MAINE COASTAL STORM AND FLOOD OF FEBRUARY 2, 1976

Report prepared jointly by the U.S. Geological Survey
and the National Oceanic and Atmospheric Administration

U.S. DEPARTMENT OF THE INTERIOR • U.S. DEPARTMENT OF COMMERCE

GEOLOGICAL SURVEY PROFESSIONAL PAPER 1087

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By R. A. MORRILL, U.S. Geological Survey, and E. H. CHIN and W. S. RICHARDSON, National Weather Service, National Oceanic and Atmospheric Administration

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CECIL D. ANDRUS, Secretary
GEOLOGICAL SURVEY
H. William Menard, Director

UNITED STATES DEPARTMENT OF COMMERCE
JUANITA M. KREPS, Secretary
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Richard A. Frank, Administrator

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FOREWORD

The U.S. Geological Survey and the National Weather Service have a long history of cooperation in monitoring and describing the Nation's water cycle—the movement of water as atmospheric moisture, as precipitation, as runoff, as streamflow, and as ground water, and finally, through evaporation, its return to the atmosphere to begin the cycle over again. The cooperative effort has been a natural blending of technical talent and responsibility. The National Weather Service is the Federal agency responsible for monitoring and predicting atmospheric moisture and precipitation, for forecasting riverflow, and for issuing warnings of destructive weather events. The U.S. Geological Survey is the primary agency for monitoring the quantity and quality of the earthbound water resources, including both ground water and surface water.

This report represents another step in the growth of our cooperative efforts. The working arrangement has been accelerated by many major flood disasters that have struck the Nation in the last few years, including hurricane Agnes in 1972, which has been called the worst natural disaster in the United States. Hundreds of lives have been lost, thousands of people have been made homeless, millions of acres of land have been inundated, and several billions of dollars in property damage in urban and industrial areas have been caused by floods.

A tidal storm surge along the coast of Maine, February 2, 1976, caused by hurricane-force winds, resulted in a water-surface elevation more than 10 feet higher than the predicted astronomical tide at Bangor, Maine. The business section of Bangor was severely damaged. Roads, docks, and beaches along the coast between Eastport and Brunswick were also heavily damaged.

These disasters emphasize the need for increased knowledge and respect of the force and flow of floodwater. The documentation of the flood in Bangor, Maine, in February 1976 should aid the understanding of such flood disasters and will help improve human preparedness for coping with future floods of similar catastrophic magnitudes.

J. S. Cragwall, Jr

JOSEPH S. CRAGWALL, JR.
Chief Hydrologist
U.S. Geological Survey
Department of the Interior

George P. Cressman

GEORGE P. CRESSMAN
Director
National Weather Service
Department of Commerce

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GLOSSARY

Astronomical tide.—The tide due to the attractions of the sun and moon in contrast to a meteorological tide which is caused mainly by wind and atmospheric pressure.

Cubic feet per second (ft^3/s).—The rate of discharge. One cubic foot per second is equal to the discharge of a stream of rectangular cross section 1 foot wide and 1 foot deep, flowing at an average velocity of 1 foot per second. It equals 28.32 liters per second (L/s) or 0.02832 cubic meters per second (m^3/s).

Cyclone.—An atmospheric low-pressure system around which the wind blows in a counterclockwise direction in the Northern Hemisphere and clockwise in the Southern Hemisphere.

Dewpoint (or dewpoint temperature).—The temperature to which a given parcel of air must be cooled at constant pressure and constant water-vapor content in order for saturation to occur.

Drainage area of a stream at a specific location.—The area, measured in a horizontal plane, which is enclosed by a topographic divide. Drainage area is given in square miles (mi^2). One square mile is equivalent to 2.590 square kilometers (km^2).

Exceedance probability.—The probability that a peak discharge will be exceeded as an annual maximum in any given year.

Extratropical low (extratropical cyclone).—Any cyclone-scale storm that is not a tropical cyclone, usually referring only to the migratory frontal cyclones of middle and high latitudes.

Flood peak.—The highest value of the stage or discharge attained by a flood.

Gust.—A sudden brief increase in the speed of the wind.

Hurricane.—A severe tropical cyclone (windspeed 64 knots or higher) in the North Atlantic Ocean, Caribbean Sea, Gulf of Mexico, and the Eastern North Pacific off the west coast of Mexico.

Jetstream.—Relatively strong winds concentrated within a narrow stream in the atmosphere.

***K* index.**—A measure of the airmass moisture content and stability, $K = (T_{850}-T_{500}) + T_{d.850} - (T_{700}-T_{d.700})$, T and T_d are temperature and dewpoint, respectively, in degrees Celsius (°C); subscripts denote pressure levels.

Knot.—A velocity of one nautical mile per hour.

Lifted index.—Difference in degrees Celsius between the observed 500-millibar (mb) temperature and the computed temperature which a parcel characterized by the mean temperature and dewpoint of the 50-mb-thick surface layer would have if it were lifted from 25 mb above the surface to 500 mb.

Mean low water.—The average level of low water at a place over a 19-year period.

Millibar (mb).—A unit of pressure equal to 1,000 dynes per square centimeter (dyn/cm^2).

National geodetic vertical datum of 1929 (NGVD).—Formerly called "sea level datum of 1929." A geodetic datum derived from a general adjustment of the first order level nets of both the United States and Canada. In the adjustment, sea levels from selected tide stations in both countries were held as fixed. The year indicates the time of the last general adjustment. This datum should not be confused with mean sea level.

Nautical mile.—A distance of 6,080.20 feet (1.853 km).

Precipitable water.—The total atmospheric water vapor contained in a vertical column of unit cross-sectional area extending between any two specified surfaces: in this report, from the surface up to the 500-mb level.

Spring tide.—The tides occurring about the times of new and full moon when the range is the greatest.

Storm surge.—The departure of water level from the normal astronomical tide, due to meteorological effects.

Time of day is expressed in 24-hour time.—Eastern standard time (EST) is used in this report. For example, 1:30 a.m. is 0130 EST, 1:00 p.m. is 1300 EST.

Tropical storm.—Tropical cyclone with winds 34 to 63 knots.

Trough.—An elongated area of relatively low atmospheric pressure.

ENGLISH-METRIC EQUIVALENTS

[The following factors may be used to convert U.S. customary units published herein to the International System of units (SI)]

Multiply U.S. customary units	by	to obtain SI units
Miles (mi)	1.609	Kilometers (km).
Square miles (mi^2)	2.590	Square kilometers (km^2).
Cubic feet per second (ft^3/s)	.02832	Cubic meters per second (m^3/s).
Feet (ft)	.3048	Meters (m).
Inches (in.)	25.4	Millimeters (mm).
Feet per mile (ft/mi)	.1894	Meters per kilometer (m/km).
Knots	1.852	Kilometers per hour (km/hr).
Inches of mercury at 32°F (in Hg)	3.38638	Pascal (Pa).
Bar	100	Kilopascal (kPa).

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By R. A. MORRILL, U.S. Geological Survey, and E. H. CHIN and W. S. RICHARDSON, National Weather Service, National Oceanic and Atmospheric Administration

ABSTRACT

A business section of Bangor, Maine, was flooded with 12 feet (3.7 m) of water on February 2, 1976. The water surface elevation reached 17.46 feet (5.32 m) above national geodetic vertical datum of 1929 (NGVD), approximately 10.5 feet (3.2 m) above the predicted astronomical tide at Bangor. The unusually high water resulted from a tidal storm surge caused by prolonged, strong, south-southeasterly winds which occurred near the time of astronomical high tide. Winds exceeded 64 knots off the New England coast. The resulting flood was the third highest since 1846 and is the first documented tidal flood at Bangor.

This report documents the meteorological and hydrologic conditions associated with the flooding and also contains a brief description of storm damage from Eastport to Brunswick, Maine. Included are flood elevations in the city of Bangor and along the coast of Maine east of the Kennebec River.

INTRODUCTION

The purpose of this study is to document the third highest known flood in Bangor, Maine, to summarize reports of storm damage, to tabulate flood elevations along the coast of Maine, and to discuss the meteorological and hydrological conditions associated with the flooding and storm damage. The flood data will aid in investigations of future storms which affect the coast of Maine and will be useful in minimizing flood damages. Analysis of meteorological and hydrologic data associated with the intense February storm indicates that the major cause of the flooding at Bangor was the combination of storm surge and high astronomical tide. The storm surge which was generated on the open coast and in the Penobscot Bay was funneled by strong south-southeasterly winds up the Penobscot River to Bangor. Flooding was not confined to Bangor. The effects of the storm surge extended along the coast of Maine from Eastport to a point southeast of Brunswick. Previously recorded floods at Bangor had been attributed to streamflow or backwater from debris or ice jams.

The flood peak occurred on February 2, 1976, at approximately 1130 hours Eastern Standard Time (EST) and receded 1 hour later. The following day, the rivers were well within their normal channels but floodmarks remained visible. The U.S. Geological Survey (USGS) obtained elevations of some floodmarks and marked others for future leveling. Elevations of marked points were obtained in May 1976 by Design Planners of Middletown, N.Y., under contract to the USGS.

ACKNOWLEDGMENTS

Wind speeds and directions at Bucksport, Maine, were obtained from the St. Regis Paper Company. Tide data were furnished by the National Ocean Survey (NOS), National Oceanic and Atmospheric Administration (NOAA). The map of the Bangor area was provided by the city of Bangor. Photographs were furnished by the Bangor Daily News. Estimates of flood damages were obtained from the Maine Office of Civil Emergency Preparedness.

STUDY AREA

The study area consists of a section of coastal Maine extending from Eastport to a point southeast of Brunswick, a distance of 170 air miles (274 km). This part of the Maine coastline (see pl. 1) is indented with numerous estuaries and bays. Data points along the coast were located for the most part in estuaries away from the open ocean, but some were on rocky peninsulas and near beaches.

Bangor, the third largest city in Maine, is located at the head of the Penobscot River estuary about 20 miles (32 km) inland from Penobscot Bay at the confluence of Kenduskeag Stream and Penobscot River (fig. 1). Bangor is the retail-wholesale distribution center for a six-county area of eastern and northern Maine, and its downtown is a hub of commercial and service activity. Most of the city's nonresidential structures are located downtown, where approximately 4,000 people are employed. The major parking facilities for this area are on flood plains along Kenduskeag Stream. The one-quarter-square-mile study area was confined to the downtown

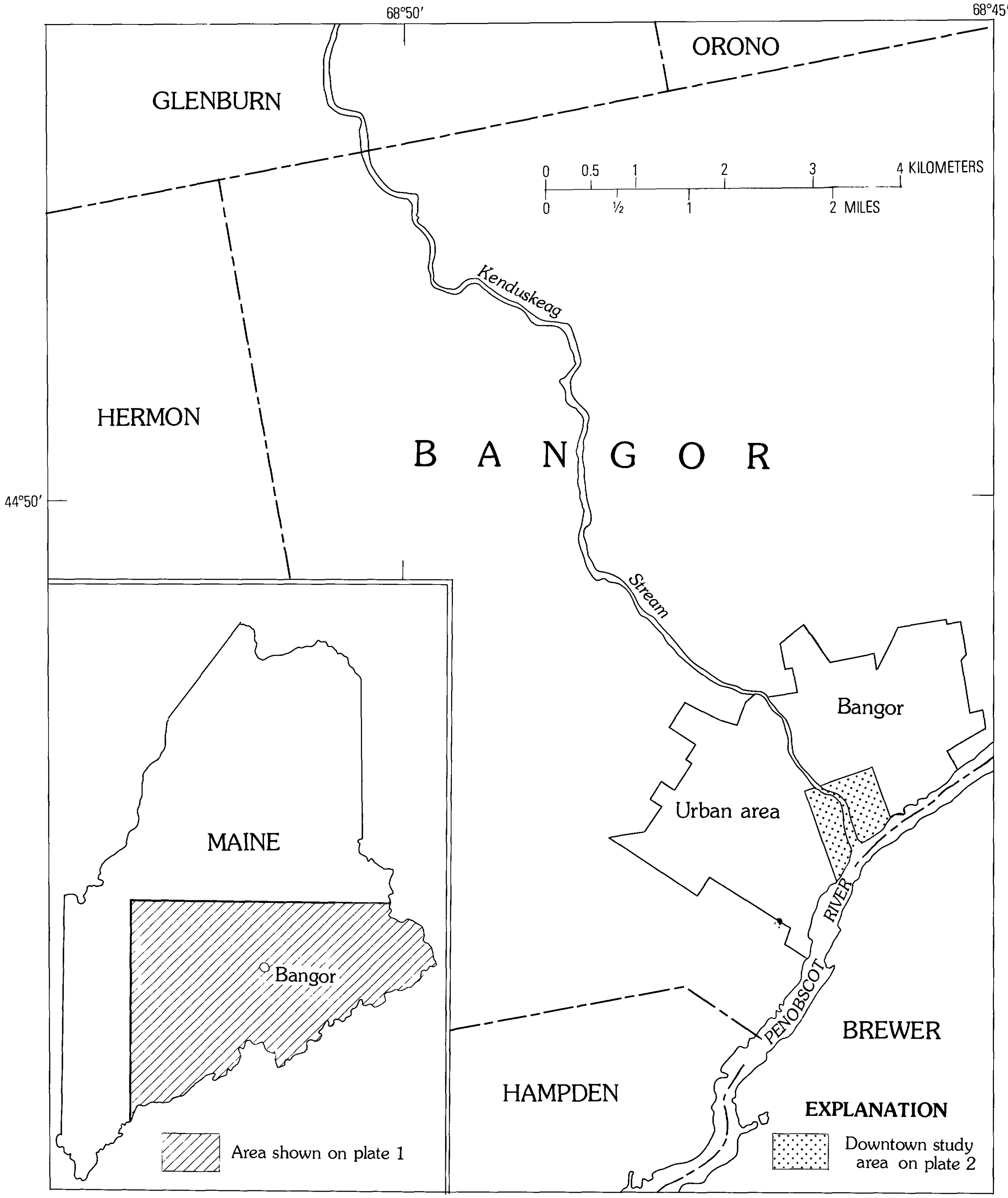

FIGURE 1.—Map showing location of study area in downtown Bangor, Maine (see pl. 2), and inset showing area covered on plate 1.

section, which is divided by Kenduskeag Stream and bordered on the south by the Penobscot River.

METEOROLOGICAL SETTING

The extratropical cyclone that passed over eastern Maine on February 2, 1976, originated in the Gulf of Mexico. An incipient low which was over Louisiana on January 31, 1976, migrated eastward over the gulf and then cut through the Florida panhandle. At 1300 EST, February 1, the low was located over Georgia and it had a central pressure of 997 millibars (mb). It then began to accelerate and steadily deepen. At 1900 EST, with its associated cyclonic circulation well organized, the low reached the Carolinas with a 986-mb central pressure. The polar jetstream was located over the Atlantic States and was oriented from North Carolina to Maine. The 300-mb winds over the Atlantic Coast were from the southwest and reached a speed of 130 knots off the Maine coast. A very deep upper air trough extending from the Lake Superior region to Florida (fig. 2) placed the Atlantic States under a trough-to-ridge upper air contour pattern.

East coast and maritime cyclones will intensify if certain conditions are fulfilled. Three conditions that govern their intensification are: (1) the location of the low center relative to the 500-mb contour pattern, (2) the 500-mb windspeed over the low, and (3) the 500-mb temperature gradient northeast of the low. George (1960) presented graphs for quantitative prediction of intensification. The conditions favorable to intensification are: (1) the low is under an open 500-mb contour and ahead of a trough, (2) the 500-mb windspeed over the low is strong, and (3) the temperature gradient extending from the low in the northwest quadrant is moderate. These conditions were all fulfilled at 1900 EST, February 1.

The upper air contour gradients over the Eastern United States further increased by 0700 EST, February 2, indicating the presence of a strong upper airflow and strong steering for the low. For example, at Portland, Maine, at 1900 EST, February 1, the observed winds at 15,100 feet (4,602 m) above the surface had a direction 220° and a speed of 64 knots; 12 hours later at 0700 EST, February 2, the windspeed at the same height increased to 106 knots from a direction of 191°. From the Carolinas, the low raced rapidly toward New England. At 0100 EST, February 2, it was off the New Jersey-Delaware coast and its central pressure had dropped to 975 mb. At this time gale winds were reported by ships offshore. By 0700 EST, February 2, the low had already reached Maine with a central pressure of 964 mb and was still deepening. An explosive drop in surface pressure exceeding 32 mb in the 12 hours ending at 0700 EST, February 2, was observed over eastern Maine (fig. 3). This was matched by corresponding upper level height decreases of 492 ft (150 m) at 500 mb, 689 ft (210 m) at 700 mb, and 787 ft (240 m) at 850 mb. At Bangor, Maine, surface pressure fell another 7.8 mb in the subsequent 4 hours. Caribou, Maine, had a record low pressure of 957 mb on February 2, while Wiscasset, Maine, reported an unofficial 945 mb.

Winds became increasingly strong and reached hurricane force (over 64 knots) off the New England coast beginning in the morning of February 2. The merchant ship *American Concord* at 39.8° N., 69.5° W., was battered by 85-knot winds and 40-foot (12.2-m) waves. The Esso *New Orleans* observed 70-knot winds with 30-ft (9-m) sea waves at 40.3° N., 69.6° W. The U.S. Ocean Weather Station "Hotel" at 38°00′ N., 71°00′ W., also recorded a windspeed of 70 knots at 0700 EST, February 2, which was a maximum compared with the February mode of 22 knots for the station. National Oceanic and Atmospheric Administration (NOAA) environmental data buoys located at 40°06′ N., 73°00′ W., and 38°42′ N., 73°36′ W., both had maximum observed winds for the month at 0700 EST, February 2. Many inland stations in eastern Maine experienced the highest wind of the storm in late morning. For example, Augusta, Maine, had a sustained windspeed of 30 knots with gusts to 56 knots at 1140 EST, and Bangor, Maine, had 40-knot winds gusting to 80 knots at 1000 EST. It should be noted that the observed wind direction at Bangor was between 150° to 190° for a 6-hour period prior to 1200 EST. A ship's report off the Maine coast at 0700 EST, February 2, also indicated that the wind was from 170°. Southerly wind also persisted over the Penobscot Bay for a considerable period after 0700 EST. Strong south and south-southeast winds, 40 to 50 knots, associated with the intense low pressure system (fig. 4) which was located about 45 miles (72.4 km) northwest of Portland, "piled up" water along the Maine coast. The storm surge reached a maximum height at Portland of 3.6 feet (1.1 m), Rockland 3.7 feet (1.1 m), and Bar Harbor 5.5 feet (1.7 m) between 1000 and 1100 EST on February 2, about 2 hours before the time of astronomical high tide (see fig. 5). The astronomical high tides at these locations were about 1.0 foot (0.30 m) higher than normal because spring tides occurred only a few days earlier.

Storm precipitation over Maine was concentrated in a 24-hour period ending 0700 EST, February 2. An analysis of stability and moisture content at the beginning of this period showed that the amount of precipitable water over Maine ranged from 0.32 inch (0.81 cm) at Portland to less than 0.22 inch (0.56 cm) over the northern region. The average relative humidity over Maine was between 70 and 85 percent. The lifted index, an indication of atmospheric stability, is the difference in degrees Celsius between the observed 500-mb temperature and the com-

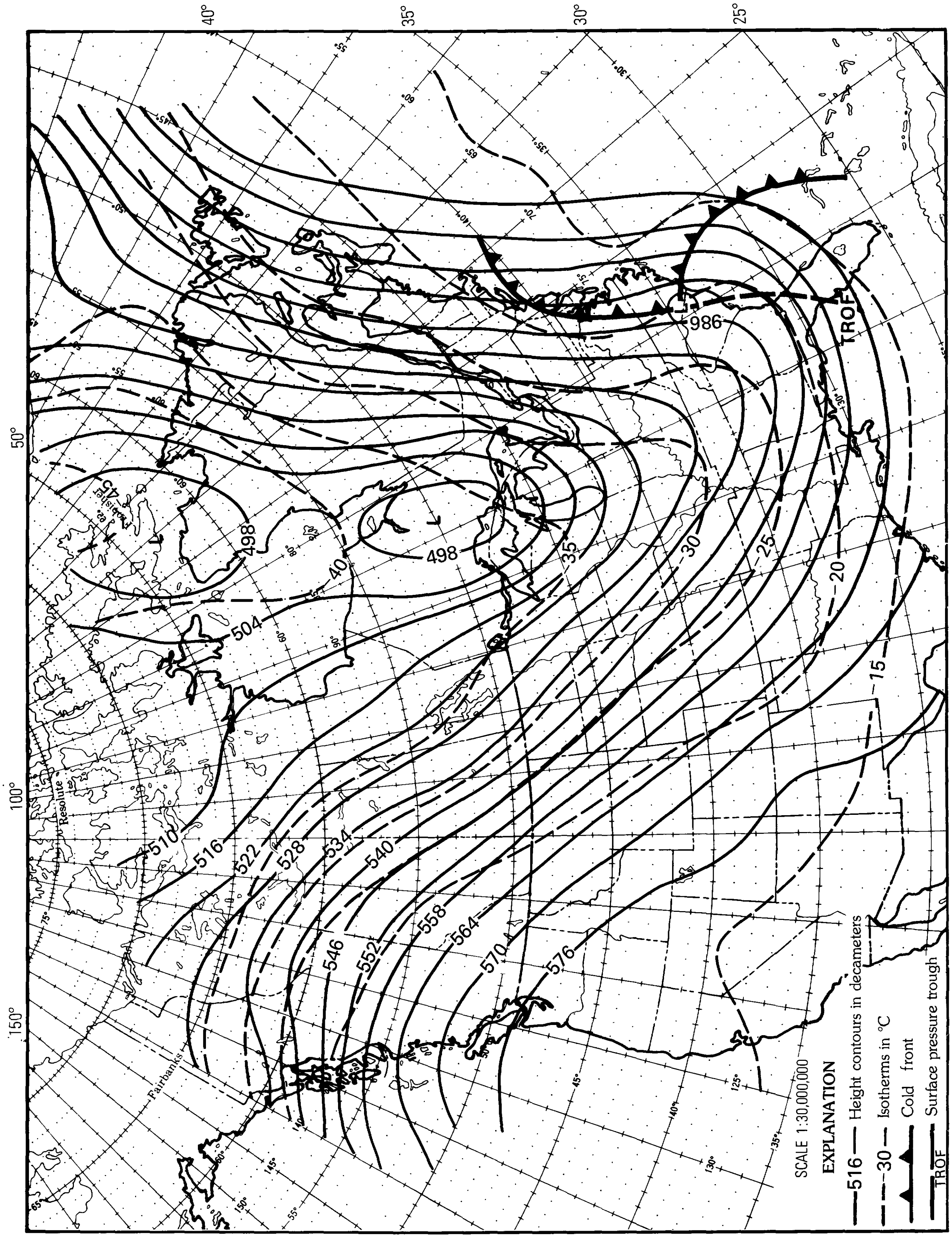

FIGURE 2.—The 500-mb analysis and surface low and fronts at 1900 EST, February 1, 1976.

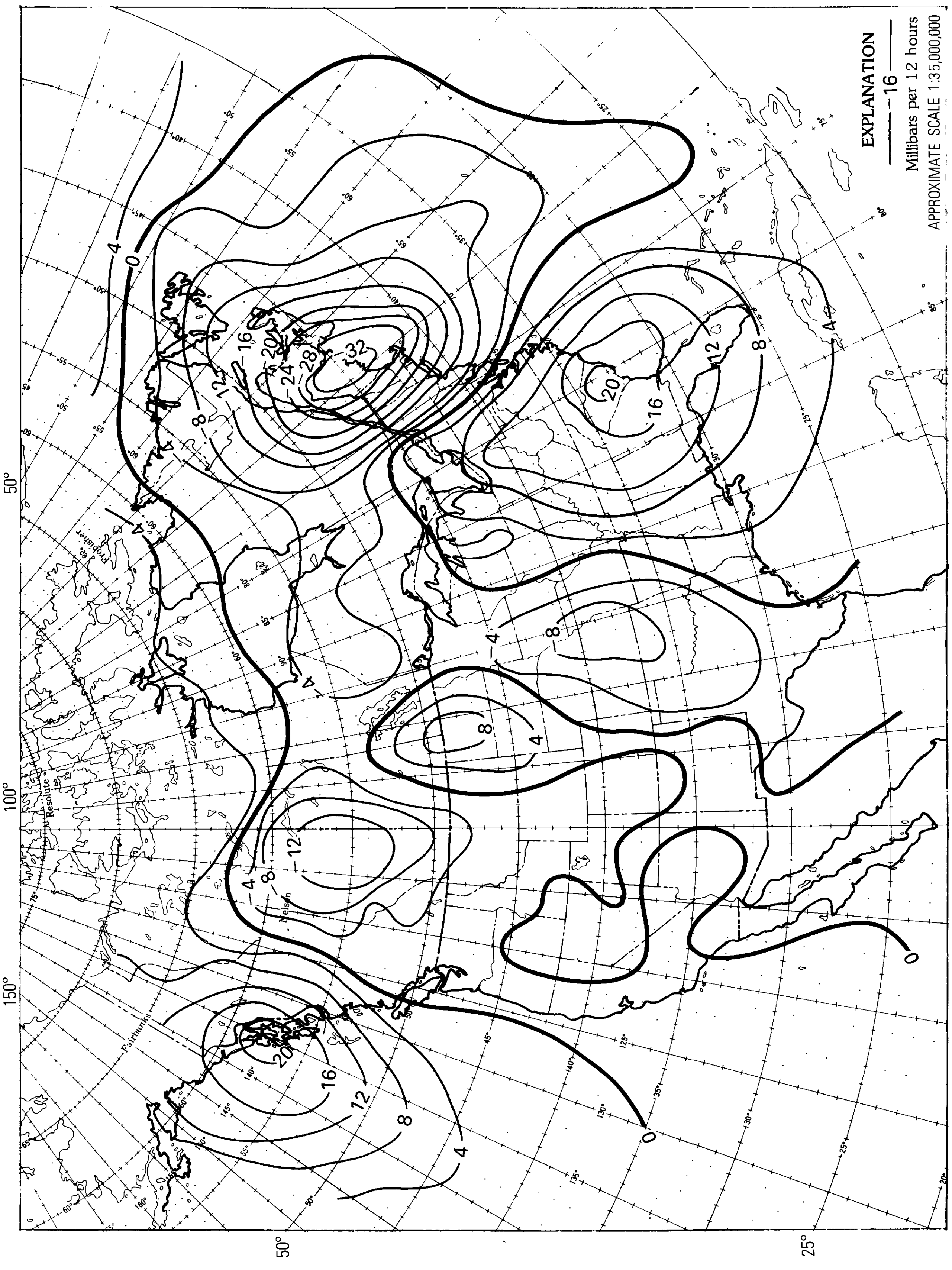

FIGURE 3.—The 12-hour surface pressure change ending 0700 EST, February 2, 1976.

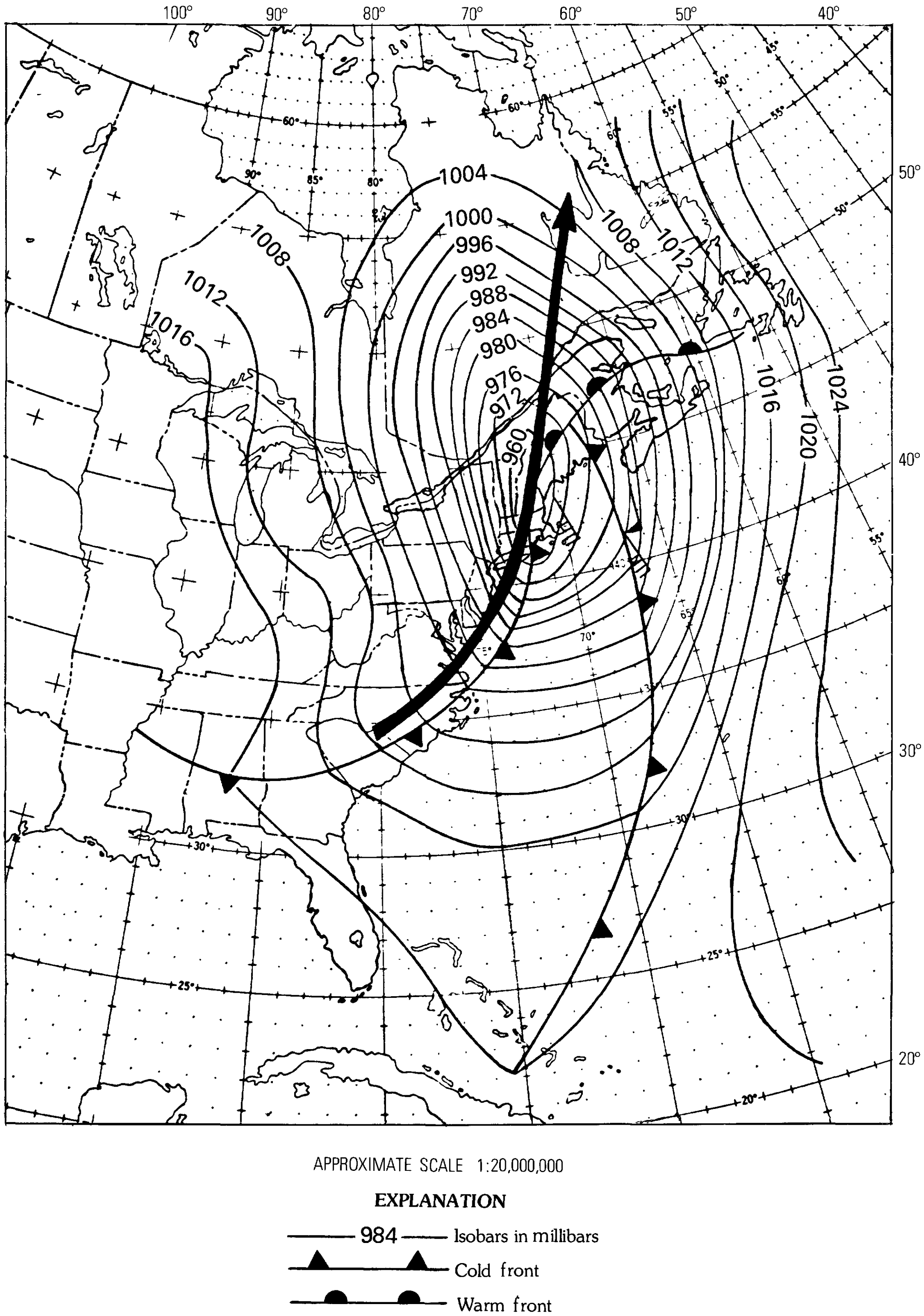

FIGURE 4.—The sea-level pressure pattern, storm track, winds, and fronts along the east coast at 0700 EST, February 2, 1976. The central pressure of the storm system was approximately 956 mb. The arrow indicates the storm track.

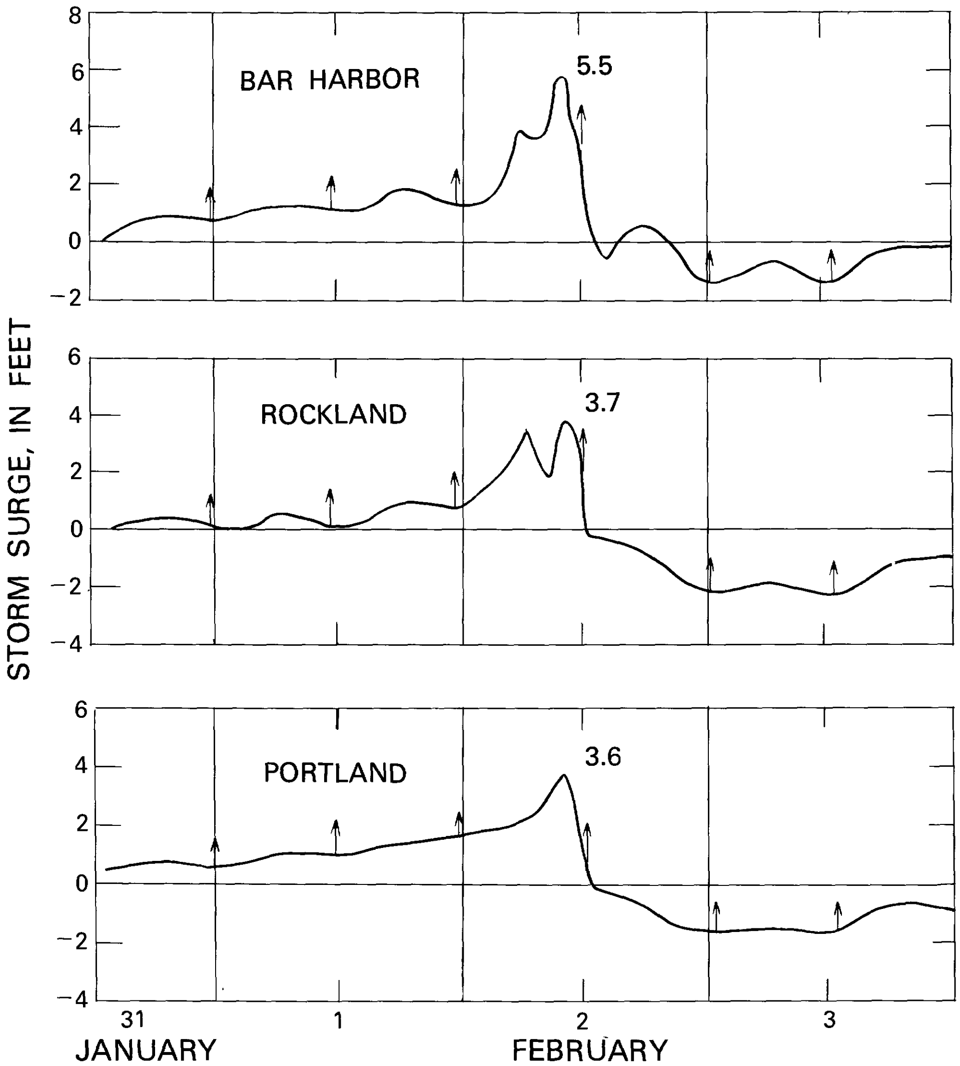

FIGURE 5. —Observed storm surges at Bar Harbor, Rockland, and Portland, Maine, January 31–February 3, 1976. Arrows indicate times of astronomical high tides.

puted temperature of a parcel characterized by the mean temperature and dewpoint of the 50-mb-thick surface layer if it were lifted from 25 mb above the surface to 500 mb. Areas with lifted index greater than +4 are considered as stable. At 0700 EST, February 1, this index was greater than 22 over Caribou, Maine, and 20 over Portland, Maine. Another measurement of atmospheric static stability and air mass moisture content is given by K Index:

$$K = (T_{850} - T_{500}) + T_{d,850} - (T_{700} - T_{d,700})$$

where T and T_d are the temperature and dewpoint in degrees Celsius, respectively, and the subscripts denote the pressure level in millibars. A K Index greater than 35 is associated with numerous thunderstorms (less than 20, no thunderstorms). The 0700 EST, February 1, K Index was −8 over Caribou, Maine, and 7 over Portland, Maine. The calculated K Index for Portland for 0700 EST, February 2, was less than 5.

This high atmospheric stability impeded the development of local convective storms. With the lack of convective thundershowers, the cyclone passage over Maine brought steady frontal precipitation, covering considerable area in the form of widespread rainfall that changed to snowfall in the mountains. The areal average 24-hour precipitation ending at 0700 EST, February 2, was approximately 0.79 inch (2.01 cm) over the northern one-third of Maine and 1.77 inches (4.50 cm) over the southern two-thirds of Maine. Precipitation on February 2 at Bangor and Augusta, Maine, was 1.46 inches (3.71 cm) and 1.81 inches (4.60 cm), respectively. Compared with the 1-year 24-hour rainfall value of 2.36 inches (5.99 cm) over southern Maine (Hershfield, 1961), these amounts were not uncommon. In general, storm rainfall was not a contributing factor to the flooding at Bangor.

By 1300 EST, February 2, the low had passed through Maine and was centered over eastern Quebec with a 953-mb central pressure. The low continued to move northward and by 1900 EST, February 2, it was located near Labrador. Heavy sea and high swell conditions prevailed for several more days in the northwestern Atlantic Ocean.

STORM DAMAGE

Storm damage due to the rapidly moving intense extratropical storm which raced across Maine on February 2, 1976, occurred from Eastport to Brunswick. Total damage estimated by the Maine Office of Civil Emergency Preparedness was $2.6 million; no deaths were reported. The locations of the cities and communities affected are shown in plate 1. A building and adjacent pier were blown into the bay at Eastport, blocking boat traffic in and out of the town dock. At West Quoddy Head, high surf washed out the underpinnings of a wharf. Hurricane-force winds accompanied by rain hit Stonington on Deer Isle in late morning. At the Little Deer Isle–Deer Isle causeway, waves hammered the breakwater and sent spray about 60 feet (18.3 m) into the air. Water rushed across the causeway, scouring out large potholes and clogging the roadway with mounds of seaweed and flotsam. A 360-foot (110-m) Japanese freighter, *Musashino Maru*, anchored in Penobscot Bay, was blown aground near Searsport shortly after 0600 EST, February 2, and was refloated at high tide on February 15, with the aid of tugs. The city of Bangor, Maine, located 19 miles (30.6 km) inland, suffered considerable flood damage. About 200 motor vehicles were submerged and many downtown businesses were inundated. Beach erosion was heavy particularly at Popham Beach near the mouth of the Kennebec River.

HYDROLOGIC DATA

DRAINAGE AREAS AND STREAMFLOWS

Bangor is at the confluence of Kenduskeag Stream and Penobscot River. The drainage areas of Kenduskeag Stream and Penobscot River are 213 mi^2 (552 km^2) and 7,720 mi^2 (20,000 km^2), respectively. The Penobscot River is tidal below the dam at Bangor. In the estuary, the mean tide is 6.5 feet (2.0 m) above mean low water, and the range of tide averages 13.1 feet (4.0 m), increasing to a spring range of 14.9 feet (4.5 m).

Streamflow data during the flood period are given in tables 1 and 2. The exceedance probability for peak flow of Kenduskeag Stream during this period was approximately 0.90, indicating that the amount of water flowing has a 90 percent chance of being equaled or exceeded as an annual maximum in any given year. During the period January 31 (1600 EST) to February 3 (1200 EST) the water in the stilling well of the tide gage was frozen and no stage readings were obtained. Daily discharge for this period was estimated as explained in table 2. On the Penobscot River at Veazie Dam (just upstream from Bangor) the peak flow had an exceedance probability less than 0.995. The flows of the two rivers during the flood period were in themselves insufficient to have caused the flood at Bangor.

A river pilot who brought an oil barge to Bangor reported ice floating in the estuary on the day following the flood, February 3; however, he reported no evidence of any serious ice jams between Bangor and the open ocean. On February 3, a USGS field person observed that the ice cover was intact on the Penobscot River upstream of the Bangor Dam, and on Kenduskeag Stream upstream of Six Mile Falls (located 6 miles (9.7 km) upstream from mouth). He concluded that the small amount of ice seen in the Penobscot River downstream of Bangor was shore ice from the bays and marshes in the estuary. There was some minor flooding from ice jams at the mouths of several small streams that flow into the estuary. Peak water-surface elevations were

TABLE 1.—*Gaging station records for Penobscot River at Veazie Dam, Veazie, Maine*

Location: Lat 44°49′55″ N., log 68°42′05″ W., Penobscot County, at dam 1 mile southwest of Orono-Veazie town line.
Drainage area: 7,764 mi^2.
Source of record: Furnished by Bangor Hydro-Electric Co.
Remarks: Flow of Feb. 6, 1976, was less than a mean annual peak (exceedance probability less than 0.995).

Date	Mean discharge (ft^3/s)
Jan. 24	8,600
25	8,800
26	8,300
27	8,500
28	11,400
29	16,000
30	20,500
31	20,800
Feb. 1	21,500
2	21,800
3	22,200
4	24,400
5	26,900
6	28,500
7	27,100
8	25,200
9	23,500
10	22,400
11	19,200
12	18,200
13	15,400

TABLE 2.—*Gaging station records for Kenduskeag Stream near Kenduskeag, Maine*

Location: Lat 44°53'48" N., long 68°53'04" W., Penobscot County, on right bank 300 ft upstream from highway bridge and 2.9 mi south of Kenduskeag.
Drainage area: 178 mi².
Period of record: October 1941 to current year.
Gage: Water-stage recorder. Datum of gage is 91.94 ft above national geodetic vertical datum of 1929.
Average discharge: 33 years (1941–74), 321 ft³/s, 24.49 in./yr.
Extremes: Period of record: Maximum discharge, 6,400 ft³/s, Sept. 12, 1954 (gage height, 14.83 ft); minimum daily, 1.0 ft³/s, Sept. 30, 1948, Aug. 8, 1965.
Remarks: Stage-discharge relation affected at times by ice. Maximum discharge on Feb. 2 was 2,010 ft³/s. This flow is less than a mean annual peak flow (exceedance probability was less than 0.90).

	Jan. 27		Jan. 28		Jan. 29		Jan. 30		Jan. 31	
Time (EST)	Gage height (ft)	Discharge (ft³/s)	Gage height (ft)	Discharge (ft³/s)	Gage height (ft)	Discharge (ft³/s)	Gage height (ft)	Discharge (ft³/s)	Gage height (ft)	Discharge (ft³/s)
0200	---	---	4.49	540	7.01	1,620	7.53	2,250	7.60	1,710
0400	---	---	4.65	611	7.14	1,710	7.55	2,190	7.60	1,680
0600	---	---	4.83	675	7.27	1,800	7.64	2,140	7.60	1,640
0800	---	---	5.01	755	7.34	1,880	7.65	2,090	7.60	1,600
1000	---	---	5.22	863	7.40	1,950	7.65	2,040	7.60	1,560
1200	---	---	5.42	958	7.45	2,040	7.64	2,000	7.60	1,540
1400	---	---	6.13	1,040	7.15	2,120	7.62	1,940	7.60	1,510
1600	3.63	324	6.15	1,130	7.19	2,200	7.62	1,900	---	1,480
1800	3.78	347	6.34	1,230	7.40	2,300	7.60	1,860	---	1,450
2000	3.94	387	6.49	1,320	7.50	2,350	7.60	1,820	---	1,420
2200	4.12	425	6.70	1,440	7.55	2,380	7.60	1,780	---	1,390
2400	4.29	483	6.86	1,550	7.51	2,320	7.60	1,740	---	1,360
Mean discharge				1,010		2,060		1,980		1,530

	Feb. 1		Feb. 2		Feb. 3		Feb. 4	
Time (EST)	Gage height (ft)	Discharge (ft³/s)	Gage height (ft)	Discharge (ft³/s)	Gage height (ft)	Discharge (ft³/s)	Gage height (ft)	Discharge (ft³/s)
0200	---	1,340	---	1,320	---	1,870	8.92	1,510
0400	---	1,310	---	1,380	---	1,840	8.92	1,490
0600	---	1,300	---	1,550	---	1,810	8.92	1,460
0800	---	1,290	---	1,690	---	1,780	8.92	1,440
1000	---	1,270	---	1,810	---	1,750	8.92	1,420
1200	---	1,260	---	1,920	---	1,720	8.92	1,410
1400	---	1,240	---	1,980	8.76	1,680	---	----
1600	---	1,220	---	2,010	8.86	1,640	---	----
1800	---	1,200	---	1,980	8.90	1,610	---	----
2000	---	1,200	---	1,950	8.91	1,580	---	----
2200	---	1,200	---	1,920	8.91	1,560	---	----
2400	---	1,240	---	1,900	8.91	1,540	---	----
Mean discharge		1,260		1,780		1,700		

NOTE: No gage height available from 1600 EST, Jan. 31, to 1200 EST, Feb. 3. Discharge estimated on basis of recorded range in stage, weather records, inspection of control, and hydrographic comparison with other nearby stations.

determined at some of these locations (see table 5). Based upon the foregoing information, ice jams were not a major factor causing the Bangor flooding.

OBSERVED HIGH-WATER MARKS

Immediately following the storm of February 2, 1976, floodmarks near highways and buildings were marked by the U.S. Geological Survey. Third-order levels were run to floodmarks in June 1976. Figure 6 shows a flooded highway bridge in West Jonesport and illustrates the difficulties of determining accurate flood elevations.

The timing of the storm surge with respect to high tide was an important factor contributing to the flood magnitude. If the storm had hit the coast during low tide, flooding would have been much less severe. The flood peak at Bangor, however, occurred about 1 hour before the time of high tide. Two distinct peaks were observed at Machias, one at about 1100 EST and the second, a higher surge about 1200 EST, which coincided with high tide there.

The times and heights of the astronomical high tide at Bangor and 62 coastal data-sites were computed from table 2, Tide Tables 1976 (National Ocean Survey, 1975b, p. 206). Table 5 gives the surveyor's description of the 62 coastal floodmarks, and plate 1 shows their locations

FIGURE 6.—The storm downeast, West Jonesport, Maine. This photograph (Bangor Daily News, 1976) is typical of the effects of the wind and wave action associated with the storm. This location is in Washington County where a small stream normally flowing from left to right empties into a tidal estuary. Photograph courtesy Bangor Daily News.

on a foldout map. Comparison of observed high-water marks (which are referenced to NGVD) to astronomical high tides (which are referenced to mean low water) required a datum conversion. For example, the astronomical high tide for site No. 41, Southwest Harbor, on February 2 was 10.50 feet (3.2 m) above mean low water. Subtracting the datum conversion factor of 4.93 feet (1.50 m) gives a predicted high tide of 5.57 feet (1.70 m) above NGVD. Where an observed high-water mark was located between two sites listed in the tide tables, a datum conversion factor was estimated. Table 3 contains observed coastal high-water elevations resulting from the storm of February 2, 1976, and predicted astronomical high tides. All elevations are in feet above NGVD.

BANGOR FLOOD

The very strong south-southeasterly winds which had been blowing for 5 to 6 hours over open water and along the major axis of the Penobscot Bay were the major cause of the storm surge in the bay and at Bangor. Other factors which were involved in the generation and modification of the storm surge in the bay were the inverted barometer effect, shoreline configuration, and bathymetry. The bay surge was further modified as it made its way up the funnel-shaped Penobscot Bay (fig. 7) to the mouth of the Penobscot River and on to Bangor.

On the morning of February 2, shoppers and officeworkers left their cars in parking lots along Kenduskeag

TABLE 3.—*Comparison of observed coastal high-water elevations resulting from storm of February 2, 1976, and predicted astronomical high tides*

[Measurements are in feet above national geodetic vertical datum of 1929]

Station No.	Location	Observed high-water elevation (feet)	Predicted high tide (feet)	Difference (feet)	Remarks
1	Small Point Beach	12.80	5.27	7.53	Wave action.
2	Popham Beach	9.90	4.87	5.03	Wave action.
3	Reid State Park	13.37	4.67	8.70	Wave action.
4	Georgetown	7.27	6.10	1.17	------------
5	Westport	7.09	5.16	1.93	------------
6	Wiscasset	7.68	5.33	2.35	------------
7	Damariscotta	8.15	5.14	3.01	------------
8	Waldoboro	8.45	5.18	3.27	------------
9	Long Cove	8.20	5.00	3.20	------------
10	Spruce Head	10.94	5.10	5.84	Wave action.
11	Thomaston	8.68	5.17	3.51	------------
12	Camden Harbor	8.41	5.10	3.31	------------
13	Lincolnville	8.57	5.10	3.47	------------
14	Belfast, Marshall	10.23	5.71	4.52	Wave action.
15	Belfast, Northport town line	11.96	5.71	6.25	Wave action.
16	Belfast	8.93	5.71	3.22	------------
17	Searsport at railroad crossing	12.93	5.30	7.63	Wave action.
18	Prospect	12.46	6.20	6.26	------------
19	Frankfort	11.98	5.80	6.18	------------
20	Frankfort Plains	11.43	5.80	5.63	------------
21	Frankfort Village:				
	Average	12.28	5.80	6.48	------------
	Bridge	12.82	5.80	7.02	------------
	Pole	11.73	5.80	5.93	------------
22	Winterport	12.68	6.50	6.18	------------
23	Winterport	17.13	6.50	10.63	Ice jam.
24	Hampden at Ferry site	15.06	6.70	8.36	------------
25	Hampden at Edgecomb residence	15.44	6.70	8.74	------------
26	Bangor at Barret Tar "pier"	16.66	6.90	9.76	------------
27	Bangor at Boyd Street "railroad crossing"	17.88	6.90	10.98	------------
28	Bangor Pool	18.67	6.90	10.12	------------
29	Bucksport	11.56	5.80	5.76	------------
30	Verona	11.29	5.80	5.49	------------
31	Castine	9.16	5.20	3.96	------------
32	Penobscot-West	8.39	5.30	3.09	------------
33	Penobscot-East	8.91	5.30	3.61	------------
34	North Brooksville	7.85	5.60	2.25	------------
35	Sedgwick-Deer Isle	9.52	5.40	4.12	------------
36	Sedgwick	9.51	5.40	4.11	------------
37	Blue Hill	9.42	5.46	3.96	------------
38	Surry	8.76	5.50	3.26	------------
39	Ellsworth:	10.97	5.50	5.47	------------
	Average	10.90	5.50	5.54	------------
	Tree	10.90	5.50	5.54	------------
	Pole	11.04	5.50	5.40	------------
40	Bar Harbor	9.39	5.64	3.75	------------
41	Southwest Harbor	8.23	5.57	2.66	------------
42	Mt. Desert	9.23	5.60	3.63	------------
43	Winter Harbor	9.57	5.40	4.17	------------
44	Milbridge, Wyman Road	9.91	6.00	3.91	------------
45	Milbridge	10.48	6.00	4.48	------------
46	Cherryfield	10.48	6.00	4.48	------------
47	Harrington, Water Street	11.39	6.10	5.29	------------
48	Harrington	10.10	6.10	4.00	------------
49	Addison	10.44	6.20	4.24	------------
50	South Addison	10.87	6.20	4.67	------------

TABLE 3.—*Comparison of observed coastal high-water elevations resulting from storm of February 2, 1976, and predicted astronomical high tides*—Continued

[Measurements are in feet above national geodetic vertical datum of 1929]

Station No.	Location	Observe high-water elevation (feet)	Predicted high tide (feet)	Difference (feet)	Remarks
51	Jonesport	11.59	6.05	5.54	------------
52	Jonesboro	11.00	6.80	4.20	------------
53	Machias	12.91	7.06	5.85	------------
54	East Machias	13.16	7.06	6.10	------------
55	East Machias	12.10	7.06	5.04	------------
56	Whiting	12.27	7.10	5.17	------------
57	Cutler	11.33	7.29	4.04	------------
58	Lubec	13.96	9.40	4.56	------------
59	Dennysivlle	13.83	10.10	3.73	------------
60	Dennsyville	12.60	10.10	2.50	------------
61	Perry	12.06	9.80	2.26	------------
62	Calais	13.44	10.60	2.84	------------

Stream unaware that their cars might soon be under water. The flood waters rose very quickly; it was estimated that it took less than 15 minutes for the water to reach its maximum depth of over 12 feet (3.7 m) (approximately 10.5 feet (3.2 m) above predicted astronomical tide) in the Kenduskeag Plaza after the stream flowed over its normal banks. Officeworkers could see the rising waters, but many could not get to their cars. By 1130 EST the flood had submerged approximately 200 motor vehicles. Several people were caught by the flood as they tried to move their cars and had to be rescued. Figures 8, 9, and 10 show the extent of flooding in the Kenduskeag Plaza during rescue attempts. The two bridges joining Bangor and Brewer were closed for a short time in the early afternoon because of the high water level of the Penobscot River. Plate 2 is a large-scale contour map that shows the inundated area of downtown Bangor.

Flood damage estimates in the downtown area were reported by the Maine Office of Civil Emergency Preparedness at more than $2 million. Much of the damage was in flooded basements and in the cellar vaults of several downtown banks. There was a power loss in the area and electrical damage sparked at least two fires. No deaths from the storm were reported.

Because the unusually high water in Bangor occurred suddenly, was of short duration, and involved a large volume of water, it was considered to be a "flash flood." The predicted (astronomical) high tide for Bangor on February 2, 1976, was due at 1225 EST, but the flood crest occurred about 1 hour before high tide (1130 EST) and the rivers receded to within their banks soon after high tide.

Elevations of floodmarks in Bangor were determined by the U.S. Geological Survey. Table 4 lists the floodmark elevations and describes their locations. Plate 2 shows the floodmark locations on a large-scale map of downtown Bangor.

HISTORICAL FLOOD ACCOUNTS

Except for the 9-month period (March–November 1970) when the National Ocean Survey (NOS) operated a tide gage at Bangor, no systematic records have been kept at Bangor for the Penobscot River. However, information concerning floods on the river often received attention in newspaper articles, books, etc. In 1964, these data were assembled and published in the U.S. Geological Survey Water Supply Paper 1779–M, "Historical Floods in New England" (Thompson and others, 1964). The following excerpts from that paper and other sources refer to the Penobscot River.

1807

PENOBSCOT RIVER IN MAINE (FEBRUARY 17)

> "An ice jam formed below Bangor Village raising the water 10 to 12 feet higher than was known before" (Thompson and others, 1964, p. M14).

1846

PENOBSCOT RIVER IN MAINE (MARCH 29)

> "The flood resulting from the storm of March 25–28 was very destructive in the Penobscot River, owing to the breaking up of ice of great thickness and to the formation of ice jams. The ice jam at Bangor was

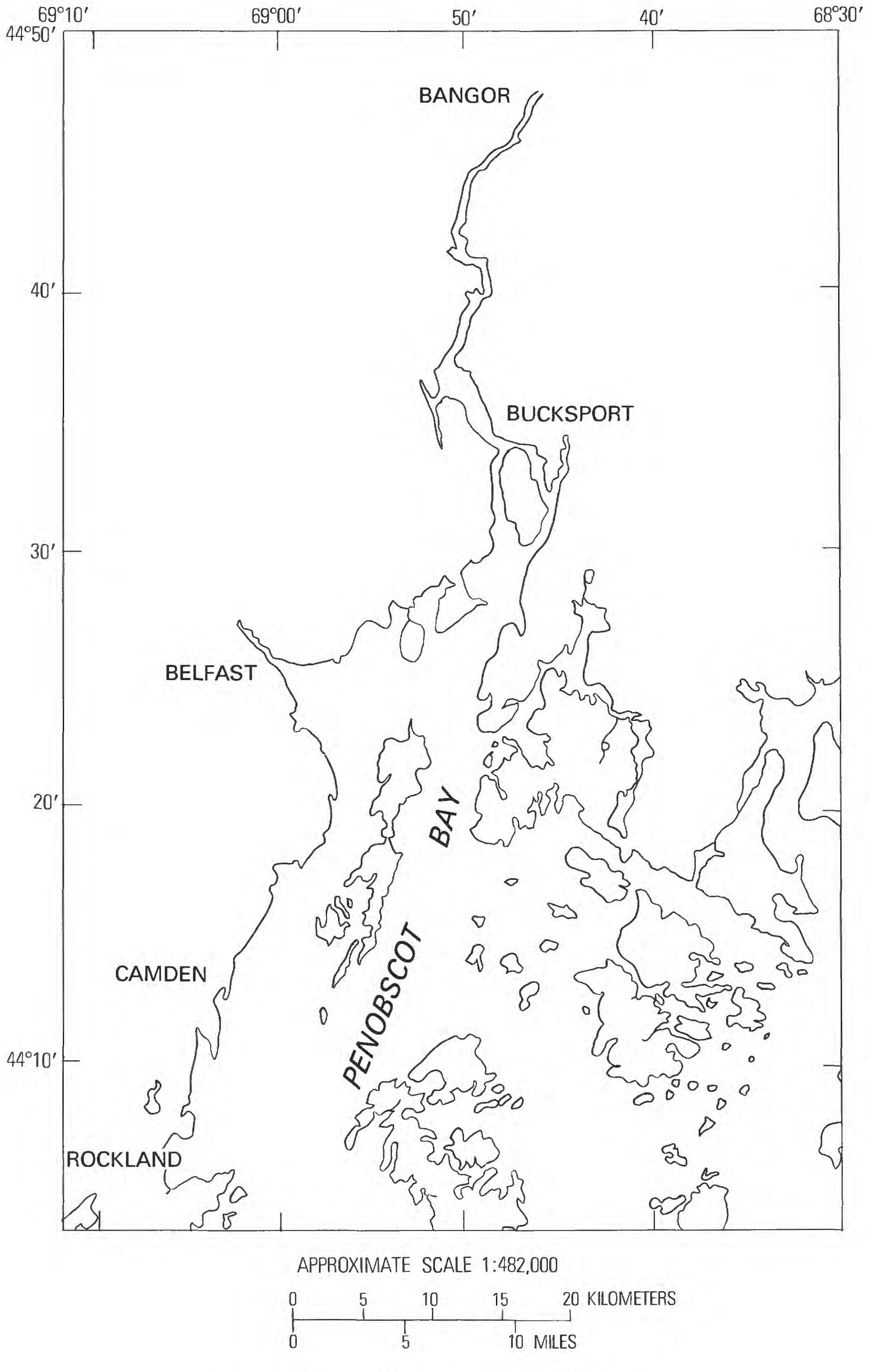

FIGURE 7.—Geographical configuration of Penobscot Bay.

FIGURE 8.—Floodwaters at highest point, Kenduskeag Plaza, Bangor, Maine. This photograph (Bangor Daily News, 1976) shows the depth and area of the downtown flood. The normal channel of the Kenduskeag is between the two light posts on the left, and footbridge guardrails are shown inundated near the center of the photograph. The normal flow is from right to left. Photograph courtesy of Bangor Daily News.

called the greatest in 100 years" (Thompson and others, 1964, p. M24).

1853

PENOBSCOT RIVER NEAR WEST ENFIELD, MAINE (NOVEMBER 13)

"The Penobscot River was the highest for 20 years. Kenduskeag Village Dam carried away with one life lost" (Thompson and others, 1964, p. M27).

1866

PENOBSCOT RIVER AT TREAT'S FALLS, MAINE (SPRING)

"During the 'heavy freshet' in the spring of this year Mr. Hiram F. Mills, a well-known hydraulic engineer, reported the flow * * * as 96,000 second-feet" (Thompson and others, 1964, p. M35).

1869

PENOBSCOT RIVER AT OLD TOWN, MAINE (OCTOBER)

"* * * River rose 9 feet * * *" (Thompson and others, 1964, p. M37).

1870

PENOBSCOT RIVER BASIN IN MAINE (FEBRUARY)

"The Kenduskeag River was reported to be 8 feet over the highway near Six Mile Falls. No serious damage occurred along the Penobscot River itself" (Thompson and others, 1964, p. M45).

FIGURE 9.—Strong currents hampering rescue attempts, Kenduskeag Plaza, Bangor, Maine (Bangor Daily News, 1976). In the center of this photograph, a young woman stranded in her car is being rescued. At this location Kenduskeag Stream is channelized between parking areas on both banks. The stream normally flows between the guardrails in a left-to-right direction. Photograph courtesy of Bangor Daily News.

1887

PENOBSCOT RIVER IN MAINE (MAY)

"Where the track of the M.C.R.R. runs between Bangor and Vanceboro the water has covered the rails to a depth of several feet * * * "

1901

PENOBSCOT RIVER IN MAINE (APRIL 10)

"This flood was the greatest on record * * * up to this time, with a maximum discharge at Bangor of 115,000 second-feet" (Thompson and others, 1964, p. M63).

1909

RIVERS IN MAINE (SEPTEMBER)

"* * * the rain began last Wednesday when an unusual downpour for several days previous caused the Penobscot, St. Croix, Passadumkeag, and Pleasant Rivers to overflow their banks and rapidly rise to freshet pitch. The City of Calais bore the brunt of the trouble" (Thompson and others, 1964, p. M64).

1923

PENOBSCOT RIVER IN MAINE (MAY 1)

"1923, May 1. This flood the largest of record in the Penobscot River Basin * * *" (Thompson and others, 1964, p. M65).

FIGURE 10.—Motorist rescued by boat from strong flood currents, Kenduskeag Plaza, Bangor, Maine. This photograph (Bangor Daily News, 1976) shows the flooding of the parking area near the Merrill Trust Company building. The normal stream channel is in the foreground with flow from left to right. Photograph courtesy of Bangor Daily News.

1936

PENOBSCOT RIVER AT BANGOR (MARCH 21)

"Flood crest stage at 15.4 feet, at Peoples Fish Market, right bank" (Grover, 1937, p. 377).

1976

PENOBSCOT RIVER AT BANGOR (FEBRUARY 2, 1976)

"Elevation 17.46 NGVD" (average of 10 readings taken in the downtown section of Bangor by U.S. Geological Survey, see table 4).

SUMMARY

An extratropical storm caused extensive damage February 2, 1976, along the coast of Maine from Eastport to a point southeast of Brunswick. Water surface elevation in downtown Bangor reached 17.46 feet (5.32 m) (NGVD), approximately 10.5 feet (3.2 m) above predicted astronomical tide. The depth of water in Kenduskeag Plaza, Bangor, was more than 12 feet (3.7 m).

The flood in Bangor was due to a combination of strong, prolonged, south-southeasterly winds and high astronomical tides. Storm rainfall, ice jams, and streamflow were not major factors causing the flood.

Winds off the New England coast exceeded hurricane force. Sustained windspeed at Bangor reached 40 knots with gusts up to 80 knots.

The storm surge reached a maximum height of 3.6 feet (1.1 m) at Portland, 3.7 feet (1.1 m) at Rockland, and 5.5 feet (1.7 m) at Bar Harbor, about 2 hours before the time of the astronomical high tides.

TABLE 4.—*Descriptions and locations of documented high-water marks in Bangor, Maine, for storm of February 1, 1976*

[High-water mark No. corresponds to station No. on plate 2; elevation is in feet above national geodetic vertical datum of 1929]

High-water No.	Elevation	Description and location
1	17.45	Marked debris line on upstream exterior wall of Viner Shoe Co. building on Front Street.
2	17.45	Marked debris line on upstream side of retaining wall of Maine Central Railroad bridge on right bank of Kenduskeag Stream.
3	17.44	Marked debris line on inside of downstream plate girder on right side of Maine Central Railroad bridge over Kenduskeag Stream.
4	17.16	Marked debris line on outside of downstream plate girder on right side of Washington Street bridge over Kenduskeag Stream.
5	17.46	Marked debris line on outside of upstream plate girder on right side of Washington Street bridge over Kenduskeag Stream.
6	17.51	Marked debris line on stream side of parking-lot attendant's building on west side of Kenduskeag Plaza.
7	17.46	Marked debris line on column supporting first floor of Merchant's National Bank; the third column from Kenduskeag Stream.
8	17.55	Marked debris line on rear door of Bangor Savings Bank in Kenduskeag Plaza.
9	17.57	High-water mark on riverside wall of State Street Merrill Trust Bank building.
10	17.50	High-water mark on wall under construction of new Merrill Trust building.

Total damages reportedly were about $2.6 million. In the downtown area of Bangor, damages were estimated at more than $2 million. No lives were lost. In Bangor, about 200 motor vehicles were submerged and many business establishments were flooded. Beach erosion was particularly heavy at Popham Beach, near the mouth of the Kennebec River.

REFERENCES

Bangor Daily News, 1976, Special edition, Tuesday, February 3, 1976, Bangor, Maine.

George, J. J., 1960, Weather forecasting for aeronautics: New York, Academic Press, 673 p.

Grover, N. C., 1937, The floods of March 1936, Part 1, New England rivers: U.S. Geological Survey Water-Supply Paper 798, 466 p.

Hershfield, D. M., 1961, Rainfall frequency atlas of the United States: Technical Paper No. 40, U.S. Department of Commerce, Weather Bureau, 115 p.

National Ocean Survey, 1975a, Tide and current glossary: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, 25 p.

———1975b, Tide tables 1976, High and low water predictions, east coast of North and South America including Greenland: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, 297 p.

Thompson, M. T., Gannon, W. B., Thomas, M. P., Hayes, G. S., and others, 1964, Historical floods in New England: U.S. Geological Survey Water-Supply Paper 1779–M, p. M1–M105.

TABLE 5.—*Locations and descriptions of documented coastal high-water marks for storm of February 2, 1976*

[Station Nos. correspond to those in table 3 and plate 1]

Station No.	Location and description
1	Phippsburg at Small Point Beach—red paint mark on ledge about 175 feet west of fence by "Kelp Shed."
2	Phippsburg at Popham Beach—painted circle on seaward end of granite wall at entrance to Fort Popham. Wall is 40 feet seaward from sign "Fort Popham."
3	Georgetown at Reid State Park, main beach—red paint mark on ledge on south side of rocks, nearly in line with bathouse.
4	Georgetown—red paint mark on stonework of second bridge from Georgetown on far bank from Post Office on north side about 10 feet from bridge and 8 feet down from curbing of bridge.
5	Westport—red paint mark on ledge 100 feet from culvert through approach to new Westport bridge.
6	Wiscasset, lumber mill yard by highway bridge—red paint mark on concrete slab 100 feet south of U.S. Route 1.
7	Damariscotta—red paint mark on granite boulder on south side of boat launch; entrance is the private road to Barrol's Point (Jack's Point).
8	Waldoboro at West Waldoboro, on State Highway Route 32 toward Round Pound—first road to left at end of road, 0.5 mile beyond inn on dirt road, between second and third camp at set of three "Keep Out" signs. Red paint mark on granite outcrop.

TABLE 5.—*Locations and descriptions of documented coastal high-water marks for storm of February 2, 1976*—Continued

[Station Nos. correspond to those in table 3 and plate 1]

Station No.	Location and description
9	St. George at Long Cove, on State Route 131, going toward Tenants Harbor—0.3 mile south of Long Cove Road, ledge outcrop on left side of highway. Red paint mark on gneiss outcrop, 60 feet from Central Maine Power Pole No. 264 in front of Mackie's house.
10	South Thomaston at Spruce Head—0.3 miles east on Lobster Lane Road from junction with State Route 73 going toward Spruce Head Island, near Lobster Lane Bookstore, 45 feet from Central Maine Power pole No. 85. Red paint mark on granite boulder near sea on right side of road.
11	Thomaston—red paint mark on downstream left abutment of Maine Central Railroad bridge over St. George River.
12	Camden at Camden Harbor—red paint mark 12 inches up harbor from tidal gage piling near pole P5153, near tie—up of square rigger.
13	Lincolnville, on municipal dock—red paint mark on piling 2 feet below dock toward shore.
14	Belfast, Marshall Wharf, Eastern Maine Towage Co.—red nail in storehouse building in back of office, 85 feet from wharf edge.
15	Belfast-Northport town line—red nail in 8-inch ash tree on Little River on right bank 100 feet from U.S. Route 1A.
16	Belfast—red mark painted on left abutment of lower highway bridge over Passagassawakeag River just upstream of railroad bridge on road to State Route 141 on upstream side of bridge. Mark is 2.3 feet below bridge seat.
17	Searsport at Bangor and Arrostook Railroad yard—painted red mark on southeast corner post of cyclone fence around electric supply to catwalk pier.
18	Prospect on State Route 174, near junction U.S. 1A—red nail on downstream side of third guardrail post from left.
19	Frankfort near U.S. Route 1A—red nail in cherry tree, 35 feet from sign "Howard L. Mendell, Wild Life Management Area, State of Maine."
20	Frankfort Plains, 0.4 mile north of high-water mark No. 19—painted red mark on downstream right guardrail post (near bottom of cross rail).
21	Frankfort Village—red paint mark on right abutment of green bridge ½ mile below dam. Also red nail on base of electric light pole No. 8, just upstream from green bridge.
22	Winterport, five miles south of Hampden-Winterport town line at old mill site now occupied by Roger Johnson, Contractor—two red nails in the green-shingled shed; one at upstream back wall on corner away from river, and one in windowsill on wall away from river, 3 feet above ground level.

TABLE 5.—*Locations and descriptions of documented coastal high-water marks for storm of February 2, 1976*—Continued

[Station Nos. correspond to those in table 3 and plate 1]

Station No.	Location and description
23	Winterport, 0.3 miles south of Winterport-Hampden town line marker—red nail in Bangor Hydro-Electric pole No. 1187, 50 feet from center line of bridge headed toward Hampden on U.S. Route 1A on right side of road, across from King's residence.
24	Hampden at ferry site just downstream from Peter Edgecomb's house (see description No. 25 on Ferry Road)—red paint mark on 8-foot fir tree 20 feet in front of house near dock.
25	Hampden, near Ram Island, 1.5 miles below the narrows and near buoy No. 22—marked high water on home of Peter Edgecomb, red paint mark on the foundation on the upstream side.
26	Bangor at Barret Tar "Pier" near Route I–95 entrance from Hampden Road—two red nails in electric pole at river edge of dock, 10 feet from pier. One nail in "No Smoking" sign, one on back of pole.
27	Bangor at foot of Boyd Street at Hancock Street—red nail in 4-inch elm, 50 feet from Bangor Hydro-Electric pole toward Orono, 1,600 feet upstream from railroad bridge. High-water mark is about 1 foot over Maine Central Railroad tracks (main line).
28	Bangor at Bangor Pool—nail painted red on telephone pole 10 feet from Bangor Hydro-Electric pole No. 28, 50 feet upstream from culvert. High-water mark is about 2.7 feet below crown of highway near culvert.
29	Bucksport—red nail on light pole just bankward of St. Regis Meterological Station near municipal dock. Water was 1½ feet over this dock February 2, 1976.
30	Verona at Verona Point, by Central Maine Power pole No. 5 in back of "Deering farmhouse"—red nail in 6-inch hornbeam tree. Wash line might indicate wave action.
31	Castine, town pier 20 feet in front of Capt. John's Restaurant—red paint mark on drainspout.
32	Penobscot on State Route 175, 0.4 mile west of Penobscot—USGS high-water mark disk in base of cut-off utility pole on right downstream of small brook that enters northern bay of Bagaduce River.
33	Penobscot on State Route 175, 0.2 mile east of Penobscot—USGS high-water mark disk in base of fifth guardrail post from left downstream side of culvert at small brook that enters northern bay of Bagaduce River.
34	Brooksville, 0.3 mile east of North Brooksville—USGS high-water mark disk in base of utility pole No. 537 on left downstream bank of Bagaduce River. Also mark on 6-inch iron pipe that is the northeast foundation support of shed about 100 feet from the marker in the utility pole. Mark is 2.5 feet above granite footing.

TABLE 5.—*Locations and descriptions of documented coastal high-water marks for storm of February 2, 1976*—Continued

[Station Nos. correspond to those in table 3 and plate 1]

Station No.	Location and description
35	Sedgwick—USGS high-water mark disk 2.75 feet below top of concrete footing on northeast corner of Deer Isle bridge over Eggemoggin Reach.
36	Sedgwick—nail in base of utility pole No. 47 on right downstream side of causeway at Benjamin River.
37	Blue Hill, on left downstream side of Mill Stream, about 100 feet below culvert on State Route 176—nail driven in side of shop building of Babson and Duffy Plumbing and Heating, located 2 feet from left side of door as you enter building; oil slick on third clapboard from bottom of building.
38	Surry, 1.7 miles east of bridge over Meadow Stream on east shore of Contention Cove—USGS high-water mark disk in base of first post of white picket fence about 200 feet from State Route 172.
39	Ellsworth on Water Street on left bank of Union River, about 0.1 mile below U.S. Route 1—USGS high-water mark disk in base of elm tree behind body shop of Morrison Chevrolet. Also disk in base of parking lot light pole, same site.
40	Bar Harbor, 0.4 mile south on State Route 3 of bridge over Mount Desert Narrows, on Western Bay side of causeway—USGS high-water mark disk in 4-foot spruce tree about 30 feet west of of shoulder of road.
41	Southwest Harbor—USGS hgh-water mark disk in top timber curb of U.S. Coast Guard pier. Marker is just right of the most right-hand parking space for U.S. Coast Guard *Brindle*, just below concrete deck of pier.
42	Mount Desert, 0.1 mile east on State Route 198 on junction State Routes 102 and 198 in Somesville—USGS high-water mark disk in stump about 75 feet off shoulder of road on left bank of Somes Harbor.
43	Winter Harbor, 0.1 mile west of junction State Route 186—USGS high-water mark disk in southwest corner of 20-by-20-foot shed across road from town garage, just west and across road from gas station.
44	Milbridge, junction U.S. Route 1 and Wyman Road—USGS high-water mark disk in northeast corner of storage barn across road from Wyman Canning Company office.
45	Milbridge—USGS high-water mark disk in base of New England Telephone and Telegraph pole No. 10 on east side of U.S. Route 1 causeway over Narranguagus River.
46	Cherryfield—USGS high-water mark disk in base of triple elm on right bank of Narranguagus River about 150 feet downstream from U.S. Route 1 bridge and across road from Tracy's Motel on left bank of small brook.
47	Harrington—USGS high-water mark disk in northwest side of office building on right side of door casing on rear door, about 3 inches above sill. Building is located on Water Street between street and small stream about 100 feet below second culvert on right bank.
48	Harrington—on Ripley Neck Road, 3 miles south of junction U.S. Route 1, on downstream side of bridge over Mill Creek in the second course down from top of 6- by 14-inch timbers.
49	Addison—USGS high-water mark disk in southeast corner of Smith's Clam Shop on left bank of West Branch of Pleasant River just below bridge.
50	Addison at South Addison—USGS high-water mark disk on southeast corner of building on D. W. Look & Son wharf about 3 feet above wharf on Eastern Harbor.
51	Jonesport—USGS high-water mark disk in base of easternmost light pole of parking lot at public boat landing, about 0.1 mile off State Route 187.
52	Jonesboro—USGS high-water mark disk on Bangor Hydro-Electric pole No. 1609 on right bank of Beaver Brook, 10 feet downstream from Roque Bluffs Road culvert, 0.1 mile east of junction U.S. Route 1.
53	Machias—marker on front of Sears store on U.S. Route 1. USGS high-water mark disk located at right side of garage door about 1.5 feet from door sill.
54	East Machias—USGS high-water mark disk in parking lot 13 feet from southwest corner of Post Office.
55	East Machias—two USGS high-water mark disks in southeast corner of Dwelleys' store about 100 feet north of Post Office.
56	Whiting, 3.5 miles west of North Cutler—PK nail in USGS high-water mark disk in right downstream bankward side of wing wall on Holmes Stream.
57	Cutler, on 90° turn of State Route 191 in built-up area of Cutler—USGS high-water mark disk in left post (against building) bracing walkway to building reading "Farris Wharf."
58	Lubec—USGS high-water mark disk in A. W. Pike's boathouse behind U.S. Custom House left side of Campobello Island bridge, in right water side of doors about 2 inches above floor sill.
59	Dennysville on old U.S. Route 1, just off U.S. Route 1—USGS high-water mark disk on lower edge of fourth clapboard up on small house on left bank of Dennys River upstream from U.S. Route 1.
60	Dennysville on old U.S. Route 1—USGS high-water mark disk in utility pole No. 6 on left bank of Dennys River 300 feet upstream from small house.

TABLE 5.—*Locations and descriptions of documented coastal high-water marks for storm of February 2, 1976*—Continued

[Station Nos. correspond to those in table 3 and plate 1]

Station No.	Location and description
61	Perry—USGS high-water mark disk in cut-off utility pole at old bridge site on left bank of Little River 200 feet upstream from new bridge on U.S. Route 1.
62	Calais, on Elm Street behind water treatment plant on right bank of St. Croix River—USGS high-water mark disk in cut-off utility pole on streamward side of treatment plant outfall.

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