Prepared in cooperation with the
Federal Emergency Management Agency

Flood of June 26–29, 2006, Mohawk, Delaware and Susquehanna River Basins, New York

Open-File Report 2009–1063

U.S. Department of the Interior
U.S. Geological Survey

Cover. Bridge (background image): Riverside Drive bridge, Binghamton, NY, on June 28, 2006. Photo courtesy of Jim DeVona.

Mohawk River basin: Fonda Speedway near Fonda, NY, on June 28, 2006. Photo courtesy of Ryan Peterson and Valley View Aviation

Delaware River basin: Narrowsburg, NY, inundated by the floodwaters of the Delaware River on June 28, 2006. Photo courtesy of the Times Herald-Record, taken by staff photographer Jeff Goulding.

Susquehanna River basin: Oneonta, NY, municipal complex and wastewater treatment plant taken from Army National Guard helicopter on June 29, 2006. Photo courtesy of The Daily Star, taken by photographer Anita Briggs.

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By Thomas P. Suro, Gary D. Firda, and Carolyn O. Szabo

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**U.S. Department of the Interior
U.S. Geological Survey**

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Conversion Factors, Datum, and Acronyms

Multiply	By	To obtain
Length		
inch (in.)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
Area		
acre	4,047	square meter (m ²)
acre	0.4047	hectare (ha)
acre	0.4047	square hectometer (hm ²)
acre	0.004047	square kilometer (km ²)
square foot (ft ²)	929.0	square centimeter (cm ²)
square foot (ft ²)	0.09290	square meter (m ²)
square mile (mi ²)	259.0	hectare (ha)
square mile (mi ²)	2.590	square kilometer (km ²)
Volume		
million gallons (Mgal)	3,785	cubic meter (m ³)
cubic foot (ft ³)	28.32	cubic decimeter (dm ³)
cubic foot (ft ³)	0.02832	cubic meter (m ³)
acre-foot (acre-ft)	1,233	cubic meter (m ³)
acre-foot (acre-ft)	0.001233	cubic hectometer (hm ³)
Flow rate		
acre-foot per day (acre-ft/d)	0.01427	cubic meter per second (m ³ /s)
cubic foot per second (ft ³ /s)	0.02832	cubic meter per second (m ³ /s)
cubic foot per second per square mile [(ft ³ /s)/mi ²]	0.01093	cubic meter per second per square kilometer [(m ³ /s)/km ²]
million gallons per day (Mgal/d)	0.04381	cubic meter per second (m ³ /s)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$^{\circ}\text{F} = (1.8 \times ^{\circ}\text{C}) + 32$$

Temperature in degrees Fahrenheit (°F) may be converted to degrees Celsius (°C) as follows:

$$^{\circ}\text{C} = (^{\circ}\text{F} - 32) / 1.8$$

Vertical coordinate information is referenced to National Geodetic Vertical Datum of 1929 (NGVD 29).

Horizontal coordinate information is referenced to North American Datum of 1983 (NAD 83).

Barge Canal Datum (BCD) is site specific and there are local conversion factors, in feet, to National Geodetic Vertical Datum of 1929.

Acronyms Used in This Report

FEMA	Federal Emergency Management Agency
NGS	National Geodetic Survey
NWS	National Weather Service
NYCDEP	New York City Department of Environmental Protection
NYS DOT	New York State Department of Transportation
PPL	Pennsylvania Power and Light Corporation
USGS	U.S. Geological Survey

Flood of June 26–29, 2006, Mohawk, Delaware, and Susquehanna River Basins, New York

By Thomas P. Suro, Gary D. Firda, and Carolyn O. Szabo

Abstract

A stalled frontal system caused tropical moisture to be funneled northward into New York, causing severe flooding in the Mohawk, Delaware, and Susquehanna River basins during June 26–29, 2006. Rainfall totals for this multi-day event ranged from 2 to 3 inches to greater than 13 inches in southern New York. The storm and flooding claimed four lives in New York, destroyed or damaged thousands of homes and businesses, and closed hundreds of roads and highways. Thousands of people evacuated their homes as floodwaters reached new record elevations at many locations within the three basins. Twelve New York counties were declared Federal disaster areas, more than 15,500 residents applied for disaster assistance, and millions of dollars in damages resulted from the flooding. Disaster-recovery assistance for individuals and businesses adversely affected by the floods of June 2006 reached more than \$227 million.

The National Weather Service rainfall station at Slide Mountain recorded storm totals of more than 8 inches of rainfall, and the stations at Walton and Fishs Eddy, NY, recorded storm totals of greater than 13 inches of rainfall. The U.S. Geological Survey (USGS) stream-gaging stations at Mohawk River at Little Falls, West Branch Delaware River at Hale Eddy, and Susquehanna River at Vestal, NY, among others, recorded peak discharges of 35,000 ft³/s, 43,400 ft³/s, and 119,000 ft³/s respectively, with greater than 100-year recurrence intervals. The peak water-surface elevation 21.47 ft and the peak discharge 189,000 ft³/s recorded on June 28, 2006, at the Delaware River at Port Jervis stream-gaging station were the highest recorded since the flood of August 1955. At the Susquehanna River at Conklin, NY, stream-gaging station, which has been in operation since 1912, the peak water-surface elevation 25.02 ft and peak discharge 76,800 ft³/s recorded on June 28, 2006, exceeded the previous period-of-record maximums that were set during the flood of March 1936. Documented peak water-surface elevations during the June 2006 flood at many study sites in the Mohawk, Delaware, and Susquehanna River basins exceeded the 100-year flood-profile elevations determined in the flood-insurance studies prepared by the Federal Emergency Management Agency.

Introduction

Major flooding occurred during June 26–29, 2006, across New York State and adjacent states resulting from a stalled frontal boundary that funneled tropical moisture over New York, New Jersey, and Pennsylvania. Prior to June 2006, streamflow conditions in the Mohawk and Delaware River basins generally were within the normal range, and conditions in the Susquehanna River basin were in the dry range. Heavy rains spread from south to north across central New York from June 26 through June 29, 2006, producing rainfall totals that generally ranged from 2 to greater than 7 in. in many areas with localized rainfall totals of greater than 10 to 13 in. in several parts of southern New York. The National Weather Service (NWS) recorded rainfall amounts of 3.62 in. at Albany, 7.13 in. at Binghamton, and 13.36 in. at Walton, NY (National Oceanic and Atmospheric Administration, 2006a). The storm and flooding claimed four lives in New York, destroyed or damaged thousands of homes and businesses, and closed hundreds of roads and highways.

Several USGS stream-gaging stations along the Mohawk, Delaware, and Susquehanna River basins recorded peak discharges with a recurrence interval of greater than 100-years during the June 2006 flood. A state of emergency was declared in many counties in southern New York including Broome, Chenango, Delaware, Montgomery, Sullivan, and Ulster. According to the New York State Department of Transportation (New York State Department of Transportation, 2006), on Wednesday, June 28, 2006, roads were closed at 138 locations throughout New York because of flooding, including approximately 275 mi of the New York Interstate Highway System (New York State Department of Transportation, 2006). Thousands of people were asked to evacuate their homes because of rising floodwaters in New York, New Jersey, and Pennsylvania. U.S. National Guard and State helicopters were dispatched to rescue victims from their rooftops as the floodwaters washed out roads and damaged homes and businesses. On July 1, 2006, the head of the Department of Homeland Security, Federal Emergency Management Agency (FEMA), announced that a major disaster had been declared for New York to supplement State and local recovery efforts in the areas struck by severe storms

and flooding that began on June 26, 2006 (Federal Emergency Management Agency, 2006). Twelve counties in New York were named in the disaster declaration, and by July 6, 2006, more than 3,200 individuals had registered for disaster assistance. On July 12, 2006, \$2.2 million was initially approved to assist flood victims in New York with housing.

Nearly \$30 million was approved for disaster assistance by July 25, 2006. The initial \$2.2 million in disaster assistance for housing was increased to \$16.2 million, \$10.4 million was added for low-interest loans to homeowners, and additional funding of about \$3.1 million was approved for other needs and assistance. More than 15,500 individuals had applied for assistance by December 18, 2006. On December 29, 2006, FEMA announced that more than \$227 million had been approved or obligated for assistance to residents and businesses for disaster-related expenses not covered by insurance and for State and local agencies to repair flood damages and rebuild infrastructure damaged during the flood (Federal Emergency Management Agency, 2006). The USGS, in cooperation with FEMA, conducted a study to characterize the effects of the 4-day storm.

This report documents the flooding in the Mohawk, Delaware, and Susquehanna River basins in New York. Included in this report are rainfall data, reservoir water-surface elevations, discharge hydrographs, peak discharges, and updated flood-frequency data for selected USGS stream-gaging stations. This report also documents peak water-surface elevations at 29 USGS stream-gaging stations and 104 study sites along the Mohawk River and selected tributaries; the East, West, and main branches of the Delaware River and selected tributaries downstream to Port Jervis, NY; and the Susquehanna River and selected tributaries downstream to Athens, PA. Rainfall amounts, streamflow discharges, updated flood frequencies, and water-surface elevations for streams and reservoirs are presented in figures and tables. Peak surface-water elevations and peak discharges are compared to those of historical floods. FEMA personnel, in cooperation with the USGS, selected the 104 study sites in the Mohawk, Delaware, and Susquehanna River basins included in this report. Peak water-surface elevations were surveyed, described, and photographed by USGS and URS Corporation personnel. Descriptions and maps of individual sites are presented in Appendix 1. Comparisons of peak water-surface elevations at selected study sites in the Delaware River basin between the September 2004 and the June 2006 floods are shown in Appendix 2. Photographs of flood damage to selected areas in the Mohawk, Delaware, and Susquehanna River basins are shown in Appendix 3. Peak water-surface elevations at many study sites exceeded the 100-year flood-profile elevations and at some study sites exceeded the 500-year flood-profile elevations as documented in flood-insurance studies by FEMA. Peak-of-record discharges were recorded at several USGS stream-gaging stations in each of the studied basins.

Storm of June 26–29, 2006

Antecedent Conditions

Prior to June 2006, streamflow conditions in the Mohawk and Delaware River basins were generally in the normal range, and streamflow conditions in the Susquehanna River basin were in the dry range. The NWS reported precipitation totals for May 2006 that ranged from 25 to 95 percent of normal across parts of the lower Delaware and Susquehanna River basins. Precipitation in the Mohawk and Hudson River basins ranged from 25 to more than 100 percent of normal for the month of May 2006 (National Oceanic and Atmospheric Administration, 2006d). Storm activity started to pick up during the first part of June with numerous storm systems moving across the State of New York. Widespread rainfall from these systems was generally less than 0.75 in.; however, a couple of storms produced about 1.5 in. of rainfall in several broad areas in western and southeastern New York. The period of June 16–22, 2006, was relatively calm with respect to precipitation. Rainfall amounts across the three basins were generally less than 0.50 in.

Precipitation

The daily mean flow at the USGS stream-gaging stations Mohawk River at Little Falls, West Branch Delaware River at Walton, and the Susquehanna River at Conklin were in the normal range on June 1, 2006. The daily mean flow on June 1, 2006, at the USGS stream-gaging station East Branch Delaware River at Margaretville was at a level exceeded less than 10 percent of the time. On Friday, June 23, a cold front moved through Pennsylvania, New Jersey, and southeastern New York. Rainfall totals from this event were light to moderate, but this weather pattern continued into the following week. Rain increased on June 25 into June 26 with daily rainfall totals of 1 to 3 in. reported in southeastern New York. On Tuesday, June 27, a frontal boundary characterized by low pressure was centered over the Midwest, and a high pressure system centered off of the southern coast of New Jersey stalled over the region. The opposite rotations of these two systems worked together to channel tropical moisture northward directly over central New York and the Susquehanna, Delaware, and Mohawk River basins. Heavy rains spread from south to north across New York from June 26 through June 29, 2006. Cumulative 4-day rainfall totals across New York ranged from less than 2 in. to greater than 12 in. (fig. 1A) and daily rainfall totals for June 26 to June 29 ranged from less than 1 in. to greater than 6 in. (fig. 1B).

This storm system produced widespread rainfall amounts of greater than 5 in. in the three basins; isolated areas received rainfall in excess of 10 in. in a 4-day period. Rainfall amounts for the storm of June 26–29 at selected sites in the Mohawk,

Figure 1A. Cumulative 4-day rainfall for the storm of June 26–29, 2006, and pertinent geographic features of New York.

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Figure 1B. Daily rainfall totals for the storm of June 26–29, 2006, and pertinent geographic features of New York.

Figure 1C. Total rainfall in the Mohawk River basin, NY, and surrounding area for the storm of June 26–29, 2006. (Precipitation sites listed in table 1. Additional National Weather Service rainfall data and provisional spotter rainfall data used to develop map.)

Figure 1D. Total rainfall in the Delaware River basin, NY, and surrounding area for the storm of June 26–29, 2006. (Precipitation sites listed in table 1. Additional National Weather Service rainfall data and provisional spotter rainfall data used to develop map.)

Figure 1E. Total rainfall in the Susquehanna River basin, NY, and surrounding area for the storm of June 26–29, 2006. (Precipitation sites listed in table 1. Additional National Weather Service rainfall data and provisional spotter rainfall data used to develop map.)

Delaware, and Susquehanna River basins are shown in figures 1C–E.

Cumulative hourly data recorded at the NWS precipitation station in Claryville, NY, describe a moderately heavy rain in the late morning hours on June 26, then a sustained rain through June 27 (fig. 2A). A heavy burst of rain was recorded from late in the evening on June 27 through the first 8 hours of June 28. This period of heavy rain increased the rainfall total for this storm from about 4.5 in. late in the day on June 27 to more than 7.5 in. by noon on June 28 at the NWS station at Claryville, NY.

Precipitation data for the NWS station at Binghamton, NY, indicate slightly different timing, but a similar rainfall pattern (fig. 2B). Recorded rainfall at Binghamton indicated a rather sharp increase in rainfall from near midnight on June 26 into the early morning hours of June 27, then a fairly slow and intermittent rain until early evening on June 27. A heavy and fairly constant period of rain was recorded from early evening on June 27 through the morning of June 28. Rainfall totals at Binghamton increased from less than 4 in. to more than 6.5 in. from June 27 to the morning of June 28.

The New York City Department of Environmental Protection (NYCDEP) recording station at the Cannonsville Reservoir recorded just over 4.4 in. of rainfall from June 26 to 29 and a total of almost 6 in. for the period of June 23–29 (fig. 2C). Additional NWS and NYCDEP precipitation stations recorded storm totals of greater than 13 in. at Walton and Fishs Eddy, NY; greater than 10 in. near Ashland, NY; greater than 7 in. at Sherburne, NY; and greater than 3.5 in. at Lansing Manor and Albany, NY (fig. 2D). Total rainfall amounts at 55 selected locations in New York are listed in table 1.

Daily rainfall totals for June 27 exceeded 5 in. at Platte Clove, 4.6 in. at East Jewett, and 4 in. at Binghamton and Delta Dam, NY (figs. 1A, 1B). On June 28 daily rainfall totals exceeded 5 in. at Rockdale, NY. Rainfall frequencies for these daily totals were estimated to have a recurrence interval of about 10 years at Platte Clove, between 5 and 10 years at Binghamton and East Jewett, from 10 to 25 years at Delta Dam, and about 50 years at Rockdale (U.S. Weather Bureau, 1961). On June 28, the largest 1-day rainfall totals in the State of New York for this storm were recorded at Walton and Fishs Eddy, NY. The NWS reported rainfall totals of 9.63 and 8.34 in. on June 28 at Walton and Fishs Eddy (National Oceanic and Atmospheric Administration, 2006b) (fig. 1B). The rainfall frequencies for these two stations exceeded the 24-hour 100-year recurrence interval (U.S. Weather Bureau, 1961). The 4-day rainfall total at Binghamton is between the 4-day 50-year and the 4-day 100-year recurrence intervals, but the 4-day rainfall totals of greater than 13 in. for Fishs Eddy and Walton exceeded the 4-day 100-year recurrence interval (U.S. Weather Bureau, 1964). Heavy rain from June 26 to June 29, 2006, produced period-of-record flooding that superseded the previous records set by the 1936, 1955, 1972,

and the 1996 storms at the Mohawk River at Little Falls, the West Branch Delaware River at Walton, and the Susquehanna River at Conklin stream-gaging stations. Rainfall frequencies for selected sites are listed in tables 2A and 2B.

Prolonged rainfall events in previous years also resulted in record-setting floods in New York and the surrounding region. Extended precipitation patterns in March 1936 produced record flooding in the Hudson, Delaware, and Susquehanna River basins. The floods of March 1936 were caused by precipitation during March 9–22, a period of warming temperatures, when much of the topography was snow covered and rivers were still ice covered. This event was categorized as one long precipitation event having two periods of concentrated heavy rain. Rain and snow during March 9–10 were followed by heavier rains during March 11–13. Precipitation amounts from the first half of this storm event were generally in the 2-in. range across the Delaware and Susquehanna River basins. Heavy precipitation from the second half of this storm event began around March 16 and continued through March 19, producing an additional 2 to as much as 6 in. of precipitation in the Delaware and Susquehanna River basins by March 22. The precipitation from this extended event caused record-breaking or extraordinary flooding in the Hudson, Delaware, and Susquehanna River basins. Records set in March 1936 at several USGS stream-gaging stations along the Susquehanna River remained until they were superseded by the June 2006 flood. Total rainfall amounts for the March 9–22, 1936, precipitation event are presented in figure 3A.

The floods from Hurricanes Connie and Diane in August 1955 were also produced by two back-to-back precipitation events. Heavy rains from Hurricane Connie produced rainfall totals of 3 to more than 7 in. during August 11–14, 1955. Hurricane Diane added an additional 2 to 9 in. of rain in southeastern New York during August 17–20, 1955. Period-of-record maximums were set at several USGS stream-gaging stations along the main stem of the Delaware River from near Barryville, NY, downstream to Trenton, NJ.

The floods resulting from Hurricane Agnes was produced by an extended period of precipitation during June 19–23, 1972 (fig. 3B). This storm produced rainfall totals of 3 to greater than 12 in. in many locations in southern New York. The heaviest rainfall in New York fell over parts of the Allegheny and Susquehanna River basins. Although at the time widespread flooding was recorded at many stations in southern New York, major flooding at the headwaters of the Susquehanna River upstream from Vestal, NY, did not occur as a result of this storm. Flooding in the Chemung River basin and downstream from the confluence of the Chemung and Susquehanna Rivers near the New York and Pennsylvania border to the Chesapeake Bay was considered to be the greatest flood known since 1784 (Bailey and others, 1975).

Figure 2A. Cumulative hourly rainfall during June 25–28, 2006, recorded at the National Weather Service hourly recording station at Claryville, NY. (Location shown in figs. 1D.)

Figure 2B. Cumulative hourly rainfall during June 25–28, 2006, recorded at the National Weather Service office at Binghamton, NY. (Location shown in figs. 1E.)

Figure 2C. Cumulative hourly rainfall during June 23–28, 2006, recorded at the New York City Department of Environmental Protection station at Cannonsville Reservoir, NY. (Location shown in figs. 1D.)

Figure 2D. Cumulative hourly rainfall during June 25–28, 2006, recorded at Albany International Airport, NY. (Location shown in figs. 1B, 1C.)

Table 1. Total rainfall for the storm of June 26–29, 2006, at selected locations in New York and surrounding areas.

[Data provided by National Oceanic and Atmospheric Administration (2006a) and New York City Department of Environmental Protection (written commun. 2007); selected data shown in fig. 1C–E]

Site number	Site name	Total rainfall (inches)
1	WDCL Radio Tower, PA	14.64
2	Aldenville, PA	13.67
3	Walton, NY	13.36
4	Fishs Eddy, NY	13.28
5	Platte Clove, NY	11.78
6	Equinunk, PA	11.68
7	Pleasant Mount, PA	10.58
8	Frost Valley, NY	9.57
9	Moscow, PA	9.16
10	Montrose, PA	8.34
11	East Jewett, NY	8.30
12	Slide Mountain, NY	8.11
13	Delhi, NY	8.10
14	Noxen, PA	8.10
15	Cooperstown, NY	7.99
16	Claryville, NY	7.79
17	Chichester NY	7.58
18	Rockdale, NY	7.53
19	Susquehanna, PA	7.46
20	Grahamsville, NY	7.23
21	Binghampton WSO, NY	7.13
22	Maryland 6 SW, NY	6.87
23	Delta Dam, NY	6.74
24	Rondout Reservoir, NY	6.29
25	Ellenville, NY	6.28
26	Orwell, PA	6.04
27	Dingman, PA	5.85
28	New London Lock 22, NY	5.78
29	North Creek, NY	5.72
30	Rhinebeck, NY	5.45
31	Cannonsville Reservoir, NY	5.43
32	Gloversville, NY	5.37
33	Ashokan Reservoir, NY	5.30
34	Tully Hebring Forest, NY	5.27
35	Alcove Dam, NY	5.08
36	Glens Falls Farm, NY	4.58
37	Spencer, NY	4.45
38	Windham, NY	4.37
39	Northville, NY	4.37
40	Gardnerville, NY	4.29

Table 1. Total rainfall for the storm of June 26–29, 2006, at selected locations in New York and surrounding areas. —Continued

[Data provided by National Oceanic and Atmospheric Administration (2006a) and New York City Department of Environmental Protection (written commun. 2007); selected data shown in fig. 1C–E]

Site number	Site name	Total rainfall (inches)
41	Whitehall, NY	3.98
42	Lansing Manor, NY	3.96
43	Chemung, NY	3.86
44	Schoharie Reservoir, NY	3.72
45	Newcomb, NY	3.6
46	Albany INTL AP, NY	3.62
47	Monroeton, PA	3.26
48	Poughkeepsie, NY	3.10
49	Delanson 2Ne, NY	3.04
50	Cobleskill, NY	3.00
51	Tribes Hill, NY	2.98
52	West Point, NY	2.97
53	Carmel, NY	2.42
54	East Chatham, NY	2.19
55	Yorktown Heights, NY	1.33

Flood of June 27–29, 2006, Discharge and Frequency

The location of the three major basins studied in this report and selected USGS stream-gaging stations are presented in figure 4. Historic flood peaks and peak discharges during the June 2006 flood at 76 USGS stream-gaging stations are presented in table 3.

Frequency analysis of annual flood-peak data recorded at stream-gaging stations provides a means of estimating the probability of occurrence of a given discharge. Flood frequency is commonly expressed in terms of recurrence interval or the probability of being exceeded (one is the reciprocal of the other). The 100-year flood, for example, has a probability of 0.01 (1-percent chance) of being equaled or exceeded in any given year.

Recurrence intervals for stream-gaging stations listed in this report were calculated by fitting annual peak-discharge data to a log-Pearson type III distribution (Interagency Advisory Committee on Water Data, 1982). The results of this analysis were weighted with the results of the regional flood-frequency analysis (Lumia, 2006) at stream-gaging stations with unregulated streamflows. Recurrence intervals at stream-gaging stations with substantial regulation were calculated from statistical analyses of annual peak discharges during the regulated period only, except along the main stem of the Delaware River from Callicoon, NY, to Montague, NJ. No adjustments were made for the amount of available storage

in the reservoirs before or during floods, or for changes in regulation procedures during the period of regulation. Recurrence intervals at stream-gaging stations along the main stem of the Delaware River from Callicoon, NY, to Montague, NJ, were computed by fitting systematic annual peak-discharge data to a log-Pearson type III distribution for the entire period of record (Schopp and Firda, 2008).

Peak discharges recorded during the June 2006 flood at several of the USGS stream-gaging stations listed in table 3 had recurrence intervals of less than 25 years. Stream-gaging stations at the Hudson River at Hadley (01318500), and Esopus Creek at Coldbrook (01362500) in the Hudson River basin; the East and West Branches of the Neversink River near Claryville (01434107 and 01434498) in the Delaware River basin; and the Tioughnioga River at Cortland (01509000) in the Susquehanna River basin all recorded peak discharges with recurrence intervals of less than 25 years. Substantial flooding and peak discharges with a greater than 100-year recurrence interval were recorded at several stations along the Mohawk, Delaware, and Susquehanna Rivers and on some of their major tributaries. Although widespread flooding did occur throughout the region, the increase in magnitude and frequency of peak discharges at several stream-gaging stations along the main branches of these rivers can be linked to major inflows from larger tributaries. (Details about peak discharges and flood frequency as a result of the June 2006 flood are discussed in the following sections.) Antecedent conditions, precipitation and runoff patterns, and basin characteristics all play a role in determining the peak

Table 2A. Rainfall-frequency relations for storms of 3-, 6-, 12-, and 24-hour duration at selected locations in New York.

[Data from U.S. Weather Bureau, 1961. Locations are shown in fig. 1C–E]

Site number	Site name	County	Recurrence interval	Rainfall, in inches for selected duration			
			(years)	3 hours	6 hours	12 hours	24 hours
3	Walton	Delaware	2	1.7	2.0	2.4	2.8
			5	2.2	2.6	3.2	3.6
			10	2.4	2.9	3.7	4.5
			25	2.9	3.6	4.3	5.0
			50	3.2	3.9	4.8	5.8
			100	3.4	4.5	5.3	6.8
4	Fishes Eddy	Delaware	2	1.7	2.1	2.6	2.9
			5	2.3	2.7	3.4	3.8
			10	2.5	3.1	3.9	4.7
			25	3.0	3.8	4.8	5.2
			50	3.4	4.1	5.0	5.9
			100	3.6	4.7	5.8	6.9
16	Claryville	Sullivan	2	1.9	2.5	3.3	3.5
			5	2.5	3.0	4.0	4.6
			10	2.9	3.9	4.6	5.8
			25	3.4	4.3	5.5	6.5
			50	3.9	5.0	6.0	7.0
			100	4.1	5.5	6.8	8.0
21	Binghamton	Broome	2	1.4	1.8	2.4	2.8
			5	2.0	2.5	3.0	3.5
			10	2.3	2.9	3.5	4.1
			25	2.5	3.4	4.0	4.8
			50	2.8	3.8	4.3	5.2
			100	3.3	4.1	5.0	5.8
28	Delta Dam	Oneida	2	1.6	1.9	2.3	2.5
			5	1.9	2.3	2.8	3.3
			10	2.4	2.8	3.3	3.7
			25	2.8	3.0	3.6	4.4
			50	3.0	3.5	3.8	4.7
			100	3.4	3.8	4.5	4.9

Table 2B. Rainfall-frequency relations for storms of 4-day duration at selected locations in New York.

[Data from U.S. Weather Bureau, 1964. Locations are shown in fig. 1C–E]

Site number	Site name	County	Rainfall, in inches for 4-day duration for selected recurrence intervals (years)					
			2	5	10	25	50	100
3	Walton	Delaware	4.1	5.0	5.9	7.0	7.8	8.8
4	Fishs Eddy	Delaware	4.4	5.3	6.0	7.4	8.0	9.0
16	Claryville	Sullivan	5.4	7.0	8.1	10.0	10.0	12.0
21	Binghamton	Broome	3.9	4.8	5.5	6.4	6.9	7.8
28	Delta Dam	Oneida	3.6	4.3	4.8	5.7	6.2	6.8

Figure 3A. Total precipitation in the Susquehanna River basin and surrounding area for the storms of March 9–22, 1936.

Figure 3B. Total rainfall in New York and surrounding area for the storm of June 19–23, 1972.

discharge at a stream-gaging station. Peak discharges for selected stream-gaging stations in the Hudson (contains the Mohawk River basin), Delaware, and Susquehanna River basins are plotted as a function of drainage area in figure 5. The spatial distribution of peak discharge frequencies for selected USGS stream-gaging stations is presented in figure 6. Annual peak discharges for the period of record through 2006, the recomputed 10-, 50-, and 100-year recurrence intervals, and a 10-year weighted moving average of annual peak discharges at 25 selected stream-gaging stations are presented in figure 7. The weighted moving average of annual peak discharges is presented in figure 7 to show the general trend or pattern of yearly maximum flows (Helsel and Hirsch, 1992). The trend lines (weighted moving average) in figure 7 generally show the dryer periods of the 1960s and 1970s and the wetter periods of the 1980s, 1990s, and 2000s. At some of

the stream-gaging stations immediately downstream from a reservoir, a reduction in the peak discharge is identifiable after the reservoirs began storage operations.

Mohawk River Basin

USGS stream-gaging stations along the Mohawk River near Rome (01336000) and Little Falls (01347000) recorded peak discharges on the morning of June 28, 2006 (fig. 8A–1). USGS stream-gaging stations on the East and West Canada Creeks, major tributaries to the Mohawk River, also recorded peak discharges on the morning of June 28, 2006. Farther downstream near the mouth of the Mohawk River at Cohoes (01357500), the peak discharge was recorded in the morning hours of June 29, 2006 (fig. 8A–1).

Figure 4A. Locations of selected U.S. Geological Survey stream-gaging stations in the Mohawk River basin, NY, and surrounding area. (Station names and flood-related data listed in table 3.)

Figure 4B. Locations of selected U.S. Geological Survey stream-gaging stations in the Delaware River basin, NY, and surrounding area. (Station names and flood-related data listed in table 3.)

Figure 4C. Locations of selected U.S. Geological Survey stream-gaging stations in the Susquehanna River basin, NY, and surrounding area. (Station names and flood-related data listed in table 3.)

Table 3. Period-of-record peak discharges and peak discharges during the flood of June 26–29, 2006, at selected U.S. Geological Survey stream-gaging stations in New York and surrounding areas.

Station number	Station name	Drain- age area (mi ²)	Period-of-record peak discharge				June 26-29, 2006, peak discharge				Recurrence interval (years)	
			Period of record	Date	Stage (ft)	Dis- charge (ft ³ /s)	Time (hr)	Stage (ft)	Dis- charge (ft ³ /s)	Dis- charge [(ft ³ /s)/ mi ²]		
Hudson River basin												
01318500	Hudson River at Hadley, NY	1,664	1921-2006	01/01/49	21.21	42,700	06/29/06	0245	12.73	21,900	13.2	3
01321000	Sacandaga River near Hope, NY	491	1911-2006	03/27/13	^a 11.00	32,000	06/28/06	1100	9.96	26,600	54.2	40
01336000	Mohawk River below Delta Dam, near Rome, NY*	152	1927-2006	10/02/45	11.18	8,560	06/28/06	--	6.88	3,100	20.4	4
01343060	West Canada Creek near Wilmurt, NY	258	2001-2006	04/14/02	11.82	15,000	06/28/06	1230	13.60	23,200	89.9	--
01346000	West Canada Creek at Kast Bridge, NY*	560	1913, 20-2006	10/02/45	8.08	20,500	06/29/06	0500	8.29	21,800	38.9	>100 & <500
01347000	Mohawk River near Little Falls, NY*	1,342	1927-2006	03/14/77	19.17	33,100	06/28/06	1230	19.72	35,000	26.1	>100 & <500
01348000	East Canada Creek at East Creek, NY	289	1945-96, 98, 00, 03-2006	10/02/45	9.00	24,000	06/28/06	0745	10.99	31,500	109.0	>500
01349150	Canajoharie Creek near Canajoharie, NY	59.7	1993-2006	11/09/96	8.88	3,630	06/28/06	0945	10.50	5,510	92.3	30
01350000	Schoharie Creek at Prattsville, NY	237	1902-2006	01/19/96	19.39	52,800	06/26/06	1815	12.70	19,100	80.6	3
01351500	Schoharie Creek at Burtonsville, NY*	886	1939-2006	01/20/96	12.88	81,600	06/28/06	2330	6.97	28,100	31.7	4
01357500	Mohawk River at Cohoes, NY*	3,450	1917-2006	03/06/64	23.15	143,000	06/29/06	0945	20.70	96,400	27.9	15
01358000	Hudson River at Green Island, NY*	8,090	1946-2006	12/31/48	27.05	181,000	06/29/06	1000	23.67	123,000	15.2	5
01362500	Esopus Creek at Coldbrook, NY**	192	1931-2006	03/21/80	21.94	65,300	06/28/06	0930	15.52	25,900	134.9	5
01371500	Wallkill River at Gardiner, NY**	695	1924-2006	10/16/55	19.81	30,800	06/28/06	1830	9.48	10,500	15.1	2
Passaic River basin												
01387420	Ramapo River at Suffern, NY**	93.0	1979-2006	04/05/84	15.38	12,300	06/28/06	0915	5.18	942	10.1	<2
Delaware River basin												
01413500	East Branch Delaware River at Margaretville, NY	163	1937-2006	01/19/96	14.88	25,800	06/28/06	1015	12.60	13,600	83.4	9
01414000	Platte Kill at Dunraven, NY	34.9	1941-62, 96-2006	01/19/96	9.60	5,690	06/28/06	0545	6.88	^b 2,200	63.0	4

[mi², square miles; ft, feet; ft³/s, cubic feet per second; hr, hours; ft³/mi², cubic feet per second per square mile; <, less than; >, greater than; --, no data available]

Table 3. Period-of-record peak discharges and peak discharges during the flood of June 26–29, 2006, at selected U.S. Geological Survey stream-gaging stations in New York and surrounding areas.

[mi², square miles; ft, feet; ft³/s, cubic feet per second; hr, hours; ft³/s/mi², cubic feet per second per square mile; <, less than; >, greater than; --, no data available]

Station number	Station name	Drain- age area (mi ²)	Period-of-record peak discharge					June 26-29, 2006, peak discharge					
			Period of record	Date	Stage (ft)	Dis- charge (ft ³ /s)	Date	Time (hr)	Stage (ft)	Dis- charge (ft ³ /s)	Dis- charge [(ft ³ /s)/ mi ²]	Recurrence interval (years)	
Delaware River basin—Continued													
01414500	Mill Brook near Dunraven, NY	25.2	1937-2006	01/19/96	12.56	5,380	06/28/06	0445	9.01	2,150	85.3	4	
01415000	Tremper Kill near Andes, NY	33.2	1937-2006	01/19/96	7.69	5,000	06/28/06	0700	6.42	2,970	89.5	10	
01417000	East Branch Delaware River at Downsville, NY*	372	1941-54, 55-2006	11/26/50	^a 14.52	23,900	06/28/06	1330	12.04	20,000	53.8	50	
01417500	East Branch Delaware River at Harvard, NY*	458	1934-54, 55-67, 77-2006	09/22/38	^a 16.93	31,400	06/28/06	1645	16.61	22,100	48.3	45	
01420500	Beaver Kill at Cooks Falls, NY	241	1913-2006	04/03/05	18.98	50,800	06/28/06	--	20.55	62,400	258.9	>100 & <500	
01421000	East Branch Delaware River at Fishs Eddy, NY*	784	1912-54, 55-2006	04/03/05	19.47	65,100	06/28/06	1045	21.43	77,400	98.7	>100 & <500	
01421610	West Branch Delaware River at Hobart, NY	15.5	2000-2006	09/18/04	2.84	738	06/28/06	0715	2.69	646	41.7	--	
01421614	Town Brook Tributary southeast of Hobart, NY	0.76	1998-2006	07/04/99	3.24	268	06/28/06	0415	3.02	179	235.5	--	
01421618	Town Brook southeast of Hobart, NY	14.3	1997-2006	07/04/99	7.54	4,400	06/28/06	0445	6.35	2,490	174.1	--	
01421900	West Branch Delaware River upstream from Delhi, NY	134	1937-70, 72-74, 96-2006	01/19/96	^a 9.80	b 13,000	06/28/06	0630	11.89	8,060	60.1	20	
01422389	Coulter Brook near Bovina Center, NY	0.76	1997-2006	04/02/05	1.93	54	06/28/06	--	2.42	b 95	125.0	--	
01422500	Little Delaware River near Delhi, NY	49.8	1937-70, 72-74, 96- 2006	01/19/96	8.51	6,100	06/28/06	0800	6.97	3,100	62.2	6	
01422738	Wolf Creek at Mundale, NY	0.61	1998-2006	04/02/05	2.90	71	06/28/06	0215	4.29	350	573.8	--	
01422747	East Brook east of Walton, NY	24.7	1998-2006	09/18/04	6.71	2,830	06/28/06	0315	9.95	7,110	287.9	--	
01423000	West Branch Delaware River at Walton, NY	332	1950-2006	01/19/96	16.36	25,000	06/28/06	0330	16.85	28,600	86.1	>100 & <500	
0142400103	Trout Creek near Trout Creek, NY	20.2	1952-67, 96-2006	01/19/96	7.24	2,800	06/27/06	1345	6.99	4,350	215.3	>100 & <500	

Table 3. Period-of-record peak discharges and peak discharges during the flood of June 26–29, 2006, at selected U.S. Geological Survey stream-gaging stations in New York and surrounding areas.

Station number	Station name	Drain-age area (mi ²)	Period-of-record peak discharge				June 26-29, 2006, peak discharge				Recurrence interval (years)	
			Period of record	Date	Stage (ft)	Dis-charge (ft ³ /s)	Time (hr)	Stage (ft)	Dis-charge (ft ³ /s)	Dis-charge [(ft ³ /s)/mi ²]		
Delaware River basin—Continued												
01425000	West Branch Delaware River at Stilesville, NY*	456	1952-63, 64-2006	01/22/59	a 9.01	17,500	06/28/06	1200	17.72	33,100	72.6	>100 & <500
01426500	West Branch Delaware River at Hale Eddy, NY*	595	1912-63, 64-2006	03/22/48	15.69	28,900	06/28/06	1300	19.10	43,400	72.9	>100 & <500
01427510	Delaware River at Callicoon, NY***	1,820	1975-2006	04/03/05	17.98	114,000	06/28/06	1715	20.38	144,000	79.1	>100 & <500
01428500	Delaware River above Lackawaxen River near Barryville, NY***	2,020	1940-2006	08/19/55	26.40	130,000	06/28/06	--	28.97	151,000	74.8	>100 & <500
01431500	Lackawaxen River at Hawley, PA *	290	1908-17, 38-60, 61-2006	08/19/55	24.80	51,900	06/28/06	1430	18.19	28,000	96.6	>100 & <500
01432900	Mongaup River at Mongaup Valley, NY	76.6	2002-2006	04/03/05	13.47	7,630	06/28/06	1130	10.65	4,730	61.7	--
01434000	Delaware River at Port Jervis, NY***	3,070	1904-2006	08/19/55	23.91	233,000	06/28/06	1815	21.47	189,000	61.6	80
0143400680	East Branch Neversink River northeast of Denning, NY	8.93	1990-2006	09/16/99	6.96	3,070	06/28/06	0800	5.82	1,760	197.1	3
01434017	East Branch Neversink River near Claryville, NY	22.9	1991-2006	04/02/05	12.33	4,590	06/28/06	0745	11.25	3,450	150.7	5
01434021	West Branch Neversink River at Winnisook Lake near Frost Valley, NY	0.77	1991-2006	04/02/05	3.37	218	06/28/06	0700	2.81	170	220.8	6
01434025	Biscuit Brook above Pigeon Brook at Frost Valley, NY	3.72	1983-2006	04/04/87	4.37	815	06/28/06	0900	3.24	266	71.5	<2
01434498	West Branch Neversink River at Claryville, NY	33.8	1991-2006	04/02/05	12.73	9,570	06/28/06	0730	12.15	8,310	245.9	15
01435000	Neversink River near Claryville, NY	66.6	1937-2006	11/25/50	15.00	23,400	06/28/06	0900	12.79	11,500	172.7	8
01436000	Neversink River at Neversink, NY *	92.6	1941-53, 54-2006	11/25/50	a 11.23	22,300	06/28/06	1115	9.48	7,840	84.7	26
01436690	Neversink River at Bridgeville, NY *	171	1992-2006	04/03/05	21.25	25,900	06/28/06	1630	16.16	12,500	73.1	25
01437500	Neversink River at Godeffroy, NY *	307	1937-53, 54-2006	08/19/55	12.49	33,000	06/28/06	--	11.08	16,600	54.1	7
01438500	Delaware River at Montague, NJ***	3,480	1939-2006	08/09/55	35.15	250,000	06/28/06	2215	32.15	212,000	60.9	80

[mi², square miles; ft, feet; ft³/s, cubic feet per second; hr, hours; ft³/s/mi², cubic feet per second per square mile; <, less than; >, greater than; --, no data available]

Table 3. Period-of-record peak discharges and peak discharges during the flood of June 26–29, 2006, at selected U.S. Geological Survey stream-gaging stations in New York and surrounding areas.

[mi², square miles; ft, feet; ft³/s, cubic feet per second; hr, hours; ft³/s/mi², cubic feet per second per square mile; <, less than; >, greater than; --, no data available]

Station number	Station name	Drain- age area (mi ²)	Period-of-record peak discharge					June 26-29, 2006, peak discharge				
			Period of record	Date	Stage (ft)	Dis- charge (ft ³ /s)	Time (hr)	Stage (ft)	Dis- charge (ft ³ /s)	Dis- charge [(ft ³ /s)/ mi ²]	Recurrence interval (years)	
Susquehanna River basin												
01497805	Little Elk Creek near Westford, NY	3.73	1978-2006	01/19/96	19.92	278		--	19.89	288	77.2	25
01500000	Ouleout Creek at East Sidney, NY *	103	1940-49, 50-2006	12/30/42	^a 7.62	7,250		2330	4.69	2,010	19.5	4
01500500	Susquehanna River at Unadilla, NY	982	1935-36, 38-2006	03/18/36	16.60	^b 31,300		0415	17.72	35,100	35.7	>100 & <500
01502500	Unadilla River at Rockdale, NY	520	1930-33, 37-2006	12/31/42	12.98	17,400		2300	13.96	23,100	44.4	>100 & <500
01502632	Susquehanna River at Bainbridge, NY	1,610	1989-2006	04/03/05	20.47	37,500		0930	27.05	58,700	36.5	>100 & <500
01502731	Susquehanna River at Windsor, NY	1,820	1988-2006	01/20/96	--	^b 40,000		2000	24.27	55,900	30.7	90
01503000	Susquehanna River at Conklin, NY	2,232	1912-2006	03/18/36	20.14	61,600		1115	25.02	76,800	34.4	>100 & <500
01503980	Chenango River at Eaton, NY	24.3	1964-65, 67-2006	04/02/05	8.25	2,780		--	8.03	2,110	86.8	40
01505000	Chenango River at Sherburne, NY	263	1936, 38- 2006	03/18/36	10.60	^b 12,500		1145	11.35	11,400	43.3	60
01507000	Chenango River at Greene, NY	593	1937-2006	04/03/05	18.67	20,800		1520	21.16	27,100	45.7	>100 & <500
01509000	Tioughnioga River at Cortland, NY	292	1938-2006	04/03/05	14.07	14,200		1545	10.95	7,620	26.1	4
01509520	Tioughnioga River at Lisle, NY	453	1988-2006	04/02/05	10.38	19,800		2300	8.95	15,200	33.6	10
01510000	Otselic River at Cincinnatus, NY	147	1938-64, 69-2006	04/03/05	10.55	12,200		0100	9.59	8,100	55.1	20
01510610	Merrill Creek Tributary near Texas Valley, NY	5.32	1976-81, 83-2006	01/19/96	--	^b 1,150		--	2.94	680	127.8	7
01511500	Tioughnioga River at Iaska, NY *	730	1929-41, 42-2006	07/08/35	16.61	61,100		0100	8.64	12,400	17.0	4
01512500	Chenango River near Chenango Forks, NY *	1,483	1912-41, 42-2006	07/08/35	20.30	96,000		1420	13.74	41,500	28.0	20
01513500	Susquehanna River at Vestal, NY	3,941	1935-2006	03/18/36	30.50	^b 107,000		1420	33.66	119,000	30.2	>100 & <500
01513831	Susquehanna River at Owego, NY	4,216	1988-96, 99-2006	04/03/05	33.15	106,000		0145	35.90	127,000	30.1	>100 & <500

Table 3. Period-of-record peak discharges and peak discharges during the flood of June 26–29, 2006, at selected U.S. Geological Survey stream-gaging stations in New York and surrounding areas.

[mi ² , square miles; ft, feet; ft ³ /s, cubic feet per second; hr, hours; ft ³ /mi ² , cubic feet per second per square mile; <, less than; >, greater than; --, no data available]												
Station number	Station name	Drainage area (mi ²)	Period-of-record peak discharge					June 26-29, 2006, peak discharge				
			Period of record	Date	Stage (ft)	Discharge (ft ³ /s)	Date	Time (hr)	Stage (ft)	Discharge (ft ³ /s)	Discharge [(ft ³ /s)/mi ²]	Recurrence interval (years)
Susquehanna River basin—Continued												
01514000	Owego Creek near Owego, NY	185	1930-2006	07/08/35	11.50	23,500	06/28/06	0900	9.25	8,320	45.0	4
01514801	Catatunk Creek near Owego, NY	151	1988-2006	01/20/96	14.83	12,200	06/28/06	--	11.06	5,200	34.4	4
01515000	Susquehanna River near Waverly, NY	4,773	1936-2006	03/18/36	22.40	^b 128,000	06/29/06	0600	22.52	128,000	26.8	40
01531000	Chemung River at Chemung, NY *	2,506	1903-78, 79-2006	06/23/72	31.62	189,000	06/28/06	0600	12.14	27,200	10.9	<2
01531500	Susquehanna River at Towanda, PA	7,797	1913-2006	06/24/72	33.43	320,000	06/29/06	0900	20.83	141,000	18.1	~ 7
Streams Tributary To Lake Ontario												
04234000	Fall Creek near Ithaca, NY	126	1925-2006	07/08/35	9.52	15,500	06/28/06	0430	3.99	2,320	18.4	<2
04235250	Flint Creek at Phelps, NY **	102	1959-95, 2002-06	03/30/60	5.83	2,940	06/29/06	0200	2.09	100	1.0	<2
04243500	Oneida Creek at Oneida, NY	113	1949-2006	10/09/76	15.01	9,110	06/28/06	0600	13.34	4,840	42.8	5

^{*}Sites in pink indicate significant regulation. Recurrence intervals at these sites were calculated from statistical analyses of annual peak discharges during the regulated period. No adjustments were made for the amount of available storage in the reservoirs before or during floods nor for changes in regulation procedures during the period of regulation. Other studies, such as flood-insurance studies, and other procedures can be investigated for alternate methods of determining discharge recurrence intervals at these sites.

^{**}Site not shown in fig. 4.

^{***}Sites in green indicate recurrence intervals computed from statistical analyses of annual peak discharges using the entire period of record and agreed upon by a multi-agency committee (Schopp and Firda, 2008).

^a At former site.

^b Estimated.

^c Flood frequency provided by USGS Pennsylvania Water Science Center.

Figure 5A. Peak discharges for the flood of June 26–29, 2006, and previous maximum known discharge at selected stream-gaging stations in the Hudson River basin, NY, as a function of drainage area.

Figure 5B. Peak discharges for the flood of June 26–29, 2006, and previous maximum known discharge at selected stream-gaging stations in the Delaware River basin, NY, as a function of drainage area.

Figure 5C. Peak discharges for the flood of June 26–29, 2006, and previous maximum known discharge at selected stream-gaging stations in the Susquehanna River basin, NY, as a function of drainage area.

Figure 6A. Peak discharge recurrence intervals at selected U.S. Geological Survey stream-gaging stations in the Mohawk River basin, NY, for the flood of June 26–29, 2006. (Data are shown in table 3.)

Figure 6B. Peak discharge recurrence intervals at selected U.S. Geological Survey stream-gaging stations in the Delaware River basin, NY, for the flood of June 26–29, 2006. (Data are shown in table 3.)

Figure 6C. Peak discharge recurrence intervals at selected U.S. Geological Survey stream-gaging stations in the Susquehanna River basin, NY, for the flood of June 26–29, 2006. (Data are shown in table 3.)

Figure 7A. (A-1, A-2) Annual peak discharges through 2006, and discharges of the 10-, 50-, and 100-year recurrence intervals for selected stations in the Mohawk River basin, NY.

Figure 7A. (A-3, A-4) Annual peak discharges through 2006, and discharges of the 10-, 50-, and 100-year recurrence intervals for selected stations in the Mohawk River basin, NY.

The USGS stream-gaging stations along the Mohawk River from below Delta Dam to Cohoes are regulated by power-generation dams, municipal water suppliers, and the New York State Canal Corporation. Recurrence intervals at these USGS stream-gaging stations ranged from less than 5 years to greater than 100 years. The USGS stream-gaging station Mohawk River below Delta Dam near Rome recorded a peak discharge of 3,100 ft³/s on June 28 which had a recurrence interval of less than 5 years (fig. 6A). Recurrence intervals at USGS stream-gaging stations on the major tributaries to the Mohawk River along the East and West Canada Creeks and the Schoharie Creek ranged from greater than 500 years at East Canada Creek at East Creek (01348000), to greater than 100 years at the West Canada Creek at Kast Bridge (01346000), to as low as less than 5 years at Schoharie Creek at Burtonsville (01351500). A major increase in the magnitude and frequency of the flooding along the Mohawk River downstream from the Mohawk River below Delta Dam near Rome stream-gaging station can be attributed to greater than 100-year inflows from the West and East Canada Creeks. The USGS stream-gaging station West Canada Creek at Kast Bridge, which has been in operation since 1920, recorded a new period-of-record maximum of 21,800 ft³/s. The East Canada Creek at East Creek stream-gaging station, in operation since 1945, also recorded a new period-of-record maximum of 31,500 ft³/s. The USGS stream-gaging station Schoharie Creek at Burtonsville recorded a peak discharge of 28,100 ft³/s on June 28, but the period-of-record maximum of 81,600 ft³/s was recorded on January 20, 1996 (fig. 7A–3). The lack of major inflow from Schoharie Creek allowed for the natural attenuation of the peak discharge and a recurrence interval of only 15 years downstream at the Mohawk River at Cohoes stream-gaging station. The USGS stream-gaging station Mohawk River at Cohoes recorded a peak discharge of 96,400 ft³/s on June 29 (fig. 7A–4). The USGS stream-gaging station Hudson River at Green Island (01358000), located downstream from the confluence with the Mohawk River, recorded a peak discharge of 123,000 ft³/s on June 29, which has a recurrence interval of only 5 years. Antecedent conditions, precipitation and runoff patterns, and basin characteristics all play a role in determining the peak water-surface elevation and discharge at a stream-gaging station. Discharge hydrographs for selected USGS stream-gaging stations in the Mohawk River Basin for the period June 25–30, 2006, are shown in figure 8.

Delaware River Basin

All USGS stream-gaging stations along the East and West Branches of the Delaware River and along the main stem of the Delaware River down to Port Jervis recorded peak discharges on June 28. The peak discharge recorded at the stream-gaging station East Branch Delaware River at Margaretville (01413500), upstream from the Pepacton Reservoir, was 13,600 ft³/s. The peak discharges recorded

at the stream-gaging stations West Branch Delaware River upstream from Delhi (01421900) and West Branch Delaware River at Walton (01423000), upstream from the Cannonsville Reservoir, were 8,060 ft³/s and 28,600 ft³/s, respectively (fig. 8B–3). The flood frequency of the peak discharge at East Branch Delaware River at Margaretville was estimated to have a 9-year recurrence interval (table 3). The flood frequency along the West Branch of the Delaware River, upstream from Cannonsville Reservoir, was much greater than that recorded along the East Branch upstream from Pepacton Reservoir (fig. 6B). The peak discharge at the West Branch Delaware River upstream from Delhi had an estimated recurrence interval of 20 years, and the peak discharge at West Branch Delaware River at Walton had an estimated recurrence interval of greater than 100 years (fig. 7B–6). Recurrence intervals were generally 25 years or less for peak discharges along several gaged tributaries to the East Branch of the Delaware River upstream from the Pepacton Reservoir. Flood frequency could not be computed at gaged tributaries upstream from Cannonsville Reservoir because of the short periods of record.

The peak discharges at USGS stream-gaging stations downstream from Pepacton and Cannonsville Reservoirs, along the East and West Branches of the Delaware River, equaled or exceeded the previous period-of-record maximums set during the 2004 and 2005 floods. The USGS stream-gaging station East Branch Delaware River at Downsville (01417000), immediately downstream from the Pepacton Reservoir, recorded a peak discharge of 20,000 ft³/s on June 28 (fig. 8B–2). The estimated recurrence interval computed for this peak is 50 years. The period-of-record maximum for this station since the Pepacton Reservoir began storage operations in September 1954 is 20,200 ft³/s, recorded on September 18, 2004 (fig. 7B–2). The peak discharge at the USGS stream-gaging station East Branch Delaware River at Harvard (01417500), 22,100 ft³/s, has a recurrence interval of 45 years (figs. 7B–3, 8B–2). Farther downstream along the East Branch of the Delaware River, the peak discharge at the USGS stream-gaging station at Fishs Eddy (01421000), 77,400 ft³/s, had a recurrence interval of greater than 100 years and as of 2006 is a new period-of-record maximum (figs. 7B–5, 8B–2). The increase in flood magnitude and frequency at this station compared to those for the Downsville and Harvard stream-gaging stations is a result of the significant inflow from the Beaver Kill. The Beaver Kill at Cooks Falls stream-gaging station (01420500) also recorded a new period-of-record maximum of 62,400 ft³/s on June 28, which had a recurrence interval greater than 100 years (figs. 6B, 7B–4).

The USGS stream-gaging station West Branch Delaware River at Stilesville (01425000) recorded a new period-of-record maximum discharge, since the current degree of regulation began in 1963, of 33,100 ft³/s on June 28 (figs. 7B–7, 8B–4). The recurrence interval for this peak was estimated to be greater than 100 years (fig. 6B). The June 28, 2006, peak discharge is also the maximum recorded discharge at this station since the station was put into operation in July 1952. The West Branch Delaware River

Figure 7B. (B-1, B-2) Annual peak discharges through 2006, and discharges of the 10-, 50-, and 100-year recurrence intervals for selected stations in the Delaware River basin, NY.

Figure 7B. (B-3, B-4) Annual peak discharges through 2006, and discharges of the 10-, 50-, and 100-year recurrence intervals for selected stations in the Delaware River basin, NY

Figure 7B. (B-5, B-6) Annual peak discharges through 2006, and discharges of the 10-, 50-, and 100-year recurrence intervals for selected stations in the Delaware River basin, NY.

at Hale Eddy stream-gaging station (01426500) recorded a new period-of-record maximum of 43,400 ft³/s on June 28 (figs. 7B–8, 8B–4). This peak discharge has an estimated recurrence interval of greater than 100 years and is the maximum discharge at this station since at least 1903.

Along the main stem of the Delaware River downstream from the confluence of the East and West Branches near Hancock to Port Jervis, peak discharges were recorded at three USGS stream-gaging stations. The Delaware River at Callicoon stream-gaging station (01427510), which has been in operation since 1975, recorded a new period-of-record maximum of 144,000 ft³/s on June 28 (figs. 7B–9, 8B–5). The USGS stream-gaging station Delaware River above Lackawaxen River near Barryville (01428500) also recorded a new period-of-record maximum of 151,000 ft³/s on June 28 (figs. 7B–10, 8B–5). The peak discharges at Callicoon and Barryville have an estimated recurrence interval of greater than 100 years. The Delaware River at Port Jervis is the most downstream USGS stream-gaging station along the main stem of the Delaware River in New York. The peak discharge at the Delaware River at Port Jervis stream-gaging station (01434000) was 189,000 ft³/s, recorded on June 28 (figs. 7B–11, 8B–5). This peak is a new period-of-record maximum, since regulation began in 1963, and ranks as the third highest peak since 1903 (fig. 7B–11). The recurrence interval for this peak discharge was calculated to be 80 years. The maximum peak discharge at this station was recorded on August 19, 1955, and unlike the June 2006 flood, the 1955 flood peak was magnified by major inflows from the Lackawaxen and Mongaup Rivers. Discharge hydrographs for selected USGS stream-gaging stations in the Delaware River basin for the period of June 25–30, 2006, are shown in figure 8.

Susquehanna River Basin

Several USGS stream-gaging stations along the Susquehanna River recorded new period-of-record maximums as a result of the June 2006 flood. The Susquehanna River at Unadilla stream-gaging station (01500500), which has been in operation since 1938, recorded a new period-of-record maximum of 35,100 ft³/s on June 29 with a recurrence interval of greater than 100 years (figs. 6C, 7C–1, 8C–1). The peak exceeded the estimated peak discharge for the March 18, 1936, flood at this site. The Unadilla River is a major tributary to the Susquehanna River and enters downstream from the Susquehanna River at Unadilla stream-gaging station. The recurrence interval for the peak discharge of 23,100 ft³/s on June 28 at the Unadilla River at Rockdale stream-gaging station (01502500) was estimated to be greater than 100 years and is a new period-of-record maximum (figs. 7C–2, 8C–1).

The USGS stream-gaging stations Susquehanna River at Bainbridge (01502632), Susquehanna River at Windsor (01502731), and Susquehanna River at Conklin (01503000) each recorded a new period-of-record maximum on June 28 or

29. The Susquehanna River at Conklin stream-gaging station has been in operation since 1913, and its previous period-of-record maximum of 61,600 ft³/s was set during the March 1936 flood. The peak discharge recorded at the Susquehanna River at Conklin stream-gaging station on June 28 was 76,800 ft³/s (fig. 7C–3). Recurrence intervals for the June 2006 flood peak discharges at these three stations range from 90 to greater than 100 years.

Most USGS stream-gaging stations along the Susquehanna River from Conklin to Vestal and on the Chenango, Tioughnioga, and Otselic Rivers recorded peak discharges on June 28. It was assumed that rainfall patterns across the region generated increased runoff downstream from Bainbridge, which resulted in a steeper slope to the rising limb of the hydrographs for this area and subsequently earlier peak discharges at downstream stations. The discharges at the Susquehanna River at Unadilla and Bainbridge stream-gaging stations continued to rise at a steady rate until they peaked on June 29 (fig. 8C–1). Peak inflows to the Susquehanna River from the Chenango and Tioughnioga Rivers were not at record levels. The recurrence interval for the peak discharge at the Chenango River at Greene stream-gaging station (01507000), which was a new period-of-record maximum, was estimated to be greater than 100 years, but the recurrence interval downstream at the Chenango River at Chenango Forks (01512500) stream-gaging station was only 20 years (fig. 7C–7). The recurrence intervals for the peak discharges at the USGS stream-gaging stations along the Tioughnioga River at Lisle (01509520) and Itaska (01511500) were less than 20 years (fig. 6C). Flood peaks in this area along other major tributaries, including the Owego and Chemung Rivers, were less than a 5-year recurrence interval. Although discharges on the major tributaries were below record levels downstream from the confluence of the Susquehanna and Unadilla Rivers, they were sufficient to maintain record levels along the Susquehanna River from Unadilla downstream to Waverly. The USGS stream-gaging station Susquehanna River at Vestal (01513500) recorded a peak discharge of 119,000 ft³/s on June 28, which has a recurrence interval of greater than 100 years; the peak discharge exceeded both the period-of-record maximum and the estimated peak discharge of 107,000 ft³/s for the March 18, 1936, flood at this site (fig. 7C–8). The floods of March 1936 and June 1972 were devastating along the Susquehanna River near and downstream from Waverly. The USGS stream-gaging station Susquehanna River near Waverly, NY, (01515000) has been in continuous operation since February 1937. The period-of-record maximum for the Susquehanna River near Waverly stream-gaging station was 121,000 ft³/s recorded on June 23, 1972 (fig. 7C–10). The March 18, 1936, peak discharge was estimated to be 128,000 ft³/s. The June 29, 2006, peak discharge was 128,000 ft³/s and was estimated to have a recurrence interval of 40 years (fig. 6C, 8C–2). The June 2006 flood ranks as the worst flood along the Susquehanna River for areas as far upstream as Unadilla and as far downstream as just upstream from Waverly since the early 1930s and possibly

Figure 7B. (B–7, B–8) Annual peak discharges through 2006, and discharges of the 10-, 50-, and 100-year recurrence intervals for selected stations in the Delaware River basin, NY.

Figure 7B. (B-9, B-10) Annual peak discharges through 2006, and discharges of the 10-, 50-, and 100-year recurrence intervals for selected stations in the Delaware River basin, NY.

Figure 7B. (B-11) Annual peak discharges through 2006, and discharges of the 10-, 50-, and 100-year recurrence intervals for selected stations in the Delaware River basin, NY.

Figure 7C. (C-1, C-2) Annual peak discharges through 2006, and discharges of the 10-, 50-, and 100-year recurrence intervals for selected stations in the Susquehanna River basin, NY.

Figure 7C. (C-3, C-4) Annual peak discharges through 2006, and discharges of the 10-, 50-, and 100-year recurrence intervals for selected stations in the Susquehanna River basin, NY.

Figure 7C. (C-5, C-6) Annual peak discharges through 2006, and discharges of the 10-, 50-, and 100-year recurrence intervals for selected stations in the Susquehanna River basin, NY.

Figure 7C. (C-7, C-8) Annual peak discharges through 2006, and discharges of the 10-, 50-, and 100-year recurrence intervals for selected stations in the Susquehanna River basin, NY.

Figure 7C. (C-9, C-10) Annual peak discharges through 2006, and discharges of the 10-, 50-, and 100-year recurrence intervals for selected stations in the Susquehanna River basin, NY.

Figure 8. Discharge hydrographs for selected stream-gaging stations in the (A-1) Mohawk River basin, NY, June 25–30, 2006. (Locations shown in figure 4A), (B-1 to B-5) Delaware River basin, NY, June 25–30, 2006. (Locations shown in figure 4B.), and (C-1 to C-2) Susquehanna River basin, NY, June 25–30, 2006. (Locations shown in figure 4C.)

Figure 8. Discharge hydrographs for selected stream-gaging stations in the (A–I) Mohawk River basin, NY, June 25–30, 2006. (Locations shown in figure 4A.), (B–I, to B–5) Delaware River basin, NY, June 25–30, 2006. (Locations shown in figure 4B.), and (C–I to C–2) Susquehanna River basin, NY, June 25–30, 2006. (Locations shown in figure 4C.)

1784 (Grover, 1937; Bailey and others, 1975). Discharge hydrographs for selected USGS stream-gaging stations in the Susquehanna River basin for the period June 25–30, 2006, are shown in figure 8.

Effects of Reservoirs on Flooding

The streamflow along reaches of the Mohawk, Delaware, and Susquehanna Rivers is affected by the outflow from one or more reservoirs in each basin. Data for the Delta, Hinckley, and Schoharie Reservoirs in the Mohawk River basin; the Pepacton, Cannonsville, Neversink, Prompton, and General Edgar Jadwin Reservoirs and Lake Wallenpaupack in the Delaware River basin; and the East Sidney and Whitney Point Lakes in the Susquehanna River basin are presented below. Reservoir water-level data for Delta Reservoir were provided by the New York State Thruway Authority, and NYCDEP provided the water-level data for the Pepacton, Cannonsville, and Neversink Reservoirs.

Mohawk River Basin

The Delta and Hinckley Reservoirs are operated and maintained by the New York State Canal Corporation, a division of the New York State Thruway Authority, and were originally constructed for navigation of the Erie Barge canal. Currently, these reservoirs are used for water supply, fisheries, power generation, and canal operations, and there is no provision for the planned regulation or mitigation of floodwaters. The Schoharie Reservoir is operated and maintained by the NYCDEP as a water-supply reservoir and it also does not have any provision for the planned regulation or mitigation of floodwater flows.

Delta Reservoir (fig. 4A) releases water at Delta Dam on the Mohawk River, which is about 4 mi upstream from Rome, NY, and has a drainage area of 148 mi². The dam was completed on August 3, 1912; controlled storage is documented to have started on May 1, 1913. The usable capacity of the reservoir is 2,800 million cubic feet at the crest of the spillway. The spillway crest elevation is 550.0 ft, Barge Canal Datum. The maximum observed elevation during 1951 to 2005 was 552.8 ft on June 22, 1972; April 17, 1994; and January 9, 1998. The maximum observed elevation during 2006 was 551.9 ft on June 28 and 29. The USGS stream-gaging station Mohawk River below Delta Dam near Rome (01336000) recorded a peak discharge of 3,100 ft³/s on June 28, which was less than a 5-year recurrence interval.

The Hinckley Reservoir (fig. 4A) is on West Canada Creek at Hinckley, NY, and has a drainage area of 372 mi². The West Canada Creek is a major tributary to the Mohawk River between Rome and Little Falls. The Hinckley Reservoir began storage operations in March 1914 and is formed by an earth and concrete dam, Hinckley Dam. The usable

capacity of the reservoir between the elevations 1,173.5 and 1,225.0 ft, elevation of spillway, is 3,320 million cubic feet. The elevation of the water level in the reservoir on June 26, 2006, was 1,223.0 ft, and the reservoir was at 93 percent of capacity (fig 9A–1). The USGS stream-gaging station West Canada Creek at Wilmurt (01343060), upstream from the Hinckley Reservoir, recorded a peak discharge of 23,200 ft³/s at 12:30 p.m. on June 28. The drainage area upstream from this stream-gaging station is 258 mi², which is about 70 percent of the total contributing area to the Hinckley Reservoir. The peak discharge recorded at this station per unit of contributing drainage area yields a peak runoff of about 90 (ft³/s)/mi². Applying this peak runoff to the entire Hinckley Reservoir drainage area yields an estimated maximum inflow of about 33,500 ft³/s on June 28. The water level in the Hinckley Reservoir reached a maximum elevation of 1,229.8 ft shortly before midnight on June 28 (fig. 9A–1). The period-of-record maximum elevation of 1,230.2 ft for the Hinckley Reservoir was set on October 2, 1945.

The Schoharie Reservoir (fig. 4A) is located along the Schoharie Creek a few miles east of Grand Gorge, NY, and has a drainage area of 315 mi². The reservoir began storage operations on July 24, 1926, and is formed by a masonry and earth dam. The usable capacity of the reservoir is 19,583 Mgal between the minimum operating elevation of 1,050.0 ft and the crest of the spillway at elevation 1,130.0 ft. On June 26, 2006, the daily mean elevation of the Schoharie Reservoir was 1,121.57 ft (fig. 9A–2). The USGS stream-gaging station Schoharie Creek at Prattsville (01350000), recorded a peak discharge of 19,100 ft³/s (table 3) on June 26, which was less than a 5-year recurrence interval, and a secondary peak of 17,500 ft³/s on June 28. The drainage area upstream from this stream-gaging station is 237 mi², which is about 75 percent of the total contributing area to the Schoharie Reservoir. The peak discharge recorded at this station per unit of contributing drainage area yields a peak runoff of 81 (ft³/s)/mi² on June 26 and 74 (ft³/s)/mi² on June 28. By applying these peak runoffs to the entire Schoharie Reservoir drainage area, an estimated maximum inflow of about 25,500 ft³/s was computed for June 26 and an estimated maximum inflow of 23,300 ft³/s for June 28. The water level in the reservoir reached a maximum elevation of 1,131.36 ft for this storm at 1:30 p.m. on June 28. The peak outflow from the reservoir was estimated on the basis of the recorded peak discharge at the USGS stream-gaging station Schoharie Creek at Gilboa (01350101) to be 17,500 ft³/s (fig. 9A–2).

Delaware River Basin

The Pepacton, Cannonsville, and Neversink Reservoirs are operated and maintained by the NYCDEP as water-supply reservoirs. The reservoirs have no provision for the planned regulation or mitigation of floodwaters. In addition, the amount of water that can be diverted through water-supply

Figure 9A-1. Fifteen minute inflow, and water-surface elevation at the Hinkley Reservoir, NY, June 26–30, 2006.

Figure 9A-2. Fifteen minute inflow, outflow, diversions and water-surface elevation at the Schoharie Reservoir, NY, June 26–30, 2006.

tunnels is inconsequential in comparison to the volume of floodwater flows.

The Pepacton Reservoir (fig. 4b) is located along the East Branch of the Delaware River just upstream from Downsville, NY, and has a drainage area of 372 mi². The Pepacton Reservoir began storage operations on September 15, 1954, and is formed by an earth filled rockfaced dam. The usable capacity of the reservoir is 140,190 Mgal, measured between the minimum operating elevation of 1,152.0 ft and the spillway crest at an elevation of 1,280.0 ft. The total capacity at the spillway crest, including dead storage, is 149,799 Mgal.

The Pepacton Reservoir was at about 101 percent of capacity at 7 a.m. on June 26, 2006, and was spilling. The combined streamflow from four USGS stream-gaging stations upstream from the Pepacton Reservoir were used to approximate the inflow to the reservoir during the June 2006 flood. The total drainage area gaged by summing the four USGS stream-gaging stations—East Branch Delaware River at Margaretville (01413500), Platte Kill near Dunraven (01414000), Mill Brook near Dunraven (01414500), and Tremper Kill near Andes (01415000),—is approximately 256 mi². This accounts for about 69 percent of the total contributing area to the Pepacton Reservoir. The hydrographs for these stream-gaging stations were combined to produce an estimated hydrograph of the inflow to the Pepacton Reservoir. The peak runoff, from the estimated inflow hydrograph, per unit of contributing drainage area was then computed to be 70 (ft³/s)/mi². Applying this peak runoff to the entire Pepacton Reservoir drainage area yields an estimated maximum inflow of about 26,000 ft³/s on June 28 (fig. 9B–1).

The water level in the Pepacton Reservoir reached a new period-of-record maximum elevation of 1,283.74 ft on June 28, as a result of this storm (fig. 9B–1). The previous period-of-record maximum observed elevation for the Pepacton Reservoir was 1,283.68 ft recorded on April 3, 2005. The USGS stream-gaging station East Branch Delaware River at Downsville (01417000), immediately downstream from the Pepacton Reservoir, recorded a peak discharge of 20,000 ft³/s in the early afternoon of June 28. This is the second highest peak recorded at the USGS stream-gaging station in Downsville since the reservoir began operations in 1954 and the fourth highest peak since the stream-gaging station was installed in July 1941 (fig. 7B–2). Although the Pepacton Reservoir was spilling on June 26, the peak outflow was still attenuated by about 23 percent because of the storage effect of the reservoir.

During flooding events in recent years, the contents of the Pepacton Reservoir have been at various levels at the start of each event. Prior to the flood of January 19–20, 1996, the Pepacton Reservoir was at 58 percent of capacity. During the January 1996 flood, the water level in the Pepacton reservoir rose nearly 20 ft, and the peak inflow to the reservoir was estimated to be greater than 50,000 ft³/s (Lumia, 1998). The period-of-record maximum discharge at the East Branch Delaware River at Margaretville stream-gaging station is 25,800 ft³/s recorded on January 19, 1996 (fig. 7B–1). The

East Branch Delaware River at Margaretville stream-gaging station is upstream from the Pepacton Reservoir and gages about 44 percent of the contributing drainage area to the reservoir. The outflow during the time of the peak inflow was about 1,800 ft³/s. The recorded peak discharge at the East Branch Delaware River at Downsville stream-gaging station, just downstream from the reservoir, was less than 2,600 ft³/s during the flood of January 18–19, 1996. Prior to the flood of September 18–19, 2004, the Pepacton Reservoir was at 99.2 percent of capacity. During the September 2004 flood, the peak inflow to the Pepacton Reservoir was estimated to be about 37,500 ft³/s on September 18, 2004 (Brooks, 2005). The recorded peak discharge at the East Branch Delaware River at Downsville stream-gaging station was 18,000 ft³/s on September 18, 2004.

The Cannonsville Reservoir (fig. 4B) located along the West Branch of the Delaware River approximately 1.8 mi southeast of Stilesville, NY, has a drainage area of 454 mi². The Cannonsville Reservoir is formed by an earth filled, rockfaced dam and began storage operations on September 30, 1963. The usable capacity of the reservoir is 95,706 Mgal between the minimum operating elevation of 1,040.00 ft and the spillway crest elevation of 1,150.00 ft. The total capacity at the spillway crest, including dead storage, is 98,618 Mgal.

The Cannonsville Reservoir was at 101 percent of capacity at 7 a.m. on June 26, 2006, and was spilling. The inflow to the Cannonsville Reservoir was approximated by combining the hydrographs for the USGS stream-gaging stations on the two major tributaries to the reservoir. The total drainage area gaged by the USGS stream-gaging stations West Branch Delaware River at Walton (01423000) and Trout Creek near Trout Creek (0142400103) is approximately 352 mi². This accounts for about 78 percent of the contributing drainage area of the Cannonsville Reservoir. The hydrograph of estimated inflow developed by combining the individual hydrographs of the West Branch Delaware River at Walton and Trout Creek near Trout Creek stream-gaging stations produced an estimated peak runoff per unit of contributing drainage area of 87 (ft³/s)/mi². Applying this peak runoff to the entire Cannonsville Reservoir drainage area yields an estimated maximum inflow of about 39,500 ft³/s on June 28 (fig. 9B–2). The peak discharges of 28,600 ft³/s on June 28 at West Branch Delaware River at Walton (fig. 7B–6) and 4,350 ft³/s on June 27 at Trout Creek near Trout Creek were both period-of-record maximum discharges.

The water level in the Cannonsville Reservoir reached a new period-of-record maximum elevation of 1,160.08 ft on June 28, as a result of this storm (fig. 9B–2). The previous period-of-record maximum observed elevation was 1,156.79 ft recorded on April 4, 2005. The USGS stream-gaging station West Branch Delaware River at Stilesville (01425000), immediately downstream from the Cannonsville Reservoir, recorded a new period-of-record maximum discharge of 33,100 ft³/s at noon of June 28 (fig. 7B–7). This new maximum discharge is more than double the previous

Figure 9B-1. Fifteen minute inflow, outflow, diversions and water-surface elevation at the Pepacton Reservoir, NY, June 26–30, 2006.

Figure 9B-2. Fifteen minute inflow, outflow, diversions and water-surface elevation at the Cannonsville Reservoir, NY, June 26–30, 2006.

peak-of-record maximum, since regulation, recorded on April 3, 2005. The peak outflow during the June 2006 flood was reduced by about 16 percent because of the storage effect of the reservoir. Although the Cannonsville Reservoir was full and spilling at the start of this storm, the flooding downstream would have been even greater if the reservoir had not been present.

The contents of the Cannonsville Reservoir were at varying amounts of full capacity at the start of past flooding events. Prior to the flood of January 19–20, 1996, the Cannonsville Reservoir was at 65 percent of full capacity. The water level in the Cannonsville Reservoir rose nearly 23 ft during the flood of January 1996 but did not spill as it stored floodwaters from the West Branch of the Delaware River and protected downstream communities from devastating flooding. The peak discharge of 25,000 ft³/s recorded on January 19, 1996, at the West Branch Delaware River at Walton stream-gaging station (01423000) upstream from the reservoir is the second highest peak recorded at this station. Prior to the flood of September 18–19, 2004, the Cannonsville Reservoir was at 99.6 percent of capacity. Upstream from the reservoir at the West Branch Delaware River at Walton stream-gaging station, a peak discharge of 15,200 ft³/s was recorded on September 18, 2004; downstream from the reservoir at West Branch Delaware River at Stilesville, a peak discharge of 10,200 ft³/s was recorded on September 19, 2004.

The Neversink Reservoir (fig. 4B) is along the Neversink River approximately 2 mi southeast of Neversink, NY, and

has a drainage area of 92.5 mi². The reservoir is formed by an earth filled rockfaced dam and began storage operations on June 2, 1953. The Neversink Reservoir has a usable capacity of 34,941 Mgal between the minimum operating elevation of 1,319.0 ft and the spillway crest elevation of 1,440.0 ft. The total capacity at the spillway crest, including dead storage, is 37,146 Mgal.

The contents of the Neversink Reservoir were at about 95 percent of capacity at 7:00 a.m. on June 26, 2006. The USGS stream-gaging station Neversink River near Claryville (01435000) recorded a peak discharge of 11,500 ft³/s on the morning of June 28. The drainage area above this stream-gaging station is about 72 percent of the total contributing area to the Neversink Reservoir. The peak discharge recorded at this station per unit of contributing drainage area yields a peak runoff of 173 (ft³/s)/mi². Applying this peak runoff to the entire Neversink Reservoir drainage yields an estimated maximum inflow of 16,000 ft³/s to the reservoir on June 28 (fig. 9B–3).

The Neversink Reservoir reached a peak elevation of 1,442.76 ft on June 28 as a result of this storm. The period-of-record maximum elevation for the Neversink Reservoir is 1,443.66 ft recorded on April 3, 2005. The USGS stream-gaging station Neversink River at Neversink (01436000), just downstream from the Neversink Reservoir, recorded a peak discharge of 7,840 ft³/s on the morning of June 28. The period-of-record maximum discharge at this station, since regulation, is 12,500 ft³/s recorded during the flood of April 2–3, 2005.

Figure 9B–3. Fifteen minute inflow, outflow, diversions and water-surface elevation at the Neversink Reservoir, NY, June 26–30, 2006.

The peak outflow from the Neversink Reservoir on June 28 was attenuated by about 51 percent because of the storage effects of the reservoir.

The Prompton Reservoir is along the West Branch Lackawaxen River 0.3 mi north of Prompton, PA, and has a drainage area of 59.6 mi². The reservoir is formed by an earth and rock filled dam and was completed by the U.S. Army Corps of Engineers in July 1960. The primary purpose for the construction of this reservoir was flood control, although it is also used for recreation. Regulation is accomplished through an ungated tunnel that slowly drains stored floodwaters. The usable capacity of the reservoir is about 15,732 Mgal between elevation 1,125.0 ft (conservation pool) and the spillway crest at elevation 1,205.0 ft.

The water level in the Prompton Reservoir was at an elevation of 1,124.1 ft at noon on June 25, 2006. During this storm event, the water level in the reservoir rose more than 32 ft and crested at 1,156.4 ft on June 28 at 3:00 p.m., nearly 49 ft below the spillway. The Prompton Reservoir successfully stored 4,272 Mgal of floodwaters, or 4.1 in. of runoff, during the June 2006 storm.

The General Edgar Jadwin Reservoir is along Dyberry Creek, a major tributary to the Lackawaxen River, 2.4 mi north of Honesdale, PA, and has a drainage area of 64.5 mi². The reservoir is formed by an earth and rock filled dam and was completed by the U.S. Army Corps of Engineers in October 1959. The primary purpose for the construction of this reservoir was flood control. Regulation is accomplished through an ungated tunnel that slowly drains stored floodwaters. The usable capacity of the reservoir is about 7,983 Mgal below the spillway crest at elevation 1,053.0 ft, and there is no dead storage.

The water level in the General Edgar Jadwin Reservoir was at an elevation of 989.2 ft at noon on June 25, 2006. During the storm, the water level rose nearly 52 ft and crested at 1,040.8 ft on June 28 at 8:00 p.m., slightly more than 12 ft below the spillway. The General Edgar Jadwin Reservoir successfully stored 5,429 Mgal, or 4.8 in. of runoff, during the June 2006 storm.

Lake Wallenpaupack is along Wallenpaupack Creek (fig. 4B), a major tributary to the Lackawaxen River, at Wilsonville, PA, and has a drainage area of 228 mi². The lake is formed by a concrete gravity-type and earth filled dam and was completed by Pennsylvania Power and Light Corporation (PPL) in November 1925. The primary purpose of the lake was hydroelectric power, although it is also used for recreation, and is operated in a manner to mitigate downstream flooding. Regulation is accomplished by 14-ft diameter roller gates affixed on top of the spillway crest at elevation 1,176.0 ft and by the intake structure for two turbines. The usable capacity of the lake is 38,000 Mgal between elevation 1,165.0 ft and the crest elevation of 1,187.0 ft (PPL Generation, LLC, and Kleinschmidt, 2002).

On June 25, 2006, the water level in Lake Wallenpaupack was at a normal operating elevation of 1,185.8 ft; by 3:30 a.m. on June 28, the water level in the lake had risen to an elevation

of 1,190.1 ft and began to spill over the top of the roller gates. On June 28, a 4-hour average peak inflow of 19,500 ft³/s was estimated and a peak outflow of 9,700 ft³/s was computed. Lake Wallenpaupack successfully stored 11,500 Mgal, or 2.9 in. of runoff, during the June 2006 storm (Gary Petrewski, Pennsylvania Power and Light Corporation, oral commun., 2008).

Susquehanna River Basin

The East Sidney Lake (fig. 4C) is along the Ouleout Creek about 4 mi upstream from its confluence with the Susquehanna River near Unadilla, NY, and has a drainage area of 103 mi². The Ouleout Creek is a major tributary to the Susquehanna River between Oneonta and Unadilla. East Sidney Lake is formed by a concrete dam and rock-filled dike. The primary purpose for the construction of this lake was flood control, although it is also used for recreation. While still under construction, East Sidney Lake began regulation of outflows in November 1949 and was first used for flood control on March 28, 1950. The U.S. Army Corps of Engineers completed construction of the reservoir in June 1950. Discharge is controlled by the operation of five large gates, which allow the lake to store floodwaters during storms and then release water when conditions permit. The usable capacity of the lake is about 10,934 Mgal between elevation 1,115.0 ft and the crest of the spillway at elevation 1,203.0 ft.

The water level in East Sidney Lake was at an elevation of 1,152.4 ft at 7:00 a.m. on June 26, 2006, 10 percent of capacity. The discharge at the USGS stream-gaging station Ouleout Creek at East Sidney (01500000), downstream from the lake, was less than 100 ft³/s on the morning of June 26, 2006. Releases from the lake were increased to about 1,000 ft³/s by late in the evening on June 26 in an attempt to lower the water level in the lake to allow a larger void to store floodwaters. When rainfall increased on the morning of June 27, releases from the lake were reduced, and by noon on June 27, the discharge was less than 40 ft³/s at the Ouleout Creek at East Sidney stream-gaging station. From 5:00 a.m. on June 27 to 5:00 a.m. on June 29, the water level in East Sidney Lake had risen more than 50 ft, and the lake was starting to spill (fig. 9C–1). This was the first time in its 56-year history that the lake spillway had been used. The water level in East Sidney Lake reached a new period-of-record maximum elevation of 1,204.35 ft on June 30. The peak discharge at the Ouleout Creek at East Sidney stream-gaging station was 2,010 ft³/s recorded on July 1, 2006, days after flood crests along the Susquehanna River had occurred. The East Sidney Lake successfully stored 11,110 Mgal, or 6.2 in. of runoff, during the June 2006 storm.

The Otselic River is a tributary to the Tioughnioga River, which is a tributary to the Chenango River. The Chenango River is a major tributary to the Susquehanna River, whose confluence is in the City of Binghamton. Whitney Point Lake

(fig. 4C) is along the Otselic River about 0.9 mi upstream from the confluence with the Tioughnioga River in Whitney Point, NY, and has a drainage area of 257 mi². The Tioughnioga River at Lisle stream-gaging station (01509520) is upstream from the confluence, and the Tioughnioga River at Itaska stream-gaging station (01511500) is downstream from the confluence (fig. 4C). Whitney Point Lake was completed by the U.S. Army Corps of Engineers in 1942 and is formed by an earth filled dam and concrete spillway. The primary purpose for the construction of this lake was flood control, and it was first used for this purpose on March 9, 1942. Discharge is controlled by the operation of three large gates, which are used to allow the lake to store floodwaters during storms and then release them when conditions permit. The usable capacity of the lake is about 28,171 Mgal between elevation 950.0 ft and the crest of the spillway at elevation 1,010.0 ft.

The water level in Whitney Point Lake was at an elevation of 973.2 ft at 7:00 a.m. on June 26, 2006, 15 percent of capacity. Streamflow at the USGS stream-gaging station Otselic River at Cincinnatus (01510000), about 12 mi upstream from Whitney Point Lake, recorded a peak discharge of 8,100 ft³/s at 1:00 a.m. on June 28 (table 3). The water level in Whitney Point Lake began a steady rise late in the evening on June 26 and reached a maximum elevation of 999.57 ft at 9:00 a.m. on June 30. Although the water level in Whitney Point Lake had increased by more than 26 ft from June 26 to June 30, there was still an additional 10 ft of storage available before the lake would spill (fig. 9C–2). Whitney Point Lake successfully stored 18,987 Mgal, or 4.3 inches of runoff, during the June 2006 storm.

Comparison of the 2006 Flood to Historic Floods

For more than a century, the USGS has documented the effects of many floods that have devastated areas in New York and adjacent states. Although the data collected from previous floods has helped Federal, State, and local officials to develop infrastructure to withstand future flooding, a comparison of this flood with past floods gives a perspective on the magnitude of this event that is not affected by changes in costs and labor practices over time. The recorded peak water-surface elevations and discharges during the June 26–29, 2006, flood at selected USGS stream-gaging stations were compared to those of several previous floods. The floods selected for comparison differed by basin because of the diverse topography and variable weather patterns typically found in New York. New York has eight physiographic regions, excluding Long Island, and widely varied mean annual precipitation patterns (Randall, 1996) that at times can contribute to widely varied streamflow conditions. It is not uncommon in New York for one part of the state to experience a major flood, while rivers and streams in other areas remain well below the NWS flood stage.

Mohawk River Basin

In the Mohawk River basin, peak discharges from the June 2006 flood were compared to historic peaks from the floods of March 1977 and January 1996 at selected USGS stream-gaging stations (table 4A). During the March 1977 flood, the USGS stream-gaging station Mohawk River below Delta Dam near Rome (01336000) recorded a peak discharge of 640 ft³/s, which is less than the 2-year recurrence interval, but downstream at the Mohawk River at Little Falls stream-gaging station (01347000), the recorded peak discharge for the March 1977 flood was 33,100 ft³/s. During the January 1996 flood, a peak discharge of 30,700 ft³/s was recorded at the Mohawk River at Little Falls stream-gaging station. The West Canada Creek is a major tributary to the Mohawk River between Rome and Little Falls. During the 1977 and 1996 floods, the recorded peak discharges at the USGS stream-gaging station West Canada Creek at Kast Bridge (01346000) were 2,850 and 13,600 ft³/s, respectively. Farther downstream from Little Falls, two additional gaged tributaries contribute to the flow in the Mohawk River. These tributaries are the East Canada Creek and the Schoharie Creek. The USGS stream-gaging stations East Canada Creek at East Creek (01348000) and Schoharie Creek at Burtonsville (01351500) recorded peak discharges of 13,300 and 35,500 ft³/s, respectively, during the March 1977 flood and 17,000 and 81,600 ft³/s, respectively, during the January 1996 flood. The USGS stream-gaging station Mohawk River at Cohoes (01357500), near the mouth of the Mohawk River, recorded peak discharges of 112,000 and 132,000 ft³/s during the March 1977 and January 1996 floods, respectively. Discharge hydrographs for selected historic floods at the Little Falls and Cohoes stream-gaging stations are shown in figure 10A.

During the June 2006 flood, new period-of-record maximum discharges were recorded at the Mohawk River at Little Falls and the East Canada Creek at East Creek stream-gaging stations, and although a new record maximum was not recorded at the West Canada Creek at Kast Bridge stream-gaging station, the maximum discharge did have a greater than 100-year recurrence interval (table 3). The maximum discharge for the June 2006 flood recorded at the USGS stream-gaging station Schoharie Creek at Burtonsville was 28,100 ft³/s with a recurrence interval of less than 5 years.

Delaware River Basin

In the Delaware River basin, peak discharges from the June 2006 flood were compared to historic peaks from the floods of August 1955, January 1996, September 2004, and April 2005 at selected USGS stream-gaging stations (table 4B). Prior to June 2006, the August 1955 flood was considered by many to be the greatest flood that ever occurred along many reaches of the main stem of the Delaware River from Hancock, NY, to Trenton, NJ, as well as many parts of southeastern New England. The flood of August 1955 was

Figure 9C-1. Fifteen minute outflow and water-surface elevation at the East Sidney Lake, NY, June 26–July 1, 2006.

Figure 9C-2. Fifteen minute discharges at selected stream-gaging stations upstream and downstream of Whitney Point Lake and water-surface elevation at Whitney Point Lake, NY, June 26–30, 2006.

Figure 10A. Discharge hydrographs for selected historic floods at (1) the Mohawk River near Little Falls, NY, and (2) the Mohawk River at Cohoes, NY, stream-gaging stations. (Locations shown in fig. 4A.)

Table 4A. Peak elevations and peak discharges for selected historical floods and the June 26–29, 2006, flood at selected U.S. Geological Survey stream-gaging stations in the Mohawk River basin, NY.[mi², square miles; --, no data available]

Station number	Station name	Drainage area (mi ²)	Peak elevations, in feet above NGVD 29; peak discharges, in cubic feet per second		
			March 1977	January 1996	June 2006
01336000	Mohawk River below Delta Dam, near Rome, NY	152	476.05; 640	476.27; 804	479.73; 3,100
01346000	West Canada Creek at Kast Bridge, NY	560	442.73; 2,850	445.81; 13,600	447.28; 21,800
01347000	Mohawk River near Little Falls, NY	1,342	328.01; 33,100	327.31; 30,700	328.56; 35,000
01348000	East Canada Creek at East Creek, NY	289	343.12; 13,300	344.02; 17,000	346.69; 31,500
01349150	Canajoharie Creek near Canajoharie, NY	59.7	-- --	648.51; 3,280	650.50; 5,510
01351500	Schoharie Creek at Burtonsville, NY	886	515.87; 35,500	520.86; 81,600	514.95; 28,100
01357500	Mohawk River at Cohoes, NY	3,450	70.89; 112,000	71.81; 132,000	69.83; 96,400

fueled by two hurricanes that traveled up the east coast and over New York and southeastern New England. Hurricanes Connie and Diane hit the area about 1 week apart, and each dropped about 4 to 8 in. of rain over parts of southeastern New York. The USGS stream-gaging station Delaware River above Lackawaxen River near Barryville, NY, (01428500) has been in operation since October 1940, and prior to the June 28, 2006, peak of 151,000 ft³/s, the period-of-record maximum discharge was 130,000 ft³/s recorded during the August 1955 flood (fig. 7B-10). The period-of-record maximum discharge at the USGS stream-gaging station Delaware River at Port Jervis (01434000), in operation since October 1904, is 233,000 ft³/s, which was recorded during the August 1955 flood. The peak discharge for the June 2006 flood at the Delaware River at Port Jervis stream-gaging station was 189,000 ft³/s (fig. 7b-11). According to historic literature, the highest flood prior to the October 1903 flood which was estimated at 205,000 ft³/s at Port Jervis, was on January 8, 1841 (Grover, 1937). The Lackawaxen and Mongaup Rivers and Shohola Creek are the larger tributaries between the near Barryville and Port Jervis stream-gaging stations, and the Lackawaxen River accounts for 57 percent of the increase in drainage area between the two stream-gaging stations. During the August 1955 flood, the peak discharge at the USGS stream-gaging station Lackawaxen River near Hawley, PA, (01431500) was 51,900 ft³/s, and during the June 2006 flood, the peak discharge was 28,000 ft³/s. Inflow during the August 1955 flood, to the Delaware River between Barryville and Port Jervis can be estimated to be about 100,000 ft³/s, but during the June 2006 flood, the inflow was probably less than 40,000 ft³/s. The large difference in inflow to the Delaware River between Barryville and Port Jervis during the August 1955 flood and the June 2006 flood is mostly attributable to precipitation and runoff amounts and patterns but is also partly attributable to the effects of Prompton Reservoir, General Edgar Jadwin Reservoir, and Lake Wallenpaupack on flood flows in the Lackawaxen River basin. Discharge hydrographs

for the August 1955 and June 2006 floods at selected sites along the main stem of the Delaware River are shown in figure 10B.

Upstream from the confluence of the East and West Branches of the Delaware River in Hancock, recorded peak flows during the January 1996, September 2004, and April 2005 floods exceeded the August 1955 flood at several USGS stream-gaging stations (table 4b). The Pepacton Reservoir is along the East Branch of the Delaware River just upstream from Downsville. The Pepacton Reservoir began storage operations on September 15, 1954. During the August 1955 flood, the USGS stream-gaging station East Branch Delaware River at Margaretville (01413500), upstream from the Pepacton Reservoir, recorded a peak discharge of 9,990 ft³/s flowing into the reservoir. The Pepacton Reservoir, which was at 39 percent of capacity on August 1, 1955, stored all the runoff from the upstream contributing drainage area and as a result, the peak discharge recorded at the USGS stream-gaging station East Branch Delaware River at Downsville (01417000), immediately downstream from the Pepacton Reservoir, was only 620 ft³/s during the August 1955 flood. On September 1, 1955, the water-level in the Pepacton Reservoir had reached and elevation of about 1,159.6 ft (fig. 11), and was at just over 50 percent of capacity after storing runoff from the back-to-back hurricanes that struck the region from August 11 to 20, 1955 (Bogart, 1960). During the January 1996 flood the water level in the Pepacton Reservoir rose nearly 20 ft with an estimated inflow of greater than 50,000 ft³/s. On June 28, 2006, the water level in the Pepacton Reservoir reached a new period-of-record maximum elevation of 1,283.74 ft. Prior to the construction of the Pepacton Reservoir, the period-of-record maximum discharge at USGS stream-gaging station East Branch Delaware River at Downsville was 23,900 ft³/s, recorded on November 26, 1950. Farther downstream at the USGS stream-gaging station East Branch Delaware River at Fishs Eddy (01421000), a peak discharge of 27,400 ft³/s was recorded during the August 1955 flood.

Figure 10B. Discharge hydrographs for selected stream-gaging stations in the Delaware River basin, NY, for the June 2006 and August 1955 floods. (Locations shown in fig. 4B.)

Subsequent to the flood of August 1955, the floods of September 2004 and April 2005 were close in magnitude along the East Branch of the Delaware River from Downsville to Fishs Eddy. Peak discharges of 20,200 and 19,400 ft^3/s were recorded at the Downsville stream-gaging station during the floods of 2004 and 2005, respectively, and 56,300 and 65,100 ft^3/s were recorded at the Fishs Eddy stream-gaging station during the floods of 2004 and 2005, respectively. The recorded peak discharge for the June 2006 flood, 77,400 ft^3/s , was a new period-of-record maximum for the USGS stream-gaging station East Branch Delaware River at Fishs Eddy since the stream-gaging station was put into operation in October 1912 (fig. 7B–5).

Along the West Branch of the Delaware River, the August 1955 flood produced peak discharges of 15,100 ft^3/s at the Walton stream-gaging station (01423000) and 16,000 ft^3/s downstream at the Hale Eddy stream-gaging station (01426500). The Cannonsville Reservoir was constructed and began operations on September 30, 1963. Prior to the June 2006 flood, the period-of-record maximum discharge at the USGS stream-gaging station West Branch Delaware River at Walton was 25,000 ft^3/s recorded on January 19, 1996. The Cannonsville Reservoir was at 65 percent of capacity prior to the January 1996 flood. The peak inflow to the Cannonsville Reservoir was computed to be about 35,000 ft^3/s on January 19, 1996 (Lumia, 1998). The

peak discharge recorded at the USGS stream-gaging station West Branch Delaware River at Stilesville (01425000), about 1.8 mi downstream from the Cannonsville Reservoir, during the January 1996 flood was 112 ft^3/s . The water level in the reservoir rose nearly 23 ft from January 18 to 23, 4.0 in. of runoff was stored during this period, and the reservoir began to spill on January 25. The Catskill Mountain part of the New York City reservoir system (includes all six New York City reservoirs in the Catskill Mountains) stored about 95.5 billion gallons of floodwaters during January 18–23, 1996 (Lumia, 1998). Peak discharges of 15,200 and 17,500 ft^3/s were recorded at the Walton and Hale Eddy stream-gaging stations during the flood of September 2004. Peak discharges of 18,400 and 21,500 ft^3/s were recorded at the Walton and Hale Eddy stream-gaging stations during the flood of April 2005, whereas period-of-record peak discharges of 28,600 and 43,400 ft^3/s were recorded during the flood of June 2006 (figs. 7B–6, 7B–8).

The June 2006 flood is the greatest flood since the flood of October 1903 along the lower reach of the East Branch Delaware River from East Branch to Hancock, along the middle and lower reaches of the West Branch Delaware River from Walton to Hancock, and along the main stem Delaware River from Hancock to the confluence with the Lackawaxen River.

Table 4B. Peak elevations and peak discharges for selected historical floods and the June 26-29, 2006, flood at selected U.S. Geological Survey stream-gaging stations in the Delaware River basin, NY.[mi², square miles; --, no data available]

Station number	Station name	Drainage area (mi ²)	Peak elevations, in feet above NGVD 29; peak discharges, in cubic feet per second					
			August 1955	January 1996	September 2004	April 2005	June 2006	
01413500	East Branch Delaware River at Margaretville, NY	163	1,313.47;	25,800	1,315.04;	1,315.22;	1,314.98;	13,600
01417000	East Branch Delaware River at Downsville, NY	372	1,098.72;	2,580	1,107.00;	1,106.82;	1,106.96;	20,000
01417500	East Branch Delaware River at Harvard, NY	458	^a 1,018.40;	12,200	1,023.48;	1,023.73;	1,024.02;	22,100
01420500	Beaver Kill at Cooks Falls, NY	241	1,163.14;	42,900	1,169.37;	1,170.68;	1,172.25;	62,400
01421000	East Branch Delaware River at Fishs Eddy, NY	784	^b 966.25;	53,000	^c 977.36;	975.43;	977.39;	77,400
01423000	West Branch Delaware River at Walton, NY	332	1,203.17;	25,000	1,203.71;	1,204.75;	1,207.15;	28,600
01425000	West Branch Delaware River at Stilesville, NY	456	^d 1,001.68;	998.87;	1,004.06;	1,005.45;	1,009.95;	33,100
01426500	West Branch Delaware River at Hale Eddy, NY	595	959.13;	13,200	959.29;	960.58;	965.56;	43,400
01427510	Delaware River at Callicoon, NY	1,820	--	751.19;	752.21;	752.86;	755.26;	144,000
01428500	Delaware River above Lackawaxen River near Barryville, NY	2,020	626.62;	98,300	624.31;	625.02;	629.19;	151,000
01431500	Lackawaxen River at Hawley, PA	290	893.80;	880.54;	883.49;	884.24;	887.19;	28,000
01434000	Delaware River at Port Jervis, NY	3,070	439.26;	433.72;	434.87;	435.87;	436.82;	189,000
01437500	Neversink River at Godeffroy, NY	307	472.15;	8,220	467.88;	472.06;	469.17;	10,300
01438500	Delaware River at Montague, NJ	3,480	405.08;	396.59;	398.30;	401.62;	402.08;	212,000

^a At site 1,100 feet upstream.^b At site 3,000 feet downstream.^c At site 0.3 mile upstream.^d At site 600 feet downstream.^e Prior to construction of Cannonsville Reservoir.

Susquehanna River Basin

In the Susquehanna River basin, peak discharges from the June 2006 flood were compared to historic peaks from the floods of March 1936, June 1972, and April 2005 at selected USGS stream-gaging stations (table 4C). At the time, the March 1936 flood was the greatest flood of record in the upper reaches of the Susquehanna River basin (upstream from Waverly, NY), except for part of the Chemung River basin that was hit even harder by the flood of July 1935 (Grover, 1937). The June 1972 flood that resulted from heavy rains brought on by remnants of Hurricane Agnes produced record flooding along the Chemung River and throughout the Susquehanna River basin downstream from Waverly. Hurricane Agnes delivered more than 19 in. of rain from June 19–24, 1972, as it moved from the Gulf of Mexico across Florida, then up the east coast through New York, into Canada, and finally out to sea. Although many long-standing flood records were exceeded in six states and 122 people were killed as a result of this storm (National Oceanic and Atmospheric Administration, 2002), peak discharges recorded during the July 1935 and March 1936 floods remained greater than those of the June 1972 storm at many locations upstream from Waverly, along the Susquehanna, Chenango, and Tioughnioga Rivers. Discharge hydrographs for selected USGS stream-gaging stations in the Susquehanna River basin for the March 1936, June 1972, and June 2006 floods are shown in figure 10C. The peak discharge at the USGS stream-gaging station Susquehanna River at Unadilla (01500500) was estimated to be about 31,300 ft³/s during the March 1936 flood. Peak discharges recorded along the Chenango River at the Sherburne (01505000) and Chenango Forks (01512500) stream-gaging stations were 12,500 (estimated) and 50,100 ft³/s, respectively (table 4C). The USGS stream-gaging stations on the Susquehanna River at Conklin (01503000) and at Vestal (01513500) recorded peak discharges of 61,600 and 107,000 ft³/s (estimated), respectively, during the March 1936 flood, and 26,500 and 50,400 ft³/s, respectively, during the June 1972 flood (figs. 7C–3, 7C–8). Several new period-of-record maximum discharges were recorded in the Susquehanna River basin as a result of the June 2006 flood. The USGS stream-gaging stations Susquehanna River at Unadilla, at Conklin, and at Vestal recorded new period-of-record maximum discharges of 35,100 ft³/s, 76,800, and 119,000 respectively, during the June 2006 flood. The Susquehanna River near Waverly, NY (01515000), stream-gaging station is 1 mi downstream from the New York-Pennsylvania state line and has been in operation since February 1937. An estimated peak discharge, outside the period of record, of 128,000 ft³/s was determined from flood profiles for the March 1936 flood. Coincidentally, a peak discharge of 128,000 ft³/s was recorded on June 28, 2006, and is considered the new period-of-record maximum for the Susquehanna River near Waverly stream-gaging station.

Peak Water-Surface Elevations at Flood Study Sites

Measurements of peak water-surface elevations were made at 104 sites along the Mohawk, Delaware, and Susquehanna Rivers. The study area in the Mohawk River basin includes study sites on the West and East Canada Creeks and along the Mohawk River from below Delta Dam near Rome east to Erie Canal Lock 9 at Rotterdam Junction (fig. 12A).

In the Delaware River basin, study sites were identified on tributaries to the East Branch Delaware River, which included the Little Beaver Kill, Willowemoc Creek, and Beaver Kill. Study sites also were selected along the East Branch Delaware River from Harvard to the confluence of the East and West Branches of the Delaware River near Hancock. Along the West Branch Delaware River, study sites were selected at points upstream from the Cannonsville Reservoir near Delhi to the confluence of the East and West Branches of the Delaware River below the Cannonsville Reservoir near Hancock. Study sites were not selected upstream from the Pepacton Reservoir along the East Branch Delaware River because several USGS stream-gaging stations in this area generally indicated peak discharges had recurrence intervals of 15 years or less. Study sites also were selected along the main stem of the Delaware River from Hancock to Port Jervis and along Callicoon Creek, a tributary to the Delaware River (fig. 12B).

In the Susquehanna River basin, study sites were selected along the Susquehanna River from Cooperstown, NY, downstream to Athens, PA. Sites also were selected along tributaries to the Susquehanna River, which included the Unadilla, the Tioughnioga, and the Chenango Rivers. Although these areas were devastated by floods in the past, major flooding was not identified during June 27–29, 2006, along the Chemung River; therefore, study sites were not selected along this major tributary to the Susquehanna River (fig. 12C).

High-water marks at each site were flagged and surveyed to obtain peak water-surface elevations, and were referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29). A data correction value used to convert elevations from NGVD 29 to North American Vertical Datum of 1988 (NAVD 88) at each site was calculated by using the National Geodetic Survey (NGS) North American Vertical Datum Conversion (VERTCON) Utility (National Oceanic and Atmospheric Administration, 2006d). At sites associated with a bridge, high-water marks were obtained upstream and downstream from the structure when possible.

The accuracy of high-water marks was rated subjectively by field personnel as “excellent,” “good,” “fair,” or “poor,” according to the guidelines of Benson and Dalrymple (1967). “Excellent” means the reported high-water mark is considered within 0.02 ft of the true high-water elevation, “good” within 0.05 ft and “fair” within 0.10 ft; “poor” implies less than “fair”

Figure 10C. Discharge hydrographs for selected historic floods at (1) the Susquehanna River near Waverly, NY, and (2) the Susquehanna River at Conklin, NY, stream-gaging stations. (Locations shown in fig. 4C.)

Table 4C. Peak elevations and peak discharges for selected historical floods and the June 26-29, 2006, flood at selected U.S. Geological Survey stream-gaging stations in the Susquehanna River basin, NY.[mi², square miles; --, no data available]

Station number	Station name	Drainage area (mi ²)	Peak elevations, in feet above NGVD 29; peak discharges, in cubic feet per second			
			March 1936	June 1972	April 2005	June 2006
01500500	Susquehanna River at Unadilla, NY	982	1,013.85; ^a 31,300	1,005.12; 6,140	1,010.93; 20,500	1,014.97; 35,100
01502500	Unadilla River at Rockdale, NY	520	--	1,000.98; 6,640	1,004.08; 13,900	1,006.21; 23,100
01503000	Susquehanna River at Conklin, NY	2,232	861.18; 61,600	853.93; 26,500	859.12; 49,400	866.06; 76,800
01505000	Chenango River at Sherburne, NY	263	1,047.76; ^a 12,500	1,046.73; 7,500	1,047.94; 9,330	1,048.51; 11,400
01507000	Chenango River at Greene, NY	593	--	907.08; 12,000	911.25; 20,800	913.74; 27,100
01509000	Tioughnioga River at Cortland, NY	292	--	1,095.39; 7,730	1,098.99; 14,200	1,095.87; 7,620
01510000	Otselic River at Cincinnatus, NY	147	--	1,041.06; 5,530	1,042.22; 12,200	1,041.26; 8,100
01511500	Tioughnioga River at Itaska, NY	730	929.88; 28,700	926.35; 11,500	928.40; 19,300	926.61; 12,400
01512500	Chenango River near Chenango Forks, NY	1,483	886.89; 50,100	882.82; 26,200	885.97; 45,400	885.37; 41,500
01513500	Susquehanna River at Vestal, NY	3,941	829.69; ^a 107,000	821.54; 50,400	828.33; 97,000	832.85; 119,000
01514000	Owego Creek near Owego, NY	185	829.82; 12,200	829.97; 10,600	828.36; 7,150	829.07; 8,320
01515000	Susquehanna River near Waverly, NY	4,773	765.36; ^a 128,000	65.20; 121,000	764.84; 105,000	766.48; 128,000

^a Estimated.

Figure 11. Water-surface elevation in the Pepacton Reservoir, NY, during August-October 1955, January 1996, and June 2006.

Figure 12A. Locations of 22 high-water-mark sites chosen for study in the Mohawk River basin, NY, for the flood of June 26–29, 2006. (Site numbers and flood data listed in table 5A.)

Figure 12B. Locations of 44 high-water-mark sites chosen for study in the Delaware River basin, NY, for the flood of June 26–29, 2006. (Site numbers and flood data listed in table 5B.)

Figure 12C. Locations of 38 high-water-mark sites chosen for study in the Susquehanna River basin, NY, for the flood of June 26–29, 2006. (Site numbers and flood data listed in table 5C.)

accuracy. The high-water-mark description, photographs, location (latitude and longitude), and location with respect to a nearby bridge or other structure were documented and are presented in appendix 1. High-water-mark locations described as “left bank” or “right bank” are in relation to an observer facing downstream.

Peak water-surface elevations for the June 2006 flood were compared with flood-profile elevations published in FEMA flood-insurance studies (Federal Emergency Management Agency; 1976a–c, 1977, 1978a–b, 1979a–c, 1980a–b, 1981a–d, 1982a–f, 1983a–b, 1984a–b, 1985, 1986a–b, 1987a–g, 1988, 1990a–b, 1991a–b, 1992a–c, 1993a–c, 1997, 1998a–b, 1999a–c, 2000, 2001a–b, 2002a–d). Peak water-surface elevations and published FEMA 10-, 50-, 100-, and 500-year flood elevations are compiled in table 5. Flood elevations at 10-, 50-, 100-, and 500-year recurrence intervals and those determined for the flood of June 26–29, 2006, for selected sites in the Mohawk, Delaware, and Susquehanna River basins are plotted in figure 13.

FEMA flood-insurance studies are not available for all the communities studied along the West Canada Creek. The 100-year elevation was available for the communities of Poland and Newport (sites 1–3). The peak water-surface elevations for sites 1 and 2 were above the 100-year flood-profile elevation, and the peak water-surface elevation at site 3 was just below the 100-year flood-profile elevation. A FEMA flood-insurance study is available for the community of Dolgeville (site 6) along the East Canada Creek. Peak water-surface elevations upstream from State Route 29 in Dolgeville were between the 50- and 100-year flood-profile elevations, and the peak water-surface elevation downstream from the Route 29 bridge was between the 100- and 500-year flood-profile elevations. FEMA flood-insurance studies were available for most of the communities along the Mohawk River from Rome (site 8) to Rotterdam Junction (site 22). Peak water-surface elevations from Rome to Little Falls (site 12) were at or below the 10-year flood-profile elevation. Peak water-surface elevations at Lock 17 in Little Falls (site 13) and at Fort Plain (site 15) were generally between the 100- and 500-year flood-profile elevations, but peak water-surface elevations at Lock 15 at Fort Plain (site 14), at Canajoharie (site 16), and at Fonda/Fultonville (site 17) were all higher than the 500-year flood-profile elevations. Peak water-surface elevations from Amsterdam (site 19) to Rotterdam Junction (site 22) were generally between the 10- and 50-year flood-profile elevations.

FEMA flood-insurance studies were available for most study sites along the Little Beaver Kill, the Willowemoc, and the Beaver Kill. Peak water-surface elevations along the Little Beaver Kill from Morriston (site 23) to Livingston Manor (site 25) were generally at the 500-year flood-profile elevations. Along the Willowemoc Creek from its confluence with the Little Beaver Kill in Livingston Manor (site 27) downstream to Roscoe (site 30), the peak water-surface elevations range from higher than the 500-year flood profile down to about equal to or just below the 50-year flood-profile

elevations, respectively. There were only limited FEMA flood-insurance studies available along the Beaver Kill from Rockland (site 31) to Peakville (site 35). Peak water-surface elevations range from slightly lower than the 100-year flood-profile elevation in the upper reach to slightly higher than the 50-year flood-profile elevation at Peakville.

Peak water-surface elevations were compared to FEMA flood-insurance study elevations for sites along the East Branch Delaware River (fig. 12b) below the Pepacton Reservoir in Harvard (site 36) to the confluence with the West Branch Delaware River in Hancock (site 40). Peak water-surface elevations were at the 10-year flood-profile elevation in Harvard and at East Branch (site 37) but generally increased to about the 50-year flood-profile elevations, from Fishs Eddy (site 38) to Hancock. FEMA flood-insurance studies are not available for all study sites along the West Branch Delaware River. Peak water-surface elevations were between the 10- and 50-year flood-profile elevations in the community of Delhi (site 41) and generally at the 100-year flood-profile elevation in the community of Walton (sites 45 and 46). Downstream from the Cannonsville Reservoir from Deposit (site 48) to Hale Eddy (site 50), the peak water-surface elevations were higher than the 500-year flood-profile elevations, and at Hancock (site 51) were at the 100-year profile. FEMA flood-insurance studies are not available for all study sites along Callicoon Creek. Along Callicoon Creek from Hortonville (site 54) to Callicoon (site 56), the peak water-surface elevations were between the 100- and 500-year flood-profile elevations. Along the main stem of the Delaware River from Lordville (site 57) to Port Jervis (site 66), the peak water-surface elevations were generally between the 100- and 500-year flood-profile elevations. Comparisons of peak water-surface elevations at selected study sites in the Delaware River basin between the September 2004 and the June 2006 floods are shown in appendix 2.

FEMA flood-insurance studies were only available for limited study sites along the Unadilla and Tioughnioga Rivers. Peak water-surface elevations along the Unadilla River at Rockdale (site 70) and near Unadilla (site 71) were higher than the 500-year flood-profile elevations. Along the Tioughnioga River at the USGS stream-gaging station at Cortland (01509000), the peak water-surface elevation was slightly lower than the 10-year flood-profile elevation and 2.8 ft lower than the 100-year flood-profile elevation; at Chenango Forks (site 72), the peak water-surface elevation is 3.3 ft lower than the 100-year flood-profile elevation (100-year flood profile was the only available profile in this area). FEMA flood-insurance studies were available for most study sites along the Chenango River. The Chenango River is a major tributary that joins the Susquehanna River in the City of Binghamton. The peak discharge at the Chenango River at Sherburne stream-gaging station (01505000) had a recurrence interval of about 60 years. The peak water-surface elevation at the Chenango River at Route 32A in Norwich (site 74) was between the 10- and 50-year flood-profile elevations. Downstream at Brisben (site 76), the peak water-surface elevation was

Table 5A. Peak water-surface elevations at 22 high-water-mark sites and 5 U.S. Geological Survey stream-gaging stations in the Mohawk River basin, NY, during the flood of June 26–29, 2006, and corresponding flood elevations for 10-, 50-, 100-, and 500-year flood-recurrence intervals.

[Recurrence-interval elevations are from the Federal Emergency Management Agency (FEMA, 1979a, 1982b, c, d, e, f, 1983b, 1984b; 1991a; 1998b; 1999a, b; 2001a; 2002b, c), --, no data available. Locations are shown in figures 4a and 12a. Site descriptions are given in appendix 1.]

Site number or station number	Selected high-water mark	Site name or station name	Peak water-surface elevation, in feet above NGVD 29, June 26–29, 2006	FEMA flood elevations, in feet above NGVD 29			
				10-year flood	50-year flood	100-year flood	500-year flood
1	1.1	West Canada Creek at State Route 28 (Creek Road) at Poland, NY	^a 702.44	--	--	702.0	--
2	2.1	West Canada Creek at County Route 200 (Old State Road) at Poland, NY	^b 689.75	--	--	686.2	--
3	3.1 3.2	West Canada Creek at County Route 200 (Bridge Street) at Newport, NY	^a 648.16 ^b 635.86	--	--	649.0	--
4	4.1 4.2	West Canada Creek at State Route 28 (Bridge Street) at Middleville, NY	^a 570.17 ^b 566.57	--	--	--	--
01346000		West Canada Creek at Kast Bridge, NY	447.28	--	--	--	--
5	5.1 5.2	East Canada Creek at County Route 104 at Emmonsburg, NY	^a 998.18 ^b 996.38	--	--	--	--
6	6.1 6.2	East Canada Creek at State Route 29 (State Street) at Dolgeville, NY	^a 796.96 ^b 792.07	794.5 790.1	796.7 791.1	797.6 791.5	800.5 792.6
01348000		East Canada Creek at East Creek, NY	346.69	--	--	--	--
7	7.1 7.4	East Canada Creek at State Route 5 at East Creek, NY	^a 329.75 ^b 328.19	--	--	--	--
01336000		Mohawk River below Delta Dam, near Rome, NY	479.73	481.6	483.2	483.9	485.2
8	8.1	Mohawk River at Harbor Way at Rome, NY	^b 422.05	424.9	425.8	426.3	427.3
9	9.1	Mohawk River at Marina Drive at Frankfort, NY	388.61	393.5	395.2	395.9	397.4
10	10.1	Mohawk River at State Route 28 (Mohawk Street) at Herkimer, NY	^a 387.81	391.6	393.6	394.1	395.4
11	11.1	Mohawk River at Erie Canal Lock 18 at Jacksonburg, NY	373.49	--	--	--	--
12	12.1	Mohawk River at Southern Avenue at Little Falls, NY	371.10	371.3	372.6	373.3	374.3
13	13.1	Mohawk River at Erie Canal Lock 17 at Little Falls, NY	332.10	328.1	330.1	331.2	332.7
01347000		Mohawk River near Little Falls, NY	328.56	--	--	--	--
14	14.1	Mohawk River at Erie Canal Lock 15 at Fort Plain, NY	312.26	301.6	305.4	306.7	309.4
15	15.1 15.2 15.3	Mohawk River at Fort Plain, NY	308.46 308.55 308.45	301.5 301.8 300.2	305.3 305.1 304.0	306.6 306.2 305.1	309.2 309.6 307.6

Table 5A. Peak water-surface elevations at 22 high-water-mark sites and 5 U.S. Geological Survey stream-gaging stations in the Mohawk River basin, NY, during the flood of June 26–29, 2006, and corresponding flood elevations for 10-, 50-, 100-, and 500-year flood-recurrence intervals.

[Recurrence-interval elevations are from the Federal Emergency Management Agency (FEMA, 1979a, 1982b, c, d, e, f, 1983b, 1984b; 1991a; 1998b; 1999a, b; 2001a; 2002b, c), --, no data available. Locations are shown in figures 4a and 12a. Site descriptions are given in appendix 1.]

Site number or station number	Selected high-water mark	Site name or station name	Peak water-surface elevation, in feet above NGVD 29, June 26–29, 2006	FEMA flood elevations, in feet above NGVD 29			
				10-year flood	50-year flood	100-year flood	500-year flood
16	16.1	Mohawk River at Canajoharie, NY	306.56	296.2	300.2	301.7	304.5
	16.2		306.46	296.1	300.1	301.6	304.4
	16.3		301.96	294.7	298.4	299.7	302.0
17	17.1	Mohawk River at Fonda and Fultonville, NY	292.15	284.1	287.5	288.6	290.8
	17.2		291.85	284.1	287.4	288.6	290.7
	17.3		291.10	--	--	--	--
18	18.1	Mohawk River at Erie Canal Lock 12 at Tribes Hill, NY	287.72	--	--	--	--
	18.2		279.72	--	--	--	--
19	19.1	Mohawk River at State Routes 5 and 67 (West Main Street) at Amsterdam, NY	274.67	271.5	275.9	277.9	280.2
20	20.1	Mohawk River at Erie Canal Lock 11 at Amsterdam, NY	273.55	270.9	274.9	276.9	279.2
	20.2		273.20	266.7	272.5	274.8	277.8
21	21.1	Mohawk River at Erie Canal Lock 10 at Cranesville, NY	263.93	--	--	--	--
	21.2		263.42	--	--	--	--
22	22.1	Mohawk River at Erie Canal Lock 9 at Rotterdam Junction, NY	249.34	244.9	249.5	250.9	254.4
	22.2		247.64	238.9	245.0	247.0	250.6
01357500		Mohawk River at Cohoes, NY	69.83	69.4	72.0	72.8	74.4

^a Upstream from bridge.

^b Downstream from bridge.

Table 5B. Peak water-surface elevations at 44 high-water-mark sites and 10 U.S. Geological Survey stream-gaging stations in the Delaware River basin, NY, during the flood of June 26-29, 2006, and corresponding flood elevations for 10-, 50-, 100-, and 500-year flood-recurrence intervals.

[Recurrence-interval elevations are from the Federal Emergency Management Agency (FEMA, 1978b; 1979c; 1985; 1987a, b, c, e; 1988; 1990a, b; 1991b; 1993b; 1999c; 2001b; 2002a, d). --, no data available. Locations are shown in figures 4b and 12b. Site descriptions are given in appendix 1.]

Site number or station number	Selected high-water mark	Site name or station name	Peak water-surface elevation, in feet above NGVD 29, June 26-29, 2006	FEMA flood elevations, in feet above NGVD 29			
				10-yearflood	50-yearflood	100-yearflood	500-yearflood
23	23.1 23.3	Little Beaver Kill at County Route 146 (Dahlia Road) at Morriston, NY	^a 1,468.72 ^b 1,462.13	1,461.6 1,460.1	1,465.9 1,461.9	1,466.6 1,462.7	1,467.8 1,464.0
24	24.1	Little Beaver Kill at County Route 178 (Old Route 17) at Livingston Manor, NY	1,427.24	1,423.7	1,425.6	1,426.6	1,427.8
25	25.1 25.2	Little Beaver Kill at Pearl Street at Livingston Manor, NY	1,426.14 1,425.92	1,421.3 1,421.1	1,424.1 1,423.9	1,425.7 1,425.5	1,426.2 1,426.0
26	26.1	Willowemoc Creek at County Route 149 (Main Street) at Livingston Manor, NY	1,426.88	1,422.8	1,426.7	1,428.7	1,430.6
27	27.1	Confluence of Willowemoc Creek and Little Beaver Kill at County Route 149 (Main Street) at Livingston Manor, NY	1,425.66	1,419.0	1,421.5	1,422.7	1,424.8
28	28.1	Willowemoc Creek at Covered Bridge Road at Livingston Manor, NY	1,398.50	1,395.8	1,397.9	1,399.0	1,401.6
29	29.3 29.4	Willowemoc Creek at Hazel Road at Hazel, NY	^a 1,340.94 ^b 1,339.33	1,337.0 1,336.6	1,340.0 1,339.0	1,341.6 1,340.0	1,346.9 1,345.4
30	30.1 30.2	Willowemoc Creek at County Route 124 (Stewart Avenue) at Roscoe, NY	^a 1,286.50 ^b 1,284.93	1,283.0 1,282.3	1,286.6 1,285.7	1,288.0 1,287.0	1,291.0 1,290.3
31	31.1	Beaver Kill at Beaverkill Road near Rockland, NY	1,345.32	--	--	--	--
32	32.1 32.3	Beaver Kill at County Route 179A (Old Route 17) at Roscoe, NY	^a 1,278.13 ^b 1,277.14	1,272.3 1,271.6	1,277.3 1,275.6	1,278.8 1,277.3	1,281.9 1,281.0
01420500		Beaver Kill at Cooks Falls, NY	1,172.25	--	--	--	--
33	33.1 33.2	Beaver Kill at Cooks Falls Road at Butternut Grove, NY	1,155.17 1,155.23 1,155.23	-- -- --	-- -- --	-- -- --	-- -- --
34	34.1	Beaver Kill at County Route 17 (Old Route 17) at Horton, NY	1,114.40	--	--	--	--
35	35.1	Beaver Kill at Peakville Road at Peakville, NY	1,038.22	1,033.7	1,038.0	1,040.0	1,044.7
01417000		East Branch Delaware River at Downsville, NY	1,106.96	1,101.4	1,103.1	1,103.5	1,104.3

Table 5B. Peak water-surface elevations at 44 high-water-mark sites and 10 U.S. Geological Survey stream-gaging stations in the Delaware River basin, NY, during the flood of June 26–29, 2006, and corresponding flood elevations for 10-, 50-, 100-, and 500-year flood-recurrence intervals.

[Recurrence-interval elevations are from the Federal Emergency Management Agency (FEMA, 1978b; 1979c; 1985; 1987a, b, c, e; 1988; 1990a, b; 1991b; 1993b; 1999c; 2001b; 2002a, d). --, no data available. Locations are shown in figures 4b and 12b. Site descriptions are given in appendix 1.]

Site number or station number	Selected high-water mark	Site name or station name	Peak water-surface elevation, in feet above NGVD 29, June 26–29, 2006	FEMA flood elevations, in feet above NGVD 29			
				10-yearflood	50-yearflood	100-yearflood	500-yearflood
36	36.2	East Branch Delaware River at Harvard Road at Harvard, NY	^a 1,026.11	1,026.3	1,029.2	1,030.7	1,033.4
	36.3		^b 1,025.84	1,025.3	1,028.5	1,030.0	1,032.8
01417500		East Branch Delaware River at Downsville, NY	1,024.02	1,023.3	1,026.4	1,027.9	1,030.9
	37.1		^a 1,011.32	1,011.1	1,015.1	1,016.6	1,020.7
	37.2		^{a,b} 1,010.82	1,010.7	1,014.5	1,016.0	1,020.0
	37.4		^b 1,008.92	1,009.4	1,012.6	1,013.9	1,017.5
01421000		East Branch Delaware River at Fishs Eddy, NY	977.39	973.8	977.8	979.6	983.6
	38.1		^a 975.32	971.6	975.9	977.8	982.2
38	38.2	East Branch Delaware River at County Route 28 at Fishs Eddy, NY	^b 973.97	971.5	975.7	977.5	981.3
39	39.1	East Branch Delaware River at State Route 97 at Hancock, NY	^a 908.53	904.1	908.8	910.6	915.8
	39.4		^b 908.38	903.9	908.5	910.4	914.7
40	40.2	East Branch Delaware River at Norfolk Southern Railway at Hancock, NY	^a 908.38	903.7	908.2	910.1	914.5
	40.3		^b 907.95	903.5	908.0	910.0	914.4
41	41.1	West Branch Delaware River at State Route 28 (Kingston Street) at Delhi, NY	^a 1,358.26	1,357.4	1,359.6	1,360.7	1,362.3
	41.2		^b 1,358.49	1,357.2	1,359.5	1,360.5	1,362.0
42	42.1	West Branch Delaware River at County Route 2 (Bagley Brook Road) at De Lancey, NY	^a 1,288.64	--	--	--	--
	42.4		^b 1,285.52	--	--	--	--
43	43.1	West Branch Delaware River at Mill Street Spur at Hamden, NY	1,270.22	--	--	--	--
44	44.4	West Branch Delaware River at County Route 26 at Hawleys, NY	^a 1,259.74	--	--	--	--
	44.6		^b 1,257.82	--	--	--	--
45	45.1	West Branch Delaware River at State Route 10 (Delaware Street) at Walton, NY	1,213.33	1,209.1	1,212.7	1,213.8	1,215.8
	45.2		1,212.53	1,208.5	1,212.3	1,213.4	1,215.2

Table 5B. Peak water-surface elevations at 44 high-water-mark sites and 10 U.S. Geological Survey stream-gaging stations in the Delaware River basin, NY, during the flood of June 26-29, 2006, and corresponding flood elevations for 10-, 50-, 100-, and 500-year flood-recurrence intervals.

[Recurrence-interval elevations are from the Federal Emergency Management Agency (FEMA, 1978b; 1979c; 1985; 1987a, b, c, e; 1988; 1990a, b; 1991b; 1993b; 1999c; 2001b; 2002a, d). --, no data available. Locations are shown in figures 4b and 12b. Site descriptions are given in appendix 1.]

Site number or station number	Selected high-water mark	Site name or station name	Peak water-surface elevation, in feet above NGVD 29, June 26-29, 2006	FEMA flood elevations, in feet above NGVD 29			
				10-yearflood	50-yearflood	100-yearflood	500-yearflood
46	46.1 46.2	West Branch Delaware River at State Routes 10 and 206 (Delaware Street) at Walton, NY	1,211.79 1,211.03	1,207.7 1,207.1	1,210.7 1,209.3	1,211.7 1,210.3	1,213.3 1,212.0
01423000		West Branch Delaware River at Walton, NY	1,207.15	1,202.5	1,204.8	1,205.7	1,207.3
47	47.1 47.5	West Branch Delaware River at State Route 10 at Beerston, NY	^a 1,172.90 ^b 1,169.04	-- --	-- --	1,171.1 1,169.7	-- --
01425000		West Branch Delaware River at Stilesville, NY	1,009.95	--	--	--	--
48	48.1 48.2	West Branch Delaware River at Oak Street at Deposit, NY	^a 995.77 ^b 994.86	987.4 986.5	988.6 987.8	989.1 988.4	990.4 989.8
49	49.1	West Branch Delaware River at Front Street at Deposit, NY	994.96	--	--	--	--
50	50.1 50.3	West Branch Delaware River at County Routes 4 (Sherman Creek Road) and 56 at Hale Eddy, NY	^a 968.70 ^b 965.92	961.9 961.3	963.4 962.8	963.9 963.3	965.3 964.7
01426500		West Branch Delaware River at Hale Eddy, NY	965.56	961.3	962.8	963.3	964.7
51	51.1 51.3	West Branch Delaware River at PA State Route 191 at Hancock, NY	^a 910.01 ^b 909.66	905.9 905.5	908.8 908.5	910.3 909.9	913.9 913.6
52	51.1 51.3	North Branch Callicoon Creek at County Route 125 at Callicoon Center, NY	^a 1,247.39 ^b 1,243.69	-- --	-- --	-- --	-- --
53	53.1 53.2	East Branch Callicoon Creek at State Route 17B at Falls Mills, NY	^a 929.33 ^b 928.43	-- --	-- --	-- --	-- --
54	54.1 54.2 54.3	Confluence of East and North Branches of Callicoon Creek at State Route 17B at Hortonville, NY	^a 792.44 ^a 791.84 ^b 789.94	-- 786.5 --	-- 789.0 --	-- 790.0 --	-- 792.0 --
55	55.1	Callicoon Creek at State Route 97 at Callicoon, NY	^b 760.74	750.6	754.3	756.2	761.0
56	56.1	Callicoon Creek at Creamery Road at Callicoon, NY	758.34	750.4	754.1	756.0	760.7
57	57.1	Delaware River at Lordville Road at Lordville, NY	^b 863.87	857.4	863.5	866.6	873.4
58	58.1 58.2	Delaware River at Bridge Street at Callicoon, NY	^a 759.41 ^b 759.59	751.5 751.2	751.5 751.2	757.0 756.8	761.9 761.7

Table 5B. Peak water-surface elevations at 44 high-water-mark sites and 10 U.S. Geological Survey stream-gaging stations in the Delaware River basin, NY, during the flood of June 26–29, 2006, and corresponding flood elevations for 10-, 50-, 100-, and 500-year flood-recurrence intervals.

[Recurrence-interval elevations are from the Federal Emergency Management Agency (FEMA, 1978b; 1979c; 1985; 1987a, b, c, e; 1988; 1990a, b; 1991b; 1993b; 1999c; 2001b; 2002a, d). --, no data available. Locations are shown in figures 4b and 12b. Site descriptions are given in appendix 1.]

Site number or station number	Selected high-water mark	Site name or station name	Peak water-surface elevation, in feet above NGVD 29, June 26–29, 2006	FEMA flood elevations, in feet above NGVD 29			
				10-yearflood	50-yearflood	100-yearflood	500-yearflood
01427510		Delaware River at Callicoon, NY	755.26	749.3	753.1	755.1	759.9
59	59.1 59.2	Delaware River at PA State Route 371 at Cohecton, NY	^a 735.07 ^b 733.56	727.7 727.6	732.0 731.9	734.1 733.9	739.9 739.7
60	60.1 60.4	Delaware River at Skinners Falls West Road at Skinners Falls, NY	^a 725.36 ^b 724.34	714.3 714.1	720.0 719.8	722.8 722.4	730.4 730.2
61	61.1 61.2 61.3 61.4 61.6 61.7 61.8	Delaware River at Narrowsburg, NY	698.16 696.61 695.75 695.58 695.01 692.29 691.91	689.4 689.0 688.5 688.0 687.1 686.2 685.7	695.3 694.9 694.4 693.9 693.1 692.3 692.0	697.8 697.3 697.0 696.5 695.7 695.0 694.6	706.1 705.8 705.6 705.3 704.9 704.3 704.0
01428500		Delaware River above Lackawaxen River near Barryville, NY	629.19	620.5	627.5	630.6	639.4
62	62.1 62.2	Delaware River at County Route 168 (Roebbling Bridge) at Minisink Ford, NY	^a 622.64 ^b 621.34	610.2 609.9	616.7 616.4	619.8 619.5	628.8 627.7
63	63.1 63.5	Delaware River at PA State Route 434 at Barryville, NY	^a 591.12 ^b 588.49	580.5 576.4	586.8 583.1	590.0 586.4	598.1 594.7
64	64.1	Delaware River at County Route 41 at Pond Eddy, NY	^a 527.78	520.4	525.4	528.0	535.4
65	65.1	Delaware River at Norfolk Southern Railway at Sparrow Bush, NY	^b 464.87	456.1	461.4	464.2	470.3
66	66.1	Delaware River at U.S. Routes 6 and 209 (Pike Street) at Port Jervis, NY	^a 438.67	430.2	434.4	436.6	442.0
01434000		Delaware River at Port Jervis, NY	436.82	429.3	433.4	435.4	440.7
66	66.2	Delaware River at U.S. Routes 6 and 209 (Pike Street) at Port Jervis, NY	^b 437.39	429.1	433.1	435.3	440.6

^a Upstream from bridge.

^b Downstream from bridge.

Table5C. Peak water-surface elevations at 38 high-water-mark sites and 14 U.S. Geological Survey stream-gaging stations in the Susquehanna River basin, NY, during the flood of June 26–29, 2006, and corresponding flood elevations for 10-, 50-, 100-, and 500-year flood-recurrence intervals.

[Recurrence-interval elevations are from the Federal Emergency Management Agency (FEMA, 1976a, b, c; 1977; 1978a; 1979b; 1980a, b; 1981a, b, c, d; 1982a; 1983a; 1984a; 1986a, b; 1987f; g; 1992a, b, c; 1993a, c; 1997; 1998a, 2000). --, no data available. Locations are shown in figures 4c and 12c. Site descriptions are given in appendix 1.]

Site number or station number	Selected high-water mark	Site name or station name	Peak water-surface elevation, in feet above NGVD 29, June26–29, 2006	FEMA flood elevations ,in feet above NGVD 29				
				10-year flood	50-year flood	100-year flood	500-year flood	
67	67.1	Unadilla River at County Route 18B (Forks Road) at Unadilla Forks, NY	^a 1,158.27	--	--	--	--	--
68	68.1	Unadilla River at County Route 13 (Lake Street) at New Berlin, NY	^b 1,088.68	--	--	--	--	--
69	69.4	Unadilla River at State Route 23 at South New Berlin, NY	^b 1,055.03	--	--	--	--	--
70	70.1	Unadilla River at County Route 1 (Lockwood Hill Road) at Rockdale, NY	^a 1,009.23	1,005.0	1,006.7	1,007.2	1,008.4	
	70.2		^b 1,006.69	1,004.3	1,005.6	1,006.0	1,007.0	
01502500		Unadilla River at Rockdale, NY	1,006.21	1,003.9	1,005.1	1,005.6	1,006.5	
71	71.1	Unadilla River at State Route 7 northwest of Sidney near Unadilla, NY	^a 988.46	982.7	985.1	985.7	987.5	
01509000		Tioughnioga River at Cortland, NY	1,095.87	1,096.2	1,097.8	1,098.7	1,100.5	
01509520		Tioughnioga River at Lisle, NY	965.47	--	--	--	--	--
01511500		Tioughnioga River at Itaska, NY	926.61	--	--	--	--	--
72	72.1	Tioughnioga River at State Route 12 at Chenango Forks, NY	^b 894.65	--	--	898.0	--	--
73	73.1	Chenango River at County Route 14 (West Main Street) at Earlville, NY	^b 1,071.51	--	--	--	--	--
01505000		Chenango River at Sherburne, NY	1,048.51	--	--	--	--	--
74	74.1	Chenango River at County Route 32A at Norwich, NY	^a 993.25	992.8	994.4	995.2	997.7	
75	75.1	Chenango River at State Route 12 (South Canal Street) at Oxford, NY	972.51	--	--	--	--	--
76	76.1	Chenango River at County Route 32C (Bridge Street) at Brisben, NY	^b 928.82	925.5	927.1	927.8	930.0	
77	77.1	Chenango River at North Chenango Street at Greene, NY	915.17	909.4	911.6	912.8	915.3	
01507000		Chenango River at Greene, NY	913.74	908.4	910.3	911.2	913.2	
78	78.1	Chenango River at South Chenango Street at Greene, NY	913.62	908.4	910.3	911.2	913.2	
01512500		Chenango River at Chenango Forks, NY	885.37	885.1	887.1	887.9	889.8	
79	79.1	Chenango River at Otseiningo Park at Dickinson, NY	849.22	842.0	846.7	849.9	856.0	
80	80.1	Chenango River at Front Street at Binghamton, NY	847.67	838.0	841.7	844.2	848.4	
81	81.1	Susquehanna River at County Route 31 (Main Street) at Cooperstown, NY	^a 1,197.34	--	--	1,194.3	--	--
	81.2		^b 1,196.94	--	--	1,194.3	--	--
82	82.1	Susquehanna River at State Route 166 at Milford, NY	^a 1,165.11	--	--	--	--	--

Table 5C. Peak water-surface elevations at 38 high-water-mark sites and 14 U.S. Geological Survey stream-gaging stations in the Susquehanna River basin, NY, during the flood of June 26–29, 2006, and corresponding flood elevations for 10-, 50-, 100-, and 500-year flood-recurrence intervals.

[Recurrence-interval elevations are from the Federal Emergency Management Agency (FEMA, 1976a, b, c; 1977; 1978a; 1979b; 1980a, b; 1981a, b, c, d; 1982a; 1983a; 1984a; 1986a, b; 1987f; g; 1992a, b, c; 1993a, c; 1997; 1998a, 2000). --, no data available. Locations are shown in figures 4c and 12c. Site descriptions are given in appendix 1.]

Site number or station number	Selected high-water mark	Site name or station name	Peak water-surface elevation, in feet above NGVD 29, June 26–29, 2006	FEMA flood elevations, in feet above NGVD 29			
				10-year flood	50-year flood	100-year flood	500-year flood
83	83.1	Susquehanna River at State Route 7 at Colliersville, NY	^b 1,116.91	--	--	--	--
84	84.1	Susquehanna River at Oneonta, NY	1,084.71	1,078.9	1,080.7	1,081.7	1,083.4
	84.2		1,080.71	1,077.0	1,079.1	1,080.2	1,082.1
85	85.1	Susquehanna River at State Route 205 at Oneonta, NY	^b 1,065.53	1,060.7	1,062.1	1,062.8	1,064.0
86	86.1	Susquehanna River at River Street at Otego, NY	1,056.42	1,052.3	1,054.4	1,054.9	1,056.7
01500500		Susquehanna River at Unadilla, NY	1,014.97	1,010.9	1,013.0	1,013.7	1,015.0
87	87.1	Susquehanna River at State Route 7 northeast of Sidney near Unadilla, NY	992.54	988.5	990.6	991.4	993.1
88	88.1	Susquehanna River at State Route 7 north of Sidney near Unadilla, NY	987.68	983.9	985.9	986.5	988.5
89	89.1	Susquehanna River at State Route 206 (East Main Street) at Bainbridge, NY	^a 984.01	--	--	980.8	--
01502632		Susquehanna River at Bainbridge, NY	983.60	--	--	980.7	--
90	90.2	Susquehanna River at State Route 41 (Maple Street) at Afton, NY	^a 972.85	966.4	968.3	969.2	970.7
	90.4		^b 971.58	966.2	968.0	968.8	970.3
91	91.1	Susquehanna River at State Route 7 at Nineveh, NY	965.05	960.6	962.7	963.4	965.2
92	92.1	Susquehanna River at County Route 28 (Chapel Street) at Windsor, NY	^a 924.58	918.7	920.9	921.6	923.2
01502731		Susquehanna River at Windsor, NY	924.27	918.6	920.7	921.5	922.9
92	92.2	Susquehanna River at County Route 28 (Chapel Street) at Windsor, NY	^b 924.06	918.5	920.6	921.4	922.8
93	93.1	Susquehanna River at Exchange Street at Susquehanna Depot, PA	903.63	903.1	904.6	905.4	906.5
94	94.1	Susquehanna River at U.S. Route 11 (Main Street) at Great Bend, PA	^b 874.03	871.3	874.0	874.9	877.0
01503000		Susquehanna River at Conklin, NY	866.06	857.3	859.8	861.2	863.7
95	95.1	Susquehanna River at State Route 7 (Conklin Road) at Conklin, NY	860.33	855.8	858.2	859.7	862.0
96	96.1	Susquehanna River at Binghamton, NY	852.00	842.3	846.2	848.3	853.2
	96.2		^a 849.72	841.3	845.1	847.2	852.1
97	97.1	Susquehanna River at Front Street at Binghamton, NY	846.26	837.6	841.5	843.5	848.3
98	98.1	Susquehanna River at Grand Avenue at Johnson City, NY	839.38	830.3	834.2	836.5	841.1
01513500		Susquehanna River at Vestal, NY	832.85	824.6	828.9	830.1	835.4

Table 5C. Peak water-surface elevations at 38 high-water-mark sites and 14 U.S. Geological Survey stream-gaging stations in the Susquehanna River basin, NY, during the flood of June 26–29, 2006, and corresponding flood elevations for 10-, 50-, 100-, and 500-year flood-recurrence intervals.

[Recurrence-interval elevations are from the Federal Emergency Management Agency (FEMA, 1976a, b, c; 1977; 1978a; 1979b; 1980a, b; 1981a, b, c, d; 1982a; 1983a; 1984a; 1986a, b; 1987f; g; 1992a, b, c; 1993a, c; 1997; 1998a, 2000). --, no data available. Locations are shown in figures 4c and 12c. Site descriptions are given in appendix 1.]

Site number or station number	Selected high-water mark	Site name or station name	Peak water-surface elevation, in feet above NGVD 29, June 26–29, 2006	FEMA flood elevations, in feet above NGVD 29			
				10-year flood	50-year flood	100-year flood	500-year flood
99	99.1	Susquehanna River at Kinney Road at Campville, NY	821.77	816.4	820.0	822.0	825.5
100	100.1	Susquehanna River at State Route 17C (5th Avenue) at Owego, NY	814.81	812.0	814.6	816.7	819.8
01513831		Susquehanna River at Owego, NY	812.54	809.3	812.6	815.0	817.7
101	101.1	Susquehanna River at William Street at Owego, NY	812.24	809.2	812.5	814.9	817.6
102	102.1	Susquehanna River at State Route 17 at Nichols, NY	795.01	789.6	793.1	794.8	798.6
103	103.1	Susquehanna River at Riverside Drive at Sayre, PA	767.48	763.9	767.0	768.4	771.0
01515000		Susquehanna River near Waverly, NY	766.48	763.2	766.3	767.7	770.2
104	104.1	Susquehanna River at Riverside Drive at Athens, PA	764.19	759.5	762.2	763.6	766.2

^a Upstream from bridge.

^b Downstream from bridge.

Figure 13A. Peak water-surface elevations at selected sites in the Mohawk River basin, NY, during flood of June 26–29, 2006, and flood-recurrence-interval elevations from Federal Emergency Management Agency flood-insurance studies. (Site names and locations are shown in table 5.)

EXPLANATION

- ▲ 500-year flood-recurrence-interval elevation (FEMA 1979a; 1982b, c, d, e, f; 1983b; 1984b; 1987d; 1991a; 1998b; 1999a, b; 2001a; 2002b, c)
- ▲ 100-year flood-recurrence-interval elevation (FEMA 1979a; 1982b, c, d, e, f; 1983b; 1984b; 1987d; 1991a; 1998b; 1999a, b; 2001a; 2002b, c)
- ▲ 50-year flood-recurrence-interval elevation (FEMA 1979a; 1982b, c, d, e, f; 1983b; 1984b; 1987d; 1991a; 1998b; 1999a, b; 2001a; 2002b, c)
- ▲ 10-year flood-recurrence-interval elevation (FEMA 1979a; 1982b, c, d, e, f; 1983b; 1984b; 1987d; 1991a; 1998b; 1999a, b; 2001a; 2002b, c)
- ▲ June 26-29, 2006, peak water-surface elevation (US Geological Survey)

Figure 13A. Peak water-surface elevations at selected sites in the Mohawk River basin, NY, during flood of June 26–29, 2006, and flood-recurrence-interval elevations from Federal Emergency Management Agency flood-insurance studies. (Site names and locations are shown in table 5.)

Figure 13A. Peak water-surface elevations at selected sites in the Mohawk River basin, NY, during flood of June 26–29, 2006, and flood-recurrence-interval elevations from Federal Emergency Management Agency flood-insurance studies. (Site names and locations are shown in table 5.)

EXPLANATION

- ▲ 500-year flood-recurrence-interval elevation (FEMA 1978b; 1979c; 1985; 1987a, b, c, e; 1988; 1990a, b; 1991b; 1993b; 1999c; 2001b; 2002a, d)
- ▲ 100-year flood-recurrence-interval elevation (FEMA 1978b; 1979c; 1985; 1987a, b, c, e; 1988; 1990a, b; 1991b; 1993b; 1999c; 2001b; 2002a, d)
- ▲ 50-year flood-recurrence-interval elevation (FEMA 1978b; 1979c; 1985; 1987a, b, c, e; 1988; 1990a, b; 1991b; 1993b; 1999c; 2001b; 2002a, d)
- ▲ 10-year flood-recurrence-interval elevation (FEMA 1978b; 1979c; 1985; 1987a, b, c, e; 1988; 1990a, b; 1991b; 1993b; 1999c; 2001b; 2002a, d)
- ▲ June 26-29, 2006, peak water-surface elevation (US Geological Survey)

Figure 13B. Peak water-surface elevations at selected sites in the Delaware River basin, NY, during flood of June 26–29, 2006, and flood-recurrence-interval elevations from Federal Emergency Management Agency flood-insurance studies. (Site names and locations are shown in table 5.)

EXPLANATION

- ▲ 500-year flood-recurrence-interval elevation (FEMA 1978b; 1979c; 1985; 1987a, b, c, e; 1988; 1990a, b; 1991b; 1993b; 1999c; 2001b; 2002a, d)
- ▲ 100-year flood-recurrence-interval elevation (FEMA 1978b; 1979c; 1985; 1987a, b, c, e; 1988; 1990a, b; 1991b; 1993b; 1999c; 2001b; 2002a, d)
- ▲ 50-year flood-recurrence-interval elevation (FEMA 1978b; 1979c; 1985; 1987a, b, c, e; 1988; 1990a, b; 1991b; 1993b; 1999c; 2001b; 2002a, d)
- ▲ 10-year flood-recurrence-interval elevation (FEMA 1978b; 1979c; 1985; 1987a, b, c, e; 1988; 1990a, b; 1991b; 1993b; 1999c; 2001b; 2002a, d)
- ▲ June 26-29, 2006, peak water-surface elevation (US Geological Survey)

Figure 13B. Peak water-surface elevations at selected sites in the Delaware River basin, NY, during flood of June 26–29, 2006, and flood-recurrence-interval elevations from Federal Emergency Management Agency flood-insurance studies. (Site names and locations are shown in table 5.)

Figure 13B. Peak water-surface elevations at selected sites in the Delaware River basin, NY, during flood of June 26–29, 2006, and flood-recurrence-interval elevations from Federal Emergency Management Agency flood-insurance studies. (Site names and locations are shown in table 5.)

Figure 13B. Peak water-surface elevations at selected sites in the Delaware River basin, NY, during flood of June 26–29, 2006, and flood-recurrence-interval elevations from Federal Emergency Management Agency flood-insurance studies. (Site names and locations are shown in table 5.)

EXPLANATION

- ▲ 500-year flood-recurrence-interval elevation (FEMA 1978b; 1979c; 1985; 1987a, b, c, e; 1988; 1990a, b; 1991b; 1993b; 1999c; 2001b; 2002a, d)
- ▲ 100-year flood-recurrence-interval elevation (FEMA 1978b; 1979c; 1985; 1987a, b, c, e; 1988; 1990a, b; 1991b; 1993b; 1999c; 2001b; 2002a, d)
- ▲ 50-year flood-recurrence-interval elevation (FEMA 1978b; 1979c; 1985; 1987a, b, c, e; 1988; 1990a, b; 1991b; 1993b; 1999c; 2001b; 2002a, d)
- ▲ 10-year flood-recurrence-interval elevation (FEMA 1978b; 1979c; 1985; 1987a, b, c, e; 1988; 1990a, b; 1991b; 1993b; 1999c; 2001b; 2002a, d)
- ▲ June 26-29, 2006, peak water-surface elevation (US Geological Survey)

Figure 13B. Peak water-surface elevations at selected sites in the Delaware River basin, NY, during flood of June 26–29, 2006, and flood-recurrence-interval elevations from Federal Emergency Management Agency flood-insurance studies. (Site names and locations are shown in table 5.)

Figure 13B. Peak water-surface elevations at selected sites in the Delaware River basin, NY, during flood of June 26–29, 2006, and flood-recurrence-interval elevations from Federal Emergency Management Agency flood-insurance studies. (Site names and locations are shown in table 5.)

EXPLANATION

- ▲ 500-year flood-recurrence-interval elevation (FEMA 1976a, b, c; 1977; 1978a; 1979b; 1980a, b; 1981a, b, c, d; 1982a; 1983a; 1984a; 1986a, b; 1987f, g; 1992a, b, c; 1993a, c; 1997; 1998a; 2000)
- ▲ 100-year flood-recurrence-interval elevation (FEMA 1976a, b, c; 1977; 1978a; 1979b; 1980a, b; 1981a, b, c, d; 1982a; 1983a; 1984a; 1986a, b; 1987f, g; 1992a, b, c; 1993a, c; 1997; 1998a; 2000)
- ▲ 50-year flood-recurrence-interval elevation (FEMA 1976a, b, c; 1977; 1978a; 1979b; 1980a, b; 1981a, b, c, d; 1982a; 1983a; 1984a; 1986a, b; 1987f, g; 1992a, b, c; 1993a, c; 1997; 1998a; 2000)
- ▲ 10-year flood-recurrence-interval elevation (FEMA 1976a, b, c; 1977; 1978a; 1979b; 1980a, b; 1981a, b, c, d; 1982a; 1983a; 1984a; 1986a, b; 1987f, g; 1992a, b, c; 1993a, c; 1997; 1998a; 2000)
- ▲ June 26–29, 2006, peak water-surface elevation (US Geological Survey)

Figure 13C. Peak water-surface elevations at selected sites in the Susquehanna River basin, NY, during flood of June 26–29, 2006, and flood-recurrence-interval elevations from Federal Emergency Management Agency flood-insurance studies. (Site names and locations are shown in table 5.)

EXPLANATION

- ▲ 500-year flood-recurrence-interval elevation (FEMA 1976a, b, c; 1977; 1978a; 1979b; 1980a, b; 1981a, b, c, d; 1982a; 1983a; 1984a; 1986a, b; 1987f, g; 1992a, b, c; 1993a, c; 1997; 1998a; 2000)
- ▲ 100-year flood-recurrence-interval elevation (FEMA 1976a, b, c; 1977; 1978a; 1979b; 1980a, b; 1981a, b, c, d; 1982a; 1983a; 1984a; 1986a, b; 1987f, g; 1992a, b, c; 1993a, c; 1997; 1998a; 2000)
- ▲ 50-year flood-recurrence-interval elevation (FEMA 1976a, b, c; 1977; 1978a; 1979b; 1980a, b; 1981a, b, c, d; 1982a; 1983a; 1984a; 1986a, b; 1987f, g; 1992a, b, c; 1993a, c; 1997; 1998a; 2000)
- ▲ 10-year flood-recurrence-interval elevation (FEMA 1976a, b, c; 1977; 1978a; 1979b; 1980a, b; 1981a, b, c, d; 1982a; 1983a; 1984a; 1986a, b; 1987f, g; 1992a, b, c; 1993a, c; 1997; 1998a; 2000)
- ▲ June 26-29, 2006, peak water-surface elevation (US Geological Survey)

Figure 13C. Peak water-surface elevations at selected sites in the Susquehanna River basin, NY, during flood of June 26–29, 2006, and flood-recurrence-interval elevations from Federal Emergency Management Agency flood-insurance studies. (Site names and locations are shown in table 5.)

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EXPLANATION

- ▲ 500-year flood-recurrence-interval elevation (FEMA 1976a, b, c; 1977; 1978a; 1979b; 1980a, b; 1981a, b, c, d; 1982a; 1983a; 1984a; 1986a, b; 1987f, g; 1992a, b, c; 1993a, c; 1997; 1998a; 2000)
- ▲ 100-year flood-recurrence-interval elevation (FEMA 1976a, b, c; 1977; 1978a; 1979b; 1980a, b; 1981a, b, c, d; 1982a; 1983a; 1984a; 1986a, b; 1987f, g; 1992a, b, c; 1993a, c; 1997; 1998a; 2000)
- ▲ 50-year flood-recurrence-interval elevation (FEMA 1976a, b, c; 1977; 1978a; 1979b; 1980a, b; 1981a, b, c, d; 1982a; 1983a; 1984a; 1986a, b; 1987f, g; 1992a, b, c; 1993a, c; 1997; 1998a; 2000)
- ▲ 10-year flood-recurrence-interval elevation (FEMA 1976a, b, c; 1977; 1978a; 1979b; 1980a, b; 1981a, b, c, d; 1982a; 1983a; 1984a; 1986a, b; 1987f, g; 1992a, b, c; 1993a, c; 1997; 1998a; 2000)
- ▲ June 26-29, 2006, peak water-surface elevation (US Geological Survey)

Figure 13C. Peak water-surface elevations at selected sites in the Susquehanna River basin, NY, during flood of June 26–29, 2006, and flood-recurrence-interval elevations from Federal Emergency Management Agency flood-insurance studies. (Site names and locations are shown in table 5.)

between the 100- and 500-year flood-profile elevations. At Greene (sites 77 and 78), the peak water-surface elevations were near the 500-year flood-profile elevations, and at the Chenango River at Greene stream-gaging station (01507000), the recorded peak water-surface elevation was near the 500-year flood profile. The peak discharge at the Chenango River at Greene stream-gaging station has a recurrence interval of greater than 100 years. At the USGS stream-gaging station Chenango River at Chenango Forks (01512500), 1.2 mi downstream from the confluence with the Tioughnioga River, the recorded peak water-surface elevation was in the range of the 10-year flood profile and the peak discharge indicated about a 20-year recurrence interval, but farther downstream at Dickinson (site 79) and at Binghamton (site 80), the peak water-surface elevations were in the range of the 100-year and the 500-year flood-profile elevations, respectively. These higher peak water-surface elevations at sites 79 and 80 were primarily because of backwater from the Susquehanna River.

The Susquehanna River was studied from Cooperstown, NY, (site 81) downstream to Athens, PA (site 104). FEMA flood-insurance studies were available for most study sites along the study reach of the Susquehanna River. The 100-year flood profile was the only profile available for the Cooperstown study site (site 81), and the peak water-surface elevation was higher than the 100-year flood-profile elevation. Peak water-surface elevations from Oneonta (site 84) to Otego (site 86) were generally equal to or higher than the 500-year flood-profile elevation. Along the Susquehanna River near the communities of Unadilla and Sidney (sites 87 and 88), the peak water-surface elevations were generally between the 100- and the 500-year flood-profile elevations. At the Susquehanna River at Unadilla stream-gaging station (01500500), the recorded peak water-surface elevation was at the 500-year flood-profile elevation, and the peak discharge indicated a recurrence interval greater than 100 years (table 3). The 100-year flood profile was the only profile available for the Bainbridge area. At Bainbridge (site 89), the peak water-surface elevation was 3.2 ft higher than the 100-year flood-profile elevation. The Susquehanna River at Bainbridge stream-gaging station (01502632) recorded a peak water-surface elevation that was 2.9 ft higher than the 100-year flood-profile elevation and a peak discharge that indicated a recurrence interval of greater than 100 years. Downstream in the communities of Afton (site 90), Nineveh (site 91), and Windson (site 92), the peak water-surface elevations were equal to or higher than the 500-year flood-profile elevations. Peak water-surface elevations at Susquehanna Depot, PA, (site 93) and Great Bend, PA, (site 94) were generally in the range of the 50-year flood profile. The USGS stream-gaging station Susquehanna River at Conklin (01503000) recorded a peak water-surface elevation that was greater than the 500-year flood profile at its location, and the peak discharge indicated a recurrence interval greater than 100 years. Peak water-surface elevations in the communities of

Conklin (site 95) downstream through the City of Binghamton (sites 96 and 97) to Johnson City (site 98) were determined to be between the range of the 100- and 500-year flood-profile elevations. At the Susquehanna River at Vestal stream-gaging station (01513500), the recorded peak water-surface elevation was between the 100- and 500-year flood profiles, and the peak discharge indicated a recurrence interval of greater than 100 years. Peak water-surface elevations in the area of Campville, NY, (site 99) downstream through sites 100 to 103 to Athens, PA, (site 104) in general were determined to be in the range of the 50- and 100-year flood-profile elevations. At the Susquehanna River at Waverly stream-gaging station (01515000), the recorded peak water-surface elevation was slightly higher than the 50-year flood profile, and the peak discharge indicated a recurrence interval of 40 years

Flood Damage

A state of emergency was declared by officials in several towns in the 12 counties that were declared Federal disaster areas after the severe flooding of June 26–29, 2006. Hundreds of residents that live near the East Canada Creek and the Mohawk River were asked to evacuate their homes because of the flooding. On June 28, 2006, the New York State Canal Corporation closed the Erie Canal system from Lock 2 west to Lock 22 and the entire Champlain Canal system because of high water. Among the damages caused by the flood in the Mohawk River basin are the collapse of a historic restaurant in Dolgeville into the East Canada Creek on June 28, damage to several of the New York State Canal Corporations locks along the Erie Canal, and millions of dollars in damage to the Beech-Nut Nutrition Corporation's facilities in Canajoharie and Fort Plain (Daily Gazette, 2008). Many of the communities that experienced major flooding in the recent September 2004 and April 2005 floods in the Delaware River basin were flooded again during June 2006. At least 1,000 residents were asked to evacuate the City of Port Jervis by June 28. The community of Livingston Manor was flooded by tributaries to the East Branch of the Delaware River. Local officials indicated that the flood hit the community suddenly, and many residents had to be rescued from their homes by emergency personnel (Times Herald Record, 2006). The flood of June 2006 was blamed for four deaths across New York, one of which was that of a 15 year-old girl in Livingston Manor who was swept away from her front porch as she waited to be rescued and the front section of her home collapsed into the floodwaters of Cattail Brook, a tributary to the Willowemoc Creek (Times Herald Record, 2006) in the morning of June 28.

In the Susquehanna River basin three people died during the morning of June 28 as a result of the flooding. One man perished when his truck plunged into White Stone Brook, a tributary to the Unadilla River, when the culvert under

Holmesville Hill Road in the Town of Norwich washed out. Two men lost their lives when their tractor trailers plunged into Carrs Creek, a tributary to the Susquehanna River, when the culvert under Interstate Route 88 in the Town of Sidney washed out (fig 14A). Along the banks of the Susquehanna River, several communities were inundated, and the City of Binghamton was not spared from the flooding (fig. 14B). Four to five thousand residents were evacuated, many roads were closed, including State Route 17 in both directions, and several thousand residents were left without power. Several days later on July 1, boil water advisories remained in effect for several towns including the towns of Union, Windsor, and Vestal, NY. More than 15,500 individuals had applied for assistance by September 1, 2006, and FEMA announced that families, individuals, and businesses who were adversely affected by the flooding in June 2006 had received more than \$112 million in assistance from FEMA, the Small Business Administration, and the State of New York (Federal Emergency Management Agency, 2006). On December 29, 2006, FEMA announced that the amount of disaster assistance approved for New York families, businesses, and public entities had been increased to more than \$227 million. Photographs of flood damage to selected areas in the Mohawk, Delaware, and Susquehanna River basins are shown in appendix 3.

Summary

Extended heavy rains that spread south to north across southern New York produced widespread rainfall amounts of 5 to 6 in. and localized reports of greater than 13 in. in several areas in New York. Prior to June 2006, streamflow conditions in the Mohawk, Delaware, and Susquehanna River regions were generally in the normal to dry range. Rainfall from this storm produced new period-of-record peak water-surface elevations and discharges at several USGS stream-gaging stations, including those at Mohawk River at Little Falls, West Branch Delaware River at Hale Eddy, and Susquehanna River at Conklin, NY. These stations and several others also recorded peak discharges that exceeded the 100-year recurrence interval as a result of this storm. Prior to the June 2006 flood, the Hinckley Reservoir was at 93 percent of capacity, and the Cannonsville and Pepacton Reservoirs were both at 101 percent of capacity. East Sidney and Whitney Point Lake, flood-control reservoirs operated by the U.S. Army Corp of Engineers, were at 10 and 15 percent of capacity, respectively, prior to the storm. Although most of the reservoirs in the Mohawk, Delaware, and Susquehanna River basins did eventually spill, with the exceptions of Whitney Point Lake, Prompton Reservoir, and General Edgar Jadwin Reservoir, they all managed to attenuate the flood magnitude to downstream communities. Four lives were lost, thousands of people were asked to evacuate, hundreds of miles

of roadway were closed, and many homes were damaged or lost as a result of this flood. The Department of Homeland Security, Federal Emergency Management Agency (Federal Emergency Management Agency, 2006) announced that a major disaster had been declared for New York to supplement state and local recovery efforts in the areas struck by severe storms and flooding that began on June 26, 2006. Twelve counties in New York were named in the disaster declaration, and by December 29, 2006, FEMA had announced that families, individuals, businesses, and public entities had received more than \$227 million in assistance from FEMA, the Small Business Administration, and the State of New York for damages not covered by insurance and for state and local agencies to repair flood damages and rebuild infrastructure damaged during the flood.

This report studied 104 sites in the combined Mohawk, Delaware, and Susquehanna River basins. Peak water-surface elevations were surveyed and compared to flood-profile elevations in the flood-insurance studies published by FEMA. Peak water-surface elevations at many of the study sites were determined to be greater than the 100-year flood-profile elevations, and some were determined to be greater than the 500-year flood-profile elevations. Along the Delaware River, the peak discharge during the June 2006 flood was greater than that from the August 1955 flood at the USGS stream-gaging station at Delaware River above Lackawaxen River near Barryville, NY; and at the USGS stream-gaging stations on the Delaware River at Port Jervis, NY, and Montague, NJ, the peak discharges were the highest since 1955. The June 2006 flood produced greater peak discharges/ than the March 1977 flood along parts of the Mohawk River and greater than the July 1935 and March 1936 floods in parts of the upper Susquehanna River basin in New York.

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Figure 14A. Top—Collapse of Interstate Route 88 over Carrs Creek near Unadilla (Exit 10), NY, on June 28, 2006. Bottom—Carrs Creek and washed-out culvert at Interstate Route 88 near Unadilla (exit 10), NY, on June 28, 2006. Photos courtesy of The Daily Star, taken by staff photographer Julie Lewis.

Figure 14B. Top—Susquehanna River floodwaters overtop floodwall along North Shore Drive, Binghamton, NY, on June 28, 2006. Photo courtesy of Alan A. Katz. Bottom—Susquehanna River floodwaters overflow Washington Street pedestrian bridge, Binghamton, NY, on June 28, 2006. Photo courtesy of James Willis.

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