FLOODING OF DECEMBER 29, 1984 THROUGH JANUARY 2, 1985, IN NORTHERN NEW YORK STATE, WITH FLOOD PROFILES OF THE BLACK AND SALMON RIVERS

By Richard Lumia, Patricia M. Burke, and William H. Johnston

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CONVERSION FROM INCH-POUND SYSTEM TO SI (METRIC) UNITS

The following factors may be used to convert inch-pound units of measurement in this report to metric (International Systems) units.

Multiply inch-pound unit	By	To obtain metric unit
	Length	
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
square mile (mi^2)	2.59	square kilometer (km^2)
	Volume	
cubic foot (ft^3)	0.0283	cubic meter (m^3)
	Flow	
cubic foot per second (ft^3/s)	0.0283	cubic meter per second (m^3/s)

Flooding of December 29, 1984 Through January 2, 1985 in Northern New York State, with Flood Profiles of the Black and Salmon Rivers

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ABSTRACT

Precipitation, snowmelt, and resultant flooding throughout northern New York from December 28, 1984 through January 2, 1985, were investigated through a detailed analysis of 56 precipitation stations, 101 stage and (or) discharge gaging stations, and 9 miscellaneous measurement sites. Flood damage to property and roads and bridges exceeded $5 million. Lewis and Oswego Counties were declared Federal disaster areas, primarily a result of flooding of the Black River and Salmon River.

Storm-precipitation and runoff maps show the storms' greatest intensity to have been over the Tug Hill and southwest Adirondack areas. Total rainfall from December 28 through January 2 was 6.90 inches at Stillwater Reservoir but only 0.69 inches at Lake Placid. New peak discharges of record occurred at 17 gaging stations throughout northern New York, and the maximum discharge at 17 sites had recurrence intervals equal to or greater than 100 years. Computed inflows to 11 major lakes and reservoirs in northern New York indicate that significant volumes of water (as much as 5 inches of storm runoff at Stillwater Reservoir) were stored during the storm-runoff period. Maximum 1-day flood volumes at two gaging stations on the Black River had recurrence intervals greater than 100 years.

To help evaluate the extent of flooding, 67 floodmarks were obtained along a 94-mile reach of the Black River from Dexter to Forestport, and several floodmarks were surveyed within major communities along the Salmon River. The floodmarks were obtained primarily near major bridges and dams along these rivers.

INTRODUCTION

Precipitation from a strong warm front during December 28-30, 1984, combined with unseasonably warm temperatures and rapidly melting snow, caused extensive flooding throughout northern New York State. Damage to highways, bridges, and private property exceeded $5 million. The counties most severely affected were Oswego, Jefferson, Lewis, Oneida, Herkimer, Hamilton, St. Lawrence, and Franklin (fig. 1). Most of the severe flooding began on December 29. The maximum amount of rainfall recorded during December 28-30 was 6.37 inches at Stillwater Reservoir in Herkimer County; less than 1 inch was recorded in Washington and Warren Counties to the east. An additional 1 to 2 inches of rain fell throughout much of northern New York during a second storm on January 1-2, 1985.

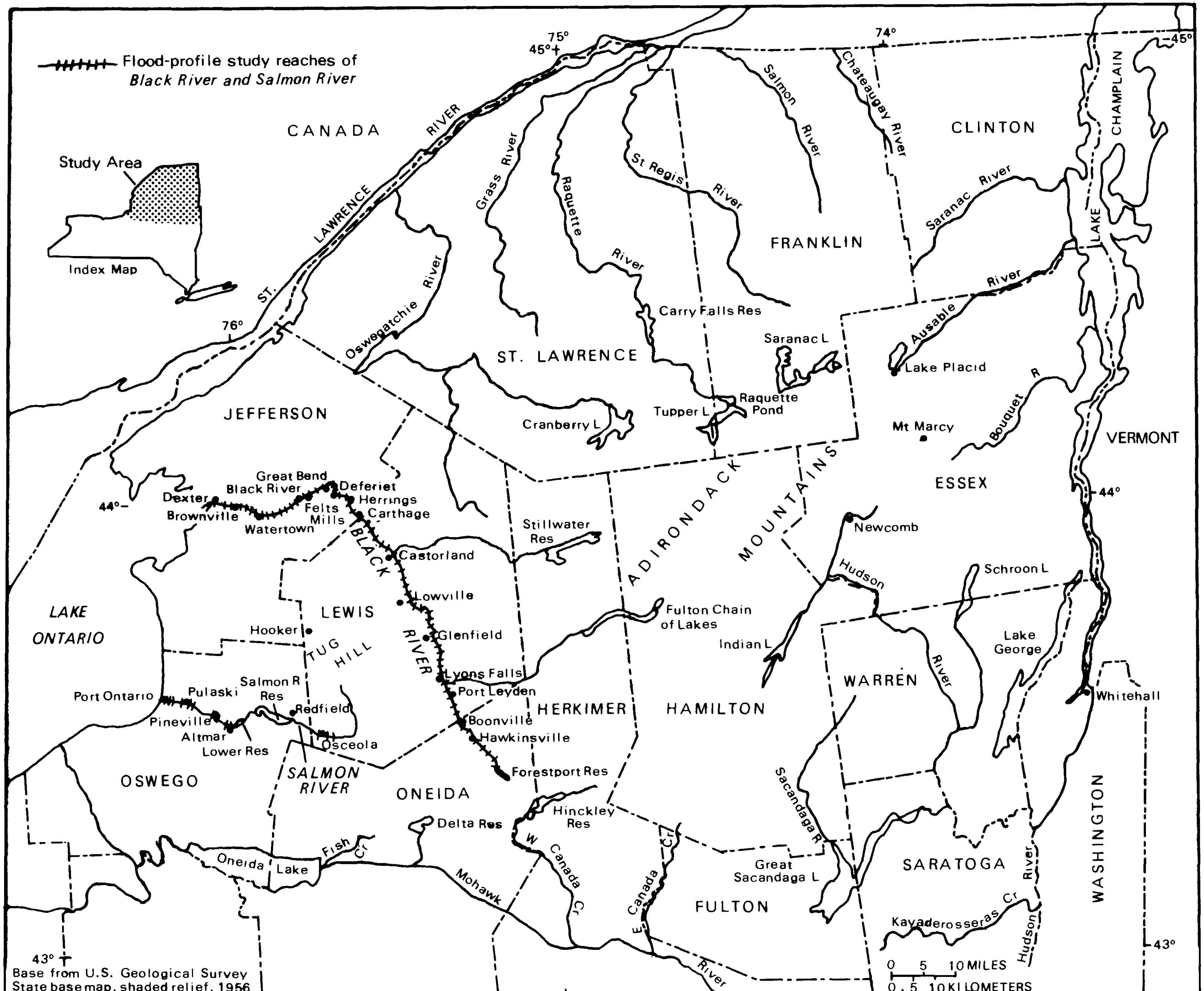

Figure 1.--Major geographic features of northern New York and location of the Black River and Salmon River flood-profile study reaches.

The most extensive flooding occurred along the Black River and Salmon River, in Lewis and Oswego Counties, respectively. Both counties were declared major disaster areas. The storms' greatest recorded intensity was near the headwaters of the Black River and Salmon River. Computed maximum discharges at 12 sites within these basins had recurrence intervals greater than or equal to 100 years, as did a site on West Canada Creek, East Branch Fish Creek, West Branch St. Regis River, and two sites on the Salmon River in Franklin County. New peak discharges of record occurred at 17 gaging stations throughout northern New York.

Purpose and Scope

As part of a continuing program with the New York State Department of Transportation to document major floods in New York, the U.S. Geological Survey compiled hydrologic data on the storms and floods of December 28, 1984 through January 2, 1985 in the northern part of the State. This report documents the storm and subsequent flooding in several tables and illustrations showing precipitation, discharge, and reservoir-storage information. It also includes information about the rates of inflow and volume of water stored in the several lakes and reservoirs during the flood and presents a series of flood profiles showing water-surface elevations along a 94-mile reach of the Black River and in major communities along the Salmon River in Oswego and Lewis Counties (fig. 1).

Acknowledgments

This study was done in cooperation with New York State Department of Transportation. Data were provided by the Hudson River-Black River Regulating District, U.S. Army Corps of Engineers (Buffalo District), National Oceanic and Atmospheric Administration, New York State Department of Environmental Conservation, New York State Emergency Management Office, New York State Department of Transportation, Village of Saranac Lake, Ballard Mill Center for the Arts, Oswegatchie River-Cranberry Reservoir Commission, Indian River Company, Niagara Mohawk Corporation, and Carroll E. Owens (photographer).

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PHYSIOGRAPHY OF NORTHERN NEW YORK

The study region covers 18,000 square miles in northern New York State (fig. 1). The primary geographic feature of the area is the Adirondack Mountains, which rise to 5,344 feet above sea level at Mount Marcy in Essex County. The region contains more than 1,500 lakes and ponds.

The northern part of the Adirondack region, an area of about 6,000 mi^2, is drained primarily by six major streams, which begin in the central highland and flow northward to the St. Lawrence River, which borders parts of Jefferson and Franklin Counties and all of St. Lawrence County to the north. These streams are the Oswegatchie, Grass, Raquette, St. Regis, Salmon (Franklin County), and Chateaugay Rivers, the last three of which cross the International boundary and traverse a part of lower Canada before joining the St. Lawrence River. The upper reaches of these streams originate in the rough, wooded Adirondack highlands and descend rapidly to the level plains bordering the St. Lawrence River. Several ponds, lakes, and reservoirs throughout the northern Adirondacks provide recreation, hydroelectric power, water supply, and flood control. The major northern Adirondack reservoirs include Cranberry Lake (Oswegatchie River basin), Tupper Lake-Raquette Pond (Raquette River basin), and Carry Falls Reservoir (Raquette River basin).

Streams in the eastern part of northern New York, an area of approximately 6,400 mi^2, flow into the Lake Champlain and Upper Hudson River basins. This area encompasses the lowlands of the Lake Champlain-Upper Hudson Valley and part of the Adirondack Mountains. The floor of the valley lies between 100 and 500 ft above sea level. Major streams in the area that drain the Lake Champlain basin include Great Chazy, Saranac, Ausable, and Bouquet Rivers; those that drain the Upper Hudson River basin include the Hudson, Indian, Schroon, and Sacandaga Rivers. The eastern part of the study area contains many lakes and ponds both in valleys and the mountains. Major lakes and reservoirs are Saranac Lake, Lake George, and Lake Champlain in the Lake Champlain basin, and Indian Lake, Schroon Lake, and Great Sacandaga Lake in the Upper Hudson River basin.

The southern part of the study region, an area of about 2,600 mi^2, is bordered on the south by the Mohawk River and Oneida Lake. The Mohawk River flows eastward to the Hudson River; Oneida Lake drains west to the Oswego River, which flows to Lake Ontario. The two major tributaries that flow south to the Mohawk River are East Canada and West Canada Creeks. The major reservoirs in this area include Hinckley Reservoir (West Canada Creek basin), Delta Reservoir (near headwaters of the Mohawk River basin), and Oneida Lake (Oswego River basin). Fish Creek is a major tributary which flows south to Oneida Lake.

The headwater areas in the Adirondacks are underlain by Ordovician crystalline limestone, Cambrian Potsdam Sandstone, or Precambrian granite and gneiss. The entire northern area was covered by the ice of the recent glacial period, and extensive deposits of Pleistocene glacial material cover most of the region (Cullings, 1939).

The climate of northern New York is generally the humid continental type, which prevails in the northeastern United States. Masses of cold, dry air frequently arrive from the northern interior of the continent, and prevailing winds from the south and southwest often transport warm, humid air to the area. These two types of airmass largely determine the climate. The mean annual precipitation over these areas ranges from about 30 inches over Lake Champlain to about 55 inches near the headwaters of East Canada and West Canada Creeks and East Branch Fish Creek (Zembrzuski and Dunn, 1979). The rainfall is evenly distributed throughout the year, but the heaviest precipitation generally occurs during the growing season.

The topography and proximity to large bodies of water have pronounced effects on the climate, as evidenced by the large range in mean annual precipitation over the area. The Adirondack region has an average seasonal snowfall in excess of 90 inches, but amounts decrease to between 60 and 70 inches in the lowlands of the St. Lawrence Valley and to about 60 inches near Lake Champlain. A snow cover generally begins to develop in the Adirondacks and northern lowlands by late November and remains into April. Monthly mean temperatures throughout the area are about 20°F in December and January and about 70°F in July. The Adirondack region has 35 to 45 days with below-zero temperatures in normal to severe winters, except near Lake Champlain and the St. Lawrence River, where the number of such days is smaller (National Oceanic and Atmospheric Administration, 1978).

PHYSIOGRAPHY OF BLACK RIVER AND SALMON RIVER BASINS

The Black River and Salmon River basins in Lewis and Oswego Counties (fig. 1) experienced extensive flooding after the storms of December 28, 1984 through January 2, 1985; therefore, the physiographic characteristics of these basins, in the western part of the study area, are described in detail.

Black River Basin

The Black River basin, within and adjacent to the western Adirondack Mountains (fig. 2), drains a 1,914-mi^2 area. Westward drainage from the Adirondacks and Tug Hill turns abruptly northward and flows as the Black River around the north end of Tug Hill into Lake Ontario. The elevation of the basin declines from about 3,000 ft in the Adirondacks to about 250 ft at the river's mouth. The Black River, about 110 mi long, begins in the Adirondacks, flows southwestward to Forestport, where it turns northwest and follows a nearly straight course to Lyons Falls. Downstream from Lyons Falls, it meanders over an ever-widening flood plain to Carthage, where it turns west and flows through a nearly straight channel in bedrock to Lake Ontario. Major tributaries to the Black River that enter from the east include the Moose, Independence, and Beaver Rivers, and Otter Creek; those entering from the west include the Sugar and Deer Rivers. Major reservoirs within the basin are Stillwater Reservoir in the Beaver River basin, First and Sixth Lakes within the Fulton chain of lakes (Moose River basin), and Forestport Reservoir, on the Black River.

The geologic formations throughout the Black River basin are similar to those elsewhere in northern New York. The principal bedrock unit is the Precambrian igneous and metamorphic basement complex of the Adirondacks. Overlying the Precambrian rock are Paleozoic sedimentary rocks, primarily the

Potsdam Sandstone. Limestones and siltstones overlie these formations. Glacial material was deposited over most of the basin during the Pleistocene Epoch (Waller and Ayer, 1975).

The climate of the Black River basin is the humid continental type. Storms enter the basin primarily from the northwest and south. Mean annual precipitation ranges from about 37 inches at the mouth of the Black River to more than 55 inches near Tug Hill (Zembrzuski and Dunn, 1979). Topography, elevation, and proximity to Lake Ontario produce seasonal snowfalls averaging more than 175 inches on the western and southwestern slopes of the Adirondacks and Tug Hill. Monthly mean temperatures over the basin are about 18°F in December, 23°F in January, and about 68°F in July (National Oceanic and Atmospheric Administration, 1982).

Salmon River Basin

The Salmon River basin is a 267-mi^2 area mainly in Oswego and Lewis Counties, although about 3 mi^2 of the Mad River drainage, a tributary to the North Branch Salmon River, lies in the southeastern corner of Jefferson County (fig. 2). About 63 mi^2 of the headwaters streams are in the western part of Lewis County, where the drainage divide between the Salmon River and Fish Creek basins meets the drainage divide of the Black River basin. The remainder of the basin drains part of Oswego County.

The Salmon River basin lies within two physiographic provinces. The eastern part of the basin is in the Tug Hill Plateau, where elevations range from about 1,800 ft above sea level at the drainage divide to about 500 ft near Pineville. The western part of the basin is in the Lake Ontario Plain, which consists of gently rolling hills that range from 600 ft to 246 ft above sea level (Miller, 1982).

The Salmon River basin is underlain by sandstone, shale, and siltstone of Ordovician and Silurian ages. The Ordovician Oswego Sandstone underlies a large part of the basin, generally to the east of Altmar and south of the Salmon River. The Ordovician Pulaski Formation, which consists of shale and siltstone, underlies the Richland-Pulaski area in the western part of the basin and north of the Salmon River. Silurian sandstone and shale underlies the higher elevations near the drainage divides (Isachsen and others, 1970, Rickard and others, 1970).

Glacial deposits overlie most of the basin. The Lake Ontario Plain is characterized by lake deposits in low areas between drumlins (long, parallel, elliptical hills consisting of lodgment till). The Tug Hill Plateau contains irregular, low, knobby mounds of ablation moraine that overlies drumlins and bedrock, and some kame and outwash sand and gravel. The regional slope of the bedrock surface from the Tug Hill Plateau to Lake Ontario, and the orientation of the drumlins, east-west in the Lake Ontario Plain and southeast-northwest on the Tug Hill Plateau, are the major factors that control the direction of streamflow (Miller, 1982).

The East and West Forks of the Salmon River join about 4 mi east of the Village of Osceola (Lewis County) to form the Salmon River, which at this point has a drainage area of less than 15 mi^2. Several brooks contribute to the flow upstream from Osceola. Between there and Oswego County, the drainage area increases to nearly 50 mi^2. From the county line, the river flows less than 3 mi to the Salmon River Reservoir near the Village of Redfield. The North Branch Salmon River, which drains nearly 90 mi^2, enters the reservoir near Redfield as well. From the reservoir complex, the Salmon River continues westward through the villages of Altmar, Pineville, Pulaski, and Port Ontario, and empties into Lake Ontario at Selkirk (Oswego County).

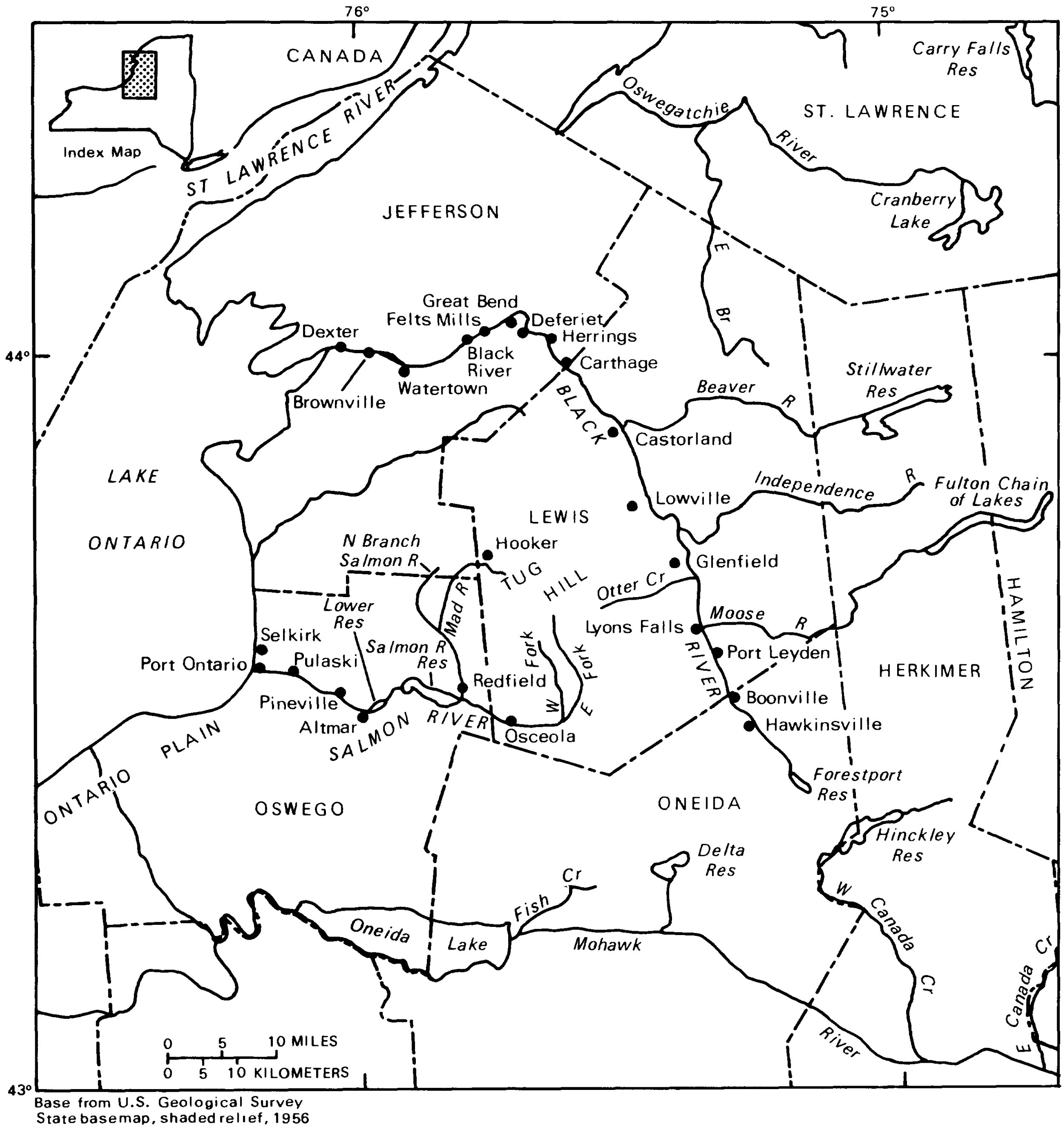


Figure 2.--Major geographic features of the Black River and Salmon River basins.

One of the main features of the basin is the Salmon River Reservoir, which has a storage capacity of about 2,900 million ft^3 (from a capacity curve furnished by Niagara Mohawk Power Corporation, Syracuse, N.Y.). The reservoir, with a spillway elevation of 937 ft above sea level, is about 6.4 mi long and averages about 0.8 mi wide. The surface area of the reservoir is 5.28 mi^2 (Greeson, 1970).

The river falls 286 ft from the Salmon River Reservoir spillway to the Lower Reservoir 3.4 mi downstream, which has a spillway elevation of 651 ft above sea level. The Lower Reservoir is only about 0.9 mi long and 0.3 mi wide and has a surface area of 0.26 mi^2 (Greeson, 1970). The relatively small storage capacity of about 137 million ft^3 has little effect on modification of peak floodflows in the basin.

The climate in the Salmon River basin is the humid continental type. Average annual precipitation ranges from about 43 inches along Lake Ontario to about 55 inches in the higher elevations of the Tug Hill Plateau. Distribution is fairly uniform throughout the year. The Tug Hill Plateau receives somewhat more precipitation in fall and winter as a result of the combination of the orographic (upland) effect and the lake effect from extra moisture carried by the prevailing winds over Lake Ontario (Dethier, 1966).

STORMS AND FLOODS OF DECEMBER 28, 1984 THROUGH JANUARY 2, 1985

On December 28-30, 1984, a strong warm front moved into New York from the south, bringing record temperatures and heavy rainfall. The mild weather continued into the first two days of January as a second storm left an additional 1 to 2 inches of rain over much of northern New York. The heaviest total rainfall, more than 6.5 inches, fell over the Tug Hill and southwest Adirondack areas and caused record flooding on several streams. As the storms moved northward, they dropped more than 4 inches of rain over several stream basins tributary to the St. Lawrence River and again caused record flooding in some streams.

Antecedent Conditions

Antecedent conditions throughout northern New York were conducive to heavy runoff from the storms. A storm on November 28-30, 1984, dropped 1 to 2 inches of rain over much of northern New York (National Oceanic and Atmospheric Administration, 1984a). December precipitation over most of that area was already at or near normal monthly amounts for December before the storms, which began late on December 28. The potential for rapid runoff was increased by occasional temperatures below zero after mid-December throughout the Adirondacks, which caused freezing of the ground at the higher elevations. Air temperatures throughout the area on December 29-30 generally ranged from the low 60's down to the low 20's at night. Also contributing to the potential for high runoff was snow cover over the area before the storm. Data on precipitation at 56 stations are given in table 1, which includes information on snow cover at stations where such data were available. The data show that areas near Tug Hill and the southwestern Adirondacks had 12 to 20 inches of snow on the ground before the storm. Almost all snow was gone by December 31. Limited information on the water content of snow showed that just before the storm, the snowpack at Boonville and at Newcomb contained about 2.5 inches of water (National Weather Service, oral commun., April 1985). These antecedent conditions, combined with temperatures in the upper 50's and lower 60's throughout the area on December 29-30 and large amounts of rainfall during that period, caused rapid snowmelt and produced floods of record on several streams tributary to the St. Lawrence River and in the Black River and Salmon River basins, both tributary to Lake Ontario. The storm precipitation and resultant flooding are discussed in the following sections.

Precipitation

The amount of rainfall during the storms of December 28-30 and January 1-2 varied widely across northern New York. Table 1 shows daily and total storm rainfalls at 56 precipitation stations (fig. 3) throughout the area (National Oceanic and Atmospheric Administration, 1984b). Most of the rain fell December 29-30; the maximum for the 2 days was 6.32 inches at Stillwater Reservoir. Total rainfall for December 28 to January 2 ranged from 6.90 inches at Stillwater Reservoir (Herkimer County) and 6.67 inches at Hooker (Lewis County) to 0.69 inches at Lake Placid (Essex County) and 0.75 inches at Whitehall (Washington County).

The variability of the storms' total rainfall is shown in figure 3. Lines of equal total storm precipitation, drawn from data in table 1, show that the most intense rain occurred over the Tug Hill area and over regions near the southwestern parts of the Adirondack Mountains. As the storm moved northward across the Adirondacks, it dropped more than 4 inches of rain near the headwaters of the Raquette, St. Regis, and Salmon (Franklin County) Rivers (fig. 1), all tributary to the St. Lawrence River. The Black River and Salmon River (Tug Hill area) basins received the largest amounts of precipitation, primarily because of the orographic effects near the headwaters of these basins. Extreme eastern parts of northern New York received the smallest amounts.

Rainfall-frequency relationships for 24- and 48-hour duration at six sites in northern New York are given in table 2. The 48-hour values were extrapolated from data from the Weather Bureau's rainfall-frequency atlas (U.S. Weather Bureau, 1961). This information indicates that at Stillwater Reservoir, the maximum 24- and 48-hour rainfalls of 4.07 and 6.32 inches, respectively, have recurrence intervals of 30 years and greater than 100 years, respectively. In contrast, the maximum 24- and 48-hour storm rainfalls at Lake Placid have recurrence intervals of less than 2 years. Table 3, which shows rainfall-frequency relationships for storms of 3-, 6-, and 12-hour duration at Boonville, is included to show that the maximum storm rainfall amounts for shorter duration were not unusual. The maximum 3-, 6-, and 12-hour storm rainfall amounts at Boonville were 0.7, 1.1, and 1.6 inches, respectively, and the recurrence interval for these rainfall intensities is less than 2 years for each duration. The most intense 3-hour rainfall (0.7 inches) at Boonville occurred between 2:00 and 5:00 p.m. on December 29.

Table 1.--Precipitation data from selected stations in northern New York, December 28, 1984 through January 2, 1985.

[Locations shown in fig. 3.]

Location on fig. 2 and station name[a]		Elevation, in feet above sea level[d]	Daily precipitation (inches) December 1984 28	29	30	31	January 1985 1	2	Total storm precipitation (inches)	Total precipitation for December 1984, and departure from normal (inches)	Snow on ground (inches) Dec.27	Dec.31
1	Bennetts Bridge	700	0.05	1.14	1.12	0.00	0.45	0.48	3.24	6.64	5.5	0.0
2	Black River[b]	530	.10	.93	.30	.00	.70	.00	2.03	4.01		
3	Fort Drum	570	.80	.79	.00	.00	.80	.02	2.41	4.41		
4	Pulaski 1 N	375	.00	1.53	.00	.00	.96	.03	2.52	5.57	[c]12.0	0.0
5	Watertown	497	.04	.98	.35	.00	.58	.25	2.20	4.24(+0.18)	1.0	0.0
6	Wellesley Island	250	.21	.24	.00	.00	.71	.05	1.21	2.52		
7	Broadalbin	800	.18	.22	.05	.00	.91	.02	1.38	3.94		
8	Camden 2 NW	510	.14	1.17	1.05	.00	.80	.36	3.52	7.34	4.0	0.0
9	Chepachet	1,240	.08	.33	.73	.00	.33	.47	1.94	4.03		
10	Dolgeville	800	.26	.80	.66	.00	1.13	.06	2.91	5.23		
11	Frankfort Lock 19	400	.06	.00	.00	.90	m	m	m	4.15		
12	Gloversville	760	.06	.29	.22	.00	.33	.52	1.44	3.83(+0.34)	5.0	0.0
13	Griffiss AFB	480	.43	1.13	.00	.07	1.19	.00	2.82	5.28		
14	Hinckley 1 SE	1,190	.05	1.84	1.27	.00	.61	1.01	4.78	7.51(+3.26)		
15	Little Falls Reservoir	910	.00	.62	.54	.00	.36	.48	2.00	3.50(+0.20)		
16	New London Lock 22	430	.00	.00	.00	2.04	.00	1.05	3.09	5.30		
17	Northville	800	.06	.22	.22	.00	.28	1.13	1.91	4.42		
18	Trenton Falls	740	.00	1.78	1.21	.00	.58	.90	4.47	7.13		
19	Utica FAA AP	525	.22	1.64	.00	.02	1.11	.00	2.99	5.55(+1.50)	2.0	0.0
20	Barnes Corners	1,860	.02	3.50	1.30	.00	.33	.14	5.29	8.50	9.0	0.0
21	Beaver Falls	760	.00	1.17	.37	.00	.44	.35	2.33	4.52		
22	Big Moose 3 SE	1,850	.53	4.55	.02	.00	.78	.00	5.88	8.86		
23	Eagle Bay[b]	1,720	1.86	2.19	.00	.02	.81	.01	4.89	7.46		
24	Boonville 2 SSW	1,575	.09	1.95	1.58	.00	.60	.86	5.08	9.05	15.0	0.0
25	Copenhagen[b]	1,200	.00	2.64	.60	.00	.72	.07	4.03	6.44		
26	Highmarket	1,786	.08	3.14	1.40	.00	.74	.58	5.94	8.17	[c]16.0	0.0
27	Hooker 4 N	1,720	.89	4.91	.09	.00	.74	.04	6.67	11.32		
28	Hope	880	.06	.35	.34	.00	.35	1.16	2.26	4.62		
29	Indian Lake 2 SW	1,640	.03	.73	.15	.00	.52	.55	1.98	4.32(+1.00)		
30	Lake Placid 2 S	1,880	.37	.14	.05	.00	.13	.00	.69	2.75(-0.29)		
31	Lowville	880	.02	1.37	.46	.00	.89	.07	2.81	5.38(+1.69)	1.0	0.0
32	Lyons Falls	800	.00	*	*	1.97	*	1.35	3.32	5.95		
33	Newcomb 3 E	1,560	.02	1.30	.22	.00	.38	.59	2.51	m	9.0	3.0
34	North Creek 5 SE	1,050	.00	.05	.16	.00	.37	.55	1.13	3.41		
35	Old Forge	1,700	.40	3.85	.15	.00	.91	.01	5.32	9.07	20.0	4.0

Location on fig. 2 and station name[a]	Elevation, in feet above sea level[d]	Daily precipitation (inches) December 1984				January 1985		Total storm precipitation (inches)	Total precipitation for December 1984, and departure from normal (inches)	Snow on ground (inches)	
		28	29	30	31	1	2			Dec.27	Dec.31
36 Pisceco	1,690	0.07	1.55	0.87	0.00	0.74	1.31	4.54	8.08		
37 Ray Brook	1,580	.00	1.75	.51	.00	.20	.26	2.72	5.23		
38 Stillwater Reservoir	1,695	.05	4.07	2.25	.00	.16	.37	6.90	9.51(+5.55)		
39 Wanakena Ranger School	1,510	.00	1.86	.00	.00	.22	.00	2.08	4.44(+0.78)		
40 Canton 4 SE	440	.00	.82	.04	.00	.32	.25	1.43	2.97(+0.18)	[e]5.0	0.0
41 Chasm Falls	1,060	.00	2.75	.97	.00	.15	.43	4.30	6.41(+2.91)		
42 Colton 2 N	900	.00	1.15	.50	.00	.15	.61	2.41	3.86		
43 Gouverneur 3 NW	430	.49	.31	.08	.00	.87	.00	1.75	2.91(-0.39)	3.0	0.0
44 Lawrenceville	450	.55	1.90	.15	.00	.32	.00	2.92	4.04(+1.83)	3.0	0.0
45 Malone	700	.01	1.95	.76	.00	.13	.41	3.26	4.88		
46 Massena FAA AP	202	.89	.11	.00	.00	.29	.00	1.29	2.85(-0.22)	1.0	0.0
47 Norfolk	270	.07	1.23	.20	.00	.35	.57	2.42	3.81		
48 Ogdensburg 4 NE	280	.03	.52	.27	.00	.61	.00	1.43	3.69(+0.95)		
49 Chazy	100	.73	.31	.00	.00	m	m	m	m		
50 Dannemora	1,340	.41	1.36	.00	.00	.38	.00	2.15	4.18(+1.59)		
51 Elizabethtown	185	.00	.82	.08	.00	.21	.49	1.60	3.92(+1.08)	0.0	0.0
52 Ellenburg Depot	850	.00	1.71	.36	.00	.24	.34	2.65	4.18	1.0	0.0
53 Plattsburgh AFB	190	.41	.53	.00	.00	.42	.00	1.36	3.20		
54 Riverbank	710	.00	.36	.00	.00	.56	.34	1.26	3.42		
55 Whitehall	140	.06	.02	.00	.00	.24	.43	.75	3.04(+0.05)		
56 Conklingville Dam	750	.09	.21	.22	.00	.31	.94	1.77	4.16(+0.33)	5.0	0.0

a Unless otherwise noted, station names and precipitation data obtained from National Climatic Data Center, 1985.
b Data provided by Hudson River-Black River Regulating District.
c Data provided by New York State Department of Environmental Conservation.
d Several estimated from topographic maps and are only included to show relative differences in elevation and possible orographic effects.
e Minimum soil temperature 4 inches below ground was 33°F on December 27-29 and reached a maximum temperature of 45°F on December 30.
m Missing data.
* Gage not read. Precipitation is included in the amount following the asterisks. Time distribution unknown.

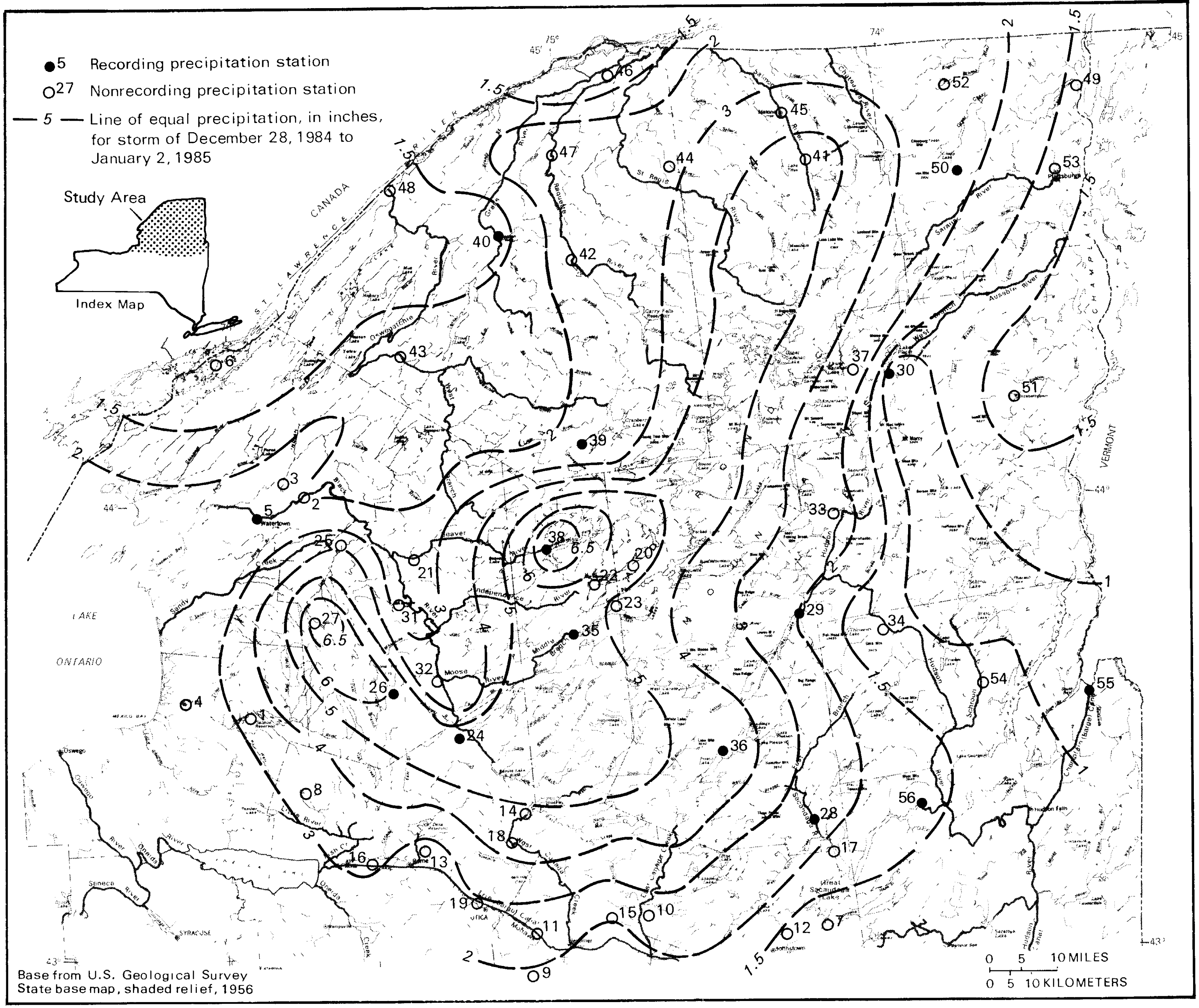


Figure 3.--Location of precipitation stations and lines of equal precipitation for the storms of December 28, 1984 through January 2, 1985. (Station names are given in table 1.)

Table 2.--Rainfall-frequency relationships for storms of 24- and 48-hour duration in selected areas of northern New York.

[Data from U.S. Weather Bureau, 1961. Locations are shown in fig. 3.]

Recurrence interval (years)	Station name and location: Stillwater/ Big Moose (22)*	Watertown (5)*	Boonville (24)*	Massena (46)*	Lake Placid (30)*	Highmarket (26)*
	Depth for 24-hour duration, in inches					
2	2.4	2.3	2.5	2.2	2.4	2.5
5	3.1	3.0	3.2	2.9	3.1	3.2
10	3.5	3.4	3.7	3.1	3.5	3.7
25	4.0	3.9	4.2	3.7	4.0	4.2
50	4.4	4.3	4.5	4.1	4.4	4.5
100	4.7	4.6	4.8	4.3	4.7	4.8
	Depth for 48-hour duration, in inches					
2	3.0	2.9	3.1	2.7	2.9	3.1
5	3.8	3.7	3.8	3.5	3.6	3.8
10	3.9	3.8	4.1	3.6	3.8	4.1
25	4.5	4.4	4.7	4.2	3.5	4.7
50	4.9	4.8	5.1	4.6	4.9	5.1
100	5.3	5.1	5.5	4.8	5.1	5.5

* Site number corresponds to that in table 1.

Table 3.--Rainfall-frequency relationships for storms of 3-, 6-, and 12-hour duration at Boonville.

[Data from U.S. Weather Bureau, 1961. Location is shown in fig. 3.]

Recurrence interval (years)	Depth for 3-hour duration (inches)	Depth for 6-hour duration (inches)	Depth for 12-hour duration (inches)
2	1.4	1.8	2.2
5	1.8	2.2	2.7
10	2.2	2.7	3.2
25	2.5	3.0	3.5
50	2.8	3.4	3.8
100	3.2	3.8	4.4

Flooding

Flooding throughout the study area forced the evacuation of more than 2,000 residents from homes and businesses. Roads and bridges were closed over widespread areas. Several dams and drainage structures were damaged, as was farmland. Private residential damage was estimated to be about $1 million, and more than 500 homes were damaged. Damages to public roads and facilities were estimated to be more than $4.4 million, including over $0.6 million to State-owned and $3.8 million to locally owned roads and facilities (State

Emergency Management Office, written commun., 1985). No loss of life was reported. Governor Mario M. Cuomo declared a disaster emergency for Lewis, Jefferson, St. Lawrence, Franklin, Oswego, Herkimer, Oneida, and Hamilton counties. Lewis and Oswego counties were declared major disaster areas by the President of the United States.

In the Town of Malone, Franklin County, about 200 people were evacuated on December 29 as floodwaters from the Salmon River inundated their homes and caused the closing of the Willow Street bridge (Malone Evening Telegram, December 31, 1984). Extensively damaged during the flood was the Ballard Mill in Malone as the Salmon River breached a dam at the mill. The photographs in figure 4 show the Ballard Mill and the dam before and after the flood.

In St. Lawrence County, the West Branch of the St. Regis River flooded, and power company officials were forced to remove stop logs from a dam in Parishville to lower the water in the pond upstream from the dam. Along the Raquette River near Potsdam, a section of Hewittville Road was closed because of high water. Several towns along the Raquette River from Piercefield to Potsdam reported road damage (Courier and Freeman, 1985). The Grass River overflowed and flooded Pyrites-Russell Road in Pyrites. In the Town of Clifton, a 3-mile stretch of road from Benson Mines to Newton Falls was closed when 3 feet of water flowed over it from the Little River. River Road between Newton Falls and Windfall was reported flooded by the Oswegatchie River (Watertown Daily Times, 1984).

The counties most severely damaged by the storm and floodwaters were Lewis and Oswego. In Lewis County, flooding occurred along all major tributaries to the Black River. Lewis County officials reported that eight roads in the county lost bridges, and another eight were closed during the flood. Several families along the Black, Beaver, and Deer Rivers were forced to evacuate their homes, and floodwaters from the Independence River in the Town of Watson washed away five camps and damaged five others. A paper mill on the Moose River at Lyonsdale was forced to close temporarily. Flooding of the Black River stranded several families on Ridge Road between Lowville and Castorland at their farms, and washouts closed bridges over the Black River between Lyons Falls and Castorland. The Davis Bridge Road in the Town of Lyonsdale was also washed out, and several hydroelectric plants within the basin were also damaged by the high water, including those in Copenhagen, Port Leyden, Kosterville, and Lyon Falls (Carthage/Lowville Times, 1985). The photograph in figure 5 shows water from the Black River flowing over Number Four Road in the Town of Watson on December 30, 1984.

The most disastrous flooding occurred along the Salmon River and its major tributaries in Oswego County. The North Branch of the Salmon River caused a complete washout of the Caster Road bridge in the Town of Redfield (Pulaski Democrat, 1985). The Salmon River destroyed the Helbock Bridge on Harvester Mill Road in Redfield, and water flowed over the flashboards of the dam on the Salmon River Reservoir at the Bennetts Bridge hydroelectric complex. At the Lower Salmon River Reservoir, the Niagara Mohawk Power Company reported that a retaining wall below the dam gave way. In the Village of Altmar, the abutments of the Salmon River bridge were damaged, and several houses north of the bridge suffered extensive flood damage. The bridge on Interstate Route 81 in Pulaski was closed during the high water. Extensive flood damage occurred along Salina Street. State Route 3 in Port Ontario was

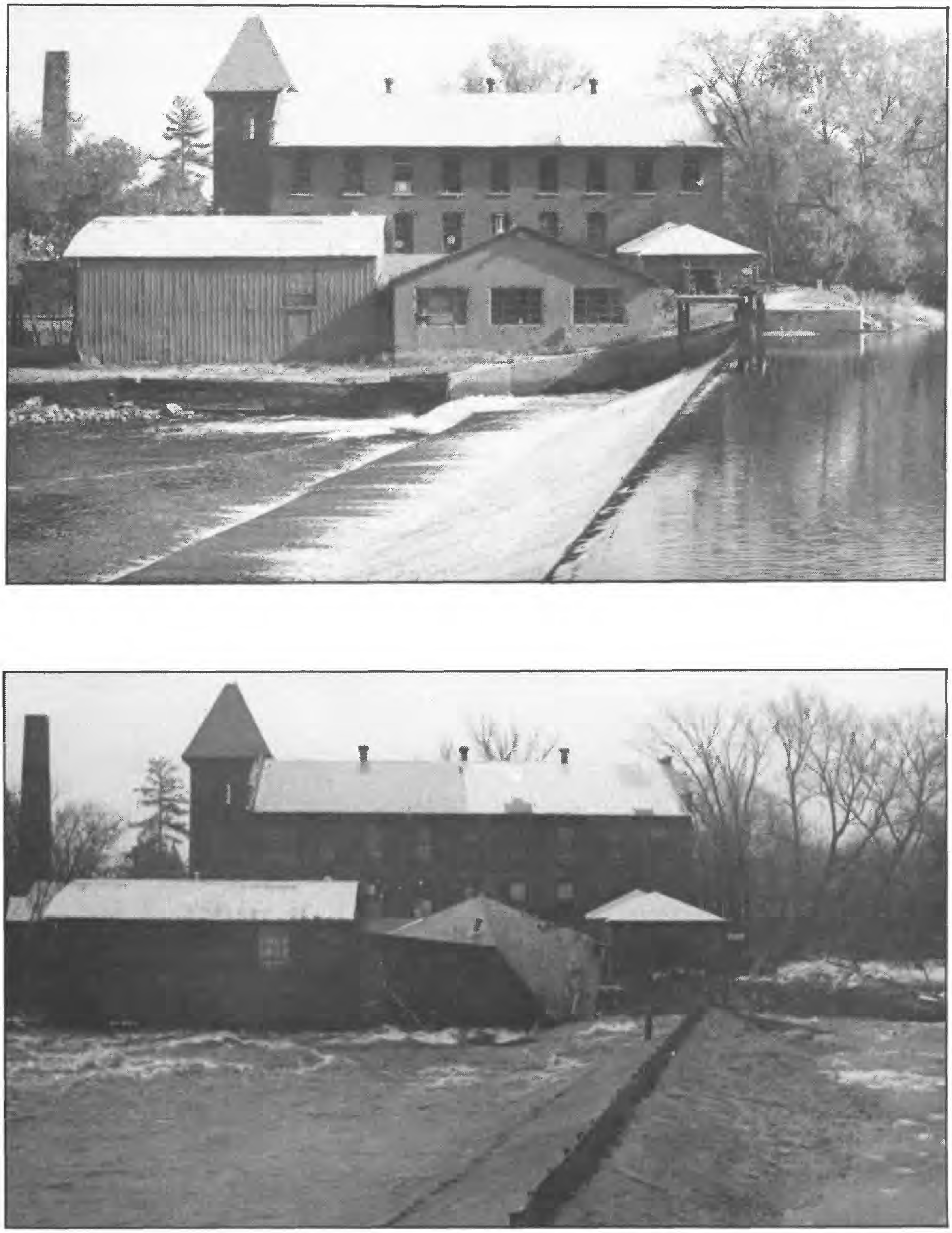


Figure 4.--Ballard Mill in Malone before and after flooding by the Salmon River on December 29, 1984. View is from west. (Courtesy of Ballard Mill Center for the Arts, 1984.)

Figure 5.

Black River flowing over Number Four Road in the Town of Watson on December 30, 1984. (Courtesy of Carroll E. Owens.)

Figure 6.--Collapsed Osceola Bridge during flood on the Salmon River in Osceola, December 29, 1984. (Courtesy of Carroll E. Owens.)

closed as the Salmon River rose to a few feet below the bridge deck. Notification to evacuate homes and businesses in the flood-prone areas of Pulaski and Altmar was given because of concern over a possible washout of an earth dam on the Salmon River Reservoir. Flooding of the upper reaches of the Salmon River in the Tug Hill area on December 29 resulted in the collapse of the Osceola Bridge (Hometown News, 1985). The photograph in figure 6 shows the collapsed bridge.

Flood Discharge and Frequency

The U.S. Geological Survey maintains 39 recording and 28 crest-stage stream-gaging stations throughout northern New York State. During and after the floods of December 29, 1984 through January 2, 1985, peak stage and discharge data were collected at these sites and at 21 discontinued gaging sites in the area. Locations of these sites are shown in figure 7. Also shown in figure 7 are 13 nonrecording sites and 9 miscellaneous sites at which indirect measurements of discharge were made after the floods. Sixteen indirect discharge measurements were made after the flooding, three of which were made at active gaging stations, four at discontinued gages, and nine at miscellaneous sites. The active gaging stations shown in figure 7 are labeled as recording or crest-stage gages. The recording gages record stream stage continuously (or at preselected time intervals), whereas crest-stage gages register only the peak stage occurring between inspections of the gage. Data from the 13 nonrecording sites were provided by sources other than the Geological Survey. The readings at these sites usually are from a staff gage read daily at preselected times. The peak stage and discharge data collected at the 110 sites shown on figure 7 are given in table 7 (at the end of report).

Data given in table 7 are listed by the major stream or lake basin in which the site is located. The sites are listed by Geological Survey station number (downstream order). Data from several sites were obtained from sources other than the Geological Survey and are footnoted. Many of these sites are at reservoirs where gages are read at specific times during the day and therefore are designated as active nonrecording gages. The source of the data is indicated in table 6 (p. 30). The period-of-record column in table 7 represents only those water years in which peak stage or discharge data were obtained. Not all periods listed are continuous or complete; an occasional year or two of peak-flow record may be missing. The previous-flood-of-record column may contain two entries; the first includes the previous maximum known discharge and associated gage height, and the second gives the previous maximum known gage height if it exceeds that in the first entry. Discharge is given in ft^3/s and $(ft^3/s)/mi^2$. Unless noted otherwise, all stages were obtained from the gage record.

One measure of a flood's severity is the probability of the flood discharge being exceeded by another flood discharge during the same year. Probability is expressed as a decimal number less than 1.0 that shows the chance that a flood will be exceeded in any given year. Probability can be converted to percent chance by multiplying by 100. The recurrence interval, or average time interval between the actual occurrence of a flood of equal or greater magnitude, is the reciprocal of the probability. For example, a flood having a probability of 0.01 (100-year flood) has a 1-percent chance of being equaled or exceeded in any given year. The recurrence interval is a

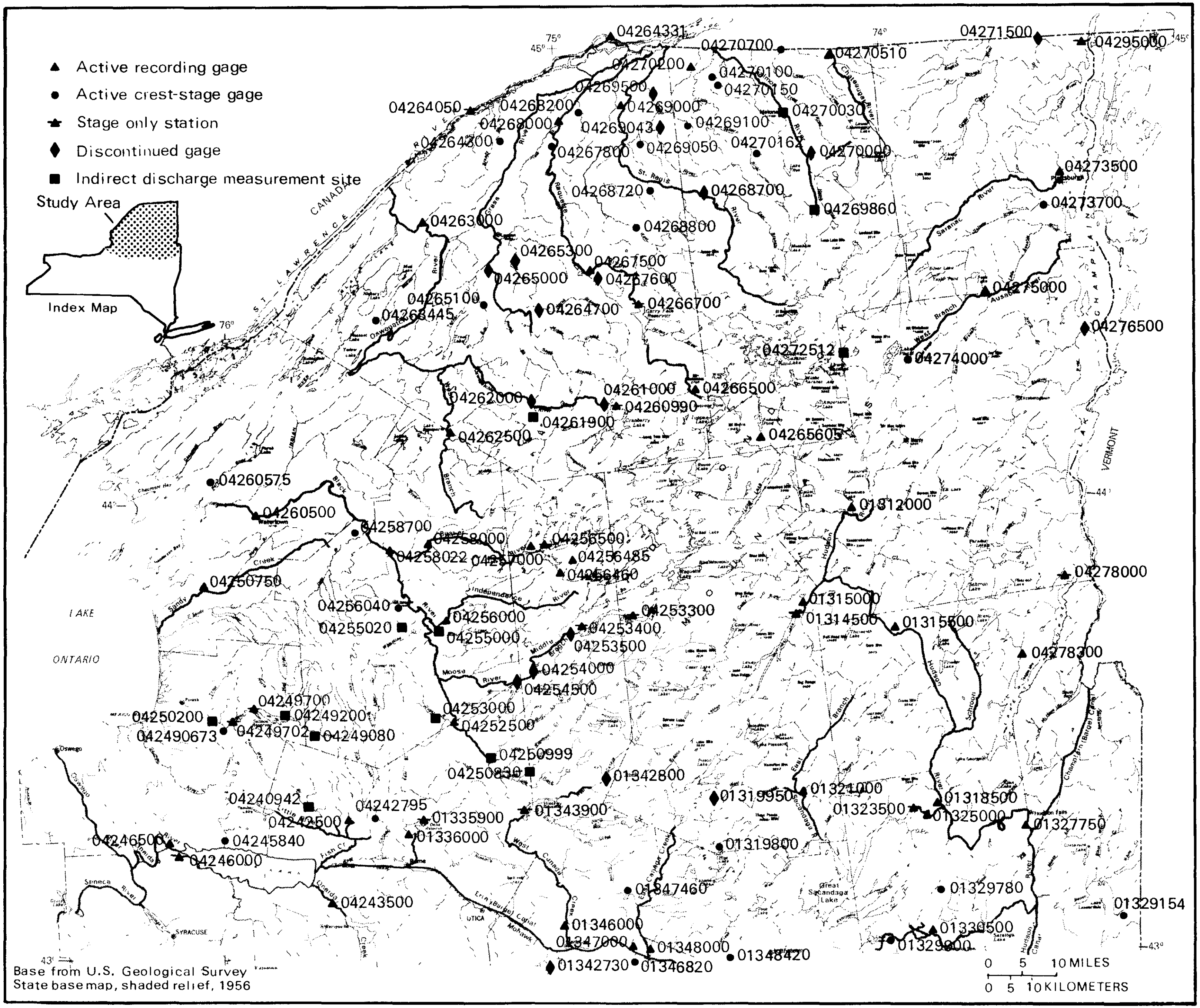


Figure 7.--Location of gaging stations and indirect-measurement sites in northern New York. (Station names are given in table 7.)

statistical average, and two or more 100-year floods could occur within a given year. The recurrence intervals given in table 7 were obtained from a combination of regional flood-frequency relationships for estimating flood magnitudes (Zembrzuski and Dunn, 1979) and log-Pearson Type III analyses of station data (U.S. Geological Survey, 1983).

Data in table 7 indicate that the most severe floods were in the Black River and Salmon River basins (each tributary to Lake Ontario); 12 of the peak discharges at sites in these basins had recurrence intervals equal to or greater than 100 years. Other sites that had peak discharges with recurrence intervals greater than 100 years were West Canada Creek at Nobleboro (01342800), East Branch Fish Creek at Taberg (04242500), West Branch St. Regis River near Parishville (04268800), Salmon River (Franklin County) at Chasm Falls (04270000), and Salmon River (Franklin County) at Malone (04270030). New peak discharges of record were set at 17 gaging stations throughout the study area, eight of which occurred at sites within the Black River basin.

The Black River basin contains several stream-gaging stations and miscellaneous-measurement sites. The relationship between peak discharge and drainage area at 12 of these sites for the flood of December 29-31, 1984, is plotted in figure 8; the curve shows the relation for sites on the Black River; the remaining sites are on major tributaries to the Black River.

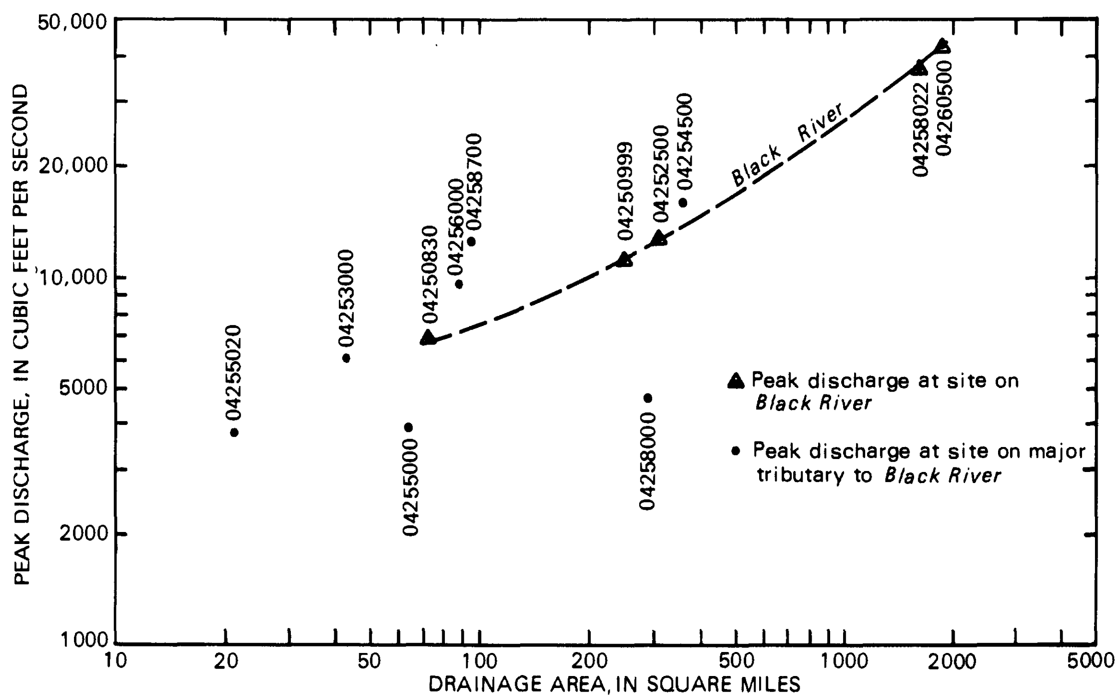


Figure 8.--Relationship of peak discharge to drainage area for sites in the Black River basin during flood of December 29-31, 1984. (Station names are given in table 7.)

Storm Runoff

The volume of storm runoff at all active recording gaging stations in the study area during December 28-29, 1984 through January 6, 1985 was computed; results are given in table 4, and locations of these sites are shown in figure 9. The computation period began on December 28 for sites at which storm runoff was evident on that day. An end date of January 6 was used at all sites for comparison purposes.

Inflows to major reservoirs in the study area were computed for sites where data were available and are included in table 4. The effect of reservoirs on flooding is discussed in the next section. Where data were available, storm runoff was adjusted for change in reservoir content upstream from gaging stations. These adjusted values and runoff values at unregulated sites were used to draw the lines of equal storm runoff shown in figure 9 for December 28-29 through January 6. Data from some sites listed in table 4 were not used for figure 9 if significant amounts of storage in upstream reservoirs were not accounted for.

The general runoff pattern shown in figure 9 compares favorably to that in figure 3 (storm-precipitation map). The highest runoff occurred near Tug Hill and near the southwestern part of the Adirondack Mountains, and the smallest storm runoff was in extreme eastern parts of the study area. Differences between storm precipitation and storm runoff can be attributed primarily to snowmelt, rates of infiltration, unknown degrees of attenuation (storage) of storm runoff by ungaged lakes and reservoirs, variations in basin topography and geology, relative size of drainage basins, location of streamgaging sites relative to precipitation-collection sites, and possible inaccuracies from data interpolation between sites.

Discharge hydrographs for December 26, 1984 through January 10, 1985 are shown in figures 10 for recording-gage sites with peak discharges having recurrence intervals of 10 years or more. The recording interval for these sites ranges from 15 minutes to 1 hour. These hydrographs are presented to show the duration and magnitude of the flood at these sites.

The greatest storm runoff and resulting flood damage occurred in the Salmon River and Black River basins. The magnitude and frequency of the maximum average consecutive 1-, 3-, 7-, 15-, and 30-day stormflows were computed for the Black River near Boonville (04252500), the Black River at Watertown (04260500), and the East Branch Fish Creek at Taberg (04242500) gages to indicate the frequency of this volume of runoff; results are presented in table 5. The East Branch Fish Creek basin is adjacent to the Salmon River basin, and data from the Taberg gage are included to indicate the volume of runoff from the Tug Hill area. Table 5 shows that record 1-day flows occurred at the Boonville and Watertown gages, and a record maximum average 3-day volume of water occurred at the Taberg gage.

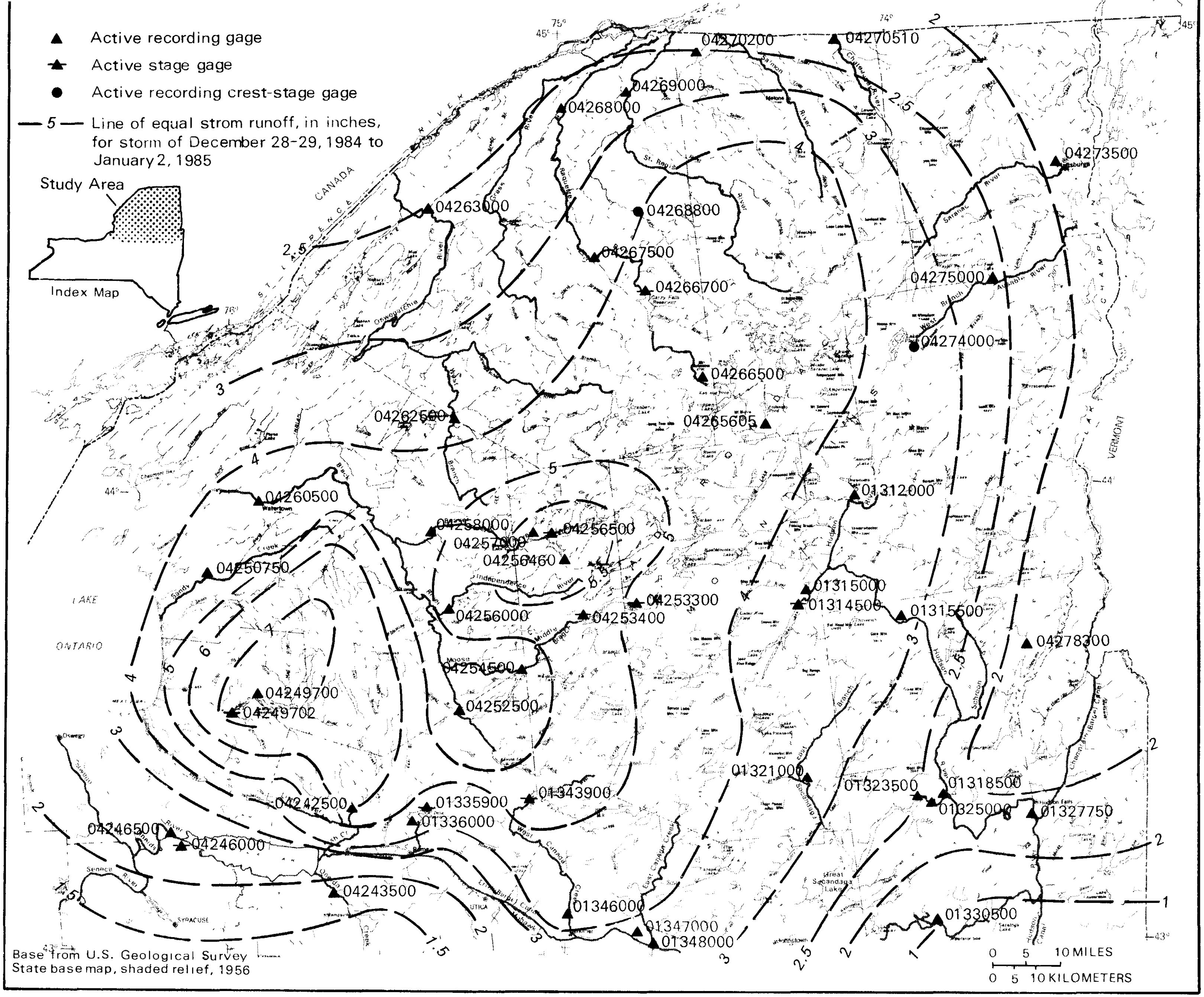


Figure 9.--Location of active recording gaging stations and lines of equal storm runoff, December 28-29, 1984 through January 6, 1985. (Station names are given in table 4.)

Table 4.--Storm runoff at all active recording gaging stations in northern New York, December 28-29, 1984 through January 6, 1985.

[Locations are shown in fig. 9.]

Station number	Station name and location	Drainage area (mi^2)	Period of runoff	Basin storm runoff: Unadjusted (inches)	Basin storm runoff: Adjusted for change in contents of upstream reservoirs* (inches)
01312000	Hudson River near Newcomb	192	12/29-1/6	3.64	--
01314500	Indian Lake near Indian Lake	131	12/28-1/6	a3.62	--
01315000	Indian River near Indian Lake	132	12/28-1/6	.84	b3.59
01315500	Hudson River at North Creek	792	12/28-1/6	2.71	b3.17
01318500	Hudson River at Hadley	1,664	12/28-1/6	1.90	b2.12
01321000	Sacandaga River near Hope	491	12/28-1/6	3.13	--
01323500	Great Sacandaga Lake at Conklingville	1,044	12/29-1/6	a2.53	--
01325000	Sacandaga River at Stewarts Bridge near Hadley	1,055	12/29-1/6	1.05	c2.50
01327750	Hudson River at Fort Edward	2,817	12/29-1/6	1.50	d2.15
01330500	Kayaderosseras Creek near West Milton	90.0	12/29-1/6	1.01	--
01335900	Delta Reservoir near Rome	148	12/28-1/6	a5.09	--
01336000	Mohawk River below Delta Dam near Rome	152	12/28-1/6	2.74	e5.02
01343900	Hinckley Reservoir at Hinckley	372	12/28-1/6	a5.16	--
01346000	West Canada Creek at Kast Bridge	560	12/28-1/6	2.09	f4.18
01347000	Mohawk River near Little Falls	1,342	12/28-1/6	2.71	g3.83
01348000	East Canada Creek at East Creek	289	12/28-1/6	3.89	--
04242500	East Branch Fish Creek at Taberg	188	12/28-1/6	6.00	--
04243500	Oneida Creek at Oneida	113	12/28-1/6	1.68	--
04246000	Oneida Lake at Brewerton	1,382	12/29-1/6	a2.77	--
04246500	Oneida River at Caughdenoy	1,382	12/29-1/6	1.61	h2.77

Table 4.--Storm runoff at all active recording gaging stations in northern New York, December 28-29, 1984 through January 6, 1985 (continued).

Station number	Station name and location	Drainage area (mi^2)	Period of runoff	Basin storm runoff: Unadjusted (inches)	Basin storm runoff: Adjusted for change in contents of upstream reservoirs* (inches)
04249700	Salmon River Reservoir near Orwell	194	12/29-1/6	a7.47	--
04249702	Lower Salmon River Reservoir near Altmar	198	12/29-1/6	a6.70	i7.31
04250750	Sandy Creek near Adams	128	12/28-1/6	4.18	--
04252500	Black River near Boonville	304	12/28-1/6	4.33	--
04253300	Sixth Lake near Old Forge	18.6	12/28-1/6	at2.49	--
04253400	First Lake near Old Forge	53.6	12/28-1/6	a5.23	jt5.32
04254500	Moose River at McKeever	363	12/28-1/6	4.37	jkt4.72
04256000	Independance River Donnattsburg	88.7	12/28-1/6	5.29	--
04256460	Cranberry Pond Outlet near Big Moose	0.60	12/28-1/6	*4.41	--
04256500	Stillwater Reservoir near Beaver River	171	12/28-1/6	a5.58	--
04257000	Beaver River below Stillwater Dam near Beaver River	171	12/28-1/6	.65	m5.58
04258000	Beaver River at Croghan	291	12/28-1/6	1.94	m4.84
04260500	Black River at Watertown	1,864	12/29-1/6	4.07	nt4.59
04262500	West Branch Oswegatchie River near Harrisville	244	12/29-1/6	3.75	--
04263000	Oswegatchie River near Heuvelton	965	12/29-1/6	2.22	P2.57
04265605	Little Simon Pond Outlet near Tupper Lake	2.95	12/28-1/6	4.47	--
04266500	Raquette River at Piercefield	721	12/29-1/6	q2.24	--
04266700	Carry Falls Reservoir near South Colton	872	12/28-1/6	aq2.67	--
04267500	Raquette River at South Colton	937	12/29-1/6	1.92	r2.42
04268000	Raquette River at Raymondville	1,125	12/28-1/6	2.02	r2.44

Table 4.--Storm runoff at all active recording gaging stations in northern New York, December 28-29, 1984 through January 6, 1985 (continued).

Station number	Station name and location	Drainage area (mi^2)	Period of runoff	Basin storm runoff: Unadjusted (inches)	Basin storm runoff: Adjusted for change in contents of upstream reservoirs* (inches)
04268800	West Branch St. Regis River near Parishville	171	12/28-1/6	4.03	--
04269000	St. Regis River at Brasher Center	612	12/29-1/6	2.82	--
04270200	Little Salmon River at Bombay	92.2	12/29-1/6	2.48	--
04270510	Chateaugay River below Chateaugay	151	12/28-1/6	2.23	--
04273500	Saranac River at Plattsburg	608	12/29-1/6	[s]1.73	--
04274000	West Branch Ausable River near Lake Placid	116	12/29-1/6	3.46	--
04275000	East Branch Ausable River at Au Sable Forks	198	12/28-1/6	2.54	--
04278300	Northwest Bay Brook near Bolton Landing	23.4	12/29-1/6	1.87	--

a Computed storm inflow to lake or reservoir
b Adjusted for change in contents of Indian Lake
c Adjusted for change in contents of Great Sacandaga Lake and Stewarts Bridge Pool
d Adjusted for change in contents of Indian Lake, Great Sacandaga Lake, and Stewarts Bridge Pool
e Adjusted for change in contents of Delta Reservoir
f Adjusted for change in contents of Hinckley Reservoir
g Adjusted for change in contents of Delta Reservoir and Hinckley Reservoir
h Adjusted for change in contents of Oneida Lake
i Adjusted for change in contents of Salmon River Reservoir
j Adjusted for change in contents of Sixth Lake
k Adjusted for change in contents of First Lake
m Adjusted for change in contents of Stillwater Reservoir
n Adjusted for change in contents of Stillwater Reservoir, Sixth Lake, and First Lake
p Adjusted for change in contents of Cranberry Lake
q Does not account for storage in Tupper Lake/Raquette Pond and several other upstream lakes and ponds
r Adjusted for change in contents of Carry Falls Reservoir only. Does not account for storage in Tupper Lake/Raquette Pond and several other upstream lakes and ponds.
s Does not account for storage in Saranac Lake
t Does not account for storage in Eighth Lake
u Does not account for unknown amount of storage in upstream swamps and ponds.
* A dash (--) indicates no significant upstream regulation, or change of contents data unavailable.

Table 5.--Magnitude and frequency of maximum average discharge for selected number of consecutive days for gaging stations on Black River near Boonville, Black River at Watertown, and East Branch Fish Creek at Taberg, December 1984 through January 1985.

[Locations are shown in fig. 7.]

Station number and name	Drainage area (mi^2)	Period of record	Number of consecutive days	Flood of December 1984 to January 1985: Maximum average flow (ft^3/s)	Flood of December 1984 to January 1985: Dates	Flood of December 1984 to January 1985: Recurrence interval (years)	Previous maximum of record: Average flow (ft^3/s)	Previous maximum of record: Year
04242500								
East Branch Fish	188	1924	1	9,740	12/29	30	10,900	1972
Creek at Taberg		to	3	6,920	12/29-12/31	>100	6,030	1947
		present	7	4,080	12/29- 1/4	15	4,800	1948
			15	2,140	12/28- 1/11	<2	3,730	1948
			30	1,210	12/28- 1/26	<2	3,250	1947
04252500								
Black River near	304	1911	1	11,100	12/30	>100	10,300	1982
Boonville		to	3	6,700	12/29-12/31	25	7,970	1972
		present	7	4,620	12/29- 1/4	15	5,720	1972
			15	2,580	12/29- 1/12	<2	4,300	1948
			30	1,770	12/29- 1/27	<2	3,510	1972
04260500								
Black River at	1,864	1921	1	39,200	12/31	>100	38,800	1977
Watertown		to	3	35,200	12/31- 1/2	100	36,000	1977
		present	7	26,000	12/30- 1/5	50	27,500	1977
			15	16,000	12/29- 1/12	4	21,400	1948
			30	9,790	12/29- 1/27	<2	16,300	1947

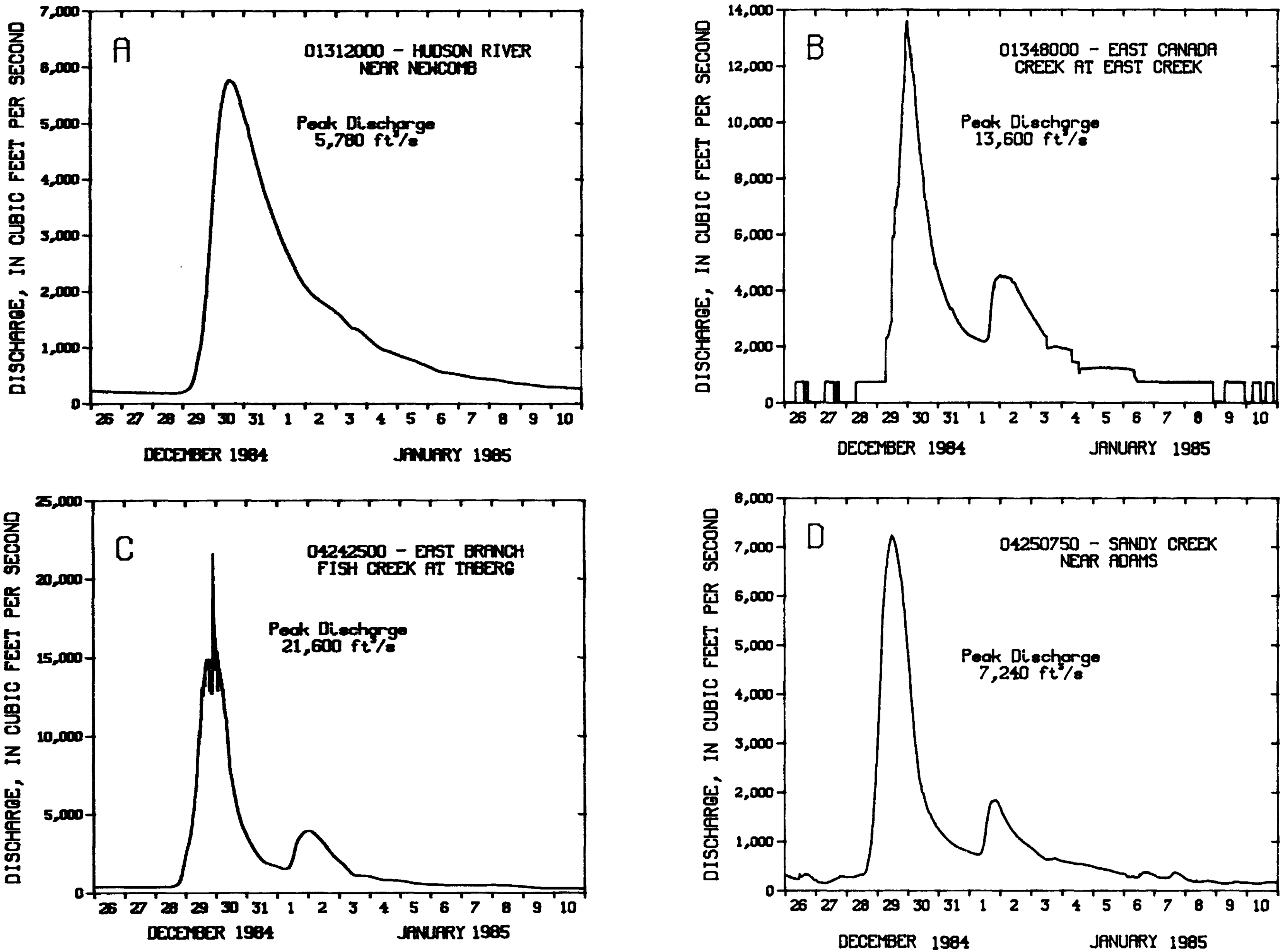


Figure 10A-10D.--*Discharge hydrographs for selected gaging stations in northern New York for December 26, 1984 through January 10, 1985. (Locations are shown in fig. 7.)*

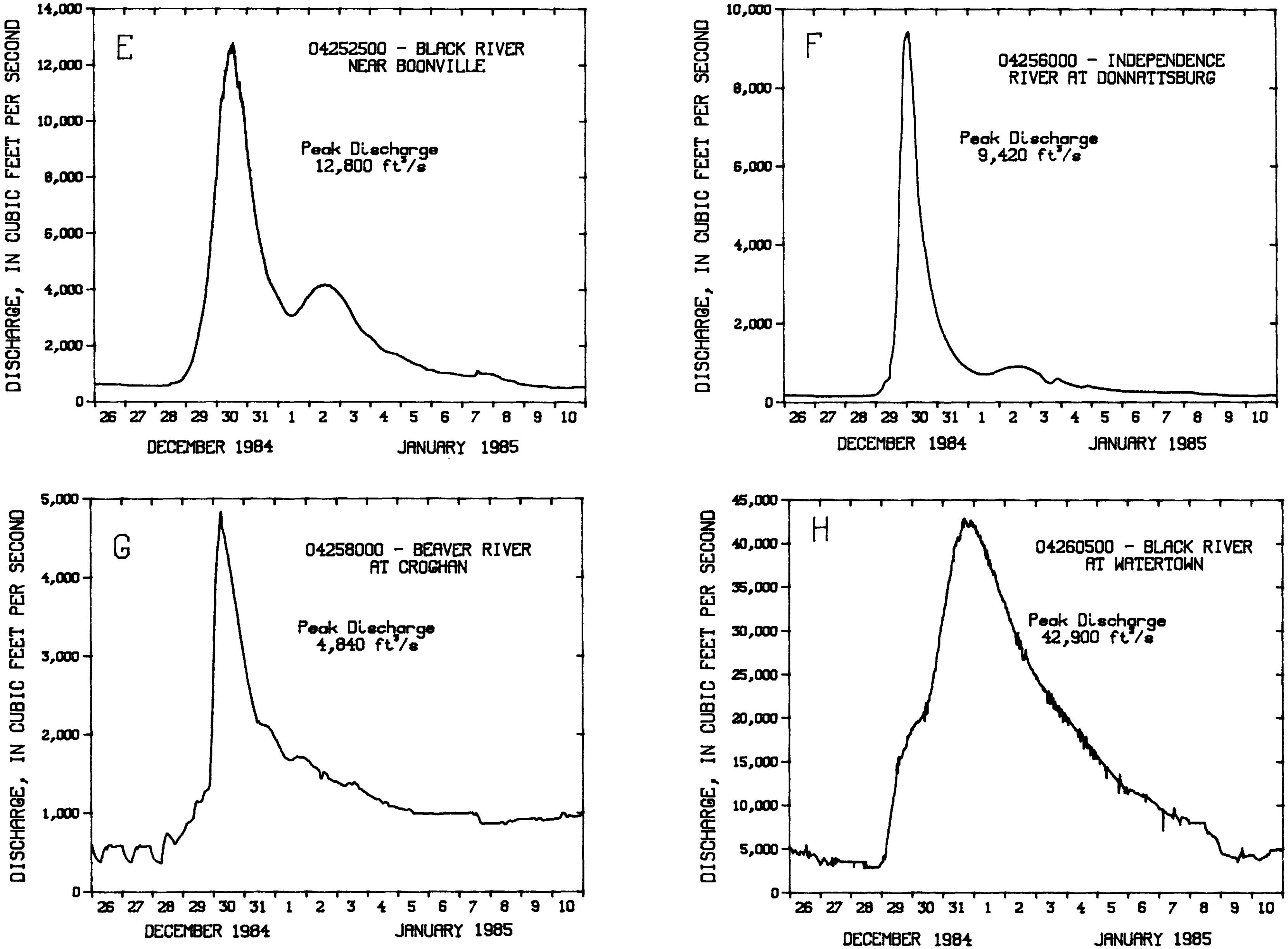


Figure 10E-10H.--*Discharge hydrographs for selected gaging stations in northern New York for December 26, 1984 through January 10, 1985. (Locations are shown in fig. 7.)*

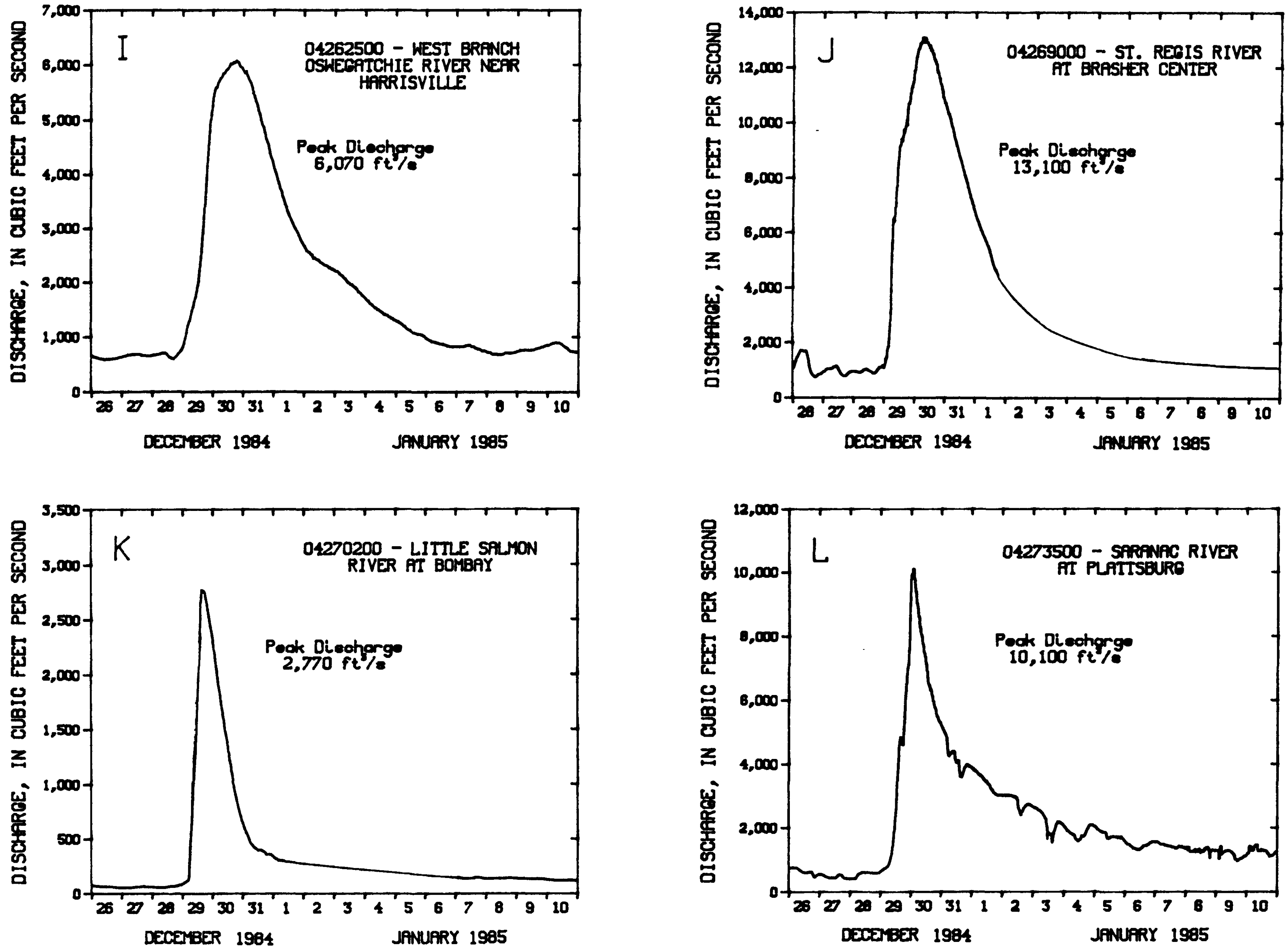


Figure 10I-10L.--Discharge hydrographs for selected gaging stations in northern New York for December 26, 1984 through January 10, 1985. (Locations are shown in fig. 7.)

Effect of Reservoirs

Reservoirs and lakes throughout northern New York had a significant effect on flooding during the storm and subsequent period of runoff. Table 6 contains data from selected lakes and reservoirs in the study area. The change in contents during the period of storm runoff is given from the time just before the lake or reservoir began to rise to the time when the maximum elevation was observed or recorded. Large amounts of storm runoff were stored, particularly in the Hinckley and Stillwater Reservoirs in the Mohawk River and Black River basins, respectively (table 6). During the runoff period, the water-surface elevation in Hinckley Reservoir rose more than 38 ft and stored 3.4 inches (2,964 million ft^3) of storm runoff from December 28 through January 3, and Stillwater Reservoir rose 7.9 ft and stored 5 inches (1,971 million ft^3) of storm runoff from December 28 through January 8.

Hydrographs of daily inflow, outflow, and lake or reservoir elevation for December 26, 1984 through January 10, 1985 are shown in figure 11 for selected lakes and reservoirs in the study area. The hydrographs show the duration and magnitude of the flood at these sites and the relationships between daily inflows, outflows, and lake or reservoir elevations. The following equation for conservation of mass was used to compute daily inflows to the lakes or reservoirs:

$$\text{Inflow} = \text{outflow} \pm \text{change in storage} \qquad (1)$$

Midnight lake or reservoir elevations were used to compute daily changes in storage. The source of lake or reservoir elevations is given in table 6. Daily outflows for many of the lakes and reservoirs listed in figure 11 were obtained from U.S. Geological Survey gaging-station records. Outflows for Sixth Lake (04253300), First Lake (04253400), and Stillwater Reservoir (04256500) were provided by the Hudson River-Black River Regulating District, and those for Hinckley Reservoir (01343900) were provided by New York State Department of Transportation. Outflows for the two Salmon River Reservoirs (04249700 and 04249702) were obtained from Niagara Mohawk Corporation. The area between the inflow and outflow curves in figure 11 represents the amount of water going into storage during the runoff period.

Intermittent lake-elevation readings indicate that peak inflows to Hinckley Reservoir (01343900) and to Salmon River Reservoir (04249700) were about 26,000 ft^3/s and 31,000 ft^3/s, respectively. The maximum inflow to Hinckley Reservoir occurred on December 30 at about 1:00 a.m., while the inflow to Salmon River Reservoir peaked on December 29 at about 2:00 p.m.

Several small reservoirs in the Black River basin, used primarily for diversions to the Mohawk River basin, and also small pools at powerplants, provide storage capacity that probably reduced the storm runoff to some degree. Their effect during the storm was not documented, however.

Table 6.--Data on selected lakes and reservoirs in northern New York during storm runoff, December 1984 through January 1985.

[Locations shown in fig. 7.]

Station number and name	Drainage area (mi^2)	Change in lake or reservoir contents during period of storm runoff: Date	Water-surface elevation* (ft)	Contents (million ft^3)	Percentage of usable capacity	Change in contents (mil ft^3)	Runoff stored (inches)	Spillway crest elevation and maximum usable capacity: Elevation* (ft)	Capacity (mil ft^3)
[1]01314500-Indian Lake near Indian Lake, NY	131	12/28	[a]1,642.20	3,089	68.6	858.0	2.8	1,651.29	4,500
		1/4	[a]1,647.29	3,947	87.7				
[2]01323500-Great Sacandaga Lake at Conklingville, NY	1,044	12/29	[b]749.36	10,750	32.4	3,880	1.6	771.00	33,120
		1/4	[b]753.56	14,630	44.2				
[3]01335900-Delta Reservoir near Rome, NY	148	12/28	[a]543.60	2,100	75.0	916.0	[e]2.0/[f]2.7	550.00	2,800
		1/2	[a]551.80	3,016	107.7				
[3]01343900-Hinckley Reservoir at Hinckley, NY	372	12/28	[a]1,187.16	391.4	11.8	2,964	[e]3.4/[f]3.4	1,225.00	3,320
		1/3	[a]1,225.27	3,355	101.0				
[4]04249700-Salmon River Reservoir near Orwell, NY	194	12/28	[c]933.80	2,426	83.6	790.0	[e]1.1/[f]1.8	937.00	2,901
		12/29	[c]938.90	3,216	110.9				
[4]04249702-Lower Salmon River Reservoir near Altmar, NY	198	12/28	[c]649.20	125.9	91.9	42.5	[e].02/[f].09	651.00	137.0
		12/29	[cg]656.00	168.4	122.9				
[2]04253300-Sixth Lake near Old Forge, NY	18.6	12/28	[a]1,784.30	242.6	81.8	73.20	[e]1.2/[f]1.7	1,786.00	296.6
		12/30	[a]1,786.60	315.8	106.5				
[2]04253400-First Lake at Old Forge, NY	53.6	12/28	[a]1,704.68	584.9	65.3	296.8	2.4	1,707.04	895.6
		1/4	[a]1,706.94	881.7	98.4				
[2]04256500-Stillwater Reservoir near Beaver River, NY	171	12/28	[a]1,671.28	2,609	56.4	1,971	5.0	1,679.30	4,623
		1/8	[a]1,679.15	4,580	99.1				
[5]04260990-Cranberry Lake at Cranberry Lake, NY	140	12/28	[d]1,484.15	1,814	71.7	956.0	[e]2.2/[f]2.9	1,486.43	2,530
		1/1	[d]1,487.55	2,770	109.5				
[4]04266700-Carry Falls Reservoir near South Colton, NY	872	12/28	[a]1,373.10	3,416	66.8	1,136	0.6	1,386.00	5,115
		1/5	[a]1,381.80	4,552	89.0				

* Above sea level
a Reading at 0800 hours
b Reading at 0900 hours
c Reading at 2400 hours
d Reading at 1200 hours
e At 100 percent usable capacity (prior to spillage)
f At time of maximum lake or reservoir water-surface elevation
g Maximum elevation was slightly higher by unknown amount
1 Records furnished by Indian River Company
2 Records furnished by Hudson River-Black River Regulating District
3 Records furnished by New York State Department of Transportation
4 Records furnished by Niagara Mohawk Corporation
5 Records furnished by Oswegatchie River-Cranberry Reservoir Commission

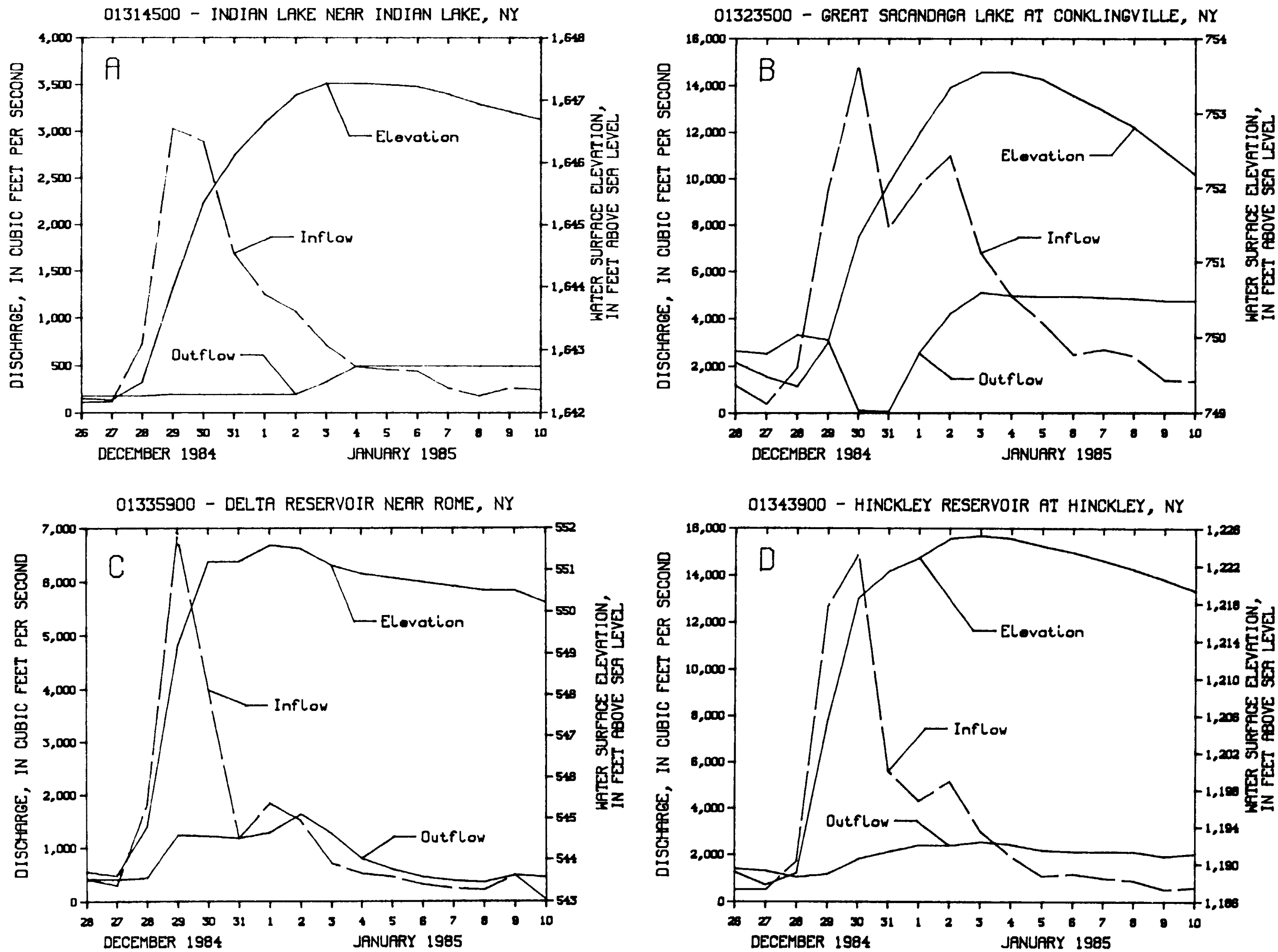


Figure 11A-11D.--Hydrographs of daily inflow, outflow, and lake or reservoir water-surface elevation for selected sites in northern New York for December 26, 1984 through January 10, 1985. (Locations are shown in fig. 7.)

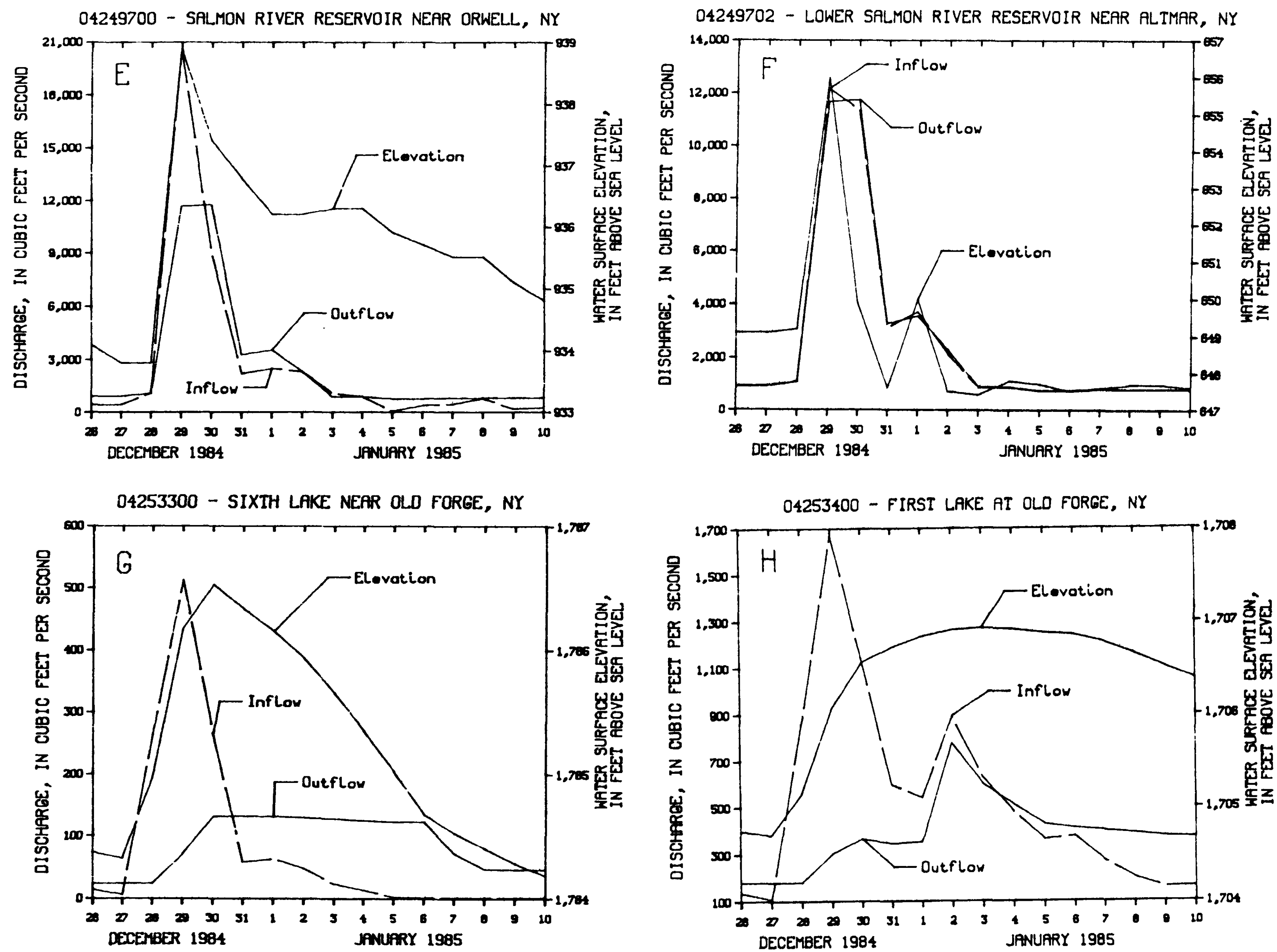


Figure 11E-11H.--Hydrographs of daily inflow, outflow, and lake or reservoir water-surface elevation for selected sites in northern New York for December 26, 1984 through January 10, 1985. (Locations are shown in fig. 7.)

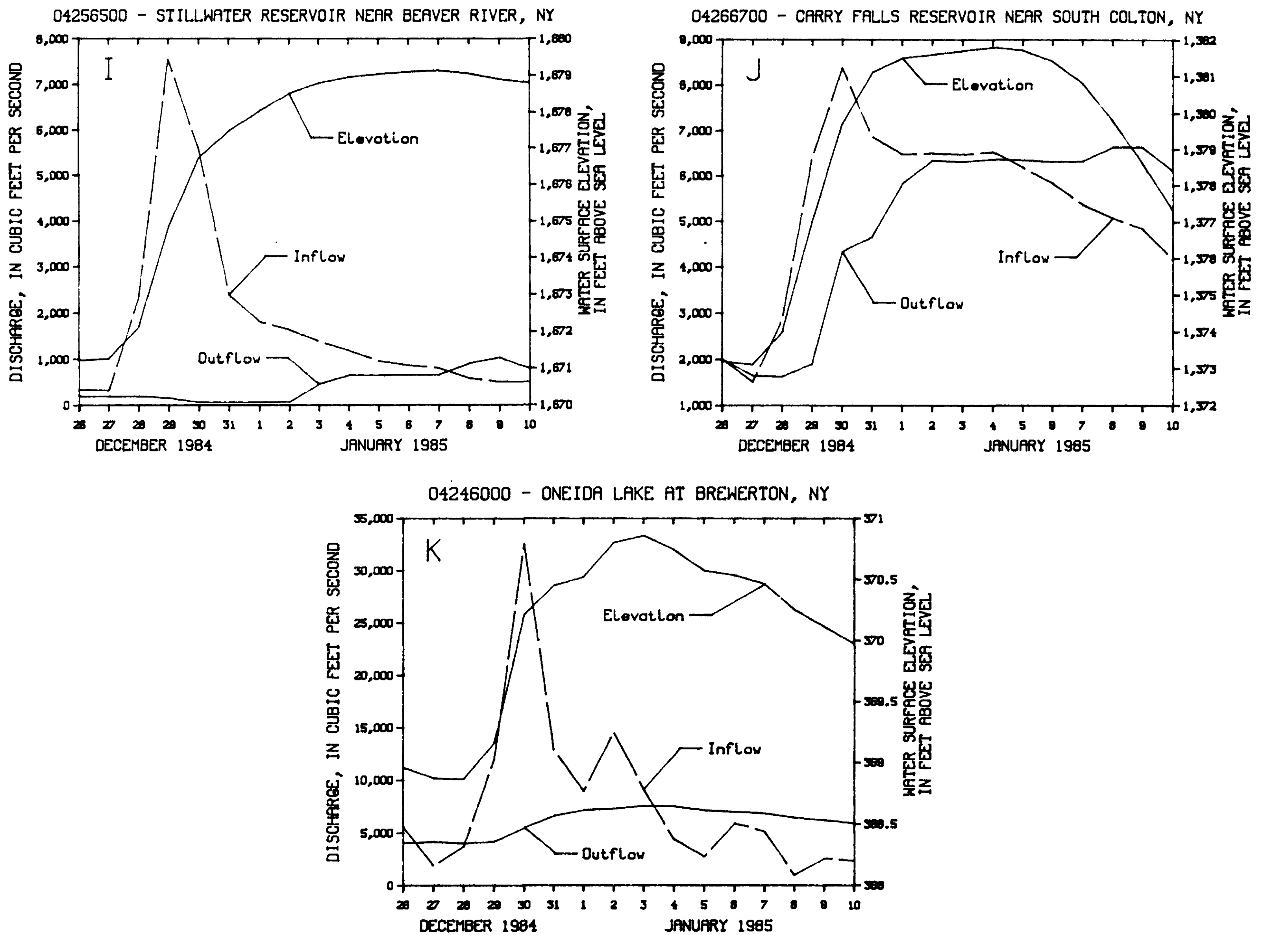


Figure 11I-11K.--Hydrographs of daily inflow, outflow, and lake or reservoir water-surface elevation for selected sites in northern New York for December 26, 1984 through January 10, 1985. (Locations are shown in fig. 7.)

Flood Profiles

The most extensive flood damage was along the Black River and Salmon River. To help document and evaluate the extent and severity of the flood, floodmarks (flood-crest stages) were obtained along a 94-mile reach of the Black River from Dexter to Forestport (fig. 2) and within major communities along the Salmon River. Figure 2 shows the locations of the study reaches and major communities along each reach.

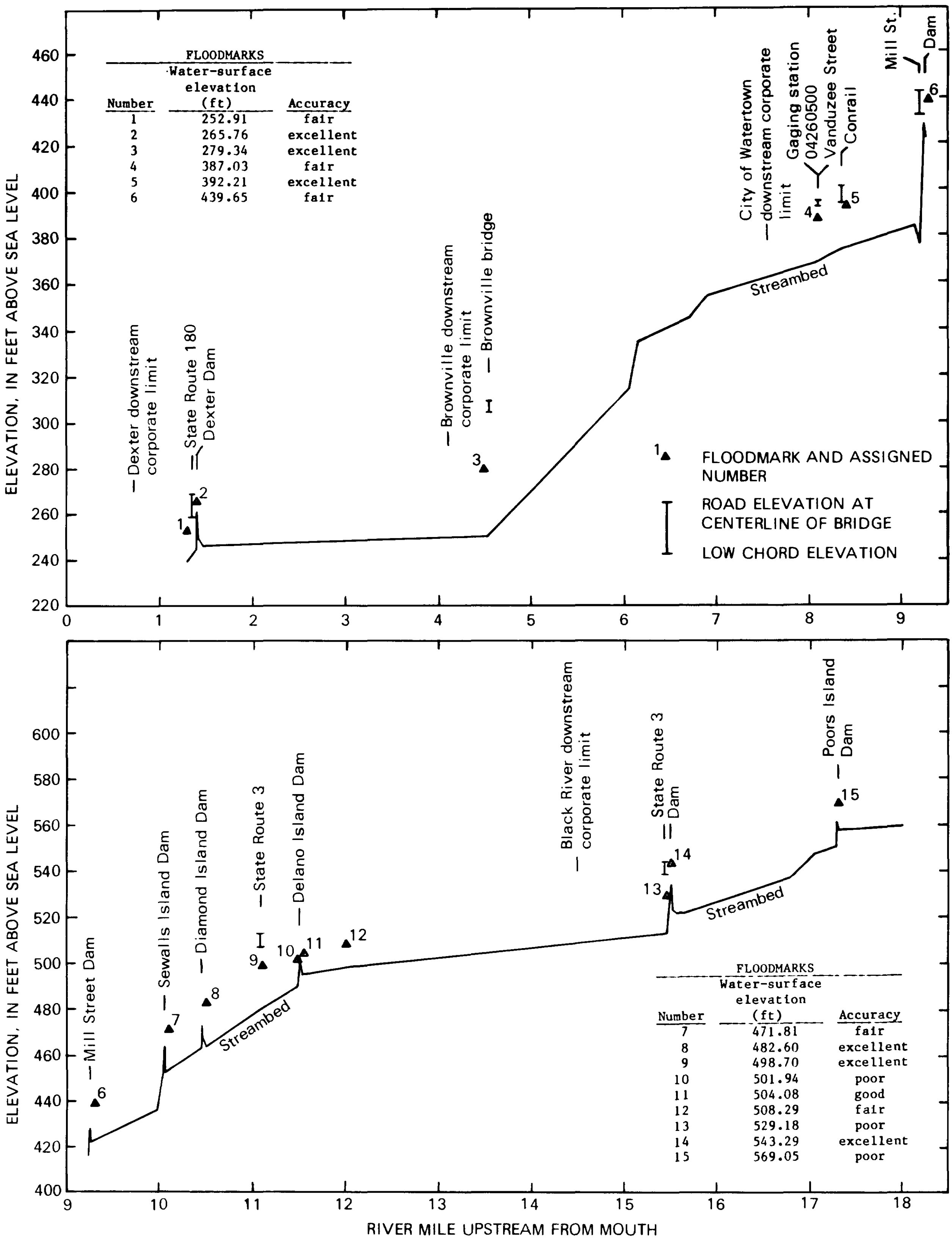
Black River.--After the high water of December 29-31, 1984, 67 floodmarks were identified along a 94-mile reach of the Black River. The water-surface elevations were measured primarily at major bridge and dam crossings and are plotted in figure 12, which also shows stream-bottom elevations, low-chord and road elevation at the centerline of each bridge, elevations of dam crests, several locations of corporate limits and major tributary streams. The floodmark, bridge, and dam-crest elevations, and also stream-bottom elevations at bridges were surveyed in the field. Other streambed elevations were obtained from previous studies (U.S. Army Corps of Engineers, 1974 and 1977) or were estimated from topographic maps of the area. Stream-bottom elevations between surveyed or estimated points were interpolated. The water-surface elevation and degree of accuracy of each floodmark is indicated on figure 12.

An accuracy rating of the floodmarks was assigned in the field according to the type of mark and the field conditions in the immediate area. For example, excellent or good marks are generally seed lines on trees or structures in protected areas; fair marks are usually debris lines or fairly well defined mud lines on the streambank, and poor marks are piles of debris, eroded banks, or poorly defined washlines. A quantitative indication of floodmark accuracy is given below:

Floodmark rating	Accuracy (ft)
excellent	$\pm$ 0.02
good	$\pm$ .05
fair	$\pm$ .10
poor	$> \pm$ .10

Salmon River.--Floodmarks for the high water of December 29-30, 1984, on the Salmon River were identified in the communities of Port Ontario, Pulaski, Pineville, Altmar, and Osceola (fig. 2). The water-surface elevations were measured primarily in the vicinity of bridge crossings and are shown in figure 13, which also indicates streambed elevations and low-chord and road elevation at the centerline of each bridge. All elevations were surveyed in the field except for some stream bottoms, which were estimated from topographic maps.

Several floodmarks were identified in the vicinity of bridges in each community; their elevations are shown on figure 13. An average water-surface-elevation profile is also included. The floodmarks were mostly fair to poor.



FLOODMARKS

Number	Water-surface elevation (ft)	Accuracy
1	252.91	fair
2	265.76	excellent
3	279.34	excellent
4	387.03	fair
5	392.21	excellent
6	439.65	fair

FLOODMARKS

Number	Water-surface elevation (ft)	Accuracy
7	471.81	fair
8	482.60	excellent
9	498.70	excellent
10	501.94	poor
11	504.08	good
12	508.29	fair
13	529.18	poor
14	543.29	excellent
15	569.05	poor

Figure 12.--Water-surface profile of the Black River from Dexter to Forestport during the flood of December 29-31, 1984, river miles 1 to 18 above mouth.

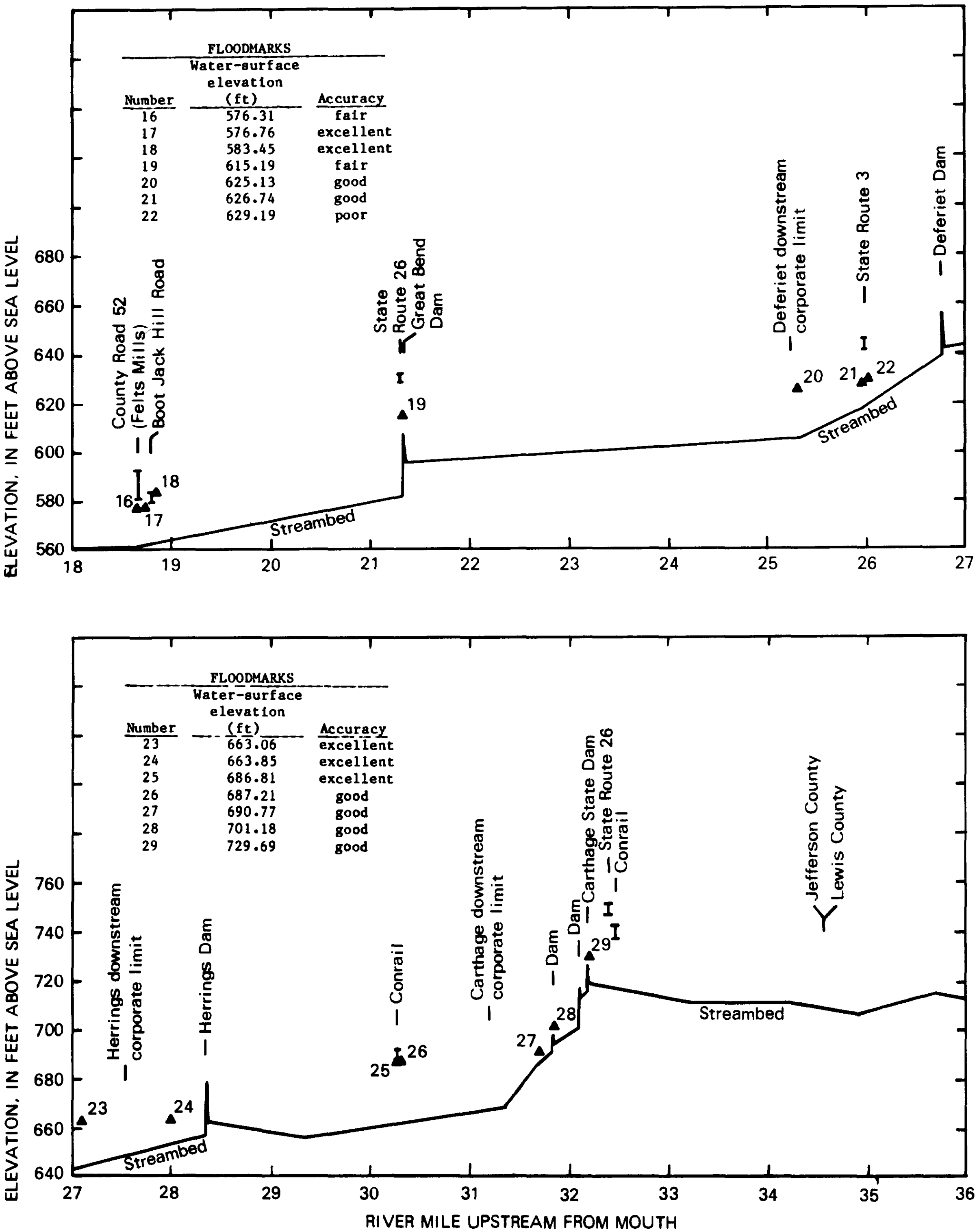


Figure 12 (continued).--Water-surface profile of the Black River from Dexter to Forestport during the flood of December 29-31, 1984, river miles 18 to 36 above mouth.

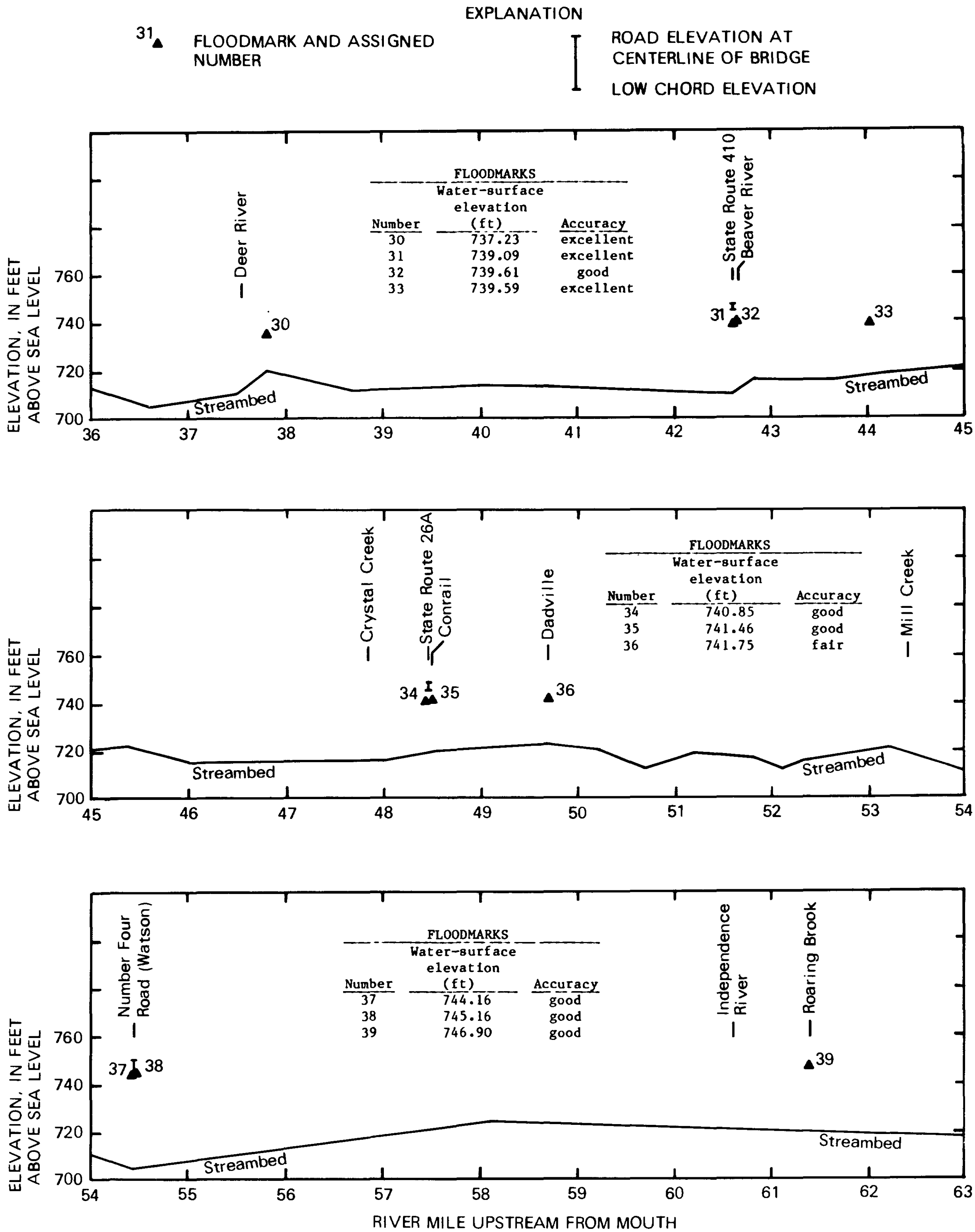
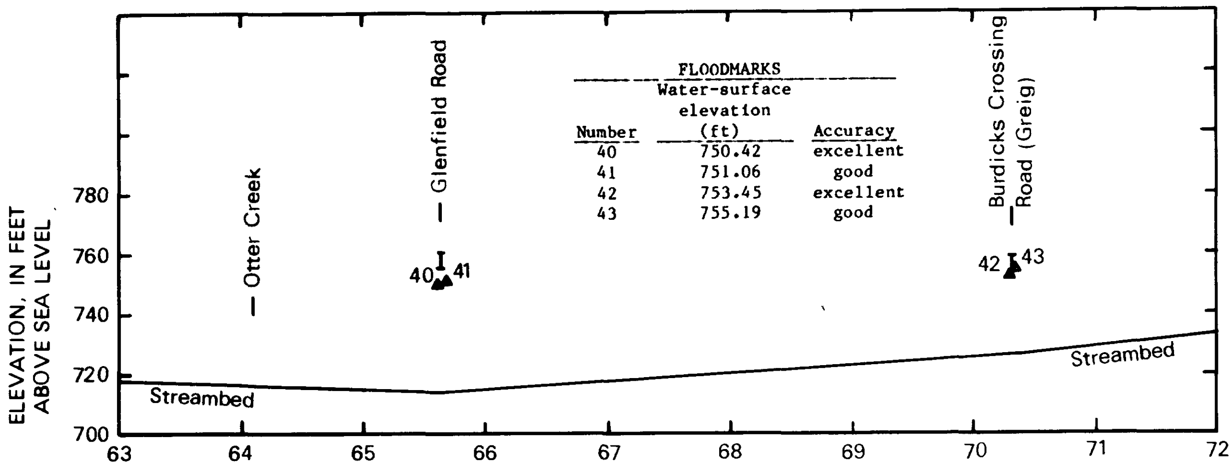
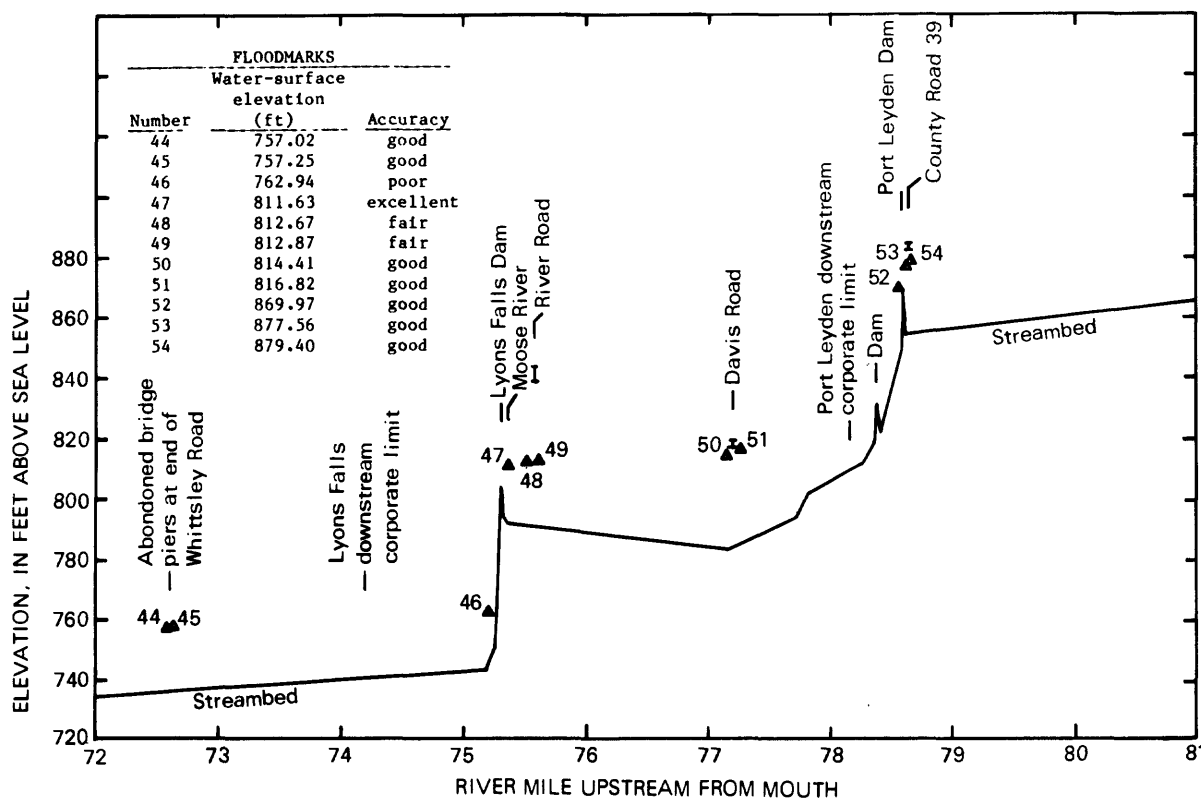


Figure 12 (continued).--Water-surface profile of the Black River from Dexter to Forestport during the flood of December 29-31, 1984, river miles 36 to 63 above mouth.



Number	Water-surface elevation (ft)	Accuracy
40	750.42	excellent
41	751.06	good
42	753.45	excellent
43	755.19	good



Number	Water-surface elevation (ft)	Accuracy
44	757.02	good
45	757.25	good
46	762.94	poor
47	811.63	excellent
48	812.67	fair
49	812.87	fair
50	814.41	good
51	816.82	good
52	869.97	good
53	877.56	good
54	879.40	good

Figure 12 (continued).--Water-surface profile of the Black River from Dexter to Forestport during the flood of December 29-31, 1984, river miles 63 to 81 above mouth.

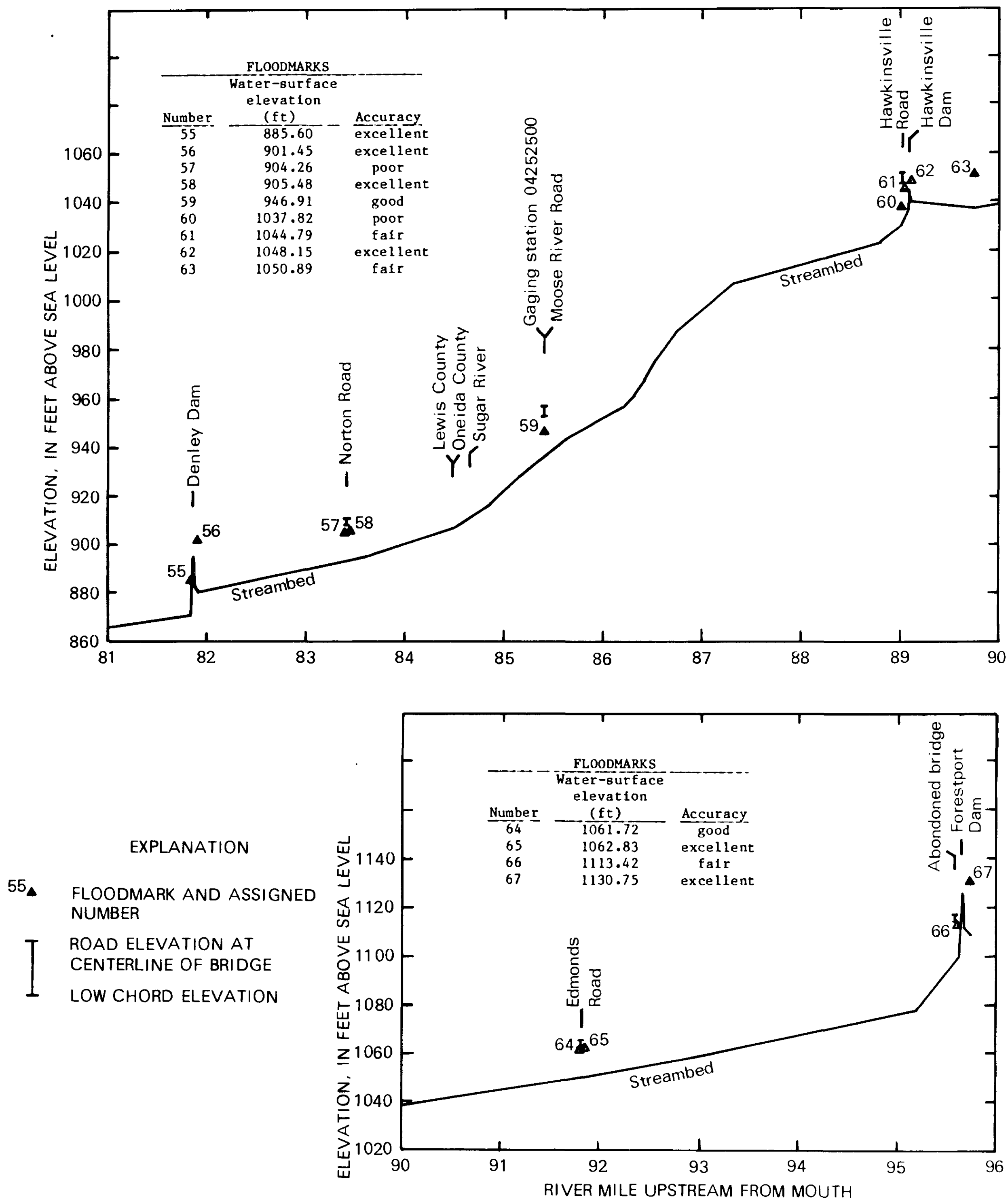
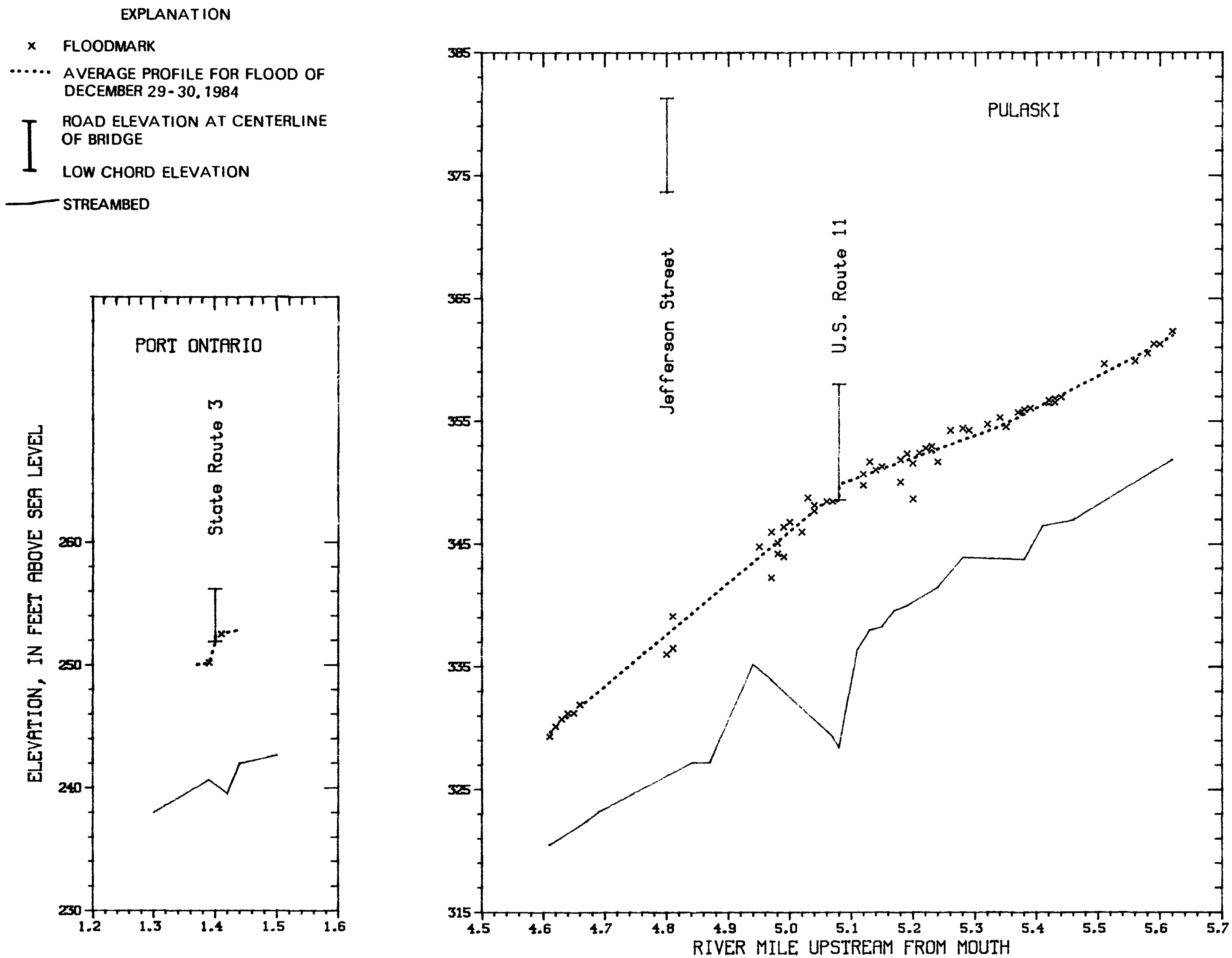


Figure 12 (continued).--Water-surface profile of the Black River from Dexter to Forestport during the flood of December 29-31, 1984, river miles 81 to 96 above mouth.


EXPLANATION
FLOODMARK
AVERAGE PROFILE FOR FLOOD OF DECEMBER 29-30, 1984
ROAD ELEVATION AT CENTERLINE OF BRIDGE
LOW CHORD ELEVATION
STREAMBED
PORT ONTARIO
State Route 3
PULASKI
Jefferson Street
U.S. Route 11
ELEVATION, IN FEET ABOVE SEA LEVEL
RIVER MILE UPSTREAM FROM MOUTH
230
240
250
260
1.2
1.3
1.4
1.5
1.6
315
325
335
345
355
365
375
385
4.5
4.6
4.7
4.8
4.9
5.0
5.1
5.2
5.3
5.4
5.5
5.6
5.7

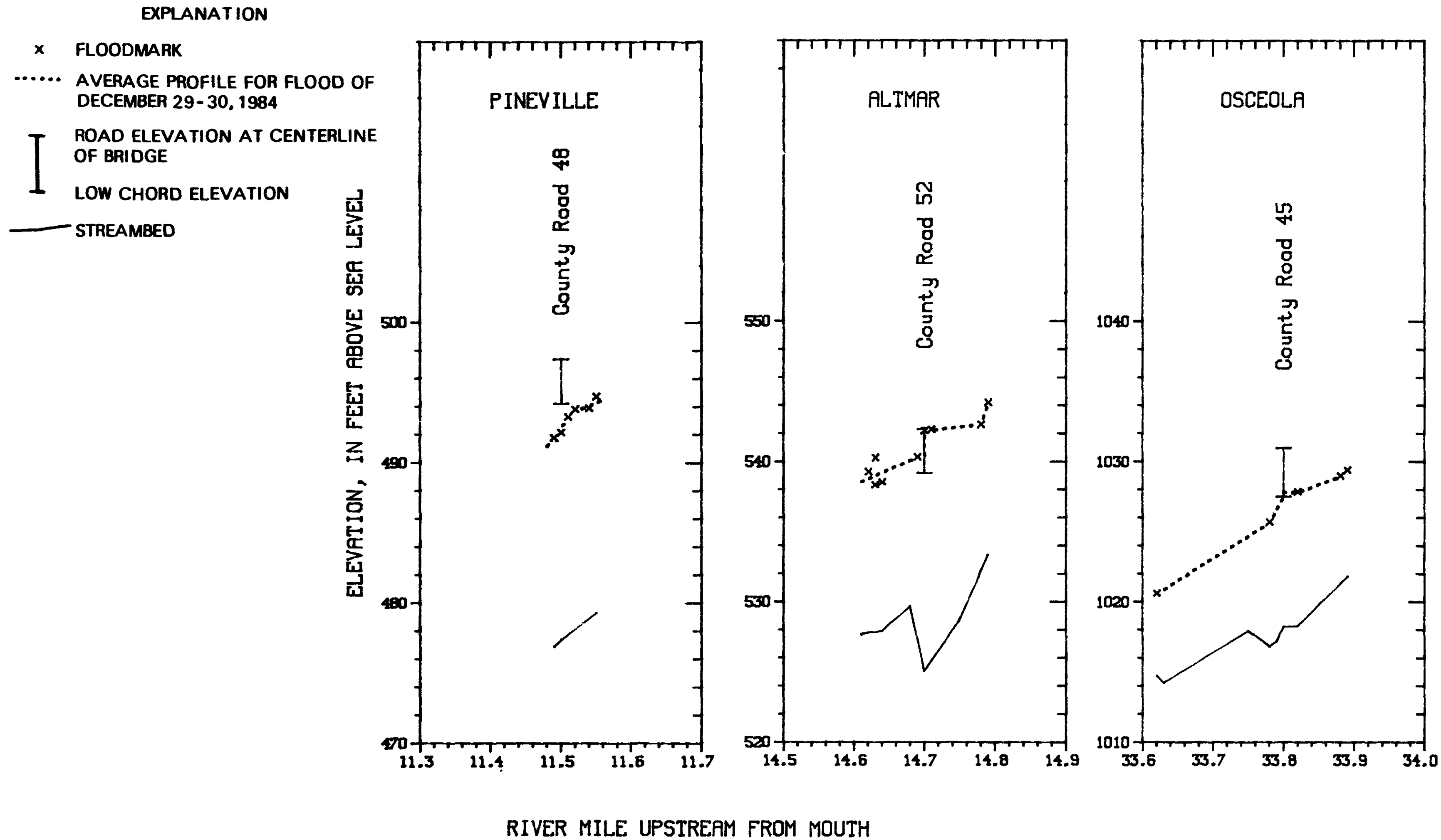


Figure 13.--Water-surface profiles of the Salmon River during the flood of December 29-30, 1984, at Port Ontario, Pulaski, Pineville, Altmar, and Osceola.

SUMMARY

A strong warm front moved into northern New York on December 28-30, 1984, with large amounts of precipitation and unseasonably warm temperatures that caused significant snowmelt and extensive flooding throughout the area. Damage to property, highways, and bridges exceeded $5 million. Almost 6.5 inches of rain fell in some areas, and as much as 2 additional inches fell January 1-2, 1985, from a second, less intense storm.

Analyses of 56 precipitation stations, 101 stage and (or) discharge-gaging stations, and 9 miscellaneous-measurement sites, showed the storms' greatest intensity to be over the Tug Hill area and southwestern Adirondacks, where the Salmon River and Black River originate, respectively. Flooding of these two rivers caused most of the damage. New peak discharges of record occurred at 17 gaging stations, 8 of which are within the Black River basin. Maximum flood discharges at 17 sites had recurrence intervals equal to or greater than 100 years.

Computed inflows to 11 major lakes and reservoirs indicate that significant volumes of water (as much as 5 inches of storm runoff at Stillwater Reservoir) were stored during the storm-runoff period. Maximum 1-day flood volumes at the Black River near Boonville (04252500) and Black River at Watertown (04260500) gaging stations had recurrence intervals greater than 100 years.

To evaluate the extent of flooding, 67 floodmarks were identified along a 94-mile reach of the Black River from Dexter to Forestport, and water-surface elevation profiles in major communities along the Salmon River in Lewis and Oswego Counties were drawn. The floodmarks were primarily at major bridges and dams.

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Table 7.--Summary of peak stages and discharges for floods of December 1984 through January 1985.

[Locations shown in fig. 7.]

Station number	Station name and location	Drainage area (mi^2)	Period of record	Previous flood of record: Date	Previous flood of record: Gage height (ft)	Previous flood of record: Discharge (ft^3/s)	Previous flood of record: Discharge ($\frac{ft^3/s}{mi^2}$)	Flood of December 1984: Date	Flood of December 1984: Gage height (ft)	Flood of December 1984: Discharge (ft^3/s)	Flood of December 1984: Discharge ($\frac{ft^3/s}{mi^2}$)	Recurrence interval (years)
	NORTH ATLANTIC SLOPE BASINS											
HUDSON RIVER BASIN												
[k]01312000	Hudson River near Newcomb	192	1926-current	1/ 1/49	11.40	7,440	38.8	12/30/84	9.58	5,780	30.1	15
[j]01314500	Indian Lake near Indian Lake	131	1901-current	3/28/13	[h]1656.71	--	--	1/ 4/85	[h]1647.29	--	--	--
[k]01315000	*Indian River near Indian Lake	132	1913,16-current	3/28/13	7.80	3,460	26.2	1/ 5/85	2.83	500	3.8	<2
[k]01315500	*Hudson River at North Creek	792	1908-current	12/31/48	12.14	28,900	36.5	12/30/84	9.92	17,000	21.5	4
[k]01318500	*Hudson River at Hadley	1,664	1922-current	1/ 1/49	21.21	42,700	25.7	12/30/84	11.60	19,200	11.5	2
[m]01319800	W Br Sacandaga R at Arietta	28.9	1963-current	3/25/79 3/ 6/79	12.76 [a]13.65	1,940 --	67.1 --	12/29/84	11.86	1,430	49.5	4
[n]01319950	Sand Lake Outlet near Piseco	7.2	1962-83	4/ 9/80 2/20/81	2.72 [a]5.41	475 --	66.0 --	12/29/84	2.60	436	60.6	7
[k]01321000	Sacandaga River near Hope	491	1912-current	3/27/13 3/ 1/55	[qr]11.00 [a]13.32	32,000 --	65.2 --	12/29/84	7.05	11,100	22.6	<2
[k]01323500	Great Sacandaga L at Conklingville	1,044	1931-current	5/ 4/83	[h]773.29	--	--	1/ 4/85	[h]753.57	--	--	--
[k]01325000	*Sacandaga River at Stewarts Bridge near Hadley	1,055	1908-current	3/28/13 5/ 4/83	[r]12.36 9.68	[b]35,500 [s]13,300	33.6 12.6	1/ 3/85	6.28	5,640	5.3	<2
[k]01327750	*Hudson River at Fort Edward	2,817	1977-current	5/ 3/83 1/11/78	28.34 [a]28.71	35,200 --	12.5 --	12/31/84	24.79	19,500	7.0	<2
[m]01329154	Steele Brook at Shushan	2.85	1979-current	3/ 5/79	5.51	115	40.4	1/ 2/85	<2.90	<25	<8.8	<2
[m]01329780	Sessions Bk at Porters Corners	1.04	1968-current	3/14/77	>13.40	[b]80	76.9	1/ 2/85	9.35	7.6	7.3	<2

Station number	Station name and location	Drainage area (mi^2)	Period of record	Previous flood of record				Flood of December 1984				Recurrence interval (years)
				Date	Gage height (ft)	Discharge (ft^3/s)	Discharge ($\frac{ft^3/s}{mi^2}$)	Date	Gage height (ft)	Discharge (ft^3/s)	Discharge ($\frac{ft^3/s}{mi^2}$)	
				NORTH ATLANTIC SLOPE BASINS								
HUDSON RIVER BASIN												
[m]01329900	Glowegee Cr Trib at Mosherville	1.42	1968-75, 1979-current	3/14/77	13.15	139	97.9	1/ 2/85	11.75	47	33.1	<2
[k]01330500	Kayaderosseras Cr nr West Milton	90.0	1928-current	3/18/36 3/14/77	[q]10.78 [q]11.20	4,710 [d]4,250	52.3 47.2	1/ 2/85	3.39	493	5.5	<2
MOHAWK RIVER BASIN												
[j]01335900	Delta Reservoir near Rome	148	1951-current	6/22/72	[h]552.8	--	--	1/ 2/85	[h]551.8	--	--	--
[k]01336000	*Mohawk R below Delta Dam near Rome	152	1922-current	10/ 2/45	11.18	[d]8,560	56.3	1/ 2/85	6.52	2,720	17.9	2
[n]01342730	Steele Creek at Ilion	26.2	1965-83	2/20/81	5.30	1,810	69.1	12/29/84	3.18	618	23.6	<2
[n]01342800	West Canada Creek at Nobleboro	193	1946, 1958-76	10/ 2/45	[q]12.56	[d]16,800	87.0	12/29/84	[q]13.93	20,000	104	>100
[j]01343900	Hinckley Reservoir at Hinckley	372	1915-current	10/ 2/45	[h]1230.2	--	--	1/ 3/85	[h]1225.27	--	--	--
[k]01346000	*West Canada Creek at Kast Bridge	560	1913,21-current	3/26/13 2/17/43	-- [a]10.47	[h]23,300 --	41.6 --	12/29/84	[b]6.1	[b]10,400	18.6	3
[m]01346820	Mohawk R Trib at Indian Castle	1.36	1974-current	3/22/80	5.05	210	154	12/29/84	<1.40	<10	<7.4	<2
[k]01347000	*Mohawk River near Little Falls	1,342	1913,28-current	3/28/13 3/14/77	-- [q]19.17	[h]34,200 33,100	25.5 24.7	12/29/84	14.23	18,000	13.4	<2
[m]01347460	Spruce L Trib nr Salisbury Center	0.54	1975-current	10/17/77 4/18/82	3.94 4.53	72 64	133 118	12/29/84	2.85	30	55.6	<2
[k]01348000	East Canada Creek at East Creek	289	1946-current	10/ 2/45	[q]9.00	[cd]24,000	83.0	12/29/84	7.68	13,600	47.1	25

Table 7.--Summary of peak stages and discharges for floods of December 1984 through January 1985 (continued).

[Locations shown in fig. 7.]

Station number	Station name and location	Drainage area (mi^2)	Period of record	Previous flood of record: Date	Previous flood of record: Gage height (ft)	Previous flood of record: Discharge (ft^3/s)	Previous flood of record: Discharge ($\frac{ft^3/s}{mi^2}$)	Flood of December 1984: Date	Flood of December 1984: Gage height (ft)	Flood of December 1984: Discharge (ft^3/s)	Flood of December 1984: Discharge ($\frac{ft^3/s}{mi^2}$)	Recurrence interval (years)
	NORTH ATLANTIC SLOPE BASINS											
HUDSON RIVER BASIN												
MOHAWK RIVER BASIN												
[m]01348420	North Creek nr Ephratah	6.52	1975-current	6/29/82	8.95	540	82.8	12/29/84	5.62	208	31.9	<2
	ST. LAWRENCE RIVER BASIN											
LAKE ONTARIO BASIN												
OSWEGO RIVER BASIN												
[P]04240942	W Br Fish Creek nr Camden	133	--	--	--	--	--	12/29/84	--	[d]4,410	33.2	10
[k]04242500	E Br Fish Creek at Taberg	188	1924-current	6/22/72 10/ 2/45	11.71 11.90	14,500 13,600	77.1 72.3	12/29/84	[q]13.81	[d]21,600	115	>100
[m]04242795	Canada Creek Trib nr Lee Center	1.34	1977-current	10/ 9/76	6.95	165	123	12/29/84	2.37	[b]42	31.3	3
[k]04243500	Oneida Creek at Oneida	113	1950-current	10/ 9/76	15.01	9,110	80.6	12/30/84	8.10	1,910	16.9	<2
[m]04245840	Scriba Creek near Constantia	38.4	1966-current	9/26/75 6/22/72	7.33 7.42	1,310 1,200	34.1 31.2	12/29/84	6.44	959	25.0	8
[k]04246000	Oneida Lake at Brewerton	1,382	1936,53-current	3/29/36	[h]373.5	--	--	1/ 3/85	370.91	--	--	--
[k]04246500	*Oneida River at Caughdenoy	1,382	1903-12 1948-current	3/25/03	--	[f]13,800	10.0	1/ 1/85	9.84	7,660	5.5	2
LAKE ONTARIO BASIN												
[m]042490673	N Br Grindstone Cr near Altmar	11.2	1976-current	3/13/77	15.03	482	43.0	12/29/84	8.82	241	21.5	<2

Station number	Station name and location	Drainage area (mi^2)	Period of record	Previous flood of record: Date	Gage height (ft)	Discharge (ft^3/s)	Discharge ($ft^3/s/mi^2$)	Flood of December 1984: Date	Gage height (ft)	Discharge (ft^3/s)	Discharge ($ft^3/s/mi^2$)	Recurrence interval (years)
	ST. LAWRENCE RIVER BASIN											
LAKE ONTARIO BASIN												
[p]04249080	Salmon River near Osceola	14.3	--	--	--	--	--	12/29/84	--	[d]1,770	124	40
[n]04249200	N Br Salmon River at Redfield	82.5	1962-64	4/ 4/63	6.85	--	--	12/29/84	--	[d]13,600	165	>100
[j]04249700	Salmon River Reservoir near Orwell	194	--	--	--	--	--	12/29/84	[h]938.91	[h]22,100	114	>100
[j]04249702	Lower Salmon River Reservoir near Altmar	198	--	--	--	--	--	12/29/84	[ht]656.+	[h]22,800	115	>100
[p]04250200	*Salmon River at Pineville	241	--	12/11/52	--	[d]18,200	76.2	12/29/84	--	[d]24,800	103	>100
[k]04250750	Sandy Creek near Adams	128	1958-current	4/ 4/63	11.01	[d]7,640	59.7	12/29/84	[q]10.63	[d]7,240	56.6	15
BLACK RIVER BASIN												
[p]04250830	Black River at Enos	72.3	--	12/11/52	--	[d]2,870	39.7	12/29/84	--	[d]6,770	93.6	>100
[j]04250999	Black River at Forestport	250	--	10/ 2/45	[q]4.30	[d]9,260	37.0	12/30/84	[q]4.81	[b]11,000	44.0	70
[k]04252500	Black River near Boonville	304	1911-current	4/18/82 2/21/81	11.31 [a]13.10	12,800 --	42.1 --	12/30/84	11.41	12,800	42.1	60
[n]04253000	Sugar River at Talcottville	43.1	1927-31, 1953, 1968-69	4/10/69	5.74	[d]5,390	125	12/29/84	--	[d]5,860	136	50
[j]04253300	Sixth Lake near Old Forge	18.6	1913-current	10/ 3/45	[h]1787.1	--	--	12/30/84	[h]1786.60	--	--	--
[j]04253400	First Lake at Old Forge	53.6	1913-current	6/17/72	[h]1707.9	--	--	1/ 4/85	[h]1706.94	--	--	--

Table 7.--Summary of peak stages and discharges for floods of December 1984 through January 1985 (continued).

[Locations shown in fig. 7.]

Station number	Station name and location	Drainage area (mi^2)	Period of record	Previous flood of record: Date	Previous flood of record: Gage height (ft)	Previous flood of record: Discharge (ft^3/s)	Previous flood of record: Discharge (ft^3/s / mi^2)	Flood of December 1984: Date	Flood of December 1984: Gage height (ft)	Flood of December 1984: Discharge (ft^3/s)	Flood of December 1984: Discharge (ft^3/s / mi^2)	Recurrence interval (years)
	ST. LAWRENCE RIVER BASIN											
LAKE ONTARIO BASIN												
BLACK RIVER BASIN												
[n]04253500	*Middle Br Moose R at Old Forge	55.0	1912-73	3/23/21	--	[f]862	15.7	1/ 2/85	[q]4.80	750	13.6	25
[n]04254000	*Middle Br Moose R near McKeever	151	1926-68	4/27/26 12/22/58	6.60 [a]7.51	2,100 --	13.9 --	12/29/84	[q]7.60	3,200	21.2	>100
[n]04254500	*Moose River at McKeever	363	1902-70	6/ 3/47	[q]17.45	[c]18,700	51.5	12/29/84	[h]16.00	15,800	43.5	>100
[n]04255000	Otter Creek near Glenfield	64.5	1925-33, 1953	4/ 8/28	7.10	[d]2,130	33.0	12/29/84	[e]762.44	[d]3,820	59.2	>100
[p]04255020	Roaring Brook at Martinsburg	21.4	--	12/11/52	--	[d]2,030	94.9	12/29/84	--	[d]3,680	172	>100
[k]04256000	Independance R at Donnattsburg	88.7	1943-current	4/18/82	9.73	5,530	62.3	12/30/84	13.34	[d]9,420	106	>100
[m]04256040	Mill Creek Trib near Lowville	1.66	1976-current	3/ 5/79	13.41	312	188	12/29/84	12.26	224	135	4
[k]04256460	Cranberry Pond Outlet nr Big Moose	0.60	1984-current	2/15/84	1.79	11	18.3	12/29/84	[a]2.98	[b]70	117	10
[j]04256500	Stillwater Reservoir nr Beaver River	171	1909-current	5/20/69	[h]1680.08	--	--	1/ 8/85	[h]1679.15	--	--	--
[j]04257000	*Beaver R below Stillwater Dam nr Beaver River	171	1909-current	5/ 3/26	--	[bh]3,700	21.6	1/ 9/85	--	[fh]1,040	6.1	<2
[k]04258000	*Beaver River at Croghan	291	1931-current	5/21/69	6.98	5,100	17.5	12/30/84	6.83	4,840	16.6	60
[k]04258022	*Black River at Castorland	1,612	1985	--	--	--	--	12/31/84	739.20	36,900	22.9	[b]90
[m]04258700	Deer River at Deer River	94.8	1957-current	4/ 4/63 3/ 6/79	9.60 [a]11.10	[d]11,400 --	120 --	12/29/84	10.63	12,400	131	100

Station number	Station name and location	Drainage area (mi^2)	Period of record	Previous flood of record: Date	Gage height (ft)	Discharge (ft^3/s)	Discharge ($\frac{ft^3/s}{mi^2}$)	Flood of December 1984: Date	Gage height (ft)	Discharge (ft^3/s)	Discharge ($\frac{ft^3/s}{mi^2}$)	Recurrence interval (years)
	ST. LAWRENCE RIVER BASIN											
LAKE ONTARIO BASIN												
BLACK RIVER BASIN												
[k]04260500	*Black River at Watertown	1,864	1869, 1921-current	4/23/1869 3/16/77	-- 12.98	[b]39,700 39,600	21.3 21.2	12/31/84	13.15	42,900	23.0	100
LAKE ONTARIO BASIN												
[m]04260575	Horse Creek Trib near Dexter	4.59	1976-current	3/13/77	14.43	700	152	12/29/84	<9.72	<72	<15.7	<2
ST. LAWRENCE RIVER MAIN STEM												
[j]04260990	Cranberry Lake at Cranberry Lake	140	1924-current	5/13-15/71	[h]18.5	--	--	1/ 1/85	[h]17.8	--	--	--
[n]04261000	*Oswegatchie R at Cranberry Lake	140	1923-82	5/13/43	7.70	1,940	13.9	1/ 1/85	[q]6.76	1,200	8.6	4
[p]04261900	Little R at Oswegatchie	61.0	--	--	--	--	--	12/29/84	--	[d]2,850	46.7	10
[n]04262000	*Oswegatchie R nr Oswegatchie	259	1925-68	4/12/47 4/26/26	6.98 7.30	4,090 3,730	15.8 14.4	1/ 1/85	[q]6.06	2,850	11.0	4
[k]04262500	W Br Oswegatchie R nr Harrisville	244	1917-current	3/15/77 1/ 9/30	9.31 9.60	7,080 6,920	29.0 28.4	12/30/84	8.74	6,070	24.9	20
[k]04263000	*Oswegatchie R nr Heuvelton	965	1917-current	4/ 6/60	10.36	19,600	20.3	1/ 2/85	6.67	9,100	9.4	2
[m]04263445	Birch Creek at Pierces Corners	1.56	1976-current	4/ 3/78	4.90	85	54.5	12/29/84	<3.19	<46	<29.5	<2
[k]04264050	St Lawrence R nr Waddington	298,500	1976-current	4/ 6/76	[f]244.80	--	--	1/14/85	242.05	--	--	--

Table 7.--Summary of peak stages and discharges for floods of December 1984 through January 1985 (continued).

[Locations shown in fig. 7.]

Station number	Station name and location	Drainage area (mi^2)	Period of record	Previous flood of record: Date	Previous flood of record: Gage height (ft)	Previous flood of record: Discharge (ft^3/s)	Previous flood of record: Discharge ($\frac{ft^3/s}{mi^2}$)	Flood of December 1984: Date	Flood of December 1984: Gage height (ft)	Flood of December 1984: Discharge (ft^3/s)	Flood of December 1984: Discharge ($\frac{ft^3/s}{mi^2}$)	Recurrence interval (years)
	ST. LAWRENCE RIVER BASIN											
ST. LAWRENCE RIVER MAIN STEM												
[m]04264300	Brandy Brook nr Waddington	27.0	1959-current	3/13/77 3/19/73	8.75 [a]9.65	941 --	34.8 --	12/29/84	5.73	166	6.1	<2
[i]04264331	*St Lawrence R at Cornwall, Ontario, near Massena	298,800	1972-current	6/22/76	--	[fh]352,000	1.2	1/27/85	--	[fh]245,000	0.8	<2
[n]04264700	N Br Grass River near Clare	46.3	1959-69	4/ 4/63	7.59	1,290	27.9	12/29/84	[q]7.76	1,420	30.7	40
[n]04265000	Grass River at Pyrites	333	1925-77	11/18/27 3/15/77	[q]13.00 13.24	[b]8,300 6,930	24.9 20.8	12/29/84	[q]12.20	6,180	18.6	7
[m]04265100	Elm Creek near Hermon	32.6	1959-current	4/ 6/74	9.07	[b]1,270	39.0	12/29/84	6.60	526	16.1	<2
[n]04265300	Little River near Canton	42.4	1959-76	4/ 5/74	8.32	3,300	77.8	12/29/84	[q]7.58	2,300	54.2	9
[k]04265605	Little Simon Pond Outlet near Tupper Lake	2.95	1984-current	4/17/84	2.76	35	11.9	12/29/84	3.78	150	50.8	4
[k]04266500	*Raquette River at Piercefield	721	1909-current	5/ 8/72	12.25	8,360	11.6	1/ 4/85	10.41	5,690	7.9	3
[j]04266700	Carry Falls Res. nr South Colton	872	1955-current	6/ 1/55	[h]1386.1	--	--	1/ 5/85	[h]1381.8	--	--	--
[k]04267500	*Raquette River at South Colton	937	1954-current	5/11/71	9.80	9,720	10.4	1/ 9/85	8.68	7,600	8.1	4
[n]04267600	Cold Brook near South Colton	18.7	1962-76	3/29/63 4/ 5/74	3.11 3.58	768 651	41.1 34.8	12/29/84	[q]3.60	679	36.3	15
[m]04267800	Trout Brook at Allen Corners	54.2	1959-current	4/ 5/74	12.40	[d]3,350	61.8	12/29/84	6.55	501	9.2	<2
[k]04268000	*Raquette River at Raymondville	1,125	1944-current	4/ 5/74 2/22/54	8.40 [a]9.24	13,000 --	11.6 --	1/10/85	6.24	7,980	7.1	3

Station number	Station name and location	Drainage area (mi^2)	Period of record	Previous flood of record: Date	Previous flood of record: Gage height (ft)	Previous flood of record: Discharge (ft^3/s)	Previous flood of record: Discharge ($\frac{ft^3/s}{mi^2}$)	Flood of December 1984: Date	Flood of December 1984: Gage height (ft)	Flood of December 1984: Discharge (ft^3/s)	Flood of December 1984: Discharge ($\frac{ft^3/s}{mi^2}$)	Recurrence interval (years)
				ST. LAWRENCE RIVER BASIN								
ST. LAWRENCE RIVER MAIN STEM												
[m]04268200	Plum Brook near Grantville	43.9	1959-68, 1971- current	3/30/63	6.94	1,920	43.7	12/29/84	<4.52	<382	<8.7	<2
[n]04268700	St Regis River at St Regis Falls	234	1959-68	4/ 4/63	6.13	3,730	15.9	12/29/84	[q]7.00	4,800	20.5	50
[m]04268720	Hopkinton Brook at Hopkinton	20.0	1962- current	3/18/73 2/15/84	3.93 [a]5.24	783 --	39.2 --	12/29/84	3.98	804	40.2	15
[m]04268800	W Br St Regis R nr Parishville	171	1959- current	4/ 4/63	6.12	4,260	24.9	12/29/84	7.37	5,960	34.9	>100
[k]04269000	St Regis River at Brasher Center	612	1911- current	4/ 6/37 4/ 6/37	12.82 [ab]15.30	16,800 --	27.5 --	12/30/84	11.80	13,100	21.4	20
[n]04269043	Deer River at North Lawrence	78.0	1973-78	3/23/77 1/ 8/73	6.18 [a]12.03	3,740 --	47.9 --	12/29/84	--	[d]1,500	19.2	<2
[m]04269050	Allen Brook near Brasher Falls	16.0	1961- current	12/ 9/80 3/ 5/79	5.27 [a]5.94	1,270 --	79.4 --	12/29/84	4.69	786	49.2	5
[m]04269100	Lawrence Brook near Moira	25.7	1959- current	3/14/77 3/31/60	6.22 [a]6.99	1,060 --	41.2 --	12/29/84	6.33	1,280	49.8	15
[n]04269500	Deer R at Brasher Iron Works	182	1913-16, 1959-80	1/17/13	[r]9.30	9,700	53.3	12/29/84	[q]6.60	3,520	19.3	4
[p]04269860	Duane Stream nr Duane Center	6.28	--	--	--	--	--	12/29/84	--	[d]370	58.9	5
[n]04270000	*Salmon River at Chasm Falls	132	1926-82	4/25/26	5.00	2,890	21.9	12/29/84	[q]5.63	3,700	28.0	>100
[p]04270030	*Salmon River at Malone	180	--	--	--	--	--	12/29/84	--	[d]4,670	25.9	>100
[m]04270100	W Br Deer Cr at Fort Covington Center	32.4	1962- current	4/ 5/74	8.23	2,050	63.3	12/29/84	7.02	1,340	41.4	7

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[Locations shown in fig. 7.]

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ST. LAWRENCE RIVER BASIN												
ST. LAWRENCE RIVER MAIN STEM												
[m]04270150	E Br Deer Cr at Fort Covington Center	23.9	1962-current	3/14/77 3/ 5/79	7.45 [a]8.16	1,740 --	72.8 --	12/29/84	6.01	912	38.2	4
[m]04270162	E Br Little Salmon R nr Skerry	7.11	1978-current	6/20/78	6.80	240	33.8	12/29/84	4.45	143	20.1	<2
[k]04270200	Little Salmon R at Bombay	92.2	1959-current	4/ 4/74	12.90	3,250	35.2	12/29/84	11.80	2,770	30.0	10
[k]04270510	*Chateaugay R below Chateaugay	151	1966-current	4/ 4/74 2/11/66	7.33 [a]10.99	5,200 --	34.4 --	12/29/84	5.48	1,610	10.7	<2
[m]04270700	Trout River at Trout River	107	1960-current	4/ 5/74	9.10	6,490	60.7	12/29/84	8.24	5,280	49.3	20
LAKE CHAMPLAIN BASIN												
[n]04271500	*Great Chazy R at Perry Mills	247	1929-68	4/ 7/37 3/ 9/46	9.74 [a]11.50	6,000 --	24.3 --	12/30/84	[q]7.60	3,680	14.9	3
[p]04272512	*Saranac River at Saranac Lake	187	--	4/21/82	--	[g]922	4.9	12/30/84	--	[d]708	3.8	<2
[k]04273500	*Saranac River at Plattsburgh	608	1904-30, 1944-current	4/ 8/28	[r]12.80	[d]11,500	18.9	12/30/84	10.08	10,100	16.6	30
[m]04273700	Salmon R at South Plattsburgh	61.9	1960-current	12/14/83 4/ 3/60	5.79 [a]7.31	1,890 1,010	30.5 16.3	12/29/84	3.03	504	8.1	<2
[m]04274000	W Br Ausable R nr Lake Placid	116	1920-68, 1983-current	9/22/38	12.20	10,800	93.1	12/29/84	9.71	6,150	53.0	15
[k]04275000	E Br Ausable R at Au Sable Forks	198	1925-current	9/22/38	12.91	20,100	102	12/29/84	8.15	7,600	38.4	3
[n]04276500	Bouquet R at Willsboro	275	1924-68	10/ 1/24	10.85	11,800	42.9	12/30/84	[q]6.30	3,500	12.7	<2

Station number	Station name and location	Drainage area (mi^2)	Period of record	Previous flood of record: Date	Previous flood of record: Gage height (ft)	Previous flood of record: Discharge (ft^3/s)	Previous flood of record: Discharge ($\frac{ft^3/s}{mi^2}$)	Flood of December 1984: Date	Flood of December 1984: Gage height (ft)	Flood of December 1984: Discharge (ft^3/s)	Flood of December 1984: Discharge ($\frac{ft^3/s}{mi^2}$)	Recurrence interval (years)
	ST. LAWRENCE RIVER BASIN											
ST. LAWRENCE RIVER MAIN STEM												
LAKE CHAMPLAIN BASIN												
k04278000	Lake George at Rogers Rock	233	1914-current	4/ 9/36	5.09	--	--	1/ 1/85	3.67	--	--	--
k04278300	Northwest Bay Bk nr Bolton Landing	23.4	1966-current	2/11/81 2/11/81	6.35 a7.14	1,770 --	75.6 --	12/30/84	2.59	204	8.7	<2
k04295000	Richelieu R (Lake Champlain) at Rouses Point	8,277	1869, 1872-current	5/4/1869	hq102.1	--	--	1/ 1/85	96.75	--	--	--

* Peak discharge at station affected by regulation
a Affected by backwater
b Estimated
c Affected by dam failure
d Peak discharge determined by indirect measurement
e Elevation, in feet above sea level, at site 0.7 miles downstream from gage
f Maximum daily average
g Miscellaneous discharge measurement
h From source other than U.S. Geological Survey
i No gage - discharge determined from summation of discharge through dams, diversions, and navigation canals
j Active nonrecording gage
k Active recording gage
m Active crest-stage gage
n Discontinued gaging station
p Miscellaneous site
q From floodmark
r At different site and/or datum different than most recent
s Maximum discharge since construction of Conklingville Dam in 1930
t Maximum elevation was slightly higher by unknown amount