



Vermont State Climate Office
 Climate Impacts Summary
May 2011

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May overview

On the heels of April's record setting rainfall, the month of May continued the trend of setting daily and monthly rainfall records. At the Burlington International Airport, 8.67" of rain fell, breaking the previous May precipitation record of 7.10" that was set in 2006. Similarly, the April 2011 precipitation total of 7.88" at this station also broke the previous record of 6.55" set in 1983. These new records helped make 2011 the wettest meteorological spring (months of March, April and May) on record at Burlington, with a total of 19.94". Statewide monthly records are given in Table 1.

Table 1: Monthly record precipitation totals for Vermont (May 2011)

STATION	MAY RAINFALL (inches)
Eden	8.94
Burlington	8.67
East Haven	7.79
Essex Junction	9.99
Hanksville	10.81
Island Pond	6.35
Montpelier 2	9.61
Barre/Montpelier Airport	9.90
Mt. Mansfield	12.06
Newport	7.61
Northfield	10.85
Plainfield	11.65
St. Johnsbury	10.5
Sutton	7.73
Sutton 2 NE	7.84

Periods of steady rainfall struck Vermont statewide during May 4-6th, 14-16th, and 19-21st. An especially heavy convective rain event moved across the northern half of the state during May 26-28th. Severe thunderstorms also struck the state during late May. Vermont's societal impacts stemmed from riverine flooding and continued shoreline flooding of Lake Champlain..

As early as 2 May, Vermont Governor Peter Shumlin had initiated the steps towards a Federal Disaster Declaration, given that flood damage estimates across the state had already exceeded \$3 million. This included a preliminary damage estimate of \$2.7 million for local infrastructure and \$622,000 for state owned facilities. The Vermont Emergency Management (VEM) had already distributed 10,000 sandbags to communities at the beginning of May and issued call to affected home and business owners to report damages, in preparation for visits by FEMA (Federal Emergency Management Agency). The Vermont Agency of Transportation (VTrans) worked tirelessly to maintain road safety and reopen roads. Northern communities like Isle La Motte were particularly hard-hit. The Disaster Declarations for individual and public assistance were requested for ten of Vermont's fourteen counties including Franklin, Grand Isle, Chittenden, Addison, Caledonia, Essex, Lamoille, Orleans, Washington and Windham

One of the more unusual aspects of the Lake Champlain flooding included piles of rotting alewife (an invasive fish species) along parts of the Vermont and New York shorelines. Shawn Good, a fisheries biologist for the Vermont Fish and Wildlife Department was quoted in the Burlington Free Press saying that the unstable water conditions in the Lake followed the "Sharp winter cold spells [which] unsettled Lake Champlain's surface water and sent it plunging into relatively warmer depths, where it flash-froze hundreds of thousands of alewife."

Lake Champlain shoreline flooding

In May, flooding along Lake Champlain continued with record high lake levels being set. The lake level at the King Street Ferry Dock in Burlington remained above flood stage (100 feet), dropping from a maximum height of 103.27 feet on 6 May to 101.95 feet on the 26th (Figure 1). Along the lakeshore, extensive flooding of basements and first floor levels continued. Roads were flooded and road beds eroded, while debris was washed inland. Periodically, north winds or south winds would favor enhanced erosion of the shorelines exposed to the wind. Recreational use of beaches and boating docks was delayed due to flooding and may have monetary impact on the tourism industry. Boaters will need to be exercise caution due to submerged piers and floating or submerged debris.

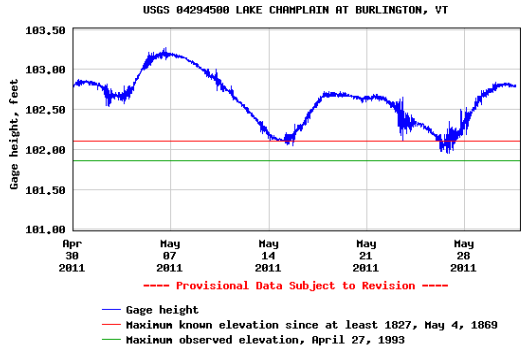


Figure 1: USGS hydrograph showing the recession of Lake Champlain at the Burlington gauging station. Pulses related to the rain events on 6-8, 17-22, 30-31 May are clearly evident.

Severe Thunderstorms and Flash Flooding May 26 and 27

Widespread severe thunderstorms moved across Vermont during the afternoon and evening of 26 May, contributing to flash flooding during the late night of 26 May into the early morning of 27 May. The thunderstorms of May 26th resulted in hail of at least 1 inch in diameter or larger across seven counties in central and northern Vermont (Addison, Caledonia, Chittenden, Franklin, Lamoille, Orleans, Washington). These storms were accompanied by wind gusts of at least 58 mph which resulted in downed trees and power lines across half the state (Chittenden, Essex, Franklin, Lamoille, Orleans, Orange, Washington counties). *The largest hailstone reported was 2.75" in diameter (baseball size) near the town of South Duxsbury (Washington County). The concentration of largest hailstones (1 ½ inch diameter or larger) and significant wind damage seems to have occurred in a swath across the north-central counties of Washington, Lamoille and Caledonia* during the evening of May 26th. In the St. Johnsbury area, a lightning strike caused significant fire damage to a house.

During the late night of 26 May into early the following morning, these storms morphed into flash flood convective rain storms. The flash flooding extended from Addison county in western Vermont, eastward across Washington, Caledonia, Essex and northern Orange counties in eastern Vermont. The core of the most devastating flash flooding appears to encompass an area from the western portion of Washington county near Waterbury and Middlesex east through Montpelier/Barre area then northeast through Plainfield into the St. Johnsbury and Lyndonville areas in southern Caledonia county. The heaviest rainfall was concentrated in Washington and southern Caledonia counties (shaded pink on Figure 2), with highest observed total of 5.22" at Plainfield in eastern Washington county (Figure 2). Other daily precipitation records are given in Table 2.

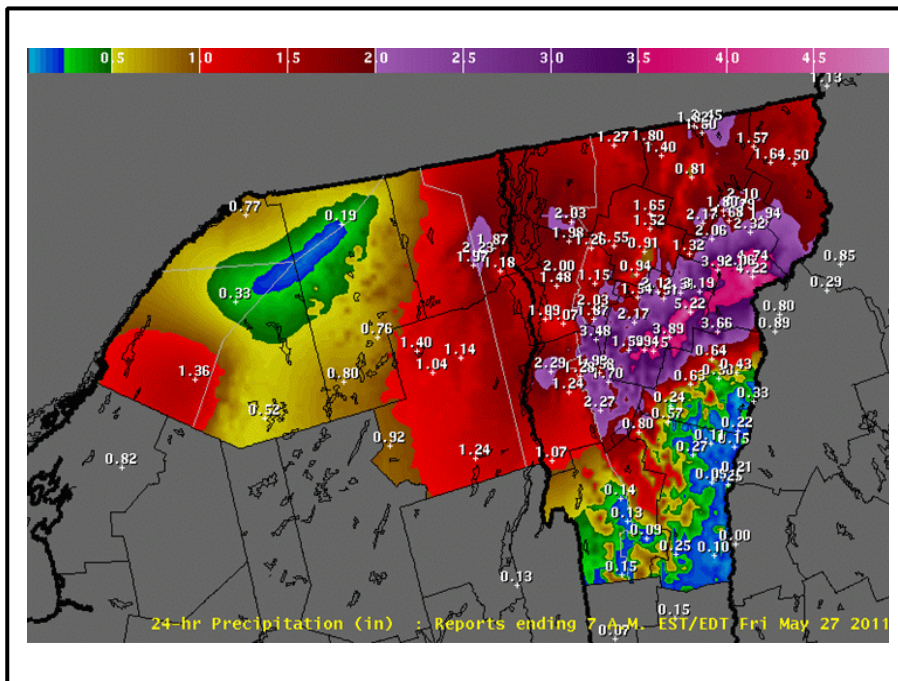


Figure 2: Daily rainfall totals as of 0700 EDT on 27 May, 2011. Courtesy NWS/BTV.

Table 2: Daily rainfall records observed at COOP stations around Vermont at 0700 EDT on 27 May 2011 unless otherwise noted

STATION	RAINFALL (inches)
Plainfield	5.22
St. Johnsbury	4.55 (Ending 0000 midnight 26 May)
Northfield	4.15
Barre/Montpelier airport	3.83 (Ending 0000 midnight 27 May)
Hanksville	3.48
Montpelier 2	3.19
East Haven	2.37
Worcester 2W	2.11

The Winooski river gauge at Montpelier (Figure 3) typifies the flashy response on rivers across northern Vermont during this event. This particular main stem river peaked in less than 12 hours. Flooding (Figure 4) resulted in the evacuation of up to 200 residents in north-central and northeast Vermont. Before weakening, some of these storms continued into southeastern Vermont with damaging winds blowing down trees and power lines in Tyson, Vermont (Windsor county) shortly after midnight on May 27th. Table 3 highlights some of the major roads that were closed by the overnight flooding of 26-27 May.

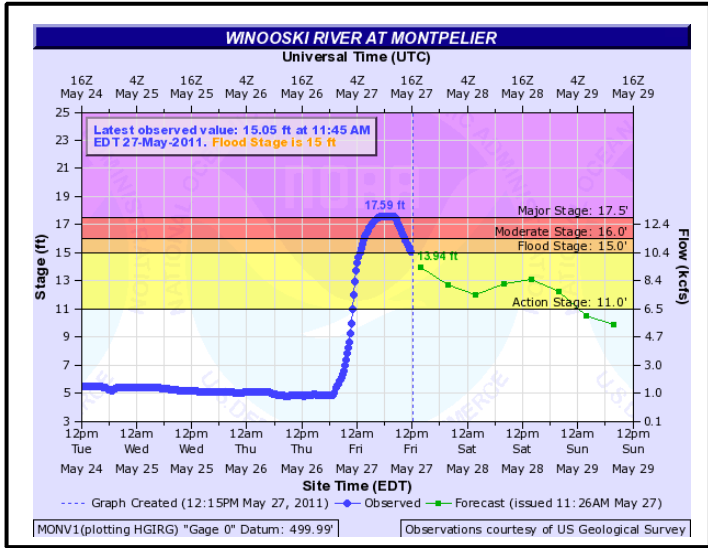


Figure 3: USGS hydrograph showing the stage at the Winooski River gauging station at Montpelier for May 2011.



(A)



(B)

Figure 4: Flooding of the Winooski River in Montpelier (a) and muddy roads in the neighboring town of Barre (b) on 27 May, 2011. (Photo credit: The Burlington Free Press).

Table 3: Selected road closures on 26-27 May, 2011 due to the flooding rains

COUNTY	TOWN	ROAD(S) AFFECTED
Washington	From Montpelier to Barre	Route 302
	From Middlesex to Montpelier. Plainfield & Cabot	Portions of Route 2
	Barre	Route 14
	From Montpelier to Northfield Falls	Route 12
	Barre	Route 62
Caledonia	Groton	Route 232
	Passumpsic	Route 5
	St. Johnsbury to Lunenburg (Essex County)	Route 2
Essex	Lunenburg	Route 2
	Maidstone	Maidstone State Highway
Orange	Williamstown	Route 14

Severe thunderstorms redeveloped during the late afternoon and evening of 27 May across portions of western, north central and northeast Vermont, resulting from these storms were hail and wind damage. Hail of at least 1" in diameter fell across the Vermont counties of Addison, Essex, Orange, Washington and Windsor. Wind damage in the form of downed trees and power lines was reported in Lamoille, Washington, Windsor and Caledonia counties.

An eyewitness account from the Barre area is reported verbatim as follows:

“Schools in Montpelier, Barre, Williamstown, Northfield, Orange, and Washington were closed because roads were impassable. In Barre, there were significant closures including businesses along Main Street and the Barre-Montpelier road. The Times-Argus had damage to its presses, and had to cancel papers on at least one day. Farms along Route 12 between Northfield Falls and Montpelier had significant erosion and deposition of river silt from the Dog River as it overflowed its banks. In Montpelier, Main Street and State Street were both flooded, and debris collected along all the bridges over the Winooski river. Damage to railroad tracks and beds was also significant. We witnessed at least five repair crews along the tracks when we went for a drive on Sunday afternoon. Also in Montpelier, the city water plant had overflow from storm run-off that contaminated the fresh water supply and many homes and businesses were without water and sewer service for most of Friday.” Dr. S.P.

Other area-specific impacts and emergency actions included:

1. Cold water rescue teams dispatched from the towns of Colchester and Stowe to evacuate residents, primarily in Montpelier and Barre. A number of local fire departments assisted in the evacuations.
2. A State of Emergency declared and emergency shelters were set up at the following Vermont locations:
 - ▶ National Life of Vermont building in Montpelier
 - ▶ Barre Auditorium in Barre
 - ▶ Berlin
 - ▶ St. Johnsbury
3. Up to 10,000 customers were without electricity at the height of the storms.
4. Vermont State offices in Washington, Orange and Caledonia counties were on reduced staffing or closed on 27 May due to the flooding.
5. Early damage estimates ranged from \$1.7 million in St Johnsbury area to about \$2 million in Barre alone.

By the end of May, Lake Champlain’s flooding had resulted in a number of socioeconomic impacts including:

- the delay of the boating season the lake due to flooded marine fueling stations and boat access areas
- damage to and the closure of segments of the Burlington and Colchester bike path. The Bike Ferry between the towns of Colchester and South Hero were cancelled for the remainder of the summer
- delayed construction of the new Vermont-New York connector bridge in West Addison

Non-flooding impacts

Apart from flood-related impacts around the state, the wet conditions in May and the Spring 2011

to date, have led to

- outbreaks of fungus-related anthracnose diseases in hardwoods
- white pine needlecast damage
- fungus-related brown rot on stone fruit
- cedar apple rust
- downed trees in areas with saturated soils and high winds.

On a positive note, the Vermont Department of Forests, Parks and Recreation (VTFPR) reported that “Vermont led all states in 2011 maple syrup production with 1,140,000 gallons, an increase of 28 percent from 2010 and the highest on record in over sixty years.” The VTFPR leaflets listed in the Additional Resources below provides more in-depth information.

In terms of agriculture, the wet May conditions translated into:

- delayed planting of silage corn due to wet soils and/or standing water in the fields
- in the northern counties, an abundance of grass in the pastures, although the wet conditions affected the timing of the first cut
- flowering fruits such as apples and strawberries thrived, although there was some concern about the risk of mold and fruit development of the latter.

ADDITIONAL RESOURCES

<http://www.lcbp.org>

http://www.lcbp.org/PDFs/2011_flood_presentation.pdf

<http://www.disasterassistance.gov/> Disaster recovery assistance (federal)

<http://vem.vermont.gov/home/return> VEM recovery assistance links

<http://vem.vermont.gov/sites/vem/files/Individual%20Assistance%20Fact%20Sheet%2013%20Oct%2010.pdf> VEM guide to individual assistance

http://vem.vermont.gov/home/dr_1995 Hazard mitigation funding availability

http://www.vtfpr.org/protection/documents/VTForestHealthUpdate_Anthracnose.pdf

<http://www.vtfpr.org/protection/documents/2011ForestHealthJuneObservations.pdf>