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Flood of April 2–3, 2005, Esopus Creek Basin, New York

Open-File Report 2007–1036

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

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Back Cover. "Ashokan Reservoir spillway, Ashokan, N.Y." Photos courtesy of James Werner.

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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	0.4047	hectare (ha)
acre	0.004047	square kilometer (km^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	
cubic foot (ft^3)	0.02832	cubic meter (m^3)
acre-foot (acre-ft)	1,233	cubic meter (m^3)
million gallons (Mgal)	3,785	cubic meter (m^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:

$$°F=(1.8\times°C)+32$$

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

$$°C=(°F-32)/1.8$$

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).

ACRONYMS USED IN REPORT

NWS National Weather Service

NYCDEP New York City Department of Environmental Protection

FEMA Federal Emergency Management Agency

USGS U.S. Geological Survey

NGS National Geodetic Survey

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Flood of April 2–3, 2005, Esopus Creek Basin, New York

By Thomas P. Suro and Gary D. Firda

Abstract

On April 2–3, 2005, heavy rain moved into southern New York and delivered rainfall amounts that ranged from about 2 in. to almost 6 in. within a 36-hour period. Significant flooding occurred on many small streams and tributaries in the area, and extensive flooding occurred on the Esopus and Roundout Creeks in Ulster and Greene Counties, New York. The flooding damaged many homes, caused millions of dollars worth of damage, and forced hundreds of residents to evacuate their homes. A total of 20 New York counties were declared Federal disaster areas.

Disaster recovery assistance for those people affected stands at almost $35 million, according to the Federal Emergency Management Agency, as more than 3,400 New Yorkers registered for Federal aid. U.S. Geological Survey stream-gaging stations on the Esopus Creek above the Ashokan Reservoir at Allaben, N.Y., and below the Ashokan Reservoir at Mount Marion, N.Y., each recorded a new record maximum water-surface elevation and discharge for the respective periods of record as a result of this storm. The peak water-surface elevation and discharge recorded during the April 2–3, 2005, storm at the U.S. Geological Survey stream-gaging station on the Esopus Creek at Cold Brook, N.Y. were the third highest elevation and discharge since the station was put into operation in 1914. Most of the study sites along the Esopus Creek indicated water-surface elevations near the 50-year flood elevations, as documented in flood-insurance studies by the Federal Emergency Management Agency.

Introduction

Widespread rainfall amounts ranging from about 2 in. to almost 6 in. in some locations produced extensive flooding in the Rondout and Esopus Creek Basins during April 2–3, 2005. The National Weather Service (NWS) recorded rainfall amounts of 2.97 inches in Cairo, N.Y. and 4.83 inches at Slide Mountain, N.Y. to as much as 5.69 inches in East Jewett, N.Y. The New York City Department of Environmental Protection (NYCDEP) recorded over 3.3 inches of rainfall at their Ashokan Reservoir recording station, which is centrally located in Ulster County. A state of emergency was declared for Ulster County on the evening of April 2 (Saturday) as hundreds of residents were forced to evacuate their homes. In addition, Ulster County emergency personnel had to complete over 40 water rescues of people stranded in their cars or homes (Daily Freeman, 2005a). Subsequently, 20 counties (11 eligible for individual assistance) including Ulster County in New York were declared Federal disaster areas.

This report documents the rainfall amounts and peak water-surface elevations in the Esopus Creek Basin during April 2–3, 2005. Federal Emergency Management Agency (FEMA) personnel selected 25 study sites along the Esopus Creek to be included for study in this report. Peak water-surface elevations were surveyed, described, and photographed by U.S. Geological Survey (USGS) personnel. Descriptions and maps of individual sites are presented in Appendix 1. Peak water-surface elevations at most study sites were nearest the 50-year flood elevations, as documented in FEMA flood-insurance studies. Record peak discharges were set at two USGS stream-gaging stations located on the Esopus Creek. The Ashokan Reservoir was full and spilling at the start of the storm, but did manage to attenuate the peak outflow to downstream communities.

Rainfall in the Esopus Creek Basin

Although total statewide precipitation for March 2005 in New York was slightly below normal, the Hudson Valley, Eastern Plateau and Coastal divisions of New York all reported above normal precipitation (National Oceanic and Atmospheric Administration, 2005d). The storm system of April 2–3, 2005, moved up the Appalachians and through the Mid-Atlantic region into New York and New England, delivering heavy rain to southeastern New York (fig. 1). This system caused widespread rainfall of more than 3 inches with some local areas reporting rainfall totals of more than 5 inches in a 36-hour period (National Oceanic and Atmospheric Administration, 2005b).

The rainfall in early April followed 1 to 2 inches of rain that fell during March 28–29 that left the Esopus Creek

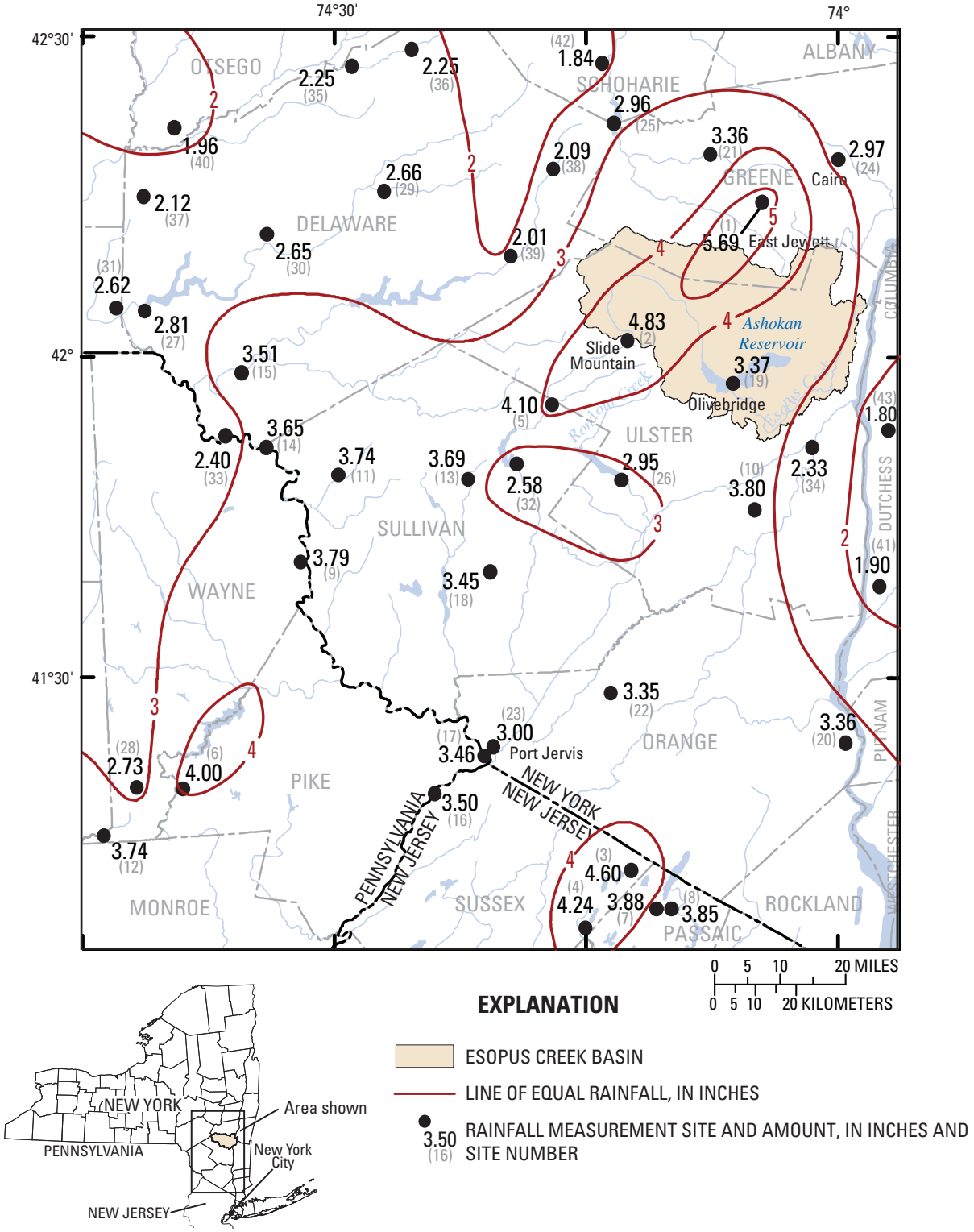

Figure 1. Pertinent geographic features of southeastern New York and rainfall amounts from the storm of April 2–3, 2005 (National Oceanic and Atmospheric Administration (2005b) and New York City Department of Environmental Protection (written commun., 2005)).

flowing at an above normal level. On April 1 the daily mean flow at the USGS stream-gaging station Esopus Creek at Allaben, N.Y. was at a level that is exceeded less than 10 percent of the time. The flow level on April 1 at the USGS stream-gaging station Esopus Creek at Coldbrook, N.Y., was at a level that is exceeded less than 15 percent of the time. The maximum recorded rainfalls for the period of April 2–3, 2005, near the headwaters of the Esopus Creek at Slide Mountain, N.Y. , and at Ashokan Reservoir (fig. 1), located midway along the Esopus Creek, were 4.83 and 3.37 inches, respectively. Rainfall amounts recorded at 43 selected sites in New York, New Jersey, and Pennsylvania are listed in table 1. Selected rainfall amounts with respect to frequency and duration at Ashokan Reservoir, N.Y., which is centrally located along the Esopus Creek (fig. 1), are listed in table 2.

The rainfall intensity was not very high in the Esopus Creek Basin, with only a 2-year recurrence interval for a 24-hour storm at Ashokan Reservoir. Generally, the rainfall frequency associated with this storm across the Esopus Creek Basin was less than a 5-year recurrence interval. Most of the rainfall at Ashokan Reservoir fell at a fairly constant rate from the early morning hours on Saturday, April 2, 2005, until about midnight. Rainfall continued at a lower intensity until late afternoon on Sunday, April 3 (New York City Department of Environmental Protection, written commun. 2005). A plot of cumulative rainfall at the NYCDEP station at Ashokan Reservoir, N.Y. (fig. 2) illustrates this rainfall pattern from the early morning of Saturday, April 2, until late afternoon on Sunday, April 3, 2005.

Although rainfall intensity did not approach record rates, 3 or more inches of rain falling on snow-covered terrain combined with daytime temperatures of 50 °F or greater at several locations in the Hudson River Basin produced significant runoff. The National Weather Service (NWS) observations at Slide Mountain, N.Y. (located near the headwaters of the Esopus Creek and West Branch Neversink River) reported about 41 inches of snow in March (the deepest snow reported in New York during March 2005 according to the National Weather Service, 2005d). Before the rainfall in late March there were about 22 inches of snow remaining at Slide Mountain; on April 1 the reported snow on the ground was down to 12 inches and by April 3 only 4 inches of snow was reported at Slide Mountain. The 7-day runoff for the period prior to April 4 was almost 9.0 inches for the stream-gaging station Esopus Creek at Coldbrook, N.Y.

Flood of April 2–3, 2005, Discharge and Frequency

The locations of 19 USGS stream-gaging stations in the Hudson River Basin cited in this report are presented in figure 3. Historical flood peak discharges and peak discharges for the flood of April 2–3, 2005, at these stations are presented in table 3.

Peak discharges at the USGS stream-gaging stations on the Esopus Creek located upstream from Ashokan Reservoir were recorded between about 10:30 p.m. on Saturday, April 2, and 1:00 a.m. on Sunday, April 3. The USGS stream-gaging station Esopus Creek at Mount Marion, N.Y., located downstream from the Ashokan Reservoir, recorded the peak discharge late in the evening on Sunday, April 3, 2005. The general trend of peaks occurring between late in the evening on April 2 and midday on April 3 was consistent for many of the USGS stream-gaging stations in the Hudson River Basin (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 systematic annual peak discharge data to a log-Pearson type III distribution (Interagency Advisory Committee on Water Data, 1982). Recurrence intervals at stream-gaging stations with significant regulation were calculated from statistical analyses of annual peak discharges during the regulated period only. 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 for Esopus Creek at Allaben and Esopus Creek at Coldbrook, N.Y. (stations located upstream from Ashokan Reservoir) were 60 and 30 years, respectively, whereas the recurrence interval for Esopus Creek at Mount Marion, N.Y. (located downstream of Ashokan Reservoir) was 80 years. The stream-gaging stations Esopus Creek at Allaben, in operation since 1963, and Esopus Creek at Mount Marion, in continuous operation since 1970, recorded new period-of-record maximums of 21,700 ft^3/s and 30,500 ft^3/s, respectively. The peak discharge of 55,200 ft^3/s at Esopus Creek at Coldbrook, N.Y. stream-gaging station was about 15 percent less than the period-of-record maximum of 65,300 ft^3/s set in March 1980. Discharge hydrographs for these three USGS stream-gaging stations (two stations are upstream from the Ashokan Reservoir and one is downstream) in the Esopus Creek Basin for the period March 27 to April 6, 2005, are presented in figure 4.

Peak streamflow frequencies at other stations in the Hudson River Basin generally remained below a 30-year recurrence interval with a few exceptions. The peak at Rondout Creek at Rosendale, N.Y. had a recurrence interval of 50 years while the peak at Bushnellsville Creek at Shandaken, N.Y. had a recurrence interval greater than 100 years. Peak discharges at selected sites in the Hudson River Basin are plotted as a function of drainage area in figure 5 as well as previous maximum discharges at stations with regulated and unregulated streamflows.

Table 1. Total rainfall for April 2-3, 2005, at selected locations in the Esopus Creek Basin and surrounding areas.

[Data provided by National Oceanic and Atmospheric Administration (2005b) and New York City Department of Environmental Protection (written commun., 2005); selected data shown in fig. 1]

Site number	Site name	Total rainfall (inches)
1	East Jewett, N.Y.	5.69
2	Slide Mountain, N.Y.	4.83
3	Highland Lakes, N.J.	4.60
4	Canistear Reservoir, N.J.	4.24
5	Claryville, N.Y.	4.10
6	Greentown, Pa	4.00
7	West Milford, N.J.	3.88
8	Hewitt, N.J.	3.85
9	Milanville, Pa	3.79
10	Mohonk Lake, N.Y.	3.80
11	North Branch, N.Y.	3.74
12	Gouldsboro, Pa	3.74
13	Liberty, N.Y.	3.69
14	Long Eddy, N.Y.	3.65
15	Fishs Eddy, N.Y.	3.51
16	Montague, N.J.	3.50
17	Matamoras, Pa	3.46
18	Monticello, N.Y.	3.45
19	Ashokan Reservoir, N.Y.	3.37
20	West Point, N.Y.	3.36
21	Windham, N.Y.	3.36
22	Middletown, N.Y.	3.35
23	Port Jervis, N.Y.	3.00
24	Cairo, N.Y.	2.97
25	Schoharie Reservoir, N.Y.	2.96
26	Rondout Reservoir, N.Y.	2.95
27	Cannonsville Reservoir, N.Y.	2.81
28	Sterling Twp, Pa	2.73
29	Delhi, N.Y.	2.66
30	Walton , N.Y.	2.65
31	Deposit, N.Y.	2.62
32	Neversink Reservoir, N.Y.	2.58
33	Lordville, N.Y.	2.40
34	Rosendale, N.Y.	2.33
35	Davenport, N.Y.	2.25
36	West Davenport, N.Y.	2.25
37	Masonville, N.Y.	2.12
38	Roxbury, N.Y.	2.09
39	Margaretville, N.Y.	2.01
40	Unadilla, N.Y.	1.96
41	Poughkeepsie, N.Y.	1.90
42	Lansing Manor, N.Y.	1.84
43	Rhinebeck, N.Y.	1.80

Table 2. Rainfall-frequency relations for storms of 3-, 6-, 12-, and 24-hour duration at Ashokan Reservoir, N.Y.

[Data from U.S. Weather Bureau, 1961. Location is shown in fig. 1]

Recurrence interval (years)	Rainfall, in inches for selected duration			
	3 hours	6 hours	12 hour	24 hours
2	2.0	2.5	3.5	4.0
5	2.6	3.5	4.0	5.0
10	3.0	4.0	5.0	6.0
25	3.5	4.5	5.5	6.5
50	4.0	5.0	6.0	7.0
100	4.1	5.5	7.0	8.0

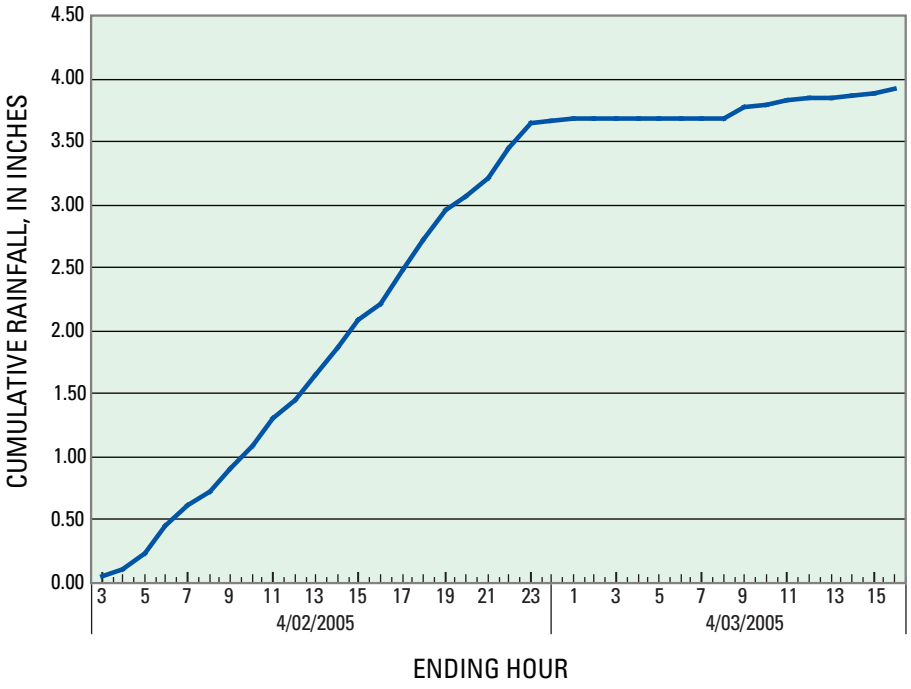

Figure 2. Cumulative rainfall during April 2-3, 2005, recorded at New York City Department of Environmental Protection station at Ashokan Reservoir, N.Y.

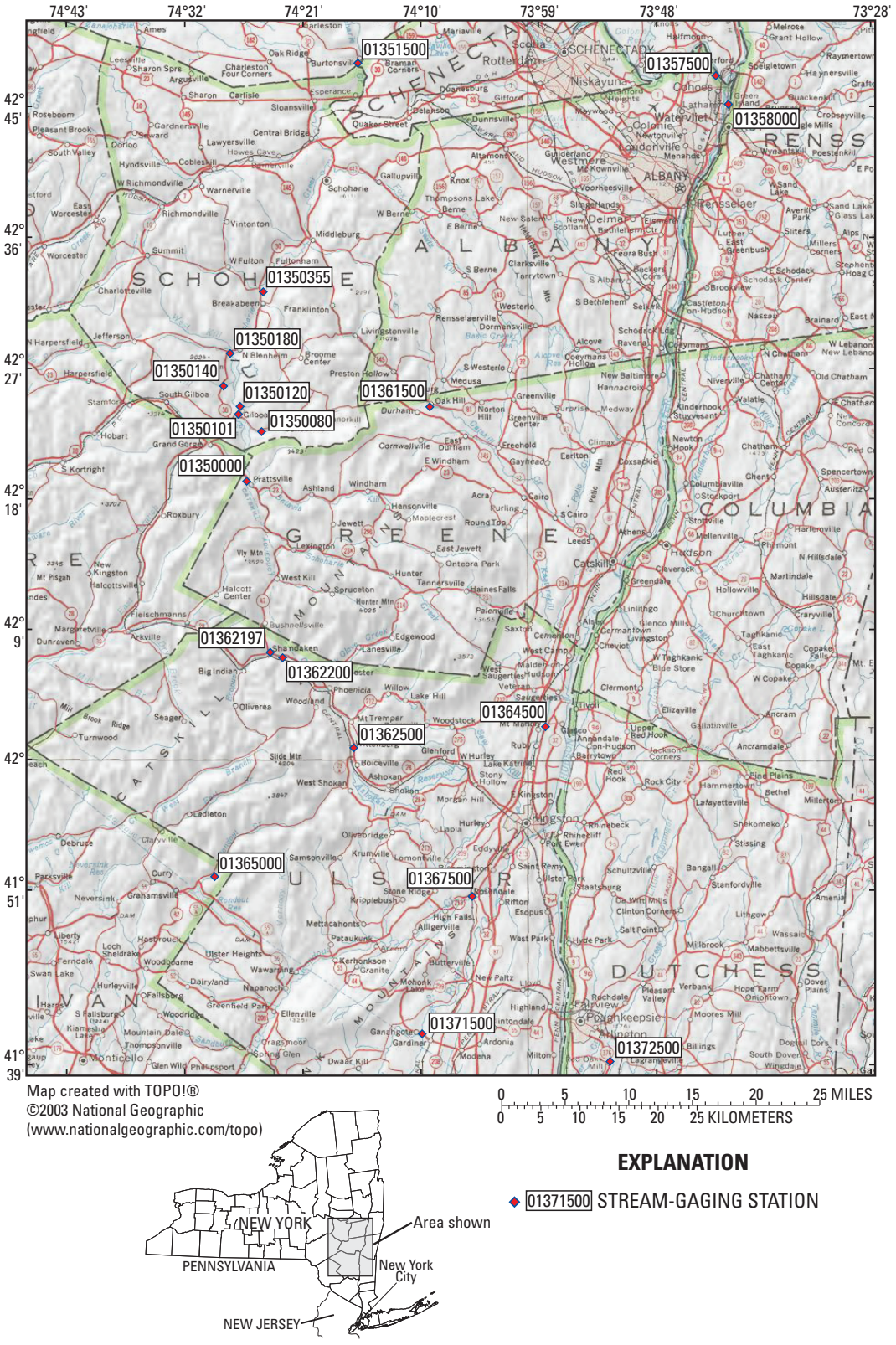

Figure 3. Locations of selected U.S. Geological Survey stream-gaging stations in the Hudson River Basin, N.Y. (See table 3 for station names and flood-related data.)

Table 3. Historical flood peak discharges and peak discharges during the flood of April 2-4, 2005, at selected U.S. Geological Survey stream-gaging stations in the Hudson River Basin, N.Y.

[mi², square miles; ft, feet; ft³/s, cubic feet per second; ft³/s/mi², cubic feet per second per square mile; <, less than; > greater than. Recurrence intervals equal to and above 25 years include the April 2005 flood discharge in the statistical analysis]

USGS station number	Station name	Drainage area (mi²)	Period of record	Previous maximum of record			Flood of April 2-4, 2005					
				Date of peak	Peak stage (ft)	Peak discharge (ft³/s)	Date of peak	Time of peak (hr)	Peak stage (ft)	Peak discharge (ft³/s)	Peak discharge (ft³/s/mi²)	Recurrence interval (years)
	Hudson River Basin											
01350000	Schoharie Creek at Prattsville,	237	1902-2005	01/19/96	19.39	52,800	04/03/05	0115	17.23	41,500	175.1	20
01350080	Manor Kill at West Conesville near Gilboa	32	1986-2005	01/19/96	10.20	5,050	04/02/05	2330	7.49	2,960	91.4	9
01350101	Schoharie Creek at Gilboa*	316	1975-2005	01/19/96	30.60	70,800	04/03/05	0345	25.27	49,400	156.3	25
01350120	Platter Kill at Gilboa	11	1975-2005	01/19/96	6.7	1,370	04/03/05	0145	4.06	396	36.3	<2
01350140	Mine Kill near North Blenheim	16	1974-2005	01/19/96	5.20	2,550	04/02/05	2300	5.51	1,810	111.7	12
01350180	Schoharie Creek at North Blenheim*	358	1970-2005	01/19/96	17.61	75,600	04/03/05	0400	14.78	51,700	144.4	25
01350355	Schoharie Creek at Breakabeen*	444	1975-2005	01/19/96	20.51	80,200	04/03/05	0515	17.40	56,600	127.5	25
01351500	Schoharie Creek at Burtonsville*	886	1939-2005	01/20/96	12.88	81,600	04/03/05	1345	10.30	56,100	63.3	25
01357500	Mohawk River at Cohoes*	3,450	1917-2005	03/06/64	23.15	143,000	04/03/05	2230	20.80	98,100	28.4	15
01358000	Hudson River at Green Island*	8,090	1946-2005	12/31/48	27.05	181,000	04/04/05	0100	24.22	132,000	16.3	7
01361500	Catskill Creek at Oak Hill*	98	1911-2005	04/04/87	16.6	15,400	04/03/05		14.22	11,600	118.4	25
01362197	Bushnellsville Creek at Shandaken	11	1951,56, 72-05	10/15/55	12.4	1,830	04/02/05		12.52	2,700	236.8	>100 & <500
01362200	Esopus Creek at Allaben	64	1963-2005	03/30/51	[abc]15.1	b 20,000	04/02/05	2245	14.44	21,700	340.7	60
01362500	Esopus Creek at Coldbrook	192	1931-2005	03/21/80	21.94	65,300	04/03/05	0045	20.57	55,200	287.5	30
01364500	Esopus Creek at Mount Marion*	419	d1970-2005	04/05/87	24.78	[d]22500	04/03/05	2215	26.46	30,500	72.8	80
01365000	Rondout Creek near Lowes Corners	38	1937-2005	07/22/38	[a]8.20	7,600	04/02/05	2215	9.09	6,170	161.1	15
01367500	Rondout Creek at Rosendale*	383	d1951-2005	10/16/55	36.8	[d]35800	04/03/05	1045	24.96	30,500	79.6	50
01371500	Wallkill River at Gardiner	695	1924-2005	10/16/55	19.81	30,800	04/03/05	0900	13.81	19,200	27.6	15
01372500	Wappinger Creek near Wappingers Falls	181	1928-2005	08/19/55	19.60	18,600	04/03/05	1415	7.09	2,370	13.1	<2

* 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.

[a]From floodmarks.

[b]About.

[c]At former site.

[d]Since current degree of regulation.

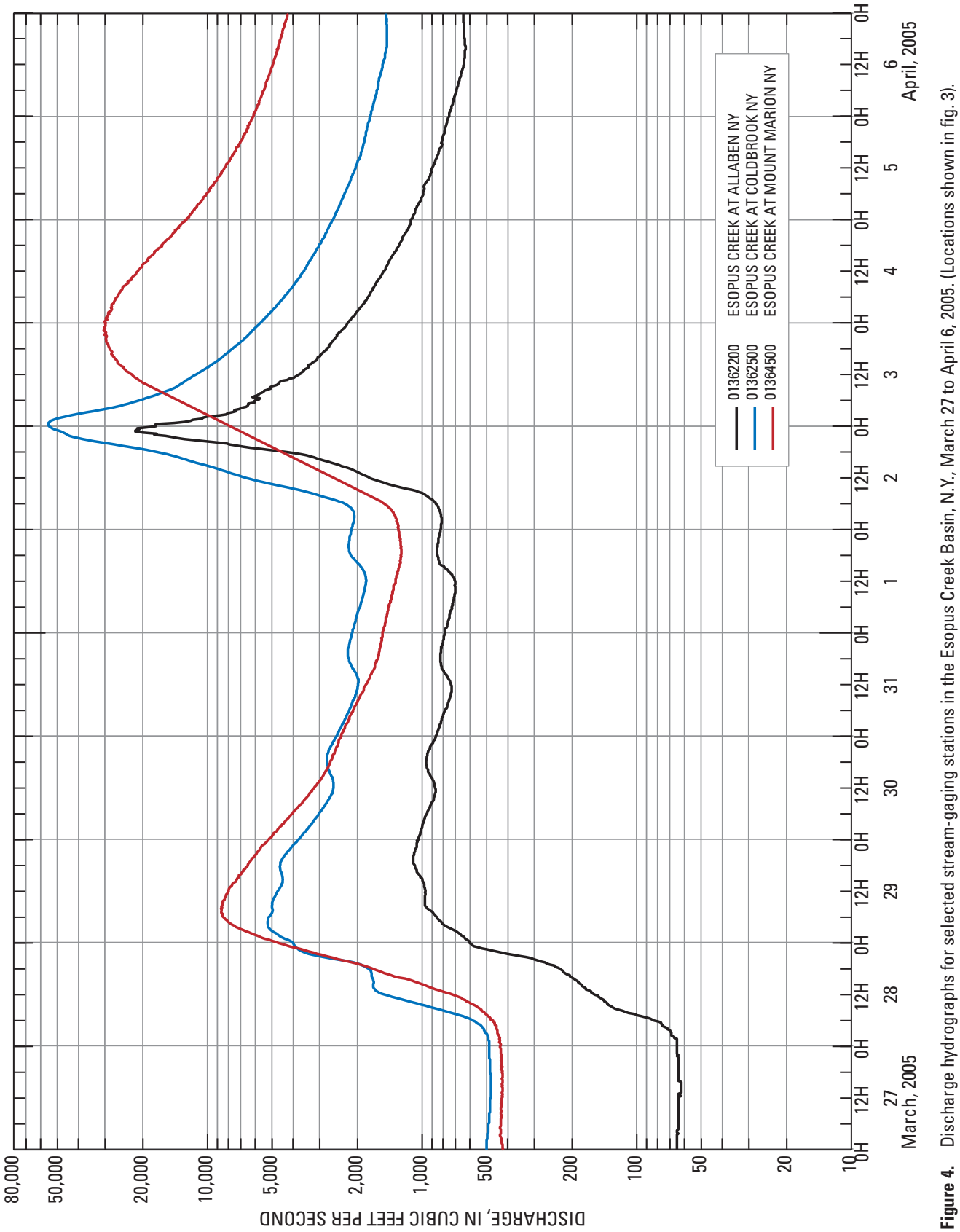

Figure 4. Discharge hydrographs for selected stream-gaging stations in the Esopus Creek Basin, N.Y., March 27 to April 6, 2005. (Locations shown in fig. 3).

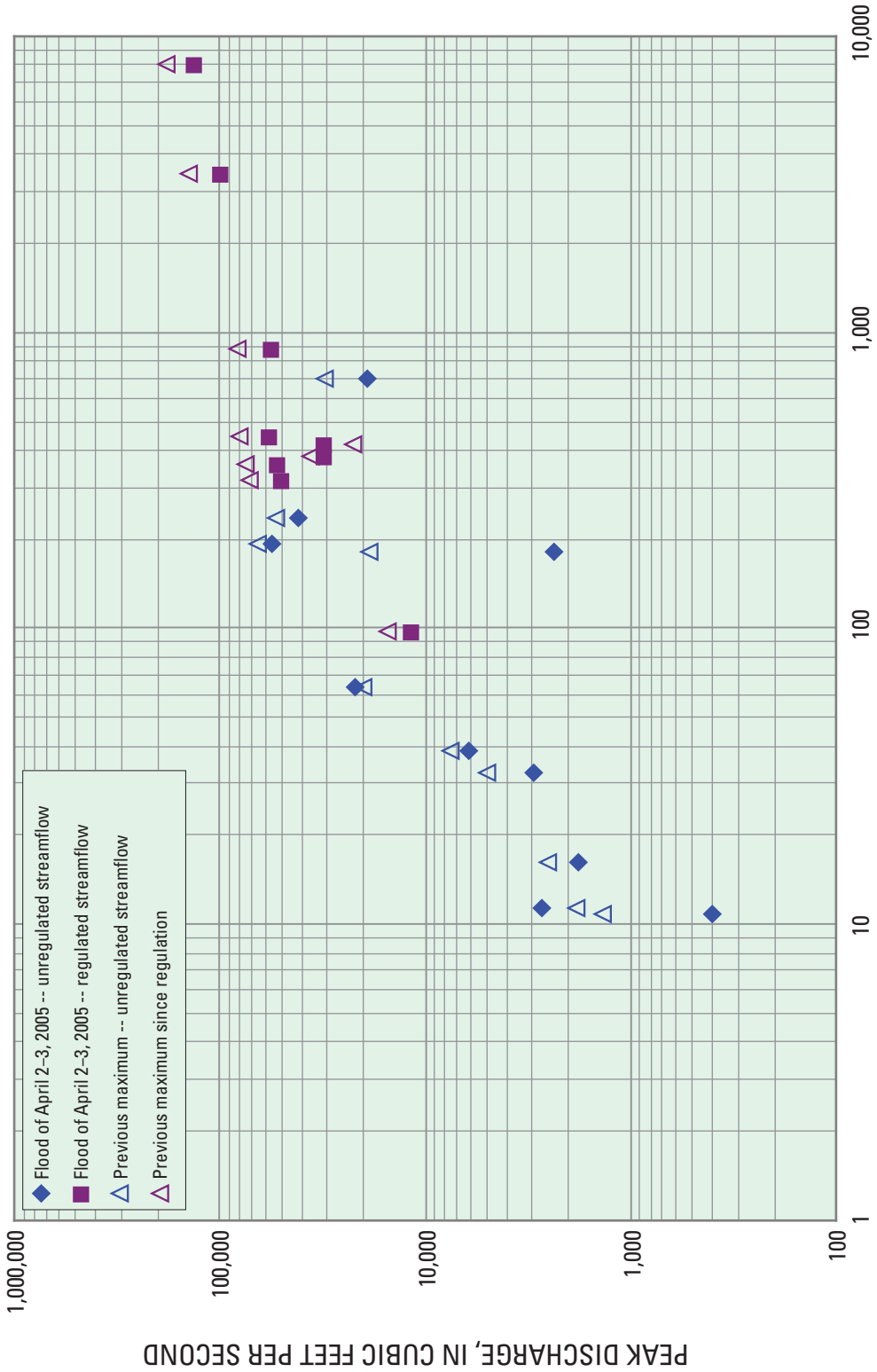

Figure 5. Peak discharges at selected stream-gaging stations in the Hudson River Basin, N.Y., as a function of drainage area during the flood of April 2-3, 2005, and previous maximum known discharges.

Effect of the Ashokan Reservoir on Downstream Flooding

The Ashokan Reservoir, which began storage operations on September 9, 1913, is divided into two basins separated by a weir containing a gatehouse. The usable capacity of the west basin is 47,180 million gallons between the minimum operating level of 495.50 ft above NGVD 29 and the crest of the spillway to the east basin at elevation 590.00 ft above NGVD 29. The dead storage of the west basin is 2,237 million gallons below the minimum operating level. Usable capacity of the east basin is 80,678 million gallons between elevation 500.00 ft above NGVD 29 and the crest of the spillway to Esopus Creek at elevation 587.10 ft above NGVD 29. There is no dead storage in the east basin.

The reservoir water-surface elevation was 590.3 ft above NGVD 29 in the west basin and 587.2 ft above NGVD 29 in the east basin on April 1 (fig. 6), and the reservoir was spilling before the storm. Maximum contents observed for the west and east basins of the Ashokan Reservoir prior to this storm occurred on March 31, 1951, at elevations of 594.33 and 592.23 ft above NGVD 29, respectively. The maximum observed water-surface elevation of the reservoir for the period of March 27 to April 6, 2005, occurred on April 3. The west basin of the reservoir reached a new period-of-record maximum elevation of 594.86 ft above NGVD 29, while the east basin reached a maximum elevation of 591.38 ft above NGVD 29.

The USGS stream-gaging station (inflow to reservoir) Esopus Creek at Coldbrook, N.Y., recorded a peak discharge of 55,200 ft^3/s at 12:45 a.m. on April 3, 2005. The drainage area above this stream-gaging station is about 75 percent of the total contributing area to the Ashokan Reservoir. The peak discharge recorded at this station per unit of contributing drainage area yields a peak runoff of 288 cubic feet per second per square mile ($ft^3/s/mi^2$). Applying this peak runoff to the entire Ashokan Reservoir drainage area yields an estimated maximum inflow of about 73,700 ft^3/s on April 3, 2005. The period-of-record maximum discharge recorded at the Esopus Creek at Coldbrook, N.Y., stream-gaging station was 65,300 ft^3/s during the March 1980 flood. The calculated peak runoff from March 1980 would yield an estimated maximum inflow 18 percent greater than the April 2005 event. The estimated peak outflow from the Ashokan Reservoir was about 29,700 ft^3/s at 8:00 a.m. on April 3, 2005. The USGS stream-gaging station Esopus Creek at Mount Marion, N.Y., recorded a peak discharge of 30,500 ft^3/s at 10:15 p.m. on April 3, 2005. Although the Ashokan Reservoir was at full capacity and spilling at the beginning of the storm, the peak outflow was attenuated by about 60 percent because of storage effects in the reservoir.

Hourly inflow and outflow hydrographs, diversions, and water-surface elevations for the Ashokan Reservoir for the period March 27 to April 6 are presented in figure 6. The maximum computed daily mean inflow to the Ashokan Reservoir was estimated as about 23,200 ft^3/s on April 3, 2005. The combined flow through the release valves and over the spillway was estimated as a maximum daily mean outflow of about 22,900 ft^3/s on April 3, 2005.

Historical flood peak discharges and peak discharges for the flood of April 2–3, 2005, at stations on the Esopus Creek before and after regulation from the Ashokan Reservoir began are presented in table 4. These peak discharges show that during the floods of 1980, 1996, and again in 2005, the presence of the reservoir significantly reduced the effects of flooding on downstream communities.

Improvements to the right bank of the Esopus Creek located between Interstate Route 587/State Route 28 and Washington Avenue have been referred to as the "Kingston Flood Control Project" in the FEMA flood-insurance studies for the City of Kingston and the Towns of Ulster, Hurley, and Saugerties, New York (FEMA 1984b, 1984c, 1992a, 1992b). The design flow for this flood-control project was 37,400 ft^3/s, which at the time represented the 100-year flood discharge and was 10 percent greater then the maximum known flood discharge of 34,000 ft^3/s. The maximum known flood discharge measured at Kingston, N.Y., is documented as occurring during the March 1951 flood in the previously mentioned FEMA flood-insurance studies. The second highest flood discharge of 30,400 ft^3/s was documented as occurring during the October 1955 flood and also was measured at Kingston, N.Y. The water-surface elevation as a result of the April 2005 flood was found to be about 3.5 feet below the top of the flood-control wall on the right bank of the Esopus Creek at the Interstate Route 587/State Route 28 bridge. These data are documented in Appendix 1 at study site 14, high-water mark 14.2.

Peak Water-Surface Elevations at Flood Study Sites

Included in this report are measurements of peak water-surface elevations at 25 sites along the Esopus Creek from immediately downstream from the Ashokan Reservoir in the Town of Marbletown to the US Route 9W/State Route 32 bridge over the Esopus Creek in the Village of Saugerties, N.Y. (fig. 7).

High-water marks at each site were surveyed to obtain peak water-surface elevations and were referenced to NGVD 29. A data correction 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, 2005g). At sites associated with a bridge, high-water marks were obtained upstream and downstream of the structure. The accuracy of high-water marks was rated subjectively by field personnel as "excellent," "good," "fair," or "poor" according to guidelines of Benson and Dalrymple

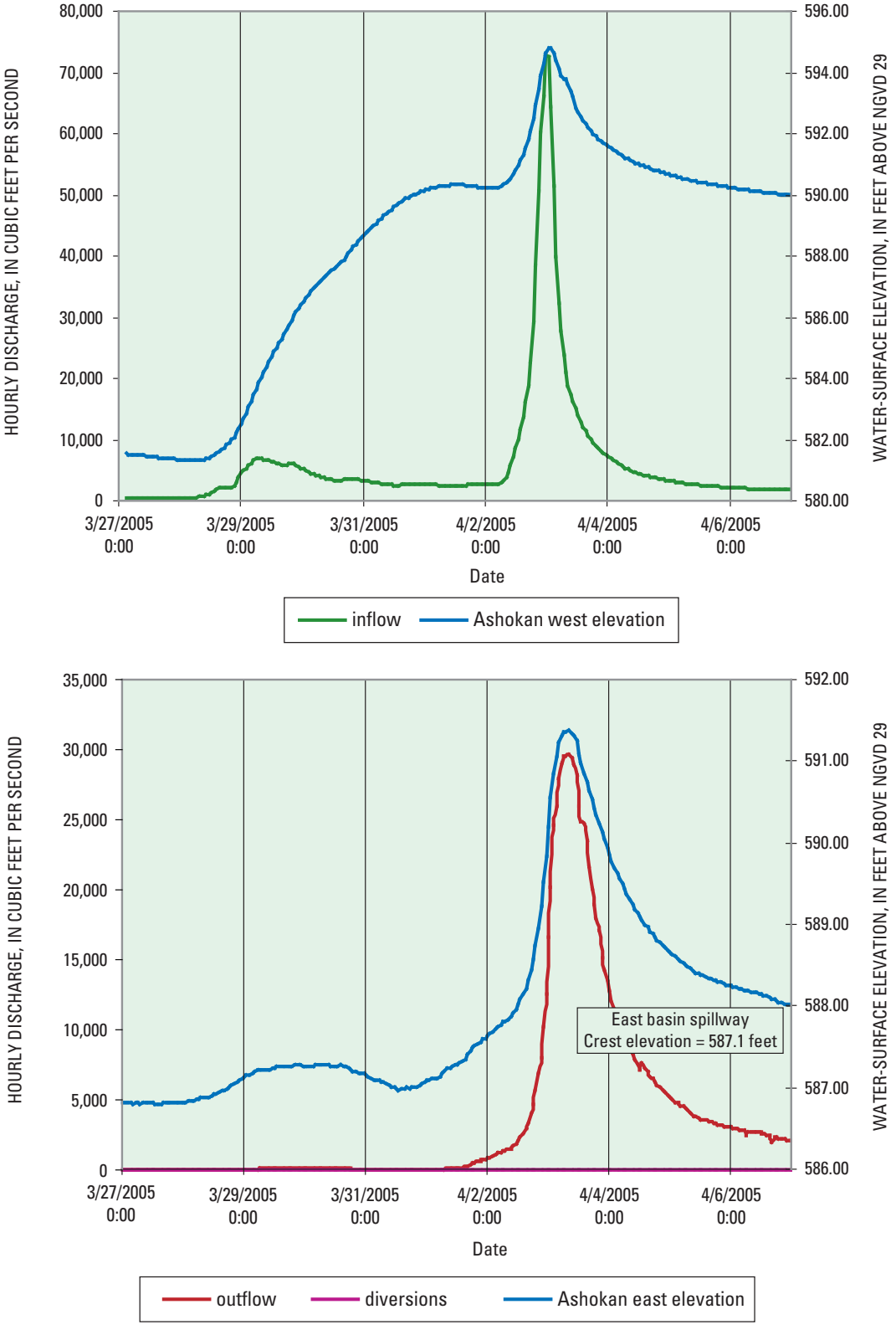

Figure 6. Hourly inflow, outflow, diversion, and water-surface elevation at the Ashokan Reservoir, N.Y., for March 27 to April 6, 2005.

Table 4. Historical flood peak discharges and peak discharges during the flood of April 2-3, 2005, at selected U.S. Geological Survey stream-gaging stations in the Esopus Creek Basin, N.Y.

[mi², square miles; --- ,no data available]

USGS station number	Station name	*Drainage area (mi²)	Period of record	Peak discharges for historical floods and flood of April 2-3, 2005, in cubic feet per second							
				Flood of April 1910	Flood of Aug. 1933	Flood of Mar. 1951	Flood of Nov. 1977	Flood of Mar. 1980	Flood of Jan. 1996	Flood of Dec. 2000	Flood of April 2005
01362200	Esopus Creek at Allaben	63.7	1963-2005	---	---	[abc] 20,000	[b] 4,860	[b]15,900	15,000	5,820	21,700
01362500	Esopus Creek at Coldbrook	192.0	[d]1914-31, 1931-2005	---	55,000	59,600	30,000	65,300	53,600	29,200	55,200
01364500	Esopus Creek at Mount Marion	419.0	1907-13, 1914-18, 1970-2005	[e]28000	---	---	13,000	19,500	11,600	12,400	30,500

[a]Information supplied by local residents.

[b]From previous site and datum then in use.

[c]Estimate.

[d]Monthly discharges only.

[e]Prior to construction of Ashokan Reservoir.

*Drainage areas based on most recent location of stream-gaging station.

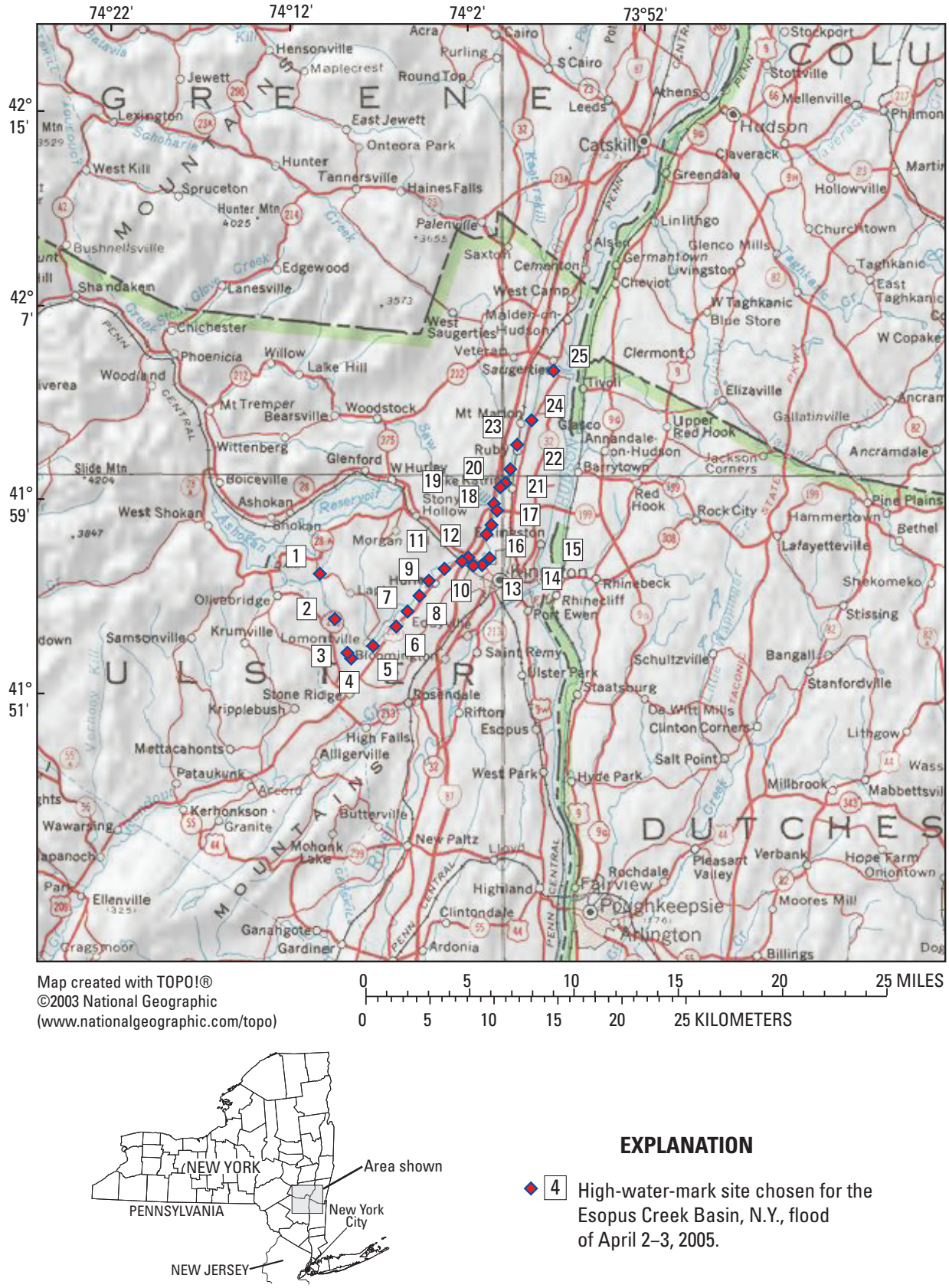

Figure 7. Locations of high-water-mark sites chosen for study in the Esopus Creek Basin, N.Y. during the flood of April 2-3, 2005.

(1967). "Excellent" means the reported high-water mark is within 0.02 ft of the true high-water elevation; "good" within 0.05 ft; "fair" within 0.10 ft; and "poor" less than "fair" accuracy. High-water-mark descriptions, photographs, locations (latitude and longitude), and locations 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 April 2005 flood were compared with flood-profile elevations published in FEMA flood-insurance studies (Federal Emergency Management Agency, 1984a, 1984b, 1984c, 1985, 1988, 1991, 1992a, 1992b). High-water-mark 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 April 2–3, 2005, for the Esopus Creek are plotted in figure 8.

FEMA flood-profile elevations were not determined in the Town of Marbletown flood-insurance study for the area immediately downstream from Ashokan Reservoir (site 1) to the upstream side of the County Route 5 bridge (site 3); therefore, a comparison of high-water-mark elevations could not be performed at study sites 1 and 2. Comparison of high-water-mark elevations with the 100-year flood profile from the FEMA flood-insurance study for the area downstream from the County Route 5 bridge near Lomontville (site 3) to Creekside Road at Riverside Park (site 7) indicated that peak water-surface elevations were lower than the 100-year flood profile (only 100-year elevations were determined in the flood-insurance study). Comparison of high-water-mark elevations with FEMA flood-insurance studies for the areas of Riverside Avenue at Riverside Park to County Route 29A (Wynkoop Road) at Hurley (sites 8 and 9), and Farm To Market Road at Kingston to Glenerie Boulevard (south) at Glenerie Lake Park (sites 17–22) indicated peak water-surface elevations at or lower than the 50-year flood profile, but higher than the 10-year flood profile. Comparison of high-water-mark elevations with FEMA flood-insurance studies for the areas of U.S. Route 209 at Kingston to Buckley Street at Kingston (sites 10–16), and Glasco Turnpike at Glenerie to U.S. Route 9W/State Route 32 at Saugerties (sites 24 and 25) indicated peak water-surface elevations at or higher than the 50-year flood profile, but lower than the 100-year flood profile. Peak water-surface elevations in the Glenerie Boulevard (north) at Glenerie Lake area (site 23) were higher than the 100-year flood profile, but lower than the 500-year flood profile. All flood-profile recurrence intervals noted above are based on published FEMA flood-insurance studies and associated profiles.

Flood Damage

A flood watch was issued on Thursday, March 31, 2005, for the Catskill and surrounding regions, and by early Saturday morning a flood warning for the Esopus Creek was issued by the NWS. A state of emergency was declared by officials in Ulster County at about 7 p.m. on Saturday, April 2 (Times Herald-Record, 2005a). Floodwaters from the Esopus and Rondout Creeks forced hundreds of residents to evacuate their homes. Ulster County emergency personnel had to complete over 40 water rescues of people stranded in their cars or homes (Daily Freeman, 2005a).

Damage from floodwaters extended beyond private homes to include public infrastructure and businesses in the area. Several major roadways, including stretches of State Route 209, Route 28, Route 42, Route 213, and Route 32, had to be closed as a result of the flooding (Times Herald-Record, 2005a). County Route 29A (Wynkoop Road) and the Kingston Circle (junction of Interstate Route 587/ Route 28 and Washington Ave) also had to be closed due to the flooding (fig. 9). Among the hardest hit areas were Farm to Market Road and Orlando Street in the Town of Ulster (Daily Freeman, 2005b). The Holiday Inn in Kingston was one of several hotels in the area forced to close due to the flooding. Animals from the Ulster County Society for the Prevention of Cruelty to Animals (SPCA) had to be evacuated by boats as the shelter was also forced to close (Daily Freeman, 2005a). Ulster County officials estimated that it would cost at least $23 million to restore what was destroyed by floodwaters from the Wallkill River and the Esopus and Rondout Creeks. The American Red Cross indicated that at least 109 homes were destroyed as a result of the flooding (Times Herald-Record, 2005e). Ulster County was among the counties declared as Federal disaster areas. Selected photographs of flood damage in the Esopus Creek Basin and surrounding areas during the flood of April 2–3, 2005, are presented in Appendix 2. More than 3,400 New York residents, business owners, and government agencies registered for disaster-recovery assistance from the April flooding in New York. This assistance reached almost $35 million (Federal Emergency Management Agency, 2005).

Table 5. Peak water-surface elevations at 25 high-water-mark sites in the Esopus Creek Basin, N.Y., during the flood of April 2-3, 2005, 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, 1984a,b,c; 1985; 1988; 1991; 1992a,b). --, no data available. Locations are shown in figure 7. Site descriptions are given in Appendix 1]

Site number	Selected high-water mark	Site name	Peak water-surface elevation, in feet above NGVD 29, April 2-3, 2005	FEMA flood elevations, in feet above NGVD 29			
				10-year flood	50-year flood	100-year flood	500-year flood
1	1.2	Esopus Creek at Spillway Road at Pacama	371.97	--	--	--	--
	1.5		369.37	--	--	--	--
2	2.1	Esopus Creek at Krom Road at Atwood	255.77	--	--	--	--
	2.8		254.30	--	--	--	--
3	3.12	Esopus Creek at County Route 5 near Lomontville	[a]208.61	--	--	--	--
	3.14		[b]208.19	--	--	208.8	–-
4	4.3	Esopus Creek at Town of Marbletown Recreation Park near	200.95	--	--	205.2	--
	4.1	Marbletown	201.81	--	--	205.1	--
5	5.1	Esopus Creek at Fording Place Road at Marbletown	188.93	--	--	192.1	--
	5.2		188.98	--	--	191.9	--
6	6.3	Esopus Creek at U.S. Route 209 near Marbletown	177.11	--	--	180.5	--
	6.2		176.87	--	--	180.5	--
7	7.1	Esopus Creek at Creekside Road at Riverside Park	171.37	--	--	175.7	--
	7.3		171.45	--	--	175.6	--
8	8.1	Esopus Creek at Riverside Avenue at Riverside Park	165.34	159.0	167.1	169.5	178.8
	8.3		165.07	159.0	167.1	169.5	178.8
9	9.5	Esopus Creek at County Route 29A (Wynkoop Road) at Hurley	[a]162.32	156.7	165.3	167.3	177.4
	9.9		[b]161.59	156.0	163.7	166.1	177.0
10	10.5	Esopus Creek at U.S. Route 209 at Kingston	[a]159.93	148.4	158.4	163.4	176.2
	10.2		[b]158.32	148.3	158.4	162.7	175.7
11	11.4	Esopus Creek at Conrail Railroad at Kingston	[b]157.54	146.7	154.9	159.2	173.6
12	12.8	Esopus Creek at Interstate Route 87 (N.Y.S. Thruway) at Kingston	[a]156.19	146.4	154.1	158.3	172.5
	12.5		[a]155.00	146.3	154.0	158.0	172.4

Table 5. Peak water-surface elevations at 25 high-water-mark sites in the Esopus Creek Basin, N.Y., during the flood of April 2-3, 2005, 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, 1984a,b,c; 1985; 1988; 1991; 1992a,b). --, no data available. Locations are shown in figure 7. Site descriptions are given in Appendix 1]

Site number	Selected high-water mark	Site name	Peak water-surface elevation, in feet above NGVD 29, April 2-3, 2005	FEMA flood elevations, in feet above NGVD 29			
				10-year flood	50-year flood	100-year flood	500-year flood
13	13.12	Esopus Creek at Washington Avenue at Kingston	[a]154.51	145.8	153.2	156.9	170.0
	13.14		[b]154.16	145.7	152.9	156.4	169.2
	13.15		[b]154.10	145.6	152.8	156.2	169.1
	13.16		[b]154.04	145.6	152.8	156.1	169.1
14	14.2	Esopus Creek at Interstate Route 587 and State Route 28 at Kingston	[a]153.46	145.5	152.6	155.6	169.0
	14.12		[b]152.65	145.5	152.4	155.6	168.8
	14.10		[b]152.68	145.5	152.4	155.6	168.8
15	15.4	Esopus Creek at Manor Lake at Kingston	152.87	145.0	152.0	155.6	168.8
	15.1		152.76	145.0	152.0	155.6	168.8
16	16.2	Esopus Creek at Buckley Street at Kingston	151.16	143.3	150.6	154.6	168.4
17	17.1	Esopus Creek at Farm To Market Road at Kingston	150.02	141.9	150.1	154.3	168.0
18	18.1	Esopus Creek at U.S. Route 209 at Lake Katrine	[a]147.11	140.2	148.4	152.7	167.6
	18.4		[b]146.76	140.1	148.2	152.5	166.8
19	19.1	Esopus Creek at Parish Lane at Lake Katrine	146.28	139.6	147.7	152.0	165.8
20	20.2	Esopus Creek at Sawmill Road at Lake Katrine	142.17	136.0	143.1	147.6	163.0
	20.4		141.85	135.9	143.0	147.5	162.9
21	21.2	Esopus Creek at Leggs Mills Road at Lake Katrine	[a]141.46	131.6	141.3	146.5	162.5
	21.8		[b]138.80	131.3	140.7	146.0	160.4
22	22.1	Esopus Creek at Glenerie Boulevard (south) at Glenerie Lake Park	136.33	129.8	137.5	142.6	155.5
23	23.2	Esopus Creek at Glenerie Boulevard (north) at Glenerie Lake Park	133.59	121.9	126.0	129.5	143.4
	23.1		133.59	121.3	125.7	129.4	143.4
24	24.2	Esopus Creek at Glasco Turnpike at Glenerie	[a]67.80	55.3	64.2	70.0	96.8
	24.4		[b]66.19	54.4	62.4	68.8	91.4
25	25.1	Esopus Creek at U.S. Route 9W and State Route 32 at Saugerties	[a]54.64	49.8	54.6	58.6	72.9
	25.4		[b]54.61	49.7	54.5	58.2	71.1

[a]Upstream from bridge.

[b]Downstream from bridge.

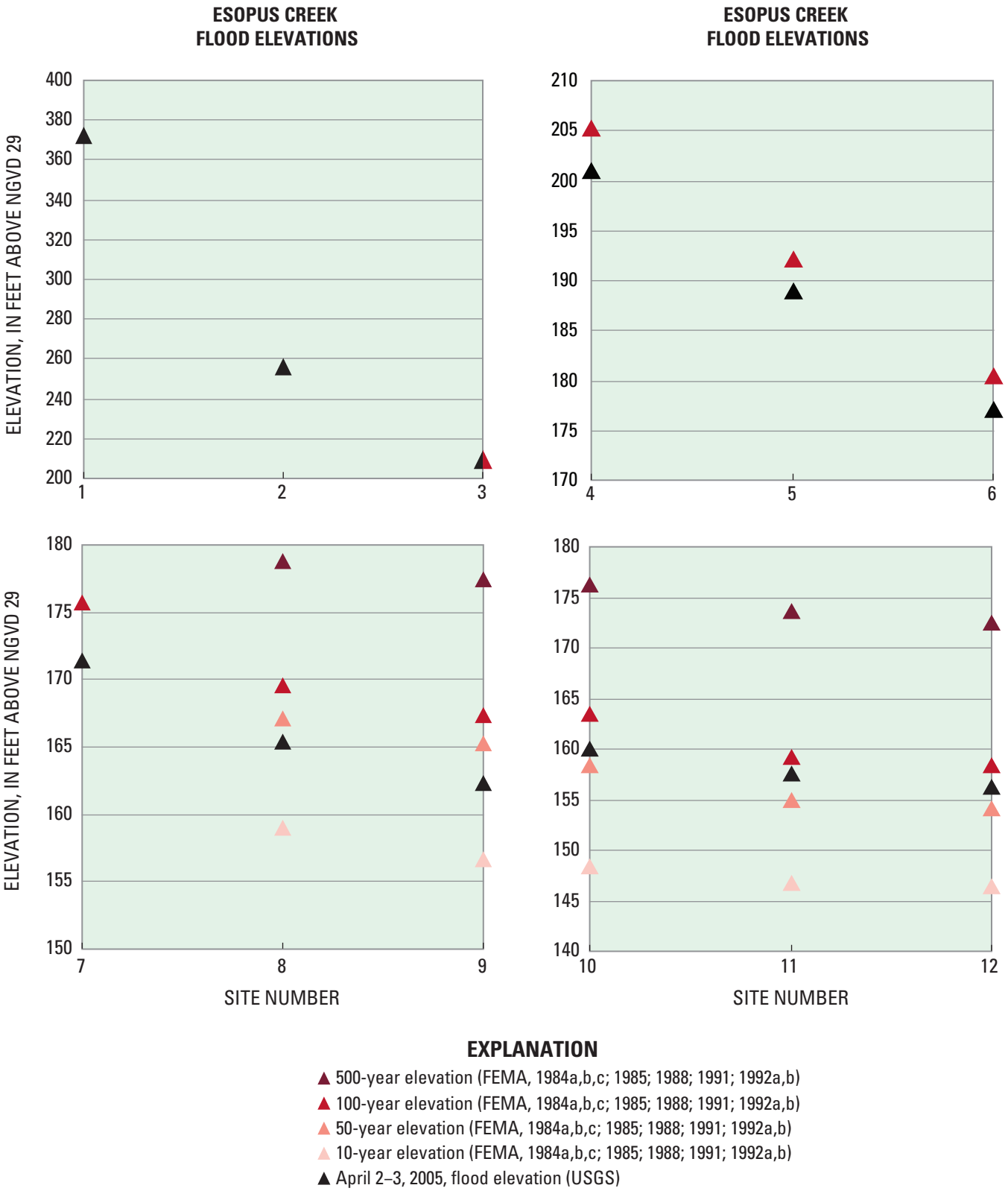

Figure 8. Peak water-surface elevations at selected sites in the Esopus Creek Basin, N.Y., during flood of April 2-3, 2005, and flood-recurrence values from Federal Emergency Management Agency flood-insurance studies. Site names and locations are listed in table 5.

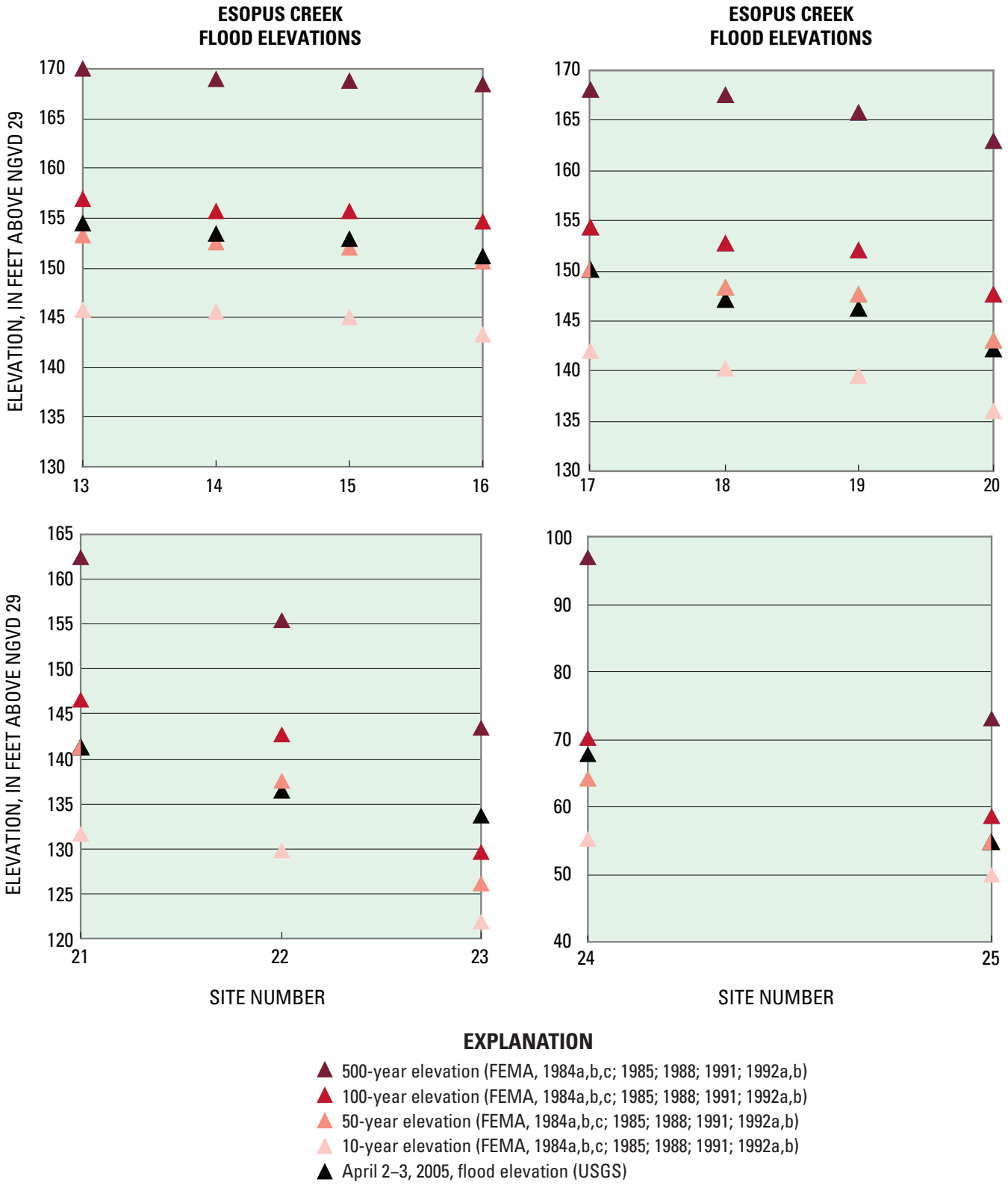

Figure 8. Peak water-surface elevations at selected sites in the Esopus Creek Basin, N.Y., during flood of April 2-3, 2005, and flood-recurrence values from Federal Emergency Management Agency flood-insurance studies. Site names and locations are listed in table 5.—Continued

Figure 9a. Study site no. 9, County Route 29A (Wynkoop Road) bridge over the Esopus Creek at Hurley, N.Y on April 3 at about 2:30 p.m. (Photo courtesy of Times Herald-Record, Middletown, N.Y.)

Figure 9b. Area between study sites 12 and 13 at the Kingston Circle, junction of Interstate Route 587, Route 28 and Washington Ave. Kingston, N.Y. (Photo courtesy of Times Herald-Record, Middletown, N.Y.)

Summary

Heavy rain ranging from about 2 inches to almost 6 inches in some locations produced widespread flooding in the Rondout and Esopus Creek basins during April 2–3, 2005. This rain came only days after the March 28–29 storm that soaked the area with 1 to 2 inches of rain, leaving the Esopus Creek flowing at above-normal levels on April 1. This storm produced peak water-surface elevations with recurrence intervals of about 50 years, as indicated by elevations documented in FEMA flood-insurance studies. The Ashokan Reservoir was at greater than 100 percent capacity and already spilling at the start of this storm.

Hundreds of people had to evacuate, and more than 100 homes were severely damaged because of the flooding in Ulster County. Ulster County was among the counties in New York declared as Federal disaster areas and eligible for assistance. Federal disaster-recovery assistance in New York was almost $35 million for this flood. Although flood damage from this storm was present throughout southeastern New York, floodwaters from the Esopus and Rondout Creeks caused extensive damage to several communities, including the Towns of Hurley and Kingston, N.Y. Portions of several roads had to be closed because of floodwaters, including State Route 213, State Route 209, State Route 42, State Route 32, and State Route 28. Peak water-surface elevations at 25 study sites along the Esopus Creek were surveyed and, where possible, were compared to flood-profile elevations in the flood-insurance studies published by FEMA. These peak water-surface elevations were near the 50-year flood elevations in most areas. The USGS stream-gaging station Esopus Creek at Cold Brook is located upstream from the Ashokan Reservoir and includes flow draining from 75 percent of the contributing drainage area to the reservoir. This stream-gaging station has been in operation since 1914 and recorded a maximum discharge of 55,200 ft^3/s on April 3 (period-of-record maximum discharge of 65,300 ft^3/s on March 21, 1980). The USGS stream-gaging station Esopus Creek at Allaben, N.Y., has been in operation since 1963 and recorded a new period-of-record maximum discharge of 21,700 ft^3/s during this storm. The USGS stream-gaging station Esopus Creek at Mount Marion, N.Y., located downstream from the Ashokan Reservoir has been in continuous operation since March 1970 and also recorded a new period-of-record maximum discharge of 30,500 ft^3/s on April 3, 2005.

Acknowledgments

Thanks are extended to the following USGS hydrologists and hydrologic technicians who collected the data for this report during and after the flood: L.T. Brooks, A.M. Gearwar, M.E. Hendricks, T.F. Hoffman, R. Lumia, K. McGrath, K.D. Metzker, C.J. Ostheimer, K.D. Reisig, S.A. Vivian, M.T. Whitehead, and B.J. Zatorsky.

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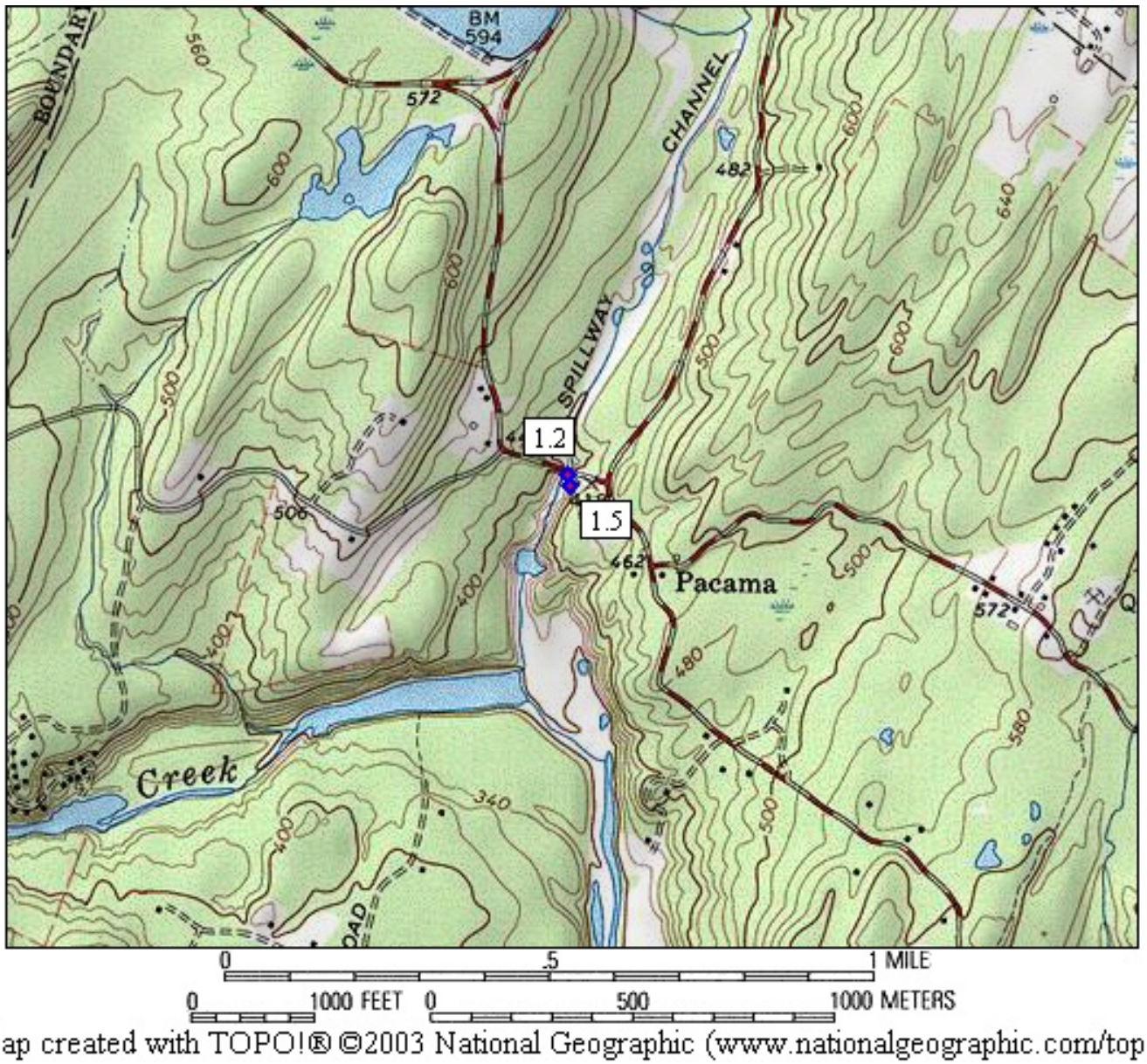
Appendix 1. Site Descriptions and High-Water Marks at Study Sites, Flood of April 2–3, 2005, Esopus Creek Basin, New York

The term “quad map” in Appendix 1 refers to a USGS 7.5' Topographic Quadrangle Map.

High-water-marks listed in table 5 are shown on the maps in Appendix 1.

All horizontal location coordinates are referenced to the North American Datum of 1983 (NAD 83); lat, latitude; long, longitude.

SITE DESCRIPTION
Site 1: Esopus Creek at Spillway Road at Pacama, N.Y.
Site Location: Bridge on Spillway Road, lat 41° 55’ 57.0”, long 74° 10’ 10.8”, NAD 83
Town of Marbletown, Ulster County, N.Y.
Ashokan USGS 7.5’ Topographic Quadrangle
High-Water Marks: Eight high-water marks were surveyed: six debris lines and two wash lines.
Photos and GPS readings were taken at each high-water mark. Field notes are filed at the USGS office in Troy, N.Y.
Marks were surveyed and photos taken by K.D. Metzker, C. J. Ostheimer, S.A. Vivian, and M.T. Whitehead on June 7, 2005.
High-water-mark elevations were surveyed from a reference mark that is a USGS chiseled square on the east end of the south concrete curbing of the Spillway Road bridge over Esopus Creek. Elevation is 417.59 feet above NGVD 29. To convert to NAVD 88, subtract 0.72 feet from all elevations at this site.
Thalweg Elevation: 340.8 feet above NGVD 29.

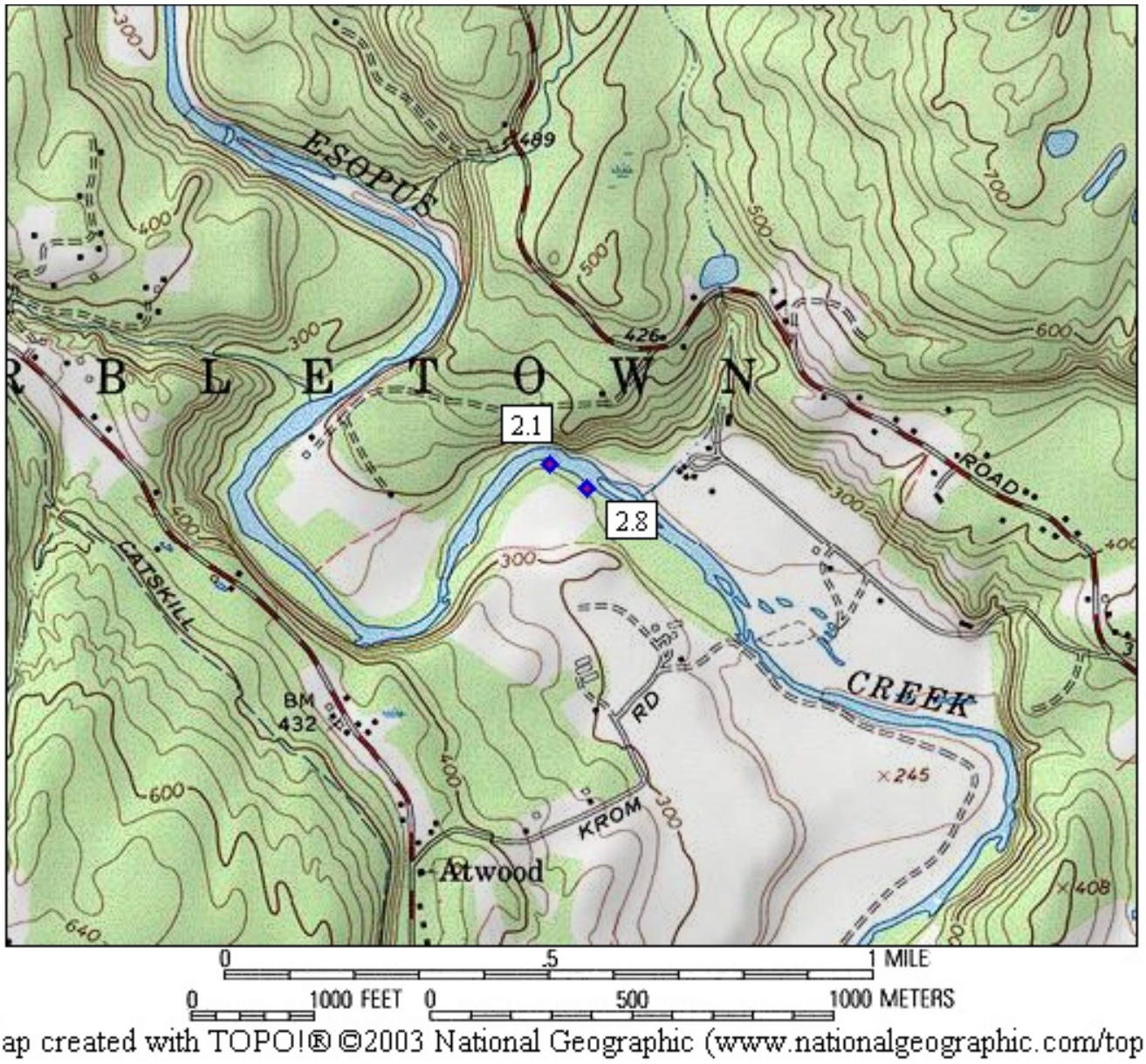


Ashokan quad map with location of site 1, Esopus Creek at Spillway Road at Pacama, N.Y.

High-water mark 1.2 is a poor wash line on the ground, on the left bank, 100 feet downstream from the Spillway Road bridge, at elevation 371.97 feet above NGVD 29 (lat 41° 55’ 56.7”, long 74° 10’ 10.8”).

High-water mark 1.5 is a poor debris line on the ground, on the left bank, 200 feet downstream from the Spillway Road bridge, at elevation 369.37 feet above NGVD 29 (lat 41° 55’ 55.9”, long 74° 10’ 10.7”).

SITE DESCRIPTION
Site 2: Esopus Creek at Krom Road at Atwood, N.Y.
Site Location: Krom Road, lat 41° 54’ 06.8”, long 74° 09’ 21.8”, NAD 83
Town of Marbletown, Ulster County, N.Y.
Ashokan USGS 7.5’ Topographic Quadrangle
High-Water Marks: Ten high-water marks were surveyed: eight debris lines and two seed lines.
Photos and GPS readings were taken at each high-water mark. Field notes are filed at the USGS office in Troy, N.Y.
Marks were surveyed and photos taken by K.D. Metzker, C. J. Ostheimer, S.A. Vivian, and M.T. Whitehead on June 6, 2005.
High-water-mark elevations were surveyed from a benchmark that is an NGS standard disk stamped W 272 1942 that is 1.0 mile north along State Route 213 from the junction of Tongore Road, 0.3 mile north of a church, 48.7 feet west of the west corner of a red barn, 79 feet southwest of the centerline of the highway, in the top of a boulder, NGS PID LY0035. Elevation is 432.27 feet above NGVD 29. To convert to NAVD 88, subtract 0.71 feet from all elevations at this site.

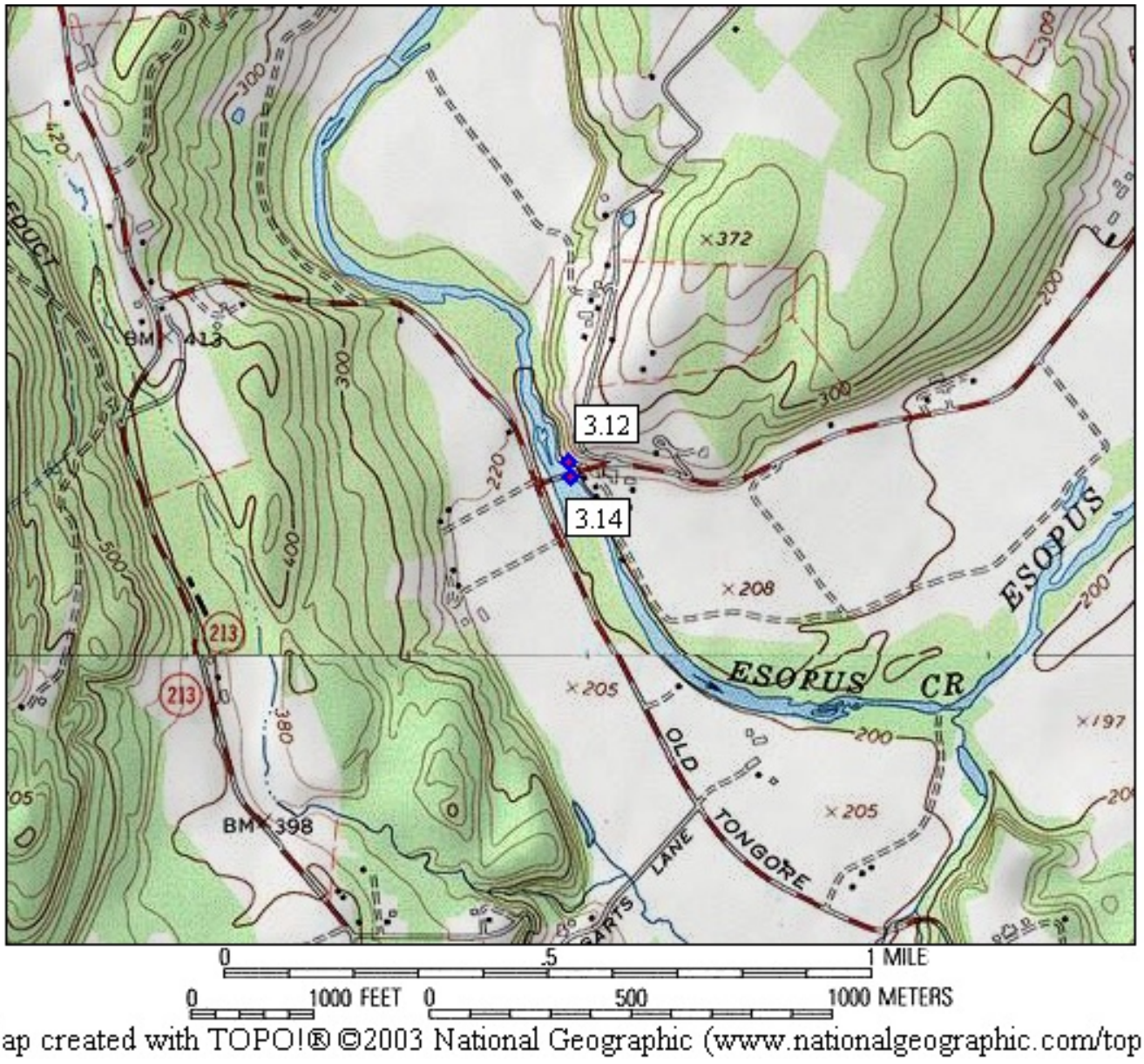


Ashokan quad map with location of site 2, Esopus Creek at Krom Road at Atwood, N.Y.

High-water mark 2.1 is a good seed line about 5.5 feet above the ground, on a tree on the right bank, at elevation 255.77 feet above NGVD 29 (lat 41° 54’ 06.8”, long 74° 09’ 21.8”).

High-water mark 2.8 is a fair debris line about 6 feet above the ground, on a tree on the right bank, at elevation 254.30 feet above NGVD 29 (lat 41° 54’ 04.8”, long 74° 09’ 17.8”).

SITE DESCRIPTION
Site 3: Esopus Creek at County Route 5 near Lomontville, N.Y.
Site Location: Bridge on County Route 5, lat 41° 52’ 44.4”, long 74° 08’ 40.8”, NAD 83
Town of Marbletown, Ulster County, N.Y.
Ashokan USGS 7.5’ Topographic Quadrangle
High-Water Marks: Fourteen high-water marks were surveyed: seven debris lines, four wash lines, and three seed lines.
Photos and GPS readings were taken at each high-water mark. Field notes are filed at the USGS office in Troy, N.Y.
Marks were surveyed and photos taken by K.D. Metzker, C. J. Ostheimer, S.A. Vivian, and M.T. Whitehead on June 6, 2005, and G.D. Firda and B.J. Zatorsky on March 29, 2006.
High-water-mark elevations were surveyed from a reference mark that is a railroad spike in pole NYT #26 on east side of Tongore Road, approximately 405 feet north along Tongore Road from its intersection with Bogart Lane. This is RM 5 in the Town of Marbletown FEMA flood-insurance study. Elevation is 200.78 feet above NGVD 29. To convert to NAVD 88, subtract 0.73 feet from all elevations at this site.
Thalweg Elevation: 192.9 feet above NGVD 29.

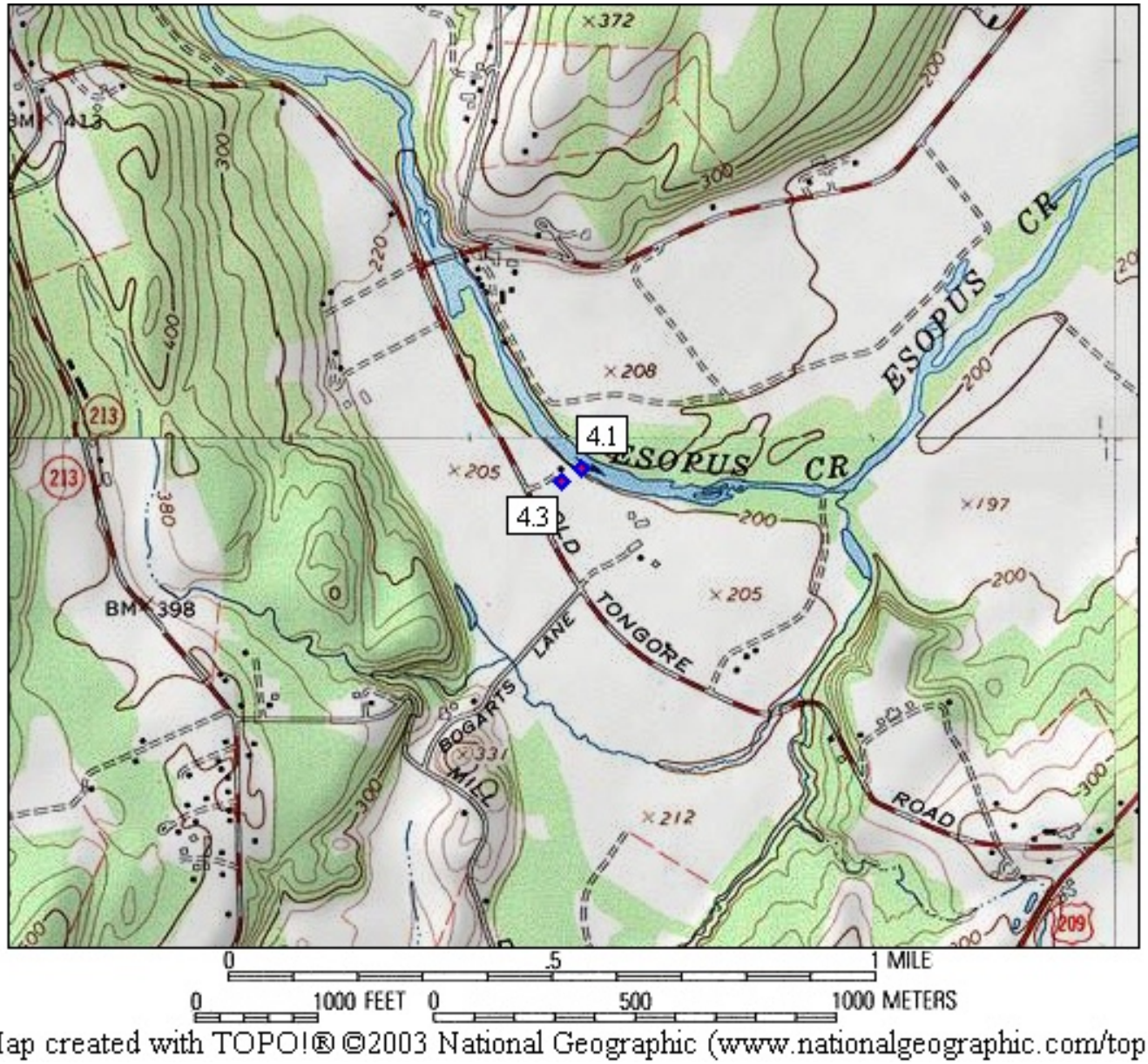


Ashokan quad map with location of site 3, Esopus Creek at County Route 5 near Lomontville, N.Y.

High-water mark 3.12 is a fair debris line about 2 feet above the ground, on a tree on the left bank, 80 feet upstream from the County Route 5 bridge, at elevation 208.61 feet above NGVD 29 (lat 41° 52’ 45.9”, long 74° 08’ 40.2”).

High-water mark 3.14 is a good seed line about 2 feet above the ground, on a support post of guest house upstream from house 2671 on County Route 5, on the left bank, 70 feet downstream from the County Route 5 bridge, at elevation 208.19 feet above NGVD 29 (lat 41° 52’ 44.6”, long 74° 08’ 39.8”).

SITE DESCRIPTION
Site 4: Esopus Creek at Town of Marbletown Recreation Park near Marbletown, N.Y.
Site Location: Town of Marbletown Recreation Park, lat 41° 52’ 27.4”, long 74° 08’ 27.5”, NAD 83
Town of Marbletown, Ulster County, N.Y.
Mohonk Lake USGS 7.5’ Topographic Quadrangle
High-Water Marks: Three high-water marks were surveyed: three mud lines.
Photos and GPS readings were taken at each high-water mark. Field notes are filed at the USGS office in Troy, N.Y.
Marks were surveyed and photos taken by K.D. Metzker, C. J. Ostheimer, S.A. Vivian, and M.T. Whitehead on June 6, 2005.
High-water-mark elevations were surveyed from a benchmark that is an NGS standard disk stamped W 272 1942 that is 1.0 mile north along State Route 213 from the junction of Tongore Road, 0.3 mile north of a church, 48.7 feet west of the west corner of a red barn, 79 feet southwest of the centerline of the highway, in the top of a boulder, NGS PID LY0035. Elevation is 432.27 feet above NGVD 29. To convert to NAVD 88, subtract 0.74 feet from all elevations at this site.

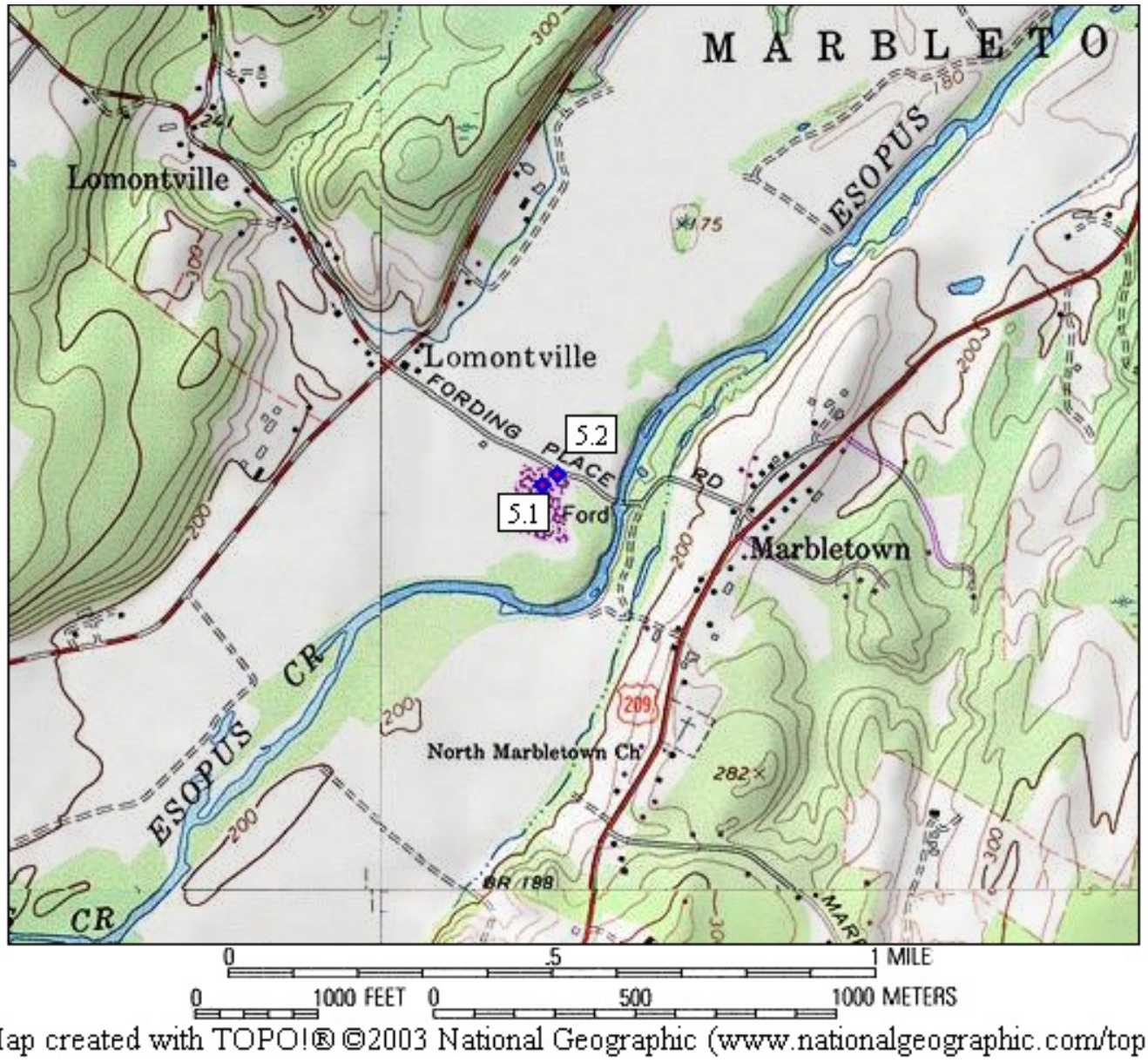


Mohonk Lake quad map with location of site 4, Esopus Creek at Town of Marbletown Recreation Park near Marbletown, N.Y.

High-water mark 4.1 is a good mud line at ground level, on the downstream side of the Town of Marbletown Recreation Park beach access stairs, on the right bank, at elevation 201.81 feet above NGVD 29 (lat 41° 52’ 27.4”, long 74° 08’ 27.5”).

High-water mark 4.3 is an excellent mud line 0.5 foot above the floor, inside of the Town of Marbletown Recreation Park concession building, on the right bank, at elevation 200.95 feet above NGVD 29 (lat 41° 52’ 26.3”, long 74° 08’ 29.5”).

SITE DESCRIPTION
Site 5: Esopus Creek at Fording Place Road at Marbletown, N.Y.
Site Location: Fording Place Road, lat 41° 53’ 02.9”, long 74° 07’ 10.9”, NAD 83
Town of Marbletown, Ulster County, N.Y.
Kingston West USGS 7.5’ Topographic Quadrangle
High-Water Marks: Four high-water marks were surveyed: two debris lines and two mud lines.
Photos and GPS readings were taken at each high-water mark. Field notes are filed at the USGS office in Troy, N.Y.
Marks were surveyed and photos taken by K.D. Metzker, C. J. Ostheimer, S.A. Vivian, and M.T. Whitehead on June 5, 2005.
High-water-mark elevations were surveyed from a benchmark that is an NGS standard disk stamped W 272 1942 that is 1.0 mile north along State Route 213 from the junction of Tongore Road, 0.3 mile north of a church, 48.7 feet west of the west corner of a red barn, 79 feet southwest of the centerline of the highway, in the top of a boulder, NGS PID LY0035. Elevation is 432.27 feet above NGVD 29. To convert to NAVD 88, subtract 0.74 feet from all elevations at this site.

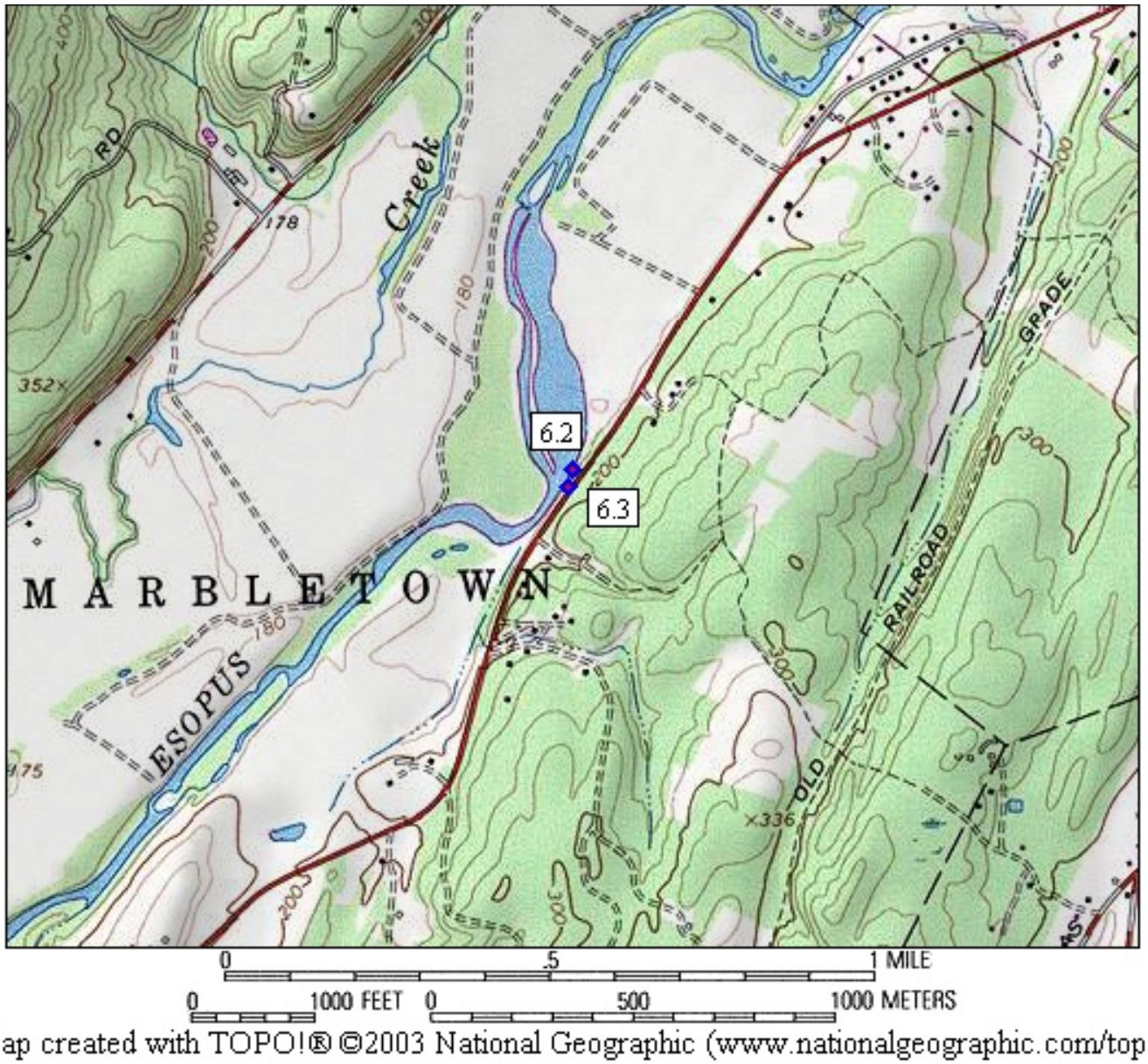


Kingston West quad map with location of site 5, Esopus Creek at Fording Place Road at Marbletown, N.Y.

High-water mark 5.1 is a good mud line about 2 feet above the ground, on farm equipment 150 feet upstream from scale house on Fording Place Road, on the left bank, 200 feet upstream from Fording Place Road, at elevation 188.93 feet above NGVD 29 (lat 41° 53’ 02.9”, long 74° 07’ 10.9”).

High-water mark 5.2 is a good mud line about 3 feet above the ground, on the downstream side of scale house on Fording Place Road, on the left bank, 30 feet upstream from Fording Place Road, at elevation 188.98 feet above NGVD 29 (lat 41° 53’ 03.8”, long 74° 07’ 09.2”).

SITE DESCRIPTION
Site 6: Esopus Creek at U.S. Route 209 near Marbletown, N.Y.
Site Location: U.S. Route 209, lat 41° 53’ 48.4”, long 74° 05’ 54.5”, NAD 83
Town of Marbletown, Ulster County, N.Y.
Kingston West USGS 7.5’ Topographic Quadrangle
High-Water Marks: Seven high-water marks were surveyed: six debris lines and one seed line.
Photos and GPS readings were taken at each high-water mark. Field notes are filed at the USGS office in Troy, N.Y.
Marks were surveyed and photos taken by K.D. Metzker, C. J. Ostheimer, S.A. Vivian, and M.T. Whitehead on June 7, 2005.
High-water-mark elevations were surveyed from a benchmark that is an NGS standard disk stamped W 272 1942 that is 1.0 mile north along State Route 213 from the junction of Tongore Road, 0.3 mile north of a church, 48.7 feet west of the west corner of a red barn, 79 feet southwest of the centerline of the highway, in the top of a boulder, NGS PID LY0035. Elevation is 432.27 feet above NGVD 29. To convert to NAVD 88, subtract 0.76 feet from all elevations at this site.

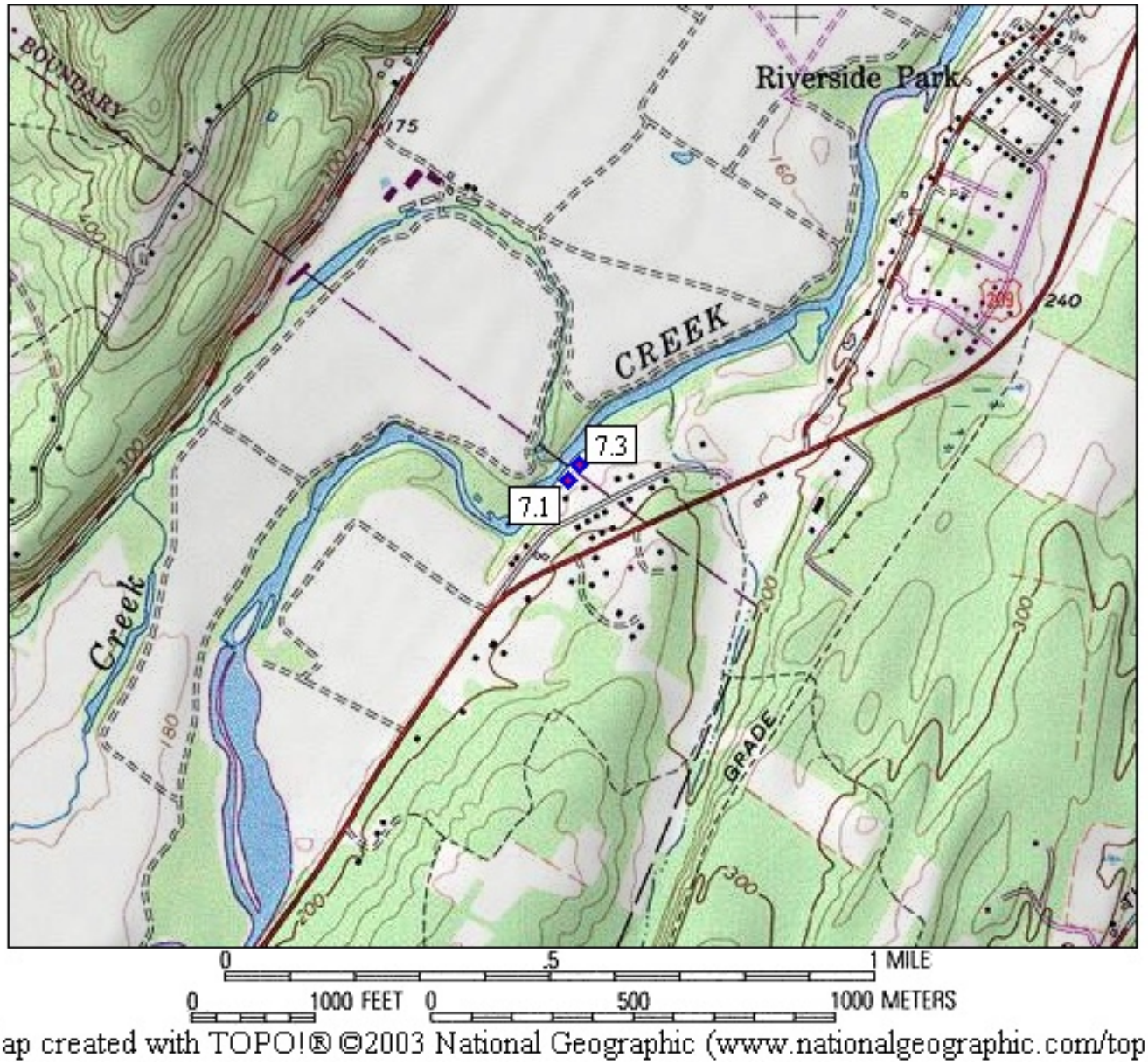


Kingston West quad map with location of site 6, Esopus Creek at U.S. Route 209 near Marbletown, N.Y.

High-water mark 6.2 is a good debris line about 2.5 feet above the ground, on a tree on the right bank, at elevation 176.87 feet above NGVD 29 (lat 41° 53’ 48.4”, long 74° 05’ 54.5”).

High-water mark 6.3 is a good seed line about 2.5 feet above the ground, on a tree on the right bank, at elevation 177.11 feet above NGVD 29 (lat 41° 53’ 47.8”, long 74° 05’ 54.5”).

SITE DESCRIPTION
Site 7: Esopus Creek at Creekside Road at Riverside Park, N.Y.
Site Location: Creekside Road, lat 41° 54’ 22.9”, long 74° 05’ 23.2”, NAD 83
Towns of Hurley and Marbletown, Ulster County, N.Y.
Kingston West USGS 7.5’ Topographic Quadrangle
High-Water Marks: Three high-water marks were surveyed: three debris lines.
Photos and GPS readings were taken at each high-water mark. Field notes are filed at the USGS office in Troy, N.Y.
Marks were surveyed and photos taken by K.D. Metzker and C. J. Ostheimer on June 5, 2005.
High-water-mark elevations were surveyed from a benchmark that is an NGS standard disk stamped W 272 1942 that is 1.0 mile north along State Route 213 from the junction of Tongore Road, 0.3 mile north of a church, 48.7 feet west of the west corner of a red barn, 79 feet southwest of the centerline of the highway, in the top of a boulder, NGS PID LY0035. Elevation is 432.27 feet above NGVD 29. To convert to NAVD 88, subtract 0.76 feet from all elevations at this site.

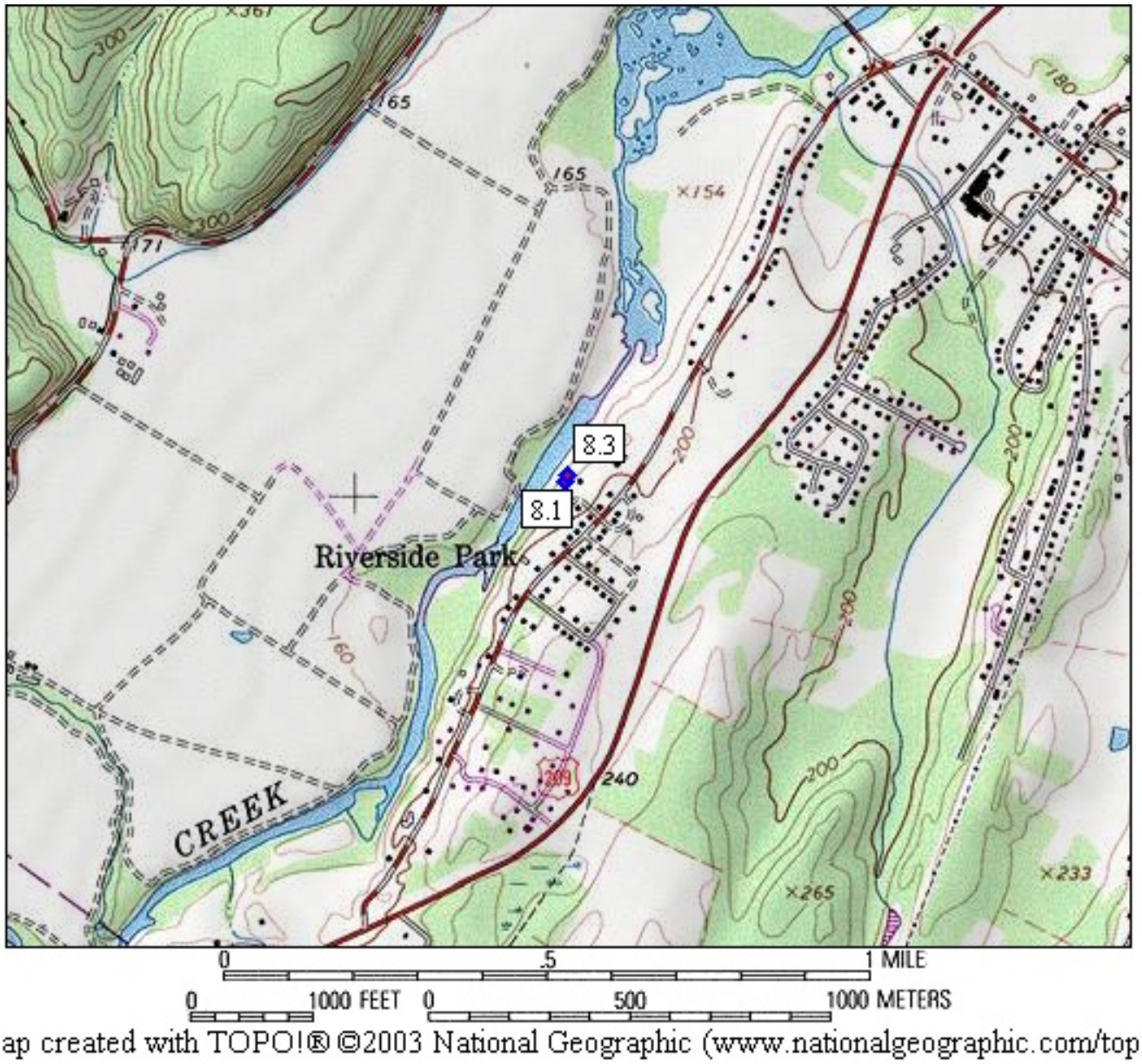


Kingston West quad map with location of site 7, Esopus Creek at Creekside Road at Riverside Park, N.Y.

High-water mark 7.1 is a fair debris line about 8 feet above the ground, on a tree on the right bank, 40 feet upstream and 110 feet streamward from house 606 on Creekside Road, at elevation 171.37 feet above NGVD 29 (lat 41° 54’ 22.9”, long 74° 05’ 23.2”).

High-water mark 7.3 is a fair debris line about 7 feet above the ground, on a tree on the right bank, 60 feet downstream and 130 feet streamward from house 606 on Creekside Road, at elevation 171.45 feet above NGVD 29 (lat 41° 54’ 23.8”, long 74° 05’ 21.9”).

SITE DESCRIPTION
Site 8: Esopus Creek at Riverside Avenue at Riverside Park, N.Y.
Site Location: Riverside Avenue, lat 41° 55’ 01.4”, long 74° 04’ 35.9”, NAD 83
Town of Hurley, Ulster County, N.Y.
Kingston West USGS 7.5’ Topographic Quadrangle
High-Water Marks: Three high-water marks were surveyed: three mud lines.
Photos and GPS readings were taken at each high-water mark. Field notes are filed at the USGS office in Troy, N.Y.
Marks were surveyed by S.A. Vivian and M.T. Whitehead on June 5, 2005, and photos were taken by G.D. Firda and B.J. Zatorsky on March 29, 2006.
High-water-mark elevations were surveyed from a benchmark that is an NGS standard disk stamped W 272 1942 that is 1.0 mile north along State Route 213 from the junction of Tongore Road, 0.3 mile north of a church, 48.7 feet west of the west corner of a red barn, 79 feet southwest of the centerline of the highway, in the top of a boulder, NGS PID LY0035. Elevation is 432.27 feet above NGVD 29. To convert to NAVD 88, subtract 0.77 feet from all elevations at this site.

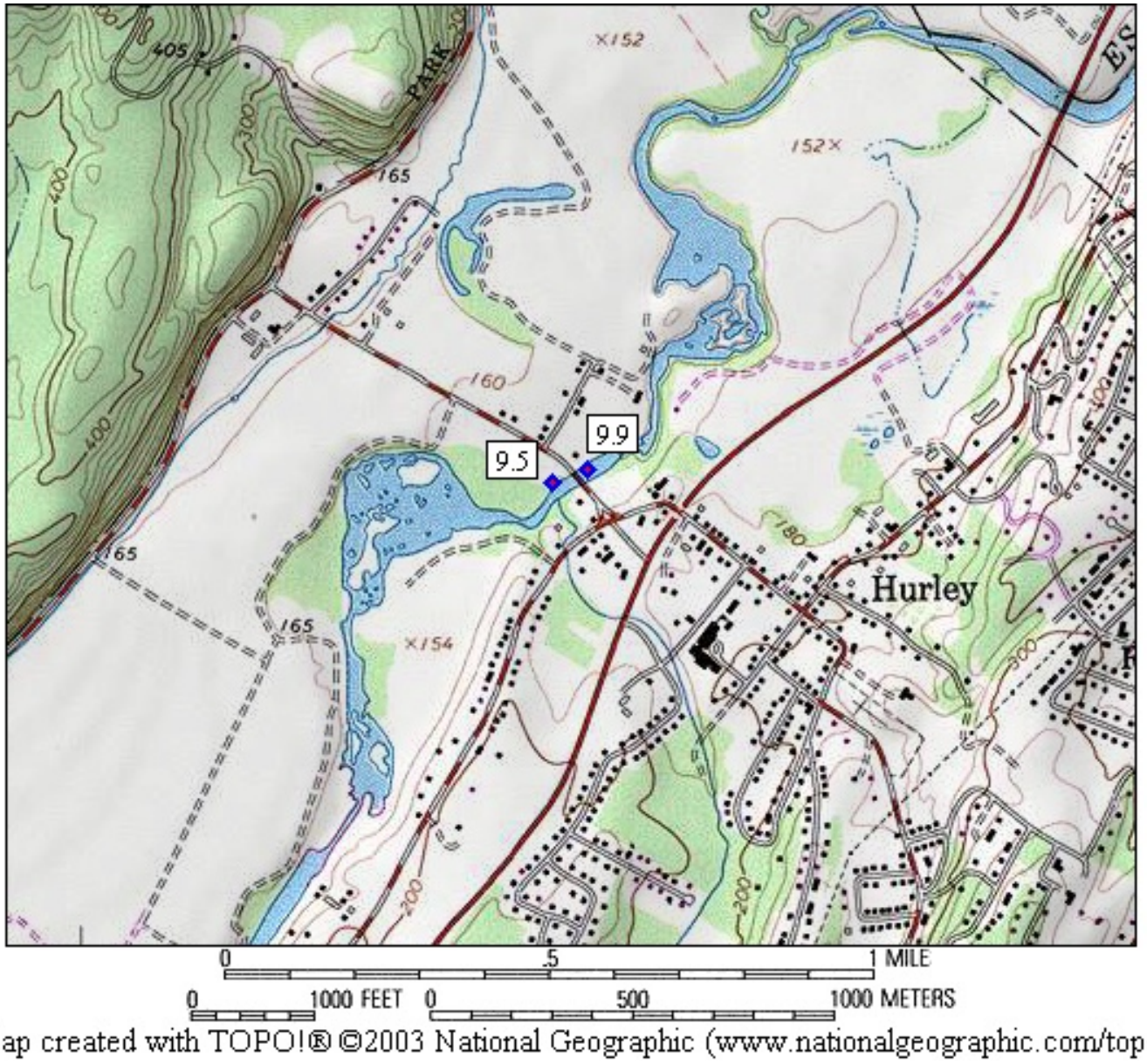


Kingston West quad map with location of site 8, Esopus Creek at Riverside Avenue at Riverside Park, N.Y.

High-water mark 8.1 is a good mud line about 2 feet above the ground, on the streamward side of house 103 on Riverside Avenue, on the right bank, at elevation 165.34 feet above NGVD 29 (lat 41° 55’ 01.4”, long 74° 04’ 35.9”).

High-water mark 8.3 is a fair mud line about 1 foot above the ground, on the streamward side of house 103 on Riverside Avenue, on the right bank, at elevation 165.07 feet above NGVD 29 (lat 41° 55’ 01.9”, long 74° 04’ 35.6”).

SITE DESCRIPTION
Site 9: Esopus Creek at County Route 29A (Wynkoop Road) at Hurley, N.Y.
Site Location: Bridge on County Route 29A, lat 41° 55’ 38.4”, long 74° 04’ 05.4”, NAD 83
Town of Hurley, Ulster County, N.Y.
Kingston West USGS 7.5’ Topographic Quadrangle
High-Water Marks: Ten high-water marks were surveyed: seven debris lines, two mud lines, and one seed line.
Photos and GPS readings were taken at each high-water mark. Field notes are filed at the USGS office in Troy, N.Y.
Marks were surveyed and photos taken by K.D. Metzker, C. J. Ostheimer, S.A. Vivian, and M.T. Whitehead on June 5, 2005.
High-water-mark elevations were surveyed from a benchmark that is an NGS standard disk stamped W 272 1942 that is 1.0 mile north along State Route 213 from the junction of Tongore Road, 0.3 mile north of a church, 48.7 feet west of the west corner of a red barn, 79 feet southwest of the centerline of the highway, in the top of a boulder, NGS PID LY0035. Elevation is 432.27 feet above NGVD 29. To convert to NAVD 88, subtract 0.78 feet from all elevations at this site.

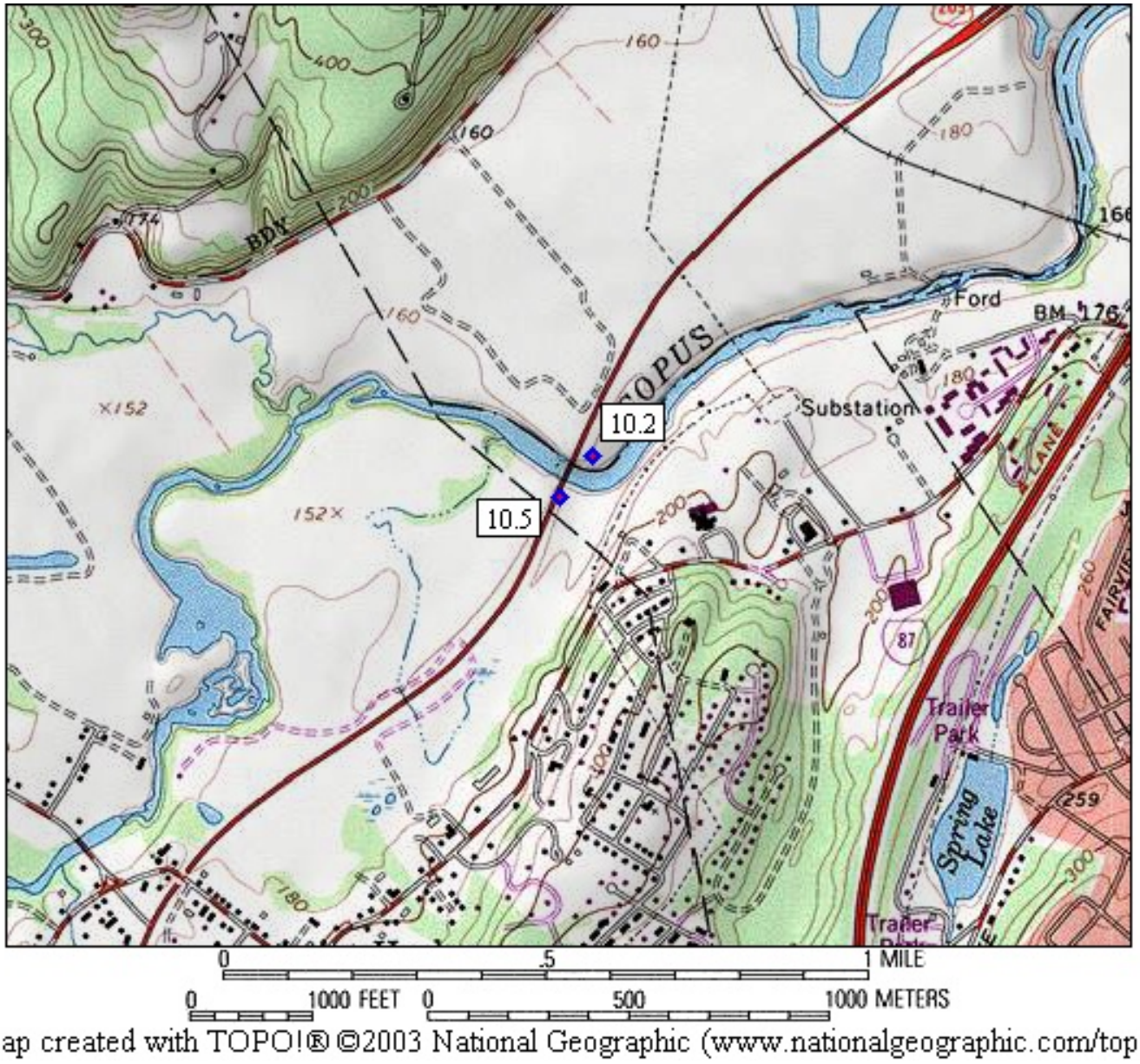


Kingston West quad map with location of site 9, Esopus Creek at County Route 29A (Wynkoop Road) at Hurley, N.Y.

High-water mark 9.5 is a fair debris line about 2.5 feet above the ground, on a tree on the left bank, 100 feet upstream from the County Route 29A bridge, at elevation 162.32 feet above NGVD 29 (lat 41° 55’ 37.7”, long 74° 04’ 07.8”).

High-water mark 9.9 is a good mud line about 2 feet above the ground, on the upstream side of a detached garage downstream of house 322 on County Route 29A, on the left bank, 150 feet downstream from the County Route 29A bridge, at elevation 161.59 feet above NGVD 29 (lat 41° 55’ 38.8”, long 74° 04’ 04.0”).

SITE DESCRIPTION
Site 10: Esopus Creek at U.S. Route 209 at Kingston, N.Y.
Site Location: Bridge on U.S. Route 209, lat 41° 56’ 08.4”, long 74° 03’ 12.6”, NAD 83
Town of Ulster, Ulster County, N.Y.
Kingston West USGS 7.5’ Topographic Quadrangle
High-Water Marks: Nine high-water marks were surveyed: seven debris lines and two seed lines.
Photos and GPS readings were taken at each high-water mark. Field notes are filed at the USGS office in Troy, N.Y.
Marks were surveyed and photos taken by K.D. Metzker, C. J. Ostheimer, S.A. Vivian, and M.T. Whitehead on June 5, 2005.
High-water-mark elevations were surveyed from a reference mark that is the top of the pier of the U.S. Route 209 bridge over Esopus Creek at this site. Elevation is 161.14 feet above NGVD 29, from NYS DOT bridge plans. To convert to NAVD 88, subtract 0.79 feet from all elevations at this site.

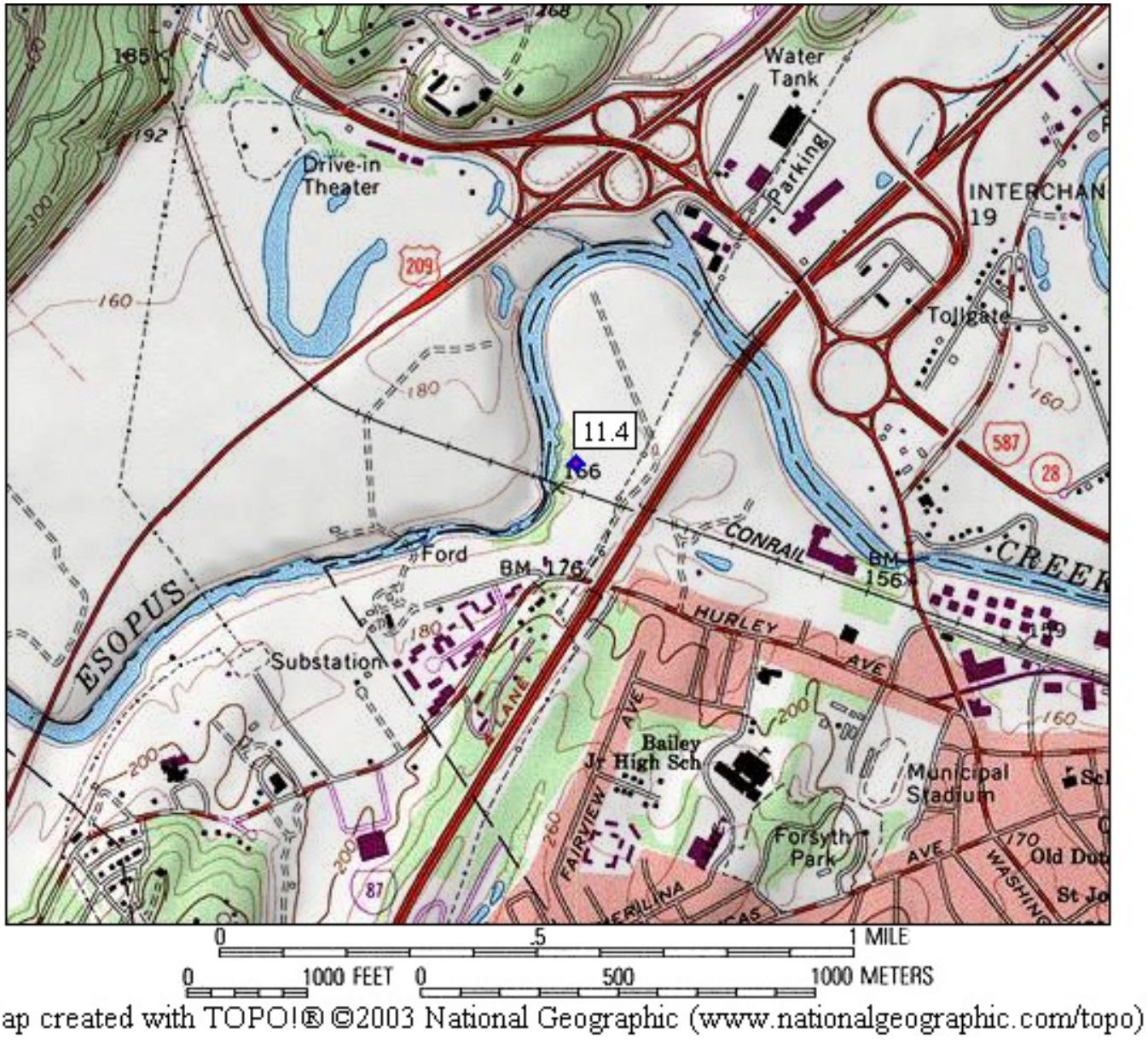


Kingston West quad map with location of site 10, Esopus Creek at U.S. Route 209 at Kingston, N.Y.

High-water mark 10.2 is a poor debris line on the ground, on the left bank, 50 feet downstream from the U.S. Route 209 bridge, at elevation 158.32 feet above NGVD 29 (lat 41° 56’ 09.3”, long 74° 03’ 11.0”).

High-water mark 10.5 is a poor seed line about 5 feet above the ground, on a tree on the right bank, 10 feet upstream from the U.S. Route 209 bridge, at elevation 159.93 feet above NGVD 29 (lat 41° 56’ 05.9”, long 74° 03’ 14.5”).

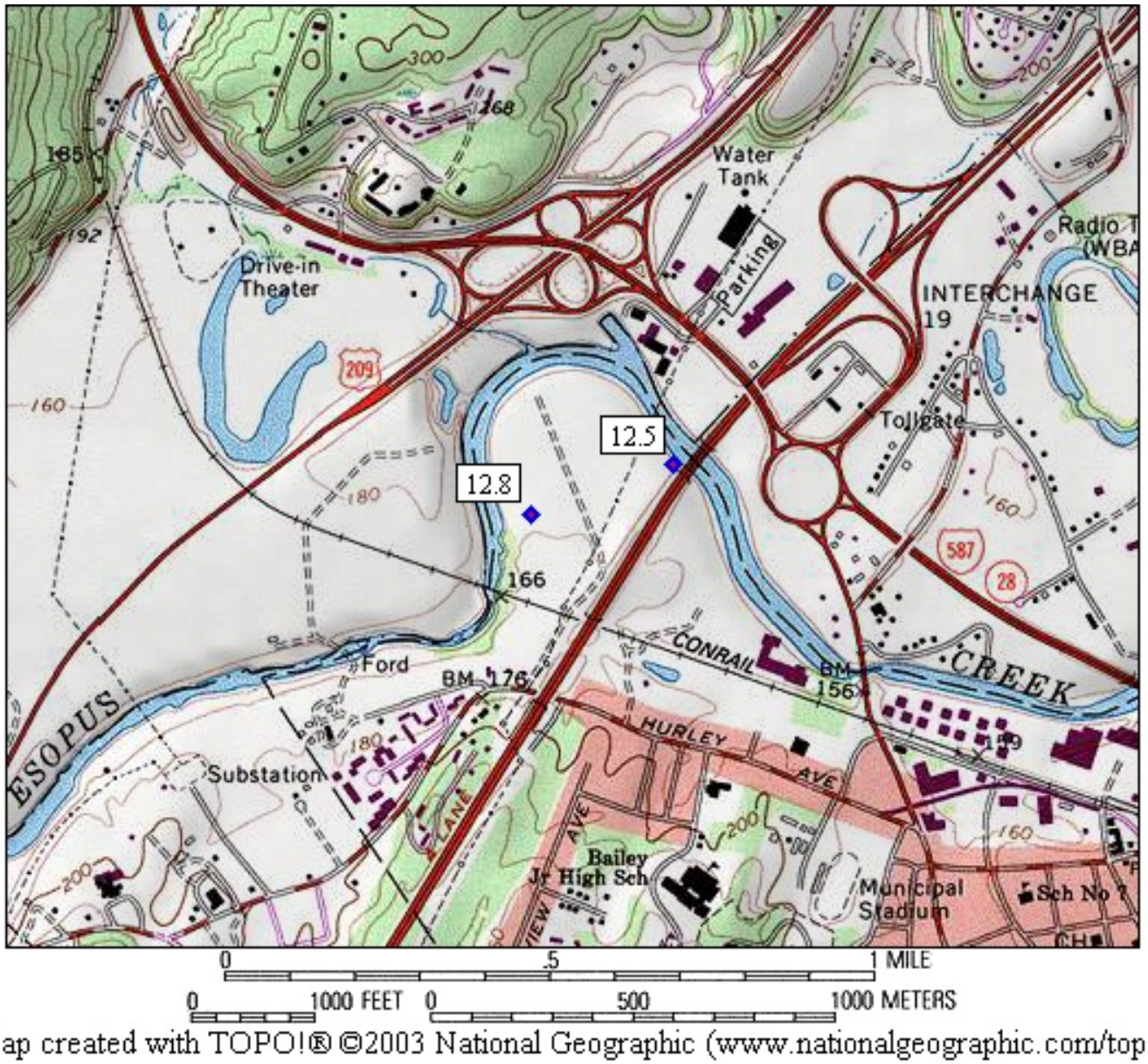
SITE DESCRIPTION
Site 11: Esopus Creek at Conrail Railroad at Kingston, N.Y.
Site Location: Bridge on Conrail Railroad, lat 41° 56’ 28.2”, long 74° 02’ 16.8”, NAD 83
City of Kingston, Town of Ulster, Ulster County, N.Y.
Kingston West USGS 7.5’ Topographic Quadrangle
High-Water Marks: Five high-water marks were surveyed: four debris lines and one seed line.
Photos and GPS readings were taken at each high-water mark. Field notes are filed at the USGS office in Troy, N.Y.
Marks were surveyed and photos taken by S.A. Vivian and M.T. Whitehead on June 4, 2005.
High-water-mark elevations were surveyed from a reference mark that is a chiseled square on the southwest corner of the northwest wingwall of the Leggs Mills Road bridge over Esopus Creek. This is RM 4 in the Town of Ulster FEMA flood-insurance study. Elevation is 157.07 feet above NGVD 29. To convert to NAVD 88, subtract 0.79 feet from all elevations at this site.



Kingston West quad map with location of site 11, Esopus Creek at Conrail Railroad at Kingston, N.Y.

High-water mark 11.4 is a poor debris line about 2 feet above the ground, on a tree on the right bank, 150 feet downstream from the Conrail Railroad bridge, at elevation 157.54 feet above NGVD 29 (lat 41^{o} 56’ 29.6”, long 74^{o} 02’ 14.7”).

SITE DESCRIPTION
Site 12: Esopus Creek at Interstate Route 87 (N.Y.S. Thruway) at Kingston, N.Y.
Site Location: Bridge on Interstate Route 87, lat 41° 56’ 39.0”, long 74° 01’ 54.6”, NAD 83
City of Kingston, Town of Ulster, Ulster County, N.Y.
Kingston West USGS 7.5’ Topographic Quadrangle
High-Water Marks: Eight high-water marks were surveyed: eight debris lines.
Photos and GPS readings were taken at each high-water mark. Field notes are filed at the USGS office in Troy, N.Y.
Marks were surveyed and photos taken by G.D. Firda and R. Lumia on June 20, 2005, L.T. Brooks and G.D. Firda on June 27, 2005, and G.D. Firda and B.J. Zatorsky on April 6, 2006.
High-water-mark elevations were surveyed from a benchmark that is a USGS chiseled square, 0.15 mile east along the Conrail Railroad from Washington Avenue, on a concrete foundation (formerly of a railroad signal), about midway along the south edge, about 2 yards north of the north rail, and about 1 foot higher than the top of the rails, NGS PID LY0215. Elevation is 158.87 feet above NGVD 1929. To convert to NAVD 88, subtract 0.79 feet from all elevations at this site.
Thalweg Elevation: 129.4 feet above NGVD 29.

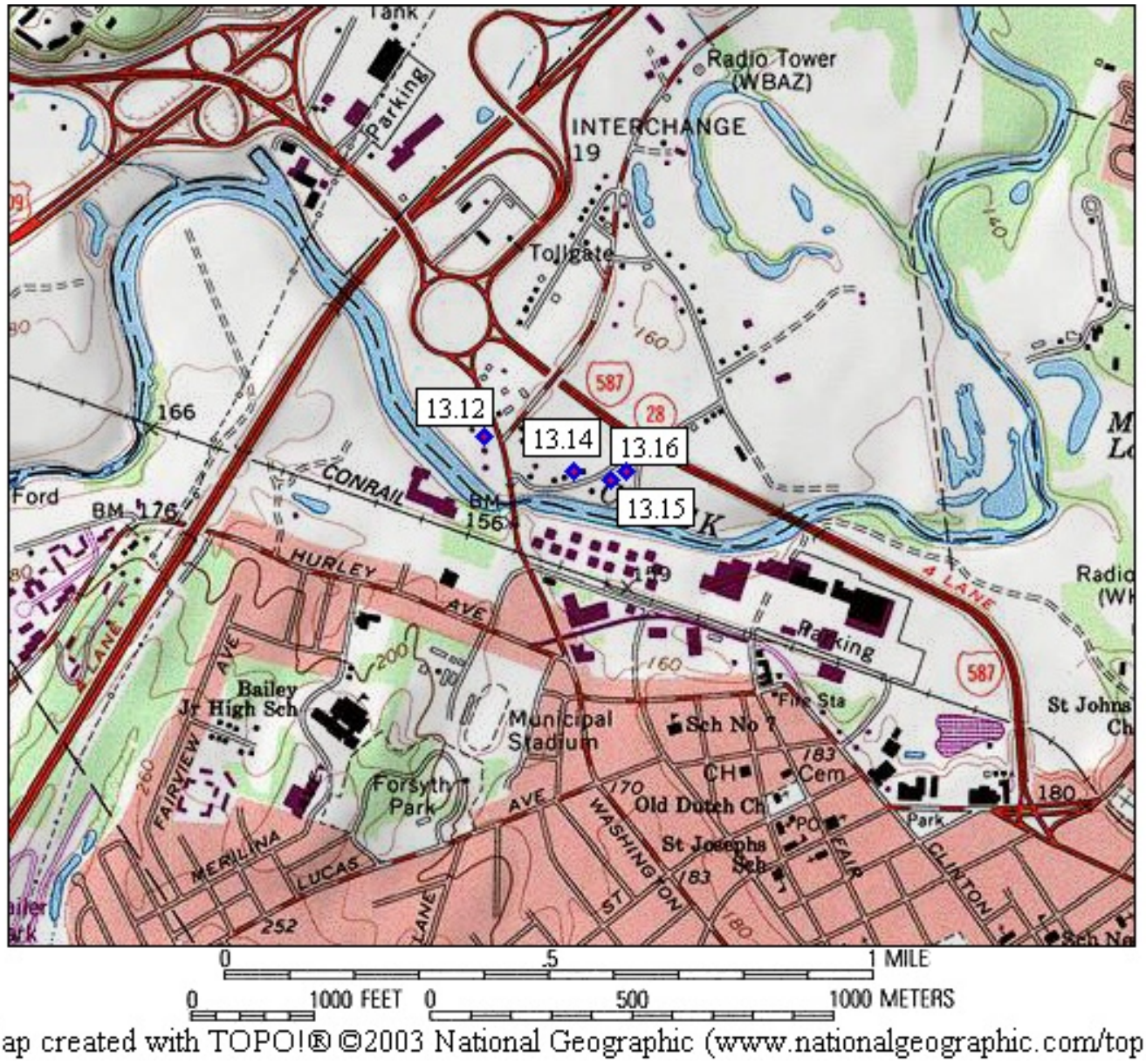


Kingston West quad map with location of site 12, Esopus Creek at Interstate Route 87 (N.Y.S. Thruway) at Kingston, N.Y.

High-water mark 12.5 is a fair debris line about 4 feet above the ground, on a tree on the right bank, 130 feet upstream from the Interstate Route 87 bridge, at elevation 155.00 feet above NGVD 29 (lat 41° 56’ 38.1”, long 74° 01’ 58.3”).

High-water mark 12.8 is a poor debris line on the ground, on the right bank, 1,015 feet upstream from the Interstate Route 87 bridge, at elevation 156.19 feet above NGVD 29 (lat 41° 56’ 34.1”, long 74° 02’ 13.5”).

SITE DESCRIPTION
Site 13: Esopus Creek at Washington Avenue at Kingston, N.Y.
Site Location: Bridge on Washington Avenue, lat 41° 56’ 21.6”, long 74° 01’ 36.6”, NAD 83
City of Kingston, Town of Ulster, Ulster County, N.Y.
Kingston West USGS 7.5’ Topographic Quadrangle
High-Water Marks: Sixteen high-water marks were surveyed: 13 debris lines, two seed lines, and one mud line.
Photos and GPS readings were taken at each high-water mark. Field notes are filed at the USGS office in Troy, N.Y.
Marks were surveyed and photos taken by G.D. Firda and R. Lumia on June 21 and 29, 2005, L.T. Brooks and G.D. Firda on June 27, 2005, and G.D. Firda and K. McGrath on March 28, 2006.
High-water-mark elevations were surveyed from a benchmark that is a USGS chiseled square, 0.15 mile east along the Conrail Railroad from Washington Avenue, on a concrete foundation (formerly of a railroad signal), about midway along the south edge, about 2 yards north of the north rail, and about 1 foot higher than the top of the rails, NGS PID LY0215. Elevation is 158.87 feet above NGVD 29. To convert to NAVD 88, subtract 0.79 feet from all elevations at this site.



Kingston West quad map with location of site 13, Esopus Creek at Washington Avenue at Kingston, N.Y.

High-water mark 13.12 is a fair debris line on the ground, on the left bank, 15 feet landward from the Szymkowicz Service Inc. parking lot, and 180 feet upstream from the Washington Avenue bridge, at elevation 154.51 feet above NGVD 29 (lat 41° 56’ 26.9”, long 74° 01’ 40.8”).

High-water mark 13.14 is an excellent mud line about 4 feet above the ground, on the streamward side of building 15 on Sandy Road, on the left bank, 415 feet downstream from the Washington Avenue bridge, at elevation 154.16 feet above NGVD 29 (lat 41° 56’ 24.0”, long 74° 01’ 31.1”).

High-water mark 13.15 is an excellent seed line about 5 feet above the ground, on the landward side of a detached garage upstream from house 32 on Sandy Road, on the left bank, 715 feet downstream from the Washington Avenue bridge, at elevation 154.10 feet above NGVD 29 (lat 41° 56’ 23.4”, long 74° 01’ 27.1”).

High-water mark 13.16 is an excellent seed line about 5.5 feet above the ground, on the upstream side of house 42 on Sandy Road, on the left bank, 830 feet downstream from the Washington Avenue bridge, at elevation 154.04 feet above NGVD 29 (lat 41° 56’ 24.1”, long 74° 01’ 25.6”).

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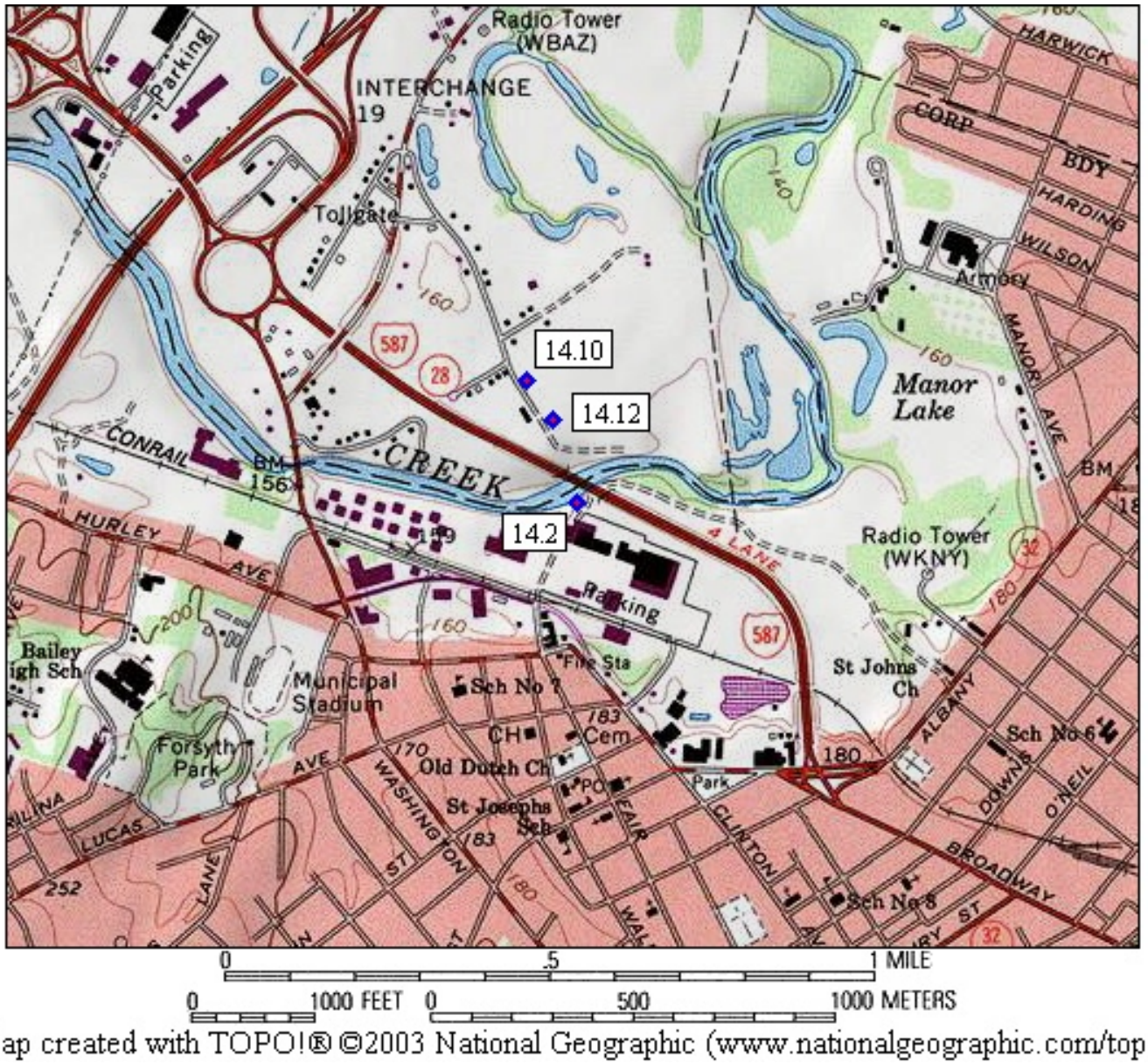
SITE DESCRIPTION
Site 14: Esopus Creek at Interstate Route 587 and State Route 28 at Kingston, N.Y.
Site Location: Bridge on Interstate Route 587 and State Route 28, lat 41° 56’ 19.8”, long 74° 01’ 06.0”, NAD 83
City of Kingston, Town of Ulster, Ulster County, N.Y.
Kingston West USGS 7.5’ Topographic Quadrangle
High-Water Marks: Twelve high-water marks were surveyed: five debris lines, three mud lines, three seed lines, and one wash line.
Photos and GPS readings were taken at each high-water mark. Field notes are filed at the USGS office in Troy, N.Y.
Marks were surveyed and photos taken by G.D. Firda and R. Lumia on June 23 and July 20, 2005.
High-water-mark elevations were surveyed from a benchmark that is a USGS chiseled square, 0.15 mile east along the Conrail Railroad from Washington Avenue, on a concrete foundation (formerly of a railroad signal), about midway along the south edge, about 2 yards north of the north rail, and about 1 foot higher than the top of the rails, NGS PID LY0215. Elevation is 158.87 feet above NGVD 29. To convert to NAVD 88, subtract 0.79 feet from all elevations at this site.



Kingston West quad map with location of site 14, Esopus Creek at Interstate Route 587 and State Route 28 at Kingston, N.Y.

High-water mark 14.2 is an excellent mud line about 6.5 feet above the ground, on the streamward side of flood wall (3.5 feet below top), on the right bank, 160 feet upstream from the Interstate Route 587 and State Route 28 bridge, at elevation 153.46 feet above NGVD 29 (lat 41° 56’ 18.4”, long 74° 01’ 07.7”).

High-water mark 14.10 is a good mud line about 6.5 feet above the ground, on the streamward side of a detached garage landward from house 8 on Weidy Road, on the left bank, 450 feet downstream from the Interstate Route 587 and State Route 28 bridge, at elevation 152.68 feet above NGVD 29 (lat 41° 56’ 28.4”, long 74° 01’ 13.0”).

High-water mark 14.12 is an excellent seed line about 1.5 feet above the ground, on the downstream side of the Ulster County Society for the Prevention of Cruelty to Animals downstream barnyard fence, on the left bank, 260 feet downstream from the Interstate Route 587 and State Route 28 bridge, at elevation 152.65 feet above NGVD 29 (lat 41° 56’ 25.1”, long 74° 01’ 10.3”).

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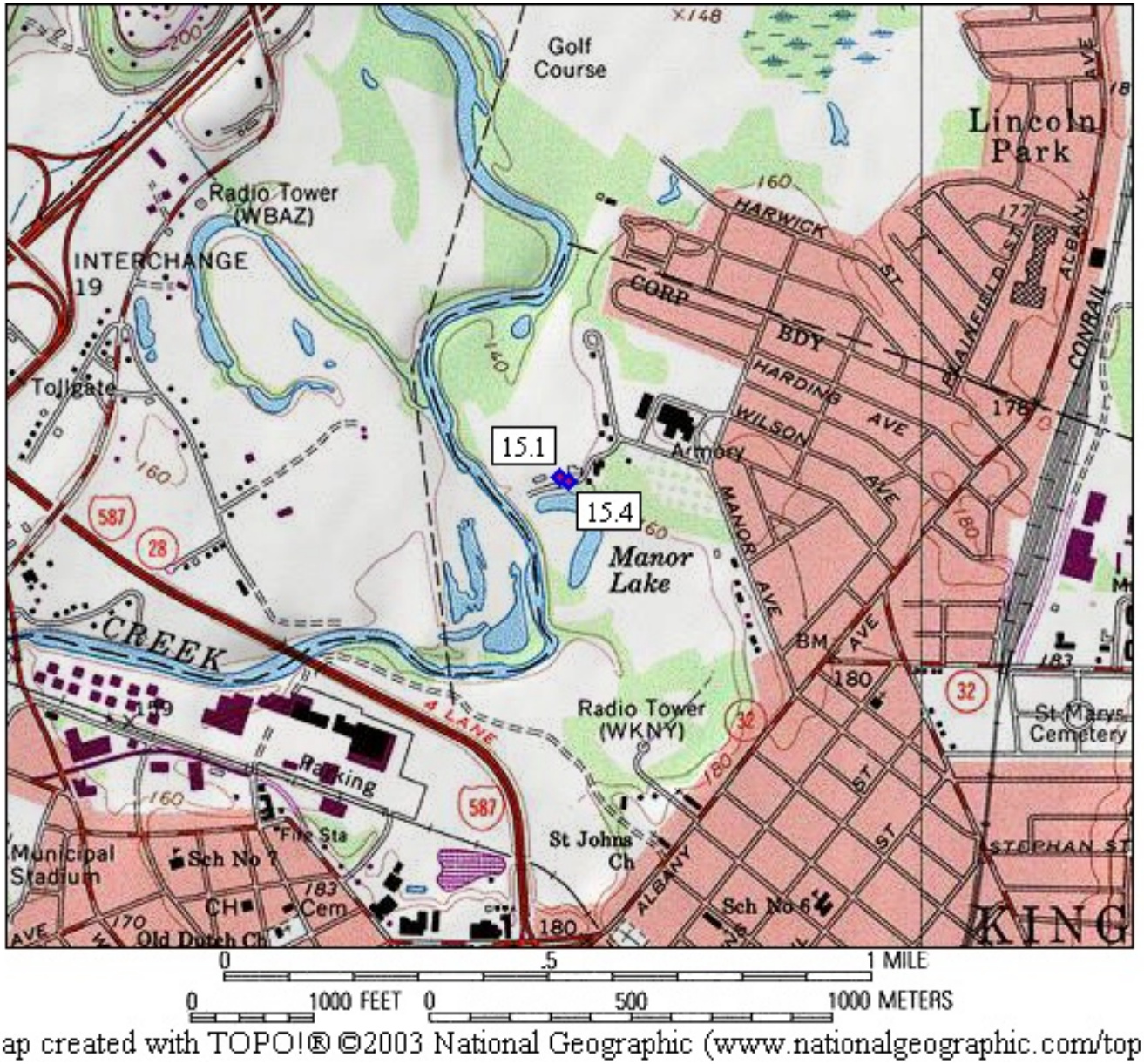
SITE DESCRIPTION
Site 15: Esopus Creek at Manor Lake at Kingston, N.Y.
Site Location: Manor Lake, lat 41° 56’ 34.5”, long 74° 00’ 38.9”, NAD 83
City of Kingston, Town of Ulster, Ulster County, N.Y.
Kingston West USGS 7.5’ Topographic Quadrangle
High-Water Marks: Four high-water marks were surveyed: two debris lines and two mud lines.
Photos and GPS readings were taken at each high-water mark. Field notes are filed at the USGS office in Troy, N.Y.
Marks were surveyed and photos taken by K.D. Metzker and C. J. Ostheimer on June 4, 2005.
High-water-mark elevations were surveyed from a reference mark that is a chiseled square on the southwest corner of the northwest wingwall of the Leggs Mills Road bridge over Esopus Creek. This is RM 4 in the Town of Ulster FEMA flood-insurance study. Elevation is 157.07 feet above NGVD 29. To convert to NAVD 88, subtract 0.80 feet from all elevations at this site.

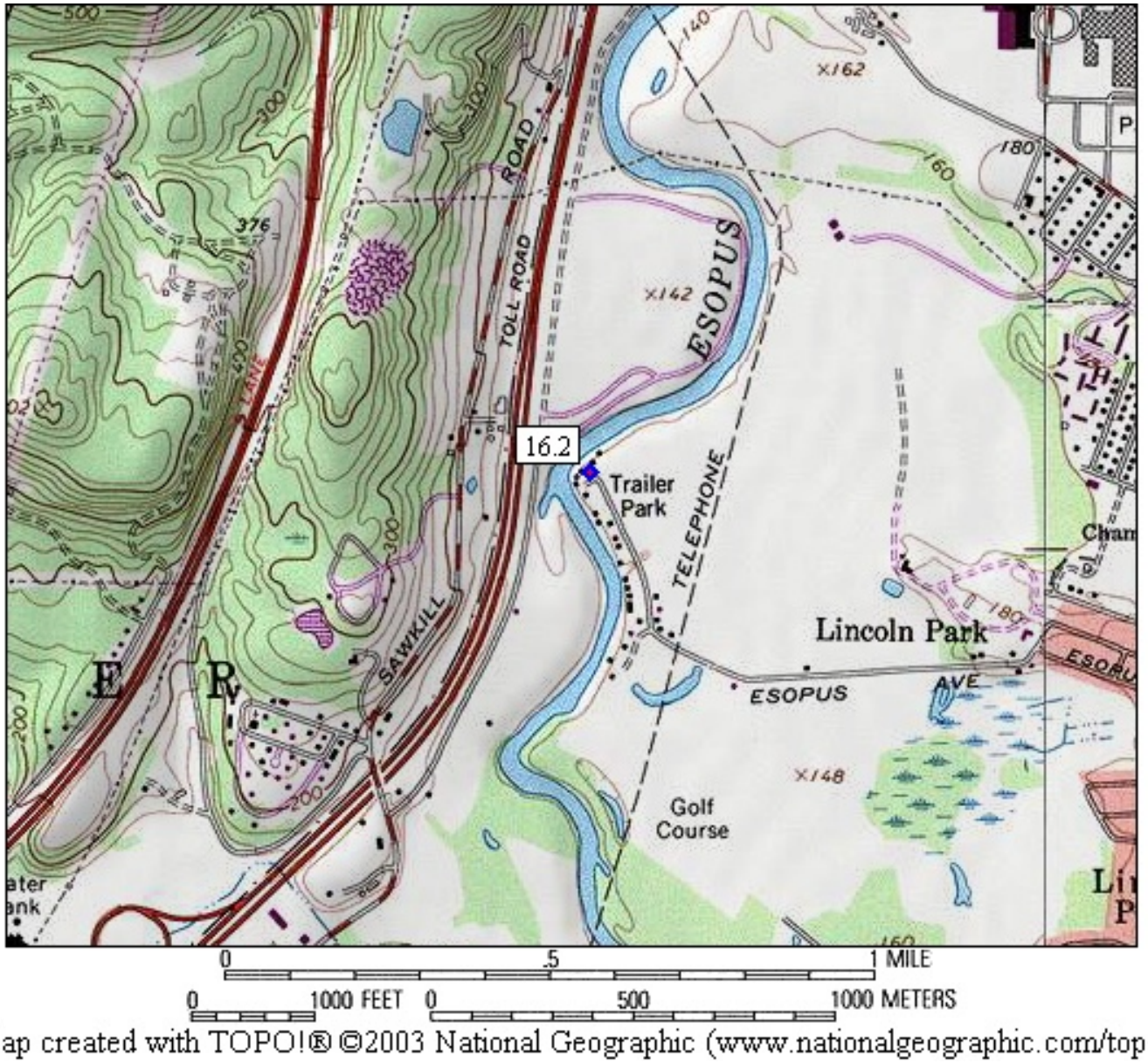


Kingston West quad map with location of site 15, Esopus Creek at Manor Lake at Kingston, N.Y.

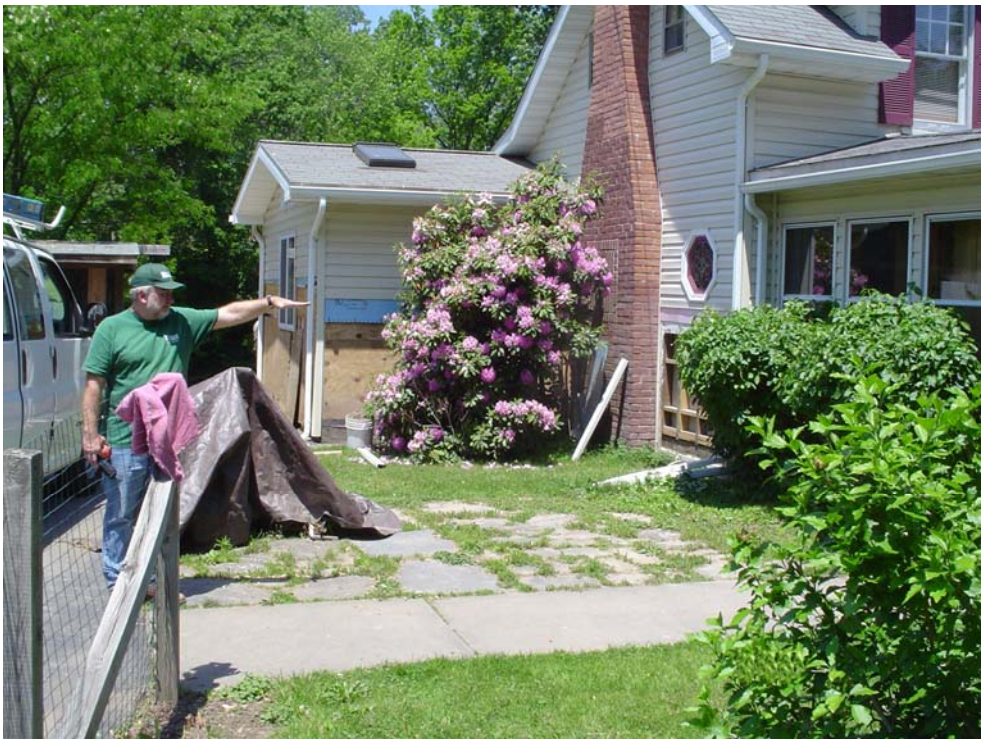
High-water mark 15.1 is a fair debris line about 3 feet above the ground, on a tree on the right bank, streamward of house 406 on Manor Lake, 20 feet downstream from Manor Lake, at elevation 152.76 feet above NGVD 29 (lat 41° 56’ 34.5”, long 74° 00’ 38.9”).

High-water mark 15.4 is a good mud line about 4 feet above the ground, on the downstream side of a storage shed streamward of house 406 on Manor Lake, on the right bank, 20 feet upstream from Manor Lake, at elevation 152.87 feet above NGVD 29 (lat 41° 56’ 34.0”, long 74° 00’ 38.0”).

SITE DESCRIPTION
Site 16: Esopus Creek at Buckley Street at Kingston, N.Y.
Site Location: Buckley Street, lat 41° 57’ 36.2”, long 74° 00’ 48.8”, NAD 83
Town of Ulster, Ulster County, N.Y.
Kingston West USGS 7.5’ Topographic Quadrangle
High-Water Marks: Two high-water marks were surveyed: two mud lines.
Photos and GPS readings were taken at each high-water mark. Field notes are filed at the USGS office in Troy, N.Y.
Marks were surveyed and photos taken by S.A. Vivian and M.T. Whitehead on June 3, 2005.
High-water-mark elevations were surveyed from a reference mark that is a chiseled square on the southwest corner of the northwest wingwall of the Leggs Mills Road bridge over Esopus Creek. This is RM 4 in the Town of Ulster FEMA flood-insurance study. Elevation is 157.07 feet above NGVD 29. To convert to NAVD 88, subtract 0.79 feet from all elevations at this site.

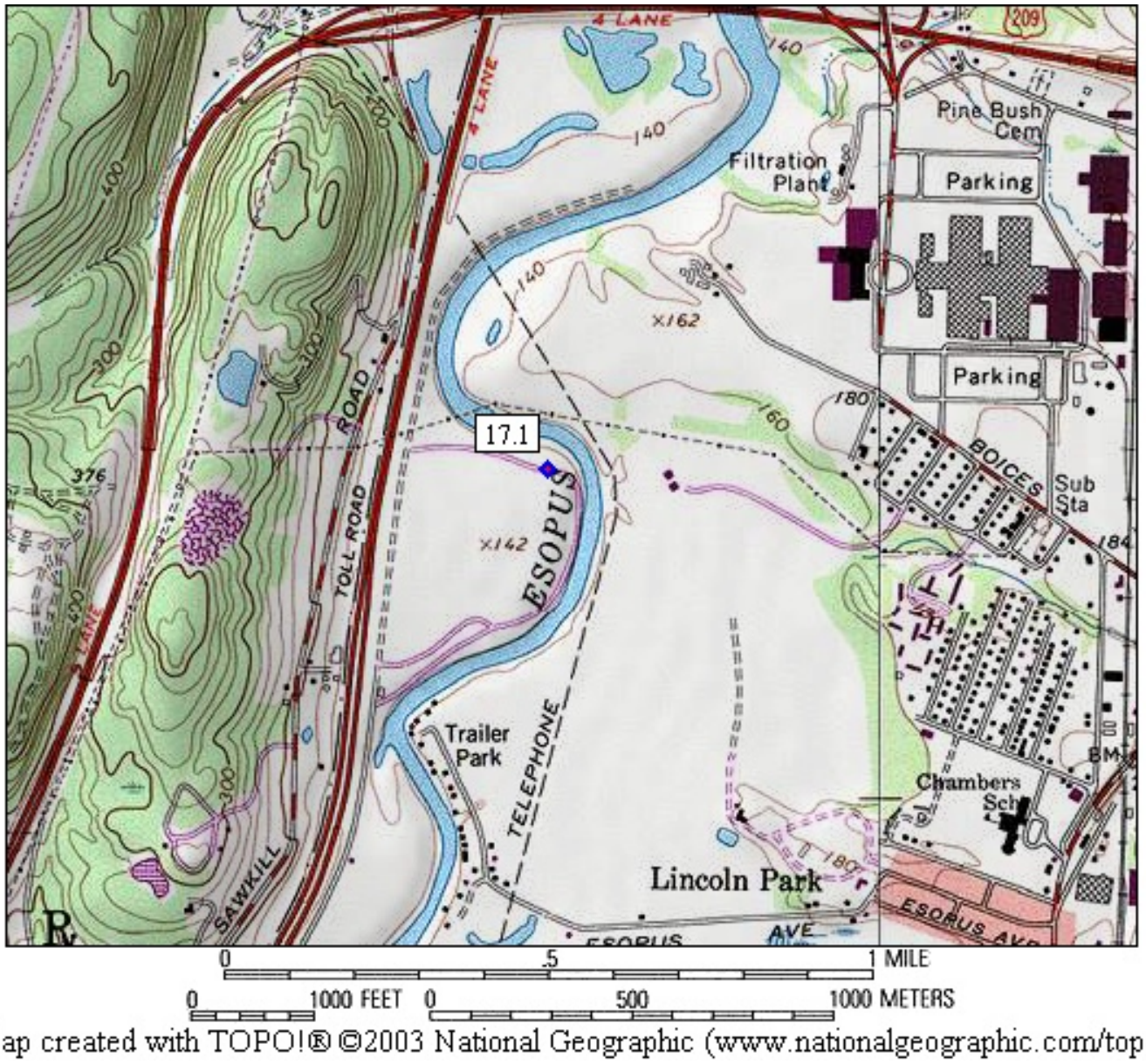


Kingston West quad map with location of site 16, Esopus Creek at Buckley Street at Kingston, N.Y.



High-water mark 16.2 is an excellent mud line about 5 feet above the ground, on the landward side of house 48 on Buckley Street, on the right bank, at elevation 151.16 feet above NGVD 29 (lat 41° 57’ 36.2”, long 74° 00’ 48.8”).

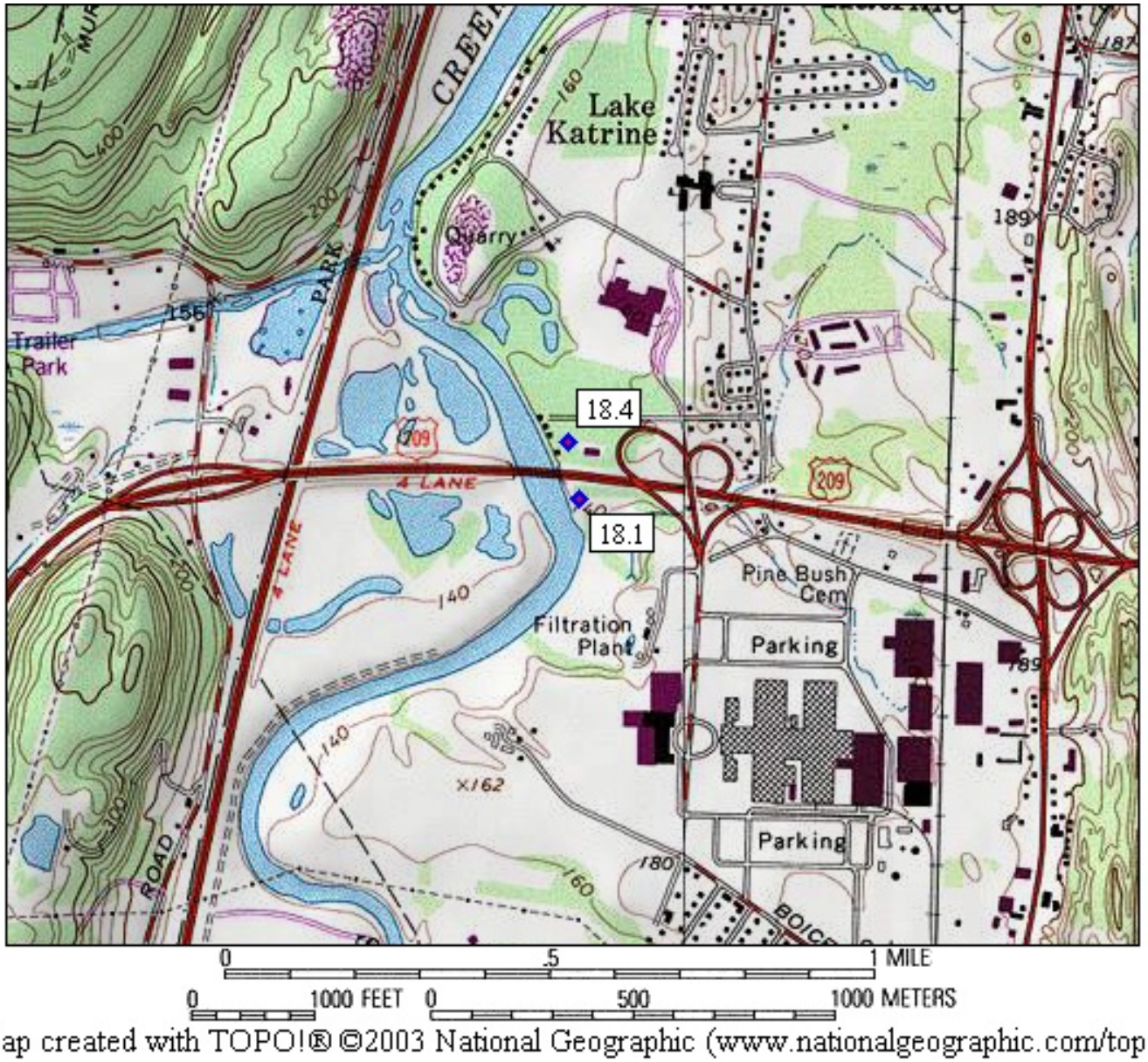
SITE DESCRIPTION
Site 17: Esopus Creek at Farm To Market Road at Kingston, N.Y.
Site Location: Farm To Market Road, lat 41° 57’ 56.7”, long 74° 00’ 35.5”, NAD 83
Town of Ulster, Ulster County, N.Y.
Kingston West USGS 7.5’ Topographic Quadrangle
High-Water Marks: Two high-water marks were surveyed: two mud lines.
Photos and GPS readings were taken at each high-water mark. Field notes are filed at the USGS office in Troy, N.Y.
Marks were surveyed by S.A. Vivian and M.T. Whitehead on June 4, 2005, and photos were taken by G.D. Firda and K. McGrath on March 28, 2006.
High-water-mark elevations were surveyed from a reference mark that is a chiseled square on the southwest corner of the northwest wingwall of the Leggs Mills Road bridge over Esopus Creek. This is RM 4 in the Town of Ulster FEMA flood-insurance study. Elevation is 157.07 feet above NGVD 29. To convert to NAVD 88, subtract 0.79 feet from all elevations at this site.



Kingston West quad map with location of site 17, Esopus Creek at Farm To Market Road at Kingston, N.Y.

High-water mark 17.1 is an excellent mud line about 5 feet above the ground, on the streamward side of house 58 on Farm To Market Road, on the left bank, at elevation 150.02 feet above NGVD 29 (lat 41° 57’ 56.7”, long 74° 00’ 35.5”). No photos were taken of high-water mark 17.1. Photo of excellent seed line about 4.5 feet above the ground on upstream side of nearby well house.

SITE DESCRIPTION
Site 18: Esopus Creek at U.S. Route 209 at Lake Katrine, N.Y.
Site Location: Bridge on U.S. Route 209, lat 41° 58’ 34.2”, long 74° 00’ 14.4”, NAD 83
Town of Ulster, Ulster County, N.Y.
Kingston West USGS 7.5’ Topographic Quadrangle
High-Water Marks: Six high-water marks were surveyed: four mud lines and two debris lines.
Photos and GPS readings were taken at each high-water mark. Field notes are filed at the USGS office in Troy, N.Y.
Marks were surveyed and photos taken by K.D. Metzker and C. J. Ostheimer on June 4, 2005.
High-water-mark elevations were surveyed from a reference mark that is a chiseled square on the southwest corner of the northwest wingwall of the Leggs Mills Road bridge over Esopus Creek. This is RM 4 in the Town of Ulster FEMA flood-insurance study. Elevation is 157.07 feet above NGVD 29. To convert to NAVD 88, subtract 0.79 feet from all elevations at this site.

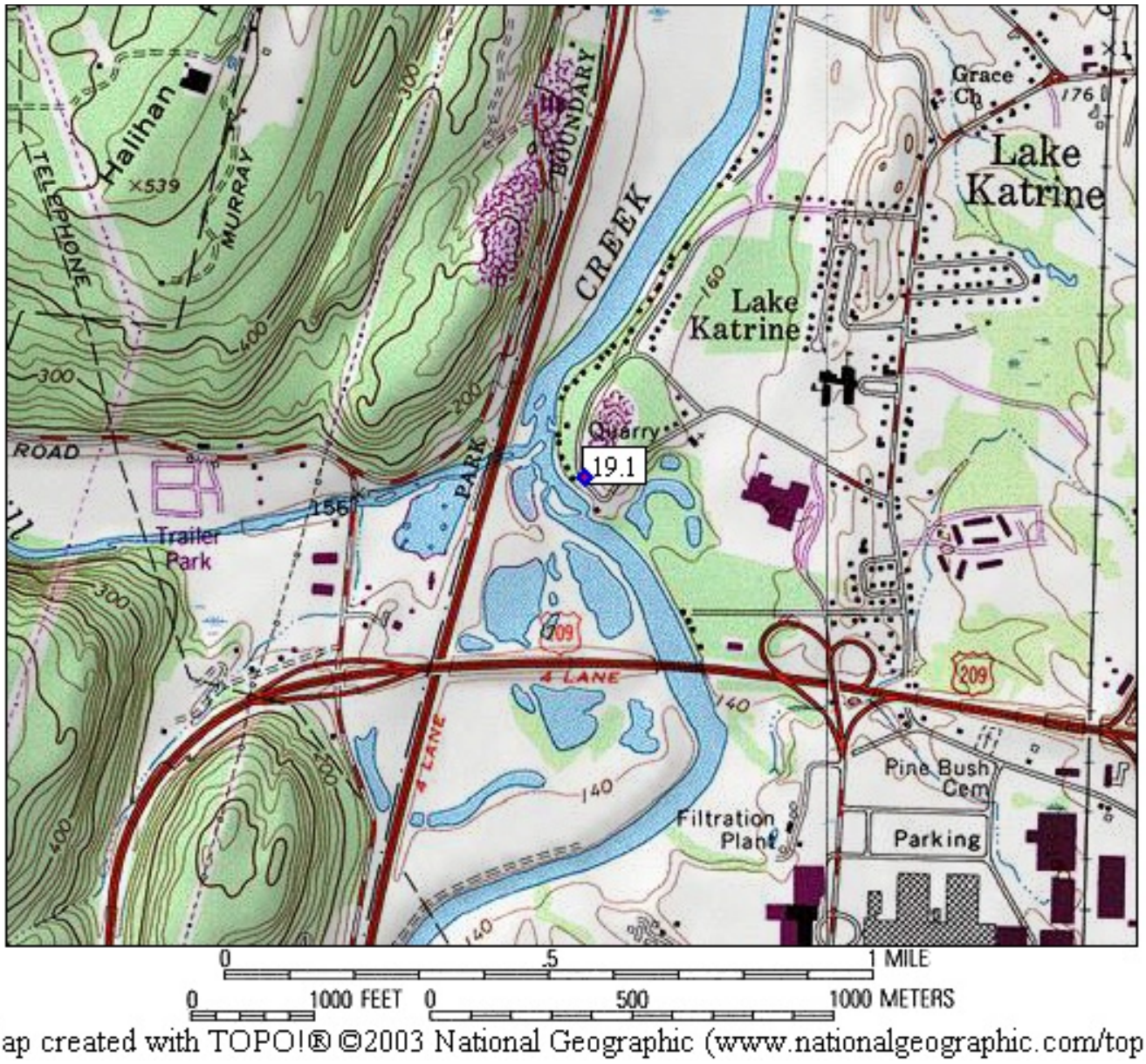


Kingston West quad map with location of site 18, Esopus Creek at U.S. Route 209 at Lake Katrine, N.Y.

High-water mark 18.1 is a fair debris line on the ground, on the right bank, 150 feet upstream from the U.S. Route 209 bridge, at elevation 147.11 feet above NGVD 29 (lat 41° 58’ 31.6”, long 74° 00’ 11.1”).

High-water mark 18.4 is an excellent mud line about 3.5 feet above the ground, on the landward side of a detached garage landward from house 18 on Mulvin Drive, on the right bank, 250 feet downstream from the U.S. Route 209 bridge, at elevation 146.76 feet above NGVD 29 (lat 41° 58’ 36.3”, long 74° 00’ 12.3”).

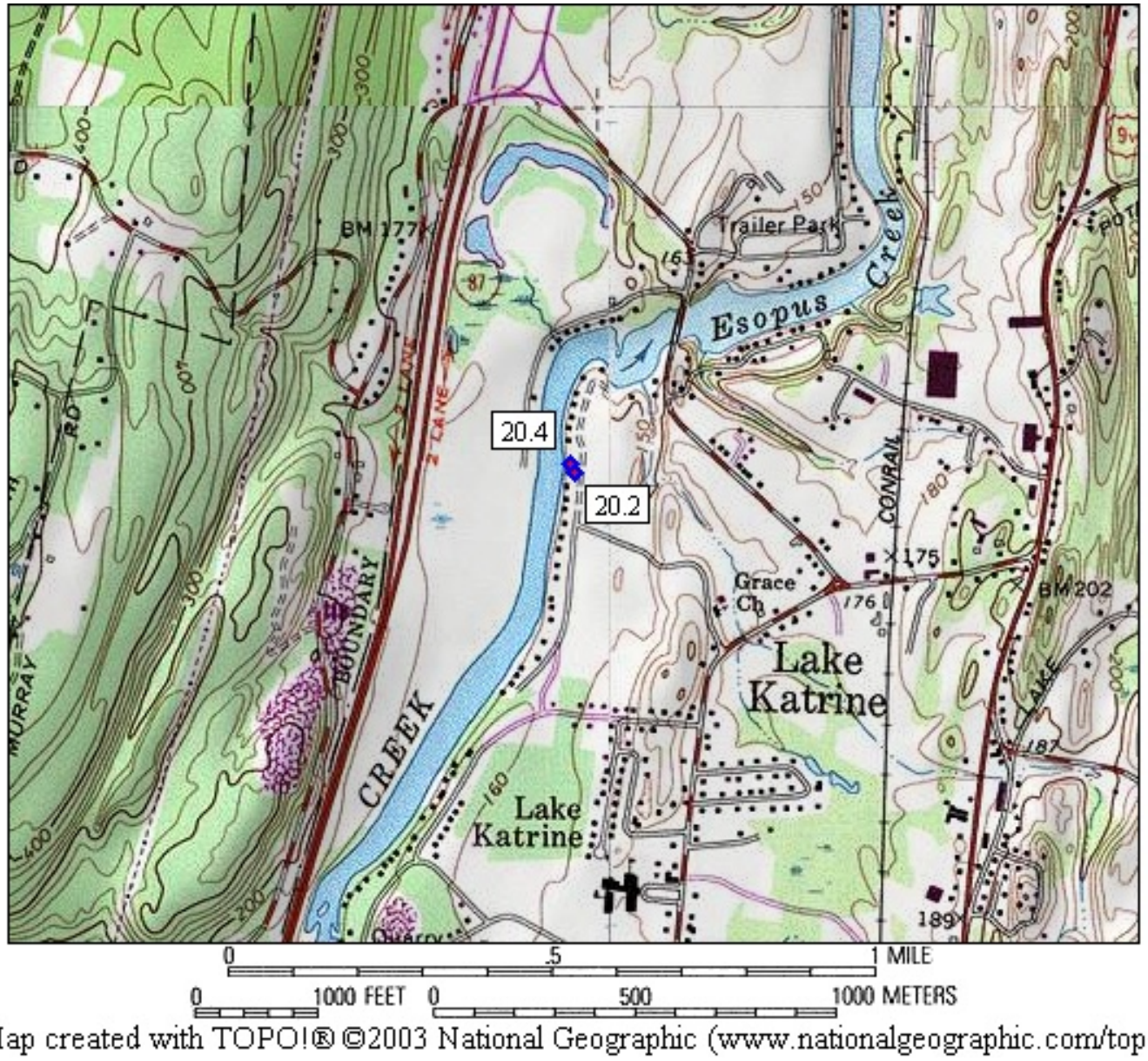
SITE DESCRIPTION
Site 19: Esopus Creek at Parish Lane at Lake Katrine, N.Y.
Site Location: Parish Lane, lat 41° 58’ 49.1”, long 74° 00’ 25.9”, NAD 83
Town of Ulster, Ulster County, N.Y.
Kingston West USGS 7.5’ Topographic Quadrangle
High-Water Marks: Two high-water marks were surveyed: two mud lines.
Photos and GPS readings were taken at each high-water mark. Field notes are filed at the USGS office in Troy, N.Y.
Marks were surveyed and photos taken by K.D. Metzker and M.T. Whitehead on June 3, 2005.
High-water-mark elevations were surveyed from a reference mark that is a chiseled square on the southwest corner of the northwest wingwall of the Leggs Mills Road bridge over Esopus Creek. This is RM 4 in the Town of Ulster FEMA flood-insurance study. Elevation is 157.07 feet above NGVD 29. To convert to NAVD 88, subtract 0.79 feet from all elevations at this site.



Kingston West quad map with location of site 19, Esopus Creek at Parish Lane at Lake Katrine, N.Y.

High-water mark 19.1 is an excellent mud line about 3 feet above the ground, on the downstream side of house 132 on Parish Lane, on the right bank, at elevation 146.28 feet above NGVD 29 (lat 41° 58’ 49.1”, long 74° 00’ 25.9”).

SITE DESCRIPTION
Site 20: Esopus Creek at Sawmill Road at Lake Katrine, N.Y.
Site Location: Sawmill Road, lat 41° 59’ 30.5”, long 74° 00’ 03.5”, NAD 83
Town of Ulster, Ulster County, N.Y.
Kingston West USGS 7.5’ Topographic Quadrangle
High-Water Marks: Four high-water marks were surveyed: three debris lines and one wash line.
Photos and GPS readings were taken at each high-water mark. Field notes are filed at the USGS office in Troy, N.Y.
Marks were surveyed and photos taken by C. J. Ostheimer and S.A. Vivian on June 3, 2005.
High-water-mark elevations were surveyed from a reference mark that is a chiseled square on the southwest corner of the northwest wingwall of the Leggs Mills Road bridge over Esopus Creek. This is RM 4 in the Town of Ulster FEMA flood-insurance study. Elevation is 157.07 feet above NGVD 29. To convert to NAVD 88, subtract 0.79 feet from all elevations at this site.



Kingston West quad map with location of site 20, Esopus Creek at Sawmill Road at Lake Katrine, N.Y.

High-water mark 20.2 is a fair debris line about 1 foot above the ground, on a tree on the right bank, streamward from house 182 on Sawmill Road, at elevation 142.17 feet above NGVD 29 (lat 41° 59’ 30.5”, long 74° 00’ 03.5”).

High-water mark 20.4 is a fair debris line on the ground, on the right bank, streamward from house 174 on Sawmill Road, at elevation 141.85 feet above NGVD 29 (lat 41° 59’ 31.2”, long 74° 00’ 04.1”).

SITE DESCRIPTION
Site 21: Esopus Creek at Leggs Mills Road at Lake Katrine, N.Y.
Site Location: Bridge on Leggs Mills Road, lat 41° 59’ 42.0”, long 73° 59’ 50.4”, NAD 83
Town of Ulster, Ulster County, N.Y.
Kingston East USGS 7.5’ Topographic Quadrangle
High-Water Marks: Nine high-water marks were surveyed: eight debris lines and one seed line.
Photos and GPS readings were taken at each high-water mark. Field notes are filed at the USGS office in Troy, N.Y.
Marks were surveyed and photos taken by K.D. Metzker, C. J. Ostheimer, S.A. Vivian, and M.T. Whitehead on June 3, 2005.
High-water-mark elevations were surveyed from a reference mark that is a chiseled square on the southwest corner of the northwest wingwall of the Leggs Mills Road bridge over Esopus Creek. This is RM 4 in the Town of Ulster FEMA flood-insurance study. Elevation is 157.07 feet above NGVD 29. To convert to NAVD 88, subtract 0.79 feet from all elevations at this site.

Kingston East quad map with location of site 21, Esopus Creek at Leggs Mills Road at Lake Katrine, N.Y.

High-water mark 21.2 is a good debris line about 2 feet above the ground, on a tree on the left bank, 370 feet upstream from the Leggs Mills Road bridge, at elevation 141.46 feet above NGVD 29 (lat 41° 59’ 42.4”, long 73° 59’ 56.5”).

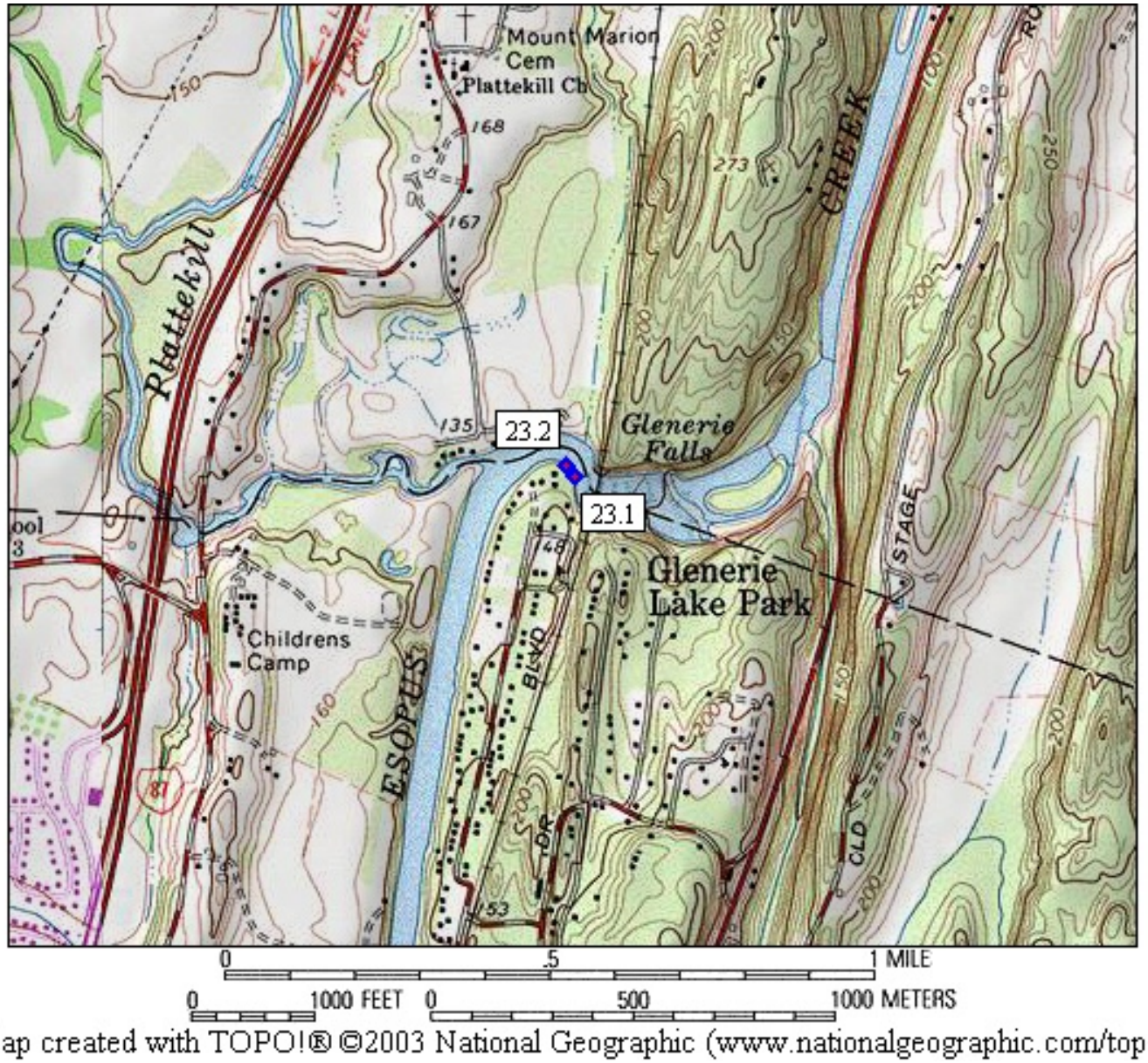
High-water mark 21.8 is a fair debris line about 1.5 feet above the ground, on the streamward side of a stone wall, on the left bank, 270 feet downstream from the Leggs Mills Road bridge, at elevation 138.80 feet above NGVD 29 (lat 41° 59’ 44.8”, long 73° 59’ 48.8”).

SITE DESCRIPTION
Site 22: Esopus Creek at Glenerie Boulevard (south) at Glenerie Lake Park, N.Y.
Site Location: Glenerie Boulevard, lat 42° 00’ 17.6”, long 73° 59’ 27.2”, NAD 83
Town of Ulster, Ulster County, N.Y.
Saugerties USGS 7.5’ Topographic Quadrangle
High-Water Marks: Four high-water marks were surveyed: three debris lines and one seed line.
Photos and GPS readings were taken at each high-water mark. Field notes are filed at the USGS office in Troy, N.Y.
Marks were surveyed and photos taken by K.D. Metzker, C. J. Ostheimer, S.A. Vivian, and M.T. Whitehead on June 2, 2005.
High-water-mark elevations were surveyed from a benchmark that is an NGS standard disk stamped H-280 1942, located at the municipal building in Saugerties, set vertically in the south face at the southwest corner, 17.7 feet east of the east curb of Partition Street, 0.6 foot above the building corner stone, NGS PID MZ0780. Elevation is 155.04 feet above NGVD 29. To convert to NAVD 88, subtract 0.79 feet from all elevations at this site.

Saugerties quad map with location of site 22, Esopus Creek at Glenerie Boulevard (south) at Glenerie Lake Park, N.Y.

High-water mark 22.1 is a good debris line about 1.5 feet above the ground, on the streamward side of a storage shed streamward from house 370 on Glenerie Boulevard, on the right bank, at elevation 136.33 feet above NGVD 29 (lat 42° 00’ 17.6”, long 73° 59’ 27.2”).

SITE DESCRIPTION
Site 23: Esopus Creek at Glenerie Boulevard (north) at Glenerie Lake Park, N.Y.
Site Location: Glenerie Boulevard, lat 42° 01’ 15.5”, long 73° 59’ 08.9”, NAD 83
Town of Ulster, Ulster County, N.Y.
Saugerties USGS 7.5’ Topographic Quadrangle
High-Water Marks: Two high-water marks were surveyed: two mud lines.
Photos and GPS readings were taken at each high-water mark. Field notes are filed at the USGS office in Troy, N.Y.
Marks were surveyed and photos taken by K.D. Metzker and C. J. Ostheimer on June 2, 2005.
High-water-mark elevations were surveyed from a benchmark that is an NGS standard disk stamped H-280 1942, located at the municipal building in Saugerties, set vertically in the south face at the southwest corner, 17.7 feet east of the east curb of Partition Street, 0.6 foot above the building corner stone, NGS PID MZ0780. Elevation is 155.04 feet above NGVD 29. To convert to NAVD 88, subtract 0.79 feet from all elevations at this site.

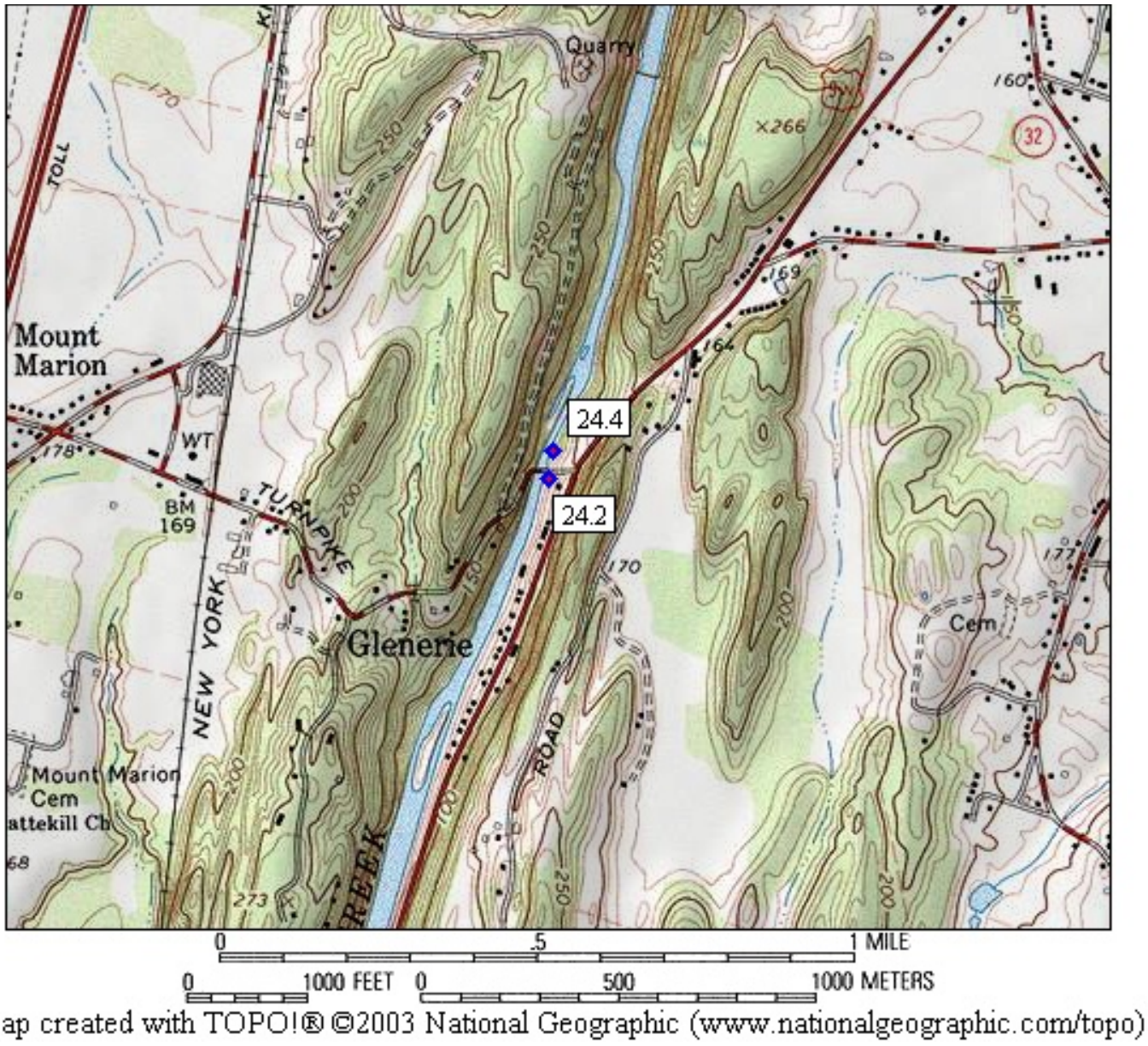


Saugerties quad map with location of site 23, Esopus Creek at Glenerie Boulevard (north) at Glenerie Lake Park, N.Y.

High-water mark 23.1 is an excellent mud line about 3 feet above the ground, on the downstream side of cabin C5 at 127 Glenerie Boulevard, on the right bank, at elevation 133.59 feet above NGVD 29 (lat 42° 01’ 15.5”, long 73° 59’ 08.9”).

High-water mark 23.2 is an excellent mud line about 3 feet above the ground, on the downstream side of cabin C7 at 127 Glenerie Boulevard, on the right bank, at elevation 133.59 feet above NGVD 29 (lat 42° 01’ 16.3”, long 73° 59’ 09.9”).

SITE DESCRIPTION
Site 24: Esopus Creek at Glasco Turnpike at Glenerie, N.Y.
Site Location: Bridge on Glasco Turnpike, lat 42° 02’ 16.2”, long 73° 58’ 18.0”, NAD 83
Town of Saugerties, Ulster County, N.Y.
Saugerties USGS 7.5’ Topographic Quadrangle
High-Water Marks: Six high-water marks were surveyed: five debris lines and one wash line.
Photos and GPS readings were taken at each high-water mark. Field notes are filed at the USGS office in Troy, N.Y.
Marks were surveyed and photos taken by S.A. Vivian and M.T. Whitehead on June 2, 2005.
High-water-mark elevations were surveyed from a reference mark that is the USGS stream-gaging station 01364500 reference mark RM 3. Elevation is 93.33 feet above NGVD 29. To convert to NAVD 88, subtract 0.79 feet from all elevations at this site.

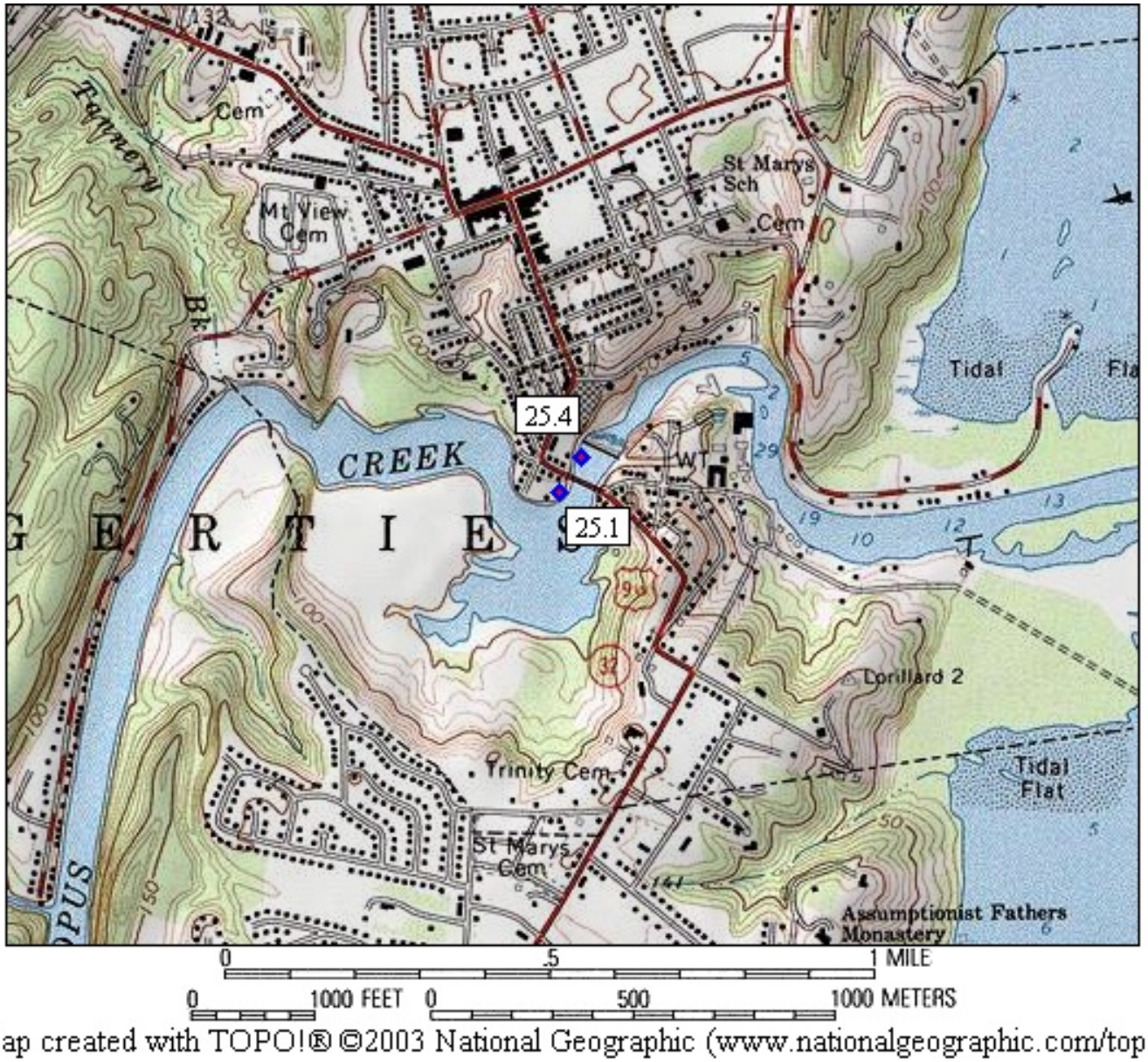


Saugerties quad map with location of site 24, Esopus Creek at Glasco Turnpike at Glenerie, N.Y.

High-water mark 24.2 is a fair wash line on the ground, on the left bank, 150 feet upstream from the Glasco Turnpike bridge, at elevation 67.80 feet above NGVD 29 (lat 42° 02’ 15.3”, long 73° 58’ 19.2”).

High-water mark 24.4 is a poor debris line about 6 feet above the ground, on a tree on the left bank, 100 feet downstream from the Glasco Turnpike bridge, at elevation 66.19 feet above NGVD 29 (lat 42° 02’ 17.5”, long 73° 58’ 18.7”).

SITE DESCRIPTION
Site 25: Esopus Creek at U.S. Route 9W and State Route 32 at Saugerties, N.Y.
Site Location: Bridge on U.S. Route 9W and State Route 32, lat 42° 04’ 16.8”, long 73° 57’ 00.6”, NAD 83
Village of Saugerties, Town of Saugerties, Ulster County, N.Y.
Saugerties USGS 7.5’ Topographic Quadrangle
High-Water Marks: Four high-water marks were surveyed: four mud lines.
Photos and GPS readings were taken at each high-water mark. Field notes are filed at the USGS office in Troy, N.Y.
Marks were surveyed and photos taken by S.A. Vivian and M.T. Whitehead on June 2, 2005.
High-water-mark elevations were surveyed from a benchmark that is an NGS standard disk stamped H-280 1942, located at the municipal building in Saugerties, set vertically in the south face at the southwest corner, 17.7 feet east of the east curb of Partition Street, 0.6 foot above the building corner stone, NGS PID MZ0780. Elevation is 155.04 feet above NGVD 29. To convert to NAVD 88, subtract 0.79 feet from all elevations at this site.



Saugerties quad map with location of site 25, Esopus Creek at U.S. Route 9W and State Route 32 at Saugerties, N.Y.

High-water mark 25.1 is an excellent mud line about 2 feet above the ground, on the downstream side of the Village of Saugerties Waterfront Park beach house, on the left bank, 220 feet upstream from the U.S. Route 9W and State Route 32 bridge, at elevation 54.64 feet above NGVD 29 (lat 42° 04’ 15.8”, long 73° 57’ 04.6”).

High-water mark 25.4 is a good mud line about 2 feet above the ground, on the upstream side of a fence, on the left bank, 105 feet downstream from the U.S. Route 9W and State Route 32 bridge, at elevation 54.61 feet above NGVD 29 (lat 42° 04’ 18.6”, long 73° 57’ 02.1”).

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Appendix 2. Selected Photographs of Flood Damage during the Flood of April 2–3, 2005, Esopus Creek Basin and Surrounding Areas

Flood Damage in Esopus Creek Basin

Ashokan Reservoir spill channel to Esopus Creek on April 3, 2005.
Photo courtesy of Times Herald-Record.

Washington Avenue in Kingston, N.Y. Photo courtesy of Times Herald-Record.

Local business adjacent to New York State Thruway, N.Y., April 3, 2005.
Photo courtesy of Times Herald-Record.

Chandler Drive, Kingston, N.Y., April 3, 2005. Photo courtesy of Times Herald-Record.

Route 28 near Kingston, N.Y., April 3, 2005. Photo courtesy of David Bondarenka.

Evergreen Lane, Hurley, N.Y., April 3, 2005. Photo courtesy of David Bondarenka.

Wynkoop Road, Hurley, N.Y., April, 3, 2005. Photo courtesy of David Bondarenka.

Ferraro's Auto Body on Esopus Ave. in Kingston, N.Y., April 4, 2005.
Photo courtesy of Times Herald-Record; photo taken by staff photographer Ken Bizzigotti.

Ashokan Reservoir spillway channel during typical spring spillage. Photo courtesy of James Werner.

Ashokan Reservoir spillway channel on April 3, 2005. Photo courtesy of James Werner.

Flood Damage in the Adjacent Rondout Creek Basin

Photos courtesy of Times Herald-Record

Sundown Road, Sundown, N.Y., April 3, 2005.

Route 209 in the area of Accord and Kerhonkson, N.Y., April 3, 2005.

Route 209 in the area of Accord and Kerhonkson, N.Y., April 3, 2005.

Route 209 in the area of Spring Glen, N.Y., April 3, 2005.

For additional information write to:
New York Water Science Center
U.S. Geological Survey
425 Jordan Road
Troy, NY 12180

Information requests:
(518) 285-5602
or visit our Web site at:
http://ny.water.usgs.gov

DELAWARE

Ashokan Reservoir spillway

Ashokan Reservoir spillway - April, 2005

Esopus Creek

TER

SULLIVAN