complied fully with the terms of the Decree and with the directives of the River Master during the year.

INTRODUCTION

The Amended Decree of the United States Supreme Court entered June 7, 1954 authorized diversions of water from the Delaware River basin and provided for releases of water from certain New York City reservoirs to the Delaware River to be made under the supervision and direction of the River Master. The Decree also stipulated that reports be made to the Court not less frequently than annually. This report describes the River Master operations from December 1, 1987 to November 30, 1988.

Part of the hydrologic data presented are records of flow and water quality at U.S. Geological Survey gaging stations. These records were collected, computed, and furnished by the Offices of the U.S. Geological Survey at Albany, New York, Malvern, Pennsylvania, and Trenton, New Jersey, in cooperation with the States of New York and New Jersey, the Commonwealth of Pennsylvania, and the City of New York.

Definitions of Terms and Procedures

The following definitions apply to various terms and procedures used in the operations described in this report. A table for converting inch-pound units to International System of Units (SI) is given on page v. The map of the Delaware River basin (fig. 1), indicates the location of pertinent streams and reservoirs.

Time of day. - Time of day is expressed in 24-hour eastern standard time, which included a 23-hour day April 3 and a 25-hour day October 30.

Rate of flow. - Mean discharge for any stated 24-hour period, in cubic feet per second (ft^3/s) or million gallons per day (Mgal/d).

Rate of flow at Montague. - Daily mean discharge of the Delaware River at Montague, N.J., on a calendar-day basis.

Reservoir-controlled releases. - Controlled releases from reservoirs passed through outlet valves in the dams or through turbines in powerplants. This does not include spillway overflow at the reservoirs.

Uncontrolled runoff at Montague. - Runoff from the drainage area upstream from Montague exclusive of the drainage area upstream from the Downsville, Cannonsville, Neversink, Wallenpaupack, and Rio dams but including spillway overflow at these dams.

Point of maximum reservoir depletion. - Elevation at the top of the highest outlet, sometimes referred to as minimum full-operation level.

Storage or contents. - Usable volume of water in a reservoir. Unless otherwise indicated, volume is computed on the basis of level pool and above the point of maximum depletion.

Capacity. - Total usable volume between the point of maximum depletion and the elevation of the lowest crest of the spillway.

Diversions. - The transfer of water by New York City from Pepacton, Cannonsville, and Neversink Reservoirs in the upper Delaware River basin through the East Delaware, West Delaware, and Neversink Tunnels, respectively, to its water-supply system.

Also, the transfer of water by New Jersey from the Delaware River through the Delaware and Raritan Canal.

Excess quantity and seasonal period for its release. - As defined in the Decree, the excess quantity of water equals 83 percent of the amount by which the estimated consumption in New York City during the year is less than the City's estimate of continuous safe yield (1,665 Mgal/d stipulated by 1954 Decree) from all its sources of supply obtainable without pumping, except that the excess quantity should not exceed 70 billion gallons. Each year the "seasonal period" for release of the excess quantity begins on June 15. The design rate for that period becomes effective at Montague on that date and continues in effect until the following March 15, or until the cumulative total of excess-release credits becomes equal to the seasonal quantity, whichever occurs first.

Daily excess-release credits. - Daily credits and deficits during the seasonal period are equal to the algebraic difference between the daily mean discharge at Montague and 1,750 ft^3/s; however, the daily credit cannot exceed the 24-hour period releases from Pepacton, Cannonsville and Neversink Reservoirs routed to Montague and made in accordance with direction, with the following exception. During the seasonal period, credits are also made for part or all of other releases from these reservoirs contributing to daily mean discharge at Montague between the excess-release rate and 1,750 ft^3/s.

Precipitation

Precipitation observed on the basin above Montague totaled 36.88 inches for the 1988 report year and was 6.41 inches below the long-term average. Precipitation ranged from 18 percent of the long-term average in June to 149 percent of the average in July. Table 1 compares the monthly precipitation during the report year with the long-term average.

Table 1.- Precipitation in inches,
Delaware River basin upstream from Montague, N.J.

Month	December 1940 to November 1987 Average	December 1987 to November 1988			
		Amount	Percentage of average	Excess (+) or deficit (-) Month	Excess (+) or deficit (-) Cumulative
December	3.46	1.75	51	-1.71	-1.71
January	2.91	1.99	68	-.92	-2.63
February	2.75	3.09	112	+.34	-2.29
March	3.27	2.04	62	-1.23	-3.52
April	3.81	2.58	68	-1.23	-4.75
May	4.17	4.71	113	+.54	-4.21
June	3.98	.70	18	-3.28	-7.49
July	4.12	6.15	149	+2.03	-5.46
August	3.91	4.33	111	+.42	-5.04
September	3.76	2.39	64	-1.37	-6.41
October	3.34	2.38	71	-.96	-7.37
November	3.81	4.77	125	+.96	-6.41
12 months	43.29	36.88	85	-6.41	

These data were computed from records collected by the National Weather Service, New York City Department of Environmental Protection, Bureau of Water Supply and the River Master, at ten stations distributed over the basin area above Montague.

December to May is generally considered the normal time of year when surface- and ground-water reservoirs fill. During this period in 1987-88, precipitation totalling 16.16 inches was observed, which was 79 percent of the 47-year average. During June to November, 20.72 inches of precipitation was observed, which was 90 percent of the long-term average. The maximum monthly precipitation listed during the year for any of the ten stations was 6.99 inches in July at Hawley, Pennsylvania; the minimum monthly precipitation observed was 0.46 inches in June at Neversink Dam.

Acknowledgments

The River Master daily operation records were prepared by the Milford Office of the Delaware River Master from hydrologic data collected principally on a day-to-day basis. Data for these records were collected and computed by the Milford Office or were furnished by agencies as follows: Data from Pepacton, Cannonsville and Neversink Reservoirs by the New York City Department of Environmental Protection, Bureau of Water Supply; from Delaware and Raritan Canal by the New Jersey Water Supply Authority; from Lake Wallenpaupack by the Pennsylvania Power & Light Company; and from Rio Reservoir by Orange and Rockland Utilities, Inc. Precipitation data and quantitative precipitation forecasts were provided by the National Oceanic and Atmospheric Administration, National Weather Service.

OPERATIONS

December to May

During the first half of the report year, precipitation was 4.21 inches below average and ranged from 51 percent of the long-term average in December to 113 percent in May (See table 1.) Runoff in the upper basin was below normal during January and April and was near normal all other months during the period.

On December 1, 1987, Pepacton Reservoir contained 110.274 billion gallons of water in storage above the point of maximum depletion, or 78.7 percent of the reservoir's storage capacity of 140.190 billion gallons. Cannonsville Reservoir contained 95.554 billion gallons, or 99.8 percent of the reservoir's storage capacity of 95.706 billion gallons and Neversink Reservoir contained 27.193 billion gallons, or 77.8 percent of the reservoir's storage capacity of 34.941 billion gallons. The combined storage in the three reservoirs as of December 1 was 233.021 billion gallons, or 86.0 percent of their combined capacity. Daily storages in Pepacton, Cannonsville and Neversink Reservoirs are shown in tables 9, 10 and 11, respectively, and the combined storage is shown graphically in figure 2.

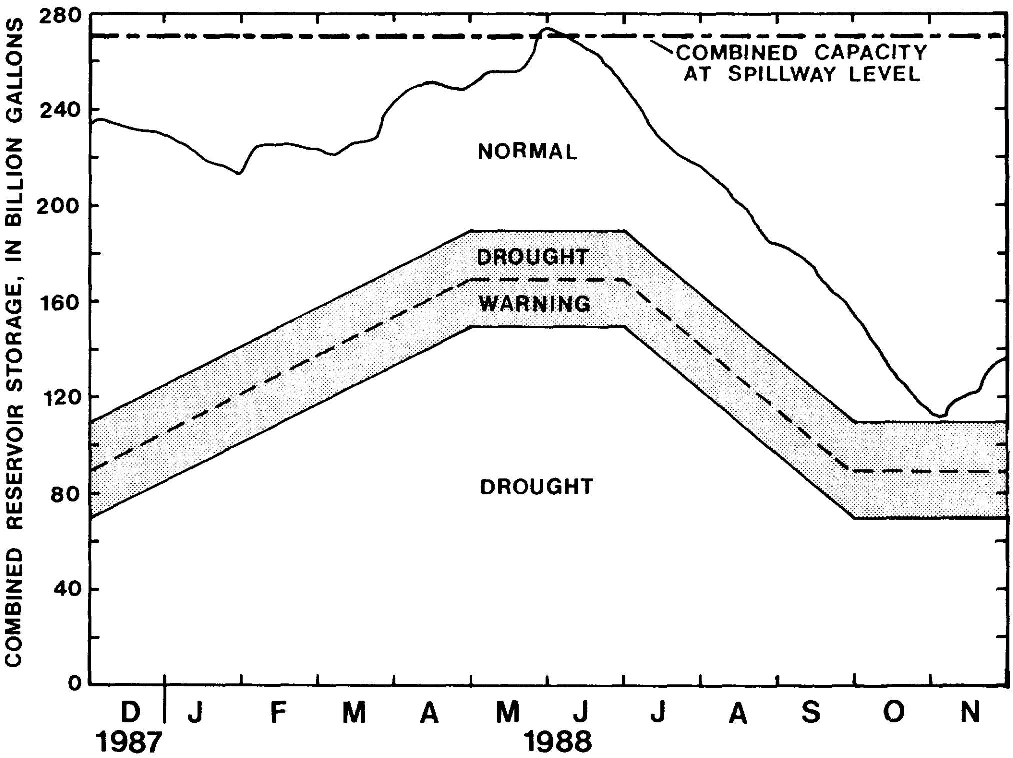

Figure 2. - Operating curves for New York City reservoirs in the Delaware River basin compared with the actual contents of the reservoirs, December 1, 1987 to November 30, 1988. (Sources: Operating curves from Interstate Water Management Recommendations of the Parties to the U.S. Supreme Court Decree of 1954, reservoir contents from New York City Bureau of Water Supply data).

The excess quantity for the seasonal period that began June 15, 1987 was 7.381 billion gallons [11,418 $(ft^3/s)\cdot d$]. By December 1, 1987, the beginning of the report year, 4.761 billion gallons [7,366 $(ft^3/s)\cdot d$] had been credited against this quantity. Operations on this date were being conducted as prescribed by the Decree. The Montague flow objective was 1,850 ft^3/s, 1,750 ft^3/s from the Montague Formula and 100 ft^3/s from the excess quantity. Allowable diversions to New York City were 800 Mgal/d and the average diversion since June 1, 1987 was 723 Mgal/d. Allowable diversions to New Jersey were 100 Mgal/d. Conservation releases from New York City reservoirs were being made at the augmented levels shown in table 2.

Pepacton Reservoir filled to capacity on May 30. The reservoir spilled May 30 to June 3 with a total of 331 million gallons being spilled.

Table 2.- Conservation release rates for New York City Delaware River basin reservoirs

Reservoir	Operative dates	Conservation releases rates Basic (ft^3/s)	Augmented (ft^3/s)
Neversink	April 1-7	5	45
	April 8 to October 31	15	45
	November 1 to March 31	5	25
Pepacton	April 1-7	6	70
	April 8 to October 31	19	70
	November 1 to March 31	6	50
Cannonsville	April 1-15	8	45
	April 16 to June 14	23	45
	June 15 to August 15	23	325
	August 16 to October 31	23	45
	November 1-30	23	33
	December 1 to March 31	8	33

Cannonsville Reservoir filled to capacity and began spilling on December 1, 1987. It spilled periodically throughout the December to May period and was at least 95.9 percent full at all times. The maximum volume of water in storage during this period was 100.518 billion gallons on March 28 when the water level was 2.99 ft. above spillway level. Approximately 46.4 billion gallons spilled during the year.

Neversink Reservoir filled to 99.3 percent of capacity on May 30 but did not spill.

The maximum volume of water in storage in the reservoirs, as shown in figure 2, was 272.209 billion gallons on May 31 when Cannonsville and Pepacton reservoirs were spilling. During the December to May period, combined storage increased 40.807 billion gallons, or 15.1 percent of capacity.

Diversions to Rondout Reservoir by the City of New York totaled 130.099 billion gallons during the December 1 to May 31 period (711 Mgal/d). During this same period, the anticipated discharge at Montague, exclusive of water released from the City reservoirs, did not fall below the applicable design rate and no releases were directed to meet the Montague flow objective. New York City made releases for conservation purposes at the augmented conservation rates shown in table 2 throughout the period.

On March 14, the seasonal period for the release of the excess quantity that began June 15, 1987 expired with 4.729 billion gallons (64.1 percent) of the available 7.381 billion gallons having been released. The Montague design rate was changed from 1,850 ft^3/s to 1,750 ft^3/s on March 15.

There was only one day during the December to May period when the observed discharge at Montague was less than the prevailing design rate. (See table 15.) This deficiency was the result of difficulty in predicting the effect of the accumulation of ice during cold weather on runoff and on transit time from the reservoirs.

Inflow to the City's reservoirs during the December through May period generally exceeds draft rates and therefore increases storage. The average inflow to Pepacton, Cannonsville, and Neversink Reservoirs for these six months during the 47-year period, December 1940 to May 1987, was 302.8 billion gallons. During the corresponding six months of the current report year, inflow to the three reservoirs totaled 233.6 billion gallons. Evaporation loss was not included in the computation. Storage in the three reservoirs increased from 231.402 billion gallons on November 30, 1987 to 272.209 billion gallons May 31, 1988.

June to November

Precipitation during the June to November period was below average in June, September, and October, was above average in July and November and was near average in August. Precipitation during the period was 20.72 inches, 2.20 inches below the 47-year average. (See table 1.)

Diversions to Rondout Reservoir June 1 to November 30 totaled 136.150 billion gallons. The equivalent diversion rate did not exceed the limit specified by the Decree and was 744 Mgal/d on November 30. Releases were directed to satisfy the Montague Formula on 127 days when the anticipated discharge at Montague exclusive of water released from the City reservoirs fell below the design rate. Releases at augmented conservation rates or at rates designed to relieve thermal stress were made at other times from each reservoir by New York City. A total of 3,090 $(ft^3/s)\cdot d$ (1.998 billion gallons) was released for the relief of thermal stress between June 13 and August 10.

During June 1-14, the flow required to be maintained in the Delaware River at Montague was the minimum basic rate of 1,750 ft^3/s. The forecasted discharge, exclusive of releases from Pepacton, Cannonsville and Neversink Reservoirs, was less than the design rate on two days during that period and releases were directed. The observed discharge at Montague was at least 1,750 ft^3/s on all but one day.

On June 15, the seasonal period began for release of the excess quantity of water from the reservoirs, and the design rate at Montague was increased to 1,860 ft^3/s. This rate was composed of the basic rate of 1,750 ft^3/s plus 110 ft^3/s of the required excess releases.

The New York City Department of Environmental Protection, Bureau of Water Supply, furnished the River Master with the following advance data for the 1988 calendar year:

1. The estimated continuous safe yield from all the City's sources, obtainable without pumping, is 1,665 Mgal/d, or a total during the calendar year 1988 of 1.665 Bgal/d x 366 days = 609.390 billion gallons.

2. The estimated consumption that the City must provide from all its sources of supply during the calendar year 1988 is 591.582 + 7.250 = 598.832 billion gallons.

On the basis of the provisions of the Decree and the above data, the aggregate quantity of excess-release water was 83 percent of (609.390 598.832) or 8.763 billion gallons. The Montague design rate during the excess release period beginning June 15, 1988, was computed as:

$$1{,}750 \text{ ft}^3\text{/s} + \frac{8.763 \text{ billion gallons x } 1{,}547 \text{ (ft}^3\text{/s)/(Bgal/d)}}{120 \text{ days}} = 1{,}860 \text{ ft}^3\text{/s}$$

Data on consumption of water by the City of New York for each calendar year, beginning in 1950, are shown in table 16.

The design rate of 1,860 ft^3/s at Montague was required June 15 to October 28 when the excess quantity was expended. Releases from the City reservoirs were designed and directed to maintain the rate of 1,860 ft^3/s at Montague on most days during the period except July 24 to August 3 when runoff from precipitation was high.

During June to November there were 126 days when the advance estimate of flow at Montague exclusive of releases from New York City reservoirs was less than the design rate and releases were directed to meet the Montague Formula. Also during this period there were 70 days when the observed flow at Montague was less than the design rate. Of those 70 days that were below the design rate, 15 were low due to the balancing adjustment and 16 additional days were within two percent of the designed flow.

The hydrographs of plate 1, show the total discharge at Montague; the portion derived from uncontrolled runoff downstream from the reservoirs; the portion contributed by the power reservoirs; and the portion contributed by Pepacton, Cannonsville and Neversink Reservoirs. In analyzing the water budget at Montague, the uncontrolled runoff downstream from the reservoirs was computed as the residual of observed flow less releases from all reservoirs and therefore was subject to all the errors in observations, transit times, and routing of the several components of flow. All of these uncertainties are contained in the computed hydrograph of uncontrolled runoff.

Summary

From December 1, 1987, to November 30, 1988, diversions to Rondout Reservoir totaled 266.249 billion gallons, and all releases from the New York City reservoirs to the Delaware River totaled 103.263 billion gallons.

During the year, maximum storage in Pepacton Reservoir was 140.598 billion gallons, on June 1. Maximum storage in Cannonsville Reservoir was 100.518 billion gallons, on March 28. Maximum storage in Neversink Reservoir was 34.685 billion gallons, on May 30. The maximum combined storage in the three reservoirs during the year was 272.209 billion gallons, on May 31.

Minimum combined storage during the year in the reservoirs was 111.208 billion gallons on November 5, 1988. Minimum storage in Pepacton Reservoir was 75.387 billion gallons (53.8 percent of capacity). Minimum storage in Cannonsville Reservoir was 25.009 billion gallons (26.1 percent of capacity) and minimum storage in Neversink Reservoir was 8.799 billion gallons (25.2 percent of capacity).

A résumé of the combined storage of the three reservoirs on the first day of the month June 1967 to November 1988 is shown in figure 4. Storage was above the median December through March and June, and was below the median April, May and July through November. On November 1, the combined storage was the second lowest during the period of record.

On November 30, 1988, combined storage in the three reservoirs was 136.758 billion gallons, or 50.5 percent of their combined capacity. During the year, combined storage decreased 94.644 billion gallons, or 34.9 percent of capacity.

SUPPLEMENTARY RELEASE FROM WALLENPAUPACK POWERPLANT

An agreement between Pennsylvania Power & Light Company and New York City provides for supplementary releases from Wallenpaupack hydroelectric powerplant if the Delaware River Basin Commission requests compensation for water consumed at the company's Martins Creek steam-electric generating station. Releases may be requested if the flow of the Delaware River at Trenton, N.J. is expected to be less than 3,000 ft^3/s for more than three consecutive days. No supplementary releases were requested during the year.

COMPONENTS OF FLOW, DELAWARE RIVER AT MONTAGUE, N.J.

The data and computations of the various components of flow formed the basic operational records required to carry out the River Master's specific responsibilities with respect to the Montague Formula during the report year. The operational record has two parts: the advance estimates of the daily average flow at Montague, exclusive of controlled releases from New York City's reservoirs (table 14) and the segregation of the daily average flow at Montague among its various source components (table 15). The time intervals required for water to travel from the various sources to Montague were taken into account.

Discharge of the Delaware River at Montague was composed of the following source components:

1. Controlled releases from Lake Wallenpaupack on Wallenpaupack Creek in the production of hydroelectric power.

2. Controlled releases from Rio Reservoir on Mongaup River in the production of hydroelectric power.

3. Runoff from the uncontrolled area upstream from Montague.

4. Controlled releases from Pepacton, Cannonsville and Neversink Reservoirs of New York City.

The release from the City's reservoirs necessary to maintain the applicable rate of flow at Montague was computed from the advance estimates of flow at Montague, exclusive of controlled releases from the City's reservoirs.

TIME OF TRANSIT

The average times for the effective transit of water from the various sources of controlled supply to Montague used for discharge routing during the 1988 report year are as follows:

Source	Hours
Pepacton Reservoir	60
Cannonsville Reservoir	48
Neversink Reservoir	33
Lake Wallenpaupack	16
Rio Reservoir	8

This schedule was developed from reservoir and powerplant operations and gaging-station records of prior years and was found generally suitable. At times, noticeable exceptions occur, for example, when a large release from Cannonsville Reservoir follows a small one, a large part of the release is expended in filling the channel en route, and the remainder may appear at Montague as much as 18 hours late. During the winter, the cold weather causes ice to form in the stream, which, together with the low streamflow, gradually increases the resistance to streamflow and lengthens the time of transit.

On several occasions when large releases were directed following small ones, these releases were directed to begin from 9 to 12 hours earlier than normal to compensate for the expected increase in travel time. These adjustments were helpful in getting the directed releases to Montague within the appropriate time frame, but were not fully successful. Therefore, the observed Montague flow tended to be low on the first day that these releases were expected to arrive and to be high on the second or third day. The average of the observed flow for approximately three days when this procedure was used was usually close to the design rate.

SEGREGATION OF FLOW AT MONTAGUE

The River Master daily operation record of reservoir releases and daily segregation of flow among the various source components contributing to the flow of the Delaware River at Montague is shown in table 15. The arrangement of data conforms with the downstream movement of water from the various sources to Montague. A horizontal summation of data in the table is equivalent to routing the various contributions to Montague, using the schedule for travel time of water discussed previously. The uncontrolled runoff was computed by subtracting the contributions of the several other sources from the observed discharge at Montague.

COMPUTATION OF DIRECTED RELEASES

In the daily operations, it was necessary that the River Master utilize: (1) discharges computed from recorded or reported stream gage heights for various 24-hour periods without current information about changes in stage-discharge relations that might have occurred; (2) daily discharge from New York City's three reservoirs obtained from venturi meters; (3) rainfall reports for the previous 24 hours; (4) actual powerplant operations converted to daily discharge; (5) advance estimates of power demand converted to daily discharge; (6) advance estimates of uncontrolled runoff at Montague; and (7) average times for routing of water from the several sources. Variable errors of estimate occur in projecting data, but these data must be used in the daily design and direction of releases from the reservoirs.

The time of transit of water from Pepacton Reservoir to Montague was greater than that from any other reservoir above Montague, therefore, the time of daily directed releases to maintain prescribed rates of flow at Montague was based on time of transit from Pepacton Reservoir. Releases from Cannonsville and Neversink Reservoirs were timed to arrive at Montague concurrently with releases from Pepacton Reservoir. To allow for the actual differences in transit times, daily directed releases began at Pepacton at 1200 hours, at Cannonsville at 2400 hours, and at 1500 hours the following day at Neversink.

The determination of the amount of release required from the City's reservoirs to maintain specified rates of flow at Montague was based on estimates of releases from Lake Wallenpaupack and Rio Reservoir and an estimate of the uncontrolled runoff at Montague. Taking into account the time of transit from these sources to Montague, this determination required that advance estimates of the following components be made on the morning of each day: (1) the expected release of water from Lake Wallenpaupack for power production for a 24-hour period, beginning at 0800, two days later; (2) expected release of water from Rio Reservoir for power production for a 24-hour period, beginning at 1600 hours, two days later; and (3) expected uncontrolled runoff at Montague three days later. The River Master daily operation record for computing daily directed release from the City's reservoirs during the periods of low flow is shown in table 14.

The electric power companies cooperated fully in furnishing advance estimates of powerplant releases. As the hydroelectric plants were used chiefly for meeting peak-power demands of the system, advance estimates were subject to many modifying factors such as the influence of the vagaries of weather upon peak-power demand and unpredictable transmission and mechanical difficulties in electric-system operation. As a result, the actual use of water for power generation was at times at considerable variance with the advance estimates that were used by the River Master's office in design computation.

For computation purposes during periods of low flow, the estimate of uncontrolled runoff at Montague three days in advance was treated as two items: (1) present runoff and (2) estimated increase in runoff from precipitation. The present runoff was computed for 2,143 square miles (mi^2) of uncontrolled drainage area above Montague based on conditions over the drainage area as of 0800 on the morning the estimate was made. The estimated increase in runoff was computed from precipitation which was forecast to on the day the estimate was made and the following two days. Estimated quantitiesfor these items are shown in table 14.

During the winter period, the advance estimate of the uncontrolled runoff (present conditions) was based on flows at nearby gaging stations and on the recession curve of the uncontrolled flow at Montague projected to the design date, three days hence.

During open-river conditions, the present runoff portion of the advance estimate of uncontrolled runoff was based on discharges as of 0800 at gaging stations listed below:

Station	Drainage area (square miles)
Beaver Kill at Cooks Falls, N.Y.	241
Cadosia Creek at Cadosia, N.Y.	17.9
Oquaga Creek at Deposit, N.Y.	67.6
Equinunk Creek at Equinunk, Pa.	56.3
Callicoon Creek at Callicoon, N.Y.	110
Tenmile River at Tusten, N.Y.	45.6
Lackawaxen River at Hawley, Pa.	290
Shohola Creek near Shohola, Pa.	83.6
Neversink River at Port Jervis, N.Y.	336

The procedure for computing the advance estimate combined a routing and recession (as applicable) of the 0800 discharges of the Beaver Kill, Oquaga, Equinunk, Callicoon and Shohola Creeks and Tenmile, Lackawaxen, and Neversink Rivers gaging stations to Montague, with a computed yield from the remaining ungaged, uncontrolled drainage area. Releases from Neversink Reservoir were deducted from discharge of the Neversink River site. The yield from the ungaged, uncontrolled drainage area was estimated on the basis of the yield of Cadosia, Oquaga, Equinunk, and Callicoon Creeks, and Tenmile and Lackawaxen Rivers with routing and recession by individual gaging stations. The yield from the ungaged-uncontrolled area was adjusted periodically to account for differences between the forecasted uncontrolled runoff and the observed runoff at the Montague gaging station.

The advance estimate of increase in runoff from precipitation is shown in table 14 under the heading of "Weather Adjustment." The National Weather Service Office, Philadelphia, Pa., cooperated throughout the lowflow periods by furnishing quantitative forecasts of average precipitation over the drainage area above Montague and air temperatures for each day of the three-day period. During the winter, the probable increase in runoff was estimated from the current state of snow and ice and from forecasted temperature and precipitation for the several days under consideration. During open-river condtions, runoff from the forecasted precipitation was estimated from previously established relationships.

The total anticipated flow at Montague, exclusive of releases from the City's reservoirs (table 14), was the sum of the forecasted releases from the power reservoirs, the estimated uncontrolled runoff under then current conditions, and the weather adjustment. The amount by which this computed flow was less than the prescribed Montague rate indicated the expected deficiency at Montague, which would have to be made up by corresponding releases from New York City reservoirs.

There were times when revised forecasts of weather or powerplant releases became available before the completion of the required release from New York City reservoirs. At such times, the release required from New York City reservoirs was recomputed on the basis of the revised information, and the release required was changed to the revised indicated deficiency. Usually this procedure resulted in a reduced release requirement from New York City reservoirs and the conservation of water. Only the final figures are shown in table 14.

ANALYSIS OF FORECASTS

Forecasts of the flow at Montague based on the anticipated flow of the several components (exclusive of the release from the City's reservoirs) vary somewhat with those actually experienced on most days even under the most favorable conditions. The daily variations in the several components are often partially compensating with the resulting forecast being fairly accurate.

The advance estimate of flow of the Delaware River at Montague exclusive of the releases from the New York City reservoirs was greater than the design rate from December 1, 1987 to June 11, 1988. Beginning June 12, the advance estimate was less than the design rate, except July 24 to August 3; and November 7-30, and releases were directed. The table below compares the advance estimates of the various contributions to the flow at Montague to the observed operations during the June 12 to July 23 and August 4 to November 6, 1988 periods when releases were directed on most days.

	Advance estimates [$(ft^3/s)\cdot d$]	Observed operations [$(ft^3/s)\cdot d$]
New York City releases		
Directed	[a] 119,708	[b] 119,878
Other		[c] 6,021
Power releases		
Lake Wallenpaupack	18,183	25,964
Rio Reservoir	14,113	16,121
Runoff from uncontrolled area	94,500	101,466

[a] Directed release as designed.
[b] Actual release in response to direction.
[c] Includes conservation releases and releases for the relief of thermal stress.

The table shows that during the period of comparison, New York City released slightly more water, 0.1 percent, than was directed. The power companies released 43 percent more water from Lake Wallenpaupack and 14 percent more water from Rio reservoir than was forecast. The total power releases were 30 percent more than the forecast. The forecasted runoff from the uncontrolled area during the period was 6.9 percent less than the observed runoff from the uncontrolled area. However, if July 21-23 and November 6, which were greatly affected by runoff from unforecasted precipitation are removed from the comparison periods, the forecasted runoff from the uncontrolled area would only be 1.9 percent less than the observed runoff.

On the basis of the observed discharges at Montague, exact forecasting of releases required from the City's reservoirs during the period, June 12 to November 6, would have totaled 120,472 $(ft^3/s)\cdot d$. The directed releases totaled 119,708 $(ft^3/s)\cdot d$, or 0.6 percent less than for exact forecasting.

A comparison of the hydrographs on figure 3, of forecast uncontrolled runoff and the actual uncontrolled runoff indicate that the forecasting procedures were generally adequate. The forecast included anticipated uncontrolled runoff under then-existing conditions plus the weather adjustment based on forecast precipitation. Analysis of the hydrographs indicate that the forecast procedures tended to underestimate the runoff during high precipitation events and to overestimate the runoff during extended dry periods. Adjustments to the forecast procedures were made to compensate for these tendencies, but due to the delay between the release of water and the observation of the affect that release had on the Montague flow, it takes several days for adjustments to become effective.

DIVERSIONS TO NEW YORK CITY WATER SUPPLY

The 1954 Amended Decree allows New York City to divert water from the Delaware River basin at a rate not to exceed 800 Mgal/d. The Decree also specifies that the rate of diversion will be computed as the aggregate total diversion beginning on June 1 of each year divided by the number of days elapsed since the previous May 31.

Table 13 shows diversions from Pepacton, Cannonsville and Neversink Reservoirs to the New York City water-supply system during the report year. The tabulation includes a running account of the average rates of the combined diversions from the reservoirs, computed as prescribed by the Decree. The tabulation shows that the allowable maximum equivalent diversion rate of 800 Mgal/d was not exceeded at any time.

STORAGE IN NEW YORK CITY RESERVOIRS

The New York City Board of Water Supply determined the "point of maximum depletion" and other pertinent reservoir levels and contents of Pepacton, Cannonsville and Neversink Reservoirs as follows:

[Elev. is distance above sea level]

Reservoir level	Pepacton Res.		Cannonsville Res.		Neversink Res.	
	Elev. (feet)	Contents (billion gallons)	Elev. (feet)	Contents (billion gallons)	Elev. (feet)	Contents (billion gallons)
Full pool or spillway crest	1,280.00	*140.190	1,150.00	*95.706	1,440.00	*34.941
Point of maximum depletion	1,152.00	*3.511	1,040.00	*1.020	1,319.00	*0.525
Sill of diversion tunnel	1,143.00	*4.200	+1,035.00	*1.564	1,314.00	
Sill of river outlet tunnel	1,126.50		1,020.5		1,314.00	
Dead storage		1.800		0.328		1.680

*Contents shown are quantities stored between listed elevations.
+Elevation of mouth of inlet channel of diversion works.

Tables 9, 10 and 11 show storage in Pepacton, Cannonsville and Neversink Reservoirs, respectively, above the "point of maximum depletion" or minimum full-operating level.

On December 1, 1987 combined storage in the three reservoirs was 233.021 billion gallons, which was 123 billion gallons above the drought warning level as defined by the Interstate Water Management Recommendations. Storage declined throughout the winter months, except for a brief rise in early February, until mid-March but it remained above the median level. Storage increased gradually after mid-March and reached 90 percent of capacity by April 3. It remained fairly constant during April and May until heavy rains occurred in late May and subsequent runoff increased storage to capacity on May 28.

Storage decreased seasonally from June through October in response to normal diversions to the New York City water-supply system and above-normal releases required to maintain the Montague flow objective. Precipitation averaging about one inch over the upper basin occurred on November 5. The resultingrunoff helped to increase storage from a seasonal low of 111.208 billion gallons on November 5 to 136.758 billion gallons on November 30. (See figure 2). It also averted what appeared to be almost certain entry into the droughtwarning zone of the operation curves.

COMPARISONS OF RIVER MASTER OPERATION DATA AND OTHER STREAMFLOW RECORDS

It has been explained that the River Master operations are, in effect, day-to-day operations, for which it is necessary to use preliminary records of streamflow. The following summaries show comparison of records used in the River Master operations and Geological Survey records. In the comparison of releases, data were used in units of million gallons per day and converted to cubic feet per second in the summaries.

Releases from New York City Reservoirs

The River Master operations data on the controlled releases from Pepacton, Cannonsville and Neversink Reservoirs, to the Delaware River were obtained from calibrated instruments connected to venturi meters installed in the outlet conduits.

The Geological Survey gaging station on the East Branch Delaware River at Downsville, N.Y., is 0.5 mile downstream from Pepacton Reservoir dam. The discharge shown in table 3 includes releases and spillage from Pepacton Reservoir. It also includes a small amount of seepage, which enters the channel between the dam and gage site, and a small amount of runoff, which originates between the dam and gage site. The drainage area at the dam is 371 square miles and at the gaging station is 372 square miles.

Releases were made at conservation rates, at rates designed by New York State to relieve thermal stress, and during October at higher rates as part of the directed releases. For flows of approximately 50, 70, 100, 290 and 610 ft^3/s at the gaging station, the venturi meter instruments indicated +1.2, +6.1, +7.5, +6.0 and +0.9 percent difference, respectively, in rates of release from the reservoir than those shown by the gaging-station record.

The Geological Survey gaging station on the West Branch Delaware River at Stilesville, N.Y. is 1.4 miles downstream from Cannonsville Dam. The discharge shown in table 4 includes releases and spillage from Cannonsville Reservoir and the runoff from 2 square miles of drainage area between the dam and the gage site. The drainage area at the dam is 454 square miles, and that at the gaging station is 456 square miles.

Releases were made in a range from conservation to high rates during the year. For flows of approximately 35 and 55 ft^3/s at the gaging station, the venturi meter instruments indicated 8.8 and 1.6 percent less water, respectively, being released from the reservoir than those shown by the gaging-station records. At flows of approximately 325, 945 and 1,150 ft^3/s, the venturi indicated 8.3, 1.1 and 2.6 percent more discharge respectively, than that shown by the gaging-station records. The gaging-station records are considered good for flows above 700 ft^3/s and fair below.

The Geological Survey gaging station on the Neversink River at Neversink, N.Y., is 1,650 feet downstream from Neversink Dam. The discharge shown in table 6 includes releases from Neversink Reservoir and, during storms, a small amount of runoff, which originates between the dam and gage site. The drainage area at the dam is 92.5 square miles and that at the gaging station is 92.6 square miles.

Releases were made at conservation or other low flows by New York City during the year. For flows of approximately 24, 43 and 72 ft^3/s at the Geological Survey gaging station, the venturi meter instrument indicated +5.0 +8.2 and +5.4 percent difference, respectively, in rates of release from the reservoir than those shown by the gaging-station records.

The above comparisons indicate good agreement between the data from the venturi meters and U.S. Geological Survey gaging stations at Pepacton and Neversink Reservoirs and for flows above 700 ft^3/s at Cannonsville Reservoir. The gaging-station records are considered only fair at the Stilesville gage for flows below 700 ft^3/s. Therefore, the venturi instruments are considered to provide more accurate records.

Releases from Lake Wallenpaupack

In the River Master operations December 1 to November 30 records of daily discharge through the Wallenpaupack powerplant were furnished by the Pennsylvania Power & Light Company (see table 15). Daily discharges were computed on an 0800 to 0800-time basis to allow for the 16-hour average transit time to Montague.

The records of daily mean discharges for Wallenpaupack Creek at Wilsonville, Pa., published by the U.S. Geological Survey, were also furnished by the Company. These discharges, shown in table 5, represent the flow through the turbines of the powerplant and are computed on a midnight-to-midnight basis.

During December 1987 through November 1988, the River Master's record based on computations by Pennsylvania Power & Light Company, agrees with the U.S. Geological Survey record except for a slight variation due to the difference in the time frame and rounding of the computations.

Delaware River at Montague, N.J.

The River Master's operation record indicated less than 0.1 percent less discharge for the year than the U.S. Geological Survey record, and daily records were in good agreement.

Diversion Tunnels

Records of diversions through the East Delaware, West Delaware, and Neversink Tunnels were furnished to the River Master's Office by the City of New York. These records were obtained from New York City's calibrated instruments connected to venturi meters installed in the tunnel conduits. These instruments include a differential pressure transmitter which is connected to a numerical totalizer that records the volume of water discharged and a rate-of-flow indicator that records on a Bristol-type chart. It is also connected to a single tube mercury manometer which is used to check the rate-of-flow indicator. The totalizer readings are transmitted electronically to the New York City Bureau of Water Supply and are reported to the River Master office daily. Current-meter measurements were made by the River Master's office to verify the accuracy of the reported diversions. The current-meter measurements were made in the outlet channels downstream from the tunnels.

Water is diverted from Pepacton Reservoir through the East Delaware tunnel into Rondout Reservoir. The conditions in the outlet channel, which is used for measuring discharge from the tunnel by current meter were unfavorable for much of the year due to the high water levels in Rondout reservoir. The results of two current-meter measurements made during the year showed on the average that the venturi-meter instruments gave higher figures by 6.0 percent for the totalizer, 6.4 percent for the manometer and 6.6 percent for the indicator needle. The remotely transmitted readings of the totalizer showed an average of 5.4 percent higher than the measured discharge.

Comparison of the data provided by New York City with discharges obtained from recorded gage-heights and the rating curve for the weir on the outlet channel indicate that the data provided by New York City were within acceptable limits.

The powerplant that used the water diverted through the tunnel operated most days of the year. On days when the powerplant was not in operation, there was a small amount of leakage through the wicket gates, which was not recorded on the totalizer. Results of a current-meter measurement March 4, 1982 indicated a rate of 10.9 ft^3/s from cooling water and leakage. An estimate of the leakage was made April 5, 1988 and showed that at least 6.0 ft^3/s was leaking through the wicket gates.

When the powerplant is not operating, the leakage by-passes the venturi instruments and is not measured. When the powerplant is operating, the leakage is included in the measured flow. Since the powerplant was not operated on 36 days and operated a portion of the time on 81 additional days during the year, the unmeasured flow is small, approximately 0.6 billion gallons.

Based upon measurements obtained this year and in previous years, the record of quantity of water diverted through the East Delaware Tunnel should be substantially correct.

The West Delaware Tunnel is used to divert water from Cannonsville Reservoir into Rondout Reservoir. Three current-meter measurements made during the year indicated that the venturi instruments gave higher results by 4.1 percent for the totalizer, and 9.5 percent for the manometer. The remotely transmitted data from the totalizer showed a +4.5 percent difference. Inspections of the channel downstream from the outlet, when valves were closed showed negligible leakage.

The results of these measurements and inspections made this year and during past years indicate that the reported record of the quantity of water diverted through the West Delaware Tunnel was substantially correct.

The Neversink Tunnel is used to divert water from Neversink Reservoir into Rondout Reservoir. Results of the comparative data from venturi measurements and two current-meter measurements showed that on average, the venturi was 3.0 percent lower for the totalizer, 4.6 percent higher for the manometer, and 2.3 percent higher for the indicator needle. The remotely transmitted data from the totalizer were 0.6 percent higher than the measurements.

When the powerplant that used the water diverted through the Neversink Tunnel was not in operation, a small amount of leakage occurred that was not recorded on the venturi instruments. Based on two measurements made during the year, the average rate of leakage is 14.2 ft^3/s (9.2 Mgal/d). When the powerplant was operating, the leakage was included in the recorded flow. Based on the above rate and on records of power plant operations, approximately 1.7 billion gallons of water was diverted but unrecorded.

DIVERSIONS BY NEW JERSEY

According to the terms of the Decree, New Jersey may divert for use outside the Delaware River basin from the Delaware River or its tributaries in New Jersey, without compensating releases, a quantity of water not to exceed 100 Mgal/d (154.7 ft^3/s) as a monthly average, with the diversion on any day not to exceed 120 Mgal/d (185.6 ft^3/s).

Prior to 1986, the diversions through the Delaware & Raritan Canal were measured at Kingston Lock. Since 1986, water has been diverted on a regular basis from the canal into Carnegie Lake and into the Millstone River upstream from the gaging station at the Kingston Lock. The New Jersey Water Supply Authority made computations of the amount being diverted on a daily basis and provided the data to the River Master office weekly. Table 12 is a listing of the data provided by the Water Supply Authority.

At the River Master Advisory Committee meeting in May 1986 the apparent inadequacy of the current monitoring system was discussed. Following that meeting, the River Master requested New Jersey to improve the monitoring system to provide accurate records of their diversions. In response to the River Master's request, the State of New Jersey in cooperation with the U.S. Geological Survey began the installation of an acoustic velocity meter and remote sensing equipment at Port Mercer near the Delaware-Raritan divide. The installation was completed during 1987, but was not fully operational by the end of the year. During 1988 numerous attempts were made to adjust the equipment to obtain reliable data. For a variety of reasons, much of the equipment was replaced and was being calibrated at the end of the 1988 report year.

The 30-day average diversion was computed weekly throughout the year to monitor compliance with the terms of the Decree. The maximum 30-day average diversion was 95.8 Mgal/d July 9 to August 7. The maximum daily diversion was 112 million gallons on December 30, 1987. These computations indicate that the diversions by New Jersey did not exceed the limits allowed by the Decree.

The data provided by the New Jersey Water Supply Authority for the flow at the Kingston Lock were compared to the U.S. Geological Survey record for the flow in the canal at the Kingston Lock and were found to be within 0.1 percent for the year.

CONFORMANCE OF OPERATIONS AS PROVIDED UNDER AMENDED DECREE OF THE U.S. SUPREME COURT, DATED JUNE 7, 1954

Operations were conducted as prescribed by the Decree for the entire report year. Diversions from the Delaware River basin to the New York City water-supply system were less than the 800 Mgal/d authorized by the Decree. Allowable and actual diversions are shown in the following table:

Effective dates	Allowable diversions Equivalent rate not to exceed (Mgal/d)	Actual diversions (Mgal/d)
June 1, 1987 to May 31, 1988	800	717
June 1 to Nov. 30, 1988	800	744

Under Compensating Releases of the Montague Formula, the City released water from its reservoirs at rates designed by the River Master to maintain 1,850 ft^3/s at Montague December 1, 1987 to March 14, 1988, 1,750 ft^3/s March 15 to June 14, 1,860 ft^3/s June 15 to October 28, and 1,750 ft^3/s October 29 to November 30. New York City complied fully with the directives of the River Master during the year.

Diversions from the Delaware River basin by New Jersey were within the limits prescribed by the Decree.

Table 3.- Daily mean discharge, in cubic feet per second, of East Branch Delaware River at Downsville, N.Y. (01417000) for the year ending November 30, 1988. Preliminary U.S. Geological Survey record.

Day	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
1	52	52	52	51	59	66	244	71	92	67	67	56
2	52	52	53	51	66	66	183	71	92	78	67	189
3	52	52	53	51	68	67	102	71	101	78	67	269
4	52	52	51	52	66	67	74	82	110	67	75	124
5	52	52	52	52	65	67	66	93	109	67	189	50
6	52	52	52	52	64	67	66	99	109	67	291	51
7	52	52	51	52	65	67	66	111	109	67	292	51
8	52	52	51	52	65	67	67	113	100	67	293	52
9	52	52	50	52	65	67	67	113	91	67	292	52
10	52	52	51	52	65	67	67	112	90	67	291	52
11	52	52	50	52	65	67	67	113	90	67	290	52
12	52	52	51	52	65	66	67	103	100	67	458	52
13	52	52	52	52	65	66	79	93	111	67	625	52
14	52	52	52	52	65	67	90	93	111	195	617	52
15	52	52	51	53	65	66	100	93	102	197	608	53
16	51	52	52	52	65	66	110	103	92	67	606	53
17	51	52	53	52	65	67	89	113	80	67	605	53
18	51	52	54	52	65	67	67	103	67	67	606	54
19	51	52	54	52	65	67	81	93	68	67	609	54
20	53	52	53	52	65	67	93	93	68	67	608	55
21	53	51	54	52	65	67	92	81	68	67	327	53
22	53	50	53	52	65	67	92	68	68	67	191	52
23	53	51	50	52	65	67	81	69	68	67	293	52
24	53	52	51	52	65	67	69	69	68	67	294	51
25	54	52	52	51	65	67	69	69	67	67	177	51
26	54	52	51	52	65	67	69	82	67	69	65	51
27	54	51	51	52	65	67	69	80	67	68	136	51
28	54	50	51	52	65	67	69	65	67	67	363	51
29	52	51	51	52	65	66	69	79	69	67	539	51
30	51	51		52	66	81	70	93	67	67	589	51
31	51	51		52		252		92	67		337	
Total	1,619	1,602	1,502	1,609	1,949	2,269	2,594	2,783	2,635	2,293	10,867	1,990
Mean	52.2	51.7	51.8	51.9	65.0	73.2	86.5	89.8	85.0	76.4	351	66.3

Year total 33,712 $(ft^3/s) \cdot d$ Mean 92.1 ft^3/s

Table 4.- Daily mean discharge, in cubic feet per second, of West Branch Delaware River at Stilesville, N.Y. (01425000) for the year ending November 30, 1988. Preliminary U.S. Geological Survey record.

Day	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
1	52	110	59	332	1,670	61	468	1,220	420	42	1,230	48
2	251	111	60	171	1,340	95	550	1,220	420	347	875	443
3	511	97	499	95	1,130	137	571	1,200	420	314	761	322
4	713	79	1,510	51	1,030	141	577	538	418	55	1,170	266
5	819	62	1,700	40	908	124	537	753	810	43	1,200	94
6	835	39	1,470	40	771	114	484	748	431	42	1,010	42
7	817	37	1,150	40	634	105	322	462	413	42	986	39
8	771	38	957	41	508	92	201	1,260	413	291	984	38
9	714	39	970	62	406	62	126	1,020	413	636	1,020	38
10	618	37	985	67	325	50	255	809	413	542	1,070	38
11	538	37	937	69	251	49	125	790	673	226	1,090	38
12	458	36	914	143	176	49	55	852	1,070	250	1,170	38
13	403	38	873	296	129	49	147	712	1,020	351	851	41
14	382	36	780	500	127	50	335	690	482	342	864	40
15	323	35	712	621	83	50	387	1,310	422	326	886	39
16	305	36	706	750	56	50	449	995	557	1,210	900	39
17	288	38	694	805	52	51	811	453	821	1,130	950	41
18	248	38	662	804	53	53	758	434	861	892	968	40
19	211	38	624	859	52	57	628	334	1,240	866	991	40
20	210	40	638	872	52	70	500	327	1,340	778	976	46
21	215	38	707	820	52	65	485	326	1,390	815	520	52
22	225	38	655	746	52	66	795	326	1,400	806	550	45
23	216	37	639	693	53	62	926	326	1,400	1,120	485	44
24	195	37	621	700	54	92	913	325	1,170	1,110	331	43
25	170	38	538	928	52	592	993	321	1,120	588	120	42
26	208	38	311	2,180	52	1,570	1,000	322	960	598	39	42
27	227	37	318	4,200	53	1,950	1,070	320	971	670	196	42
28	220	37	358	4,200	59	1,600	1,140	317	935	678	248	43
29	222	36	366	3,470	57	1,220	1,160	366	440	872	269	43
30	181	37		2,810	57	899	1,180	425	59	1,310	270	42
31	128	37		2,280		627		420	43		193	
Total	11,674	1,431	21,413	29,685	10,294	10,252	17,948	19,921	22,945	17,292	23,173	2,208
Mean	377	46.2	738	958	343	331	598	643	740	576	748	73.6

Year total 188,236 $(ft^3/s) \cdot d$ Mean 514 ft^3/s

Table 5.- Daily mean discharge, in cubic feet per second, of Wallenpaupack Creek at Wilsonville, Pa. (01432000) for the year ending November 30, 1988. Record furnished by Pennsylvania Power & Light Company.

Day	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
1	245	0	224	863	0	0	845	0	529	0	0	0
2	234	0	218	951	0	0	842	0	865	82	0	0
3	232	0	227	939	0	0	825	0	699	0	343	79
4	236	219	330	978	233	0	0	0	502	0	350	0
5	0	678	446	418	229	0	0	465	482	0	0	0
6	0	698	465	381	224	0	694	0	0	93	0	0
7	321	707	463	456	231	0	707	0	0	56	0	0
8	327	705	227	476	277	0	699	360	555	61	0	0
9	258	214	215	432	0	0	697	0	557	58	0	0
10	240	222	228	469	0	0	698	0	690	0	0	0
11	237	712	283	471	228	0	0	594	862	0	0	79
12	0	725	475	0	242	0	0	452	649	237	0	0
13	0	727	0	0	232	0	861	464	615	229	0	0
14	237	721	0	471	269	0	690	718	0	234	0	0
15	232	258	404	472	219	0	758	518	850	221	0	0
16	230	0	536	459	0	0	735	0	352	239	0	0
17	229	0	586	476	0	72	451	0	548	0	0	0
18	230	237	516	351	231	0	0	648	338	0	0	2
19	0	220	596	0	234	0	0	407	351	350	0	0
20	0	225	225	0	258	0	213	337	0	386	3	0
21	232	219	217	465	253	0	699	346	0	348	0	27
22	229	223	641	475	238	0	864	0	0	345	0	3
23	227	0	672	463	0	281	577	0	0	356	0	0
24	0	0	665	458	0	747	0	0	0	0	0	0
25	0	223	437	464	0	984	0	454	53	0	0	0
26	0	217	727	0	0	1,140	0	479	0	469	0	0
27	0	218	472	0	0	1,010	75	572	0	460	0	0
28	221	219	468	470	0	0	0	581	0	484	0	151
29	250	226	450	488	0	0	0	706	82	480	0	0
30	691	0		479	0	0	0	290	0	473	0	0
31	230	0		471		816		0	0		111	
Total	5,568	8,813	11,413	13,296	3,598	5,050	11,930	8,391	9,579	5,661	807	341
Mean	180	284	394	429	120	163	398	271	309	189	26	11.4

Year total 84,447 $(ft^3/s)\cdot d$ Mean 231 ft^3/s

Table 6.- Daily mean discharge, in cubic feet per second, of Neversink River at Neversink, N.Y. (01436000) for the year ending November 30, 1988. Preliminary U.S. Geological Survey record.

Day	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
1	26	24	24	23	33	35	39	43	70	46	44	33
2	25	24	24	23	38	39	43	43	69	46	44	24
3	25	24	24	23	39	42	44	43	72	47	43	24
4	25	24	23	23	40	43	45	43	78	48	43	24
5	24	24	24	23	42	43	45	51	78	47	43	25
6	24	24	24	23	44	43	44	63	78	46	43	24
7	25	24	24	23	42	43	45	71	78	46	42	24
8	25	24	24	23	42	43	45	83	75	46	42	24
9	25	24	24	23	42	44	42	83	66	46	42	24
10	25	24	23	23	40	44	41	82	66	46	42	24
11	25	24	24	23	45	44	41	82	66	46	42	23
12	25	24	23	23	41	44	41	82	65	46	44	24
13	25	24	23	23	41	44	41	76	69	46	46	24
14	25	24	23	23	37	44	41	64	77	46	45	23
15	25	24	23	23	36	44	42	64	76	45	45	23
16	25	24	23	23	36	44	42	64	72	46	45	23
17	24	24	23	23	37	44	42	71	66	46	45	23
18	24	24	23	23	37	44	41	77	58	45	44	24
19	25	24	23	23	37	44	41	69	46	45	44	24
20	25	24	23	23	38	45	42	68	46	46	44	25
21	25	24	23	23	40	45	45	59	46	44	44	23
22	25	24	23	23	42	45	53	46	46	45	44	24
23	25	24	23	23	45	45	55	45	46	45	43	24
24	25	24	23	23	44	45	43	45	47	45	44	24
25	25	24	23	23	44	45	43	45	47	47	43	23
26	25	24	23	24	45	45	43	53	47	47	46	24
27	25	23	23	23	45	43	43	54	48	45	46	24
28	25	24	23	23	45	39	43	44	48	44	46	18
29	24	24	23	24	45	41	43	57	49	44	43	23
30	23	24		24	42	44	43	70	46	44	46	24
31	24	23		24		44		70	46		46	
Total	768	742	676	717	1,224	1,341	1,301	1,910	1,887	1,371	1,363	717
Mean	24.8	23.9	23.3	23.1	40.8	43.3	43.4	61.6	60.9	45.7	44.0	23.9

Year total 14,017 $(ft^3/s)\cdot d$ Mean 38.3 ft^3/s

Table 7.- Daily mean discharge, in cubic feet per second, of the Delaware River at Montague, N.J. (01438500) for the year ending November 30, 1988. Preliminary U.S. Geological Survey record.

Day	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
1	11,800	2,700	2,400	3,000	9,430	5,270	5,970	1,730	2,280	2,370	1,950	1,740
2	9,550	3,500	4,800	3,400	8,570	4,650	5,700	1,820	2,960	1,760	1,810	1,800
3	8,300	3,200	16,000	3,800	8,000	4,410	5,010	1,770	3,110	1,670	1,720	1,350
4	7,520	2,700	13,800	4,000	7,850	3,870	4,360	1,840	2,800	1,250	1,640	1,850
5	6,930	3,100	11,800	4,000	7,760	3,650	3,430	1,790	2,240	2,720	1,670	1,850
6	5,850	3,600	9,600	3,100	7,090	4,030	3,180	1,820	2,260	3,010	1,750	2,900
7	5,690	2,800	7,700	3,300	6,280	4,960	3,340	1,660	1,590	2,410	1,680	7,180
8	5,670	2,800	6,400	4,100	5,870	4,570	3,150	1,550	1,400	1,970	1,650	5,080
9	5,380	3,000	6,100	4,600	5,060	4,000	2,930	1,710	1,960	1,490	1,700	4,100
10	4,900	2,300	5,400	7,000	4,260	3,680	2,760	1,770	1,840	1,590	1,650	3,440
11	4,680	2,200	5,200	9,900	3,920	3,510	2,510	1,810	2,040	1,650	1,900	2,850
12	4,120	2,900	4,800	8,100	3,650	3,310	1,780	2,470	2,280	1,640	1,760	2,530
13	3,770	3,000	4,600	7,300	3,610	3,350	1,740	2,230	2,170	1,990	1,750	2,290
14	3,960	3,200	4,000	9,600	3,440	2,820	2,890	1,880	2,370	1,530	1,810	3,200
15	3,960	3,000	3,700	9,500	3,020	2,670	2,660	2,190	1,680	1,660	1,770	4,400
16	4,270	2,100	4,500	8,100	2,990	2,490	2,710	1,890	2,230	2,040	1,810	3,850
17	4,640	1,700	4,700	7,300	2,820	2,510	2,600	1,930	1,390	1,750	1,800	3,290
18	4,170	2,000	4,600	6,600	2,720	2,890	2,270	1,810	1,620	2,010	1,810	3,560
19	3,350	2,800	4,300	6,400	2,780	4,350	1,920	2,360	1,670	2,010	1,890	3,670
20	3,130	3,300	4,500	5,700	2,740	8,460	1,930	2,120	1,710	2,110	1,830	3,790
21	4,190	3,800	4,900	5,200	2,560	12,100	2,200	3,530	1,640	2,000	1,920	12,800
22	4,690	4,200	4,900	4,900	2,320	11,700	2,570	3,310	1,640	1,970	2,060	12,100
23	4,370	3,600	4,900	4,600	2,210	14,300	2,570	2,980	1,740	1,980	2,020	8,560
24	3,760	2,800	5,000	4,600	2,020	11,600	2,290	3,250	2,040	1,920	2,270	6,510
25	3,300	2,500	4,400	5,800	2,350	13,900	1,710	3,090	2,500	1,810	2,010	5,610
26	3,830	2,900	4,300	11,700	2,530	14,600	1,670	3,270	2,100	1,750	2,050	4,930
27	4,270	2,500	3,800	26,900	2,310	12,900	1,670	3,850	1,870	1,790	1,670	4,090
28	4,320	2,100	3,200	21,000	2,820	10,800	1,750	4,950	1,590	1,690	1,280	4,120
29	4,340	2,300	3,000	15,500	5,530	8,330	1,770	4,240	1,860	1,850	1,190	4,190
30	4,080	2,500		12,400	5,380	7,020	1,770	3,820	3,760	1,790	1,370	4,240
31	3,750	2,300		10,800		6,070		2,640	3,950		1,630	
Total	156,540	87,400	167,300	242,200	131,890	202,770	82,810	77,080	66,290	57,180	54,820	131,870
Mean	5,050	2,819	5,769	7,813	4,396	6,541	2,760	2,486	2,138	1,906	1,768	4,396

Year total 1,458,150 $(ft^3/s) \cdot d$ Mean 3,984 ft^3/s

Table 8.- Daily mean discharge, in cubic feet per second, of Delaware River at Trenton, N.J. (01463500) for the year ending November 30, 1988. Preliminary U.S. Geological Survey record.

Day	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
1	30,600	7,100	6,900	8,680	17,800	10,000	13,400	3,330	7,300	8,350	3,400	3,350
2	29,300	7,210	9,590	8,400	16,200	9,710	14,100	3,400	6,270	6,450	3,550	3,660
3	23,100	6,480	17,700	8,640	14,900	8,910	13,400	3,480	6,120	4,800	4,260	3,690
4	19,700	6,650	28,800	11,100	14,100	8,730	11,900	3,510	5,920	4,440	3,670	3,710
5	17,400	7,290	27,000	18,800	13,700	8,050	10,700	3,370	5,750	9,010	3,460	3,540
6	15,400	7,900	20,700	15,800	13,600	8,200	9,140	3,340	5,090	9,700	3,350	5,180
7	13,800	5,730	17,900	13,100	12,800	10,200	8,440	3,260	4,540	9,160	3,180	5,880
8	12,700	5,510	15,000	12,600	12,100	10,700	7,870	3,320	4,310	8,170	3,240	9,340
9	12,300	5,390	13,200	13,000	11,300	10,300	7,350	3,190	3,730	6,560	3,190	9,710
10	11,800	6,040	12,200	14,000	10,200	9,130	7,450	3,180	3,480	5,250	3,140	7,950
11	11,300	5,410	11,400	16,900	9,050	10,300	7,200	3,390	3,830	4,470	3,130	6,770
12	10,600	4,840	12,700	19,200	8,260	9,660	6,710	3,320	3,800	4,200	3,090	6,030
13	10,100	5,840	11,300	17,100	7,970	8,690	6,130	3,500	3,930	4,360	3,300	5,510
14	9,100	5,870	10,300	16,500	7,570	8,320	5,420	4,200	4,080	6,230	3,330	5,940
15	9,000	5,290	9,700	18,800	7,390	8,060	5,470	3,610	3,830	5,950	3,290	6,120
16	11,900	5,160	12,400	18,100	7,070	7,180	5,800	3,400	3,900	4,870	3,360	7,370
17	11,500	4,960	13,000	15,800	6,700	6,840	5,680	4,030	3,370	4,410	3,670	8,790
18	10,800	4,870	12,400	14,300	6,520	7,820	5,560	6,250	3,790	4,900	3,430	8,300
19	10,100	5,170	11,800	13,500	6,460	13,700	5,220	5,630	3,240	4,810	3,330	7,620
20	9,300	7,380	18,900	12,900	6,420	35,600	4,770	5,280	3,110	4,410	3,360	13,300
21	9,160	13,700	18,900	11,700	6,240	34,500	4,460	7,430	3,160	4,550	3,490	26,900
22	9,440	12,500	14,400	10,800	6,000	33,000	4,350	8,000	3,070	4,420	4,630	29,400
23	10,400	10,700	13,100	10,400	5,600	34,300	4,460	8,670	3,030	4,050	5,670	25,000
24	9,880	9,120	13,000	9,750	5,430	34,400	4,610	10,800	3,640	3,890	5,270	19,200
25	9,220	7,960	12,700	9,660	5,210	28,800	4,620	11,100	5,780	3,920	5,240	15,100
26	8,590	7,680	11,400	11,200	5,120	32,400	4,090	9,620	5,540	3,780	5,400	12,900
27	8,500	7,030	10,400	25,400	5,300	29,200	3,910	22,900	5,120	3,620	4,700	11,400
28	9,070	6,820	10,000	37,700	6,900	25,000	3,740	13,900	4,290	3,540	4,440	16,300
29	8,830	6,260	9,240	31,200	7,170	21,000	3,440	11,700	3,820	3,450	3,840	13,500
30	8,990	5,560		24,700	8,960	17,400	3,360	10,600	5,230	3,340	3,310	11,900
31	7,840	6,060		20,400		15,300		8,600	7,410		3,110	
Total	389,720	213,480	406,030	490,130	272,040	515,400	202,750	199,310	139,480	159,060	116,830	313,360
Mean	12,570	6,886	14,000	15,810	9,068	16,630	6,758	6,429	4,499	5,302	3,769	10,450

Year total 3,417,590 (ft^3/s)·d Mean 9,338 ft^3/s

Table 9. - Storage in Pepacton Reservoir, N.Y., for year ending November 30, 1988
(Storage in millions of gallons above elevation 1,152.00 ft. Add 7,711 million gallons for total contents above sill of outlet tunnel, elevation 1,126.50 ft.) Storage at spillway level is 140,190 million gallons.
(River Master daily operations record; gage reading at 0800)

Day	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
1	110,274	107,156	98,568	103,767	116,044	125,402	140,598	130,954	120,718	108,234	95,176	76,635
2	110,599	106,980	99,444	103,641	116,981	126,010	140,412	130,564	120,412	107,766	94,650	76,303
3	110,534	106,692	101,617	103,563	117,771	126,482	140,357	130,174	119,987	107,412	94,231	75,971
4	110,680	106,436	102,775	103,421	118,749	126,901	140,116	129,643	119,631	106,980	93,797	75,653
5	110,762	106,292	103,436	103,279	119,648	127,198	139,987	129,236	119,189	106,660	93,349	75,387
6	110,631	106,020	103,846	103,106	120,514	127,635	139,767	128,779	118,800	106,132	92,695	75,706
7	110,583	105,685	104,161	102,948	120,855	127,741	139,546	128,304	118,395	105,685	92,131	76,170
8	110,631	105,368	104,462	102,869	121,540	127,741	139,344	127,917	118,007	105,230	91,526	76,409
9	110,615	105,066	104,669	102,743	121,967	127,600	139,105	127,373	117,552	104,875	90,967	76,568
10	110,453	104,891	104,812	103,342	122,429	127,565	138,719	126,971	117,215	104,462	90,307	76,676
11	110,469	104,494	104,891	103,815	122,946	127,548	138,608	126,395	116,797	104,004	89,709	76,662
12	110,258	104,177	104,971	104,067	123,360	127,408	138,223	125,993	116,362	103,578	89,126	76,515
13	110,095	103,972	105,114	104,447	123,722	127,390	137,895	125,575	115,910	103,169	88,591	76,422
14	109,982	103,594	104,923	104,748	124,015	127,618	137,603	125,072	115,392	102,680	87,524	76.676
15	109,819	103,200	104,939	105,050	124,344	127,776	137,311	124,482	114,828	102,102	86,694	76,971
16	109,771	102,869	105,018	105,256	124,344	127,987	137,055	123,963	114,496	101,602	85,882	76,877
17	109,511	102,555	105,018	105,415	124,309	128,198	136,690	123,532	114,047	101,164	85,103	77,105
18	109,332	102,352	104,971	105,542	124,326	128,515	136,417	123,170	113,601	100,761	84,328	77,226
19	109,088	102,180	104,939	105,717	124,135	128,866	136,055	122,826	113,058	100,311	83,570	77,306
20	108,959	101,977	104,939	105,733	124,135	129,253	135,584	122,378	112,728	99,800	82,788	77,346
21	108,782	101,789	104,955	105,653	124,066	129,607	135,312	122,190	112,251	99,614	82,134	78,086
22	108,653	101,445	104,796	105,558	124,032	130,121	134,877	122,292	111,809	99,044	81,705	78,668
23	108,395	101,164	104,844	105,463	123,963	130,706	134,678	122,087	111,285	98,629	81,195	79,115
24	108,218	100,869	104,812	105,574	123,963	131,827	134,211	121,830	110,893	98,122	80,726	79,400
25	108,089	100,621	104,685	105,844	123,911	133,671	133,779	121,693	110,485	97,832	80,356	79,619
26	108,008	100,404	104,526	107,044	123,894	135,674	133,294	121,437	109,965	97,405	79,960	79,728
27	107,928	100,032	104,367	110,680	123,842	137,183	132,934	121,522	109,754	96,933	79,592	79,878
28	107,766	99,598	104,224	112,629	124,015	138,369	132,416	121,420	108,992	96,658	79,088	79,919
29	107,686	99,336	104,083	113,948	124,326	139,215	131,934	121,403	108,637	96,068	78,532	79,974
30	107,573	98,937		114,811	124,933	139,969	131,417	121,197	108,830	95,584	77,775	79,960
31	107,156	98,629		115,392		140,524		120,941	108,492		77,091	
Change	- 2,842	-8,527	+5,454	+11,309	+9,541	+15,591	-9,107	-10,476	-12,449	-12,908	-18,493	+2,869
Equiv. Mgal/d	-97.1	-275.1	+188.1	+364.8	+318.0	+502.9	-303.6	-337.9	-401.6	-430.3	-596.5	+95.6
Equiv. ft^3/s	-142	-426	+291	+564	+492	+778	-470	-523	-621	-666	-923	+148

Change for year -30,038 Mgal   Equiv. for year -82.1 Mgal/d   Equiv. for year -127 ft^3/s

Table 10. - Storage in Cannonsville Reservoir, N.Y., for year ending November 30, 1988
(Storage in millions of gallons above elevation 1,040.00 ft. Add 2,584 million gallons for total contents above sill of outlet tunnel, elevation 1,020.50 ft.) Storage at spillway level is 95,706 million gallons.
(River Master daily operations record; gage reading at 0800)

Day	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
1	95,554	95,980	91,766	96,639	98,329	95,691	96,736	84,357	63,625	46,535	36,915	25,673
2	96,237	95,980	93,059	96,221	97,943	95,851	96,768	83,374	63,027	46,546	36,231	25,868
3	96,752	95,980	96,478	95,851	97,685	95,980	96,816	82,305	62,581	46,324	35,796	25,817
4	97,025	95,851	97,943	95,615	97,540	96,076	96,897	81,365	62,186	46,335	35,271	25,885
5	97,154	95,770	98,217	95,356	97,412	95,980	96,897	80,653	61,715	46,479	34,597	26,124
6	97,154	95,463	98,072	95,098	97,283	95,980	96,784	79,921	61,052	46,546	33,913	26,745
7	97,154	95,098	97,685	94,748	97,138	95,947	96,510	79,217	60,720	46,591	33,348	28,591
8	97,154	94,854	97,412	94,611	96,897	95,851	96,189	78,539	60,549	46,591	32,759	29,672
9	97,041	94,550	97,428	94,352	96,655	95,722	95,883	77,531	59,902	46,313	32,203	30,562
10	97,025	94,231	97,412	94,991	96,623	95,463	95,706	76,744	59,499	45,990	31,610	31,267
11	96,897	93,942	97,412	95,722	96,317	95,463	95,219	75,970	59,047	45,734	30,970	31,860
12	96,768	93,622	97,412	95,996	96,157	95,219	95,006	75,279	58,473	45,668	30,312	32,342
13	96,639	93,288	97,412	96,237	96,012	94,991	94,809	74,381	57,667	45,479	29,672	32,778
14	96,527	93,120	97,283	96,768	95,851	94,824	94,733	73,702	56,971	45,290	29,181	33,437
15	96,494	92,999	97,154	96,977	95,722	94,611	94,626	72,894	56,519	45,156	28,653	34,171
16	96,494	92,862	97,154	97,154	95,584	94,322	94,474	71,781	56,055	44,711	28,149	34,686
17	96,494	92,710	97,154	97,251	95,387	93,987	94,231	71,040	55,433	43,989	27,621	35,211
18	96,366	92,497	97,122	97,283	95,234	93,850	93,835	70,616	54,789	43,361	27,043	35,954
19	96,301	92,497	97,025	97,283	95,098	93,729	93,485	70,059	53,996	42,888	26,549	36,608
20	96,301	92,497	97,025	97,412	94,976	93,744	93,227	69,636	53,074	42,426	25,928	37,242
21	96,237	92,618	97,154	97,283	94,854	93,850	92,755	69,093	52,094	42,027	25,392	39,001
22	96,366	92,618	97,090	97,154	94,733	94,474	92,253	68,656	51,009	41,512	25,366	41,018
23	96,301	92,618	97,025	97,154	94,413	95,098	91,522	68,192	49,971	41,039	25,051	42,342
24	96,237	92,497	97,025	97,025	94,352	95,676	90,777	67,688	48,993	40,378	25,009	43,403
25	96,124	92,451	97,025	97,363	94,231	96,720	90,016	67,166	48,192	39,842	25,085	44,322
26	96,253	92,481	96,543	98,200	94,109	97,975	89,165	66,720	47,347	39,526	25,400	45,134
27	96,350	92,344	96,494	100,293	93,972	98,555	88,298	66,325	46,602	39,148	25,477	45,812
28	96,366	92,177	96,575	100,518	94,215	98,200	87,435	65,892	45,846	38,770	25,570	46,424
29	96,366	92,010	96,623	99,939	94,733	97,814	86,409	65,510	45,312	38,276	25,630	47,147
30	96,237	91,888		99,376	95,295	97,428	85,427	64,797	45,946	37,698	25,630	47,758
31	96,108	91,751		98,973		97,025		64,236	46,368		25,621	
Change	+1,512	-4,357	+4,872	+2,350	-3,678	+1,730	-11,598	-21,191	-17,868	-8,670	-12,077	+22,137
Equiv. Mgal/d	+48.8	-140.5	+168.0	+75.8	-122.6	+55.8	-386.6	-683.6	-576.4	-289	-389.6	+737.9
Equiv. ft^3/s	+75.5	-217	+260	+117	-190	+86.3	-598	-1,057	-892	-447	-603	+1,142

Change for year -46,838 Mgal Equiv. for year -128 Mgal/d Equiv. for year -198 ft^3/s

Table 11. - Storage in Neversink Reservoir, N.Y. for year ending November 30, 1988
(Storage in millions of gallons above elevation 1,319.00. Add 525 million gallons for total contents above sill of outlet tunnel, elevation 1,314.00 ft.) Storage at spillway level is 34,941 million gallons.
(River Master daily operation record; gage reading at 0800)

Day	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
1	27,193	25,541	22,190	23,246	27,645	30,574	34,581	31,443	30,832	28,460	20,559	10,678
2	27,292	25,462	22,244	23,306	27,974	30,675	34,483	31,318	30,841	28,363	20,261	10,421
3	27,305	25,370	22,630	23,353	28,272	30,772	34,384	31,155	30,809	28,298	19,858	10,208
4	27,322	25,269	22,847	23,429	28,561	30,878	34,233	30,993	30,703	28,206	19,551	9,941
5	27,322	25,167	22,921	23,505	28,933	30,961	34,125	30,864	30,588	28,302	19,217	9,697
6	27,309	25,060	22,945	23,533	29,222	31,062	34,018	30,680	30,455	28,062	18,896	10,148
7	27,266	24,945	22,909	23,597	29,450	31,215	33,974	30,519	30,401	27,805	18,583	10,395
8	27,193	24,809	22,886	23,533	29,612	31,308	33,915	30,369	30,305	27,520	18,275	10,336
9	27,150	24,719	22,937	23,489	29,774	31,411	33,877	30,200	30,209	27,240	17,983	10,248
10	27,129	24,621	22,949	23,513	29,914	31,490	33,823	30,032	30,095	26,945	17,643	10,124
11	27,077	24,494	22,917	23,545	30,046	31,536	33,756	29,851	29,996	26,642	17,350	9,972
12	27,043	24,397	22,949	23,525	30,050	31,644	33,717	29,684	29,901	26,359	17,036	9,816
13	26,966	24,279	22,913	23,513	30,050	31,714	33,635	29,464	29,760	26,064	16,712	9,613
14	26,906	24,136	22,898	23,549	30,046	31,794	33,557	29,293	29,657	25,770	16,351	9,515
15	26,847	23,995	22,850	23,565	30,055	31,864	33,494	29,119	29,535	25,453	16,060	9,375
16	26,804	23,870	22,843	23,565	30,055	31,902	33,437	28,941	29,405	25,134	15,703	9,248
17	26,761	23,789	22,815	23,561	30,050	31,986	33,350	28,804	29,284	24,830	15,348	9,073
18	26,676	23,665	22,799	23,537	30.046	32,066	33,288	28,769	29,168	24,531	15,037	9,053
19	26,570	23,577	22,764	23,525	30,041	32,212	33,182	28,791	29,035	24,213	14,674	8,958
20	26,515	23,529	22,752	23,513	30,023	32,453	33,110	28,795	28,901	23,914	14,312	8,799
21	26,430	23,433	22,760	23,461	29,973	32,767	32,971	28,973	28,808	23,625	13,963	9,259
22	26,354	23,318	22,709	23,381	29,950	32,981	32,838	29,342	28,707	23,341	13,626	9,413
23	26,278	23,214	22,788	23,365	29,910	33,465	32,676	29,500	28,583	23,032	13,355	9,423
24	26,186	23,099	22,866	23,314	29,887	33,727	32,519	29,612	28,522	22,756	13,075	9,375
25	26,118	22,980	22,949	23,377	29,837	33,901	32,359	29,751	28,482	22,439	12,839	9,269
26	26,089	22,835	22,988	23,886	29,891	34,267	32,203	29,887	28,411	22,054	12,548	9,155
27	26,022	22,725	23,052	25,453	29,941	34,453	32,047	30,113	28,298	21,768	12,227	9,003
28	25,938	22,599	23,127	26,202	30,068	34,581	31,906	30,360	28,210	21,454	11,899	8,893
29	25,845	22,501	23,183	26,633	30,305	34,665	31,756	30,606	28,184	21,169	11,618	9,000
30	25,758	22,384		26,983	30,451	34,685	31,597	30,703	28,433	20,897	11,284	9,040
31	25,637	22,275		27,339		34,660		30,776	28,486		10,965	
Change	-1,171	-3,362	+908	+4,156	+3,112	+4,209	-3,063	-821	-2,290	-7,589	-9,932	-1,925
Equiv. mgal/d	-37.8	-108.5	+31.3	+134.1	+103.7	+135.8	-102.1	-26.5	-73.9	-253	-320	-64.2
Equiv. ft^3/s	-58.4	-168	+48.4	+207	+160	+210	-158	-41.0	-114	-391	-496	-99.3

Change for year -17,768 Mgal   Equiv. for year -48.5 Mgal/d   Equiv. for year 75.1 ft^3/s

Table 12. - Diversions by New Jersey through the Delaware & Raritan Canal in million gallons
Record furnished by New Jersey Water Supply Authority

Day	December 1987			January 1988			February			March		
	Waste gate	Kingston Lock	Daily Total	Waste gate	Kingston Lock	Daily Total	Waste gate	Kingston Lock	Daily Total	Waste gate	Kingston Lock	Daily Total
1	24	77	101		61	61		74	74		76	76
2	24	74	98		57	57		76	76		76	76
3	21	80	101		62	62		77	77		76	76
4	0	78	78		67	67		77	77		76	76
5	0	76	76		67	67		79	79		79	79
6	0	77	77		70	70		77	77		77	77
7	0	76	76		72	72		73	73		76	76
8	0	76	76		74	74		72	72		76	76
9	0	76	76		75	75		75	75		76	76
10	0	77	77		75	75		75	75		75	75
11	0	78	78		75	75		76	76		76	76
12	0	80	80		76	76		81	81		75	75
13	0	80	80		76	76		83	83		76	76
14	0	83	83		77	77		79	79		76	76
15	0	103	103		76	76		77	77		75	75
16	0	109	109		76	76		81	81		75	75
17	0	107	107		75	75		76	76		76	76
18	0	98	98		76	76		75	75		76	76
19	0	90	90		76	76		76	76		76	76
20	0	85	85		75	75		81	81		76	76
21	0	86	86		79	79		77	77		76	76
22	0	87	87		75	75		78	78		75	75
23	0	87	87		76	76		78	78		72	72
24	0	87	87		77	77		77	77		71	71
25	0	87	87		76	76		77	77		71	71
26	0	88	88		76	76		77	77		71	71
27	0	88	88		76	76		76	76		77	77
28	0	87	87		75	75		77	77		77	77
29	0	89	89		75	75		76	76		76	76
30	25	87	112		76	76					76	76
31	0	55	55		76	76					76	76
Total			2,702			2,275			2,233			2,338
Mean			87.2			73.4			77.0			75.4
Maximum			112			79			83			79

Table 12. - Diversions by New Jersey through the Delaware & Raritan Canal in million gallons
Record furnished by New Jersey Water Supply Authority

Day	April			May			June			July		
	Waste gate	Kingston Lock	Daily Total	Waste gate	Kingston Lock	Daily Total	Waste gate	Kingston Lock	Daily Total	Waste gate	Kingston Lock	Daily Total
1		76	76	0	68	68		76	76		93	93
2		76	76	0	78	78		78	78		93	93
3		75	75	0	75	75		77	77		93	93
4		75	75	0	71	71		77	77		90	90
5		76	76	0	72	72		75	75		86	86
6		76	76	0	75	75		76	76		91	91
7		75	75	0	80	80		76	76		93	93
8		77	77	0	80	80		79	79		92	92
9		76	76	0	78	78		69	69		91	91
10		76	76	0	77	77		76	76		91	91
11		75	75	0	78	78		77	77		93	93
12		76	76	0	77	77		75	75		95	95
13		77	77	0	77	77		75	75		97	97
14		77	77	0	76	76		75	75		97	97
15		77	77	0	76	76		88	88		97	97
16		76	76	0	76	76		92	92		96	96
17		76	76	0	76	76		91	91		97	97
18		76	76	0	77	77		92	92		95	95
19		77	77	3	76	79		92	92		95	95
20		77	77	12	81	93		92	92		98	98
21		75	75	0	77	77		93	93		98	98
22		73	73	0	78	78		93	93		100	100
23		75	75	0	78	78		92	92		103	103
24		77	77	0	79	79		90	90		99	99
25		77	77	0	78	78		93	93		97	97
26		74	74	0	77	77		92	92		97	97
27		74	74	0	75	75		93	93		100	100
28		78	78	0	76	76		93	93		97	97
29		77	77	0	76	76		93	93		97	97
30		68	68	0	76	76		93	93		84	84
31				0	76	76					93	93
Total			2,270			2,385			2,533			2,938
Mean			75.7			76.9			84.4			94.8
Maximum			78			93			93			103

Table 12. - Diversions by New Jersey through the Delaware & Raritan Canal in million gallons
Record furnished by New Jersey Water Supply Authority

Day	August			September			October			November		
	Waste gate	Kingston Lock	Daily Total	Waste gate	Kingston Lock	Daily Total	Waste gate	Kingston Lock	Daily Total	Waste gate	Kingston Lock	Daily Total
1		95	95		96	96		87	87	0	89	89
2		95	95		98	98		87	87	0	91	91
3		94	94		96	96		89	89	0	90	90
4		94	94		96	96		89	89	0	90	90
5		95	95		97	97		89	89	0	81	81
6		94	94		96	96		87	87	0	83	83
7		100	100		96	96		87	87	0	81	81
8		93	93		90	90		87	87	0	95	95
9		93	93		91	91		87	87	0	94	94
10		93	93		89	89		87	87	0	94	94
11		93	93		90	90		87	87	0	94	94
12		93	93		89	89		87	87	0	89	89
13		93	93		96	96		85	85	0	93	93
14		89	89		96	96		87	87	0	98	98
15		94	94		93	93		86	86	0	95	95
16		95	95		89	89		87	87	0	95	95
17		94	94		87	87		87	87	50	43	93
18		95	95		89	89		87	87	95	0	95
19		94	94		89	89		87	87	59	36	95
20		95	95		89	89		87	87	0	93	93
21		95	95		89	89		87	87	0	106	106
22		94	94		91	91		90	90	0	106	106
23		98	98		91	91		89	89	0	97	97
24		98	98		91	91		87	87	0	88	88
25		98	98		89	89		87	87	0	97	97
26		95	95		91	91		87	87	0	95	95
27		95	95		89	89		87	87	0	94	94
28		96	96		89	89		87	87	0	104	104
29		94	94		88	88		86	86	0	101	101
30		96	96		88	88		87	87	0	85	85
31		96	96					87	87			
Total			2,936			2,748			2,704			2,801
Mean			94.7			91.6			87.2			93.4
Maximum			100			98			90			106

Table 13. - Diversions to New York City water supply
Million gallons per day for 24-hour period beginning 0800 local time
(River Master daily operation record)

Date 1987	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average to date June 1, 1987 to date	Date 1988	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average to date June 1, 1987 to date
Dec. 1	450	0	147	723	Jan. 1	450	354	152	737
2	450	0	147	723	2	450	353	154	738
3	451	0	146	722	3	450	354	150	739
4	451	0	150	721	4	450	353	149	740
5	451	0	148	721	5	452	475	162	741
6	451	0	141	720	6	451	496	149	743
7	451	0	160	719	7	451	497	155	744
8	451	0	150	719	8	451	497	153	746
9	449	195	150	719	9	450	497	154	748
10	449	235	153	720	10	450	497	166	749
11	450	234	148	720	11	450	497	152	751
12	449	234	174	721	12	451	497	156	752
13	449	233	143	721	13	451	349	171	753
14	460	233	152	722	14	450	295	157	754
15	450	233	148	723	15	451	295	155	755
16	451	233	147	723	16	451	295	147	755
17	451	233	160	724	17	451	295	162	756
18	451	233	156	724	18	451	295	160	756
19	451	233	158	725	19	450	295	155	757
20	450	233	164	726	20	449	295	156	758
21	450	234	154	726	21	450	295	169	758
22	450	231	149	727	22	450	295	139	759
23	449	231	152	727	23	450	295	160	760
24	449	349	147	728	24	449	295	165	760
25	449	353	147	729	25	449	295	218	761
26	449	353	144	730	26	450	295	152	762
27	450	353	153	731	27	450	295	149	762
28	450	353	159	732	28	450	295	138	763
29	450	353	148	733	29	451	295	145	763
30	451	354	148	735	30	451	295	132	764
31	448	354	151	736	31	451	295	135	764
Total	13,961	6,280	4,694			13,961	11,026	4,817	

Table 13. - Diversions to New York City water supply - continued
Million gallons per day for 24-hour period beginning 0800 local time
(River Master daily operation record)

Date 1988	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average to date June 1, 1987 to date	Date 1988	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average to date June 1, 1987 to date
Feb. 1	449	295	100	764	Mar. 1	229	478	0	739
2	450	296	146	765	2	338	497	0	739
3	450	297	58	765	3	339	497	0	739
4	449	297	99	765	4	339	497	0	740
5	449	297	96	766	5	336	497	0	740
6	284	297	104	765	6	339	498	0	740
7	256	297	100	765	7	339	498	111	741
8	337	67	105	764	8	340	497	104	742
9	363	0	100	763	9	337	366	103	742
10	343	0	102	762	10	335	498	98	743
11	337	0	99	760	11	302	498	105	743
12	333	0	112	759	12	301	496	100	744
13	322	0	100	758	13	411	498	109	745
14	319	0	111	756	14	335	466	99	745
15	338	0	104	755	15	339	265	104	745
16	342	0	106	754	16	335	180	98	745
17	338	0	99	753	17	337	180	107	744
18	335	0	102	752	18	337	51	99	743
19	331	0	101	750	19	335	0	92	742
20	312	0	102	749	20	335	0	118	741
21	324	0	109	748	21	339	0	124	740
22	402	0	0	747	22	337	0	89	739
23	334	0	0	745	23	336	0	104	738
24	340	0	0	744	24	335	0	102	737
25	339	434	0	744	25	337	0	116	736
26	303	145	0	743	26	337	0	99	735
27	335	0	0	741	27	338	0	89	734
28	371	0	0	740	28	336	0	0	733
29	453	0	0	739	29	337	0	0	732
					30	310	0	0	730
					31	330	367	0	730
Total	10,338	2,722	2,155			10,310	7,824	2,170	

Table 13. - Diversions to New York City water supply - continued
Million gallons per day for 24-hour period beginning 0800 local time
(River Master daily operation record)

Date 1988	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average to date June 1, 1987 to date	Date 1988	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average to date June 1, 1987 to date
Apr. 1	0	498	0	729	May 1	0	498	0	726
2	0	475	0	729	2	0	498	0	726
3	0	498	0	728	3	0	498	0	725
4	0	498	0	727	4	0	498	0	724
5	0	498	0	726	5	11	498	0	724
6	3	498	0	726	6	332	498	0	724
7	0	498	0	725	7	325	498	0	724
8	0	498	0	724	8	331	498	0	725
9	0	498	0	724	9	336	498	0	725
10	0	498	0	723	10	336	325	0	725
11	0	498	99	722	11	329	496	0	725
12	0	497	105	722	12	297	496	0	725
13	0	395	99	721	13	0	496	0	724
14	0	498	98	721	14	0	496	0	724
15	374	497	108	722	15	0	496	0	723
16	321	497	100	722	16	0	496	0	723
17	329	497	107	723	17	0	496	0	722
18	337	497	104	724	18	0	496	0	721
19	337	497	105	724	19	38	495	0	721
20	339	365	103	725	20	313	496	0	721
21	337	498	100	725	21	343	496	0	721
22	337	498	105	726	22	327	495	0	722
23	328	498	100	726	23	37	496	95	721
24	338	498	102	727	24	0	496	91	721
25	338	496	0	727	25	0	11	98	719
26	338	498	0	728	26	0	22	100	718
27	337	497	0	728	27	0	479	100	717
28	300	497	0	728	28	0	496	101	717
29	0	496	0	728	29	0	496	113	717
30	0	498	0	727	30	0	496	196	716
					31	354	497	195	717
Total	4,693	14,669	1,435			3,709	14,246	1,089	

Table 13. - Diversions to New York City water supply - continued
Million gallons per day for 24-hour period beginning 0800 local time
(River Master daily operation record)

Date 1988	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average to date June 1, 1988 to date	Date 1988	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average to date June 1, 1988 to date
June 1	396	25	212	633	July 1	447	346	139	722
2	421	0	180	617	2	446	346	147	728
3	397	0	230	620	3	445	345	151	735
4	395	0	193	612	4	446	345	145	741
5	395	0	163	601	5	446	345	148	746
6	397	245	97	624	6	448	345	157	752
7	397	351	101	656	7	449	343	144	757
8	398	350	101	680	8	449	253	147	760
9	398	350	97	699	9	447	227	146	761
10	397	350	104	714	10	450	226	148	763
11	397	350	97	726	11	449	312	151	766
12	396	351	99	736	12	446	342	149	770
13	397	9	106	719	13	448	342	148	774
14	397	0	98	703	14	446	343	152	778
15	396	0	102	689	15	446	341	140	781
16	392	0	99	677	16	446	341	140	784
17	396	0	95	666	17	445	340	148	788
18	395	0	106	657	18	445	340	0	788
19	395	0	97	648	19	443	339	0	787
20	396	175	154	652	20	442	339	0	787
21	395	230	158	658	21	444	339	0	787
22	395	229	145	663	22	443	339	0	787
23	432	229	149	669	23	443	339	0	787
24	447	228	150	676	24	443	339	0	787
25	446	229	138	681	25	443	338	0	787
26	447	229	147	687	26	442	338	0	787
27	449	275	144	694	27	442	337	0	787
28	449	293	146	700	28	442	337	0	786
29	449	292	143	707	29	441	336	0	786
30	450	338	153	715	30	443	336	0	786
					31	441	336	0	786
Total	12,307	5,128	4,004			13,796	10,214	2,500	

Table 13. - Diversions to New York City water supply - continued
Million gallons per day for 24-hour period beginning 0800 local time
(River Master daily operation record)

Date 1988	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average to date June 1, 1988 to date	Date 1988	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average to date June 1, 1988 to date
Aug. 1	441	336	0	786	Sept.1	444	25	104	756
2	441	213	102	785	2	442	0	106	754
3	436	130	101	784	3	441	0	98	752
4	439	172	99	782	4	439	0	108	750
5	439	171	107	781	5	439	0	318	750
6	441	172	104	780	6	441	0	334	750
7	441	172	101	780	7	440	0	329	750
8	440	171	102	779	8	440	0	325	750
9	441	172	104	778	9	439	0	306	750
10	438	170	86	776	10	439	0	321	750
11	441	171	103	776	11	440	0	327	751
12	440	171	110	775	12	438	0	319	751
13	439	171	104	774	13	440	0	319	751
14	441	171	96	773	14	390	0	323	750
15	439	171	105	772	15	439	0	316	750
16	437	170	98	772	16	436	0	320	750
17	437	163	97	771	17	435	0	316	750
18	436	170	115	770	18	433	0	324	751
19	435	170	104	769	19	436	0	320	751
20	435	170	100	768	20	436	0	321	751
21	435	170	102	768	21	435	0	300	750
22	445	170	101	767	22	437	0	309	750
23	446	169	103	766	23	436	0	299	750
24	444	168	102	766	24	435	0	334	750
25	444	169	105	765	25	435	0	380	751
26	444	169	108	765	26	436	0	302	751
27	443	169	91	764	27	436	0	304	751
28	442	168	103	763	28	437	0	317	751
29	442	8	132	761	29	439	0	253	750
30	440	95	99	760	30	438	0	349	751
31	443	55	98	758					
Total	13,645	5,087	3,082			13,091	25	8,701	

Table 13. - Diversions to New York City water supply - continued
Million gallons per day for 24-hour period beginning 0800 local time
(River Master daily operation record)

Date 1988	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average to date June 1, 1988 to date	Date 1988	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average to date June 1, 1988 to date
Oct. 1	438	0	293	750	Nov. 1	442	0	325	755
2	436	0	418	751	2	439	0	318	755
3	436	0	311	751	3	437	0	330	755
4	435	0	328	751	4	380	0	315	755
5	437	0	318	751	5	379	0	284	754
6	438	0	301	751	6	381	0	292	754
7	440	0	295	751	7	387	0	324	753
8	440	0	314	751	8	388	0	270	753
9	439	0	312	751	9	387	0	293	752
10	439	0	311	751	10	385	0	305	752
11	438	0	321	751	11	386	0	270	751
12	441	0	314	751	12	386	0	307	751
13	441	0	350	752	13	386	0	365	751
14	440	0	292	751	14	384	0	306	751
15	439	0	367	752	15	386	0	290	750
16	439	0	338	752	16	386	0	310	750
17	437	0	317	752	17	385	0	295	750
18	438	0	355	752	18	385	0	296	749
19	439	0	374	753	19	385	0	327	749
20	439	0	345	753	20	386	0	362	749
21	439	0	355	753	21	386	0	342	749
22	440	0	349	754	22	388	0	279	748
23	439	0	346	754	23	388	0	303	748
24	435	0	327	754	24	388	0	303	748
25	440	0	352	754	25	444	0	298	748
26	440	0	348	754	26	443	0	302	748
27	440	0	346	754	27	443	0	266	747
28	439	0	336	755	28	440	0	94	746
29	455	0	374	755	29	441	0	95	745
30	436	0	321	755	30	441	0	97	744
31	442	0	303	755					
Total	13,614	0	10,331			12,062	0	8,563	

Table 14.- New York City Reservoir release design data

(River Master daily operation record)

Date of advance estimate	Advance estimate of discharge of Delaware River at Montague exclusive of New York City reservoir releases: Powerplant release forecasts: Lake Wallenpaupack ft^3/s	Powerplant release forecasts: Rio Reservoir ft^3/s	Uncontrolled runoff: Present conditions ft^3/s	Uncontrolled runoff: Weather adjustment ft^3/s	Date	Discharge ft^3/s	Indicated deficiency ft^3/s	Balancing adjustment ft^3/s	Directed release: Daily ft^3/s	Directed release: Cumulative (ft^3/s)·d	Actual deficiency: Daily ft^3/s	Actual deficiency: Cumulative (ft^3/s)·d	Cumulative difference (ft^3/s)·d	Balancing adjustment ft^3/s
1987/88	1	2	3	4		5	6	7	8	9	10	11	12	13
	MONTAGUE DESIGN RATE = 1,850 ft^3/s DECEMBER 1, 1987 TO MARCH 14, 1988, 1,750 ft^3/s MARCH 15 TO JUNE 14, AND 1,860 ft^3/s JUNE 15 TO OCTOBER 28													
	The estimated Montague discharge was greater than the Montague design rate December 1, 1987 to June 11, 1988													
June 9	0	0	1,328	0	June 12	1,328	422		422					
10	0	227	1,337	0	13	1,564	186		186					
11	470	638	1,217	0	14	2,325	0		0					
12	470	638	1,128	0	15	2,236	0		0	0	0	0	0	0
13	470	255	1,031	0	16	1,756	104		104	104	0	0	104	-10
14	706	355	948	0	17	2,009	0		0	104	0	0	104	-10
15	470	0	902	0	18	1,372	488		488	592	270	270	322	-32
16	0	0	790	44	19	834	1,026	0	1,026	1,618	960	1,230	388	-39
17	0	114	803	38	20	955	905	-10	895	2,513	840	2,070	443	-44
18	0	284	795	0	21	1,079	781	-10	771	3,284	450	2,520	764	-76
19	0	397	744	0	22	1,128	732	-32	700	3,984	0	2,520	1,464	-110
20	0	397	696	38	23	1,131	729	-39	690	4,674	0	2,520	2,154	-110
21	0	100	656	58	24	814	1,046	-44	1,002	5,676	586	3,106	2,570	-110
22	0	0	603	80	25	683	1,177	-76	1,101	6,777	1,263	4,369	2,408	-110
23	0	0	661	22	26	683	1,177	-110	1,067	7,844	1,267	5,636	2,208	-110
24	0	0	608	7	27	615	1,245	-110	1,135	8,979	1,350	6,986	1,993	-110
25	0	0	571	22	28	593	1,267	-110	1,157	10,136	1,280	8,266	1,870	-110
26	0	0	531	0	29	531	1,329	-110	1,219	11,355	1,316	9,582	1,773	-110
27	0	0	452	0	30	452	1,408	-110	1,298	12,653	1,407	10,989	1,664	-110

Col. 1 - Furnished by power company.
Col. 2 - Furnished by power company.
Col. 3 - Computed from index stations.
Col. 4 - Computed increase in runoff based on weather forecasts.
Col. 5 = Col. 1 + Col. 2 + Col. 3 + Col. 4.
Col. 6 = Design rate - Col. 5, when positive; otherwise Col. 6 = 0.
Col. 7 = Col. 13 (4 days earlier).
Col. 8 = Design rate - Col. 5 + Col. 7, when positive; otherwise Col. 8 = 0.
Col. 9 = Summation of Col. 8.
Col. 10 = Design rate - (Col. 9 + Col. 10 from Table 15), when positive; otherwise Col. 10 = 0.
Col. 11 = Summation of Col. 10.
Col. 12 = Col. 9 - Col. 11.
Col. 13 = Col. 12 divided by minus 10, limited to ±110.

Note.--Cols. 9-13 are used only for the computation of the balancing adjustment June 15 to Oct. 25.

Table 14.- New York City Reservoir release design data

(River Master daily operation record)

Date of advance estimate	Advance estimate of discharge of Delaware River at Montague exclusive of New York City reservoir releases: Powerplant release forecasts: Lake Wallenpaupack ft^3/s	Rio Reservoir ft^3/s	Uncontrolled runoff: Present conditions ft^3/s	Weather adjustment ft^3/s	Date	Discharge ft^3/s	Indicated deficiency ft^3/s	Balancing adjustment ft^3/s	Directed release: Daily ft^3/s	Cumulative (ft^3/s)·d	Actual deficiency: Daily ft^3/s	Cumulative (ft^3/s)·d	Cumulative difference (ft^3/s)·d	Balancing adjustment ft^3/s
1988	1	2	3	4		5	6	7	8	9	10	11	12	13
June 28	0	0	450	0	July 1	450	1,410	-110	1,300	13,953	1,445	12,434	1,519	-110
29	0	0	416	0	2	416	1,444	-110	1,334	15,287	1,385	13,819	1,468	-110
30	0	0	398	0	3	398	1,462	-110	1,352	16,639	1,451	15,270	1,369	-110
July 1	0	0	381	0	4	381	1,479	-110	1,369	18,008	1,399	16,669	1,339	-110
2	0	0	430	0	5	430	1,430	-110	1,320	19,328	1,403	18,072	1,256	-110
3	472	191	402	0	6	1,065	795	-110	685	20,013	741	18,813	1,200	-110
4	0	447	362	0	7	809	1,051	-110	941	20,954	1,151	19,964	990	-99
5	0	447	355	0	8	802	1,058	-110	948	21,902	1,266	21,230	672	-67
6	472	240	343	0	9	1,055	805	-110	695	22,597	850	22,080	517	-52
7	0	0	253	0	10	253	1,607	-110	1,497	24,094	1,600	23,680	414	-41
8	0	240	297	0	11	537	1,323	-99	1,224	25,318	1,269	24,949	369	-37
9	472	0	301	0	12	773	1,087	-67	1,020	26,338	421	25,370	968	-97
10	472	0	300	45	13	817	1,043	-52	991	27,329	760	26,130	1,199	-110
11	472	0	224	59	14	755	1,105	-41	1,064	28,393	994	27,124	1,269	-110
12	472	240	236	5	15	953	907	-37	870	29,263	562	27,686	1,577	-110
13	472	180	247	0	16	899	961	-97	864	30,127	829	28,515	1,612	-110
14	0	0	243	23	17	266	1,594	-110	1,484	31,611	1,442	29,957	1,654	-110
15	0	250	302	44	18	596	1,264	-110	1,154	32,765	1,199	31,156	1,609	-110
16	355	440	282	123	19	1,200	660	-110	550	33,315	185	31,341	1,974	-110
17	355	440	409	229	20	1,433	427	-110	317	33,632	430	31,771	1,861	-110
18	355	180	582	342	21	1,459	401	-110	291	33,923	0	31,771	2,152	-110
19	355	180	529	334	22	1,398	462	-110	352	34,275	0	31,771	2,504	-110
20	0	0	554	730	23	1,284	576	-110	466	34,741	0	31,771	2,970	-110

The estimated Montague discharge was greater than the Montague design rate July 24 to August 3

Col. 1 - Furnished by power company.
Col. 2 - Furnished by power company.
Col. 3 - Computed from index stations.
Col. 4 - Computed increase in runoff based on weather forecasts.
Col. 5 = Col. 1 + Col. 2 + Col. 3 + Col. 4.
Col. 6 = Design rate - Col. 5, when positive; otherwise Col. 6 = 0.
Col. 7 = Col. 13 (4 days earlier).
Col. 8 = Design rate - Col. 5 + Col. 7, when positive; otherwise Col. 8 = 0.
Col. 9 = Summation of Col. 8.
Col. 10 = Design rate - (Col. 9 + Col. 10 from Table 15), when positive; otherwise Col. 10 = 0.
Col. 11 = Summation of Col. 10.
Col. 12 = Col. 9 - Col. 11.
Col. 13 = Col. 12 divided by minus 10, limited to ±110.

Table 14.- New York City Reservoir release design data

(River Master daily operation record)

Date of advance estimate	Advance estimate of discharge of Delaware River at Montague exclusive of New York City reservoir releases: Powerplant release forecasts: Lake Wallenpaupack ft³/s	Powerplant release forecasts: Rio Reservoir ft³/s	Uncontrolled runoff: Present conditions ft³/s	Uncontrolled runoff: Weather adjustment ft³/s	Date	Discharge ft³/s	Indicated deficiency ft³/s	Balancing adjustment ft³/s	Directed release: Daily ft³/s	Directed release: Cumulative (ft³/s)·d	Actual deficiency: Daily ft³/s	Actual deficiency: Cumulative (ft³/s)·d	Cumulative difference (ft³/s)·d	Balancing adjustment ft³/s
1988	1	2	3	4		5	6	7	8	9	10	11	12	13
Aug. 1	355	213	1,051	0	Aug. 4	1,619	241	-110	131	34,872	0	31,866	3,006	-110
2	355	213	881	0	5	1,449	411	-110	301	35,173	145	32,011	3,162	-110
3	355	0	752	0	6	1,107	753	-110	643	35,816	168	32,179	3,637	-110
4	0	0	695	0	7	695	1,165	-110	1,055	36,871	1,211	33,390	3,481	-110
5	0	355	636	112	8	1,103	757	-110	647	37,518	1,049	34,439	3,079	-110
6	355	355	580	81	9	1,371	489	-110	379	37,897	467	34,906	2,991	-110
7	355	355	732	13	10	1,455	405	-110	295	38,192	609	35,515	2,677	-110
8	355	425	693	0	11	1,473	387	-110	277	38,469	357	35,872	2,597	-110
9	355	425	551	0	12	1,331	529	-110	419	38,888	163	36,035	2,853	-110
10	355	0	511	0	13	866	994	-110	884	39,772	583	36,618	3,154	-110
11	0	0	490	0	14	490	1,370	-110	1,260	41,032	812	37,430	3,602	-110
12	0	28	489	0	15	517	1,343	-110	1,233	42,265	1,422	38,852	3,413	-110
13	356	213	471	0	16	1,040	820	-110	710	42,975	372	39,224	3,751	-110
14	356	213	473	27	17	1,069	791	-110	681	43,656	1,153	40,377	3,279	-110
15	550	0	430	0	18	980	880	-110	770	44,426	1,017	41,394	3,032	-110
16	356	0	392	0	19	748	1,112	-110	1,002	45,428	1,213	42,607	2,821	-110
17	356	0	374	22	20	752	1,108	-110	998	46,426	1,165	43,772	2,654	-110
18	0	0	377	0	21	377	1,483	-110	1,373	47,799	1,596	45,368	2,431	-110
19	0	0	287	0	22	287	1,573	-110	1,463	49,262	1,694	47,062	2,200	-110
20	0	0	232	0	23	232	1,628	-110	1,518	50,780	1,658	48,720	2,060	-110
21	0	0	216	0	24	216	1,644	-110	1,534	52,314	1,386	50,106	2,208	-110
22	0	0	200	13	25	213	1,647	-110	1,537	53,851	939	51,045	2,806	-110
23	0	0	164	293	26	457	1,403	-110	1,293	55,144	1,076	52,121	3,023	-110
24	0	0	353	139	27	492	1,368	-110	1,258	56,402	1,260	53,381	3,021	-110
25	0	0	638	32	28	670	1,190	-110	1,080	57,482	1,309	54,690	2,792	-110
26	0	0	633	0	29	633	1,227	-110	1,117	58,599	1,126	55,816	2,783	-110
27	0	0	540	145	30	685	1,175	-110	1,065	59,664	0	55,816	3,848	-110
28	0	0	472	791	31	1,263	597	-110	487	60,151	0	55,816	4,335	-110

Col. 1 - Furnished by power company.
Col. 2 - Furnished by power company.
Col. 3 - Computed from index stations.
Col. 4 - Computed increase in runoff based on weather forecasts.
Col. 5 = Col. 1 + Col. 2 + Col. 3 + Col. 4.
Col. 6 = Design rate - Col. 5, when positive; otherwise Col. 6 = 0.
Col. 7 = Col. 13 (4 days earlier).
Col. 8 = Design rate - Col. 5 + Col. 7, when positive; otherwise Col. 8 = 0.
Col. 9 = Summation of Col. 8.
Col. 10 = Design rate - (Col. 9 + Col. 10 from Table 15), when positive; otherwise Col. 10 = 0.
Col. 11 = Summation of Col. 10.
Col. 12 = Col. 9 - Col. 11.
Col. 13 = Col. 12 divided by minus 10, limited to ±110.

Table 14.- New York City Reservoir release design data

(River Master daily operation record)

Date of advance estimate	Advance estimate of discharge of Delaware River at Montague exclusive of New York City reservoir releases: Powerplant release forecasts: Lake Wallenpaupack ft^3/s	Powerplant release forecasts: Rio Reservoir ft^3/s	Uncontrolled runoff: Present conditions ft^3/s	Uncontrolled runoff: Weather adjustment ft^3/s	Date	Discharge ft^3/s	Indicated deficiency ft^3/s	Balancing adjustment ft^3/s	Directed release: Daily ft^3/s	Directed release: Cumulative (ft^3/s)·d	Actual deficiency: Daily ft^3/s	Actual deficiency: Cumulative (ft^3/s)·d	Cumulative difference (ft^3/s)·d	Balancing adjustment ft^3/s
1988	1	2	3	4		5	6	7	8	9	10	11	12	13
Aug. 29	0	0	660	1,162	Sept. 1	1,822	38	-110	0	60,151	0	55,816	4,335	-110
30	0	340	3,011	0	2	3,351	0	-110	0	60,151	216	56,032	4,119	-110
31	0	227	1,556	0	3	1,783	77	-110	0	60,151	297	56,329	3,822	-110
Sept. 1	0	0	1,173	0	4	1,173	687	-110	577	60,728	1,153	57,482	3,246	-110
2	0	114	938	287	5	1,339	521	-110	411	61,139	0	57,482	3,657	-110
3	0	283	767	706	6	1,756	104	-110	0	61,139	0	57,482	3,657	-110
4	0	283	708	785	7	1,776	84	-110	0	61,139	0	57,482	3,657	-110
5	0	283	1,928	0	8	2,211	0	-110	0	61,139	35	57,517	3,622	-110
6	0	283	1,421	0	9	1,704	156	-110	46	61,185	536	58,053	3,132	-110
7	0	180	1,063	0	10	1,243	617	-110	507	61,692	780	58,833	2,859	-110
8	0	0	954	0	11	954	906	-110	796	62,488	1,011	59,844	2,644	-110
9	0	255	804	0	12	1,059	801	-110	691	63,179	905	60,749	2,430	-110
10	238	490	710	0	13	1,438	422	-110	312	63,491	242	60,991	2,500	-110
11	238	490	584	0	14	1,312	548	-110	438	63,929	839	61,830	2,099	-110
12	238	490	507	0	15	1,235	625	-110	515	64,444	760	62,590	1,854	-110
13	238	490	549	0	16	1,277	583	-110	473	64,917	357	62,947	1,970	-110
14	238	250	489	0	17	977	883	-110	773	65,690	911	63,858	1,832	-110
15	0	0	393	0	18	393	1,467	-110	1,357	67,047	1,261	65,119	1,928	-110
16	0	0	447	37	19	484	1,376	-110	1,266	68,313	1,125	66,244	2,069	-110
17	356	0	365	0	20	721	1,139	-110	1,029	69,342	814	67,058	2,284	-110
18	356	0	393	0	21	749	1,111	-110	1,001	70,343	955	68,013	2,330	-110
19	356	0	378	61	22	795	1,065	-110	955	71,298	838	68,851	2,447	-110
20	356	0	419	0	23	775	1,085	-110	975	72,273	891	69,742	2,531	-110
21	356	0	452	0	24	808	1,052	-110	942	73,215	926	70,668	2,547	-110
22	0	0	466	15	25	481	1,379	-110	1,269	74,484	1,353	72,021	2,463	-110
23	0	0	501	0	26	501	1,359	-110	1,249	75,733	1,424	73,445	2,288	-110
24	475	0	551	0	27	1,026	834	-110	724	76,457	837	74,282	2,175	-110
25	475	0	515	0	28	990	870	-110	760	77,217	933	75,215	2,002	-110
26	475	0	460	0	29	935	925	-110	815	78,032	950	76,165	1,867	-110
27	475	0	435	0	30	910	950	-110	840	78,872	971	77,136	1,736	-110

Col. 1 - Furnished by power company.
Col. 2 - Furnished by power company.
Col. 3 - Computed from index stations.
Col. 4 - Computed increase in runoff based on weather forecasts.
Col. 5 = Col. 1 + Col. 2 + Col. 3 + Col. 4.
Col. 6 = Design rate - Col. 5, when positive; otherwise Col. 6 = 0.
Col. 7 = Col. 13 (4 days earlier).
Col. 8 = Design rate - Col. 5 + Col. 7, when positive; otherwise Col. 8 = 0.
Col. 9 = Summation of Col. 8.
Col. 10 = Design rate - (Col. 9 + Col. 10 from Table 15), when positive; otherwise Col. 10 = 0.
Col. 11 = Summation of Col. 10.
Col. 12 = Col. 9 - Col. 11.
Col. 13 = Col. 12 divided by minus 10, limited to ±110.

Table 14.- New York City Reservoir release design data

(River Master daily operation record)

Date of advance estimate	Advance estimate of discharge of Delaware River at Montague exclusive of New York City reservoir releases: Powerplant release forecasts: Lake Wallenpaupack ft^3/s	Rio Reservoir ft^3/s	Uncontrolled runoff: Present conditions ft^3/s	Weather adjustment ft^3/s	Date	Discharge ft^3/s	Indicated deficiency ft^3/s	Balancing adjustment ft^3/s	Directed release: Daily ft^3/s	Cumulative (ft^3/s)·d	Actual deficiency: Daily ft^3/s	Cumulative (ft^3/s)·d	Cumulative difference (ft^3/s)·d	Balancing adjustment ft^3/s
1988	1	2	3	4		5	6	7	8	9	10	11	12	13
Sept.28	475	0	263	0	Oct. 1	738	1,122	-110	1,012	79,884	985	78,121	1,763	-110
29	0	0	295	0	2	295	1,565	-110	1,455	81,339	1,535	79,656	1,683	-110
30	0	0	378	0	3	378	1,482	-110	1,372	82,711	1,501	81,157	1,554	-110
Oct. 1	357	0	361	44	4	762	1,098	-110	988	83,699	1,169	82,326	1,373	-110
2	357	0	352	138	5	847	1,013	-110	903	84,602	1,109	83,435	1,167	-110
3	0	0	378	62	6	440	1,420	-110	1,310	85,912	1,434	84,869	1,043	-104
4	0	0	368	33	7	401	1,459	-110	1,349	87,261	1,539	86,408	853	-85
5	0	0	378	0	8	378	1,482	-110	1,372	88,633	1,591	87,999	634	-63
6	0	0	389	0	9	389	1,471	-110	1,361	89,994	1,531	89,530	464	-46
7	0	0	404	0	10	404	1,456	-104	1,352	91,346	1,568	91,098	248	-25
8	0	0	381	0	11	381	1,479	-85	1,394	92,740	1,358	92,456	284	-28
9	0	0	367	0	12	367	1,493	-63	1,430	94,170	1,529	93,985	185	-18
10	0	0	358	0	13	358	1,502	-46	1,456	95,626	1,561	95,546	80	-8
11	0	0	307	0	14	307	1,553	-25	1,528	97,154	1,581	97,127	27	-3
12	0	0	314	0	15	314	1,546	-28	1,518	98,672	1,624	98,751	-79	+8
13	0	0	296	0	16	296	1,564	-18	1,546	100,218	1,607	100,358	-140	+14
14	0	0	290	0	17	290	1,570	-8	1,562	101,780	1,627	101,985	-205	+20
15	0	0	275	0	18	275	1,585	-3	1,582	103,362	1,619	103,604	-242	+24
16	0	0	242	0	19	242	1,618	+8	1,626	104,988	1,583	105,187	-199	+20
17	0	0	234	0	20	234	1,626	+14	1,640	106,628	1,641	106,828	-200	+20
18	0	0	215	0	21	215	1,645	+20	1,665	108,293	1,591	108,419	-126	+13
19	0	0	246	0	22	246	1,614	+24	1,638	109,931	1,429	109,848	83	-8
20	0	0	228	530	23	758	1,102	+20	1,122	111,053	942	110,790	263	-26
21	0	0	221	930	24	1,151	709	+20	729	111,782	309	111,099	683	-68
22	0	0	495	536	25	1,031	829	+13	842					
23	0	0	994	153	26	1,147	713	-8	705					
24	0	0	1,292	115	27	1,407	453	-26	427	Excess release quantity expired October 25, 1988 and the balancing adjustment was terminated.				
25	0	0	1,846	0	28	1,846	16	-68	0					
26	0	0	1,396	0	29	1,396	354	-	354					
27	0	0	1,099	95	30	1,194	556	-	556					
28	0	0	831	54	31	885	865	-	865					

Col. 1 - Furnished by power company.
Col. 2 - Furnished by power company.
Col. 3 - Computed from index stations.
Col. 4 - Computed increase in runoff based on weather forecasts.
Col. 5 = Col. 1 + Col. 2 + Col. 3 + Col. 4.
Col. 6 = Design rate - Col. 5, when positive; otherwise Col. 6 = 0.
Col. 7 = Col. 13 (4 days earlier).
Col. 8 = Design rate - Col. 5 + Col. 7, when positive; otherwise Col. 8 = 0.
Col. 9 = Summation of Col. 8.
Col. 10 = Design rate - (Col. 9 + Col. 10 from Table 15), when positive; otherwise Col. 10 = 0.
Col. 11 = Summation of Col. 10.
Col. 12 = Col. 9 - Col. 11.
Col. 13 = Col. 12 divided by minus 10, limited to ±110.

Table 14.- New York City Reservoir release design data

(River Master daily operation record)

Date of advance estimate	Advance estimate of discharge of Delaware River at Montague exclusive of New York City reservoir releases: Powerplant release forecasts, Lake Wallenpaupack ft^3/s	Powerplant release forecasts, Rio Reservoir ft^3/s	Uncontrolled runoff, Present conditions ft^3/s	Uncontrolled runoff, Weather adjustment ft^3/s	Date	Discharge ft^3/s	Indicated deficiency ft^3/s	Balancing adjustment ft^3/s	Directed release, Daily ft^3/s	Directed release, Cumulative $(ft^3/s)\cdot d$	Actual deficiency, Daily ft^3/s	Actual deficiency, Cumulative $(ft^3/s)\cdot d$	Cumulative difference $(ft^3/s)\cdot d$	Balancing adjustment ft^3/s
1988	1	2	3	4		5	6	7	8	9	10	11	12	13
Oct. 29	0	0	841	0	Nov. 1	841	909		909					
30	0	0	743	212	2	955	795		795					
31	0	0	816	1,349	3	2,165	0		0					
Nov. 1	0	0	785	313	4	1,098	652		652					
2	0	0	946	121	5	1,067	683		683					
3	0	0	1,220	0	6	1,220	530		530					

The estimated Montague discharge was greater than the Montague design rate
November 7-30, 1988

Col. 1 - Furnished by power company.
Col. 2 - Furnished by power company.
Col. 3 - Computed from index stations.
Col. 4 - Computed increase in runoff based on weather forecasts.
Col. 5 = Col. 1 + Col. 2 + Col. 3 + Col. 4.
Col. 6 = Design rate - Col. 5, when positive; otherwise Col. 6 = 0.
Col. 7 = Col. 13 (4 days earlier).
Col. 8 = Design rate - Col. 5 + Col. 7, when positive; otherwise Col. 8 = 0.

Table 15. - Controlled releases for reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, N.J.
(River Master daily operation record)
Mean discharge in cubic feet per second for 24 hours

Controlled releases from New York City reservoirs: Directed, Date 1987	Directed, Amount 1	Pepacton 2	Cannonsville 3	Neversink 4	Controlled releases from power reservoirs: Date	Lake Wallenpaupack 5	Rio Reservoir 6	Delaware River at Montague, Segregation of flow: Date	Controlled releases, N.Y.C. reservoirs, Directed 7	N.Y.C. reservoirs, Other 8	Power-plants 9	Computed uncontrolled 10	Total 11	Excess Release Credits, Daily 12	Excess Release Credits, Cumul. 13
Nov. 28		53	34	26	Nov. 30	236	745	Dec. 1		113	981	10,706	11,800		7,366
29		53	34	26	Dec. 1	245	606	2		113	851	8,546	9,510		7,366
30		53	34	25	2	234	691	3		112	925	7,263	8,300		7,366
Dec. 1		53	34	25	3	232	691	4		112	923	6,465	7,500		7,366
2		53	34	25	4	236	528	5		112	764	6,044	6,920		7,366
3		53	34	25	5	0	230	6		112	230	5,488	5,830		7,366
4		53	34	25	6	2	361	7		112	363	5,185	5,660		7,366
5		53	34	25	7	319	727	8		112	1,046	4,472	5,630		7,366
6		53	34	25	8	327	712	9		112	1,039	4,209	5,360		7,366
7		53	34	25	9	258	461	10		112	719	4,079	4,910		7,366
8		53	34	25	10	240	173	11		112	413	4,135	4,660		7,366
9		53	34	25	11	237	120	12		112	357	3,621	4,090		7,366
10		53	34	25	12	0	0	13		112	0	3,658	3,770		7,366
11		53	34	25	13	0	245	14		112	245	3,573	3,930		7,366
12		53	34	25	14	237	301	15		112	538	3,300	3,950		7,366
13		53	60	25	15	232	46	16		138	278	3,824	4,240		7,366
14		53	34	25	16	230	245	17		112	475	4,013	4,600		7,366
15		53	34	25	17	229	479	18		112	708	3,350	4,170		7,366
16		53	34	25	18	230	202	19		112	432	2,876	3,420		7,366
17		53	34	25	19	0	14	20		112	14	3,014	3,140		7,366
18		53	34	26	20	0	273	21		113	273	3,794	4,180		7,366
19		53	34	26	21	232	510	22		113	742	3,825	4,680		7,366
20		56	34	26	22	229	546	23		116	775	3,439	4,330		7,366
21		56	34	26	23	227	351	24		116	578	3,076	3,770		7,366
22		56	34	26	24	0	113	25		116	113	3,091	3,320		7,366
23		56	34	26	25	0	0	26		116	0	3,674	3,790		7,366
24		56	34	26	26	0	0	27		116	0	4,124	4,240		7,366
25		57	34	26	27	0	223	28		117	223	3,970	4,310		7,366
26		57	34	26	28	221	464	29		117	685	3,548	4,350		7,366
27		57	34	26	29	250	393	30		117	643	3,340	4,100		7,366
28		57	34	26	30	691	532	31		117	1,223	2,410	3,750		7,366
Total	0	1,674	1,080	788		5,574	10,982		0	3,542	16,556	136,112	156,210		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
Col. 4 - 24 hours beginning 1500 one day later.
Col. 5 - 24 hours beginning 0800 of date shown.
Col. 6 - 24 hours beginning 1600 of date shown.
Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to Col. 1.
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
Col. 9 = Col. 5 + Col. 6.

Col. 10 = Col. 11 - Col. 7 - Col. 8 - Col. 9.
Col. 11 - 24 hours of calendar day shown.
Col 12 = Col. 11 - Col. 8 - 1,750 ft^3/s computed algebraically, but not greater than Col. 7; except that part of Col. 8 contributing to the excess-release increment of Col. 11.
Col. 13 - Season limit of cumulative credit beginning June 15, 1987 = 11,418 $(ft^3/s)\cdot d$.

Table 15. - Controlled releases for reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, N.J.
(River Master daily operation record)
Mean discharge in cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Delaware River at Montague Segregation of flow						
Directed		Pepacton	Cannonsville	Neversink	Date	Lake Wallen-paupack	Rio Reservoir	Date	Controlled releases: N.Y.C. reservoirs Directed	Controlled releases: N.Y.C. reservoirs Other	Controlled releases: Power-plants	Computed uncon-trolled	Total	Excess Release Credits Daily	Excess Release Credits Cumul.
Date	Amount														
1876/88	1	2	3	4		5	6		7	8	9	10	11	12	13
Dec. 29		53	34	26	Dec. 31	230	174	Jan. 1		113	404	2,183	2,700	0	7,366
30		53	36	26	Jan. 1	0	262	2		115	262	3,123	3,500	0	7,366
31		53	36	26	2	0	248	3		115	248	2,837	3,200	0	7,366
Jan. 1		53	36	26	3	0	145	4		115	145	2,440	2,700	0	7,366
2		53	36	26	4	219	312	5		115	531	2,454	3,100	0	7,366
3		53	36	26	5	678	575	6		115	1,253	2,232	3,600	0	7,366
4		53	36	25	6	698	280	7		114	978	1,708	2,800	0	7,366
5		53	34	25	7	707	259	8		112	966	1,722	2,800	0	7,366
6		53	34	25	8	705	212	9		112	917	1,971	3,000	0	7,366
7		53	34	25	9	214	209	10		112	423	1,765	2,300	0	7,366
8		53	34	25	10	222	270	11		112	492	1,596	2,200	0	7,366
9		53	34	25	11	712	290	12		112	1,002	1,786	2,900	0	7,366
10		53	34	25	12	725	362	13		112	1,087	1,801	3,000	0	7,366
11		53	34	25	13	727	641	14		112	1,368	1,720	3,200	0	7,366
12		53	34	25	14	721	450	15		112	1,171	1,717	3,000	0	7,366
13		53	34	25	15	258	0	16		112	258	1,730	2,100	0	7,366
14		53	34	25	16	0	0	17		112	0	1,588	1,700	-50	7,316
15		53	34	25	17	0	134	18		112	134	1,754	2,000	0	7,316
16		53	34	25	18	237	560	19		112	797	1,891	2,800	0	7,316
17		53	34	25	19	220	472	20		112	692	2,496	3,300	0	7,316
18		53	34	25	20	225	252	21		112	477	3,211	3,800	0	7,316
19		53	34	25	21	219	413	22		112	632	3,456	4,200	0	7,316
20		53	34	25	22	223	184	23		112	407	3,081	3,600	0	7,316
21		50	34	25	23	0	0	24		109	0	2,691	2,800	0	7,316
22		53	34	25	24	0	124	25		112	124	2,264	2,500	0	7,316
23		53	34	25	25	223	560	26		112	783	2,005	2,900	0	7,316
24		53	34	25	26	217	387	27		112	604	1,784	2,500	0	7,316
25		53	34	25	27	218	128	28		112	346	1,642	2,100	0	7,316
26		53	34	25	28	219	450	29		112	669	1,519	2,300	0	7,316
27		51	34	25	29	226	340	30		110	566	1,824	2,500	0	7,316
28		51	34	25	30	0	315	31		110	315	1,875	2,300	0	7,316
Total	0	1,636	1,066	781		9,043	9,008		0	3,483	18,051	65,866	87,400		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
Col. 4 - 24 hours beginning 1500 one day later.
Col. 5 - 24 hours beginning 0800 of date shown.
Col. 6 - 24 hours beginning 1600 of date shown.
Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to Col. 1.
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
Col. 9 = Col. 5 + Col. 6.

Col. 10 = Col. 11 - Col. 7 - Col. 8 - Col. 9.
Col. 11 - 24 hours of calendar day shown.
Col 12 = Col. 11 - Col. 8 - 1,750 ft^3/s computed algebraically, but not greater than Col. 7; except that part of Col. 8 contributing to the excess-release increment of Col. 11.
Col. 13 - Season limit of cumulative credit beginning June 15, 1987 = 11,418 $(ft^3/s)\cdot d$.

Table 15. - Controlled releases for reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, N.J.
(River Master daily operation record)
Mean discharge in cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Delaware River at Montague Segregation of flow							
Directed		Pepacton	Cannonsville	Neversink	Date	Lake Wallen-paupack	Rio Reservoir	Date	Controlled releases N.Y.C. reservoirs		Controlled releases Power-plants	Computed uncon-trolled	Total	Excess Release Credits	
Date	Amount								Directed	Other				Daily	Cumul.
1988	1	2	3	4		5	6		7	8	9	10	11	12	13
Jan. 29		51	34	25	Jan. 31	0	298	Feb. 1		110	298	1,992	2,400		7,316
30		53	34	25	Feb. 1	224	348	2		112	572	4,116	4,800		7,316
31		53	62	25	2	218	493	3		140	711	15,149	16,000		7,316
Feb. 1		53	34	25	3	227	730	4		112	957	12,731	13,800		7,316
2		53	34	25	4	330	574	5		112	904	10,784	11,800		7,316
3		53	36	25	5	446	379	6		114	825	8,661	9,600		7,316
4		50	34	25	6	465	543	7		109	1,008	6,583	7,700		7,316
5		53	34	25	7	463	503	8		112	966	5,322	6,400		7,316
6		53	34	25	8	227	567	9		112	794	5,194	6,100		7,316
7		53	34	25	9	215	418	10		112	633	4,655	5,400		7,316
8		51	36	25	10	228	348	11		112	576	4,512	5,200		7,316
9		51	36	25	11	283	206	12		112	489	4,199	4,800		7,316
10		53	36	25	12	475	298	13		114	773	3,713	4,600		7,316
11		51	36	25	13	0	273	14		112	273	3,615	4,000		7,316
12		53	36	25	14	0	127	15		114	127	3,459	3,700		7,316
13		53	36	25	15	404	383	16		114	787	3,599	4,500		7,316
14		56	36	25	16	536	351	17		117	887	3,696	4,700		7,316
15		51	36	25	17	586	408	18		112	994	3,494	4,600		7,316
16		48	36	25	18	516	294	19		109	810	3,381	4,300		7,316
17		51	36	25	19	596	287	20		112	883	3,505	4,500		7,316
18		54	36	25	20	225	343	21		115	568	4,217	4,900		7,316
19		48	36	25	21	217	337	22		109	554	4,237	4,900		7,316
20		50	36	25	22	641	382	23		111	1,023	3,766	4,900		7,316
21		51	36	25	23	672	460	24		112	1,132	3,756	5,000		7,316
22		53	36	25	24	665	340	25		114	1,005	3,281	4,400		7,316
23		51	36	25	25	437	638	26		112	1,075	3,113	4,300		7,316
24		51	36	25	26	727	0	27		112	727	2,961	3,800		7,316
25		53	36	25	27	472	0	28		114	472	2,614	3,200		7,316
26		53	36	25	28	468	0	29		114	468	2,418	3,000		7,316
Total	0	1,507	1,054	725		10,963	10,328		0	3,286	21,291	142,723	167,300		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
Col. 4 - 24 hours beginning 1500 one day later.
Col. 5 - 24 hours beginning 0800 of date shown.
Col. 6 - 24 hours beginning 1600 of date shown.
Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to Col. 1.
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
Col. 9 = Col. 5 + Col. 6.

Col. 10 = Col. 11 - Col. 7 - Col. 8 - Col. 9.
Col. 11 - 24 hours of calendar day shown.
Col 12 = Col. 11 - Col. 8 - 1,750 ft^3/s computed algebraically, but not greater than Col. 7; except that part of Col. 8 contributing to the excess-release increment of Col. 11.
Col. 13 - Season limit of cumulative credit beginning June 15, 1987 = 11,418 $(ft^3/s)\cdot d$.

Table 15. - Controlled releases for reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, N.J.
(River Master daily operation record)
Mean discharge in cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Delaware River at Montague Segregation of flow							
Directed		Pepacton	Cannonsville	Neversink	Date	Lake Wallenpaupack	Rio Reservoir	Date	Controlled releases			Computed uncontrolled	Total	Excess Release Credits	
									N.Y.C. reservoirs		Powerplants				
Date	Amount								Directed	Other				Daily	Cumul.
1988	1	2	3	4		5	6		7	8	9	10	11	12	13
Feb. 27		53	36	25	Feb. 29	450	0	Mar. 1		114	450	2,436	3,000		7,316
28		53	36	25	Mar. 1	863	103	2		114	966	2,320	3,400		7,316
29		53	36	25	2	951	358	3		114	1,309	2,377	3,800		7,316
Mar. 1		51	36	25	3	939	400	4		112	1,339	2,549	4,000		7,316
2		51	36	25	4	978	0	5		112	978	2,910	4,000		7,316
3		51	36	25	5	418	0	6		112	418	2,570	3,100		7,316
4		51	36	25	6	381	149	7		112	530	2,658	3,300		7,316
5		51	34	25	7	456	390	8		110	846	3,144	4,100		7,316
6		53	34	25	8	476	326	9		112	802	3,686	4,600		7,316
7		53	34	25	9	432	382	10		112	814	6,074	7,000		7,316
8		53	62	25	10	469	397	11		140	866	8,894	9,900		7,316
9		53	36	25	11	471	727	12		114	1,198	6,788	8,100		7,316
10		53	36	25	12	0	0	13		114	0	7,186	7,300		7,316
11		53	36	25	13	0	167	14		114	167	9,319	9,600		7,316
12		53	36	25	14	471	344	15		114	815	8,571	9,500		
13		53	36	25	15	472	347	16		114	819	7,167	8,100		
14		53	36	25	16	459	294	17		114	753	6,433	7,300		
15		53	36	25	17	476	337	18		114	813	5,673	6,600		
16		53	36	25	18	351	570	19		114	921	5,365	6,400		
17		53	36	25	19	0	465	20		114	465	5,121	5,700		
18		53	36	25	20	0	372	21		114	372	4,714	5,200		
19		53	36	25	21	465	468	22		114	933	3,853	4,900		
20		53	36	25	22	475	309	23		114	784	3,702	4,600		
21		53	36	25	23	463	284	24		114	747	3,739	4,600		
22		53	36	25	24	458	414	25		114	872	4,814	5,800		
23		53	36	25	25	464	617	26		114	1,081	10,505	11,700		
24		51	36	25	26	0	433	27		112	433	26,255	26,800		
25		53	36	26	27	0	674	28		115	674	20,111	20,900		
26		53	36	26	28	470	553	29		115	1,023	14,362	15,500		
27		53	36	26	29	488	472	30		115	960	11,325	12,400		
28		51	36	26	30	479	507	31		113	986	9,701	10,800		
Total	0	1,629	1,136	779		13,275	10,859		0	3,544	24,134	214,322	242,000		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
Col. 4 - 24 hours beginning 1500 one day later.
Col. 5 - 24 hours beginning 0800 of date shown.
Col. 6 - 24 hours beginning 1600 of date shown.
Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to Col. 1.
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
Col. 9 = Col. 5 + Col. 6.
Col. 10 = Col. 11 - Col. 7 - Col. 8 - Col. 9.
Col. 11 - 24 hours of calendar day shown.
Col 12 = Col. 11 - Col. 8 - 1,750 ft^3/s computed algebraically, but not greater than Col. 7; except that part of Col. 8 contributing to the excess-release increment of Col. 11.
Col. 13 - Season limit of cumulative credit beginning June 15, 1987 = 11,418 $(ft^3/s)\cdot d$.

Table 15. - Controlled releases for reservoirs in the upper Delaware River basin
and segregation of flow of Delaware River at Montague, N.J.
(River Master daily operation record)
Mean discharge in cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Delaware River at Montague Segregation of flow							
Directed		Pepacton	Cannonsville	Neversink	Date	Lake Wallen-paupack	Rio Reservoir	Date	Controlled releases			Computed uncon-trolled	Total	Excess Release Credits	
									N.Y.C. reservoirs		Power-plants				
Date	Amount								Directed	Other				Daily	Cumul.
1988	1	2	3	4		5	6		7	8	9	10	11	12	13
Mar. 29		53	36	26	Mar. 31	471	582	Apr. 1		115	1,053	8,252	9,420		
30		53	36	31	Apr. 1	0	524	2		120	524	7,926	8,570		
31		54	40	42	2	0	460	3		136	460	7,424	8,020		
Apr. 1		71	45	42	3	0	500	4		158	500	7,212	7,870		
2		74	45	43	4	233	482	5		162	715	6,873	7,750		
3		74	45	45	5	229	514	6		164	743	6,173	7,080		
4		71	45	48	6	224	425	7		164	649	5,457	6,270		
5		71	45	46	7	231	507	8		162	738	4,980	5,880		
6		71	45	46	8	277	635	9		162	912	3,966	5,040		
7		70	45	46	9	0	124	10		161	124	3,975	4,260		
8		70	45	45	10	0	28	11		160	28	3,742	3,930		
9		71	45	48	11	228	0	12		164	228	3,258	3,650		
10		71	45	48	12	242	266	13		164	508	2,948	3,620		
11		71	45	43	13	232	372	14		159	604	2,637	3,400		
12		71	45	43	14	269	106	15		159	375	2,486	3,020		
13		71	71	42	15	219	0	16		184	219	2,587	2,990		
14		71	45	42	16	0	0	17		158	0	2,672	2,830		
15		71	45	42	17	0	0	18		158	0	2,572	2,730		
16		70	45	42	18	231	31	19		157	262	2,371	2,790		
17		70	45	42	19	234	18	20		157	252	2,341	2,750		
18		71	45	43	20	258	113	21		159	371	2,040	2,570		
19		70	45	43	21	253	0	22		158	253	1,919	2,330		
20		70	45	46	22	238	0	23		161	238	1,811	2,210		
21		70	45	48	23	0	0	24		163	0	1,867	2,030		
22		71	45	48	24	0	124	25		164	124	2,062	2,350		
23		70	45	48	25	0	259	26		163	259	2,118	2,540		
24		70	45	50	26	0	255	27		165	255	1,890	2,310		
25		70	45	50	27	0	401	28		165	401	2,254	2,820		
26		71	45	50	28	0	209	29		166	209	5,155	5,530		
27		70	45	50	29	0	0	30		165	0	5,215	5,380		
Total	0	2,072	1,353	1,328		4,069	6,935		0	4,753	11,004	116,183	131,940		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
Col. 4 - 24 hours beginning 1500 one day later.
Col. 5 - 24 hours beginning 0800 of date shown.
Col. 6 - 24 hours beginning 1600 of date shown.
Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to Col. 1.
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
Col. 9 = Col. 5 + Col. 6.

Col. 10 = Col. 11 - Col. 7 - Col. 8 - Col. 9.
Col. 11 - 24 hours of calendar day shown.
Col 12 = Col. 11 - Col. 8 - 1,750 ft^3/s computed algebraically, but not greater than Col. 7; except that part of Col. 8 contributing to the excess-release increment of Col. 11.
Col. 13 - Season limit of cumulative credit beginning June 15, 1987 = 11,418 $(ft^3/s)\cdot d$.

Table 15. - Controlled releases for reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, N.J.
(River Master daily operation record)
Mean discharge in cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Delaware River at Montague Segregation of flow							
Directed		Pepacton	Cannonsville	Neversink	Date	Lake Wallen-paupack	Rio Reservoir	Date	Controlled releases			Computed uncon-trolled	Total	Excess Release Credits	
									N.Y.C. reservoirs		Power-plants				
Date	Amount								Directed	Other				Daily	Cumul.
1988	1	2	3	4		5	6		7	8	9	10	11	12	13
Apr. 28	0	70	45	50	Apr. 30	0	0	May 1	0	165	0	5,065	5,230		
29	0	70	45	40	May 1	0	160	2	0	155	160	4,335	4,650		
30	0	70	45	42	2	0	535	3	0	157	535	3,738	4,430		
May 1	0	70	45	45	3	0	301	4	0	160	301	3,419	3,880		
2	0	71	45	46	4	0	323	5	0	162	323	3,175	3,660		
3	0	71	45	45	5	0	482	6	0	161	482	3,387	4,030		
4	0	71	45	45	6	0	340	7	0	161	340	4,469	4,970		
5	0	70	45	46	7	0	273	8	0	161	273	4,146	4,580		
6	0	70	45	46	8	0	263	9	0	161	263	3,576	4,000		
7	0	70	45	46	9	0	426	10	0	161	426	3,093	3,680		
8	0	70	45	46	10	0	195	11	0	161	195	3,154	3,510		
9	0	70	45	46	11	0	170	12	0	161	170	2,989	3,320		
10	0	70	45	46	12	0	426	13	0	161	426	2,763	3,350		
11	0	70	45	46	13	0	0	14	0	161	0	2,669	2,830		
12	0	70	45	46	14	0	0	15	0	161	0	2,529	2,690		
13	0	70	45	46	15	0	0	16	0	161	0	2,339	2,500		
14	0	70	45	46	16	0	124	17	0	161	124	2,225	2,510		
15	0	70	45	46	17	72	344	18	0	161	416	2,313	2,890		
16	0	70	45	48	18	0	702	19	0	163	702	3,485	4,350		
17	0	70	45	48	19	0	599	20	0	163	599	7,708	8,470		
18	0	70	45	48	20	0	0	21	0	163	0	11,937	12,100		
19	0	70	45	48	21	0	31	22	0	163	31	11,606	11,800		
20	0	68	45	48	22	0	440	23	0	161	440	13,599	14,200		
21	0	68	45	48	23	281	734	24	0	161	1,015	10,424	11,600		
22	0	68	45	48	24	804	723	25	0	161	1,527	12,112	13,800		
23	0	68	45	48	25	984	719	26	0	161	1,703	12,736	14,600		
24	0	68	45	48	26	1,138	716	27	0	161	1,854	10,885	12,900		
25	0	68	45	48	27	958	706	28	0	161	1,664	8,975	10,800		
26	0	70	45	43	28	0	298	29	0	158	298	7,854	8,310		
27	0	70	45	43	29	0	351	30	0	158	351	6,491	7,000		
28	0	70	45	48	30	0	368	31	0	163	368	5,519	6,050		
Total	0	2,161	1,395	1,433		4,237	10,749		0	4,989	14,986	182,715	202,690		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
Col. 4 - 24 hours beginning 1500 one day later.
Col. 5 - 24 hours beginning 0800 of date shown.
Col. 6 - 24 hours beginning 1600 of date shown.
Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to Col. 1.
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
Col. 9 = Col. 5 + Col. 6.

Col. 10 = Col. 11 - Col. 7 - Col. 8 - Col. 9.
Col. 11 - 24 hours of calendar day shown.
Col 12 = Col. 11 - Col. 8 - 1,750 ft^3/s computed algebraically, but not greater than Col. 7; except that part of Col. 8 contributing to the excess-release increment of Col. 11.
Col. 13 - Season limit of cumulative credit beginning June 15, 1987 = 11,418 $(ft^3/s) \cdot d$.

Table 15. - Controlled releases for reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, N.J.
(River Master daily operation record)
Mean discharge in cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Delaware River at Montague Segregation of flow							
Directed		Pepacton	Cannonsville	Neversink	Date	Lake Wallen-paupack	Rio Reservoir	Date	Controlled releases			Computed uncon-trolled	Total	Excess Release Credits	
									N.Y.C. reservoirs		Power-plants				
Date	Amount								Directed	Other				Daily	Cumul.
1988	1	2	3	4		5	6		7	8	9	10	11	12	13
May 29	0	70	45	46	May 30	816	368	June 1	0	161	1,184	4,605	5,950		
30	0	70	45	43	June 1	845	660	2	0	158	1,505	4,027	5,690		
31	0	70	45	45	2	842	368	3	0	160	1,210	3,620	4,990		
June 1	0	73	45	46	3	825	0	4	0	164	825	3,351	4,340		
2	0	71	45	48	4	0	57	5	0	164	57	3,189	3,410		
3	0	71	45	48	5	0	177	6	0	164	177	2,819	3,160		
4	0	71	45	48	6	694	0	7	0	164	694	2,462	3,320		
5	0	71	45	48	7	707	0	8	0	164	707	2,249	3,120		
6	0	71	45	48	8	699	49	9	0	164	748	1,978	2,890		
7	0	71	45	46	9	697	0	10	0	162	697	1,871	2,730		
8	0	71	45	45	10	698	0	11	0	161	698	1,631	2,490		
9	422	71	312	45	11	0	0	12	428	0	0	1,322	1,750		
10	186	71	73	45	12	52	85	13	189	0	137	1,404	1,730		
11	0	71	45	45	13	808	766	14	0	161	1,574	1,145	2,880		
12	0	71	218	45	14	690	709	15	0	334	1,399	907	2,640	0	0
13	104	99	379	45	15	758	557	16	104	419	1,315	852	2,690	0	0
14	0	99	442	46	16	735	99	17	0	587	834	1,169	2,590	0	0
15	488	121	503	46	17	451	0	18	488	182	451	1,139	2,260	328	328
16	1,026	114	851	45	18	0	0	19	1,010	0	0	900	1,910	160	488
17	895	71	784	45	19	0	227	20	900	0	227	793	1,920	170	658
18	771	73	662	45	20	213	465	21	780	0	678	732	2,190	440	1,098
19	700	104	548	48	21	699	528	22	700	0	1,227	633	2,560	700	1,798
20	690	99	549	48	22	864	277	23	696	0	1,141	723	2,560	690	2,488
21	1,002	99	837	70	23	577	78	24	1,006	0	655	619	2,280	530	3,018
22	1,101	99	959	45	24	0	0	25	1,103	0	0	597	1,700	-50	2,968
23	1,067	71	951	45	25	0	0	26	1,067	0	0	593	1,660	-90	2,878
24	1,135	71	1,023	46	26	0	0	27	1,140	0	0	510	1,650	-100	2,778
25	1.157	71	1,043	46	27	75	0	28	1,160	0	75	505	1,740	-10	2,768
26	1,219	71	1,109	46	28	0	89	29	1,226	0	89	455	1,770	20	2,788
27	1,298	71	1,180	46	29	0	43	30	1,297	0	43	410	1,750	0	2,788
Total	13,261	2,397	12,963	1,403		12,745	5,602		13,294	3,469	18,347	47,210	82,320		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
Col. 4 - 24 hours beginning 1500 one day later.
Col. 5 - 24 hours beginning 0800 of date shown.
Col. 6 - 24 hours beginning 1600 of date shown.
Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to Col. 1.
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
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Col. 11 - 24 hours of calendar day shown.
Col 12 = Col. 11 - Col. 8 - 1,750 ft^3/s computed algebraically, but not greater than Col. 7; except that part of Col. 8 contributing to the excess-release increment of Col. 11.
Col. 13 - Season limit of cumulative credit beginning June 15, 1987 = 11,418 $(ft^3/s)\cdot d$.

Table 15. - Controlled releases for reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, N.J. - continued
(River Master daily operation record)
Mean discharge in cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Delaware River at Montague Segregation of flow							
Directed		Pepacton	Cannonsville	Neversink	Date	Lake Wallen-paupack	Rio Reservoir	Date	Controlled releases N.Y.C. reservoirs Directed	Other	Power-plants	Computed uncon-trolled	Total	Excess Release Credits Daily	Cumul.
Date 1988	Amount 1	2	3	4		5	6		7	8	9	10	11	12	13
June 28	1,300	71	1,188	46	June 30	0	0	July 1	1,305	0	0	415	1,720	-30	2,758
29	1,334	71	1,219	45	July 1	0	0	2	1,335	0	0	475	1,810	60	2,818
30	1,352	71	1,235	45	2	0	0	3	1,351	0	0	409	1,760	10	2,828
July 1	1,369	71	1,253	45	3	0	0	4	1,369	0	0	461	1,830	80	2,908
2	1,320	71	1,207	45	4	0	156	5	1,323	0	156	301	1,780	30	2,938
3	685	71	575	45	5	465	180	6	691	0	645	474	1,810	60	2,998
4	941	99	775	67	6	0	376	7	941	0	376	333	1,650	-100	2,898
5	948	99	780	67	7	0	337	8	946	0	337	257	1,540	-210	2,688
6	695	114	486	90	8	360	124	9	690	0	484	526	1,700	-50	2,638
7	1,497	121	1,289	90	9	0	0	10	1,500	0	0	260	1,760	10	2,648
8	1,224	121	1,010	88	10	0	237	11	1,219	0	237	354	1,810	60	2,708
9	1,020	121	812	88	11	594	397	12	1,021	0	991	448	2,460	710	3,418
10	991	121	781	88	12	452	230	13	990	0	682	418	2,090	340	3,758
11	1,064	121	855	88	13	464	85	14	1,064	0	549	317	1,930	180	3,938
12	870	99	705	68	14	718	128	15	872	0	846	452	2,170	420	4,358
13	864	99	702	68	15	518	0	16	869	0	518	513	1,900	150	4,508
14	1,484	99	1,315	68	16	0	0	17	1,482	0	0	418	1,900	150	4,658
15	1,154	99	982	68	17	0	280	18	1,149	0	280	381	1,810	60	4,718
16	550	121	476	88	18	648	422	19	551	134	1,070	605	2,360	475	5,193
17	317	121	476	73	19	407	404	20	317	353	811	619	2,100	110	5,303
18	291	99	357	73	20	337	472	21	291	238	809	2,192	3,530	291	5,594
19	352	99	353	70	21	346	0	22	353	169	346	2,432	3,300	352	5,946
20	466	99	351	48	22	0	0	23	469	29	0	2,472	2,970	466	6,412
21	0	71	353	48	23	0	0	24	0	472	0	2,778	3,250	0	6,412
22	0	71	351	48	24	0	216	25	0	470	216	2,394	3,080	0	6,412
23	0	71	351	48	25	454	482	26	0	470	936	1,864	3,270	0	6,412
24	0	71	351	48	26	479	209	27	0	470	688	2,682	3,840	0	6,412
25	0	71	351	63	27	572	415	28	0	485	987	3,468	4,940	0	6,412
26	0	101	348	46	28	581	429	29	0	495	1,010	2,765	4,270	0	6,412
27	0	68	347	50	29	706	645	30	0	465	1,351	2,064	3,880	0	6,412
28	0	68	407	73	30	290	188	31	0	548	478	1,704	2,730	0	6,412
Total	22,088	2,870	22,041	1,985		8,391	6,412		22,098	4,798	14,803	35,251	76,950		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
Col. 4 - 24 hours beginning 1500 one day later.
Col. 5 - 24 hours beginning 0800 of date shown.
Col. 6 - 24 hours beginning 1600 of date shown.
Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to Col. 1.
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
Col. 9 = Col. 5 + Col. 6.

Col. 10 = Col. 11 - Col. 7 - Col. 8 - Col. 9.
Col. 11 - 24 hours of calendar day shown.
Col 12 = Col. 11 - Col. 8 - 1,750 ft^3/s computed algebraically, but not greater than Col. 7; except that part of Col. 8 contributing to the excess-release increment of Col. 11.
Col. 13 - Season limit of cumulative credit beginning June 15, 1987 = 11,418 $(ft^3/s)\cdot d$.

Table 15. - Controlled releases for reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, N.J.
(River Master daily operation record)
Mean discharge in cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Delaware River at Montague Segregation of flow							
Directed		Pepacton	Cannonsville	Neversink	Date	Lake Wallen-paupack	Rio Reservoir	Date	Controlled releases			Computed uncon-trolled	Total	Excess Release Credits	
									N.Y.C. reservoirs		Power-plants				
Date	Amount								Directed	Other				Daily	Cumul.
1988	1	2	3	4		5	6		7	8	9	10	11	12	13
July 29	0	97	464	74	July 31	0	245	Aug. 1	0	635	245	1,520	2,400	95	6,507
30	0	97	461	74	Aug. 1	529	606	2	0	632	1,135	1,323	3,090	0	6,507
31	0	97	461	73	2	865	553	3	0	631	1,418	1,211	3,260	0	6,507
Aug. 1	131	97	461	73	3	699	587	4	131	500	1,286	1,013	2,930	131	6,638
2	301	99	464	82	4	502	340	5	301	344	842	873	2,360	266	6,904
3	643	119	467	82	5	482	415	6	643	25	897	795	2,360	585	7,489
4	1,055	119	848	84	6	0	0	7	1,051	0	0	649	1,700	-50	7,439
5	647	119	466	84	7	0	7	8	647	22	7	804	1,480	-270	7,169
6	379	119	464	84	8	555	39	9	379	288	594	799	2,060	110	7,279
7	295	119	462	68	9	557	24	10	295	354	581	670	1,900	110	7,389
8	277	97	462	68	10	690	170	11	277	350	860	643	2,130	110	7,499
9	419	97	458	68	11	862	319	12	419	204	1,181	516	2,320	366	7,865
10	884	97	718	68	12	649	0	13	883	0	649	628	2,160	411	8,276
11	1,260	97	1,097	68	13	615	11	14	1,262	0	626	422	2,310	558	8,834
12	1,233	121	1,029	82	14	0	60	15	1,232	0	60	378	1,670	-80	8,754
13	710	121	509	82	15	850	167	16	712	0	1,017	471	2,200	448	9,202
14	681	121	480	82	16	352	0	17	683	0	352	355	1,390	-360	8,842
15	770	101	606	70	17	548	0	18	777	0	548	295	1,620	-130	8,712
16	1,002	101	832	70	18	338	0	19	1,003	0	338	309	1,650	-100	8,612
17	998	71	886	48	19	351	0	20	1,005	0	351	344	1,700	-50	8,562
18	1,373	71	1,259	46	20	0	0	21	1,376	0	0	264	1,640	-110	8,452
19	1,463	71	1,357	46	21	0	0	22	1,474	0	0	166	1,640	-110	8,342
20	1,518	71	1,411	46	22	0	0	23	1,528	0	0	202	1,730	-20	8,322
21	1,534	71	1,419	46	23	0	0	24	1,536	0	0	474	2,010	260	8,582
22	1,537	71	1,422	46	24	0	0	25	1,539	0	0	921	2,460	710	9,292
23	1,293	71	1,179	46	25	53	0	26	1,296	0	53	731	2,080	330	9,622
24	1,258	71	1,143	46	26	0	0	27	1,260	0	0	600	1,860	110	9,732
25	1,080	71	972	46	27	0	0	28	1,089	0	0	551	1,640	-110	9,622
26	1,117	71	999	46	28	0	67	29	1,116	0	67	667	1,850	100	9,722
27	1,065	71	947	46	29	82	82	30	1,064	0	164	2,512	3,740	1,064	10,786
28	487	71	370	46	30	0	234	31	487	0	234	3,379	4,100	487	11,273
Total	25,410	2,887	24,573	1,990		9,579	3,926		25,465	3,985	13,505	24,485	67,440		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
Col. 4 - 24 hours beginning 1500 one day later.
Col. 5 - 24 hours beginning 0800 of date shown.
Col. 6 - 24 hours beginning 1600 of date shown.
Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to Col. 1.
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Col. 13 - Season limit of cumulative credit beginning June 15, 1987 = 11,418 $(ft^3/s)\cdot d$.

Table 15. - Controlled releases for reservoirs in the upper Delaware River basin
and segregation of flow of Delaware River at Montague, N.J.
(River Master daily operation record)
Mean discharge in cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Delaware River at Montague Segregation of flow							
Directed		Pepacton	Cannonsville	Neversink	Date	Lake Wallen-paupack	Rio Reservoir	Date	Controlled releases N.Y.C. reservoirs Directed	Other	Power-plants	Computed uncon-trolled	Total	Excess Release Credits Daily	Cumul.
Date 1988	Amount 1	2	3	4		5	6		7	8	9	10	11	12	13
Aug. 29	0	71	39	46	Aug. 31	0	227	Sept. 1	0	156	227	1,997	2,380	0	11,273
30	0	71	39	46	Sept. 1	0	280	2	0	156	280	1,364	1,800	50	11,323
31	0	71	40	46	2	82	429	3	0	157	511	1,052	1,720	-30	11,293
Sept. 1	577	71	466	46	3	0	0	4	583	0	0	707	1,290	-460	10,883
2	411	97	268	46	4	0	0	5	411	0	0	2,359	2,770	411	11,244
3	0	70	39	46	5	0	543	6	0	155	543	2,322	3,020	0	11,244
4	0	70	39	46	6	93	372	7	0	155	465	1,790	2,410	0	11,244
5	0	70	39	46	7	56	255	8	0	155	311	1,514	1,980	35	11,279
6	46	70	40	46	8	61	131	9	46	110	192	1,132	1,480	-270	11,009
7	507	70	394	46	9	58	347	10	510	0	405	675	1,590	-160	10,849
8	796	70	685	46	10	0	131	11	801	0	131	718	1,650	-100	10,749
9	691	70	579	46	11	0	284	12	695	0	284	671	1,650	-100	10,649
10	312	70	196	46	12	237	266	13	312	0	503	1,115	1,930	180	10,829
11	438	70	323	46	13	229	124	14	439	0	353	668	1,460	-290	10,539
12	515	70	404	46	14	234	142	15	520	0	376	724	1,620	-130	10,409
13	473	71	360	46	15	221	670	16	477	0	891	612	1,980	230	10,639
14	773	347	388	46	16	239	284	17	781	0	523	426	1,730	-20	10,619
15	1,357	73	1,242	46	17	0	0	18	1,361	0	0	599	1,960	210	10,829
16	1,266	71	1,148	46	18	0	255	19	1,265	0	255	480	2,000	250	11,079
17	1,029	71	917	46	19	350	110	20	1,034	0	460	586	2,080	330	11,409
18	1,001	71	888	46	20	386	0	21	1,005	0	386	519	1,910	160	11,569
19	955	71	812	45	21	348	92	22	928	0	440	582	1,950	200	11,769
20	975	71	855	45	22	345	0	23	971	0	345	624	1,940	190	11,959
21	942	71	829	46	23	356	0	24	946	0	356	578	1,880	130	12,089
22	1,269	71	1,157	45	24	0	0	25	1,273	0	0	507	1,780	30	12,119
23	1,249	71	1,128	45	25	0	0	26	1,244	0	0	436	1,680	-70	12,049
24	724	71	616	50	26	469	0	27	737	0	469	554	1,760	10	12,059
25	760	71	647	45	27	460	0	28	763	0	460	467	1,690	-60	11,999
26	815	73	702	45	28	484	64	29	820	0	548	362	1,730	-20	11,979
27	840	70	726	45	29	480	0	30	841	0	480	409	1,730	-20	11,959
Total	18,721	2,425	16,005	1,377		5,188	5,006		18,763	1,044	10,194	26,549	56,550		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
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Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to Col. 1.
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
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Col. 11 - 24 hours of calendar day shown.
Col 12 = Col. 11 - Col. 8 - 1,750 ft^3/s computed algebraically, but not greater than Col. 7; except that part of Col. 8 contributing to the excess-release increment of Col. 11.
Col. 13 - Season limit of cumulative credit beginning June 15, 1987 = 11,418 $(ft^3/s)\cdot d$.

Table 15. - Controlled releases for reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, N.J.
(River Master daily operation record)
Mean discharge in cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Delaware River at Montague Segregation of flow							
Directed		Pepacton	Cannonsville	Neversink	Date	Lake Wallen-paupack	Rio Reservoir	Date	Controlled releases: N.Y.C. reservoirs Directed	N.Y.C. reservoirs Other	Power-plants	Computed uncon-trolled	Total	Excess Release Credits Daily	Excess Release Credits Cumul.
Date 1988	Amount 1	2	3	4		5	6		7	8	9	10	11	12	13
Sept.28	1,012	70	900	45	Sept.30	473	0	Oct. 1	1,015	0	473	402	1,890	140	12,099
29	1,455	70	1,340	45	Oct. 1	0	0	2	1,455	0	0	325	1,780	30	12,129
30	1,372	70	1,256	45	2	0	0	3	1,371	0	0	359	1,730	-20	12,109
Oct. 1	988	70	874	45	3	343	0	4	989	0	343	348	1,680	-70	12,039
2	903	70	794	45	4	350	0	5	909	0	350	401	1,660	-90	11,949
3	1,310	70	1,199	45	5	0	42	6	1,314	0	42	384	1,740	-10	11,939
4	1,349	91	1,213	45	6	0	0	7	1,349	0	0	321	1,670	-80	11,859
5	1,372	305	1,021	45	7	0	0	8	1,371	0	0	269	1,640	-110	11,749
6	1,361	311	1,007	43	8	0	0	9	1,361	0	0	329	1,690	-60	11,689
7	1,352	309	996	43	9	0	0	10	1,348	0	0	292	1,640	-110	11,579
8	1,394	309	1,036	43	10	0	188	11	1,388	0	188	314	1,890	140	11,719
9	1,430	309	1,077	43	11	0	14	12	1,429	0	14	317	1,760	10	11,729
10	1,456	308	1,098	45	12	0	0	13	1,451	0	0	299	1,750	0	11,729
11	1,528	306	1,177	48	13	0	0	14	1,531	0	0	279	1,810	60	11,789
12	1,518	616	863	45	14	0	0	15	1,524	0	0	236	1,760	10	11,799
13	1,546	619	883	45	15	0	0	16	1,547	0	0	253	1,800	50	11,849
14	1,562	617	905	45	16	0	0	17	1,567	0	0	233	1,800	50	11,899
15	1,582	617	917	45	17	0	0	18	1,579	0	0	241	1,820	70	11,969
16	1,626	614	964	45	18	0	0	19	1,623	0	0	277	1,900	150	12,119
17	1,640	613	973	45	19	0	0	20	1,631	0	0	219	1,850	100	12,219
18	1,665	617	999	45	20	3	0	21	1,661	0	3	266	1,930	180	12,399
19	1,638	616	978	45	21	0	0	22	1,639	0	0	431	2,070	320	12,719
20	1,122	610	467	45	22	0	0	23	1,122	0	0	918	2,040	290	13,009
21	729	79	605	45	23	0	109	24	729	0	109	1,442	2,280	530	13,539
22	842	312	507	45	24	0	39	25	864	0	39	1,107	2,010	17	13,556
23	705	311	360	45	25	0	0	26	716	0	0	1,344	2,060		
24	427	311	74	46	26	0	0	27	431	0	0	1,239	1,670		
25	0	71	36	46	27	0	0	28	0	153	0	1,127	1,280		
26	354	70	240	46	28	0	0	29	356	0	0	844	1,200		
27	556	220	294	45	29	0	0	30	559	0	0	811	1,370		
28	865	526	294	46	30	30	0	31	866	0	30	744	1,640		
Total	36,659	10,107	25,347	1,394		1,199	392		36,695	153	1,591	16,371	54,810		

Col. 2 - 24 hours beginning 1200 of date shown.
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Col. 4 - 24 hours beginning 1500 one day later.
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Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to Col. 1.
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Col. 13 - Season limit of cumulative credit beginning June 15, 1987 = 11,418 $(ft^3/s)\cdot d$.

Table 15. - Controlled releases for reservoirs in the upper Delaware River basin
and segregation of flow of Delaware River at Montague, N.J.
(River Master daily operation record)
Mean discharge in cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Delaware River at Montague Segregation of flow							
Directed		Pepacton	Cannonsville	Neversink	Date	Lake Wallen-paupack	Rio Reservoir	Date	Controlled releases: N.Y.C. reservoirs Directed	Controlled releases: N.Y.C. reservoirs Other	Controlled releases: Power-plants	Computed uncon-trolled	Total	Excess Release Credits Daily	Excess Release Credits Cumul.
Date 1988	Amount 1	2	3	4		5	6		7	8	9	10	11	12	13
Oct. 29	909	570	294	48	Oct. 31	81	0	Nov. 1	912	0	81	747	1,740		
30	795	599	156	40	Nov. 1	0	266	2	795	0	266	739	1,800		
31	0	70	36	25	2	30	177	3	0	131	207	1,012	1,350		
Nov. 1	652	50	577	25	3	50	7	4	652	0	57	1,141	1,850		
2	683	364	292	25	4	0	0	5	681	0	0	1,169	1,850		
3	530	206	292	25	5	0	0	6	523	0	0	2,367	2,890		
4	0	51	36	25	6	0	180	7	0	112	180	6,898	7,190		
5	0	51	36	25	7	0	135	8	0	112	135	4,833	5,080		
6	0	51	36	25	8	0	277	9	0	112	277	3,721	4,110		
7	0	51	36	25	9	0	309	10	0	112	309	3,029	3,450		
8	0	51	36	25	10	0	152	11	0	112	152	2,596	2,860		
9	0	51	37	25	11	79	0	12	0	113	79	2,348	2,540		
10	0	51	37	25	12	0	0	13	0	113	0	2,207	2,320		
11	0	51	37	25	13	0	188	14	0	113	188	2,899	3,200		
12	0	51	37	25	14	0	315	15	0	113	315	3,982	4,410		
13	0	51	37	25	15	0	518	16	0	113	518	3,219	3,850		
14	0	51	37	25	16	0	152	17	0	113	152	3,025	3,290		
15	0	51	37	25	17	0	223	18	0	113	223	3,234	3,570		
16	0	51	37	25	18	2	0	19	0	113	2	3,565	3,680		
17	0	51	37	25	19	0	0	20	0	113	0	3,687	3,800		
18	0	53	37	25	20	0	390	21	0	115	390	12,295	12,800		
19	0	53	37	25	21	27	698	22	0	115	725	11,260	12,100		
20	0	53	39	25	22	3	468	23	0	117	471	7,982	8,570		
21	0	50	39	25	23	0	106	24	0	114	106	6,290	6,510		
22	0	48	39	25	24	0	138	25	0	112	138	5,360	5,610		
23	0	48	39	25	25	0	447	26	0	112	447	4,381	4,940		
24	0	48	39	25	26	0	177	27	0	112	177	3,811	4,100		
25	0	48	39	25	27	0	213	28	0	112	213	3,805	4,130		
26	0	48	39	19	28	151	258	29	0	106	409	3,685	4,200		
27	0	48	39	19	29	0	667	30	0	106	667	3,477	4,250		
Total	3,569	3,070	2,546	776		423	6,461		3,563	2,829	6,884	118,764	132,040		

Col. 2 - 24 hours beginning 1200 of date shown.
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Table 16. - Consumption of Water by New York City - 1950 to 1988. Data furnished by New York City, Department of Environmental Protection, Bureau of Water Supply

Year	Average daily consumption			Annual consumption (bg)
	City proper (Mgal/d)	Outside communities (Mgal/d)	Total (Mgal/d)	
1950	953.3	29.1	982.4	358.576
51	1,041.9	28.1	1,070.0	390.550
52	1,087.0	32.7	1,119.7	409.810
53	1,093.9	44.6	1,138.5	415.552
54	1,063.4	46.3	1,109.7	405.040
1955	1,109.9	45.3	1,155.2	421.648
56	1,111.3	48.9	1,160.2	424.633
57	1,169.0	57.2	1,226.2	447.563
58	1,152.9	49.6	1,202.5	438.912
59	1,204.3	60.3	1,264.6	461.579
1960	1,199.4	58.9	1,258.3	460.529
61	1,221.0	64.0	1,285.0	469.022
62	1,207.6	68.8	1,276.4	465.896
63	1,218.0	76.7	1,294.7	472.582
64	1,189.2	79.4	1,268.6	464.295
1965	1,052.1	71.2	1,123.3	409.995
66	1,044.9	73.2	1,118.1	408.128
67	1,135.3	71.0	1,206.3	440.302
68	1,242.0	78.2	1,320.2	483.175
69	1,328.7	80.1	1,408.8	514.229
1970	1,400.3	90.4	1,490.7	544.116
71	1,423.6	87.9	1,511.5	551.695
72	1,412.4	83.0	1,495.4	547.340
73	1,448.9	95.4	1,544.3	563.681
74	1,441.8	96.3	1,538.1	561.409
1975	1,415.0	92.1	1,507.1	550.093
76	1,435.0	95.8	1,530.8	560.264
77	1,483.0	104.7	1,587.7	579.510
78	1,479.4	103.0	1.582.4	577.566
79	1,513.0	104.6	1,617.6	590.426
1980	1,506.3	110.1	1,616.3	591.582
81	1,309.5	100.0	1,409.5	514.475
82	1,383.0	104.8	1,487.8	543.060
83	1,424.2	112.6	1,536.8	561.010
84	1,465.2	113.9	1,579.1	577.963
1985	1,325.4	106.5	1,431.9	522.656
86	1,351.1	115.2	1,466.3	535.200
87	1,447.1	119.8	1,566.9	571.885
88	1,484.3	125.6	1,609.9	589.090

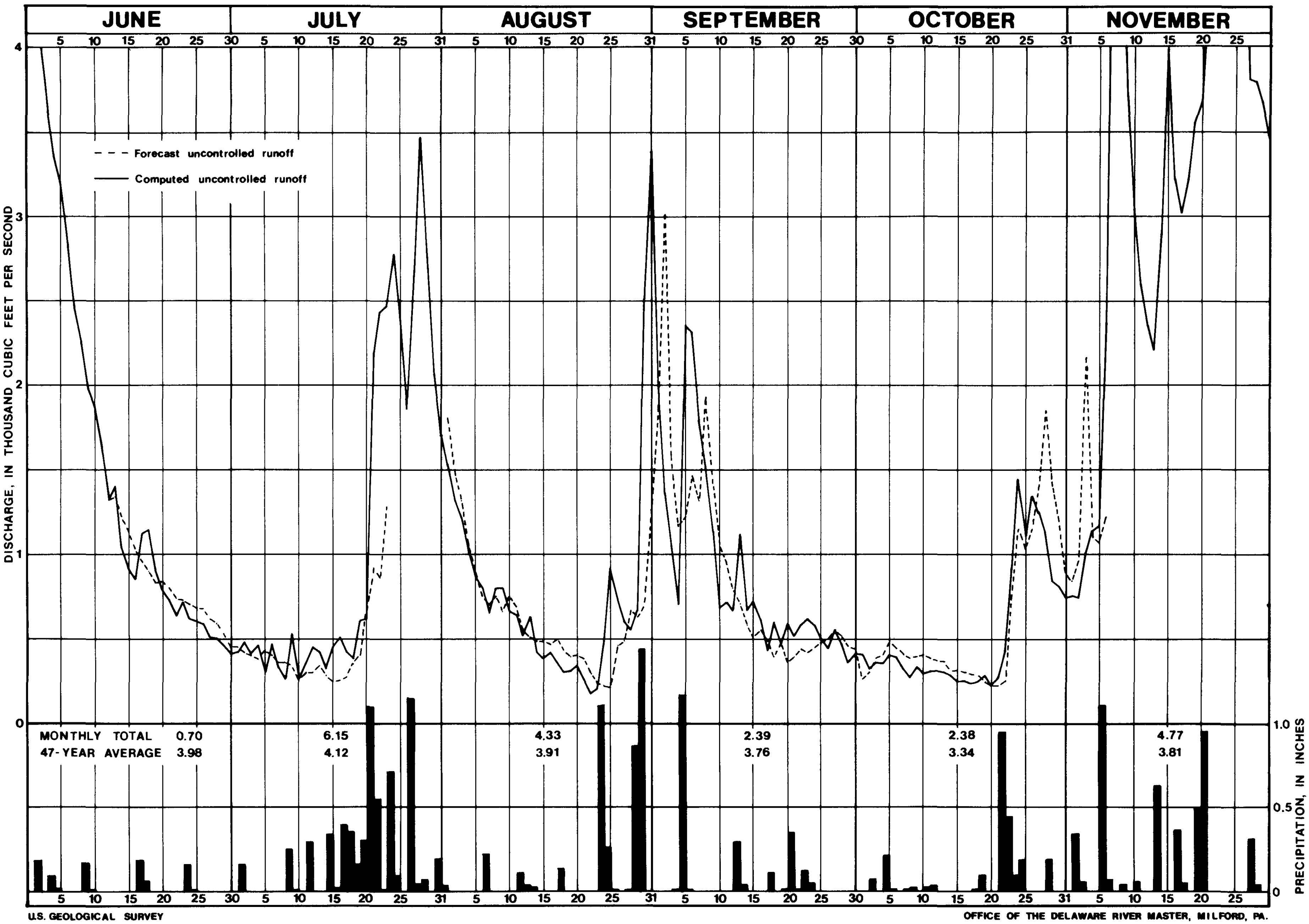

Figure 3. - Uncontrolled runoff component, Delaware River at Montague, N.J., June 1 to November 30, 1988.

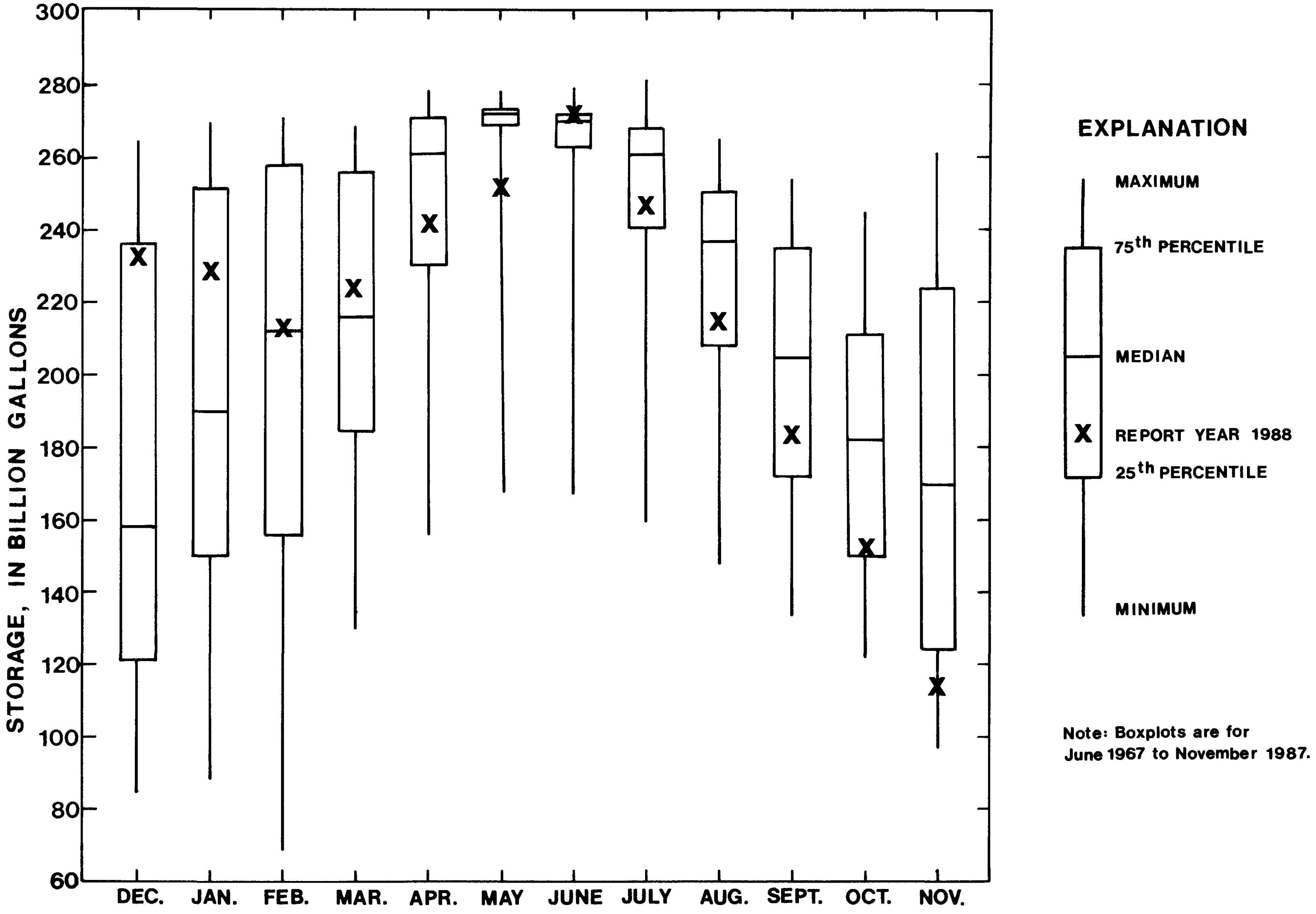

Figure 4. - Combined storage in Pepacton, Cannonsville, and Neversink Reservoirs on the first day of the month, December 1987 to November 1988

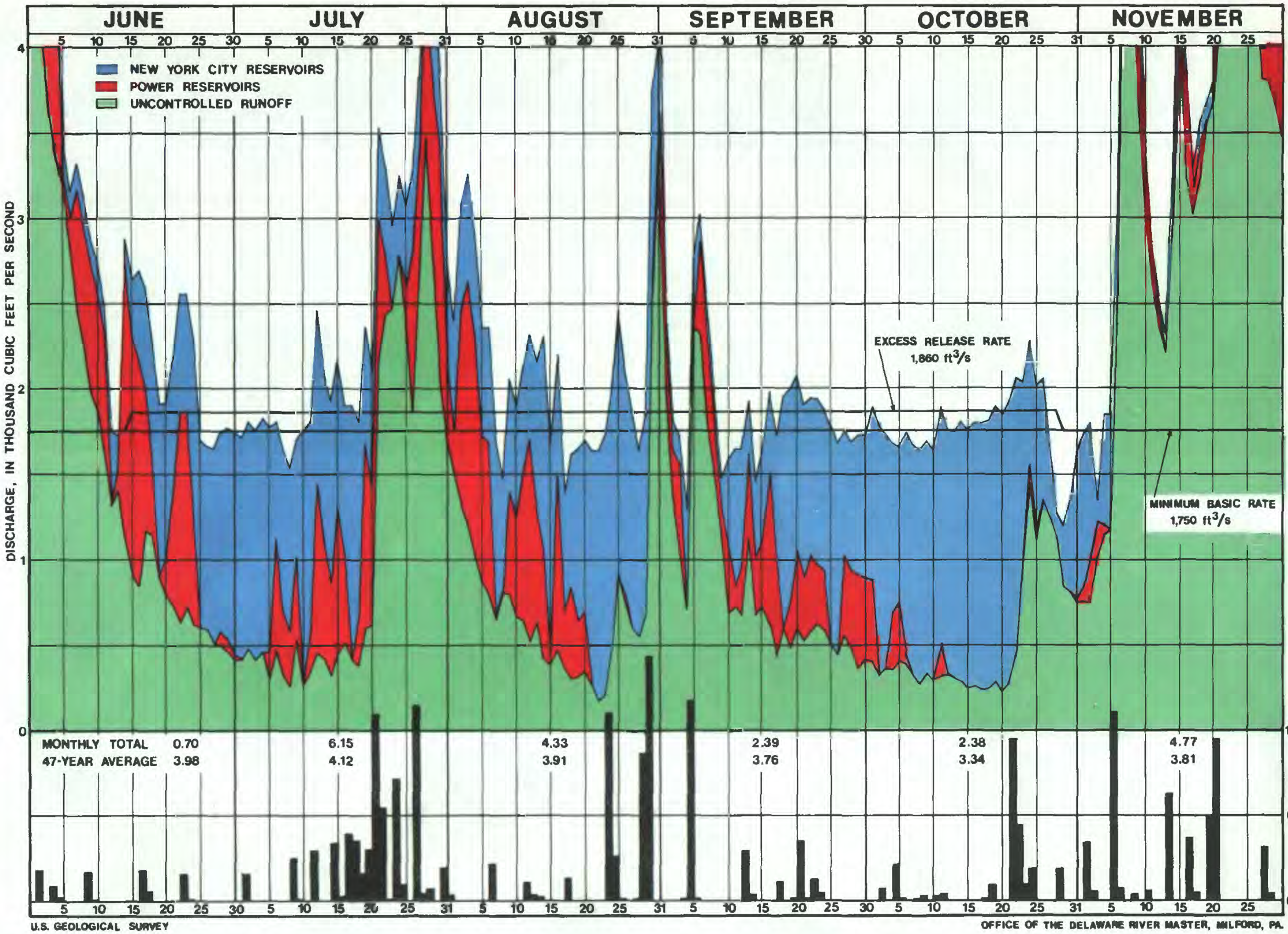

Plate 1. - Components of flow, Delaware River at Montague, N.J., June 1 to November 30, 1988.

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page 73 follows

Section III

WATER QUALITY OF THE DELAWARE RIVER ESTUARY

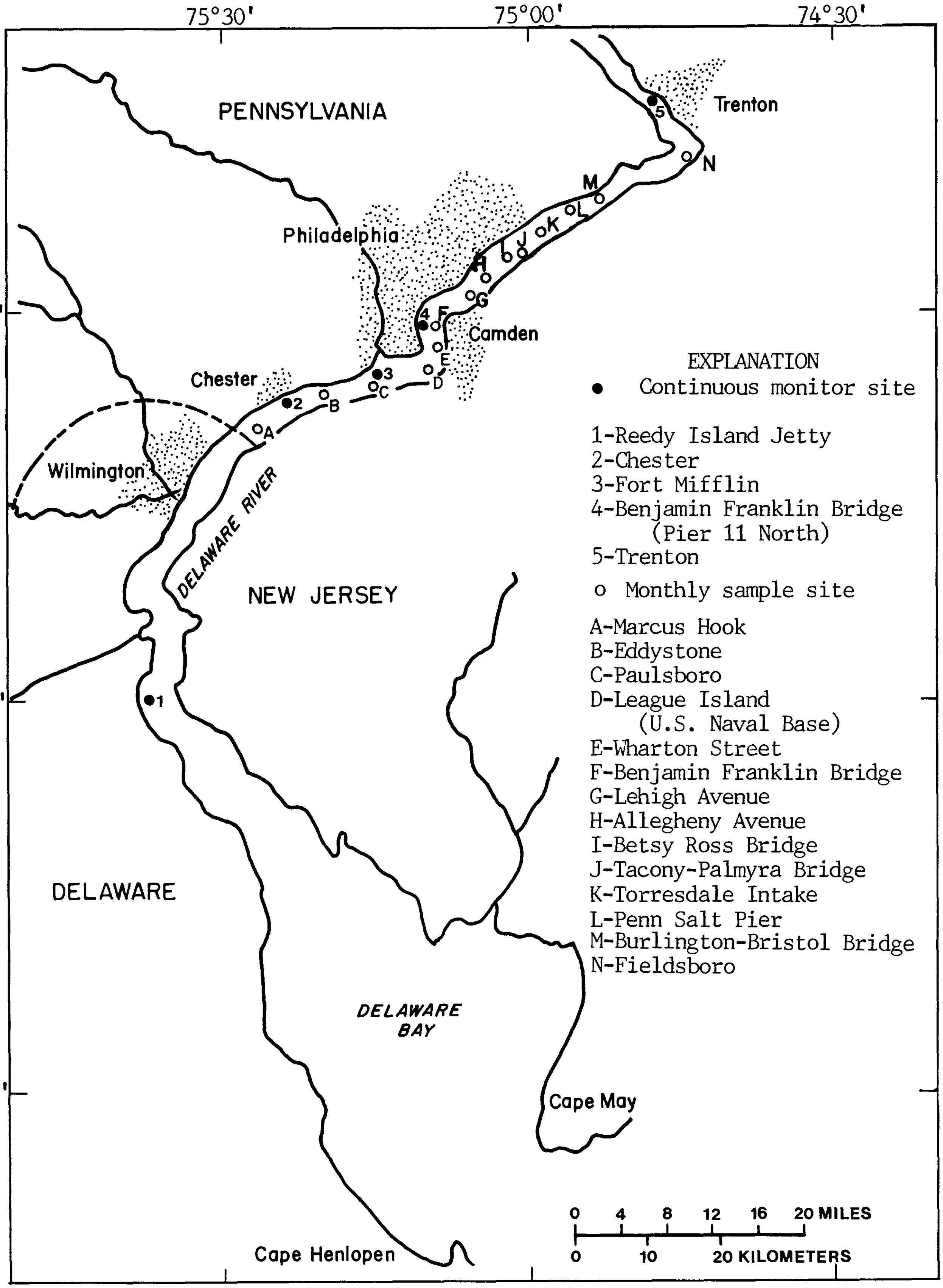

Figure 5.- Delaware River Estuary

Section III

WATER QUALITY OF THE DELAWARE RIVER ESTUARY

By Kirk E. White

INTRODUCTION

This section describes the water-quality monitoring program conducted by the U.S. Geological Survey in the Delaware Estuary during the 1988 report year. Also presented here are some of the data that were obtained by this program and a brief discussion of the significance of the data.

WATER-QUALITY MONITORING PROGRAM

Water quality of the Delaware River and Estuary was monitored between Trenton, N.J., and Reedy Island Jetty, Del.. Data were acquired continuously by electronic instruments at five monitor sites, one at Trenton, upstream of the head of tide and at four sites in the estuary (fig. 5). The monitors at Chester, Pa., Fort Mifflin, Pa. and Benjamin Franklin Bridge were not operated from early December 1987 through the end of February 1988. At Fort Mifflin the water was monitored for two parameters: temperature and specific conductance. At the remaining sites, the water was monitored for four parameters: temperature, specific conductance, dissolved oxygen, and pH.

Additional data were obtained twice a month at 14 sites between Fieldsboro, N.J., and Marcus Hook, Pa. (fig. 5). At each of these sites, samples of water were collected at the center of the river channel. These samples were analyzed for temperature, chloride, alkalinity, biochemical oxygen demand, specific conductance, dissolved oxygen, and pH.

Data obtained from the continuous monitoring sites were processed by computer and stored for future reference by the U.S. Geological Survey. They were also distributed regularly to cooperators and are published annually by the U.S. Geological Survey in "Water Resources Data for Pennsylvania, Volume 1, Delaware River Basin." Data from the twice a month sites were collected by the State of Delaware under the auspices of the Delaware River Basin Commission for the City of Philadelphia Water Department. These data can be obtained from the City of Philadelphia Water Department.

The above-described programs were carried out in cooperation with the City of Philadelphia Water Department, Delaware River Basin Commission, Delaware River Master, and other agencies of federal, state, and county governments.

ESTUARINE WATER-QUALITY DATA DURING 1988

The following is a summary and discussion of the data that were collected during the 1988 report year.

Streamflow

Streamflow is a vital factor which influences the water quality of the estuary. Increased streamflow usually results in better water quality by limiting saltwater intrusion and diluting the concentration of dissolved minerals, both of which contribute to a lower specific conductance and chloride level. Increased flow also aids in maintaining lower water temperature during warm weather and supporting higher dissolved-oxygen levels.

On the basis of streamflow records for the Delaware River at Trenton, monthly mean streamflow was lowest for the year during October (3,769 ft^3/s) and highest for the year during May (16,630 ft^3/s) (see table 8). The monthly mean streamflow was above the respective median for the period of record December, February, March, May, October and November, and below the median for the remainder of the year.

Temperature

The significance of water temperature in regard to water quality in the estuary lies in its profound influence on various physical, chemical, and biological properties of the water. In general, increases in water temperature have deleterious effects on water quality by lowering the saturation level of dissolved oxygen and increasing biological activities.

The primary factors involved in controlling water temperature in the estuary are climatic; however, various uses of the water by man can also have significant effects.

Based on records from Benjamin Franklin Bridge (Pier 11 North) Philadelphia, Pa., monthly mean temperatures for the period March to July 1988 were below normal in May, June and July and equaled or exceeded the norm during March and April. The norm is based on historical temperature records from 1962 to 1987 (see fig. 6). Temperature data for the months August through November are not available, due to suspension of the monitoring station.

Specific Conductance and Chloride

Specific conductance is the ability of a solution to conduct electricity. Basically, it can be used to measure the amount of ionized material in solution and relates approximately to dissolved-solids content.

Specific conductance values in bodies of water usually reflect the geochemistry of the drainage basin; however, pollution and the intrusion of oceanic salts can also have considerable effects. Increasing streamflows reduce the concentration of dissolved solids, thus lowering specific conductance and chloride levels. Conversely, decreasing flows have the opposite effects.

In the Delaware Estuary the intrusion of oceanic salts is important to those who must use the estuary as a water supply. For this reason, chloride concentration is of great interest. Water with chloride concentrations in excess of 250 mg/L (milligrams per liter) is usually considered undesirable for domestic use and water with concentrations in excess of 50 mg/L is unsatisfactory for some industrial uses.

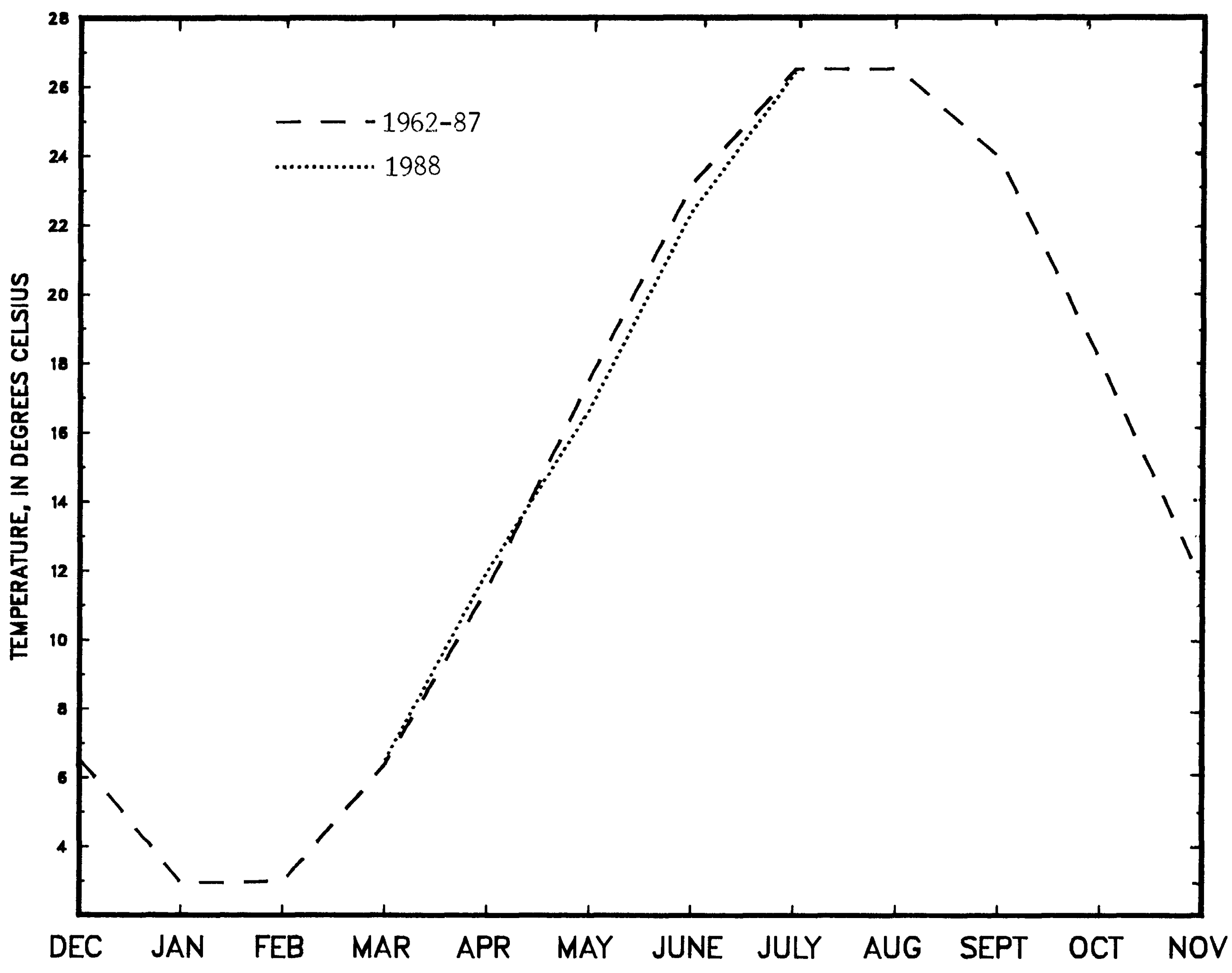

Figure 6.--Mean monthly temperatures of Delaware River at Benjamin Franklin Bridge, Philadelphia, Pennsylvania.

As sea water has a chloride concentration of approximately 19,000 mg/L the location of a body of water in relation to the sea can influence chloride levels in that body of water. For this reason, chloride concentrations in the Delaware Estuary generally increase with distance downstream toward the Delaware Bay and Atlantic Ocean.

Chloride concentration was not measured directly at Fort Mifflin, Pa., and Reedy Island Jetty, Del., but a correlation between specific conductance and chloride concentration has been developed based on analyses of water samples taken in the estuary. Chloride concentrations at those sites presented in tables 17 and 19 were estimated from that relationship. The relationship is less reliable when chloride concentrations are lower than 30 mg/L because other ionized materials may be present in amounts large enough to affect the conductance-chloride relationship. Therefore, chloride concentrations derived from specific conductance are not given when the relationship indicates chloride concentrations of less than 30 mg/L. Chloride concentrations at Chester, Pa., (table 18) were furnished by Scott Paper Company.

At Fort Mifflin, the maximum daily chloride concentration equaled or exceeded 50 mg/L 15 percent of the time (see table 17). The maximum was 100 mg/L on June 10. At Chester, the minimum daily chloride concentration equaled or exceeded 50 mg/L 25 percent of the time and the maximum daily concentration was greater than 50 mg/L 44 percent of the time. The maximum daily chloride concentration exceeded 250 mg/L on October 8 through 10, 18 through 28, and October 31 through November 2, and November 5. The maximum chloride concentration equaled 450 mg/L on October 20 (see table 18). Minimum chloride concentrations at Reedy Island Jetty were below 250 mg/L on March 28 through 30, April 4, and May 23 through 26. During the period December through May, maximum chloride concentrations typically ranged from 2,000 to 5,500 mg/L, whereas the typical maximum chloride range for June through November was 3,500 to 7,500 mg/L (see table 19). The maximum at this site was 8,800 mg/L on October 9.

Table 17.- Daily maximum and minimum chloride concentrations, Delaware River at Fort Mifflin, Pa., in milligrams per liter
December 1, 1987 to November 30, 1988
[A dash (-) indicates missing data; * indicates less than 30 mg/L (milligrams per liter);
Max is maximum value; Min is minimum value]

Day	December		January		February		March		April		May		June		July		August		September		October		November	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1							-	-	*	*	32	*	*	*	35	*	-	-	-	-	40	35	42	35
2							-	-	*	*	31	*	*	*	36	*	-	-	-	-	38	34	-	-
3							-	-	*	*	33	*	*	*	33	*	-	-	-	-	51	35	43	35
4							-	-	*	*	34	*	*	*	33	*	-	-	-	-	48	36	43	35
5							35	*	*	*	34	*	*	*	34	*	-	-	-	-	56	37	-	-
6							*	*	*	*	44	*	*	*	38	*	-	-	-	-	51	37	-	-
7							*	*	31	*	42	*	*	*	37	*	-	-	-	-	57	38	-	-
8							*	*	30	*	42	*	*	*	39	31	-	-	-	-	43	37	49	42
9							*	*	*	*	43	*	97	*	39	31	-	-	-	-	43	38	51	39
10							*	*	*	*	35	*	100	*	41	33	-	-	-	-	43	37	51	40
11							*	*	*	*	33	*	38	*	47	33	-	-	-	-	-	-	83	39
12							*	*	*	*	35	*	33	*	54	35	-	-	-	-	63	48	-	-
13							*	*	*	*	30	*	32	*	51	37	-	-	-	-	63	47	-	-
14							*	*	*	*	*	*	33	*	53	39	-	-	-	-	69	50	-	-
15							*	*	*	*	*	*	30	*	48	40	-	-	33	*	63	53	-	-
16							31	*	30	*	*	*	33	*	48	40	-	-	30	*	61	52	-	-
17							*	*	31	*	*	*	37	*	48	39	-	-	*	*	63	50	-	-
18							*	*	*	*	31	*	33	*	-	-	-	-	30	*	61	51	-	-
19							*	*	34	*	38	*	32	*	-	-	-	-	32	*	60	49	-	-
20							*	*	34	*	*	*	32	*	-	-	-	-	30	*	54	50	-	-
21							*	*	31	*	*	*	*	*	-	-	-	-	35	*	65	48	-	-
22							*	*	30	*	*	*	31	*	-	-	-	-	37	30	80	52	-	-
23							*	*	*	*	*	*	32	*	-	-	-	-	34	30	82	48	-	-
24							*	*	37	*	*	*	33	*	-	-	-	-	38	30	62	46	-	-
25							*	*	38	*	*	*	31	*	-	-	-	-	36	31	58	46	-	-
26							*	*	*	*	*	*	30	*	-	-	-	-	44	30	58	44	-	-
27							32	*	31	*	*	*	34	*	-	-	-	-	39	32	54	43	-	-
28							30	*	42	*	*	*	33	*	-	-	-	-	41	32	-	-	-	-
29							*	*	39	*	*	*	33	*	-	-	-	-	34	31	-	-	-	-
30							*	*	36	*	*	*	34	*	-	-	-	-	38	30	43	35	-	-
31							*	*			*	*			-	-	-	-			-	-		

Table 18.- Daily maximum and minimum chloride concentrations, Delaware River at Chester, Pa., in milligrams per liter December 1, 1987 to November 30, 1988. Collection and analysis by Scott Paper Company.
[A dash (-) indicates missing data; * indicates less than 30 mg/L (milligrams per liter); Max is maximum value; Min is minimum value]

Day	December		January		February		March		April		May		June		July		August		September		October		November	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1	37	36	40	34	56	45	45	33	39	*	45	37	30	*	73	44	44	35	62	45	230	70	300	145
2	42	35	45	38	61	48	48	35	38	30	44	40	*	*	110	42	41	33	75	51	191	88	266	100
3	36	30	42	34	63	54	45	36	38	34	42	36	33	*	130	54	45	34	80	50	193	75	157	80
4	35	*	35	34	63	56	41	32	38	30	44	35	32	*	166	48	44	35	70	49	185	85	218	106
5	35	*	42	35	62	49	42	36	37	*	42	37	34	*	204	55	41	36	67	48	193	97	290	124
6	30	*	38	34	56	46	44	35	31	*	43	38	34	30	120	48	41	36	60	44	175	88	190	141
7	32	*	42	40	58	42	38	34	38	*	42	35	34	31	128	52	39	36	56	42	165	82	185	98
8	30	*	40	36	62	39	40	33	33	31	43	36	34	*	180	56	46	36	60	43	282	84	164	100
9	33	*	48	36	56	36	42	34	34	*	44	38	58	*	220	80	55	36	56	32	335	100	160	132
10	30	*	47	38	43	40	40	36	40	*	47	39	*	*	168	76	46	37	49	40	265	118	150	110
11	30	*	42	38	44	36	39	34	38	32	40	36	33	*	142	74	52	41	52	44	236	120	136	72
12	35	*	44	38	53	40	40	34	36	32	44	42	36	32	175	77	57	40	49	44	232	110	138	56
13	34	30	50	35	51	38	40	35	36	*	40	40	33	32	137	73	60	40	54	44	248	96	112	65
14	31	*	48	40	47	34	42	35	42	*	40	34	33	32	190	90	63	40	53	43	160	-	95	64
15	30	*	55	41	50	34	41	34	36	30	40	38	40	33	219	90	49	42	52	45	-	-	85	60
16	34	*	47	41	58	39	35	30	34	*	41	38	40	33	268	120	48	41	49	42	-	-	120	58
17	37	*	47	42	52	30	45	32	38	30	42	38	45	35	268	100	67	47	50	44	190	112	100	96
18	35	*	50	43	45	43	41	34	41	32	44	38	30	*	200	90	51	42	55	48	265	130	128	110
19	32	*	54	44	45	40	38	36	36	32	44	39	*	*	220	92	66	52	60	46	370	122	-	-
20	37	30	57	46	44	40	43	34	38	33	-	-	33	30	200	91	65	50	75	48	450	140	114	54
21	36	*	58	49	45	36	45	35	35	30	56	51	36	33	185	90	59	50	80	44	430	166	58	42
22	34	30	60	49	42	34	45	34	37	32	36	*	46	34	113	60	75	50	142	58	255	136	56	36
23	33	*	57	50	65	36	42	36	36	33	33	*	44	38	76	53	87	53	85	50	280	110	44	34
24	32	*	57	40	40	34	40	36	39	35	32	*	45	38	72	54	68	45	80	47	295	118	36	31
25	34	31	51	46	44	36	36	30	41	32	34	*	80	42	65	54	58	47	125	53	365	140	36	32
26	32	*	58	48	38	33	38	34	41	35	39	*	44	34	63	44	68	55	145	56	274	130	38	*
27	38	30	53	46	38	33	36	33	50	34	37	32	48	37	46	39	68	54	150	65	270	113	40	31
28	32	*	52	48	40	34	38	32	40	35	38	33	57	46	45	33	60	55	115	65	270	114	37	*
29	36	30	51	48	39	33	38	*	40	34	37	35	59	36	41	38	85	47	185	75	248	100	*	*
30	38	*	54	48			42	32	42	35	37	*	70	35	58	38	69	47	150	68	246	100	-	-
31	36	30	54	47			38	30			34	*			66	33	86	44			310	130		

Table 19.- Daily maximum and minimum chloride concentrations, Delaware River at Reedy Island Jetty, Del., in milligrams per liter
December 1, 1987 to November 30, 1988
[A dash (-) indicates missing data; Max is maximum value; Min is minimum value]

Day	December		January		February		March		April		May		June		July		August		September		October		November	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1	-	-	4200	1700	-	-	4100	1000	1500	250	5100	1600	3800	790	6200	3000	4000	1200	5500	2500	6100	3300	6700	3400
2	-	-	4200	1600	4200	1300	3800	1100	1600	260	4500	1700	3100	800	-	-	3800	1300	5300	2500	5900	3400	6500	3800
3	-	-	4600	1700	4500	1300	3100	900	2100	250	5200	1700	4000	1100	-	-	3500	1300	5400	2600	5400	3000	5500	2800
4	-	-	5300	2100	4000	1100	3100	920	1900	240	4900	1600	3500	940	-	-	3700	1300	5500	2700	6400	3100	6400	2800
5	-	-	3800	1400	2700	880	2900	750	1500	280	3600	1500	3400	950	-	-	3500	1300	4700	2200	7300	4200	7700	3800
6	-	-	-	-	-	-	2500	650	1800	310	4400	1600	2600	820	5300	2800	3700	1200	4900	1900	6600	3700	6600	4100
7	3300	780	-	-	-	-	2000	590	2800	580	4800	1500	-	-	5600	2900	4000	1200	5200	2000	7200	3500	-	-
8	-	-	-	-	-	-	-	-	3400	750	4400	1500	4200	1100	5900	2900	-	-	5700	2000	8100	4400	6200	3100
9	-	-	-	-	-	-	2100	570	3100	670	3600	1600	4500	1300	5700	2900	-	-	5600	2200	8800	4800	5400	2900
10	-	-	-	-	-	-	2400	500	3700	700	2900	1400	4800	1300	5800	2700	-	-	5600	2300	8300	4600	6400	3200
11	-	-	-	-	-	-	2600	480	4700	1000	3100	1300	4800	1400	6100	2800	4000	1600	5600	2400	-	-	5400	2700
12	-	-	-	-	-	-	2200	480	5600	1700	3200	1100	5000	1600	5700	2900	4500	1500	5200	2600	6600	3800	5600	2800
13	-	-	-	-	-	-	2000	390	5300	2300	3500	1100	4700	1400	6000	2900	4700	1500	5700	2500	6600	3700	6200	2900
14	-	-	-	-	-	-	3100	350	4800	1900	3400	940	4800	1600	6400	2900	4500	1400	5400	2400	7600	3800	6000	3000
15	-	-	-	-	-	-	3500	530	4100	2100	3700	980	4800	1600	6100	3100	4300	1300	5200	2500	6700	3700	5200	2800
16	-	-	-	-	-	-	3700	510	4100	1700	3600	1200	4500	1700	6100	3100	3800	1200	5900	2600	7400	3800	5600	2800
17	-	-	-	-	-	-	3500	620	4000	1600	3700	1200	4300	1700	5500	3100	4900	1400	5800	2600	7200	4100	4600	2700
18	-	-	-	-	2700	530	3900	660	4000	1600	3500	1200	4200	1700	4900	2800	5000	1800	5400	2700	7700	4100	4500	2500
19	-	-	-	-	2700	550	3500	750	4000	1600	3500	1100	4400	1700	6100	3100	4400	2000	5300	2200	7300	3900	5000	2400
20	-	-	-	-	2800	560	3900	760	4100	780	2700	660	3700	1800	5200	2800	-	-	6300	2400	7500	3800	5200	2500
21	5900	2100	-	-	1600	390	2800	530	3800	1300	1300	410	3700	1700	5100	2600	-	-	5900	2300	6900	4100	-	-
22	3600	2100	-	-	1100	390	2500	440	3600	1300	1400	280	4400	1800	4100	1800	-	-	6400	2200	-	-	-	-
23	4900	1800	-	-	470	340	2400	470	3900	1400	1200	210	4400	1800	4200	1800	-	-	6000	2400	-	-	4000	1200
24	4200	1800	-	-	750	260	2400	310	4200	1500	1200	170	5500	1700	4600	1800	7300	2600	5700	2600	-	-	3900	1100
25	3700	1600	3100	2200	1400	250	1900	330	4000	1400	1600	140	5500	2200	5200	1600	7200	3000	-	-	7000	4000	-	-
26	3500	1500	-	-	1900	200	2500	520	4900	1700	2800	200	4300	2000	4900	1600	6500	3000	-	-	-	-	-	-
27	3800	1700	-	-	2600	370	-	-	5000	2200	3300	570	5800	1800	4300	1400	6900	2900	6200	3000	-	-	-	-
28	3400	1600	-	-	3400	990	1900	150	4300	2100	3500	520	5800	2200	3700	1200	-	-	6000	3100	-	-	-	-
29	4800	1900	-	-	3900	1100	2400	130	4400	1800	3400	570	6100	2600	4000	1100	-	-	6400	3100	-	-	1500	630
30	4200	1600	-	-			2100	220	4600	1600	3400	560	6000	2600	4000	1100	-	-	6000	3200	-	-	2800	600
31	5600	1800	-	-			1900	280			3600	730			4000	1200	5800	2500			6200	3600		

Dissolved Oxygen

Dissolved oxygen is necessary in water for the respiration of aquatic organisms. It also plays a significant role in chemical reactions in aquatic environments. The major sources of dissolved oxygen in water are diffusion from the air and photosynthesis in aquatic plants. Dissolved-oxygen levels are limited by temperature, salinity, and the partial pressure of atmospheric oxygen.

Dissolved-oxygen levels in the estuary generally are highest near Trenton and decrease with distance downstream to the Benjamin Franklin Bridge where minimum values are usually reached.

During the past year, daily mean dissolved-oxygen concentration at the Benjamin Franklin Bridge was below 5 mg/L from June 21 through July 28; data subsequent to this date are not available, due to suspension of the monitoring site. The minimum daily mean was 2.3 mg/L on July 24. At Chester, the daily mean dissolved-oxygen concentration was below 5 mg/L from June 17 through 23, June 28 through July 1, July 6 through August 23, and August 25 through September 15 (see table 20). The lowest daily mean was 2.5 mg/L on August 1. The minimum hourly value was 2.1 mg/L on August 2. At Reedy Island Jetty, minimum hourly value was 3.7 mg/L on August 1.

Figure 7 shows the frequency of hourly dissolved-oxygen concentration at Chester during the critical summer period, July through September, 1988. Dissolved oxygen concentration was below 4 mg/L 35 percent of the time at Chester in 1988, as compared with 78 percent of the time in 1987.

Hydrogen-Ion Concentration (pH)

Hydrogen-ion concentration (pH) is fundamentally a measure of acidity or alkalinity. Values of pH below 7 indicate acidity, whereas values above 7 indicate alkalinity. In natural waters, pH generally ranges from 6.0 to 8.5. The main factors controlling the pH of a body of water are usually the geochemistry of the drainage basin and external influences such as pollution. Photosynthetic activity can also have a considerable influence on pH values. Increased photosynthetic activity (algal bloom) produces higher pH values. All pH values at Benjamin Franklin Bridge, Chester, and Reedy Island Jetty were in a range of 6.3 to 8.3. The pH range for each station is: Reedy Island Jetty, 6.9 to 8.3; Chester, 6.3 to 7.7; Benjamin Franklin Bridge, 6.5 to 7.7. The pH in the estuary tends to be lowest near Trenton, N.J., and to increase downstream.

Table 20.- Dissolved oxygen, Delaware River at Chester, Pa.
Daily mean dissolved oxygen in milligrams per liter
December 1, 1987, to November 30, 1988
[Monitor was not in operation December 4, 1987 to February 29, 1988]

Day	December	January	February	March	April	May	June	July	August	September	October	November
1	8.9			8.0	9.5	10.1	6.4	4.9	2.5	3.5	5.6	7.5
2	8.8			8.1	9.1	9.6	6.8	5.1	2.6	3.3	5.7	7.6
3	9.0			8.2	8.6	9.2	7.1	5.1	2.8	3.5	5.7	7.8
4				8.2	8.2	8.6	7.0	5.1	3.0	4.1	5.6	7.8
5				8.4	8.0	8.0	6.9	5.0	3.3	4.8	5.8	7.8
6				8.5	8.0	7.8	7.0	4.8	3.7	4.7	5.9	8.0
7				8.5	8.5	7.5	6.8	4.6	3.8	4.6	5.9	7.9
8				8.7	8.5	7.1	6.5	4.6	4.1	4.6	6.2	7.7
9				8.8	8.6	6.8	6.2	4.5	4.2	4.6	6.6	7.5
10				9.0	8.7	6.5	6.1	4.3	4.2	4.5	6.8	7.4
11				9.2	8.7	6.1	6.0	4.2	4.0	4.3	7.0	7.4
12				9.3	8.8	5.9	5.9	4.1	3.9	4.1	7.1	7.3
13				9.4	9.0	5.8	5.8	4.1	3.8	4.1	7.2	7.4
14				9.5	9.1	6.0	5.6	4.1	4.1	4.3	7.4	7.3
15				9.6	9.0	6.0	5.3	4.0	4.3	4.8	7.4	7.3
16				9.8	8.9	5.9	5.2	3.9	4.0	5.3	7.5	7.1
17				10.0	9.2	5.7	4.9	4.3	4.1	5.3	7.4	7.1
18				10.1	9.2	5.7	4.4	4.0	3.1	5.4	7.3	7.1
19				10.0	9.1	6.0	4.3	3.8	3.5	5.2	7.3	7.0
20				10.1	9.5	5.6	4.4	3.8	4.2	5.2	7.3	7.2
21				10.2	9.9	5.6	4.3	3.9	4.0	5.2	7.4	7.7
22				10.2	10.5	5.7	4.3	3.9	4.2	5.1	7.7	8.0
23				10.2	10.8	5.9	4.6	3.4	4.5	5.2	7.6	8.0
24				10.3	10.9	6.3	5.0	3.6	5.0	5.2	7.6	8.2
25				10.4	11.2	6.4	5.4	3.1	4.7	5.1	7.6	8.4
26				10.3	11.4	6.5	5.6	2.9	4.5	5.0	7.5	8.4
27				10.2	11.4	6.5	5.2	3.3	4.3	5.1	7.4	8.4
28				10.1	10.9	6.5	4.9	3.0	4.3	5.1	7.3	8.6
29				9.7	10.6	6.4	4.7	2.8	4.4	5.5	7.3	9.2
30				9.7	10.4	6.2	4.6	2.6	4.2	5.6	7.3	9.2
31				9.7		6.3		2.6	3.7		7.4	

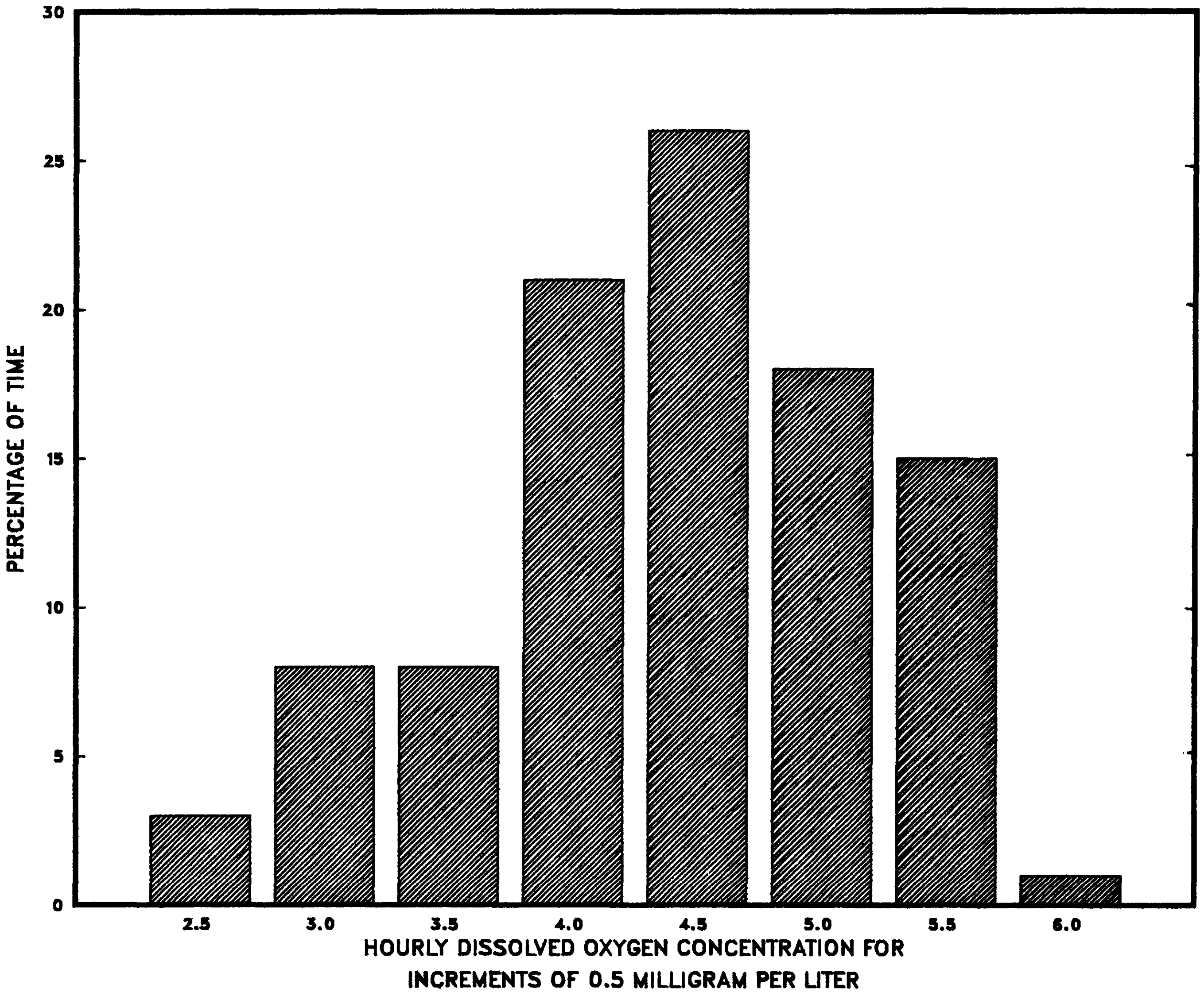

Figure 7.--Frequency of occurrence of dissolved-oxygen concentrations at Delaware River at Chester, Pennsylvania, during July, August, and September 1988.

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