

In cooperation with the
Federal Emergency Management Agency

Flooding of the Androscoggin River during December 18-19, 2003, in Canton, Maine

Open File Report 2005-1176

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

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By Robert W. Dudley

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U.S. Geological Survey

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U.S. Geological Survey

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U.S. Geological Survey, Reston, Virginia: 2005

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Conversion Factors

Inch/Pound to SI

Multiply	By	To obtain
inch (in.)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
square mile (mi ²)	2.590	square kilometer (km ²)
cubic foot per second (ft ³ /s)	0.02832	cubic meter per second (m ³ /s)

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

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

Flooding of the Androscoggin River during December 18-19, 2003, in Canton, Maine

by Robert W. Dudley

Abstract

The Androscoggin River flooded the town of Canton, Maine in December 2003, resulting in damage to and (or) evacuation of 44 homes. Streamflow records at the U.S. Geological Survey (USGS) streamflow-gaging stations at Rumford (USGS station identification number 01054500) and Auburn (01059000) were used to estimate the peak streamflow for the Androscoggin in the town of Canton for this flood (December 18-19, 2003). The estimated peak flood streamflow at Canton was approximately 39,800 ft³/s, corresponding to an estimated recurrence interval of 4.4 years; however, an ice jam downstream from Canton Point on December 18-19 obstructed river flow resulting in a high-water elevation commensurate with an open-water flood approximately equal to a 15-year event. The high water-surface elevations attained during the December 18-19 flood event in Canton were higher than the expected open-water flood water-surface elevations; this verified the assumption that the water-surface elevation was augmented due to the downstream ice jam.

The change in slope of the riverbed from upstream of Canton to the impoundment at the downstream corporate limits, and the river bend near Stevens Island are principal factors in ice-jam formation near Canton. The U.S. Army Corps of Engineers Ice Jam Database indicates five ice-jam-related floods (including December 2003) for the town of Canton: March 13, 1936; January 1978; March 12, 1987; January 29, 1996; and December 18-19, 2003. There have been more ice-jam-related flood events in Canton than these five documented events, but the exact number and nature of ice jams in Canton cannot be determined without further research.

Introduction

The town of Canton is in eastern Oxford County in southwestern Maine (fig. 1). The population of Canton in 2000 was 1,121 (Maine Register, 2002) with the major population center in downtown Canton near the outlet of Anasagunticook Lake along Whitney Brook (fig. 2). The Androscoggin River flows through the town of Canton; it enters the town from the west, where Canton borders the towns of Peru and Dixfield, and exits the town to the east where Canton borders the town of Jay. Approximately 2,470 mi² (square miles) of the 3,524-mi² Androscoggin River Basin is upstream from the downstream

corporate limits of the town of Canton (Federal Emergency Management Agency, 1989).

The most up-to-date Flood Insurance Study (FIS) for Canton (Federal Emergency Management Agency, 1989) noted that significant flooding has occurred in the community in past years; the most notable floods in recent history were those of March 1936 and April 1987. The March 1936 flood had a recurrence interval estimated to be greater than 100 years, and the April 1987 flood had a recurrence interval estimated to be 75 years (Federal Emergency Management Agency, 1989).

The present report was done by the U.S. Geological Survey (USGS) in cooperation with the Federal Emergency Management Agency (FEMA). The purpose of this report is to document the results of a study to estimate the peak streamflow for the Androscoggin in Canton and place the December 2003 flood event in context with the existing FIS for Canton (Federal Emergency Management Agency, 1989). The report also provides a map showing the 100-year flood line from the existing Flood Insurance Rate Map (FIRM), and locations of flooded structures as identified by the Canton Fire Department. The 10-year flood elevations from the existing FIS are delineated on the map in relation to the flooded structures.

Flooding of the Androscoggin River during December 18-19, 2003, in Canton, Maine

During December 18-19, 2003, rainfall combined with snowmelt runoff resulted in high streamflows on the Androscoggin River. A USGS precipitation gage at the streamflow-gaging station on the Androscoggin River at Rumford (01054500), approximately 15 mi (miles) upstream from Canton, recorded 3.23 in. (inches) of precipitation during a 16-hour period beginning December 17 at 1000 (local time) and ending December 18 at 0230. The town of Canton, Maine experienced ice-jam related flooding from the Androscoggin River that resulted in damage to and (or) evacuation of 44 homes (Wayne Dube, Town of Canton Fire Department, written communication, 2004).

Andrew Tuthill, an engineer with the U.S. Army Engineer Research and Development Center Cold Regions Research and Engineering Laboratory, noted antecedent meteorological and hydrologic conditions favorable for ice jamming: "The ice jam floods resulted from an unusually cold December accompanied by above average river discharges. A thaw with nearly 3 inches

2

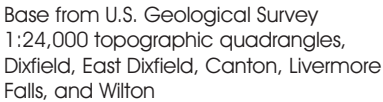


Figure 1. Location of the town of Canton, Maine

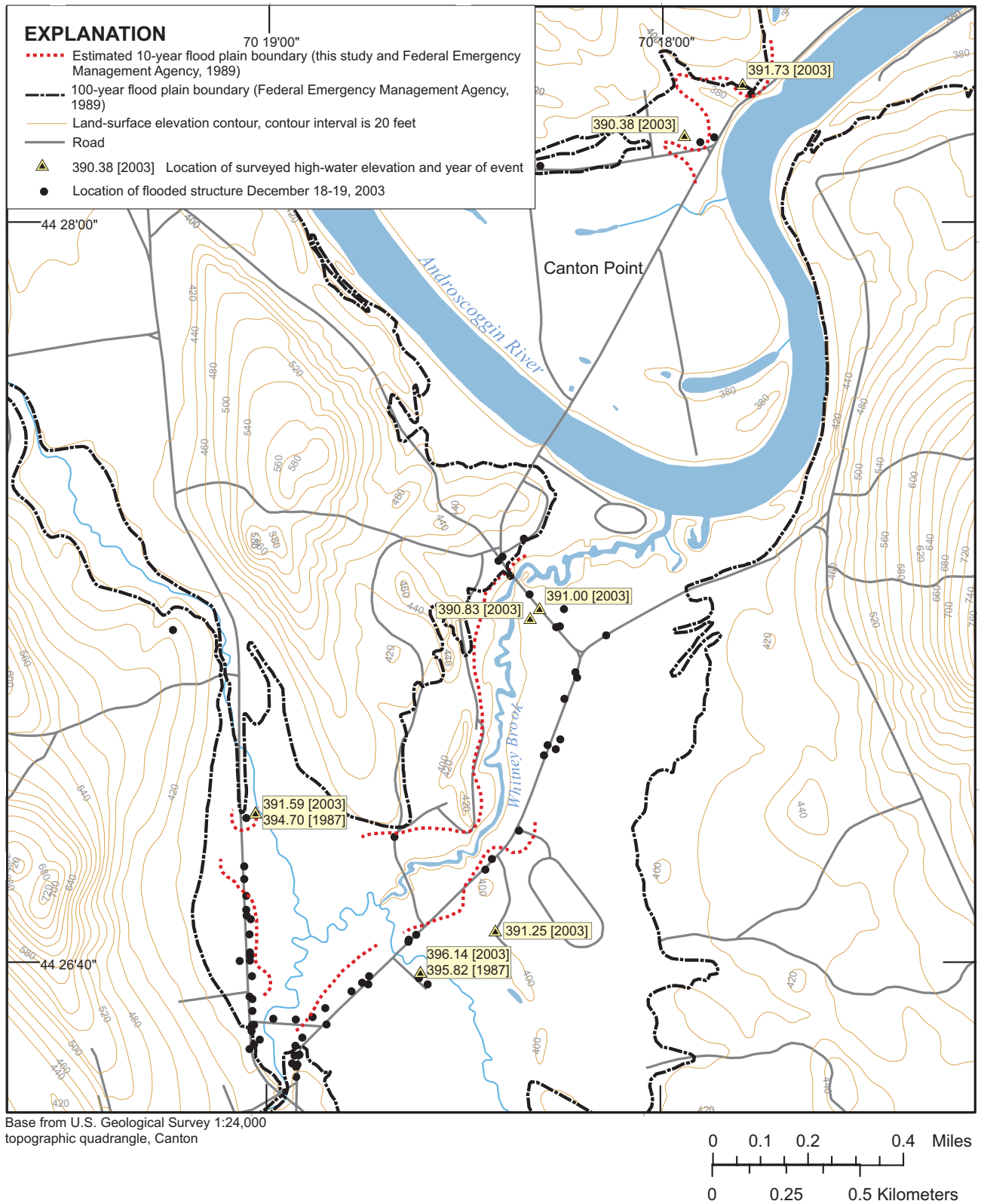


Figure 2. Locations of high-water elevations for floods in December 2003 and April 1987, structures flooded in the December 2003 flood, and the 100-year and estimated 10-year floodplains in Canton, Maine.

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of rain on December 18th broke up the Androscoggin ice cover below Rumford, and the ice jammed in the sharp bend below Canton Point along Stevens Island. ... The low temperatures and high discharges resulted in above average frazil ice production and thicker-than-normal ice covers on the rivers. When the ice covers broke up on Dec 11 and again on Dec 17, discharge was sufficiently high that the added resistance to flow due to ice jams was enough to cause flooding at many locations” (Tuthill, 2003).

Tuthill (2003) reports that ice-jam-related flooding in Canton is “...not that uncommon.” The change in the slope of the riverbed from upstream of Canton to the impoundment at the downstream corporate limits, and the river bend near Stevens Island are principal factors in ice-jam formation near Canton (Katherine White, U.S. Army Corps of Engineers Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory, oral commun., 2004). The U.S. Army Corps of Engineers Ice Jam Database indicates five ice-jam related floods (including December 2003) for the town of Canton: March 13, 1936; January 1978; March 12, 1987; January 29, 1996; and December 18-19, 2003. There have been more ice-jam-related flood events in Canton than the five listed in the ice-jam database. For example, an ice-jam flood event in the spring of 1986, undocumented in the ice-jam database, “...caused stages at least 3 ft higher than the Dec. 18, 2003 event” (Tuthill, 2003). The exact number and nature of ice jams in the town of Canton cannot be determined without further research.

USGS streamflow-gaging stations on the Androscoggin River at Rumford (01054500) and near Auburn (01059000) recorded flooding during December 18-19, 2003, upstream and downstream (respectively) from the town of Canton (figs. 3, 4). The station at Rumford, approximately 15 mi upstream of the town of Canton, measures streamflow draining a basin of 2,068 mi². The station near Auburn, approximately 43 mi downstream of the town of Canton, measures streamflow draining a basin of 3,263 mi² (Stewart and others, 2004). During the flood of December 18-19, 2003, the peak streamflow of 35,200 ft³/s occurred at the Rumford station on December 18 at 1945 Eastern Standard Time (EST); the peak streamflow of 48,000 ft³/s occurred at the Auburn station on December 19 at 1645 EST.

Based on flood flows recorded at the Rumford and Auburn stations, the peak streamflow on the Androscoggin River in Canton is estimated to have occurred during the early morning hours of December 19. The magnitude of the December 18-19 peak streamflow at the Canton-Jay corporate limits was computed by adjusting the hydrograph data from the USGS streamflow-gaging stations at Rumford and near Auburn using a drainage-area-adjustment formula (Hodgkins, 1999). The two adjusted peak-streamflow values (from the Rumford and Auburn stations) were combined in a drainage-area-weighted average and yielded an estimated peak streamflow of 39,800 ft³/s at the Canton-Jay corporate limits.

Peak streamflows and their recurrence intervals for the USGS streamflow-gaging stations at Rumford and near Auburn were computed by Hodgkins in 1999 (Hodgkins, 1999). Using the same drainage-area-adjustment technique, peak flows for selected recurrence intervals for the Androscoggin River at the Canton-Jay corporate limits were computed (table 1). Recurrence intervals were computed on the basis of a log-space interpolation of data in table 1. Peak streamflow at the USGS station at Rumford during the December 18-19, 2003 event (35,200 ft³/s) approximately corresponds to the 4.3-year annual flood (table 1). Peak streamflow at the USGS station near Auburn (48,000 ft³/s) approximately corresponds to the 3.9-year annual flood (table 1). The estimated peak streamflow at the Canton-Jay corporate limits (39,800 ft³/s) approximately corresponds to the 4.4-year annual flood.

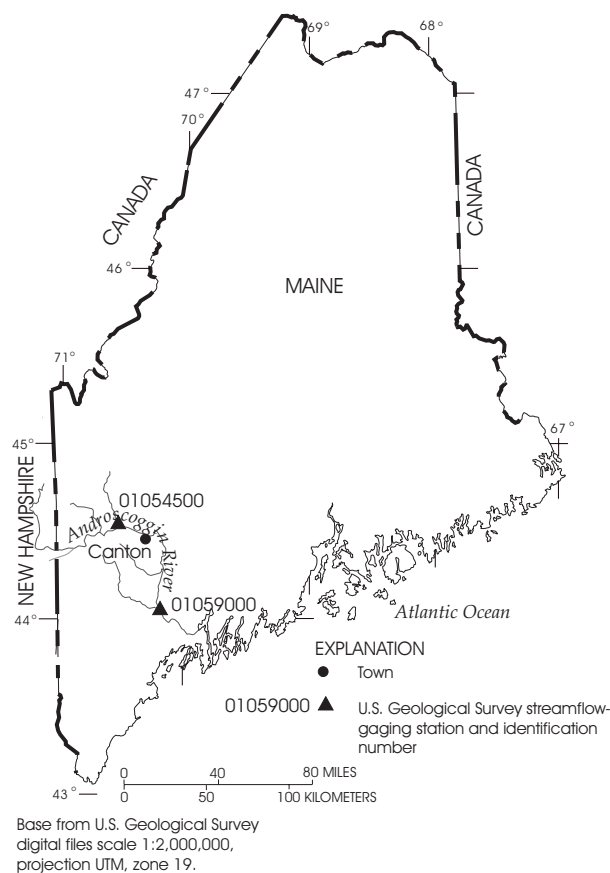


Figure 3. Locations of USGS streamflow-gaging stations at Rumford (USGS station identification number 01054500) and Auburn (01059000) on the Androscoggin River.

Peak streamflows with 10-, 50-, 100-, and 500-year recurrence intervals were computed for the Canton FIS in 1989 (table 2) (Federal Emergency Management Agency, 1989). The peakstreamflows computed for this hydrologic analysis differ from those cited in the Canton FIS because of the availabil-

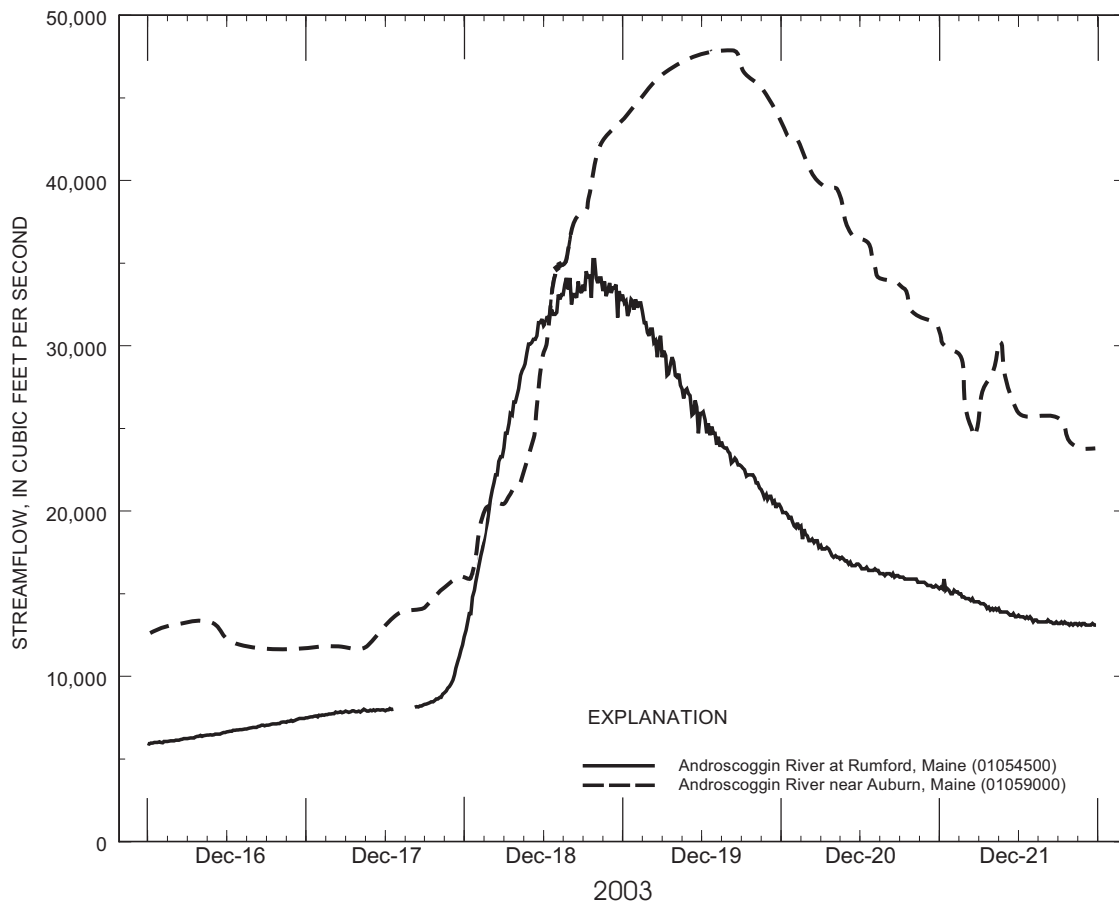


Figure 4. Streamflow for the Androscoggin River measured at Rumford (01054500) and near Auburn (01059000) during December 16-21, 2003. Missing record on December 17, 2003, at station near Auburn represented by gap in line. Data are provisional and subject to revision.

ity of additional streamflow data. Based on the FIS-published peak streamflows, the December 18-19, 2003 peak streamflow at the Canton-Jay corporate limits (39,800 ft³/s) has a recurrence interval of less than 10 years. For a given recurrence interval, peak streamflows computed for the Androscoggin River at the Canton-Jay corporate limits are not expected to be substantially different from peak streamflows below the confluence with Whitney Brook.

High-water elevations for the December 18-19, 2003, flood were surveyed May 20-28, 2004. Seven anecdotal high-water elevations associated with the December 18-19 flood were identified by citizens of Canton and range from 390.38 ft to 396.14 ft NAVD 88 (table 3). The 396.14 ft high-water elevation may have been erroneously identified because the remaining six high-water marks have a maximum elevation of 391.73 ft NAVD 88 (table 3). The locations of surveyed high-water elevation points are shown on figure 2. Two additional high-water elevations, associated with the flood of April 1987,

were identified by citizens of Canton during surveying May 20-28, 2004 (table 3); these points also are shown on figure 2. On the basis of a semi-log-space interpolation of flood-profile elevations from the Canton FIS (Federal Emergency Management Agency, 1989), the average high-water elevation during December 18-19, 2003, near the mouth of Whitney Brook due to backwater from the Androscoggin River (390.9 ft NAVD 88; average of the two points closest to the mouth (fig.2)) is commensurate with an open-water flood approximately equal to a 15-year event (table 2, fig. 2).

Flood elevations corresponding to the April 1, 1987, flood event identified by citizens of Canton during May 20-28, 2004 (table 3) compare closely with flood elevations surveyed on Whitney Brook by USGS personnel immediately following the 1987 event. Flood elevations on Whitney Brook published by Fontaine and Nielsen (1994) range from 394.9 ft NGVD 1929 (approximately 394.5 ft NAVD 88) to 397.0 ft NGVD 1929 (approximately 396.6 ft NAVD 88).

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Table 1. Estimated peak streamflows and their recurrence intervals for selected locations on the Androscoggin River, Maine. [USGS, U.S. Geological Survey; ft³/s, cubic feet per second; mi², square miles]

Location	Drainage area (mi ²)	Peak streamflow (ft ³ /s) for given recurrence interval						
		2 years	5 years	10 years	25 years	50 years	100 years	500 years
USGS streamflow-gaging station at Rumford, Maine(01054500) ¹	2,068	26,400	35,700	42,000	49,100	54,700	60,000	72,000
Canton-Jay corporate limits ²	2,470	30,600	40,800	47,700	55,500	61,600	67,300	80,200
USGS streamflow-gaging station near Auburn, Maine (01059000) ¹	3,263	38,500	50,500	58,300	67,400	74,200	80,500	95,000

¹ Peak-streamflow data and associated recurrence intervals from Hodgkins (1999); period of known peak streamflows at Rumford, 1870-1996; period of known peak streamflows at Auburn, 1814-1996

² Peak streamflows estimated using peak-streamflow data from USGS stations 01054500 and 01059000

Part of the town of Canton, the locations of structures flooded during the December 18-19, 2003, flood, and locations of high-water elevation points surveyed during May 20-28, 2004, are shown on figure 2. The 100-year flood plain is delineated based on the Canton Flood Insurance Rate Map (FIRM) (Federal Emergency Management Agency, 1989). An estimated partial delineation of the 10-year flood elevation is also shown in figure 2 and is based on surveyed ground points and the 10-year flood elevation set forth in the town of Canton 1989 FIS (Federal Emergency Management Agency, 1989). The high water-surface elevations attained during the December 18-19 flood event in Canton were higher than the expected open-water

flood water-surface elevations; this verified the assumption that the water-surface elevation was augmented due to the downstream ice jam.

Table 2. Estimated peak streamflow and flood water-surface elevations for selected recurrence intervals on the Androscoggin River, Maine¹.

[ft³/s, cubic feet per second; mi², square miles; ft, feet; elevations referenced to North American Vertical Datum of 1988]

Location	Peak streamflow (ft ³ /s) for given recurrence interval			
	10 years	50 years	100 years	500 years
Canton-Jay corporate limits	52,600	73,800	85,200	113,000
Location	Flood water-surface elevation (ft) for given recurrence interval			
	10 years	50 years	100 years	500 years
Confluence with Whitney Brook	390.0	393.3	394.6	398.2

¹ Federal Emergency Management Agency (1989); based on streamflow records at Rumford (01054500) and Auburn (01059000); period of known peak streamflows at Rumford, 1892-1976; period of known peak streamflows at Auburn, 1928-1976

Table 3. High-water elevations in the town of Canton, Maine identified by citizens and surveyed by the U.S. Geological Survey May 20, 24, and 28, 2004. Measurement locations are shown in figure 2.

[N, north; W, west; ft, feet; horizontal coordinates referenced to World Geodetic System of 1984; elevations referenced to North American Vertical Datum of 1988]

Flood date	Latitude (degrees, minutes)	Longitude (degrees, minutes)	Elevation (ft)
December 18-19, 2003	N 44° 28.282	W 70° 17.791	391.73
December 18-19, 2003	N 44° 28.187	W 70° 17.937	390.38
December 18-19, 2003	N 44° 27.319	W 70° 18.287	391.00
December 18-19, 2003	N 44° 27.301	W 70° 18.311	390.83
December 18-19, 2003	N 44° 26.730	W 70° 18.387	391.25
December 18-19, 2003	N 44° 26.938	W 70° 19.003	391.59
December 18-19, 2003	N 44° 26.652	W 70° 18.576	396.14
April 1, 1987	N 44° 26.938	W 70° 19.003	394.70
April 1, 1987	N 44° 26.652	W 70° 18.576	395.82

References Cited

- Federal Emergency Management Agency, 1989, Flood Insurance Study, Town of Canton, Maine, Oxford County, November 3, 1989, 21 p.
- Fontaine, R.A., and Nielsen, J.P., 1994, Flood of April 1987 in Maine: U.S. Geological Survey Water-Supply Paper 2424, 50 p.
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- Stewart, G.J., Caldwell, J.M., and Cloutier, A.R., 2004, Water resources data, Maine, water year 2003: U.S. Geological Survey Water-Data Report ME-03-1, 250 p.
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Dudley, Robert W. — **Flooding of the Androscoggin River during December 18-19, 2003, in Canton, Maine**—USGS Open File Report 2005-1176

