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U.S. Department of Homeland Security
Federal Emergency Management Agency

Elevation of the March–April 2010 Flood High Water in Selected River Reaches in Rhode Island

Open-File Report 2011–1029

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

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By Phillip J. Zarriello and Gardner C. Bent

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KEN SALAZAR, Secretary

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Conversion Factors

Multiply	By	To obtain
	Length	
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
square mile (mi^2)	259.0	hectare (ha)
square mile (mi^2)	2.590	square kilometer (km^2)
	Flow rate	
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)

Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD 88).

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

Elevation, as used in this report, refers to distance above the vertical datum.

Elevation of the March–April 2010 Flood High Water in Selected River Reaches in Rhode Island

By Phillip J. Zarriello and Gardner C. Bent

Abstract

A series of widespread, large, low-pressure systems in southern New England in late February through late March 2010 resulted in record, or near record, rainfall and runoff. The total rainfall in the region during this period ranged from about 19 to 25 inches, which coupled with seasonal low evaporation, resulted in record or near record peak flows at 21 of 25 streamgages in Rhode Island and southeastern Massachusetts. The highest record peaks occurred in late March–early April and generally greatly exceeded the earlier March peaks that were near or exceeded the peak of record for 10 of the 25 streamgages.

Determination of the flood-peak high-water elevation is a critical part of the recovery operations and post-flood analysis for improving future flood-hazard maps and flood-management practices. High-water marks (HWMs) were identified by the U.S. Geological Survey (USGS) from April 2–7, 2010, and by the U.S. Army Corps of Engineers (USACE) from April 3–7, 2010, in five major river basins including the Blackstone, Hunt, Moshassuck, Pawtuxet, and Woonasquatucket along the mainstems and in many tributaries. The USGS identified 276 HWMs at 137 sites. A site may have more than one HWM, typically upstream and downstream of a bridge. The USACE identified 144 HWMs at 127 sites. The HWMs identified by the USGS and USACE covered about 170 river miles, determined from the upstream and downstream HWMs. Elevation of HWMs were later determined to a standard vertical datum (NAVD 88) using the Global Navigation Satellite System and survey-grade Global Positioning System (GPS) receivers along with standard optical surveying equipment.

Introduction

Flood flows and water levels set, or nearly set, record highs in late March into early April 2010 following repeated storms. In the wake of the severe flooding, a state of emergency was declared in many communities in Rhode Island, and a statewide Presidential Disaster (number 3311) was declared on March 31, 2010. The President's action affected the emergency recovery operations in Bristol, Kent, Newport, Providence, and Washington Counties. No official estimate of the flood damages could be found, but the flood has been characterized as the worst in 200 years and is estimated to have damages in the $100's of millions of dollars. As part of the recovery operations, the U.S. Department of Homeland Security's Federal Emergency Management Agency (FEMA) required analysis of the flood to assess damages and to prepare for and minimize future flood damages.

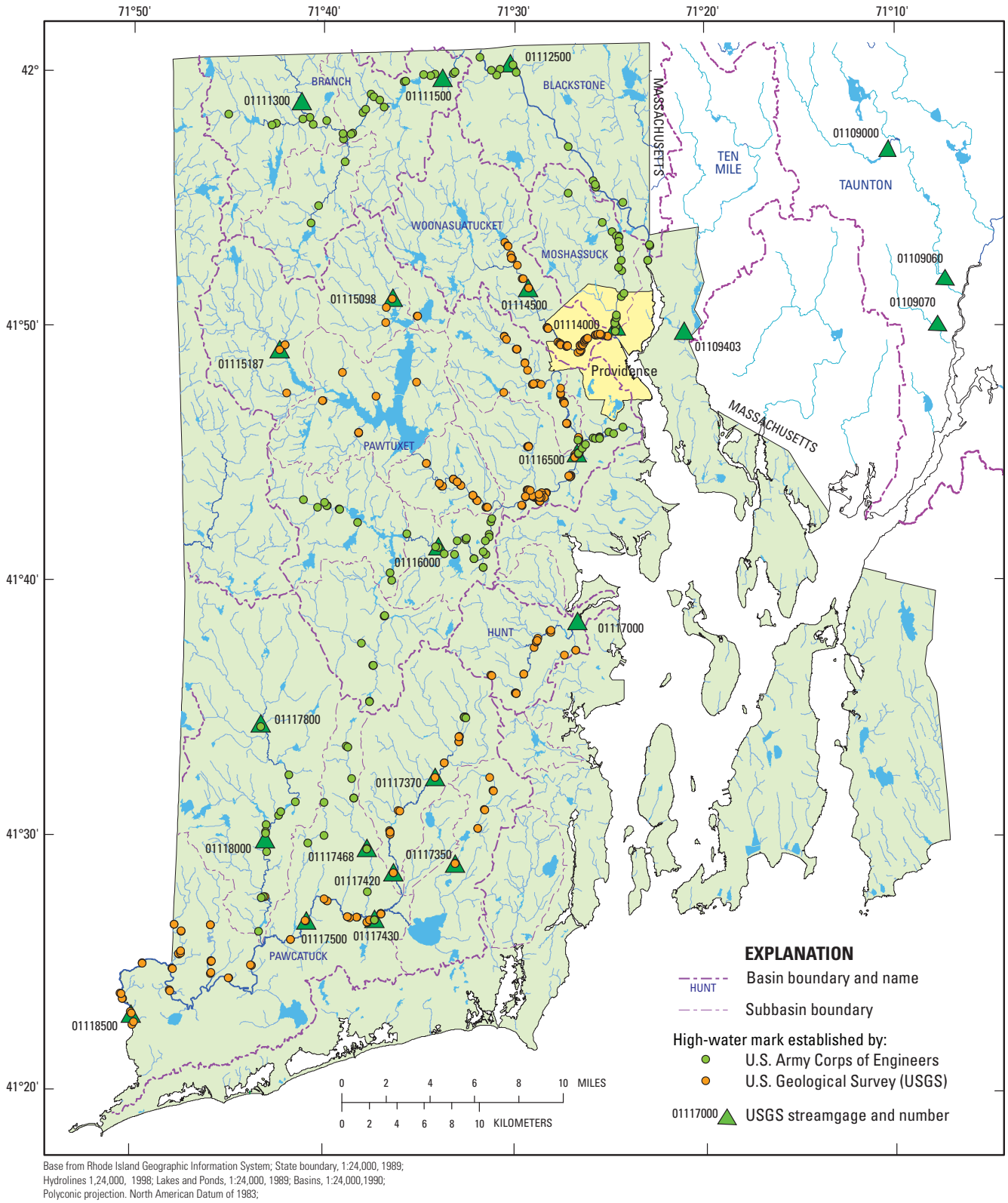
Determination of the peak high-water elevation is a critical part of the recovery operations and post-flood analysis. This information also is extremely valuable when defining and understanding flood risks for flood management. The U.S. Geological Survey (USGS) initially entered into an agreement with the U.S. Army Corps of Engineers (USACE) on April 2010 to identify high-water marks (HWMs) in selected river reaches in Rhode Island. A subsequent agreement between FEMA and the USGS was signed in August 2010 to complete the HWM survey work from the March–April 2010 flood and document the work as part of a larger project with FEMA to support flood-mitigation efforts.

Purpose and Scope

The purpose of this report is to document the elevation of peak high water following the March–April 2010 flood in selected river reaches in Rhode Island. The report describes the climate and flow conditions prior to the flood, recorded peak gage heights and flows at USGS streamgages, methods used to identify high-water marks, and the surveying methods used to obtain a vertical datum of the HWM. The report summarizes the HWM data for selected river reaches and presents data in tables and figures.

Study Area

High-water elevations from the March–April 2010 flood were obtained in selected river reaches throughout Rhode Island (fig. 1). These include the Blackstone, Branch, Hunt, Moshassuck, Pawtuxet, Pawcatuck, and Woonasquatucket Rivers (basin names shown in fig. 1). HWMs and elevations were also obtained in many main tributaries to these rivers including the including the Beaver, Chipuxet, Wood, and Queen-Usquepaug Rivers in the Pawcatuck River basin, the North and South Branches and Pocasset Rivers in the



Base from Rhode Island Geographic Information System; State boundary, 1:24,000, 1989; Hydrolines 1,24,000, 1998; Lakes and Ponds, 1:24,000, 1989; Basins, 1:24,000,1990; Polyconic projection. North American Datum of 1983;

Figure 1. River basins where high-water elevations were determined following the March–April 2010 floods in Rhode Island. Streamgage 01108000 and 01111212 not shown because they are outside the map extent.

Pawtuxet River Basin, and other smaller tributaries (subbasin boundaries are shown in figure 1, but the names are not for clarity). In general, HWMs were obtained over a large part of Rhode Island, but the greatest concentration of HWMs was obtained in and around the Providence area.

Rainfall and Antecedent Conditions

A series of widespread, large, low-pressure systems passed through the New England region in late February and in mid- through late March 2010 resulted in record, or near record, amounts of rainfall. The total March 2010 rainfall at Kingston southeast of Providence is the highest monthly recorded (19.37 in) by the National Weather Service (NWS) since 1893 (COOPID–374266, fig. 2). The second highest total monthly rainfall recorded at Kingston (14.35 in.) was in June 1982.

During a period when evaporation losses are normally low, these low-pressure systems maintained wet soil-moisture conditions and filled available surface storages that resulted in record, or near record, floods in southern New England. The Northeast Regional Climate Center (2010) March Climate Summary report described the following conditions: "The mid-March storm hit the region from March 13–15, dropping as much as 9 inches of rain in eastern Massachusetts. As floodwaters began to recede an additional 2 to 5 inches of rain fell on March 22nd and 23rd, followed by 5 to 9 inches of rain on the 29th and 30th."

Rainfall hyetographs and cumulative rainfall (figs. 3A and 3B) for five NWS Rhode Island daily record stations (COOPIDs–374266, 375270, 376698, 377581, and 379423; fig. 2) exemplify the pattern of excessive moisture during late February and March. Prior to the March high water, a late February storm dropped about 5 inches of rain over the region, saturating soils, filling available storage, and elevating streamflows. Thus, conditions were primed for the first runoff response following the 4 to 7 inches of rain that fell between March 13th and 15th. From late February through mid-March total precipitation ranged from about 8 to 12 inches in the study area. As high water began to recede, an additional 2 to 5 inches of rain fell on March 22–23, which maintained wet conditions and again elevated streamflows in the region. Wet conditions continued through late March with another storm that brought the largest pulse of rain of about 7 to 9 inches on the 29th and 30th. The additional rain resulted in peak stream stages and flows that generally greatly exceeded the earlier March stages and flows.

Overall, the total rainfall at the five NWS stations (fig. 3) from late February through March ranged from about 19 to 25 inches, which is unprecedented in the past 100-year weather history, especially during the cool season when moisture losses to evaporation are low. Rainfall during this period represents about half the total annual precipitation, which is relatively evenly distributed throughout the year. The total rainfall during February and March 2010 in southeastern New England (fig. 2) indicates the highest amounts occurred from southeastern Connecticut and southern Rhode Island northward along the southern New England coast. The area of high rainfall in northeastern Massachusetts and northward was about equal to the total rainfall in southeastern Massachusetts and Rhode Island, but flooding was less severe in northeastern Massachusetts because a greater portion of the total rainfall in this region occurred in late February when water storage was more available.

Streamflows

Peak stages and flows recorded at USGS streamgages in Rhode Island and southeastern Massachusetts (table 1) indicate the magnitude of the March–April 2010 flood relative to the magnitude of past floods over the period of the streamgage record. The 2010 stage and flow data are provisional until the entire segment of streamflow record is analyzed and approved. Waiting for the approval of the 2010 streamflow data would cause undue delays for this report. Approval of the data was not considered necessary for the primary objective of documenting the elevation of the flood high water. However, the data on peak stage and flow were reviewed and are considered to be in good condition for use in this report.

Of the 25 streamgages listed in table 1, the March–April 2010 flood set new peak stage and flow records at all streamgages except Wading River near Norton, MA (01109000), which was within about 10 percent of the peak record, and the Blackstone River Basin streamgages (01111300, 01111500, 01112500) with the exception of the relatively new streamgage on the Blackstone River near Uxbridge, MA (01111212). The flood peak occurred at the end of March or the beginning of April for all streamgages listed in table 1. The increase in peak flows from the previous peak of record at the streamgages (excluding Wading River and the Blackstone River Basin streamgages) ranged from about 2 to 275 percent with median increase of 88 percent. The streamgage records indicate that the largest increase in the record peak flow was in the upper Pawcatuck River Basin, including the Wood River Basin and neighboring basins to the north and east, including the Hunt River Basin, the mainstem of the Pawtuxet River, and the South Branch of the Pawtuxet River (fig. 1).

The mid-March peak and the peak around March 24–25 would have been annual peak had more rainfall not occurred. At five streamgages these peaks exceeded the previous peak of record (01117430, 01117800, 01115098, 01116000, and 01108000; table 1) and were within about 20 percent of the peak of record at five other streamgages (01117420, 01117468, 01118000, 01115187, and 01116500; table 1). The magnitude of these secondary peaks and the duration of high water reflect the severity of the flood conditions in the area. Unlike HWMs identified in many river reaches in central and eastern Massachusetts that were confounded by mid-March peaks that equaled or exceeded the late March–early April peaks

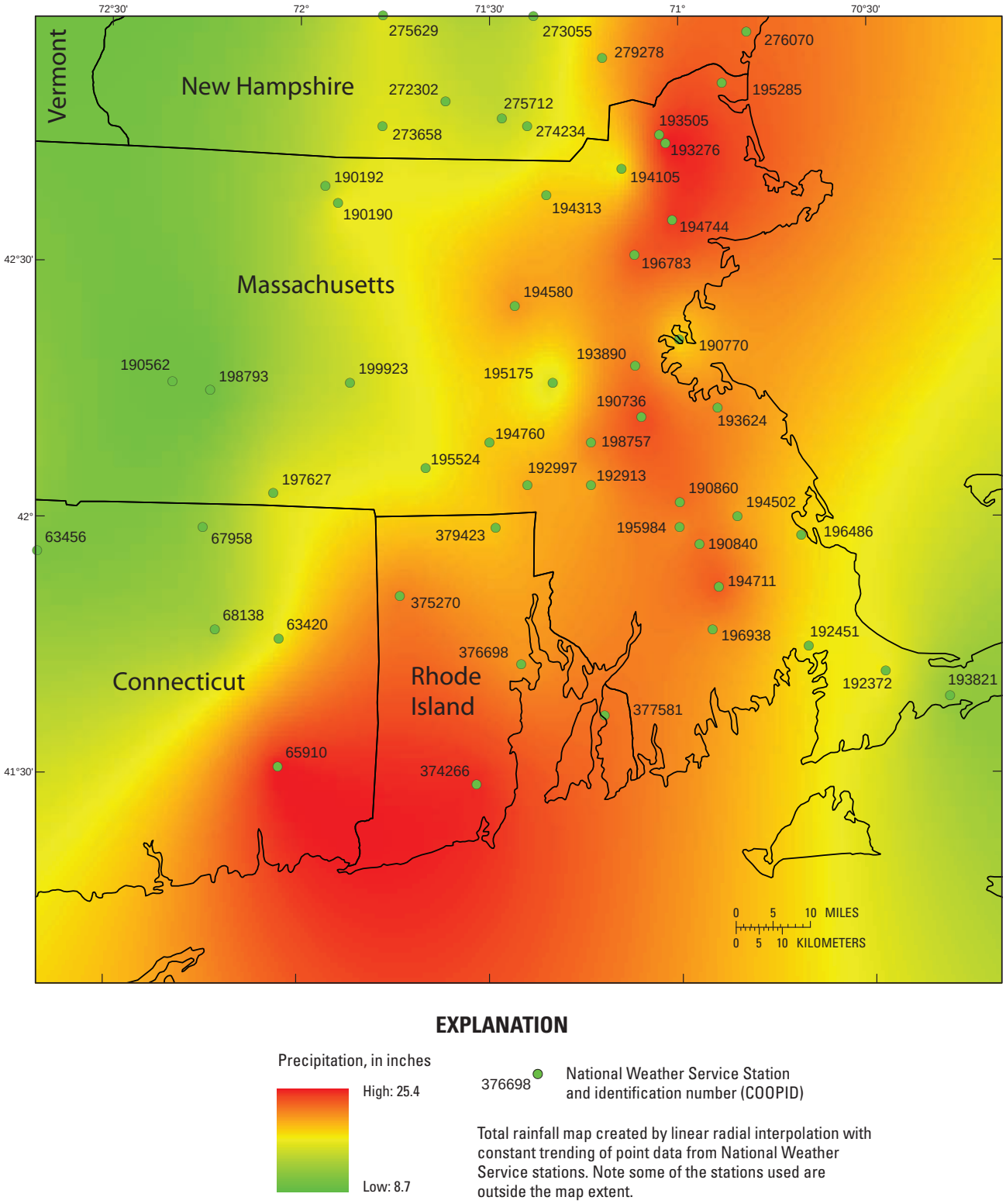


Figure 2. Total rainfall during February and March 2010 in southeastern New England.

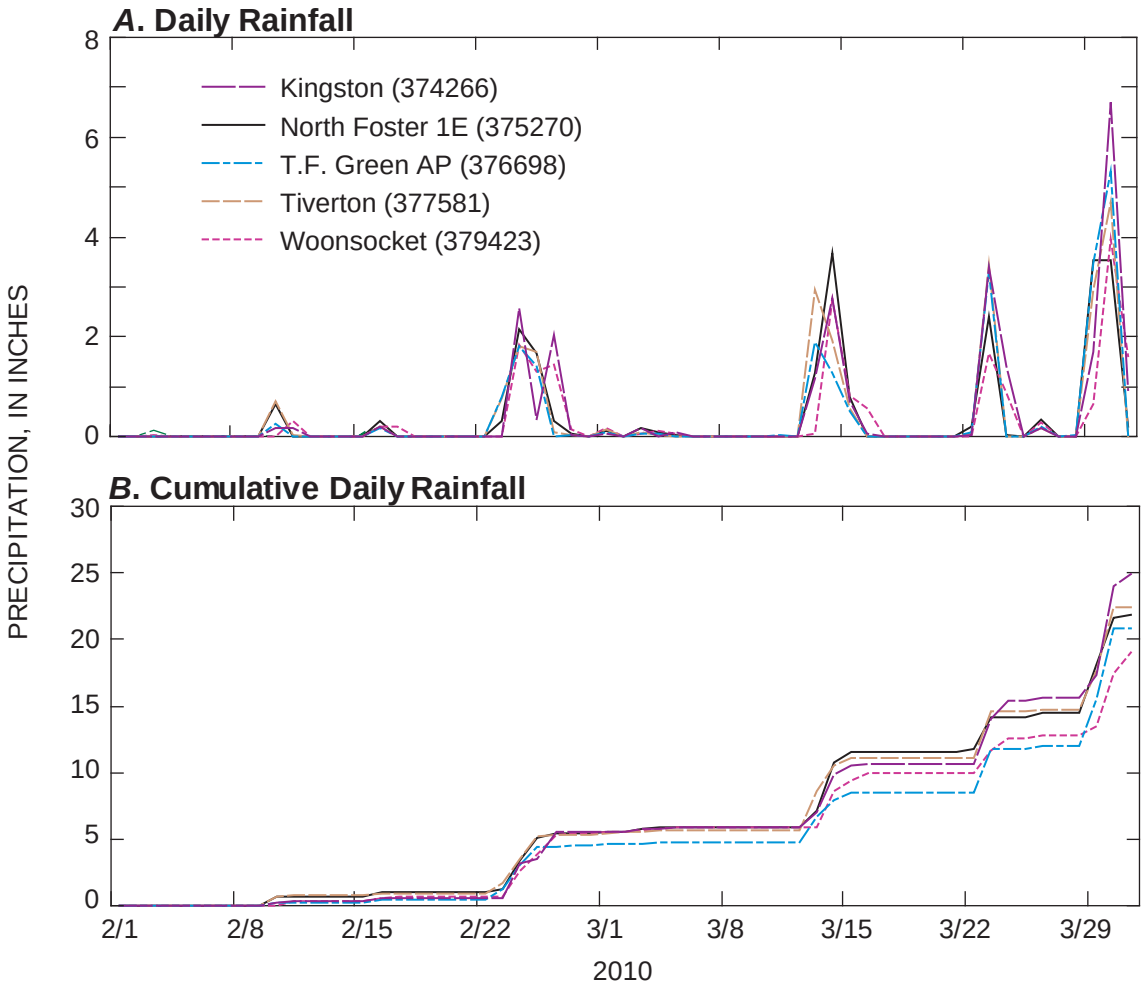


Figure 3. Daily rainfall (*A*) hyetographs and (*B*) cumulative totals during February and March 2010 at five National Weather Service stations (NWS) in Rhode Island. Number in parenthesis is the NWS COOPID shown in figure 2.

(Zarriello and Bent, 2010), the HWMs in Rhode Island are distinctly identified by late March–early April peak that greatly exceeded the earlier peaks.

Flow conditions in the region prior to the March floods are illustrated by the daily mean flow for the 2010 water year in relation to the 10th-, 25th-, 50th-, 75th-, and 90th-percentile flows for a given day, calculated from the period-of-record daily mean flows at Hunt River near East Greenwich (01117000) and Wood River at Hope Valley (01118000) (fig. 4A and 4B, respectively). Note that these streamgages were established in 1939 and 1940, respectively. Prior to the late February rainfall, flows were below the median (50th percentile) but quickly rose well above the 90th percentile following the late February rainfall. Flows that exceeded the 90th percentile occurred only 10 percent of the time at this time of year, which is the normal seasonal high-flow period. Flows receded to about the median range in early March, then rose sharply following the mid-March rains and again following the mid–late March rains that set a new peak flow for water year 2010. Flows continued to stay above the 90th percentile in late March because of saturated conditions and additional rainfall. Another large rainfall event at the end of March caused a rise in streamflow that exceeded earlier peaks and set new period of record peaks at most streamgages in Rhode Island.

Methods

HWMs are the evidence of the highest water levels during a flood (Benson and Dalrymple, 1967). There are many types of HWMs, but most are left by vegetative debris stranded at the highest water elevation. The best HWMs are small seeds or floating debris that adhere to smooth surfaces or lodge in tree bark that forms a distinct water line. Stain lines on buildings, fences, and other structures also provide excellent marks. HWMs are best identified immediately following the peak stage as time and weather (wind and rain) fade the

Table 1. Summary of March–April 2010 flood peak stage and flow data at selected U.S. Geological Survey streamgages in Rhode Island and southeastern Massachusetts.

[Locations shown on figure 1; mi^2, square miles; ft feet; ft^3/s, cubic feet per second; numbers in **bold** indicate new peak of record]

Station number	Station name	Drainage area (mi^2)	Start of record	March – April 2010 peak[b]			Recorded peak prior to March–April 2010 flood			Secondary peak[b] March–April 2010		
				Date	Gage height (ft)	Discharge (ft^3/s)	Date	Gage height (ft)	Discharge (ft^3/s)	Date	Gage height (ft)	Discharge (ft^3/s)
BLACKSTONE RIVER BASIN												
01111212	Blackstone River, Rt 122 Bridge near Uxbridge, MA	244	2006	03/31	**19.56**	**7,310**	04/17/2007	18.44	6,420	03/15	16.77	5,170
01111300	Nipmuc River near Harrisville, RI	16.0	1965	03/30	8.29	2,230	04/16/2006	9.44	3,900	03/14	7.59	1,380
01111500	Branch River at Forestdale, RI	91.2	1940	03/31	12.05	5,260	10/15/2006	13.09	6,290	03/14	8.95	2,640
01112500	Blackstone River at Woonsocket, RI	416	1929	03/31	14.50	14,900	08/19/1955	21.80	32,900	03/15	10.29	8,280
HUNT RIVER BASIN												
01117000	Hunt River near East Greenwich, RI	22.9	1940	03/30	**5.61**	**2,420**	10/15/2005	4.71	1,680	03/24	3.12	671
MOSHASSUCK RIVER BASIN												
01114000	Moshassuck River at Providence, RI	23.1	1963	03/30	**6.26**	**1,600**	03/18/1968	4.34	1,220	03/24	4.61	729
PAWCATUCK RIVER BASIN												
01117350	Chipuxet River at West Kingston, RI	9.59	1973	03/31	**9.78**	**688**	10/16/2005	8.07	306	03/24	7.39	222
01117370	Queen River at Liberty Rd at Liberty, RI	19.6	1998	03/30	**8.44**	**2,760**	10/15/2005	6.08	919	03/14	5.38	591
01117420	Usquepaug River near Usquepaug, RI	36.1	1976	03/31	**11.16**	**2,950**	06/06/1982	9.23	1,060	03/15	7.91	863
01117430	Pawcatuck River at Kenyon, RI	72.7	2002	04/01	**7.21**	**2,510**	04/17/2007	3.54	885	03/25	4.05	1,080
01117468	Beaver River near Usquepaug, RI	9.22	1974	03/30	**6.41**	**1,390**	06/06/1982	3.95	370	03/14	3.94	311
01117500	Pawcatuck River at Wood River Junction, RI	100	1940	03/31	**11.16**	**3,490**	06/07/1982	8.75	1,860	03/25	6.42	1,280
01117800	Wood River near Arcadia, RI	35.2	1964	03/30	**10.56**	**2,660**	03/18/1968	8.64	896	03/14	8.45	1,080
01118000	Wood River at Hope Valley, RI	72.4	1941	03/30	**13.72**	**5,470**	06/06/1982	10.26	2,390	03/14	8.89	1,890
01118500	Pawcatuck River at Westerly, RI	295	1940	03/30	**15.38**	**9,330**	06/06/1982	12.86	7,070	03/24	9.35	4,000

Table 1. Summary of March–April 2010 flood peak stage and flow data at selected U.S. Geological Survey streamgages in Rhode Island and southeastern Massachusetts.—Continued

[Locations shown on figure 1; mi², square miles; ft feet; ft³/s, cubic feet per second; numbers in **bold** indicate new peak of record]

Station number	Station name	Drainage area (mi²)	Start of record	March – April 2010 peak[b]			Recorded peak prior to March–April 2010 flood			Secondary peak[b] March–April 2010		
				Date	Gage height (ft)	Discharge (ft³/s)	Date	Gage height (ft)	Discharge (ft³/s)	Date	Gage height (ft)	Discharge (ft³/s)
PAWTUXET RIVER BASIN												
01115098	Peeptoad Brook at Elmdale Rd near North Scituate, RI	4.83	1994	03/30	**2.55**	**249**	10/20/1996	2.48[c]	180	03/14	2.43	191
01115187	Ponaganset River at South Foster, RI	14.4	1994	03/30	**6.57**	**1,330**	06/30/1998	6.37	1,200	03/14	6.04	1,000
01116000	South Branch Pawtuxet River at Washington, RI	62.8	1940	03/31	**9.22**	**5,280**	06/06/1982	5.30	1,980	03/15	5.4	2,080
01116500	Pawtuxet River at Cranston, RI[a]	200	1939	03/31	**20.79**	**14,100**	06/07/1982	14.50	5,440	03/15	14.98	5,380
TAUNTON RIVER BASIN												
01108000	Taunton River near Bridgewater, MA	261	1930	04/01	**14.97**	**5,480**	03/20/1968	14.48	4,980	03/17	14.51	5,230
01109000	Wading River near Norton, MA	43.3	1926	03/30	**11.48**	1,310	03/19/1968	11.47	1,460	03/15	9.93	786
01109060	Threemile River at North Dighton, MA	84.3	1967	03/31	**8.98**	**2,930**	06/16/1998	8.89	2,870	03/16	7.23	1,840
01109070	Segreganset River near Dighton, MA	10.6	1967	03/30	**8.66**	**1,010**	03/18/1968	7.69	867	03/15	5.70	426
TEN MILE RIVER BASIN												
01109403	Ten Mile River at East Providence, RI	53.1	1987	03/31	**10.79**	**2,250**	10/16/2005	10.00	1,900	03/15	7.36	975
WOONASQUATUCKET RIVER BASIN												
01114500	Woonasquatucket River at Centerdale, RI	38.3	1941	03/30	**9.00**	**1,750**	10/15/2005	8.26	1,530	03/14	4.71	651

[a] Streamflow affected by regulation.

[b] Gage height and discharge may change pending further analysis of entire water-year record.

[c] Peak gage height is from July 1, 1998, as a result of backwater from Scituate Reservoir.

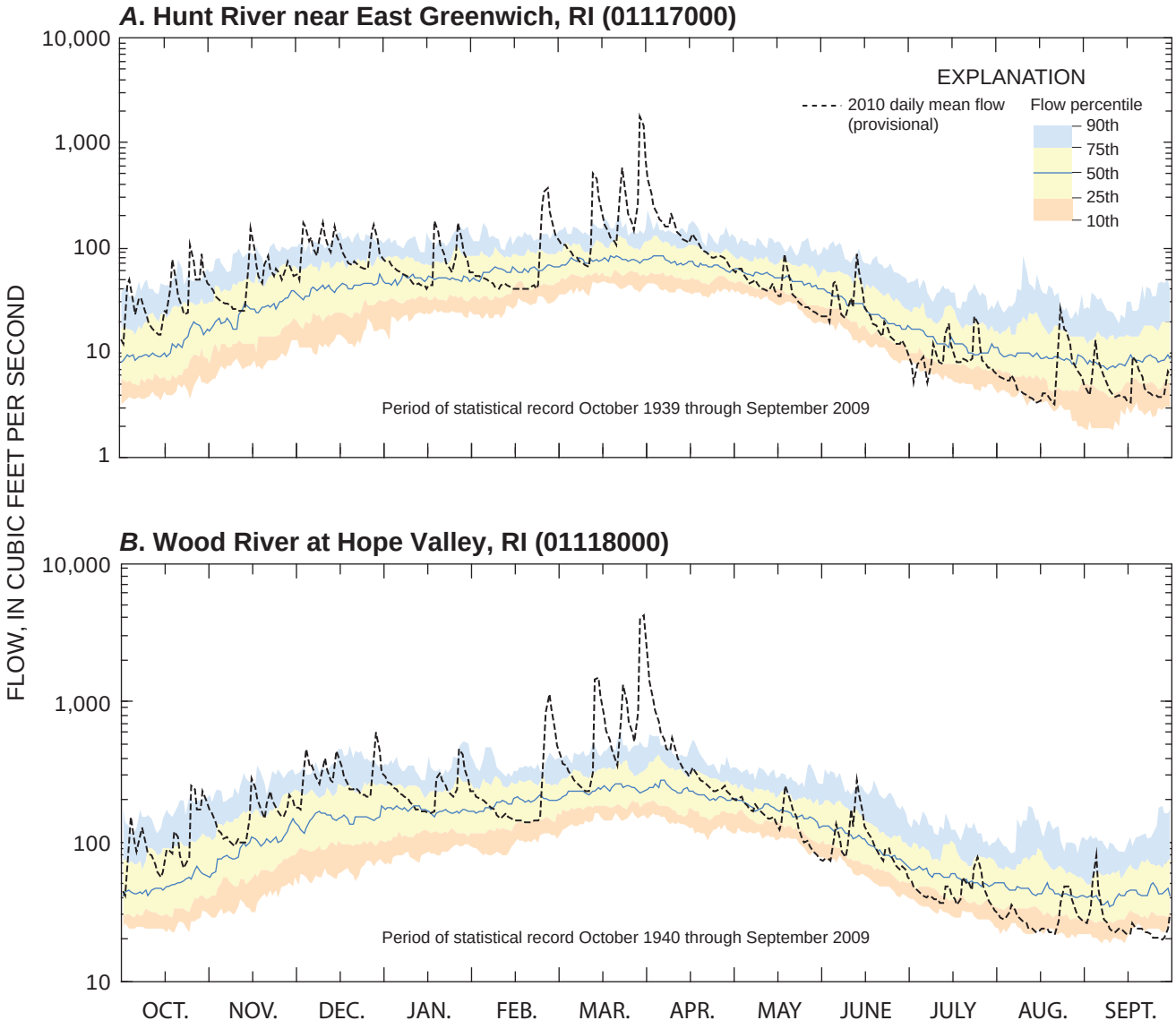


Figure 4. Period-of-record daily mean flow percentiles and 2010 daily mean flow at (*A*) Hunt River near East Greenwich (01117000) and (*B*) Wood River at Hope Valley (01118000), Rhode Island. Location shown in figure 1.

evidence of the peak-water line. Additionally, care was taken to identify HWMs farthest from the main channel as possible where velocities are generally small and pileup or drawdown's common in fast moving waters are best avoided. The general methods used to identify and document HWMs are described by Benson and Dalrymple (1967).

Setting High-Water Marks

USGS field crews consisted of at least one person experienced in identifying HWMs. Crews would identify HWMs and corroborating evidence of surrounding HWMs. The corroborating information became more important as the quality of the HWM decreased. After a satisfactory HWM was found, a more permanent identification mark was established, such as a disk, stake, chisel mark, pen line or paint line (examples shown in fig. 5). Flagging, written descriptions, sketches, photos, and handheld Geographic Position System (GPS) horizontal position measurements were made so the marks could be found later and surveyed to a standard vertical datum or for other analysis, such as determination of the flood profile over the river reach.

Identification of HWMs by the USGS began on April 2 and continued through April 7, 2010, by up to six field crews on a given day. Most of the HWMs were determined from April 5–7, when five or six crews were deployed. In the first 2 days, April 2–3, only one and two crews were deployed, respectively, because of outstanding streamgaging activities related to the flood. The HWMs generally were of good quality because they were obtained soon after the flood peak. Dates and other supporting information on HWMs obtained by the USACE were not noted in the summary spreadsheet or in limited field notes supplied by the USACE. Christopher Hatfield (USACE, oral commun., 2011) indicated the USACE HWMs were obtained from April 3–7.

Elevation of High-Water Marks

Elevation of HWMs were later surveyed to a standard vertical datum (NAVD 88) using the Global Navigation Satellite System (GNSS) and survey-grade GPS receivers along with standard optical-surveying equipment. The GPS surveys were conducted using four Trimble R8 receivers that support the L1 and L2 signals; two of the receivers also support GLONASS L2C and L5 signals. At each HWM site a temporary survey point (PK) was established in an open area to provide the best possible satellite reception. For each PK, the GPS receiver was initialized away from the PK and then positioned over the PK. This procedure was repeated by reinitializing the GPS unit (flipping the unit upside down for several seconds to lose the GPS signals) to obtain an independent reading. If the vertical elevation of the PK differed by more than about 0.10 ft, the procedure was repeated until an acceptable agreement was reached. Elevation of repeated PK measurements generally agreed to within 0.05 ft. Standard optical surveying equipment was then used to tie the HWM to the PK elevation using a closed-loop survey. Ninety-eight percent of the 291 loop surveys closed to within 0.01 ft or less, 2 percent closed to within 0.02 ft.

Continuous real-time differential corrections to the GPS horizontal and vertical positions were made using a proprietary fixed-base station GPS network operated by KeyNetGPS, Inc. The network and associated software determine corrections for satellite signals received by the field GPS receiver for ionosphere and other atmospheric disturbances recorded at three or more of the closest fixed-base stations relative to the position of the field GPS receiver. The fixed-base stations receivers continuously stream data to a central server that calculates corrections at the location of the field GPS receiver in real time. The Trimble GPS field controllers require version 12 controller software to utilize the fixed network. The fixed-station network in the Rhode Island region, nearest the HWMs, consists of five stations (fig. 6)—Providence, RI (NBC1), Fall River (ABL1), Framingham (KP16), Boston (KP19), MA, and Norwich, CT (MTG1). Quality-assurance GPS measurements were made at 29 National Geodetic Survey (NGS) bench marks (BMs) with vertical datum throughout the study area (fig. 6). The elevation of the GPS measured BMs yielded a vertical root mean square error (RMSE) of 0.09 ft (table 2). The accuracy of the HWM survey meets the standards specified by FEMA (2003) in Guidelines and specifications for flood hazards mapping partners, Appendix A: Guidance for aerial mapping and surveying.

Elevations of 87 USGS HWMs were initially surveyed with a Leica system 1200 (GX1220) GPS that uses a temporary GPS base station to make baseline corrections for atmospheric and ionosphere disturbances to the rover GPS unit. Most of these HWM elevations (75) were resurveyed with the Trimble GPS with the exception of 6 HWMs that were found destroyed and 6 that had been surveyed during the initial HWM work and would likely be difficult to find because of limited field notes. The Leica GPS survey work was redone to the extent possible because check measurements with the Trimble GPS yielded inconsistent results. Of the 75 HWMs that were surveyed using the Leica and Trimble GPS systems, the elevation of HWMs determined with the Leica GPS had a mean and median difference of -0.11 ft and ranged from 0.20 to -0.68 ft different from the elevation determined with the Trimble GPS. The elevations determined using the Trimble GPS survey are reported, where possible, because more ground-truth information was obtained, and the atmospheric and ionosphere corrections were considered more accurate.

The USACE surveyed 41 out of the 144 HWMs identified as part of their initial effort to identify high-water levels. The HWMs surveyed by USACE used survey-grade Leica GPS equipment that uses a temporary base GPS station and a rover GPS unit to make baseline corrections for atmospheric and ionosphere disturbances. The control information appears to be limited to two NGS bench marks. The HWMs were not resurveyed by the USGS because of difficulty finding USACE HWMs, which were generally limited to horizontal position coordinates.

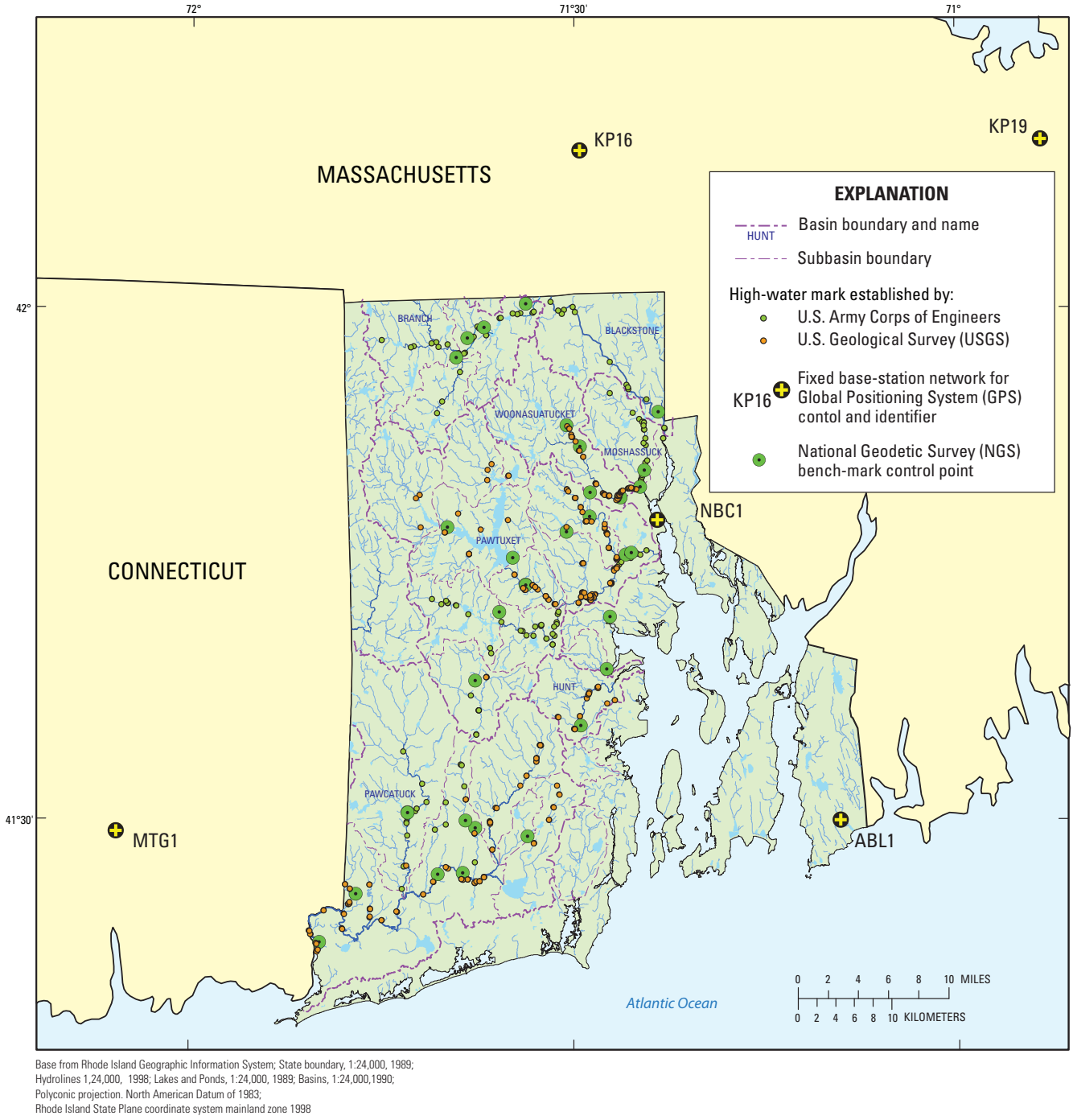
Ashaway River (Ash-20.1)

Pawcatuck River (500904)

Woonasquatucket River (WR-2-2.1)

Pawtuxet River (500310)

Figure 5. Examples of high-water mark debris lines on trees and structures following the March–April 2010 floods in Rhode Island. Value in parentheses refers to the HWM_ID in appendix table 1-1.



Base from Rhode Island Geographic Information System; State boundary, 1:24,000, 1989;
Hydrolines 1,24,000, 1998; Lakes and Ponds, 1:24,000, 1989; Basins, 1:24,000,1990;
Polyconic projection. North American Datum of 1983;
Rhode Island State Plane coordinate system mainland zone 1998

Figure 6. Fixed-based station Global Positioning System receiver network and National Geodetic Survey bench-mark control points used in the determination of the elevation of the March–April 2010 flood high water in Rhode Island.

Table 2. Summary of Global Positioning System (GPS) measurements made to National Geodetic Survey (NGS) bench marks.

[PID, NGS identification; EAST and NORTH, horizontal position referenced to North American Datum of 1983 (NAD 83), in feet; ELEV(88), vertical reference to North American Datum of 1988 (NAVD 88), in feet; OFFSET, GPS point offset from bench mark to obtain the best quality signal; DELTAS, difference between published and surveyed values, in feet; –, not determined; RMSE, Root Mean Square Error, in feet]

PID	Published by NGS			Surveyed by GPS			OFFSET (feet)	Deltas		
	EAST	NORTH	ELEV(88)	EAST	NORTH	ELEV(88)		EAST	NORTH	ELEV(88)
LW1207	290,212.264	323,557.039	445.08	290,212.437	323,557.217	445.140	0.00	0.17	0.18	0.06
MY6203	310,892.869	335,656.078	243.29	310,882.757	335,646.307	241.788	1.63	–	–	0.13
LW1892	292,989.929	201,602.231	434.8	292,989.792	201,602.270	434.671	0.00	-0.14	0.04	-0.13
LW1141	–	–	83.45	268,925.367	154,707.535	83.590	0.00	–	–	0.14
LW0771	–	–	55.49	279,430.066	132,676.297	55.790	-0.36	–	–	-0.06
LW1347	–	–	202.54	310,850.487	235,538.720	200.180	2.26	–	–	-0.10
LW1453	–	–	314.4	282,621.512	256,357.091	321.464	-7.15	–	–	-0.09
LW0111	–	–	32.60	339,853.707	205,684.041	32.539	0.00	–	–	-0.06
LW1641	–	–	36.51	346,542.753	246,432.034	36.418	0.00	–	–	-0.09
LW0316	–	–	64.77	358,095.657	297,277.180	64.631	0.00	–	–	-0.14
LW0949	–	–	79.68	250,252.691	125,495.235	76.660	3.00	–	–	-0.02
LW0163	–	–	23.35	351,839.553	270,472.909	20.368	2.90	–	–	-0.09
LW1424	–	–	289.10	301,519.936	225,959.068	289.159	0.00	–	–	0.06
LW0750	–	–	19.77	237,223.597	108,644.453	15.264	4.52	–	–	0.01
LW1022	–	–	136.89	311,742.468	146,171.612	136.960	0.00	–	–	0.07
LW0121	–	–	23.04	341,073.675	224,402.591	25.781	-2.82	–	–	-0.08
LW1204	–	–	415.63	286,033.511	316,574.751	414.916	0.73	–	–	0.02
LW0445	–	–	211.42	333,815.001	268,562.117	211.436	0.00	–	–	0.02
LW1464	–	–	201.31	325,530.807	292,335.225	193.683	7.51	–	–	-0.12
LW0165	–	–	41.17	353,039.393	276,507.026	38.895	2.17	–	–	-0.11
LW1027	–	–	117.63	293,017.509	149,091.060	117.652	0.00	–	–	0.02
LW0410	–	–	112.84	330,259.121	284,989.079	112.425	0.32	–	–	-0.09
LW0085	–	–	80.24	330,604.679	185,688.068	80.192	0.00	–	–	-0.05
LW1029	–	–	173.96	289,483.622	151,846.597	173.834	0.00	–	–	-0.13
LW0440	–	–	53.08	344,755.447	266,854.500	53.092	0.00	–	–	0.01
LW1211	–	–	301.69	295,992.778	327,273.661	301.751	0.00	–	–	0.06
LW1435	–	–	302.35	306,323.441	245,229.788	299.566	2.83	–	–	0.05
LW0774	–	–	66.03	288,483.352	132,983.684	63.207	2.67	–	–	-0.15
LW1430	–	–	328.95	325,556.259	254,358.123	320.180	8.81	–	–	0.04
									RMSE	**0.09**

Summary of High-Water Marks Identified

High-water marks were identified along five major river corridors including the Blackstone, Hunt, Moshassuck, Pawtuxet, and Woonasquatucket Rivers and in many tributaries to these rivers by the USGS and the USACE following the March–April 2010 flood (fig. 1; table 3). The USGS identified 276 HWMs at 137 sites (a site may have more than one HWM, typically a bridge crossing with HWMs identified on the upstream and downstream sides from the bridge), which are listed in the appendix table 1-1. Field notes indicate some sites were visited, but no suitable HWM could be found; these sites were not tracked and were not entered into the spreadsheet. Of the 276 HMWs, 6 were found destroyed and no elevation could be obtained. Another six HWMs were also found destroyed during the later GPS survey but had been previously surveyed (USGS-73, USGS-74, USGS-111, USGS-119a, USGS-132, USGS-168). The previously surveyed elevations are reported in table 1-1. Six HWMs identified along the Pocasset River (USGS-182a through USGS-182f) during the initial GPS survey were not resurveyed but are reported in table 1-1. One HWM (USGS-21) was not found during the GPS survey but is reported in table 1-1 without an elevation. In total, of the 276 HWMs identified by the USGS, the elevation is reported for 269 HWMs.

The USACE identified 144 HWMs at 127 sites, which are listed in the appendix, table 1-2. Note the number of sites was determined from horizontal position information because the descriptive information was limited and the number of sites could be more or less than estimated. Forty-three of the 144 HWMs were previously surveyed by the USACE and were not resurveyed by the USGS. Seventeen of the 144 HWMs were not found and 9 were destroyed; 75 HWMs were surveyed by the USGS. In total, of the 144 HWMs identified by the USACE, the elevation is reported for 118 HWMs.

The HWMs identified by the USGS and USACE covered about 170 river miles, as determined from the upstream and downstream HWMs along river reaches, which is about equally divided by river miles covered by USGS and USACE, respectively. The density of HWMs per mile of river reach for USGS HWMs ranges from a lower quartile of about 2.0 to an upper quartile of about 4.2, with a median of about 3.0 HWMs per mile. The density of USACE HWMs ranged from a lower quartile of about 1.0 to an upper quartile of about 2.0, with a median of 1.5 HWMs per mile.

The elevation of USGS HWMs upstream from bridges at 65 locations were, on average, about 1.9 ft higher than the downstream HWMs near the same bridge; near 8 bridges, HWMs at the upstream elevation were lower than the downstream elevation (these sites were not included in the average elevation difference between upstream and downstream HWMs). HWMs higher at the downstream side than upstream side were attributed to the quality of the water mark, which is often reflected in the rating of the HWM for marks identified by USGS.

Potential Use of High-Water Data

HWMs provide critical information on inundation following a flood. Mapping flood inundation is greatly enhanced by the availability of LIDAR (LIght Detection and Ranging) elevation data, which provides a high level of precision and accuracy (Gesch, 2009). As part of the American Recovery and Reinvestment Act of 2009, a comprehensive LIDAR mapping program was begun in the summer of 2010 to map the coastal northeast (fig. 7) at a 2-meter resolution and a vertical accuracy of 15 cm (Smith and others, 2010).The LIDAR data generated by this program are not expected to be completed until the fall of 2011. When the LIDAR data become available, the HWM elevations determined in this study can be used to define the extent and depth of flooding in the selected reaches. The new LIDAR data are expected to provide complete coverage of Rhode Island.

Summary

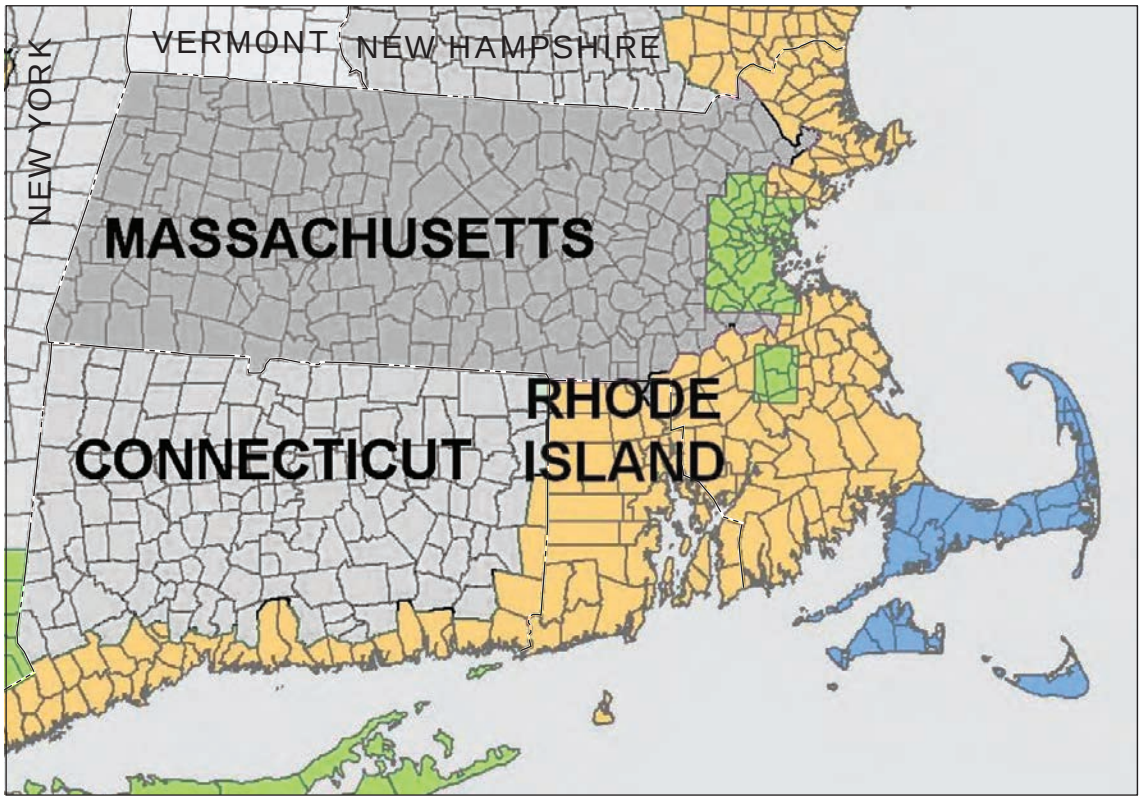
A series of widespread, large, low-pressure systems in southern New England in late February and in mid- through late March resulted in record, or near record, amounts of rainfall. The late February storm dropped nearly 5 inches of rain over the region that primed conditions for triggering high water that followed the 4 to 7 inches of rain that fell between March 13 and 15, 2010. As flood waters began to recede, 2 to 5 inches of rain fell on March 22–23, maintaining wet conditions and elevating streamflows over the region. This was followed by another storm on March 29–30 that brought an additional 7 to 9 inches of rain, which compounded with the low moisture losses to evaporation during the cool season further elevated streamflows. The total rainfall in Rhode Island from late February to the end of March 2010 ranged from about 19 to 25 inches, which is unprecedented in the past 100-year weather history.

Record total rains during late February and March resulted in peak stream stages and flows that set new period-of-record peaks at 21 of 25 streamgages in Rhode Island and southeastern Massachusetts. The highest record peaks occurred in late March–early April and generally greatly exceeded the earlier March peaks that were near or exceeded the previous record peak flows at 10 of the 25 streamgages. Following the late February rains, streamflow at two long-term streamgages, Hunt River near East Greenwich (01117000) and Wood River at Hope Valley (01118000), rose well above the 90th flow percentile, receded, then rose well above the 90th percentile again following rains in mid-March, between mid- and late March, and late March. Flows remained above the 90th flow percentile during this normally seasonal high flow period until about mid-April.

Table 3. Summary of high-water marks (HWMs) established by the U.S. Geological Survey (USGS) and the U.S. Army Corps of Engineers (USACE) following the March–April 2010 floods in Rhode Island.

[Locations, number of unique locations where HWMs were identified such as upstream and downstream from a bridge; Length, approximate reach length between the most upstream and downstream HWMs; Bk, brook; Br, Branch; HWMs and basin locations are shown in figure 1]

By USGS					By USACE				
Basin	River	Number of		Length (miles)	Basin	River	Number of		Length (miles)
		HWMs	Locations				HWMs	Locations	
Hunt		14	6	4.6	Blackstone		15	14	16
	Hunt/Scrabbletown Bk	2	1	0		Branch	15	15	8.8
	Frenchtown Bk-Hunt	1	1	0		Stingo Bk	2	2	1.1
	Sand Hill Bk	3	2	0.7		Dry Arm Bk	1	1	0
Pawtuxet		40	13	5.8		Clear	7	7	6
	North Br Pawtuxet	22	9	5.2		Herring Bk	1	1	0
	Situate Tribs	18	14	0		Chepachet	1	1	0
	Pocasset	32	17	9.1	Moshassuck		23	20	8.8
	Simmons Bk	3	2	0.06	Pawcatuck		1	1	0
	Furnace Hill Bk	5	2	0.05		Meadow Bk	4	4	2.6
	Big	1	1	0		Beaver	7	6	8.5
Pawcatuck		40	19	28		Queen	5	2	0
	Queen	12	7	6.8		Wood	11	10	15
	Usquepaug	6	3	2.6		Bushy Bk	1	1	0
	Ashaway	7	4	2.3	Pawtuxet		12	11	3.4
	Green Falls	2	1	0		South Br Pawtuxet	19	18	8.1
	Beaver	3	2			Big	4	3	2.7
	Chipuxet	9	6	5.2		Flat	5	2	2.4
	Tomaquag	7	3	3.4		Congdon	5	3	5.4
	Wood	1	1			Nooseneck	1	1	0
Woonasquatucket		48	23	9.4		Quidneck Bk	1	1	0
						McCuster Bk	1	1	0
						Whaley Bk	1	1	0
						Hawkinson Bk	1	1	0
Total		**276**	**137**	**83**			**144**	**127**	**89**



From http://mapserver.maine.gov/lidar/usgs_arra_proposal.pdf

EXPLANATION

- Existing LIDAR data
- LIDAR data planned for aquistion in 2010–2011
- FEMA planned LIDAR data aquistion in 2010–2011

Figure 7. Areas of availability of LIght Detection and Ranging (LIDAR) data and projected 2011 LIDAR data in Rhode Island and adjacent states.

High-water marks (HWMs) were identified by the USGS from April 2–7, 2010, and by the USACE from April 3–7, 2010. The elevation of HWMs were later determined to a standard vertical datum (NAVD 88) using the Global Navigation Satellite System and survey-grade Global Positioning System (GPS) receivers along with standard optical-surveying equipment. Differential corrections to the GPS positions were made using a proprietary fixed-base station network or temporary base station. Quality-assurance GPS measurements made at 29 National Geodetic Survey bench marks with vertical datum throughout the study area yielded a vertical root mean square error of 0.09 feet.

HWMs following the March–April 2010 flood were obtained in five major river corridors including the Blackstone, Hunt, Moshassuck, Pawtuxet, and Woonasquatucket and along many of the main tributaries to these rivers. The USGS identified 276 HWMs at 137 sites. A site may have more than one HWM, typically a bridge crossing with HWMs identified on the upstream and downstream sides of the bridge. The USACE identified 144 HWMs at 127 sites. The HWMs identified by the USGS and USACE covered about 170 river miles, as determined from the upstream and downstream HWMs along a reach.

Acknowledgments

Identification of HWMs was made by USGS personnel from Water Science Centers in Massachusetts–Rhode Island (Robert Breault, Mark Nimiroski, Gene Parker, Lance Ransby, and Andy Waite), Maine (Pamela Lombard, Nicholas Stasulis, and Greg Stewart), and New York (Loyd Brook, Gary Firda, and Carolynn Szabo). HWMs identified and surveyed by USACE were supplied by Christopher Hatfield, Richard Loyd, and Gary Strangeland. Survey of HWMs was made by personnel from USGS Water Science Centers in Massachusetts–Rhode Island (Jean Campbell, Paul Friesz, Andy Massey, Timothy McCobb, Lance Ostiguy, and Andy Waite) and Ohio (Carrie Huitger, Chad Ostheimer, and Matthew Whitehead).

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Appendix 1

Appendix 1. High-water marks identified by the U.S. Geological Survey and the U.S. Army Corps of Engineers

Note, most of the information contained in the tables can be obtained electronically in a geographical information system format (shape file) at *http://pubs.usgs.gov/ofr/2011/1029*/.

- Table 1-1. High-water marks identified by the U.S. Geological Survey following the March–April 2010 flood in Rhode Island.
- Table 1-2. High-water marks identified by the U.S. Army Corps of Engineers (USACE) following the March–April 2010 flood in Rhode Island.

Table 1-1. High-water marks (HWMs) identified by the U.S. Geological Survey following the March–April 2010 flood in Rhode Island.

[GPS_ID, unique identification number used for global position survey (GPS), Site_ID, unique identification of a location, HWM_ID, unique identification of HWM at a location, Lat_DD, Latitude in decimal degrees (North American Datum of 1983 (NAD 83)), Long_DD, Longitude in decimal degrees (NAD 83); Rated– E, excellent; G, good; F, fair; P, poor; U, undetermined; Mark– type of mark; u, unspecified; Bank– R, right; L, left; u, undetermined; Elevation, in feet above North American Vertical Datum of 1988 (NAVD 88); NF, Not Found; –, not determined or unknown]

GPS_ID	Site_ID	HWM_ID	Party	Lat_DD	Long_DD	Date	River	Location	Rated	Mark	Bank	Elevation (feet)
USGS-1	ASH-Lau	Ash-21.1	PJL,ALU	41.423	-71.791	04/06/2010	Ashaway River	Laurel St, Brdg 50 US 01118360 disc.	G	Chisel	R	37.22
USGS-2	ASH-Lau	Ash-21.2	PJL,ALU	41.424	-71.792	04/06/2010	Ashaway River	Laurel St, Brdg 50 DS 01118360 disc.	G	Disk	R	35.90
USGS-3	ASH-Lau2	Ash-20.1	PJL,ALU	41.424	-71.790	04/06/2010	Ashaway River	Rt 216 & Laurel St DS	E	Pencil	u	39.43
USGS-4	ASH-Lau2	Ash-20.2	PJL,ALU	41.424	-71.790	04/06/2010	Ashaway River	Rt 216 & Laurel St DS	G	Pencil	u	39.59
USGS-5	ASH-Rt216	Ash-19.1	PJL,ALU	41.425	-71.790	04/06/2010	Ashaway River	Rt 216 (Ash 19.1)	G	Pencil	R	44.81
USGS-6	ASH-Wel	Ash-18.1	PJL,ALU	41.438	-71.790	04/06/2010	Ashaway River	Wellstown Rd Brdg 49 DS	U	Disk	R	49.79
USGS-7	ASH-Wel	Ash-18.2	PJL,ALU	41.438	-71.790	04/06/2010	Ashaway River	Wellstown Rd Brdg 49 US	G	Chisel	L	51.89
USGS-8	BEAV-Hil	Hill-DSH1	GJS, MTN	41.526	-71.639	04/06/2010	Beaver River	Hillsdale Rd. DS	G	Disk	L	224.11
USGS-9	BEAV-Hil	Hill-USH2	GJS, MTN	41.526	-71.639	04/06/2010	Beaver River	Hillsdale Rd. US	G	Disk	L	232.47
USGS-10	BEAV-138	US138	GJS, MTN	41.493	-71.628	04/06/2010	Beaver River	01117468 Rt 138 (Usquepaugh Rd)	F	Disk	R	114.48
USGS-11	CHIP-Cam	CR-3-3.1	GDF, LRR	41.539	-71.521	04/06/2010	Chipuxet River	Camp Rd. Brdg	E	Nail	R	135.93
USGS-12	CHIP-Ind	CR-4-4.1	GDF, LRR	41.530	-71.518	04/06/2010	Chipuxet River	Indian Corner Rd. Brdg DS	F	Hub	R	126.04
USGS-13	CHIP-Ind	CR-4-4.2	GDF, LRR	41.530	-71.518	04/06/2010	Chipuxet River	Indian Corner Rd. Brdg US	F	Hub	R	124.88
USGS-14	CHIP-Yaw	CR-5-5.1	GDF, LRR	41.518	-71.526	04/06/2010	Chipuxet River	Yawgoo Valley Rd. Brdg US	E	Nail	R	112.40
USGS-15	CHIP-Yaw	CR-5-5.2	GDF, LRR	41.518	-71.525	04/06/2010	Chipuxet River	Yawgoo Valley Rd. Brdg DS	F	u	L	109.90
USGS-16	CHIP-Wol	CR-6-6.1	GDF, LRR	41.506	-71.531	04/06/2010	Chipuxet River	Wolf Rocks Rd. Brdg US	E	Pen	L	102.12
USGS-17	CHIP-Wol	CR-6-6.2	GDF, LRR	41.506	-71.531	04/06/2010	Chipuxet River	Wolf Rocks Rd. Brdg DS	E	Pen	L	102.06
USGS-18	CHIP-138	CR-7-7.1	GDF, LRR	41.483	-71.551	04/06/2010	Chipuxet River	Hwy 138 Brdg US (gage DS)	E	Nail	R	96.36
USGS-19	CHIP-138.2	01117350-1	GJS, MTN	41.483	-71.551	04/06/2010	Chipuxet River	Sta 01117350 Rt 138	G	Chisel	R	98.18
USGS-20	1115280	01115280	GJS, MTN	41.804	-71.650	04/05/2010	Cork Brook	Sta 1115280 Rockland Rd	G	Disk	R	418.95
USGS-21	1115190	01115190-1	GJS, MTN	41.822	-71.700	04/05/2010	Dolly Cole Brook	Sta 01115190 Rt 6	G	u	R	NF
USGS-22	1115190	01115190-2	GJS, MTN	41.822	-71.700	04/05/2010	Dolly Cole Brook	Sta 01115190 Rt 6	F	Disk	R	353.78
USGS-23	500502	500502	RFB, GJS	41.630	-71.479	04/07/2010	Frenchtown Bk-Hunt R	01116905 Hunt River	U	None	R	35.18
USGS-24	60-100	60-100-DS1	GJS, GCB	41.756	-71.488	04/03/2010	Furnace Hill Brook	Phenix Rd Brdg DS	F	Disk	R	64.21
USGS-25	60-100	60-100-US1	GJS, GCB	41.756	-71.488	04/03/2010	Furnace Hill Brook	Phenix Rd US1	G	Disk	R	69.90
USGS-26	60-100	60-100-US2	GJS, GCB	41.756	-71.488	04/03/2010	Furnace Hill Brook	Phenix Rd US2	G	Disk	R	69.77
USGS-27	60-100	60-100-US10A	GJS, GCB	41.756	-71.487	04/03/2010	Furnace Hill Brook	Phenix Rd US10A	G	Disk	R	59.90
USGS-28	60-100	60-100-DS10A	GJS, GCB	41.756	-71.487	04/03/2010	Furnace Hill Brook	Phenix Rd DS10A	F	Disk	R	58.57
USGS-29	GREF-Rt95	GreenFalls1	PJL,ALU	41.443	-71.796	04/06/2010	Green Falls River	Rt 95 New London Tpk Brdg 48 US	G	Chisel	R	57.67

Table 1-1. High-water marks (HWMs) identified by the U.S. Geological Survey following the March–April 2010 flood in Rhode Island.—Continued

[GPS_ID, unique identification number used for global position survey (GPS), Site_ID, unique identification of a location, HWM_ID, unique identification of HWM at a location, Lat_DD, Latitude in decimal degrees (North American Datum of 1983 (NAD 83)), Long_DD, Longitude in decimal degrees (NAD 83); Rated– E, excellent; G, good; F, fair; P, poor; U, undetermined; Mark– type of mark; u, unspecified; Bank– R, right; L, left; u, undetermined; Elevation, in feet above North American Vertical Datum of 1988 (NAVD 88); NF, Not Found; –, not determined or unknown]

GPS_ID	Site_ID	HWM_ID	Party	Lat_DD	Long_DD	Date	River	Location	Rated	Mark	Bank	Elevation (feet)
USGS-30	GREF-Rt95	GreenFalls2	PJL,ALU	41.443	-71.796	04/06/2010	Green Falls River	Rt 95 New London Tpk Brdg 48 DS	G	Chisel	R	56.43
USGS-31	1115265	01115265	GJS, MTN	41.791	-71.699	04/05/2010	Hemlock Brook	Sta 01115265 King Rd	F	Disk	R	406.87
USGS-32	HUNT-403	HR-4-4.1	GDF, LRR	41.624	-71.482	04/07/2010	Hunt River	Davisvill Rd Brdg US	E	Nail	L	43.48
USGS-33	HUNT-402	HR-5-5.1	GDF, LRR	41.628	-71.480	04/07/2010	Hunt River	Hwy 402 Brdg US	F	Nail	L	37.05
USGS-34	HUNT-402	HR-5-5.2	GDF, LRR	41.628	-71.480	04/07/2010	Hunt River	Hwy 402 Brdg US	F	Nail	L	36.97
USGS-35	HUNT-402	HR-5-5.3	GDF, LRR	41.629	-71.480	04/07/2010	Hunt River	Hwy 402 Brdg DS	E	Pen	R	36.32
USGS-36	HUNT-1	HR-6-6.1	GDF, LRR	41.635	-71.468	04/07/2010	Hunt River	Hwy 1 Brdg US	G	Nail	L	30.05
USGS-37	HUNT-1	HR-6-6.2	GDF, LRR	41.634	-71.468	04/07/2010	Hunt River	Hwy 1 Brdg DS	G	Nail	L	28.59
USGS-38	HUNT-1	HR-6-6.3	GDF, LRR	41.636	-71.468	04/07/2010	Hunt River	Hwy 1 Brdg DS	E	Pen	L	27.89
USGS-39	1115110	01115110	GJS, MTN	41.847	-71.612	04/05/2010	Huntinghouse Bk.	Sta 01115110 Eludale Rd	G	Disk	R	298.09
USGS-40	HUNT-Rt2	HR rt4 LE1	PJL,ALU	41.594	-71.499	04/07/2010	Hunts R.- Scrabbletown Bk	Rt 2, Rt 4, Stony Ln. LE Brdg abutment	G	Pen	L	60.64
USGS-41	HUNT-Rt2	HR rt2 US LE2	PJL,ALU	41.594	-71.498	04/07/2010	Hunts R.- Scrabbletown Bk	Rt 2, Rt 4, Stony Ln. US	F	Disk	L	58.96
USGS-42	HUNT-Rt2	HR rt 2 US LE3	PJL,ALU	41.594	-71.498	04/07/2010	Hunts R.- Scrabbletown Bk	Rt 2, Rt 4 , Stony Ln. US	F	Disk	L	59.03
USGS-43	HUNT-Rt2	HR DS LE4	PJL,ALU	41.594	-71.498	04/07/2010	Hunts R.- Scrabbletown Bk	Rt 2, Rt 4 , Stony Ln. DS	P	Disk	L	55.54
USGS-44	HUNT-Rt2	HR DS RE 5	PJL,ALU	41.594	-71.498	04/07/2010	Hunts R.- Scrabbletown Bk	Rt 2, Rt 4 , Stony Ln. DS	P	Stake	R	55.68
USGS-45	HUNT-Sou	HR-US LE1	PJL,ALU	41.606	-71.520	04/07/2010	Hunts R.- Scrabbletown Bk	South Rd., Shady Hill Dr., US	F	Pen	L	243.86
USGS-46	HUNT-Sou	HR-DS LE2	PJL,ALU	41.606	-71.519	04/07/2010	Hunts R.- Scrabbletown Bk	South Rd., Shady Hill Dr., DS	F	Pen	L	237.56
USGS-47	HUNT-Sou2	HR-South-US1	PJL,ALU	41.607	-71.491	04/07/2010	Hunt River	Rt 2 & South Rd. US	G	Disk	R	44.96
USGS-48	HUNT-Sou2	HR-South-DS2	PJL,ALU	41.607	-71.491	04/07/2010	Hunt River	Rt 2 & South Rd. DS	F	Disk	R	44.40
USGS-49	1115170	01115170-DS	GJS, MTN	41.841	-71.585	04/05/2010	Moswansicut Str.	Sta 01115170 Rt 116 DS	G	Disk	R	296.51
USGS-50	1115170	01115170-US	GJS, MTN	41.841	-71.584	04/05/2010	Moswansicut Str.	Sta 01115170 Rt 116 US	F	Disk	R	298.97
USGS-51	NPAW-Fai	Fair-USRE1	PJL,ALU	41.721	-71.533	04/05/2010	N Br Pawtuxet River	Fairview Rd Brdg US	P	Disk	R	101.69
USGS-52	NPAW-Fai	Fair-DSRE2	PJL,ALU	41.720	-71.532	04/05/2010	N Br Pawtuxet River	Fairview Rd Brdg DS	F	Disk	R	101.23

Table 1-1. High-water marks (HWMs) identified by the U.S. Geological Survey following the March–April 2010 flood in Rhode Island.—Continued

[GPS_ID, unique identification number used for global position survey (GPS), Site_ID, unique identification of a location, HWM_ID, unique identification of HWM at a location, Lat_DD, Latitude in decimal degrees (North American Datum of 1983 (NAD 83)), Long_DD, Longitude in decimal degrees (NAD 83); Rated– E, excellent; G, good; F, fair; P, poor; U, undetermined; Mark– type of mark; u, unspecified; Bank– R, right; L, left; u, undetermined; Elevation, in feet above North American Vertical Datum of 1988 (NAVD 88); NF, Not Found; –, not determined or unknown]

GPS_ID	Site_ID	HWM_ID	Party	Lat_DD	Long_DD	Date	River	Location	Rated	Mark	Bank	Elevation (feet)
USGS-53	NPAW-Lic	Linc-USRE1	PJL,ALU	41.724	-71.536	04/05/2010	N Br Pawtuxet River	Lincoln Ave Brdg US	G	Disk	R	107.60
USGS-54	NPAW-Lic	Linc-DSRE2	PJL,ALU	41.724	-71.536	04/05/2010	N Br Pawtuxet River	Lincoln Ave Brdg DS	G	Chisel	R	105.96
USGS-55	NPAW-Lic	Linc-DSRE3	PJL,ALU	41.724	-71.536	04/05/2010	N Br Pawtuxet River	Lincoln Ave Brdg DS	G	Disk	R	105.83
USGS-56	NPAW-Hil	Hill-USRE1	PJL,ALU	41.730	-71.547	04/05/2010	N Br Pawtuxet River	Hill St Br off of Rt 115 US	G	Disk	R	145.78
USGS-57	NPAW-Hil	Hill-DSRE2	PJL,ALU	41.730	-71.546	04/05/2010	N Br Pawtuxet River	Hill St Br off of Rt 115 DS	G	Disk	R	145.71
USGS-58	NPAW-Gra	GrantWay1	PJL,ALU	41.744	-71.576	04/05/2010	N Br Pawtuxet River	30 Grant Way (house) DS	G	Pen	u	204.51
USGS-59	NPAW-Gra	GrantWay2	PJL,ALU	41.744	-71.576	04/05/2010	N Br Pawtuxet River	30 Grant Way (house) US	E	Pen	u	204.63
USGS-60	NPAW-116.2	Rt116.2-USRE1	PJL,ALU	41.730	-71.563	04/05/2010	N Br Pawtuxet River	Rte 116 Brdg US	F	Disk	R	193.31
USGS-61	NPAW-116.2	Rt116.2-DSRE2	PJL,ALU	41.730	-71.563	04/05/2010	N Br Pawtuxet River	Rte 116 Brdg DS	P	Stake	R	190.97
USGS-62	NPAW-Fur	Fur-USRE1	PJL,ALU	41.731	-71.565	04/05/2010	N Br Pawtuxet River	Dam-Hope Furnace Rd off Rt 116 US	G	Disk	R	201.14
USGS-63	NPAW-Fur	Fur-USRE2	PJL,ALU	41.731	-71.565	04/05/2010	N Br Pawtuxet River	Dam-Hope Furnace Rd off Rt 116 US	G	Disk	R	201.09
USGS-64	NPAW-Col	Col-USRE1	PJL,ALU	41.734	-71.553	04/05/2010	N Br Pawtuxet River	Colvin Rd US	P	Disk	R	164.76
USGS-65	NPAW-Col	Col-USRE2	PJL,ALU	41.734	-71.553	04/05/2010	N Br Pawtuxet River	Colvin Rd US	F	Disk	R	164.56
USGS-66	NPAW-Col	COL-DSRE3	PJL,ALU	41.734	-71.553	04/05/2010	N Br Pawtuxet River	Colvin Rd DS	P	Disk	R	163.22
USGS-67	NPAW-Col	Col-DSRE4	PJL,ALU	41.734	-71.553	04/05/2010	N Br Pawtuxet River	Colvin Rd DS	P	Disk	R	163.66
USGS-68	NPAW-6001	Fisk-USLE1	PJL,ALU	41.733	-71.550	04/05/2010	N Br Pawtuxet River	USGS sta 01115500 disc	P	Chisel	L	153.41
USGS-69	NPAW-6001	Fisk-USLE2	PJL,ALU	41.733	-71.550	04/05/2010	N Br Pawtuxet River	USGS sta 01115500 disc	P	Disk	L	153.23

Table 1-1. High-water marks (HWMs) identified by the U.S. Geological Survey following the March–April 2010 flood in Rhode Island.—Continued

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GPS_ID	Site_ID	HWM_ID	Party	Lat_DD	Long_DD	Date	River	Location	Rated	Mark	Bank	Elevation (feet)
USGS-70	NPAW-116	Rt116-USRE1	PJL,ALU, GLS	41.716	-71.524	04/05/2010	N Br Pawtuxet River	Rt 116 Brdg US1	F	Disk	R	67.50
USGS-71	NPAW-116	Rt116-USRE2	PJL,ALU, GLS	41.716	-71.524	04/05/2010	N Br Pawtuxet River	Rt 116 Brdg US2	G	Disk	R	67.51
USGS-72	NPAW-116	Rt116-DSRE3	PJL,ALU, GLS	41.716	-71.523	04/05/2010	N Br Pawtuxet River	Rt 116 Brdg DS1	G	Pen	L	65.68
USGS-73	11117340	011117340-1US	COS, GCB	41.450	-71.616	04/06/2010	Pawcatuck River	Biscuit City Rd. US	G	tape	R	[1]93.11
USGS-74	11117340	011117340-2US	COS, GCB	41.450	-71.616	04/06/2010	Pawcatuck River	Biscuit City Rd. US	G	tape	R	[1]93.38
USGS-75	11117340	011117340-3DS	COS, GCB	41.450	-71.616	04/06/2010	Pawcatuck River	Biscuit City Rd. DS	G	tape	R	92.78
USGS-76	PAW-Sher	PAW-SHER-1US	COS, GCB	41.444	-71.627	04/06/2010	Pawcatuck River	Sherman Ave. US	G	Pen	L	89.92
USGS-77	PAW-Sher	PAW-SHER-2US	COS, GCB	41.444	-71.627	04/06/2010	Pawcatuck River	Sherman Ave. US	G	Nail	L	89.92
USGS-78	PAW-Sher	PAW-SHER-3DS	COS, GCB	41.444	-71.628	04/06/2010	Pawcatuck River	Sherman Ave. DS	G	Pen	L	89.87
USGS-79	PAW-Sher	PAW-SHER-4US	COS, GCB	41.446	-71.626	04/06/2010	Pawcatuck River	Sherman Ave. US	G	Stake	R	90.09
USGS-80	PAW-Rt2	PAW-Rt2-1US	COS, GCB	41.446	-71.621	04/06/2010	Pawcatuck River	Rt. 2 (01117430) US	F	Nail	L	92.27
USGS-81	PAW-Rt2	PAW-Rt2-2US	COS, GCB	41.446	-71.621	04/06/2010	Pawcatuck River	Rt. 2 (01117430) US	F	Nail	L	92.29
USGS-82	PAW-Shann	PAW-Shann-US	COS, GCB	41.447	-71.636	04/06/2010	Pawcatuck River	Shannock Village Rd. US	F	Pen	L	83.95
USGS-83	PAW-Shann	PAW-Shann-DS	COS, GCB	41.447	-71.637	04/06/2010	Pawcatuck River	Shannock Village Rd. DS	F	Nail	L	75.41
USGS-89	PAW-KFR	Kings-DSREW1	PJL,ALU	41.433	-71.694	04/06/2010	Pawcatuck River	Kings Factory Rd Brdg 542 DS	P	Disk	R	50.65
USGS-90	PAW-KFR	Kings-USREW2	PJL,ALU	41.433	-71.694	04/06/2010	Pawcatuck River	Kings Factory Rd Brdg 542 US	U	Disk	R	52.62
USGS-91	PAW-Bur	Brud-DSLEW1	PJL,ALU	41.416	-71.728	04/06/2010	Pawcatuck River	Brudickville Rd Bdg 375 disc 01118010 DS	G	Disk	L	47.11
USGS-92	PAW-Bur	Burd-USREW2	PJL,ALU	41.416	-71.729	04/06/2010	Pawcatuck River	Brudickville Rd Bdg 375 disc 01118010 US	G	Pen	R	48.40
USGS-93	PAW-Bis	Biscuit-USRE1.1	PJL,ALU	41.450	-71.616	04/06/2010	Pawcatuck River	Biscuit City Rd Brdg (on house USLB)	G	Pencil	L	Destroyed
USGS-94	PAW-Rt91	DS Bridge REW	PJL,ALU	41.445	-71.681	04/06/2010	Pawcatuck River	Rt 91 DS Brdg nr USGS gage (Carolina)	G	Disk	R	54.06
USGS-94a	Paw-WRJ	1117500	–	41.445	-71.681	–	Pawcatuck River	gage hse 01117500 Wood R Junc	U	u	u	54.02
USGS-95	500900	500900-DS1	RFB, AMW	41.377	-71.832	04/06/2010	Pawcatuck River	Rt. 1 DS	P	Disk	R	6.59
USGS-96	500900	500900-US1	RFB, AMW	41.379	-71.831	04/06/2010	Pawcatuck River	Rt. 1 US	F	Stake	R	9.03
USGS-97	500901	500901-US1	RFB, AMW	41.386	-71.834	04/06/2010	Pawcatuck River	NAPA Auto Parts US	F	Pen	R	14.76
USGS-98	500901	500901-DS1	RFB, AMW	41.384	-71.833	04/06/2010	Pawcatuck River	NAPA Auto Parts DS	G	Pen	L	13.98
USGS-99	500902	500902-DS1	RFB, AMW	41.394	-71.840	04/06/2010	Pawcatuck River	Rt. 78 DS	G	Disk	L	16.58

Table 1-1. High-water marks (HWMs) identified by the U.S. Geological Survey following the March–April 2010 flood in Rhode Island.—Continued

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GPS_ID	Site_ID	HWM_ID	Party	Lat_DD	Long_DD	Date	River	Location	Rated	Mark	Bank	Elevation (feet)
USGS-100	500902	500902-US1	RFB, AMW	41.394	-71.841	04/06/2010	Pawcatuck River	Rt. 78 US	G	Disk	L	15.33
USGS-101	500904	500904-DS1	RFB, AMW	41.398	-71.843	04/06/2010	Pawcatuck River	Bridge St. DS	G	Disk	R	18.36
USGS-102	500904	500904-US1	RFB, AMW	41.397	-71.841	04/06/2010	Pawcatuck River	Bridge St. US	E	Disk	L	18.61
USGS-103	500905	500905-DS1	RFB, AMW	41.418	-71.823	04/06/2010	Pawcatuck River	Boombridge Rd. US	G	Disk	R	29.54
USGS-104	500905	500905-US1	RFB, AMW	41.417	-71.823	04/06/2010	Pawcatuck River	Boombridge Rd. DS	G	Disk	L	29.73
USGS-105	500906	500906-US1	RFB, AMW	41.414	-71.798	04/06/2010	Pawcatuck River	Potter Hill Rd. US	E	Disk	L	33.33
USGS-106	500906	500906-DS1	RFB, AMW	41.414	-71.797	04/06/2010	Pawcatuck River	Potter Hill Rd. DS	P	Pen	R	32.36
USGS-107	500907	500907-DS1	RFB, AMW	41.400	-71.799	04/06/2010	Pawcatuck River	Rt. 3 DS	F	Disk	R	34.15
USGS-108	500907	500907-US1	RFB, AMW	41.399	-71.799	04/06/2010	Pawcatuck River	Rt. 3 US	G	Pen	R	36.73
USGS-109	PAW-Rt216	Paw US RE 1	PJL,ALU	41.408	-71.748	04/07/2010	Pawcatuck River	Rt 91&216 Brdg 194 US	G	Disk	R	41.60
USGS-110	PAW-Rt216	Paw DS RE 2	PJL,ALU	41.408	-71.748	04/07/2010	Pawcatuck River	Rt 91&216 Brdg 194 DS	F	Pen	R	40.96
USGS-111	PAW-OSR	Paw US DAM RE 1	PJL,ALU	41.447	-71.643	04/07/2010	Pawcatuck River	Old Shannok Rd Brdg 58 dam	F	Disk	R	[1]71.54
USGS-112	PAW-OSR	Paw US LE 2	PJL,ALU	41.448	-71.645	04/07/2010	Pawcatuck River	Old Shannok Rd Brdg 58 US	F	Disk	L	65.75
USGS-113	PAW-OSR	Paw DS LE 3	PJL,ALU	41.448	-71.645	04/07/2010	Pawcatuck River	Old Shannok Rd Brdg 58 DS	F	Disk	L	64.94
USGS-114	PAW-Rt112	Paw-Rt112-US1	PJL,ALU	41.459	-71.663	04/07/2010	Pawcatuck River	Rt 112 & Butter Ln. US	G	Disk	R	60.25
USGS-115	PAW-Rt112	Paw-Rt112-US2	PJL,ALU	41.458	-71.663	04/07/2010	Pawcatuck River	Rt 112 & Butter Ln. US	F	Disk	L	60.20
USGS-116	PAW-Rt112	Paw DS of Mill	PJL,ALU	41.460	-71.665	04/07/2010	Pawcatuck River	Rt 112 & Butter Ln. DS	F	Nail	u	55.42
USGS-117	40-301	40-301-DS1	GJS, GCB	41.723	-71.489	04/03/2010	Pawtuxet River	East Ave. DS	G	Disk	L	41.20
USGS-118	40-301	40-301-US1	GJS, GCB	41.723	-71.490	04/03/2010	Pawtuxet River	East Ave. US	G	Disk	L	41.79
USGS-119	500300	500300-DS1	RFB, AMW, ALU	41.751	-71.444	04/03/2010	Pawtuxet River	USGS sta 01116500	G	Disk	L	27.73
USGS-119a	1116500	1116500	PJL, MTN	41.751	-71.444	04/12/2010	Pawtuxet River	at USGS sta 01116500	U	u	u	[1]28.09
USGS-120	500301	500301-DS1	RFB, AMW, ALU	41.750	-71.447	04/03/2010	Pawtuxet River	Worthington Road	G	Chisel	L	28.42
USGS-121	500302	500302-US1	RFB, AMW, ALU	41.749	-71.447	04/03/2010	Pawtuxet River	Rt. 37 between brdgs	G	Disk	L	28.76
USGS-122	500303	500303-US1	RFB, AMW, ALU	41.749	-71.447	04/03/2010	Pawtuxet River	Rt. 37 US	G	Disk	L	28.94
USGS-123	500304	500304-DS1	RFB, AMW, ALU	41.726	-71.471	04/03/2010	Pawtuxet River	Rt. 5 DS	G	Disk	R	34.24
USGS-124	500305	500305-US1	RFB, AMW, ALU	41.725	-71.472	04/03/2010	Pawtuxet River	Rt. 5 US	F	Disk	R	33.65
USGS-125	500306	500306-US1	RFB, AMW, ALU	41.720	-71.478	04/03/2010	Pawtuxet River	295 S US	G	Disk	L	38.41
USGS-126	500306	500306-DS1	RFB, AMW, ALU	41.720	-71.478	04/03/2010	Pawtuxet River	295 S, between N&S lanes	G	Disk	L	37.81
USGS-127	500307	500307-DS1	RFB, AMW, ALU	41.720	-71.477	04/03/2010	Pawtuxet River	295 N DS	G	Disk	L	37.47
USGS-128	500308	500308-DS1	RFB, AMW, ALU	41.723	-71.481	04/03/2010	Pawtuxet River	Rt. 2, most DS	G	Disk	R	39.11
USGS-129	500308	500308-US1	RFB, AMW, ALU	41.723	-71.482	04/03/2010	Pawtuxet River	Rt. 2, between N&S lanes	G	Disk	R	39.15

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GPS_ID	Site_ID	HWM_ID	Party	Lat_DD	Long_DD	Date	River	Location	Rated	Mark	Bank	Elevation (feet)
USGS-130	500309	500309-US1	RFB, AMW, ALU	41.722	-71.482	04/03/2010	Pawtuxet River	Rt. 2, most US	F	Disk	R	39.60
USGS-131	500310	500310-US1	RFB, AMW, ALU	41.723	-71.481	04/03/2010	Pawtuxet River	Rt. 2, most US	G	Stake	R	[1]39.57
USGS-132	500311	500311-US1	RFB, AMW, ALU	41.723	-71.481	04/03/2010	Pawtuxet River	Rt. 2, between N&S lanes	F	Disk	R	38.90
USGS-133	500311	500311-DS1	RFB, AMW, ALU	41.723	-71.481	04/03/2010	Pawtuxet River	Rt. 2, most DS	E	Disk	L	39.05
USGS-134	500312	500312-DS1	RFB, AMW, ALU	41.723	-71.484	04/03/2010	Pawtuxet River	On Ramp Rt 2 to 295 DS	G	Disk	R	39.67
USGS-135	500312	500312-US1	RFB, AMW, ALU	41.723	-71.484	04/03/2010	Pawtuxet River	On Ramp Rt 2 to 295 US	U	Disk	R	40.40
USGS-136	500314	500314-WM1	RFB, AMW	41.726	-71.476	04/05/2010	Pawtuxet River	Warwick Mall-Subway Door	E	Pen	u	36.87
USGS-137	500314	500314-WM2	RFB, AMW	41.724	-71.475	04/05/2010	Pawtuxet River	Warwick Mall-Sports Auth	E	Pen	u	36.55
USGS-138	500314	500314-WM3	RFB, AMW	41.722	-71.473	04/05/2010	Pawtuxet River	Warwick Mall-Showcase Cin	E	Pen	u	36.62
USGS-139	500314	500314-WM4	RFB, AMW	41.722	-71.476	04/05/2010	Pawtuxet River	Warwick Mall-Target	E	Pen	u	36.67
USGS-140	500314	500314-WM5	RFB, AMW	41.722	-71.478	04/05/2010	Pawtuxet River	Warwick Mall-Firestone	E	Pen	u	36.71
USGS-141	500314	500314-WM6	RFB, AMW	41.724	-71.478	04/05/2010	Pawtuxet River	Warwick Mall-opp. Longhorn Rest	E	Pen	u	37.63
USGS-142	500315	500315-DS1	RFB, AMW	41.717	-71.493	04/05/2010	Pawtuxet River	Rt. 33 DS	G	Nail	R	54.37
USGS-143	500315	500315-US1	RFB, AMW	41.717	-71.493	04/05/2010	Pawtuxet River	Rt. 33 US	G	Nail	R	55.45
USGS-144	500316	500316-WWTP1	RFB, AMW	41.751	-71.443	04/05/2010	Pawtuxet River	Cranston WWTP (same as 500200)	G	Pen	L	27.45
USGS-145	500316	500316-WWTP2	RFB, AMW	41.752	-71.443	04/05/2010	Pawtuxet River	Cranston WWTP	E	Pen	L	27.58
USGS-146	500316	500316-WWTP3	RFB, AMW	41.752	-71.443	04/05/2010	Pawtuxet River	Cranston WWTP	E	Pen	L	27.51
USGS-147	500317	500317-WWTP1	RFB, AMW	41.737	-71.450	04/05/2010	Pawtuxet River	Warwick WWTP, Admin bldg	E	Pen	u	31.61
USGS-148	500317	500317-WWTP2	RFB, AMW	41.736	-71.450	04/05/2010	Pawtuxet River	Warwick WWTP, Operation bldg	E	Pen	u	31.62
USGS-149	500317	500317-WWTP3	RFB, AMW	41.736	-71.451	04/05/2010	Pawtuxet River	Warwick WWTP, inlet bldg	G	Pen	u	31.72
USGS-150	500317	500317-WWTP4	RFB, AMW	41.736	-71.451	04/05/2010	Pawtuxet River	Warwick WWTP, digester	E	Pen	u	31.66
USGS-151	500317	500317-WWTP5	RFB, AMW	41.736	-71.452	04/05/2010	Pawtuxet River	Warwick WWTP, solids bldg	E	Pen	u	31.56
USGS-152	500318	500318-WWTP1	RFB, AMW	41.727	-71.488	04/05/2010	Pawtuxet River	WWTP	U	Pen	L	41.07
USGS-153	500318	500318-WWTP2	RFB, AMW	41.727	-71.488	04/05/2010	Pawtuxet River	WWTP	E	Pen	L	Destroyed
USGS-154	500318	500318-WWTP3	RFB, AMW	41.727	-71.487	04/05/2010	Pawtuxet River	WWTP	E	Pen	L	Destroyed
USGS-155	500318	500318-WWTP4	RFB, AMW	41.727	-71.486	04/05/2010	Pawtuxet River	WWTP	U	Pen	L	41.03
USGS-156	1115098	01115098	GJS, MTN	41.852	-71.606	04/05/2010	Peeptoad Brook	Sta 01115098 Emdale Rd	F	Disk	R	318.12
USGS-158	500201	500201 US1	ALU,GJS,GCB	41.760	-71.443	04/02/2010	Pocasset River	Pontiac Dr. US	G	Disk	L	26.06
USGS-159	500201	500201 DS1	ALU,GJS,GCB	41.760	-71.443	04/02/2010	Pocasset River	Pontiac Dr. DS	G	Disk	L	25.61
USGS-160	500202	500202 DS1	ALU,GJS,GCB	41.761	-71.444	04/02/2010	Pocasset River	Garden City Dr. DS	F	Stake	L	26.28
USGS-161	500202	500202 US1	ALU,GJS,GCB	41.761	-71.443	04/02/2010	Pocasset River	Garden City Dr. US	G	Disk	L	27.19

Table 1-1. High-water marks (HWMs) identified by the U.S. Geological Survey following the March–April 2010 flood in Rhode Island.—Continued

[GPS_ID, unique identification number used for global position survey (GPS), Site_ID, unique identification of a location, HWM_ID, unique identification of HWM at a location, Lat_DD, Latitude in decimal degrees (North American Datum of 1983 (NAD 83)), Long_DD, Longitude in decimal degrees (NAD 83); Rated– E, excellent; G, good; F, fair; P, poor; U, undetermined; Mark– type of mark; u, unspecified; Bank– R, right; L, left; u, undetermined; Elevation, in feet above North American Vertical Datum of 1988 (NAVD 88); NF, Not Found; –, not determined or unknown]

GPS_ID	Site_ID	HWM_ID	Party	Lat_DD	Long_DD	Date	River	Location	Rated	Mark	Bank	Elevation (feet)
USGS-162	500203	500203 DS1	ALU,GJS,GCB	41.770	-71.453	04/02/2010	Pocasset River	Rt. 2 DS1	G	Disk	R	27.87
USGS-163	500203	500203 DS2	ALU,GJS,GCB	41.771	-71.453	04/02/2010	Pocasset River	Rt. 2 DS2	F	Disk	L	27.86
USGS-164	500203	500203 US1	ALU,GJS,GCB	41.771	-71.454	04/02/2010	Pocasset River	Rt. 2 US1	F	Disk	L	28.18
USGS-165	500203	500203 US2	ALU,GJS,GCB	41.771	-71.454	04/02/2010	Pocasset River	Rt. 2 US2	P	Disk	R	28.09
USGS-166	500203	500203 US3	ALU,GJS,GCB	41.771	-71.454	04/02/2010	Pocasset River	Rt. 2 US3	P	Stake	R	28.65
USGS-167	500204	500204 US1	ALU,GJS,GCB	41.785	-71.457	04/02/2010	Pocasset River	Old Park Ave. US	F	Disk	R	42.85
USGS-168	500204	500204 DS1	ALU,GJS,GCB	41.785	-71.456	04/02/2010	Pocasset River	Old Park Ave. DS	P	Disk	L	[1]41.34
USGS-169	500205	500205 US1	ALU,GJS,GCB	41.784	-71.456	04/02/2010	Pocasset River	Rt. 12 US	F	Disk	L	41.92
USGS-170	500205	500205 DS1	ALU,GJS,GCB	41.784	-71.456	04/02/2010	Pocasset River	Rt. 12 DS	F	Disk	L	39.68
USGS-171	500206	500206 DS1	ALU,GJS,GCB	41.790	-71.459	04/02/2010	Pocasset River	Cranston Ave. DS	F	Disk	R	47.46
USGS-172	500206	500206 US1	ALU,GJS,GCB	41.790	-71.459	04/02/2010	Pocasset River	Cranston Ave., nr printworks US	G	Chisel	R	49.72
USGS-173	500206	500206 US2	ALU,GJS,GCB	41.794	-71.459	04/02/2010	Pocasset River	Cranston Ave. US	G	Chisel	L	67.46
USGS-174	500207	500207	ALU,GJS,GCB	41.751	-71.444	04/02/2010	Pocasset River	at WWTP	G	Pen	L	79.80
USGS-175	500208	500208	ALU,GJS,GCB	41.805	-71.488	04/02/2010	Pocasset River	Morgan Ave.	F	Disk	L	94.62
USGS-176	500209	500209 US1	ALU,GJS,GCB	41.810	-71.491	04/02/2010	Pocasset River	Central Ave. US	G	Disk	L	100.12
USGS-177	500209	500209 DS1	ALU,GJS,GCB	41.810	-71.491	04/02/2010	Pocasset River	Central Ave. DS	F	Disk	R	98.30
USGS-178	50-270	50-270-US1	GJS, GCB	41.828	-71.508	04/03/2010	Pocasset River	Memorial Ave. US	G	Chisel	L	155.10
USGS-179	50-270	50-270-DS1	GJS, GCB	41.828	-71.508	04/03/2010	Pocasset River	Memorial Ave. DS	G	Disk	R	152.18
USGS-180	50-260	50-260-US1	GJS, GCB	41.826	-71.506	04/03/2010	Pocasset River	Rt. 6A	G	Disk	L	149.54
USGS-181	50-250	50-250-DS1	GJS, GCB	41.819	-71.497	04/03/2010	Pocasset River	Rt. 5 DS	F	Disk	R	124.50
USGS-182	50-250	50-250-US1	GJS, GCB	41.819	-71.498	04/03/2010	Pocasset River	Rt. 5	F	Disk	R	125.14
USGS-182a	POCA-Pla	–	–	41.797	-71.480	04/22/2010	Pocasset River	Plainfield Pike USLE	U	u	L	[1]79.88
USGS-182b	POCA-AtUS	–	–	41.796	-71.484	04/22/2010	Pocasset River	Atwood Ave USLE	U	u	L	[1]89.13
USGS-182c	POCA-AtDS	–	–	41.797	-71.483	04/22/2010	Pocasset River	Atwood Ave DSRE	U	u	R	[1]86.79
USGS-182d	POCA-AtNUS	–	–	41.819	-71.498	04/22/2010	Pocasset River	Atwood Ave North USRE	U	u	R	[1]125.26
USGS-182e	POCA-AtNDS	–	–	41.819	-71.497	04/22/2010	Pocasset River	Atwood Ave North DSDE	U	u	R	[1]124.57
USGS-182f	POCA-RSt	–	–	41.723	-71.490	04/22/2010	Pocasset River	#21 River St near East Ave	U	u	u	[1]41.55
USGS-183	POCA-Fle	Eastland	PJL,ALU,GLS	41.796	-71.476	04/05/2010	Pocasset River	69 Fletcher Ave	G	Pen	u	76.14
USGS-184	1115187	01115187	GJS, MTN	41.819	-71.705	04/05/2010	Poganset River	Sta 01115187 Rans Trail	G	Disk	L	354.88
USGS-185	QUEN-KGM	QU-USGC1	GJS, MTN	41.504	-71.608	04/06/2010	Queen River	Glen Rock Rd. at mill pond	G	Disk	R	113.80
USGS-186	QUEN-Dug	QU-DSDB1	GJS, MTN	41.517	-71.601	04/06/2010	Queen River	Dugway Rd Brdg DS	G	Disk	R	119.98

Table 1-1. High-water marks (HWMs) identified by the U.S. Geological Survey following the March–April 2010 flood in Rhode Island.—Continued

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GPS_ID	Site_ID	HWM_ID	Party	Lat_DD	Long_DD	Date	River	Location	Rated	Mark	Bank	Elevation (feet)
USGS-187	QUEN-Dug	QU-USDB2	GJS, MTN	41.517	-71.599	04/06/2010	Queen River	DugwayRd Brdg US	G	Disk	L	116.69
USGS-188	QUEN-Mai	QU-Mail	GJS, MTN	41.539	-71.569	04/06/2010	Queen River	Mail Rd 01117370	G	Chisel	L	125.62
USGS-189	QUEN-WAR	QU-Allen-US1	GJS, MTN	41.549	-71.561	04/06/2010	Queen River	West Allenton Rd Brdg US	G	Disk	R	135.20
USGS-190	QUEN-WAR	QU-Allen-DS1	GJS, MTN	41.548	-71.561	04/06/2010	Queen River	West Allenton Rd Brdg DS	G	Disk	R	134.71
USGS-191	QUEN-WRR	QU-WR-US1	GJS, MTN	41.563	-71.548	04/06/2010	Queen River	William Reynolds Rd Brdg US	G	Disk	L	147.84
USGS-192	QUEN-WRR	QU-WR-DS1	GJS, MTN	41.562	-71.548	04/06/2010	Queen River	William Reynolds Rd Brdg DS	F	Disk	L	145.89
USGS-193	QUEN-3545	011173545-1	GJS, MTN	41.566	-71.548	04/06/2010	Queen River	disc 011173545 William Reynolds Rd.	F	Disk	L	156.43
USGS-194	QUEN-3545	011173545-2	GJS, MTN	41.566	-71.548	04/06/2010	Queen River	disc 011173545 William Reynolds Rd.	P	Disk	L	156.50
USGS-195	QUEN-3545	011173545-3	GJS, MTN	41.566	-71.548	04/06/2010	Queen River	disc 011173545 William Reynolds Rd.	P	Disk	L	156.54
USGS-196	QUEN-Rt102	Rt102-SG	GJS, MTN	41.578	-71.543	04/06/2010	Queen River	Rt 102 (10 Rod Rd.) staff gage	F	Disk	L	188.53
USGS-197	1115183	01115183	GJS, MTN	41.798	-71.585	04/05/2010	Quonopaug Brook	Sta 01115183 Rt 116	F	Disk	L	315.74
USGS-198	1115114	01115114	GJS, MTN	41.837	-71.612	04/05/2010	Rush Brook.	Sta 1115114 Eludale Rd	G	Disk	R	297.21
USGS-199	500500	500500	RFB, GJS	41.619	-71.456	04/07/2010	Sandhill Brook	Chadsey Rd.	G	Disk	R	26.40
USGS-200	500501	500501-US1	RFB, GJS	41.622	-71.446	04/07/2010	Sandhill Brook	Potter Rd. US	G	Disk	L	22.45
USGS-201	500501	500501-DS1	RFB, GJS	41.622	-71.446	04/07/2010	Sandhill Brook	Potter Rd. DS	G	Disk	L	20.38
USGS-202	50-402	50-402	GJS, GCB	41.791	-71.509	04/03/2010	Simmons Brook	Ranp of I295 to Rt. 114 West	G	Disk	R	285.08
USGS-203	50-401	50-401-US1	GJS, GCB	41.796	-71.484	04/03/2010	Simmons Brook	Rt. 5 US	G	Disk	L	88.83
USGS-204	50-401	50-401-DS2	GJS, GCB	41.797	-71.483	04/03/2010	Simmons Brook	Rt. 5 DS	G	Disk	R	86.64
USGS-205	1115184	01115184	GJS, MTN	41.789	-71.621	04/05/2010	Spruce Brook	Sta 01115184 Rt 14 Wilbur Hollow Rd.	U	Disk	R	296.77
USGS-206	TOMA-Col	Tom1.1 USREW	PJL,ALU	41.443	-71.764	04/06/2010	Tomaquag River	Collins Rd Brdg US	G	Chisel	R	89.55
USGS-207	TOMA-Col	Tom1.2 DSLEW	PJL,ALU	41.443	-71.764	04/06/2010	Tomaquag River	Collins Rd Brdg DS	P	Disk	L	85.65
USGS-208	TOMA-Dia	Tom2.1 DSREW	PJL,ALU	41.418	-71.764	04/06/2010	Tomaquag River	Diamond Hill Rd culvert DS	F	Disk	R	43.85
USGS-209	TOMA-Dia	Tom2.2 USREW	PJL,ALU	41.419	-71.763	04/06/2010	Tomaquag River	Diamond Hill Rd culvert US	F	Disk	R	46.57
USGS-210	TOMA-Dia	Tom2.3 USLEW	PJL,ALU	41.419	-71.763	04/06/2010	Tomaquag River	Diamond Hill Rd culvert US	F	Disk	L	46.73
USGS-211	TOMA-Rt216	Tom3.1	PJL,ALU	41.411	-71.764	04/06/2010	Tomaquag River	Rt 216-Chase Hill Rd DS	U	Disk	R	39.16
USGS-212	TOMA-Rt216	Tom3.2	PJL,ALU	41.411	-71.764	04/06/2010	Tomaquag River	Rt 216-Chase Hill Rd US	F	Disk	L	39.21
USGS-213	USQU-Rt2-US	01117420-1	GJS, MTN	41.477	-71.605	04/06/2010	Usquepaug River	Sta 01117420 US	G	Chisel	L	101.97
USGS-214	USQU-Rt2-DS	01117420-2	GJS, MTN	41.477	-71.605	04/06/2010	Usquepaug River	Sta 01117420 DS	G	Chisel	R	101.08

Table 1-1. High-water marks (HWMs) identified by the U.S. Geological Survey following the March–April 2010 flood in Rhode Island.—Continued

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GPS_ID	Site_ID	HWM_ID	Party	Lat_DD	Long_DD	Date	River	Location	Rated	Mark	Bank	Elevation (feet)
USGS-215	USQU-Rt138	US138-1-US	GJS, MTN	41.503	-71.608	04/06/2010	Usquepaug River	dsc. 01117410 Rt 138 US	G	Disk	L	108.63
USGS-216	USQU-Rt138	DS138-2-DS	GJS, MTN	41.502	-71.608	04/06/2010	Usquepaug River	dsc. 01117410 Rt 138 DS	U	Disk	L	107.88
USGS-217	USQU-Our	USQ-1-US	GJS, MTN	41.503	-71.608	04/06/2010	Usquepaug River	Old Usquepaug Rd US	F	Disk	L	111.82
USGS-218	USQU-Our	USQ-2-DS	GJS, MTN	41.503	-71.608	04/06/2010	Usquepaug River	Old Usquepaug Rd DS	G	Disk	L	107.55
USGS-219	1115276	01115276-1-DS	GJS, MTN	41.786	-71.667	04/05/2010	Westconnaug Str.	Sta 01115276 Rt 12	F	Disk	L	339.88
USGS-220	1115276	01115276-2-US	GJS, MTN	41.786	-71.667	04/05/2010	Westconnaug Str.	Sta 01115276 Rt 12 DSRB	F	Chisel	R	341.14
USGS-221	1115297	01115297-1	GJS, MTN	41.765	-71.636	04/05/2010	Wilbur Hollow Bk.	Sta 01115297 at dam	G	Disk	L	337.18
USGS-222	1115297	01115297-2	GJS, MTN	41.765	-71.636	04/05/2010	Wilbur Hollow Bk.	Sta 01115297 US Old Plain Field Pike Brdg	F	Stake	L	333.30
USGS-223	1115297	01115297-3	GJS, MTN	41.765	-71.636	04/05/2010	Wilbur Hollow Bk.	Sta 01115297 DS Old Plain Field Pike Brdg	F	Disk	L	329.96
USGS-224	1115297	01115297-4	GJS, MTN	41.765	-71.636	04/05/2010	Wilbur Hollow Bk.	Sta 01115297 OG	G	OG	L	326.28
USGS-225	WOON-Sti	WR-1-1.1	GDF, LRR	41.889	-71.508	04/05/2010	Woonasquatucket R.	Stillwater Rd. boat ramp	G	Nail	R	155.20
USGS-226	WOON-Whi	WR-2-2.1	GDF, LRR	41.887	-71.506	04/05/2010	Woonasquatucket R.	Whipple Ave. Brdg US	E	Pen	R	128.85
USGS-227	WOON-Whi	WR-2-2.2	GDF, LRR	41.887	-71.505	04/05/2010	Woonasquatucket R.	Whipple Ave. Brdg DS	F	Hub	L	127.90
USGS-228	WOON-Wat	WR-3-3.1	GDF, LRR	41.881	-71.503	04/05/2010	Woonasquatucket R.	Waterman Ave Brdg US	F	Nail	R	123.59
USGS-229	WOON-Esm	WR-4-4.1	GDF, LRR	41.878	-71.501	04/05/2010	Woonasquatucket R.	Esmond St. Brdg DS	G	Hub	L	Destroyed
USGS-230	WOON-Esm	WR-4-4.2	GDF, LRR	41.879	-71.502	04/05/2010	Woonasquatucket R.	Esmond St. Brdg US	F	Hub	R	121.74
USGS-231	WOON-Esm	WR-4-4.3	GDF, LRR	41.879	-71.502	04/05/2010	Woonasquatucket R.	Esmond St. Brdg US	U	Pen	R	121.76
USGS-232	WOON-Esm2	WR-5-5.1	GDF, LRR	41.874	-71.497	04/05/2010	Woonasquatucket R.	Esmond St. Brdg US	E	Nail	L	117.12
USGS-233	WOON-Gre	WR-6-6.1	GDF, LRR	41.865	-71.493	04/05/2010	Woonasquatucket R.	Greystone Ave Brdg US	E	Pen	R	111.68
USGS-234	WOON-Gre	WR-6-6.2	GDF, LRR	41.865	-71.492	04/05/2010	Woonasquatucket R.	Greystone Ave Brdg DS	G	Hub	L	110.34
USGS-235	1114500	01114500-WR30	LTB, DM	41.860	-71.487	04/05/2010	Woonasquatucket R.	Rt. 44 US	G	Nail	L	104.61

Table 1-1. High-water marks (HWMs) identified by the U.S. Geological Survey following the March–April 2010 flood in Rhode Island.—Continued

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GPS_ID	Site_ID	HWM_ID	Party	Lat_DD	Long_DD	Date	River	Location	Rated	Mark	Bank	Elevation (feet)
USGS-236	1114500	01114500-WR31	LTB, DM	41.860	-71.487	04/05/2010	Woonasquatucket R.	Rt. 44 US	G	flag	L	104.60
USGS-237	WOON-Grn1	WPT 049-WR32US	LTB, DM	41.833	-71.471	04/05/2010	Woonasquatucket R.	Greenville US	F	None	L	65.12
USGS-238	WOON-Grn1	WPT 049-WR33US	LTB, DM	41.833	-71.471	04/05/2010	Woonasquatucket R.	Greenville US	F	None	L	65.12
USGS-239	WOON-Grn2	WPT 050-WR34DS	LTB, DM	41.833	-71.470	04/05/2010	Woonasquatucket R.	Greenville DS	P	Nail	R	Destroyed
USGS-240	WOON-Grn2	WPT 051-WR35DS	LTB, DM	41.833	-71.470	04/05/2010	Woonasquatucket R.	Greenville DS	P	Nail	R	61.77
USGS-241	WOON-Rt6-1	WPT 052-WR36	LTB, DM	41.824	-71.461	04/05/2010	Woonasquatucket R.	Glen Bridge US	U	Nail	L	49.65
USGS-242	WOON-Rt6-1	WPT 054-WR37	LTB, DM	41.823	-71.460	04/05/2010	Woonasquatucket R.	Glen Bridge DS	P	Nail	L	48.37
USGS-243	WOON-Rt6-1	WPT 055-WR38	LTB, DM	41.823	-71.459	04/05/2010	Woonasquatucket R.	Glen Bridge US	P	Nail	L	47.17
USGS-244	WOON-Rt6-1	WPT 056-WR39	LTB, DM	41.822	-71.459	04/05/2010	Woonasquatucket R.	Glen Bridge DS	F	None	R	46.34
USGS-245	WOON-Rt6-2	WPT 057-40	LTB, DM	41.821	-71.454	04/06/2010	Woonasquatucket R.	Rt. 6 US	G	Nail	R	43.19
USGS-246	WOON-Rt6-2	WPT 057-41	LTB, DM	41.821	-71.454	04/06/2010	Woonasquatucket R.	Rt. 6 US	G	Nail	R	43.17
USGS-247	WOON-Rt6-3	WPT 058-42	LTB, DM	41.822	-71.453	04/06/2010	Woonasquatucket R.	Rt. 6 DS	F	Nail	L	Destroyed
USGS-248	WOON-Ped	WPT059-WR43	LTB, DM	41.822	-71.453	04/06/2010	Woonasquatucket R.	Perdestrian Brdg at Marino Park	P	Nail	L	38.65
USGS-249	WOON-San	WPT 060-WR43	LTB, DM	41.817	-71.442	04/06/2010	Woonasquatucket R.	San Souci Dr stores	P	Nail	R	25.37
USGS-250	WOON-Man	WPT 061-WR44	LTB, DM	41.817	-71.444	04/06/2010	Woonasquatucket R.	Manton Ave	P	Nail	L	30.25
USGS-251	WOON-Val	WPT 062-WR45	LTB, DM	41.819	-71.441	04/06/2010	Woonasquatucket R.	Delanie St & Valley St	P	u	R	24.01
USGS-252	WOON-Del	WPT 063-WR46	LTB, DM	41.819	-71.442	04/06/2010	Woonasquatucket R.	Delanie St & Valley St	U	flag	R	23.95

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GPS_ID	Site_ID	HWM_ID	Party	Lat_DD	Long_DD	Date	River	Location	Rated	Mark	Bank	Elevation (feet)
USGS-253	WOON-Del	WPT 063-WR47	LTB, DM	41.821	-71.442	04/06/2010	Woonasquatucket R.	Delanie St & Valley St	F	Pen	R	20.75
USGS-254	WOON-RSM	WPT 064-WR48	LTB, DM	41.822	-71.442	04/06/2010	Woonasquatucket R.	parking lot off Valley St nr low dam	F	Nail	R	19.73
USGS-255	WOON-RSM	WPT 064-WR49	LTB, DM	41.822	-71.442	04/06/2010	Woonasquatucket R.	parking lot off Valley St nr low dam	P	Nail	R	20.68
USGS-256	WOON-Val2	WPT 065-WR50	LTB, DM	41.823	-71.441	04/06/2010	Woonasquatucket R.	195 Valley St US	P	Pen	L	18.61
USGS-257	WOON-Val2	WPT 065-WR51	LTB, DM	41.822	-71.440	04/06/2010	Woonasquatucket R.	195 Valley St DS	G	u	R	17.55
USGS-258	WOON-Atw	WPT068-WR52	LTB, DM	41.824	-71.438	04/07/2010	Woonasquatucket R.	Atwells Ave US	G	Pen	L	14.02
USGS-259	WOON-Atw	WPT068-WR53	LTB, DM	41.825	-71.438	04/07/2010	Woonasquatucket R.	Atwells Ave DS	P	u	R	12.39
USGS-260	WOON-PR	WPT070-WR54	LTB, DM	41.826	-71.437	04/07/2010	Woonasquatucket R.	service Rd off Atwells Ave Price Rite US	G	Pen	L	11.78
USGS-261	WOON-PR	WPT070-WR55	LTB, DM	41.826	-71.437	04/07/2010	Woonasquatucket R.	service Rd off Atwells Ave Price Rite DS	G	Pen	L	10.86
USGS-262	WOON-Eag	WPT072-WR56	LTB, DM	41.826	-71.436	04/07/2010	Woonasquatucket R.	Eagle St Brdg US	G	Pen	R	10.45
USGS-263	WOON-Eag	WPT072-WR57	LTB, DM	41.827	-71.435	04/07/2010	Woonasquatucket R.	Eagle St Brdg DS	F	Pen	R	9.45
USGS-264	WOON-Aco	WPT074-WR58	LTB, DM	41.829	-71.429	04/07/2010	Woonasquatucket R.	Acorn St Brdg US	F	Nail	R	7.01
USGS-265	WOON-Aco	WPT075-WR59	LTB, DM	41.829	-71.428	04/07/2010	Woonasquatucket R.	Acorn St Brdg DS	G	Nail	R	6.59
USGS-266	WOON-Ple	WPT076-WR60	LTB, DM	41.829	-71.427	04/07/2010	Woonasquatucket R.	Pleasant Valley Pkwy-Dean St Brdg US	P	Nail	R	6.61
USGS-267	WOON-Ple	WPT077-WR61	LTB, DM	41.829	-71.427	04/07/2010	Woonasquatucket R.	Pleasant Valley Pkwy-Dean St Brdg DS	F	Nail	L	6.45
USGS-268	WOON-I95	Rt95-1	COS,AMW	41.828	-71.419	04/07/2010	Woonasquatucket R.	Rt95 nr Kinsley St USRB	F	Disk	R	5.30
USGS-269	WOON-I95	Rt95-2	COS,AMW	41.828	-71.418	04/07/2010	Woonasquatucket R.	Rt95 nr Kinsley St USRB	E	Pen	R	5.38

Table 1-1. High-water marks (HWMs) identified by the U.S. Geological Survey following the March–April 2010 flood in Rhode Island.—Continued

[GPS_ID, unique identification number used for global position survey (GPS), Site_ID, unique identification of a location, HWM_ID, unique identification of HWM at a location, Lat_DD, Latitude in decimal degrees (North American Datum of 1983 (NAD 83)), Long_DD, Longitude in decimal degrees (NAD 83); Rated– E, excellent; G, good; F, fair; P, poor; U, undetermined; Mark– type of mark; u, unspecified; Bank– R, right; L, left; u, undetermined; Elevation, in feet above North American Vertical Datum of 1988 (NAVD 88); NF, Not Found; –, not determined or unknown]

GPS_ID	Site_ID	HWM_ID	Party	Lat_DD	Long_DD	Date	River	Location	Rated	Mark	Bank	Elevation (feet)
USGS-270	WOON-Ple2	Pleas-DS1	COS,AMW	41.829	-71.423	04/07/2010	Woonasquatucket R.	Pleasant Val Pkwy Brdg & Kinsley St DS	G	Disk	R	6.00
USGS-271	WOON-Ple2	Pleas-US2	COS,AMW	41.829	-71.424	04/07/2010	Woonasquatucket R.	Pleasant Val Pkwy Brdg & Kinsley St US	F	Disk	R	5.93
USGS-272	WOON-Ped2	Pred-USRB	COS,AMW	41.829	-71.424	04/07/2010	Woonasquatucket R.	Predestrian Brdg & Kinsley St USRB	F	Disk	R	5.41
USGS-273	Big_R_gage	–	–	41.645	-71.613	–	Big River	Inside gage house 01115800	U	Pen	u	255.84
USGS-274	Wood-Ward	–	–	41.461	-71.716	–	Wood River	94 Woodville Rd	U	u	u	58.55

[1] Elevation determined from initial GPS survey using Leica GPS equipment

Table 1-2. High-water marks (HWMs) identified by the U.S. Army Corps of Engineers (USACE) following the March–April 2010 flood in Rhode Island.

[GPS_ID, unique identification number used for global position system (GPS) survey, HWM_ID, unique identifiation of a location, Lat_DD, Latitude in decimal degrees (North American Datum of 1983 (NAD83)), Long_DD, Longitude in decimal degrees (NAD83); DS, downstream; US, upstream; LB, left bank; RB, right bank; pt, point; –, not reported; Elevation, in feet above North American Vertical Datum of 1988 (NAVD 88); NF, Not Found; note, meaning of some of the USACE descriptor abbreviations are unknown]

GPS_ID	HWM_ID	Lat_DD	Long_DD	River	Description	Elevation (feet)
ACE-1	pic 40	41.560	-71.646	Beaver River	–	318.49
ACE-2	pic 41	41.559	-71.645	Beaver River	–	319.25
ACE-3	pic 42	41.538	-71.641	Beaver River	–	253.90
ACE-4	pic 43	41.525	-71.639	Beaver River	–	236.76
ACE-5	pic 44	41.492	-71.628	Beaver River	–	112.92
ACE-5A	pic 45	41.498	-71.617	Beaver River	#14 Schoolhouse Rd, base pole #4	NF
ACE-6	pic 46	41.464	-71.628	Beaver River	–	94.15
ACE-7	Big-1	41.673	-71.608	Big River	hf frr, site 7	252.55
ACE-8	Big-2	41.668	-71.607	Big River	hh frr, site 6	253.32
ACE-9	Big-3	41.645	-71.613	Big River	Rt 3 bridge, US LB, site 5, pt 12	NF
ACE-10	Big-4	41.645	-71.613	Big River	Rt 3 bridge, DS LB, site 13, pt 13	254.81
ACE-11	Black-1	42.001	-71.498	Blackstone River	Hamlet Ave., DS	118.13
ACE-12	Black-2	42.006	-71.501	Blackstone River	Kendrick St. bridge	118.75
ACE-13	Black-3	42.003	-71.512	Blackstone River	Court St. bridge	126.34
ACE-14	Black-4	41.999	-71.515	Blackstone River	River Island Park	130.30
ACE-15	Black-5	42.002	-71.520	Blackstone River	Northeast St.	152.97
ACE-16	Black-6	42.011	-71.530	Blackstone River	Singleton St., US	150.77
ACE-17	hwm23	41.961	-71.641	Branch River	HWM-23	304.93
ACE-18	hwm24	41.974	-71.632	Branch River	HWM-24	296.31
ACE-19	pic 25	41.960	-71.643	Branch River	–	NF
ACE-20	hwm25	41.976	-71.630	Branch River	HWM-25	291.23
ACE-21	hwm26	41.986	-71.625	Branch River	HWM-26	282.31
ACE-22	hwm27	41.984	-71.623	Branch River	HWM-27	272.90
ACE-23	hwm28	41.978	-71.614	Branch River	HWM-28	258.65
ACE-24	hwm29	41.982	-71.618	Branch River	HWM-29	271.75
ACE-25	hwm16	42.000	-71.553	Branch River	HWM-16	186.00
ACE-26	hwm17	42.001	-71.552	Branch River	HWM-17	180.74
ACE-27	hwm18	41.999	-71.569	Branch River	HWM-18	204.64
ACE-28	hwm19	41.998	-71.573	Branch River	HWM-19	207.43
ACE-29	hwm20	41.999	-71.579	Branch River	HWM-20	217.02
ACE-30	hwm21	41.994	-71.596	Branch River	HWM-21	126.01
ACE-31	hwm22	41.995	-71.595	Branch River	HWM-22	237.12
ACE-32	bb-1	41.508	-71.716	Brushy Brook	–	85.20
ACE-33	pic 23	41.942	-71.648	Chepachet River	–	343.88
ACE-34	pic 24	41.957	-71.649	Clear River	–	309.81
ACE-35	pic 26	41.960	-71.650	Clear River	–	311.37
ACE-36	pic 28	41.966	-71.676	Clear River	–	NF
ACE-37	pic 29	41.971	-71.679	Clear River	–	338.88
ACE-38	pic 30	41.970	-71.685	Clear River	–	NF
ACE-39	pic 31	41.967	-71.708	Clear River	–	390.02
ACE-40	pic 32	41.966	-71.712	Clear River	–	407.23

Table 1-2. High-water marks (HWMs) identified by the U.S. Army Corps of Engineers (USACE) following the March–April 2010 flood in Rhode Island.—Continued

[GPS_ID, unique identification number used for global position system (GPS) survey, HWM_ID, unique identifiation of a location, Lat_DD, Latitude in decimal degrees (North American Datum of 1983 (NAD83)), Long_DD, Longitude in decimal degrees (NAD83); DS, downstream; US, upstream; LB, left bank; RB, right bank; pt, point; –, not reported; Elevation, in feet above North American Vertical Datum of 1988 (NAVD 88); NF, Not Found; note, meaning of some of the USACE descriptor abbreviations are unknown]

GPS_ID	HWM_ID	Lat_DD	Long_DD	River	Description	Elevation (feet)
ACE-41	Cong-1	41.612	-71.623	Congdon River	cm, US LB, pt 8, site 3	Destroyed
ACE-42	Cong-2	41.612	-71.623	Congdon River	cm, US LB, pt 9, site 3	Destroyed
ACE-43	Cong-3	41.612	-71.623	Congdon River	cm, DS LB, pt 10, site 3	278.45
ACE-44	Cong-4	41.589	-71.626	Congdon River	Rt 102, 0	338.57
ACE-45	Cong-5	41.589	-71.626	Congdon River	Rt 102, hp, US LB	339.48
ACE-46	pic 33	41.973	-71.750	Dry Arm Brook	–	539.09
ACE-47	Flat-1	41.721	-71.684	Flat River	mv fr2, US RB, site 13, pt 23	346.66
ACE-48	Flat-2	41.717	-71.663	Flat River	h fr, DS RB, site 11, pt 20	280.88
ACE-49	Flat-3	41.717	-71.663	Flat River	h fr, US RB, site 11, pt 21	Destroyed
ACE-50	Flat-4	41.715	-71.653	Flat River	mv fr, US LB, site 9, pt 17	259.09
ACE-51	Flat-5	41.714	-71.652	Flat River	mv fr, DS RB, site 9, pt 18	256.10
ACE-52	hwm8	41.677	-71.527	Hawkinson Brook	–	NF
ACE-53	pic 27	41.969	-71.664	Herring Brook	–	319.98
ACE-54	McBk-1	41.716	-71.671	McCuster Brook	f fr, US RB, site 12, pt 22	303.60
ACE-55	pic 48	41.523	-71.665	Meadow Brook	–	235.25
ACE-56	pic 49	41.501	-71.665	Meadow Brook	–	Destroyed
ACE-57	pic 50	41.496	-71.680	Meadow Brook	–	115.87
ACE-57A	pic 51	41.467	-71.667	Meadow Brook	Pinehill Rd., pole 19	NF
ACE-58	Mosh-1	41.871	-71.405	Moshassuck River	Grotto St., upstream	38.55
ACE-59	Mosh-2	41.873	-71.408	Moshassuck River	Mineral Spring Ave., US	40.41
ACE-60	Mosh-3	41.878	-71.406	Moshassuck River	Weeden St., US	47.74
ACE-61	Mosh-4	41.854	-71.406	Moshassuck River	Cemetary St., US	29.84
ACE-62	Mosh-5	41.856	-71.404	Moshassuck River	Smithfield, US	33.33
ACE-63	Mosh-6	41.832	-71.411	Moshassuck River	Smith St., US	15.94
ACE-64	Mosh-7	41.833	-71.411	Moshassuck River	Mill St., DS	14.86
ACE-65	Mosh-8	41.834	-71.411	Moshassuck River	Mill St., US of gage	NF
ACE-66	Mosh-9	41.834	-71.411	Moshassuck River	pipe US of foot bridge	NF
ACE-67	Mosh-10	41.837	-71.412	Moshassuck River	Stevens St., US	NF
ACE-68	Mosh-11	41.836	-71.412	Moshassuck River	Stevens St., DS	19.61
ACE-69	Mosh-12	41.840	-71.410	Moshassuck River	Industrial St., DS	23.31
ACE-70	Mosh-13	41.842	-71.410	Moshassuck River	Industrial St., US	23.68
ACE-71	Mosh-14	41.831	-71.411	Moshassuck River	Smith St., DS	12.21
ACE-72	Mosh-15	41.922	-71.452	Moshassuck River	Sherman Rd., US	168.03
ACE-73	Mosh-16	41.902	-71.423	Moshassuck River	Table Rock Rd., US	74.31
ACE-74	Mosh-17	41.896	-71.414	Moshassuck River	Barney Pond Dam, DS	NF
ACE-75	Mosh-18	41.893	-71.408	Moshassuck River	Barney Pond Dam, US	60.53
ACE-76	Mosh-19	41.893	-71.410	Moshassuck River	Walker St., US	61.65
ACE-77	Mosh-20	41.893	-71.408	Moshassuck River	dam upstream	NF
ACE-78	Mosh-21	41.886	-71.408	Moshassuck River	Higginson Ave., US	53.32
ACE-79	Mosh-22	41.886	-71.408	Moshassuck River	Higginson Ave., DS	52.75
ACE-80	Mosh-23	41.890	-71.408	Moshassuck River	pumping station	54.38

Table 1-2. High-water marks (HWMs) identified by the U.S. Army Corps of Engineers (USACE) following the March–April 2010 flood in Rhode Island.—Continued

[GPS_ID, unique identification number used for global position system (GPS) survey, HWM_ID, unique identifiation of a location, Lat_DD, Latitude in decimal degrees (North American Datum of 1983 (NAD83)), Long_DD, Longitude in decimal degrees (NAD83); DS, downstream; US, upstream; LB, left bank; RB, right bank; pt, point; –, not reported; Elevation, in feet above North American Vertical Datum of 1988 (NAVD 88); NF, Not Found; note, meaning of some of the USACE descriptor abbreviations are unknown]

GPS_ID	HWM_ID	Lat_DD	Long_DD	River	Description	Elevation (feet)
ACE-81	Noos-1	41.627	-71.633	Nooseneck River	Rt 3, US LB, site 4	268.35
ACE-82	pic 47	41.446	-71.621	Pawcatuck River	–	97.20
ACE-83	pic 1	41.751	-71.443	Pawtuxet River- main	flag CLF WWTP	[1]27.83
ACE-84	pic 2	41.760	-71.444	Pawtuxet River- main	nail pole #1	[1]25.59
ACE-85	pic 3	41.761	-71.431	Pawtuxet River- main	nail pole #87	[1]24.30
ACE-86	pic 4	41.761	-71.429	Pawtuxet River- main	nail pole #90	[1]21.82
ACE-87	pic 5	41.762	-71.425	Pawtuxet River- main	nail pole #9057	[1]22.81
ACE-88	pic 6	41.761	-71.425	Pawtuxet River- main	Elwood Ave. bridge, 19 inches above BM 267	[1]21.93
ACE-89	pic 7	41.761	-71.425	Pawtuxet River- main	nail pole #250	[1]22.03
ACE-90	pic 8	41.765	-71.417	Pawtuxet River- main	nail pole #1/2	[1]20.57
ACE-91	pic 9	41.768	-71.405	Pawtuxet River- main	nail pole #9069	[1]16.84
ACE-92	pic 10	41.764	-71.413	Pawtuxet River- main	stake end of Tennyson	[1]19.82
ACE-93	pic 11	41.755	-71.440	Pawtuxet River- main	nail pole #38, 9 ft above ground	[1]26.29
ACE-94	pic 12	41.757	-71.437	Pawtuxet River- main	nail pole #6-50	[1]26.14
ACE-95	pic 13	41.685	-71.552	Pawtuxet River- S. Br.	stake ground, bridge #258	[1]221.88
ACE-96	pic 14	41.682	-71.535	Pawtuxet River- S. Br.	stake ground, US old mill dam	[1]157.70
ACE-97	pic 15	41.682	-71.535	Pawtuxet River- S. Br.	stake ground, DS old mill dam	[1]157.12
ACE-98	pic 16	41.686	-71.561	Pawtuxet River- S. Br.	Sandy Motors, 18 inches on door	[1]224.56
ACE-99	hwm1	41.706	-71.520	Pawtuxet River- S. Br.	paint Arctic Mill	[1]114.68
ACE-100	hwm2	41.708	-71.519	Pawtuxet River- S. Br.	paint River Walk	[1]86.79
ACE-101	hwm3	41.698	-71.522	Pawtuxet River- S. Br.	paint rock Agawam Mills	[1]117.81
ACE-102	hwm4	41.696	-71.522	Pawtuxet River- S. Br.	nail in lot, Agawam Mills	[1]130.56
ACE-103	hwm5	41.694	-71.525	Pawtuxet River- S. Br.	nail fence, #13 Dale Ave.	[1]132.53
ACE-104	hwm6	41.685	-71.525	Pawtuxet River- S. Br.	nail tree, Hope Valley Dyeing	[1]147.05
ACE-105	hwm7	41.687	-71.527	Pawtuxet River- S. Br.	nail bldg, American Bakery Supply	[1]137.46
ACE-106	hwm8	41.677	-71.527	Pawtuxet River- S. Br.	nail tree, #55 Turner Dr.	161.22
ACE-107	hwm9	41.695	-71.542	Pawtuxet River- S. Br.	paint rock, DS Clarient Dam	[1]185.78
ACE-108	hwm10	41.695	-71.542	Pawtuxet River- S. Br.	paint rock, 150 feet DS HWM 9	[1]185.10
ACE-109	hwm11	41.696	-71.542	Pawtuxet River- S. Br.	nail stump, across house #519	[1]198.00
ACE-110	hwm12	41.690	-71.566	Pawtuxet River- S. Br.	nail tree, USGS gage	[1]227.91
ACE-111	hwm13	41.690	-71.568	Pawtuxet River- S. Br.	ground stake, behind old mill	[1]239.08
ACE-112	hwm14	41.694	-71.549	Pawtuxet River- S. Br.	nail sapling, bike path	[1]222.83
ACE-113	hwm15	41.698	-71.593	Pawtuxet River- S. Br.	nail tree, DS from dam	[1]245.35
ACE-114	Quen-1	41.579	-71.543	Queen River	Rt 102, US RB, pt 3, site 1	Destroyed
ACE-115	Quen-2	41.579	-71.542	Queen River	Rt 102, US LB, pt 4, site 1	192.90
ACE-116	Quen-3	41.578	-71.543	Queen River	Rt 102, DS RB, pt 2, site 1	Destroyed
ACE-117	Quen-4	41.578	-71.543	Queen River	–	Destroyed
ACE-118	Quen-5	41.578	-71.542	Queen River	Rt 102, DS LB, pt 5, site 1	Destroyed
ACE-119	Quid-1	41.706	-71.637	Quidneck Brook	hf frr2, site 8, pt 16	[1]252.33
ACE-120	pic 21	41.902	-71.678	Stingo Brook	–	[1]426.93
ACE-121	pic 22	41.913	-71.671	Stingo Brook	–	[1]414.51

Table 1-2. High-water marks (HWMs) identified by the U.S. Army Corps of Engineers (USACE) following the March–April 2010 flood in Rhode Island.—Continued

[GPS_ID, unique identification number used for global position system (GPS) survey, HWM_ID, unique identifiation of a location, Lat_DD, Latitude in decimal degrees (North American Datum of 1983 (NAD83)), Long_DD, Longitude in decimal degrees (NAD83); DS, downstream; US, upstream; LB, left bank; RB, right bank; pt, point; –, not reported; Elevation, in feet above North American Vertical Datum of 1988 (NAVD 88); NF, Not Found; note, meaning of some of the USACE descriptor abbreviations are unknown]

GPS_ID	HWM_ID	Lat_DD	Long_DD	River	Description	Elevation (feet)
ACE-122	Whal-1	41.719	-71.665	Whaley Brook	mv ut, DS RB, site 10, pt 19	Destroyed
ACE-123	wr-1	41.438	-71.722	Wood River	paint base tree	[1]54.57
ACE-124	wr-2	41.461	-71.718	Wood River	nail fence	[1]58.91
ACE-125	wr-3	41.460	-71.720	Wood River	nail tree	[1]60.99
ACE-126	wr-4	41.490	-71.715	Wood River	nail base tree	[1]69.83
ACE-127	wr-5	41.503	-71.716	Wood River	nail root	[1]81.04
ACE-128	wr-6	41.503	-71.716	Wood River	paint fence	[1]75.37
ACE-129	wr-7	41.514	-71.705	Wood River	paint fence	[1]85.88
ACE-130	wr-8	41.516	-71.703	Wood River	stake	[1]99.48
ACE-131	wr-9	41.523	-71.690	Wood River	nail base tree	[1]102.05
ACE-132	wr-10	41.541	-71.696	Wood River	nail base tree	[1]115.21
ACE-133	wr-11	41.572	-71.721	Wood River	–	NF
ACE-134	Point 1a	41.877	-71.383	Blackstone River	–	NF
ACE-135	Point 1b	41.878	-71.382	Blackstone River	–	NF
ACE-136	Point 2	41.887	-71.381	Blackstone River	–	34.88
ACE-137	Point 3	41.888	-71.381	Blackstone River	–	41.90
ACE-138	Point 4	41.915	-71.405	Blackstone River	–	NF
ACE-139	Point 5	41.925	-71.428	Blackstone River	–	70.65
ACE-140	Point 6	41.930	-71.430	Blackstone River	–	71.08
ACE-141	Point 7	41.927	-71.428	Blackstone River	–	71.03
ACE-142	Point 8	41.952	-71.452	Blackstone River	–	NF

[1] Elevation determined by USACE GPS survey using Leica GPS equipment .

For additional information, write to:
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Massachusetts Water Science Center
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http://ma.water.usgs.gov/

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