



July 2023 Flooding and Comparable Events in Vermont

2023 Vermont Emergency Preparedness
Conference

Burke Mountain Hotel and Conference Center
20 September 2023

Scott Whittier – scott.whittier@noaa.gov
Warning Coordination Meteorologist
NOAA/NWS/WFO Burlington, VT





Outline

- Largely Focus on July 9-11 Flooding
 - Other Flash Flooding during the Summer of 2023
 - July 7th, July 14th, July 16th, July 21st, August 3rd, August 4th
- NWS Decision Support Services during the Summer Flooding of 2023
 - Briefings, Messaging, On-site deployment
- Comparison with Irene 2011
- Comparison with June 29-30th, 1 (see  years Ago)
- Are you Storm Ready?





VT Presidential Disaster Declarations (through 2022)

History of Presidential Disaster Program

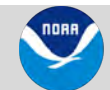
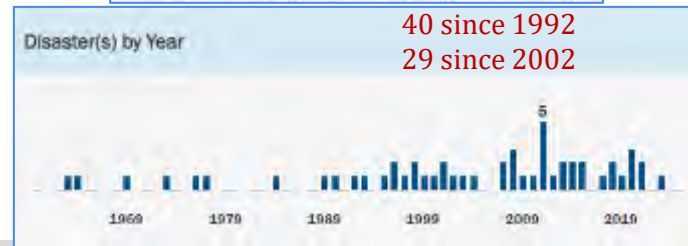
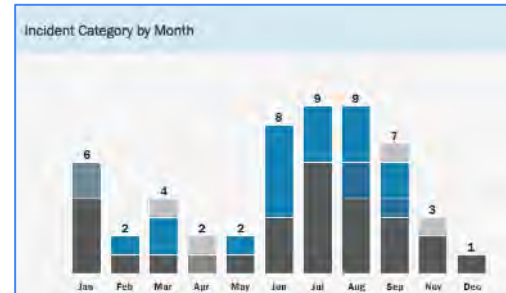
- **1950: Federal Disaster Assistance Program**
 - For the first time, the Federal Government was authorized to respond to major disasters, determined by the President of the United States
- **1970: Disaster Relief Act of 1970**
 - authorized Federal loans and tax assistance to individuals affected by disasters, as well as Federal funding for the repair and replacement of public facilities.
 - The Disaster Relief Act also introduced hazard mitigation as a Federal priority, authorizing the use of Federal funds to reduce the potential impact of future disasters
- **1974: Disaster Relief Act of 1974**
 - established the Presidential disaster declaration process.
- **1988: Robert T. Stafford Act**
 - designed to bring an orderly and systematic means of federal natural disaster assistance for state and local governments in carrying out their responsibilities to aid citizens.
 - encourage states and localities to develop comprehensive disaster preparedness plans, prepare for better intergovernmental coordination in the face of a disaster, encourage the use of insurance coverage, and provide federal assistance programs for losses due to a disaster.

Major Disaster Declaration Thresholds

- State of VT: \$1.14 Million Counties: \$4.44 per capita

48 Presidential Disasters since 1963

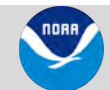
- 39 Flood/Severe (Wind) ~ 81%
- 5 Winter (Ice Storm 1998)
- 2 Tropical (Irene '11, Floyd '99)
- 1 Drought
- 1 Biological (COVID)





Top Weather Events for Vermont (prior to 2023)

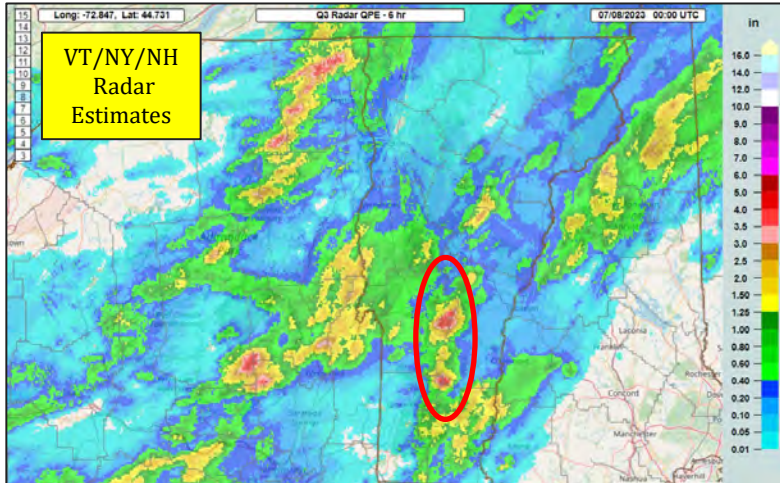
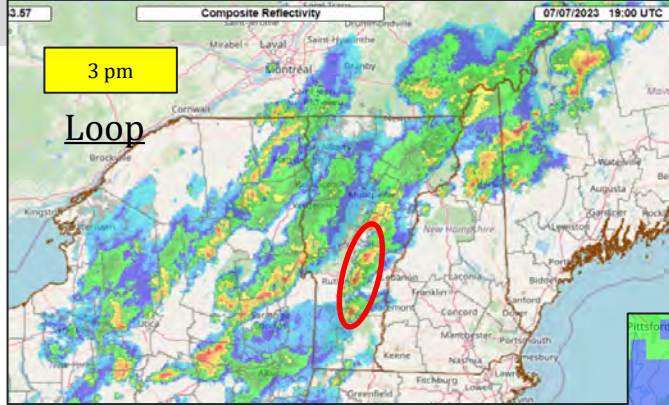
- **November 1927 Flood**
 - 84 fatalities, ~\$35 Million (~\$615 Million)
 - 1285 bridges lost, hundreds of miles of roads/RR tracks destroyed
- **Tropical Storm IRENE – August 2011**
 - 5 fatalities, ~ \$600-900 Million (~ \$1 Billion)
 - 200 Bridges, hundreds of miles of roads
- **Long Island/New England Hurricane – September 1938**
 - 5 fatalities, ~\$30 Million (~ \$600 Million)
 - Devastating WIND and flood damage (~30% timber loss)
- **June 29-30, 1973 Flood**
 - 2 fatalities, ~\$64 Million (~\$440 Million)
 - Dozens of bridges lost, hundreds of miles of roads/RR tracks destroyed
- **December 1969 Snow/Ice Storm**
 - Feet of snow combined with ≥ 1 " Ice accumulation. Roof collapses. Livestock killed.
 - >4 fatalities of stranded motorists due to poisoning, Power outages for week.
- **January 1998 Ice Storm**
 - First \$1. Billion storm to impact northern NY, VT and ME
 - Power outages for weeks. Major farm losses. 10% Forests damaged



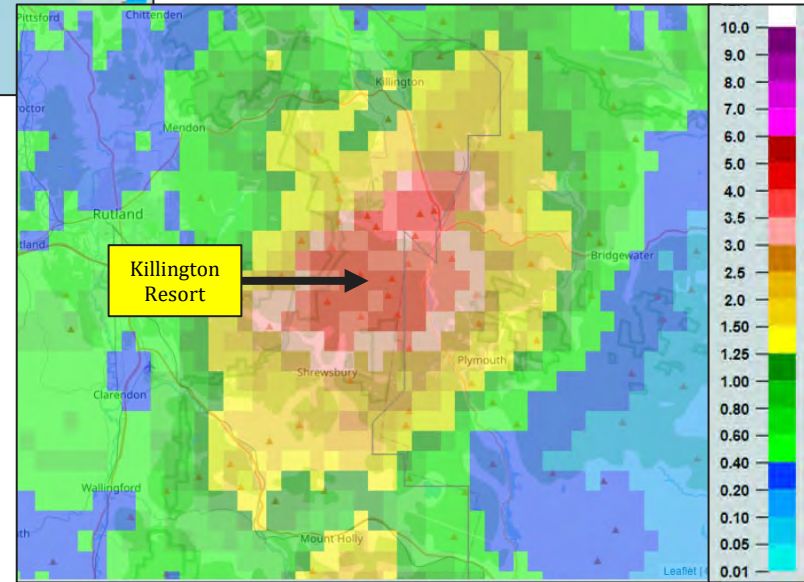


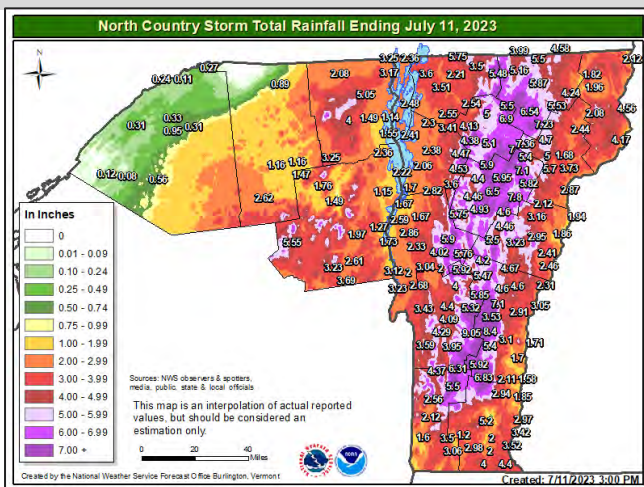
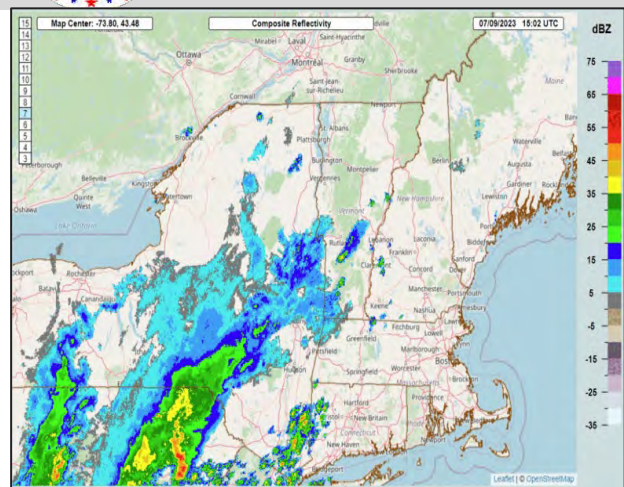
July 7, 2023

- Thunderstorms developed and moved across the state from Noon to 8 pm.
- Thunderstorms remained nearly stationary between 230-530 pm in Killington area.



- West Bridgewater - 4.60"
- Killington - 4.43"
- Killington - 3.51"
- Bridgewater - 3.11"
- Killington - 2.66"
- Royalton - 2.48"
- Weston - 2.24"
- Wilmington - 2.10"
- Mount Holly - 2.01"
- Okemo - 1.59"
- Shrewsbury 1.50"





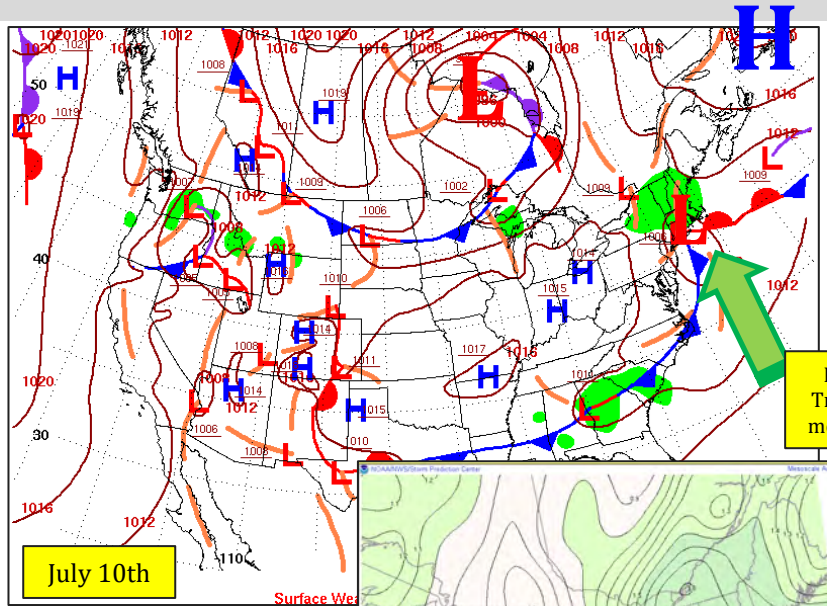
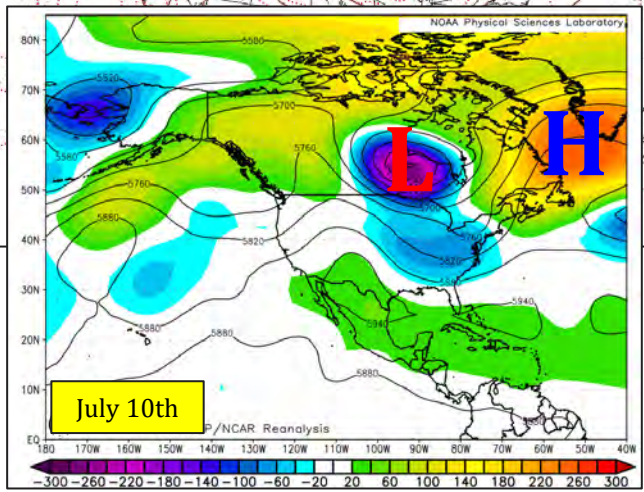
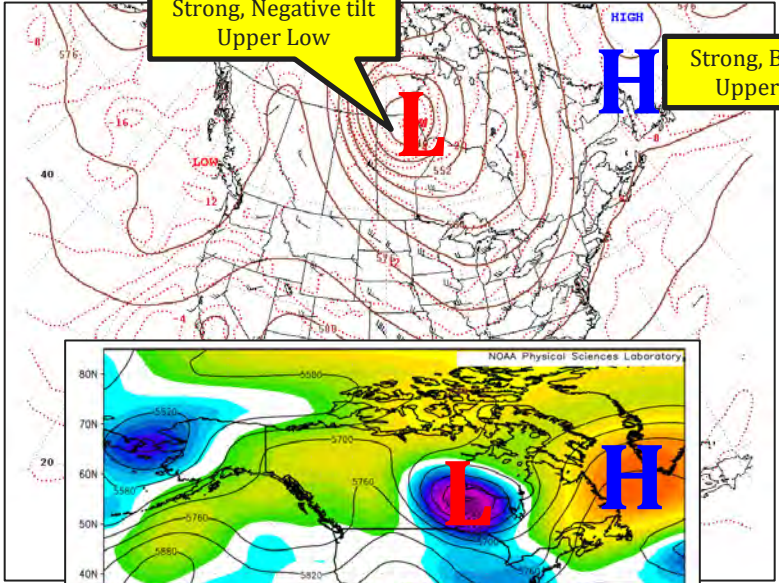
July 9-11, 2023 Flood Event



July 9-11, 2023 - Meteorology

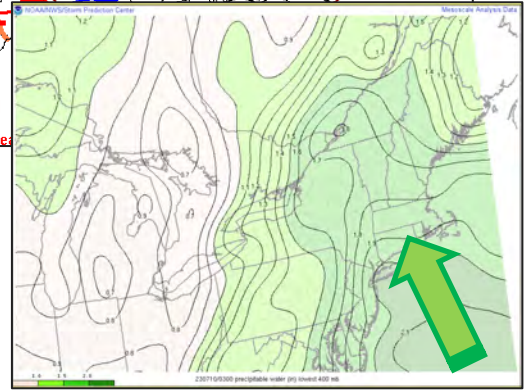
Strong, Negative tilt Upper Low

Strong, Blocking Upper High



Deep, Tropical moisture

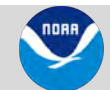
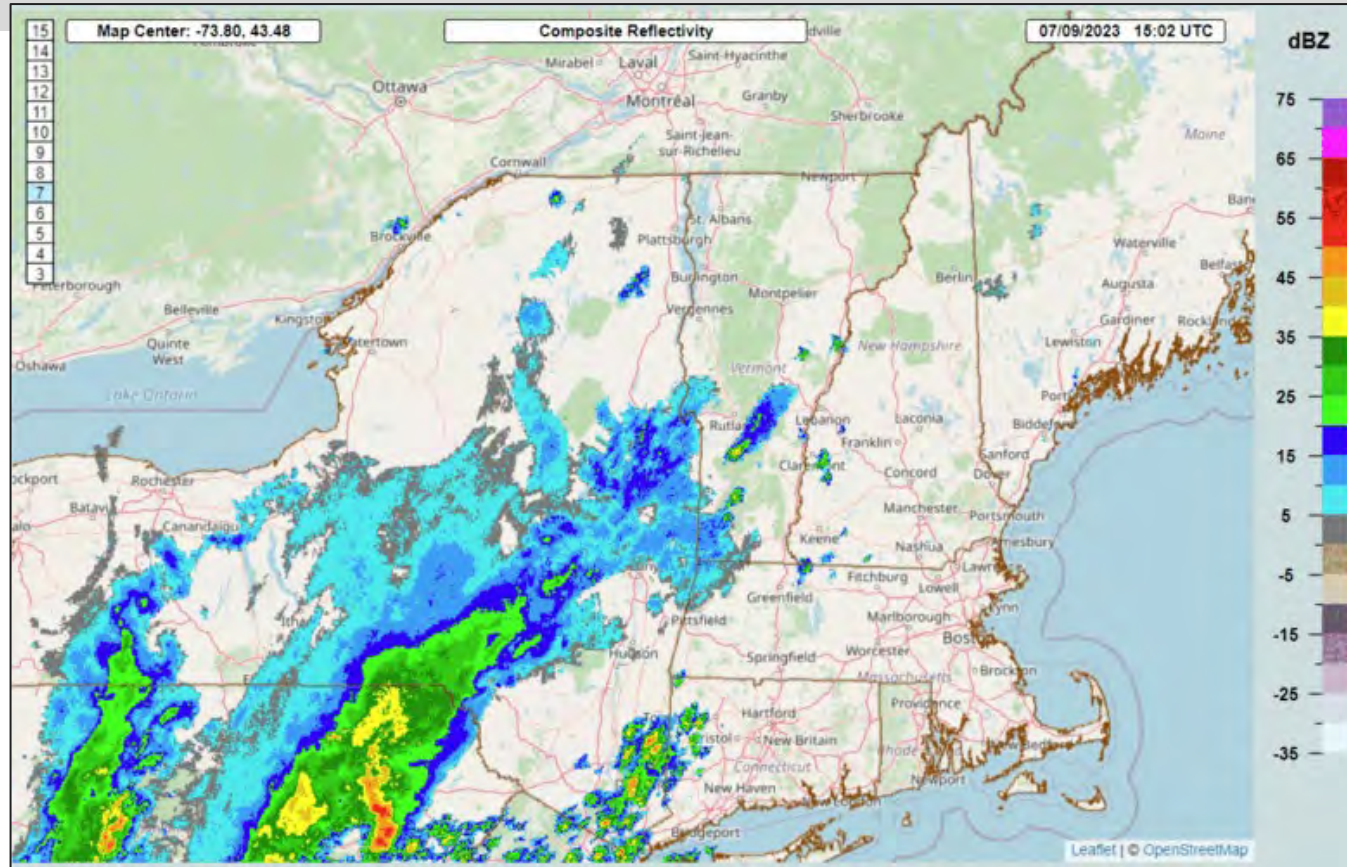
- **Upper/Lower Atmospheric Conditions**
 - **Unseasonably Strong Blocking Pattern, similar to Cool Season (Oct-Apr).**
 - Stalled movement, development of surface wave along the front.
 - **Deep Tropical Moisture**





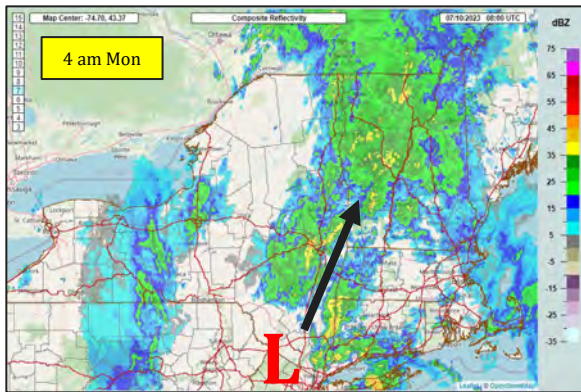
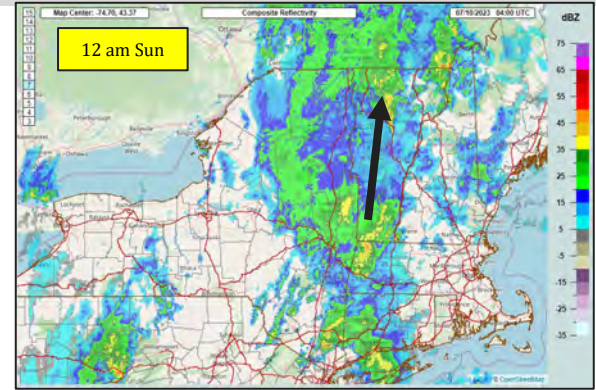
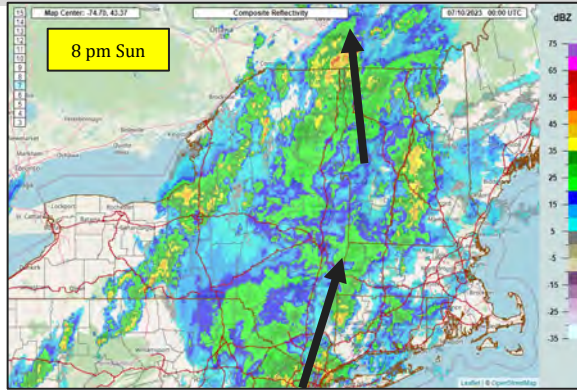
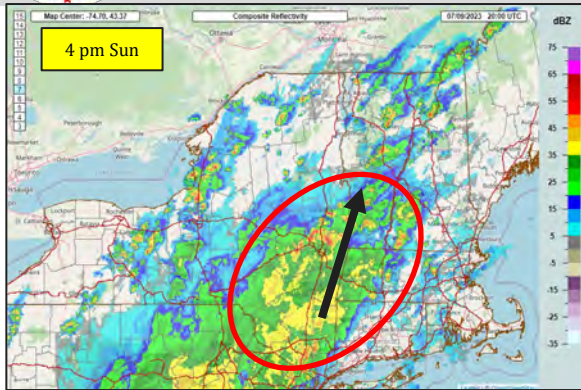
Hourly Radar Loop (Noon 7/9/23 – Noon 7/11/23)

- Main event was late Sunday through Monday evening, moving north across the state.
- Rainfall rates in excess of 1 inch per hour at times, especially at the onset late Sunday, otherwise largely $\frac{1}{4}$ to $\frac{1}{2}$ inch per hour.
- Flash Flooding early Monday morning through Monday evening transitioning to Major River Flooding that continued into Tuesday.

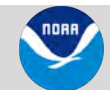
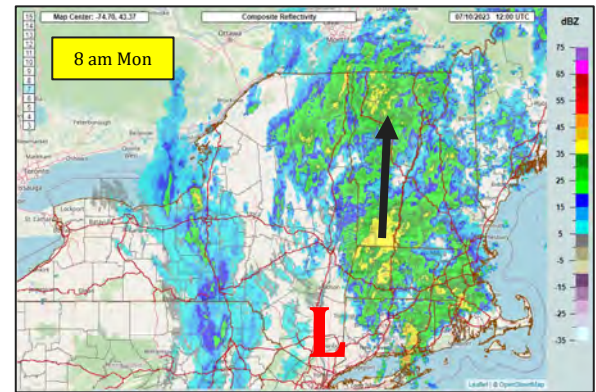




Sunday (7/9/23 – 4 pm) to Monday (7/10/23 – 8 am)

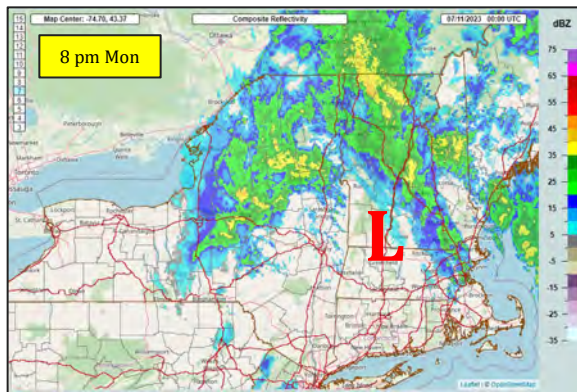
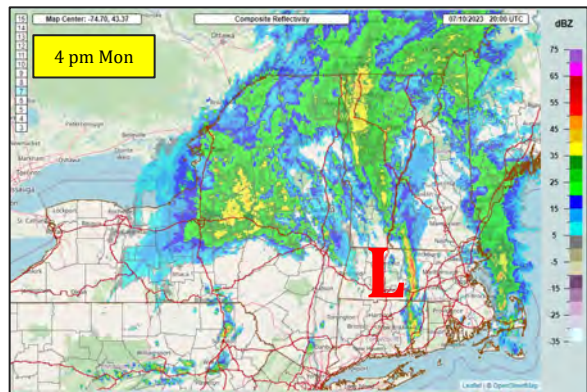
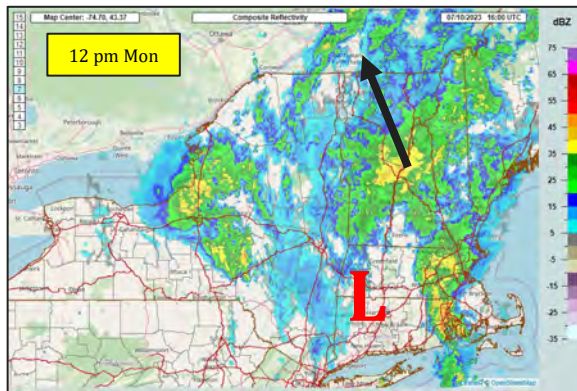
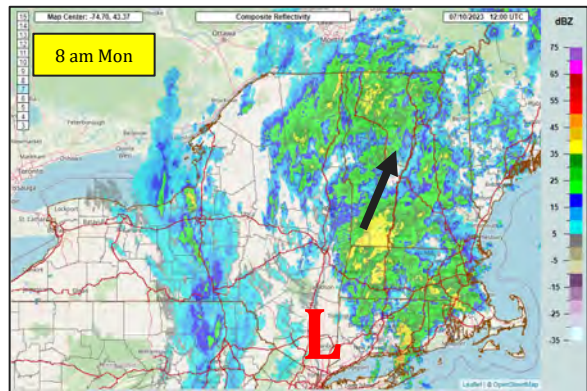


- Event begins across southern VT by late Sunday afternoon.
- Several rounds of heavy rain showers rotate south to north during Sunday night into Monday morning.
- **Rainfall rates in excess of 1 inch per hour at times.**
- Greatest impacts across southern VT, especially eastern slopes of Southern Greens with FLASH FLOODING.

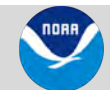




Monday (7/10/23 – 8 am to 8 pm)

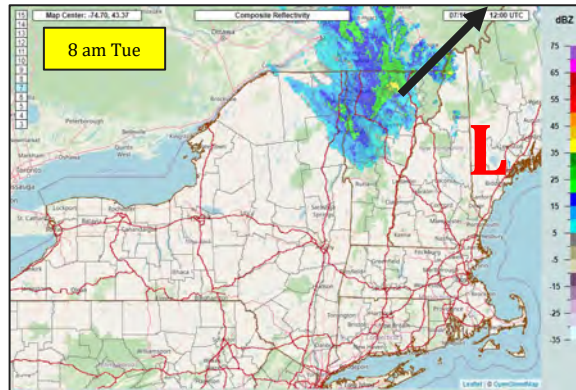
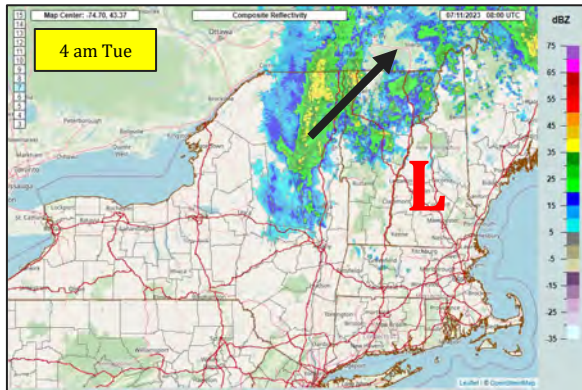
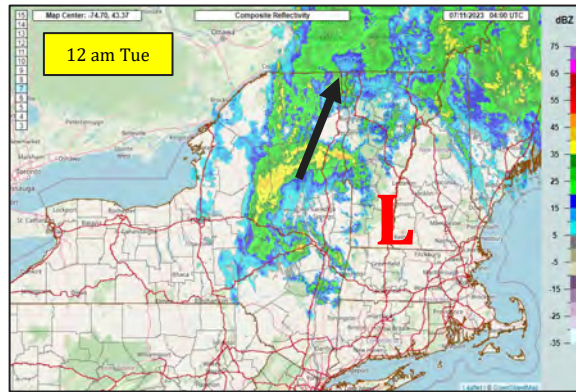
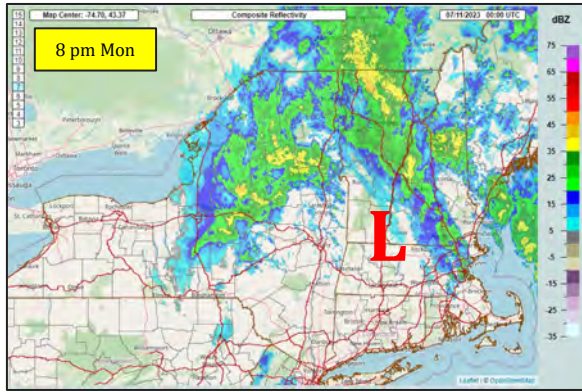


- Slow moving weak area of low pressure moves across southeast NY toward the lower Connecticut River Valley.
- Several rounds of heavy rain showers rotate south to north/northwest. Rainfall is largely ending across southern VT.
- Rainfall rates $\frac{1}{2}$ to 1 inch per hour at times lifting into northern VT.
- FLASH FLOODING on-going across southern - central VT and developing to the north.
- FLASH FLOODING transitioning to Major River flooding.

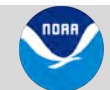
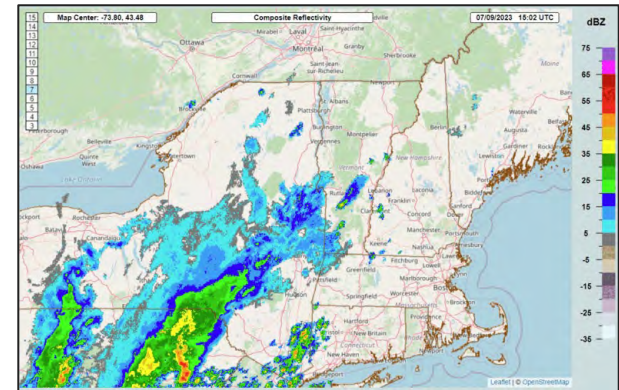




Monday (7/10/23 – 8 pm) to Tuesday (7/11/23 – 8 am)

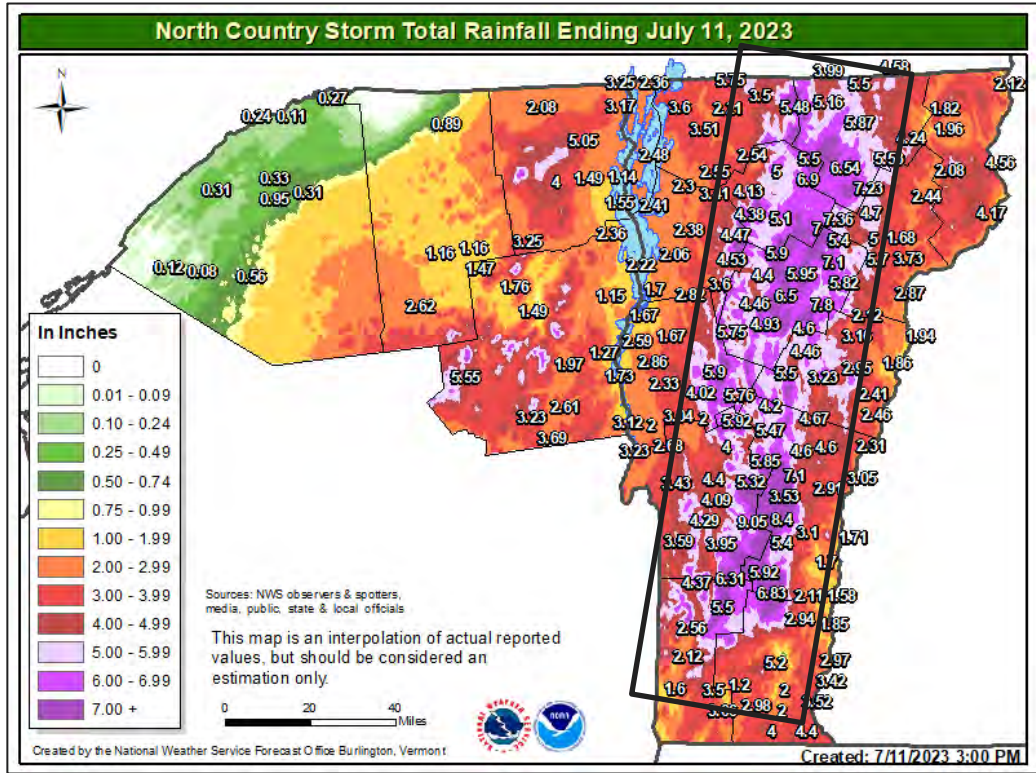


- Slow moving weak area of low pressure moves across the lower Connecticut River Valley into NH/ME.
- Steadiest rainfall is across northern half of VT.
- FLASH FLOODING on-going across central-northern VT and transitioning to Major River flooding statewide.

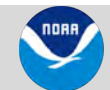
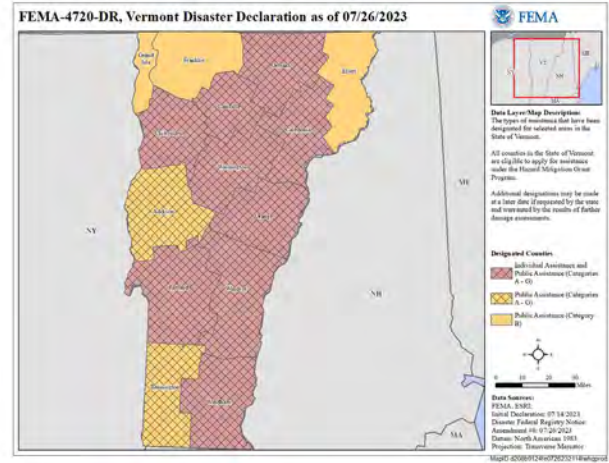




July 9-11, 2023 Rainfall



- Main event was July 9-11th with widespread 4 to 6 inches of rain across Green Mountains and foothills with 2 to 4 inches elsewhere.
- Major to Catastrophic flooding across a good portion of the area.
- Multiple, more localized flash flooding occurred days prior and after the main event.



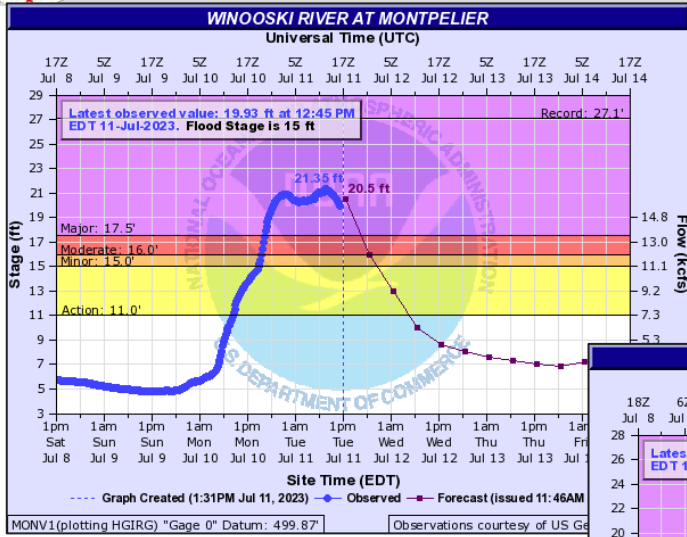


Courtesy of VT Digger



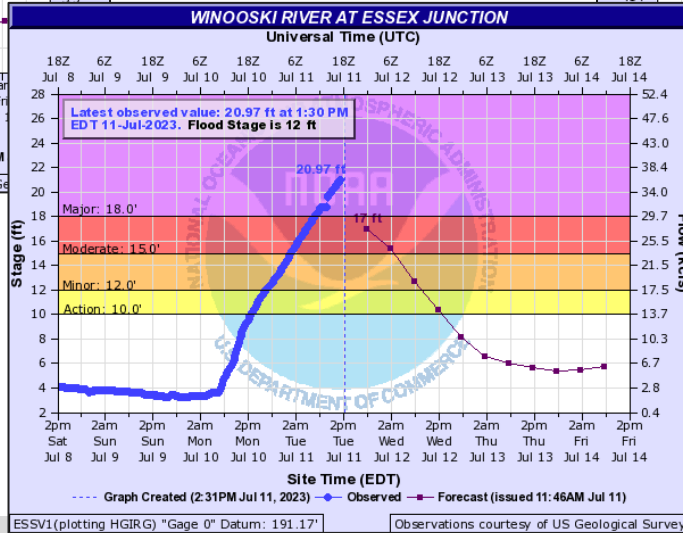
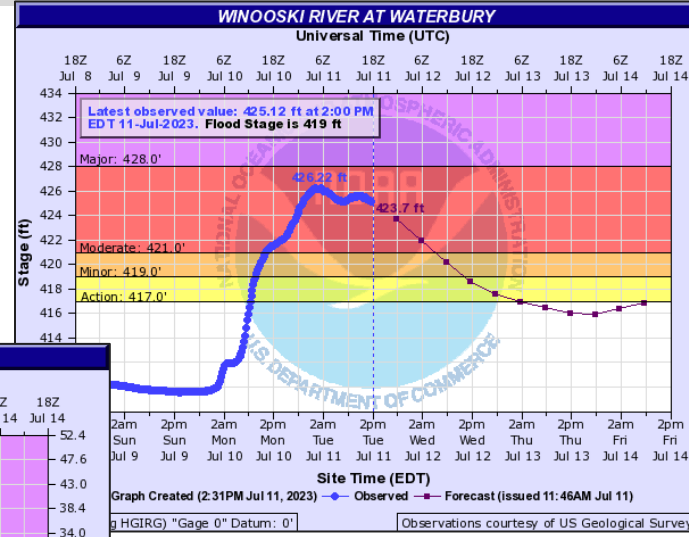


Winooski River Basin



Historic Crests

- (1) 51.40 ft on 11/04/1927
- (2) 24.54 ft on 03/19/1936
- (3) 23.28 ft on 07/11/2023 (P)
- (4) 22.19 ft on 08/29/2011
- (5) 22.17 ft on 02/21/1981
- (6) 19.06 ft on 03/14/1977
- (7) 18.72 ft on 09/22/1938
- (8) 18.60 ft on 04/19/1933
- (9) 18.28 ft on 04/18/1982
- (10) 17.47 ft on 07/01/1973



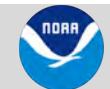
Historic Crests

- (1) 27.10 ft on 11/03/1927
- (2) 21.35 ft on 07/11/2023 (P)
- (3) 19.05 ft on 08/29/2011
- (4) 17.59 ft on 05/27/2011
- (5) 17.55 ft on 06/30/1973

Historic Crests

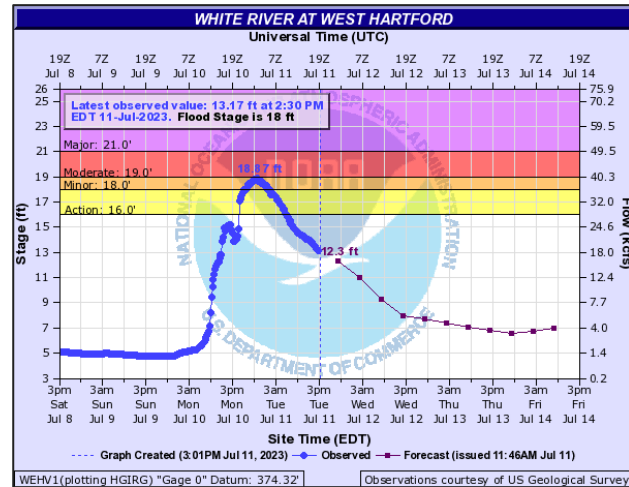
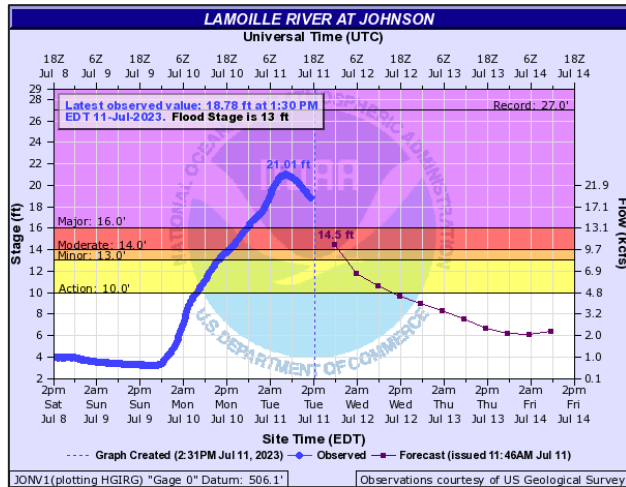
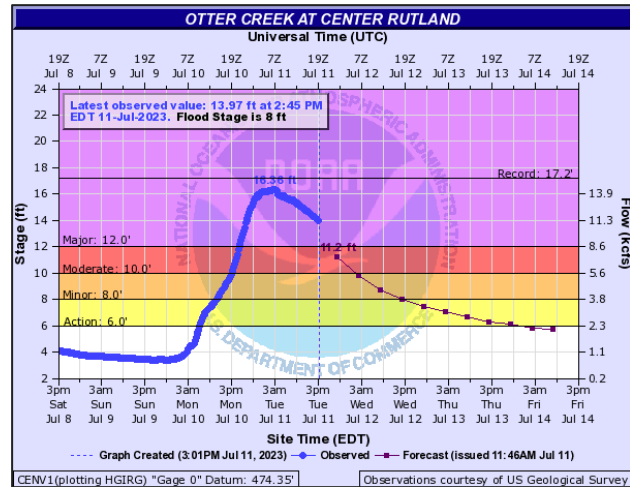
- (1) 430.00 ft on 08/29/2011
- (2) 426.22 ft on 07/11/2023 (P)
- (3) 423.30 ft on 05/27/2011

Red = July 2023
 Bold Black is Irene 2011
 Blue is June 1973





Main Stem Rivers at/near Major Flood



Historic Crests

- (1) 17.21 ft on 08/29/2011
- (2) 16.36 ft on 07/11/2023 (P)
- (3) 13.45 ft on 09/22/1938
- (4) 13.25 ft on 06/30/1973
- (5) 13.01 ft on 04/06/1987

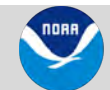
Red = July 2023
Black is Irene 2011
 Blue is June 1973

Historic Crests

- (1) 27.00 ft on 11/04/1927
- (2) 21.01 ft on 07/11/2023
- (3) 19.98 ft on 08/06/1995
- (4) 17.33 ft on 07/01/1973
- (5) 17.28 ft on 11/01/2019
- (6) 16.97 ft on 04/27/2011
- (7) 16.54 ft on 08/29/2011

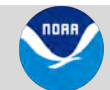
Historic Crests

- (1) 29.30 ft on 11/04/1927
- (2) 28.36 ft on 08/29/2011
- (3) 19.26 ft on 09/22/1938
- (4) 19.13 ft on 06/30/1973
- (5) 18.89 ft on 03/18/1936
- (6) 18.87 ft on 07/11/2023





- Any Quick Questions?
- Next – NWS Decision Support Services during the July 2023 Flooding





NWS Decision Support Services

Forecasts and Services:

What you need, When you need it and in the format(plain language) for the user to understand

WHY?! – Forecasts have NO “intrinsic value” alone.
They acquire value by people taking the correct, appropriate action to mitigate the hazard.

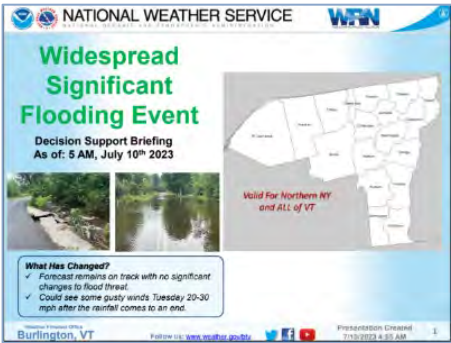
Decision Support Services

Which is more effective?

Forecast

Rainfall amounts of 2-4 inches with localized 5+ inches

Rainfall amounts of 2-4 inches with localized 5+ inches
Numerous Flash Flooding
“Most significant event since Irene, perhaps localized comparable damage.”





NWS Decision Support Services

Forecasts and Services: *What you need, When you need it and in the format and plain language for the user to understand*

WHY?! – Forecasts have NO “intrinsic value” alone.
They acquire value by people taking the correct, appropriate action to mitigate the hazard.



FEMA



Working closely with partners; **prior, during and after a weather event**

– Partners

- Local, State and Federal Agencies, VEM, RPC, LEPC, Local EM/1st Responders, Health Dept, Transportation, FEMA, Academia, electronic media, etc.

– Prior, During and After an event

Prior

- Tabletop Exercises (TTX), Planning meetings, training, workshops, mitigation
- Interacting with partners **BEFORE** hand for what, when and how they want/need services/support...”building relationships”, “building trust”.

During

- Situational Awareness e-mails/briefings/conference calls
- EOC Deployment for BIG weather or public safety event?
- Specialized forecasts for public safety at public events via the Public Safety community

After

- Forecasts and support for/during recovery operations
- Collaborate with NWS Regional Operation Centers for assistance to FEMA for potential Presidential Disaster Assistance (PDA) declarations
- Participating in After Action Reviews, Hot Washes



Dangerously Cold Wind Chills Expected
Friday into Saturday

Burlington, VT
www.burlingtonweather.com

OVERVIEW:
A dangerously cold arctic air mass will move into and impact the Northeast late Thursday night lingering through Saturday morning. The coldest period will be Friday into early Saturday morning with **dangerously cold wind chills of -30° to -45°.**

HAZARDS & TIMING:

- Wind Chill Warning** in effect for all of Vermont & northern New York from 1 AM Friday to 1 PM Saturday.
- Daytime temperatures of -10° to +5°F on Friday and early Saturday combined with very brisk northwest winds will create dangerously cold wind chills of -15° to -35°.
- Friday night will be extremely cold with temperatures -15° to -25°F and wind chills of -30° to -45°F.

IMPACTS:

- Cold temperatures and dangerously cold wind chills will increase the threat of hypothermia and cause frostbite on exposed skin in as little 10 minutes.
- These cold temperatures will have impacts on all mechanical systems such as heating systems and vehicles. **PLAN ACCORDINGLY!**

ADDITIONAL INFORMATION:

- Please visit the **NWS Extreme Cold Safety Page** for cold weather safety tips.

NEXT BRIEFING:

- By 5 pm Thursday, February 2, 2023.

Minimum Wind Chill Forecast
for Burlington, VT
for Feb. 02, 2023

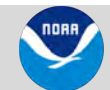
REQUIRE: 2/2/2023 4:59 AM nwsdot@fox.com 802.638.0150 www.weather.gov/burl





NWS Burlington Decision Support – July 2023

- **Twice Daily “Heads-up” Briefings to Decision Makers (Before/During)**
- **On-site Deployment to VT State Emergency Operations Center (SEOC)**
 - July 10th – July 21st
 - 3-4 briefings daily (including Governor)
 - Support Situational Awareness Section and entire SEOC
 - Forecasts and Weather Safety information/support
- **Remote Support to VT SEOC from July 22nd to September 1st**
 - Providing the same support/functions
- **Conducted Flood surveys to QC and improve Flood Impact statements**
 - Working with Town Officials to possibly change Flood categories (Winooski @ Waterbury).





NWS Burlington Decision Support – Briefing e-mails

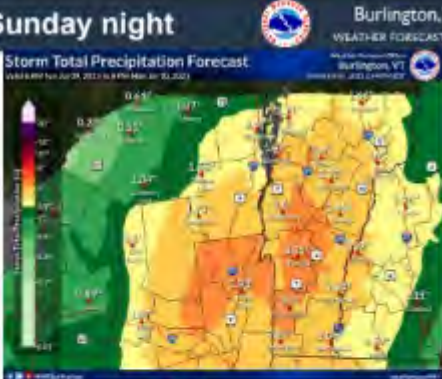

Friday (7/7) – First Briefing

Widespread Flash Flooding Late Sunday into Sunday night Burlington, VT WEATHER FORECAST OFFICE

OVERVIEW
Another round of widespread heavy rainfall is expected late Sunday into Sunday night. With grounds saturated and elevated river levels, the forecast additional rainfall will likely lead to more widespread flash flooding and river flooding.

TIMING	<ul style="list-style-type: none"> Late Sunday into Monday. River flooding may persist into late Monday and even Tuesday.
HAZARDS & IMPACTS	<ul style="list-style-type: none"> Flash Flooding: Widespread rainfall of 1-3 inches with localized higher amounts will likely lead to widespread flash flooding. Expect washed out roads and culverts. River Flooding: Rivers most susceptible to flooding include: Ausable River at Ausable Forks, Otter Creek at Center Rutland, Winooski River at Essex Junction and Mad River at Moretown.
ADDITIONAL INFORMATION	<ul style="list-style-type: none"> NWS Burlington – www.weather.gov/btv NWS Albany – www.weather.gov/aly Threat of additional heavy rain increasing for Sunday night into Monday.
NEXT BRIEFING	<ul style="list-style-type: none"> By 5 AM Saturday, July 8th 2023

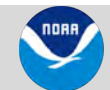
ISSUED: 7/7/2023 4:11 PM www.weather.gov/btv

Storm Total Precipitation Forecast
Valid 12Z Fri Jul 07 2023 to 12Z Mon Jul 10 2023
Forecasted by WEGMAN

Day 3 Excessive Rainfall Outlook
Valid 12Z Sun Jul 09 2023
Thru 12Z Mon Jul 10 2023
Issued: 1716Z Fri Jul 07 2023
Forecaster: WEGMAN
NWS/NWS/NCEP/WPC
Risk of rainfall exceeding flash flood guidance within 25 miles of a point to the right of a line
HIGH: At Least 70% SLGT: At Least 15%
MDT: At Least 40% MROL: At Least 5%

- Initial brief to notify decision makers leading into the weekend.
- Rainfall 1-3+ inches with locally higher.
- ***“Threat of additional heavy rain increasing Sunday night into Monday.”***





NWS Burlington Decision Support – Briefing e-mails

Saturday (7/8) – Flood Watch Issued

NATIONAL WEATHER SERVICE

Widespread Flooding Event

Decision Support Briefing
As of: 5PM, July 8th



Valid For Northern NY and ALL of VT

What Has Changed?

- A Flood Watch is in now in effect for most of the region from 2 PM Sunday to 8 PM Monday

Western Forecast Office
Burlington, VT

Follow us: www.weather.gov/btv

Presentation Created: 7/8/2023 4:44 PM

NATIONAL WEATHER SERVICE

Numerous Flash Floods: Potential Impacts

- Urban street flooding, clogged storm drains, washed out culverts and washed out dirt road shoulders/roads are most susceptible.
- Highly sloped, small drainage basins are most vulnerable for flash flooding.
- Area creeks and streams are currently running high, heightening risk of flooding.



Understanding WPC Excessive Rainfall Risk Categories

No Rainfall	WPC (REG)	SLIGHT (SLGT)	MODERATE (MOD)	HEAVY (HEAVY)
Very Low Risk	Low Risk	Low to Moderate Risk	High Risk	Very High Risk

Western Forecast Office
Burlington, VT

Follow us: www.weather.gov/btv

Presentation Created: 7/8/2023 4:44 PM

- **Flood Watch issued**
 - 2-4 inches with localized 5+ inches Sunday night into Monday.
 - **Widespread Flooding Sun Ngt-Mon.**
 - **Flash Flooding transitioning to River flooding on Monday.**

NATIONAL WEATHER SERVICE

Flash Flood and Severe Timeline



Sunday
Rainfall will encompass the region Sun afternoon. Moderate to heavy rainfall is expected to develop by late afternoon. Flash flood threat increases late afternoon.

Sun Night
Heavy rain will continue Monday morning and taper off. Flash flooding and river flooding likely. Strong to severe storms with gusty winds, heavy rain and great hail possible in the afternoon.

Monday
A few showers will be possible. Rivers will begin to crest and fall. Heavy flooding is still expected in places.

Mon Night
Transitions will dissipate and rainfall will mostly come to an end. Rivers will continue to rise as water continues to run off from higher elevations.

Tuesday
Heaviest rainfall is expected Sun night. Significant rain flooding is likely, especially in areas that have received heavy rainfall recently.

Travel Impact Legend

- Little to No Impact
- Minor Impact
- Major Impact
- Severe Impact


Western Forecast Office
Burlington, VT

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NATIONAL WEATHER SERVICE

3-Day Significant River Flood Outlook



For additional river forecasts, visit [AHPS page](http://www.ahps.gov) (Advanced Hydrologic Prediction Service)

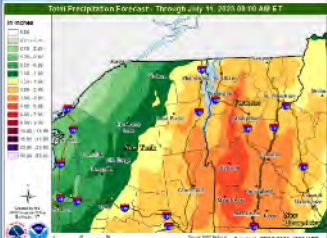
Western Forecast Office
Burlington, VT

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Presentation Created: 7/8/2023 4:44 PM

NATIONAL WEATHER SERVICE

Expected Storm Total Rainfall



Timing and Magnitude -

- Showers and thunderstorms become widespread Sunday evening
- Widespread heavy rainfall of 2-4 inches with localized 5+ inches will lead to widespread flooding for much of the region

Impacts -

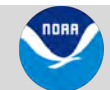
- Several river basins may reach flood stage. Flood stage is forecast late Monday into early Tuesday include Winooski, Ausable, and Mad, with moderate flood stage expected for Otter Creek.
- Given the recent antecedent rainfall, saturated soils and elevated river levels, numerous floods are likely.
- By Monday, the threat transitions into more of an areal and river flood threat.

For updated river forecasts, visit [AHPS page](http://www.ahps.gov) (Advanced Hydrologic Prediction Service)

Western Forecast Office
Burlington, VT

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Presentation Created: 7/8/2023 4:44 PM





NWS Burlington Decision Support – Briefing e-mails

Sunday morning (7/9)

NATIONAL WEATHER SERVICE WFSN

Widespread Flooding Event

Decision Support Briefing
As of: 5 AM, July 9th

Valid For Northern NY and ALL of VT

What Has Changed?
No significant changes with this forecast package

Walter Pomeroy Office
Burlington, VT

Follow us: www.weather.gov/burl

Presentation Created: 7/9/2023 4:44 AM

NATIONAL WEATHER SERVICE WFSN

TODAY AND TONIGHT: Numerous Flash Floods Likely

Today's Excessive Rainfall Outlook

MAJOR RISK (RISK)	SLIGHT RISK (RISK)	MODERATE RISK (RISK)	HIGH RISK (RISK)
Widespread heavy rain possible	Scattered heavy rain possible	Widespread heavy rain possible	Widespread heavy rain possible

- Scattered showers/thunderstorms develop mid/late this afternoon.
- Very heavy rainfall is main threat, though some storms could become strong to locally severe, with strong winds and small hail.
- Very heavy rain becomes more widespread this evening and overnight. Rainfall rates of 3+ inches in 3 hours are possible.
- Flash flooding threat highest in areas that have seen recent heavy rainfall, areas of steep terrain, and more urban locations.
- Likely impacts include clogged and washed out culverts, urban street flooding, and washed out dirt road shoulders/roads.
- Highly sloped, fast-responding small creeks and streams are most vulnerable for flash flooding, leading to additional washed out roads.

Burlington, VT

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Presentation Created: 7/9/2023 4:44 AM

NATIONAL WEATHER SERVICE WFSN

Flash Flood and Severe Timeline

Sunday
Showers and thunderstorms will overspread the region this afternoon. Moderate to heavy rainfall is expected to develop by late afternoon, increasing the flash flood threat.

Sun Night
Heavy rain will continue Monday morning, then transition to showers and thunderstorms. Flash flooding and river flooding likely. Strong storms with heavy rain, gusty winds, and small hail possible in the afternoon.

Monday
A few showers will be possible, mainly in northern/western VT. Rivers will begin to crest and fall. River flooding is still expected in places.

Mon Night
Thunderstorms will dissipate, though scattered showers/river flows will continue to rise as water continues to run off from higher elevations.

Tuesday
Heaviest rainfall in expected tonight. Significant flash flooding is likely, especially in areas that have recently received heavy rainfall.

Travel Impact Legend

- Little to No Impact
- Minor Impact
- Major Impact
- Extreme Impact
- Secondary Impact

NATIONAL WEATHER SERVICE NWS Burlington, VT

ISSUED: 6:30 AM Sunday, July 9, 2023

NATIONAL WEATHER SERVICE WFSN

MONDAY AND MONDAY NIGHT: Areal/River Flooding Expected Additional Flash Flooding Likely

Monday Excessive Rainfall Outlook

MAJOR RISK (RISK)	SLIGHT RISK (RISK)	MODERATE RISK (RISK)	HIGH RISK (RISK)
Widespread heavy rain possible	Scattered heavy rain possible	Widespread heavy rain possible	Widespread heavy rain possible

- Widespread heavy rain transitions toward scattered showers and thunderstorms by mid/late morning.
- Heavy rainfall still main threat from thunderstorms, but isolated strong storms capable of producing gusty winds and small hail also possible.
- Flash flooding threat will be highest in areas that received the most rainfall Sunday/Sunday night.
- Larger mainstream rivers will show sharp rises by late Monday morning, with several gages expected to approach/exceed flood stage during the evening/overnight hours.
- Additional washed out roads possible.

Burlington, VT

Page 5 / 8

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Presentation Created: 7/9/2023 4:44 AM

- **Flood Watch in effect**
 - 2-4 inches with localized 5+ inches Tonight into Monday.
 - **Numerous Flash Flooding transitioning to River flooding.**
 - **Comparisons to IRENE during State of VT conference call**
 - *"Most significant event since Irene, perhaps localized comparable damage."*
 - Assisted VT USAR to seek outside resources

NATIONAL WEATHER SERVICE WFSN

5 Day Significant River Flood Outlook

Monday Night

Tuesday Morning

For additional river forecasts, visit [AHPFS page](#) (Advanced Hydrologic Prediction Service)

National Weather Service
Burlington, VT

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Presentation Created: 7/9/2023 4:44 AM

NATIONAL WEATHER SERVICE WFSN

Storm Total Rainfall

Storm Total Precipitation Forecast

Timing and Magnitude

- Showers and thunderstorms have widespread the Saturday and overnight periods through Monday.
- Widespread heavy rainfall of 2-4 inches, near 5 inches, will lead to widespread flooding for much of the region.

Impacts

- Greatly eroded heavy 1916, saturated soils, and elevated river levels, means a flood year likely.
- By Monday, the flood crest sets to rise 2 or 3 feet and, near flood stage.
- Severe river banks may reach flood stage on Monday into early Tuesday, by using the historical, Assate, Mass, and Otter Creek.

NATIONAL WEATHER SERVICE
Burlington, VT

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Presentation Created: 7/9/2023 4:44 AM





NWS Burlington Decision Support – Briefing e-mails

Sunday afternoon/evening (7/9)

NATIONAL WEATHER SERVICE WFN

Widespread Significant Flooding Event

Decision Support Briefing
As of: 5 PM, July 9th 2023



Valid for Northern NY and ALL of VT


What Has Changed?

- WPC has placed most of the region in High Risk Excessive Rainfall Outlook for Monday into Monday night.
- Increased rainfall forecast amounts.

Burlington, VT

NATIONAL WEATHER SERVICE WFN

TODAY AND TONIGHT: Numerous Flash Floods Likely



Sunday Excessive Rainfall Outlook

- Scattered showers/thunderstorms have developed across the region.
- Very heavy rainfall is main threat, though some storms could become strong to locally severe, with strong winds and small hail.
- Very heavy rain becomes more widespread this evening and overnight. Rainfall rates of 3+ inches in 3 hours are possible.
- Flash flooding threat highest in areas that have seen recent heavy rainfall, areas of steep terrain, and more urban locations.
- Likely impacts include clogged and washed out culverts, urban street flooding and washed out dirt road shoulders/roads.
- Highly sloped, fast-responding small creeks and streams are most vulnerable for flash flooding, leading to additional washed out roads.

Burlington, VT

- “Widespread significant to catastrophic flooding”
- HIGH Risk for Flash Flooding (WPC-ERO)
- 3-5 inches with localized 7+ inches Tonight into Monday. (System stalling).
- Numerous Flash Flooding transitioning to River flooding
- Significant River flooding expected

NATIONAL WEATHER SERVICE WFN


Expected Hazards

Hazard	Impacts	Location	Timing
Flash Flooding	Widespread significant to potentially catastrophic flash flooding, especially where multiple storms train over the same area, in locations that have seen recent heavy rainfall, and in areas of steep terrain	All of Vermont, northeastern New York	This afternoon into Monday
River Flooding	Widespread heavy rainfall will cause significant rises on area rivers, with several forecasted to exceed flood stage	Much of northeastern New York and Vermont	Monday afternoon into Tuesday
Strong Thunderstorms	Cloud-to-ground lightning, damaging winds, localized downburst, and small hail	All of northern New York and Vermont	This afternoon and Monday afternoon

Burlington, VT

NATIONAL WEATHER SERVICE WFN

MONDAY AND MONDAY NIGHT: Areal/River Flooding Expected Additional Flash Flooding Likely




Monday Excessive Rainfall Outlook

- Widespread heavy rain transitions toward scattered showers and thunderstorms by mid/late morning
- Another round of heavier rainfall is expected Monday afternoon after a period of lighter rain
- Significant to potentially catastrophic widespread flash flooding threat
- Larger main stem rivers will show sharp rises by late Monday morning, with several gages expected to approach/exceed flood stage during the evening/overnight hours
- Additional washed out roads possible

Burlington, VT

NATIONAL WEATHER SERVICE WFN

3 Day Significant River Flood Outlook



Monday Night

Tuesday Afternoon

For additional river forecasts, visit www2.mnh.gov/AdvancedHydrologicPredictionService/

Burlington, VT

NATIONAL WEATHER SERVICE WFN

Storm Total Rainfall



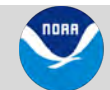
Timing and Magnitude

- Widespread heavy rain arrives this evening through the overnight hours
- Another round of heavy rain is expected Monday afternoon after a period of lighter rain Monday in the morning
- Widespread heavy rainfall of 2.5 inches, locally 3+ inches, will lead to widespread flooding for much of the region

Impacts

- Given recent heavy rainfall, saturated soils, and elevated river levels, numerous floods are likely
- As Monday, the above conditions to result in an area and river flood threat
- Several river basins are likely reach flood stage for Monday into early Tuesday, including the Wisconsin, Anoka, SAM, and Otter Creeks

Burlington, VT





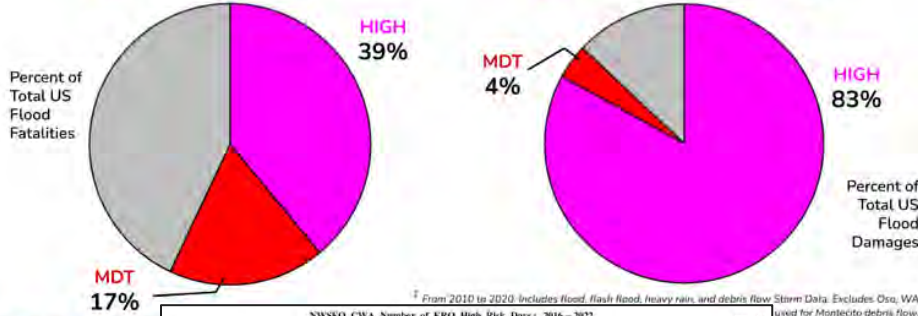
First HIGH Risk for Flash Flooding in VT since Irene (August 28, 2011)

WPC High Risk Days are a BIG DEAL

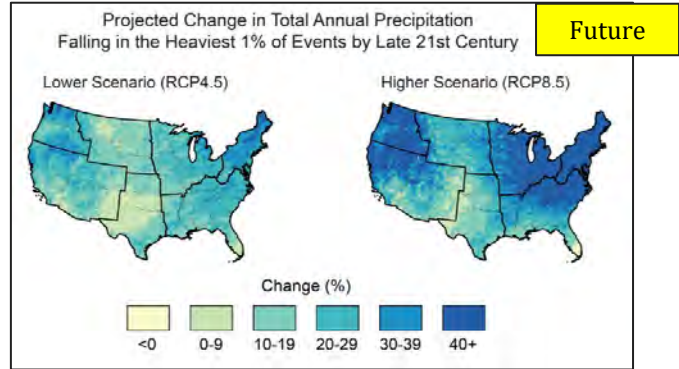
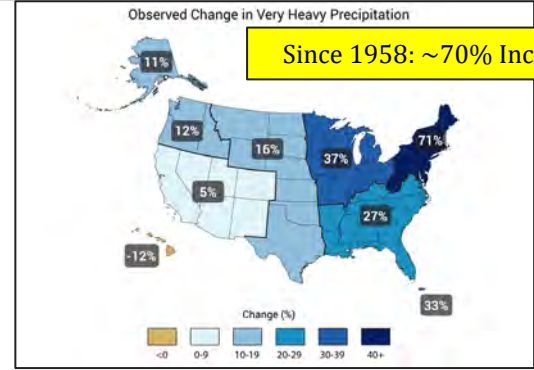
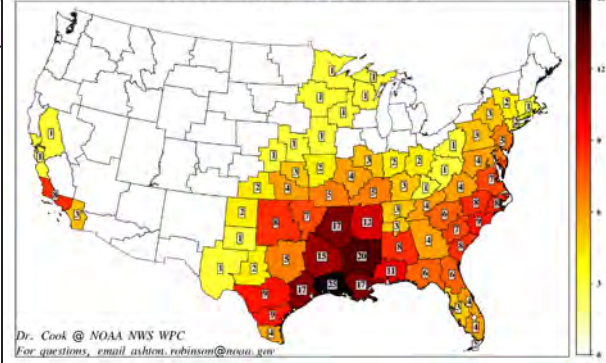
High Risks are only issued by WPC on ~4% of days, but "High Risk Days" have accounted¹ for:

2/5 of ALL Flood-related Fatalities

4/5 of ALL Flood-related Damages



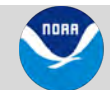
NWSFO CWA Number of ERO High Risk Days: 2016 - 2022



30-40+% increase in Heaviest 1% Rainfall Events*



*National Climate Assessment 2014, 2018






NWS Burlington Decision Support – Briefing e-mails

Monday morning (7/10) - Event ongoing – Flash Flooding stage

NATIONAL WEATHER SERVICE WFN

Widespread Significant Flooding Event

Decision Support Briefing
As of: 5 AM, July 10th 2023



Valid For Northern NY and ALL of VT


What Has Changed?

- Forecast remains on track with no significant changes to flood threat.
- Could see some gusty winds Tuesday 20-30 mph after the rainfall comes to an end.

Burlington, VT | Presentation Created: 7/10/2023 4:55 AM

NATIONAL WEATHER SERVICE WFN

Today and Tonight: Areal/River Flooding Expected Additional Flash Flooding Likely



Monday Excessive Rainfall Outlook

NATIONAL WATCH Widespread heavy rain expected	SLIGHT RISK Scattered flash floods possible	MODERATE RISK Heavy rainfalls, flash flooding, and some landslides are possible	HIGH RISK Widespread flash flooding expected
---	---	---	--

- Widespread heavy rain transitions toward scattered showers and thunderstorms by mid/late morning
- Another round of heavier rainfall is expected this afternoon after a period of lighter rain
- Significant to potentially catastrophic widespread flash flooding threat remains on track
- Larger mainstem rivers already rising sharply, with several gages expected to approach/exceed flood stage during the evening/overnight hours
- Additional washed out roads possible

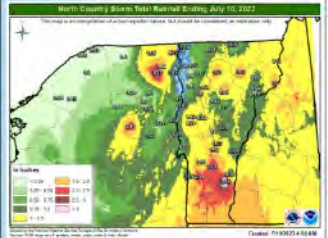
Burlington, VT | Presentation Created: 7/10/2023 4:55 AM

NATIONAL WEATHER SERVICE WFN

Rainfall Reports So Far as of 4 AM

Rainfall reports as of 4 AM Monday July 10

North County / South Teton Watershed District, July 10, 2023



What has happened so far:


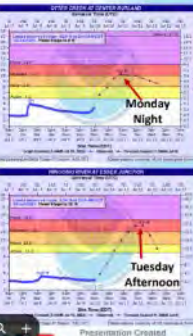
- Waves of heavy rain fell overnight. Hardest hit areas overnight have been southern Vermont, where 3+ inches of rain locally fell over just a couple of hours.
- As of 4:30 AM, the wave of heavy rain is progressing northward into central Vermont.
- Multiple road washouts reported in southern Rutland and Windsor Counties as of 4:30 AM.
- Will likely get more reports over the next few hours as people wake. Please pass on any flooding reports you receive!

Burlington, VT | Presentation Created: 7/10/2023 4:55 AM

NATIONAL WEATHER SERVICE WFN

5-Day Significant River Flood Outlook

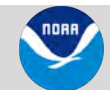
Valid: 07/09/2023 08:00 AM - 07/14/2023 10:00 AM EDT

For additional river forecasts, visit [AHPS page](#) (Advanced Hydrologic Prediction)

Burlington, VT | Presentation Created: 7/10/2023 4:55 AM

- **“Widespread significant to catastrophic flooding”**
 - **NO CHANGES** – messaging remains the same
 - **HIGH** Risk for Flash Flooding (WPC-ERO)
 - Rainfall of 3-5 inches with localized 7+ inches.
 - **Numerous Flash Flooding transitioning to River flooding.**
 - **Significant River flooding expected.**
 - Ground truth rainfall and storm reports of flooding.
 - **NWS Forecaster deployed to VT SEOC.**





NWS Burlington Decision Support – Briefing e-mails

Monday afternoon/evening (7/10) - Event ongoing – Flash to Major River Flooding

NATIONAL WEATHER SERVICE WFN

Widespread Significant Flooding Event

Decision Support Briefing
As of: 5 PM, July 10th 2023

Valid For Northern NY and ALL of VT

What Has Changed?

- Forecast remains on track with no significant changes.
- Moderate to Major Flooding is now expected for main stem rivers.

Burlington, VT | Presentation Created: 7/10/2023 5:03 PM

NATIONAL WEATHER SERVICE WFN

Today and Tonight: Areal/River Flooding Expected Additional Flash Flooding Likely

Day One Executive Summary

- Additional rounds of heavy rain are likely this evening through overnight tonight.
- Significant to potentially catastrophic widespread flash flooding threat is slowly diminishing and becoming more of an areal and river flooding threat.
- Creeks and river levels are already rising sharply and in flood stage in response to the heavy rain that has fallen so far. Several main stem rivers are now forecast to crest at moderate to major flood stage overnight tonight into tomorrow.
- Additional washed out roads are possible.

Burlington, VT | Presentation Created: 7/10/2023 6:03 PM

- **“Major flooding for area rivers”**
 - **Observed 3-5 inches with localized 7+ inches.**
 - **Numerous, significant Flash Flooding observed.**
 - **Significant River flooding expected with main stem rivers already in flood.**
 - **NWS Forecaster and VT SEOC** evacuated from Waterbury Office complex.

NATIONAL WEATHER SERVICE WFN

Rainfall Reports So Far as of 4 PM

Rainfall reports as of 4 PM Monday July 10

What has happened so far:

- Multiple rounds of moderate to heavy rainfall have occurred
- Widespread 2-5 inches of rain with locally 7 inches have already fallen
- Numerous reports of road washouts and closed roads across the region

Burlington, VT | Presentation Created: 7/10/2023 5:03 PM

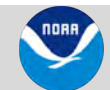
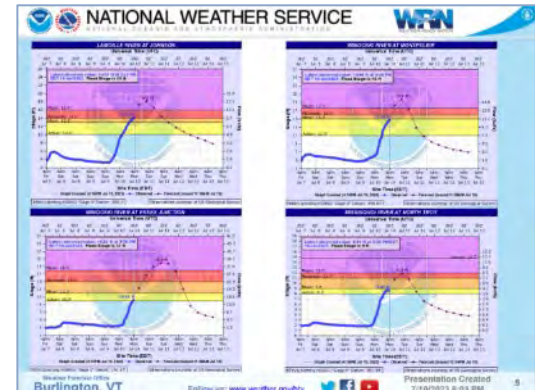
NATIONAL WEATHER SERVICE WFN

5-Day Significant River Flood Outlook

- Many rivers are already flooding or are expected to reach flood stage.
- Major flooding is forecast to occur in portions of the Mad River, Lamolle, and Winooski Rivers.
- Rivers should crest late this evening into tomorrow.

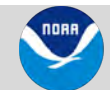
For additional river forecasts, visit [AMPS page](#) (Advanced Hydrologic Prediction Service)

Burlington, VT | Page 5 / 8 | Presentation Created: 7/10/2023 6:03 PM



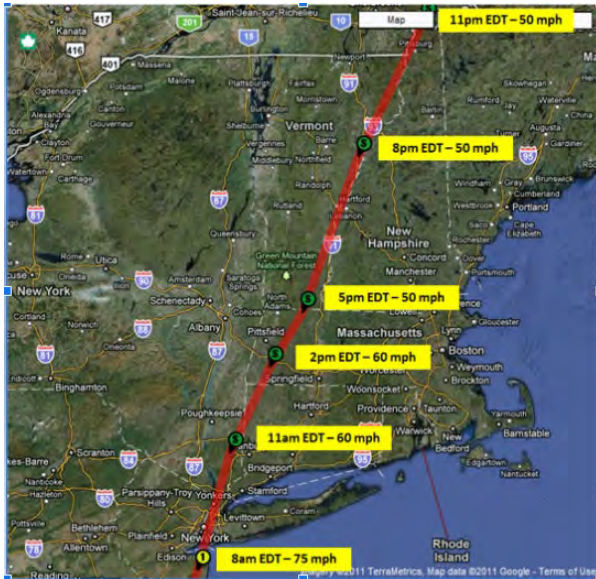


- Any Quick Questions?
- Next – July 2023 Flooding vs. Other Flooding events

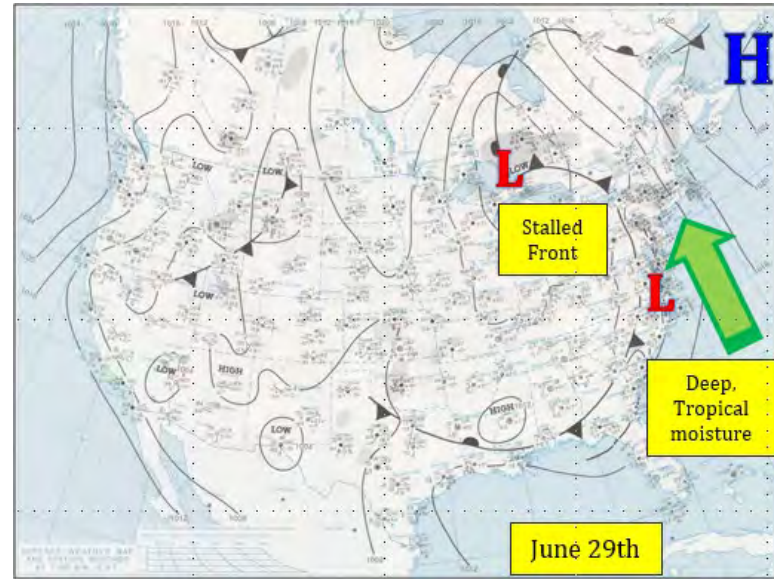




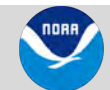
July 9-11, 2023 Rainfall/Flooding Comparisons



Irene - August 2011

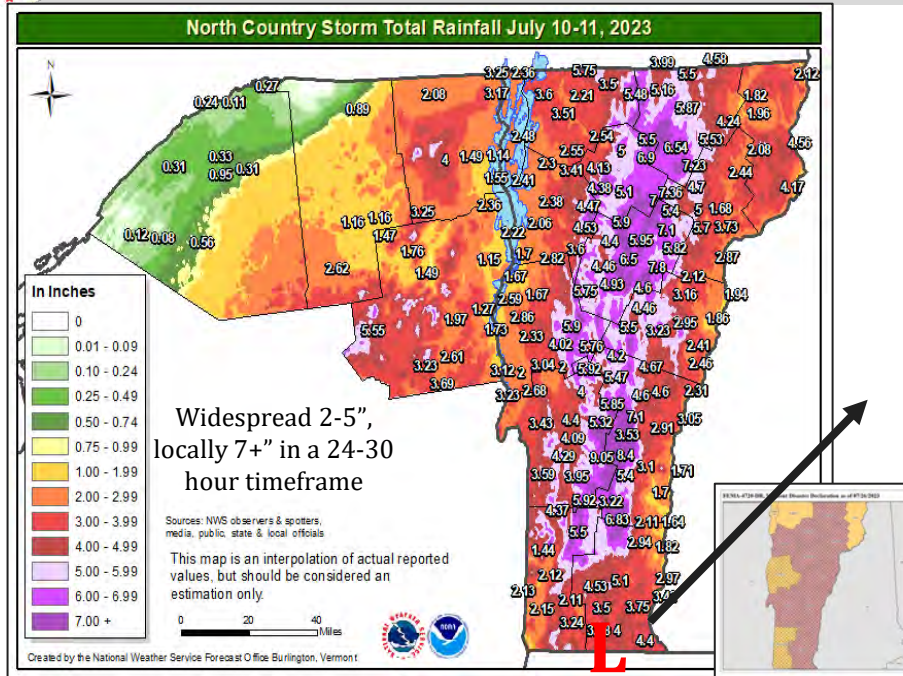


June 29-30, 1973

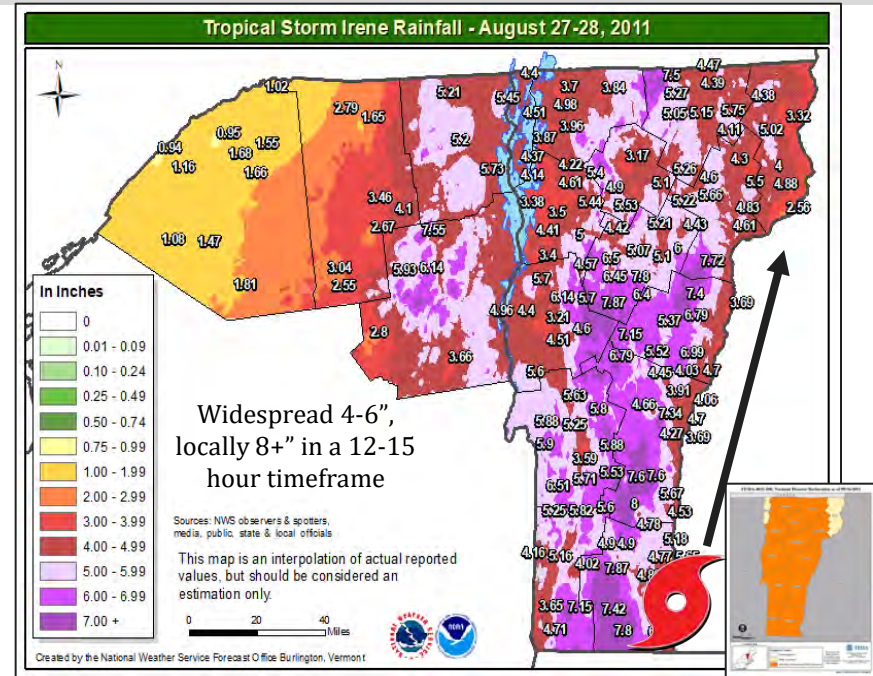




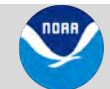
Storm Rainfall: July 2023 vs. Irene 2011



- Rainfall was centered across the Green Mountains from Massachusetts to Canadian border.
- Stalled frontal boundary as well as an unseasonable blocking pattern in the atmosphere. Similar to June 1973.

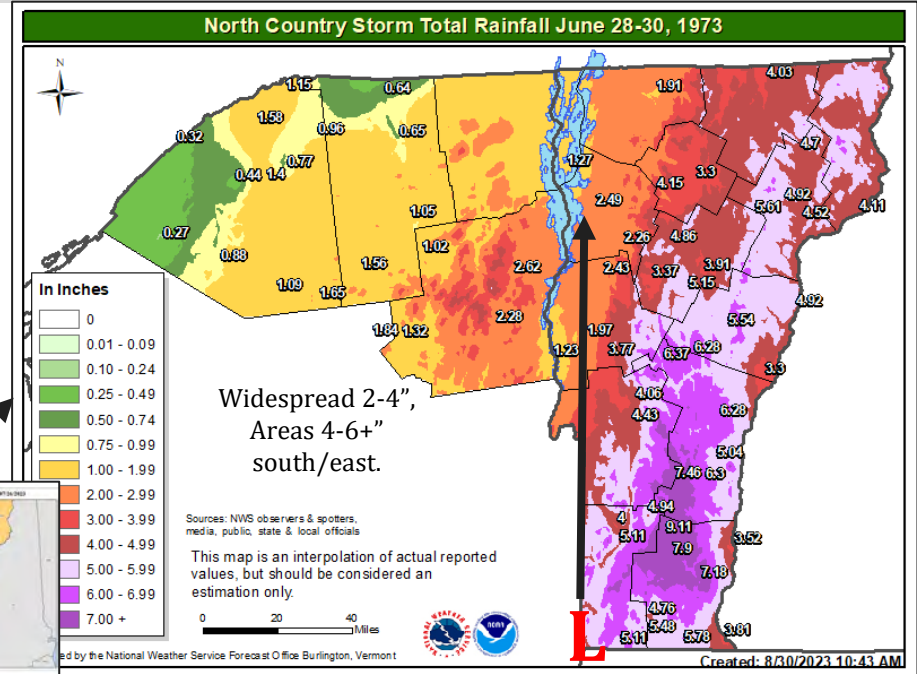
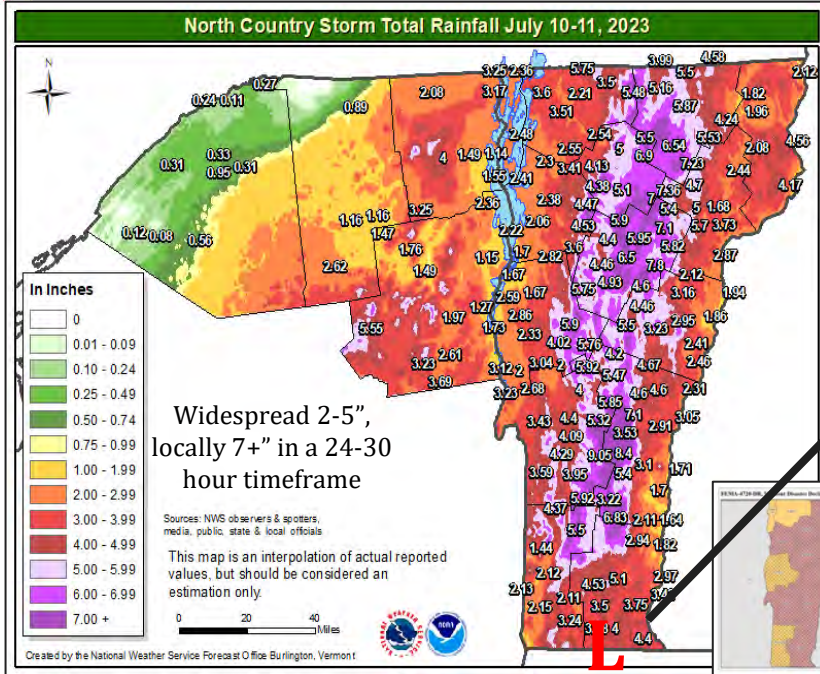


- Rainfall was more focused on the eastern slopes of Vermont's Greens with greatest rainfall totals in southern half of the state.
- Tropical system: Hurricane weakening to Tropical Storm.





Storm Rainfall: July 2023 vs. June 1973

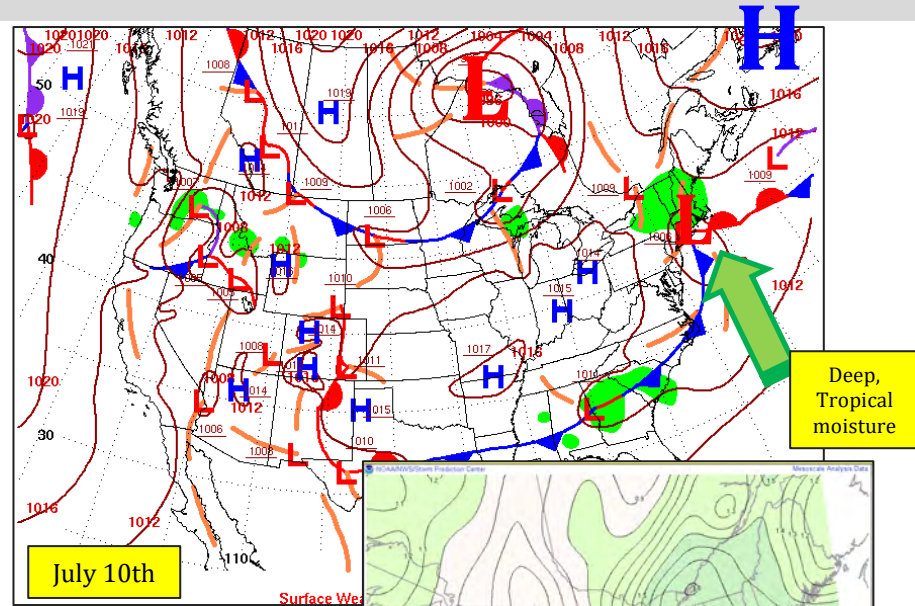
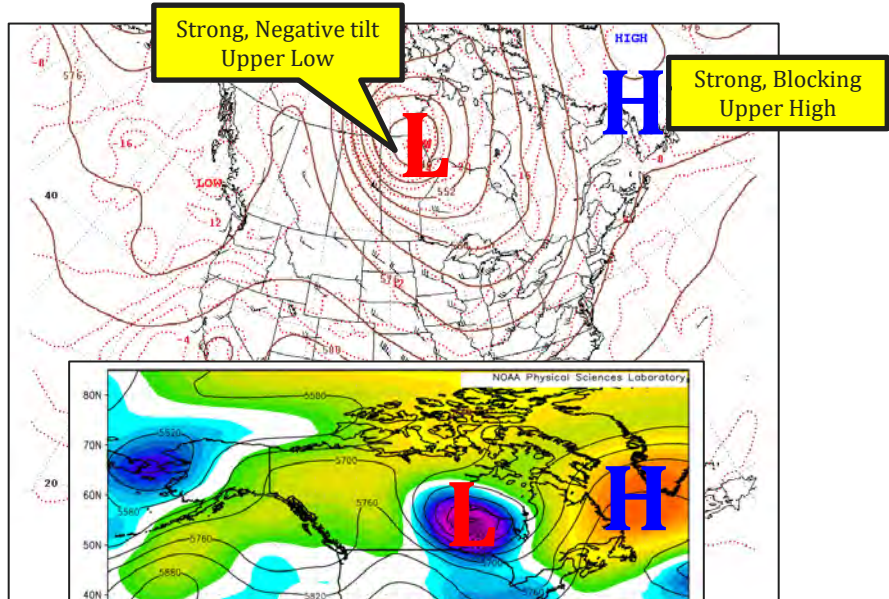


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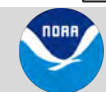
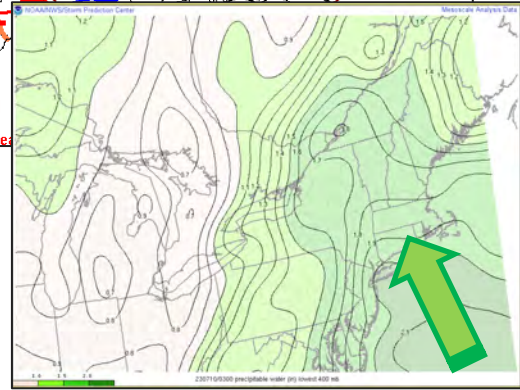
- Rainfall was more focused on the eastern slopes of Vermont's Greens with greatest rainfall totals in southern half of the state.



July 9-11, 2023



- **Upper/Lower Atmospheric Conditions**
 - **Unseasonably Strong Blocking Pattern, similar to Cool Season (Oct-Apr).**
 - Stalled movement, development of surface wave along the front.
 - **Deep Tropical Moisture**

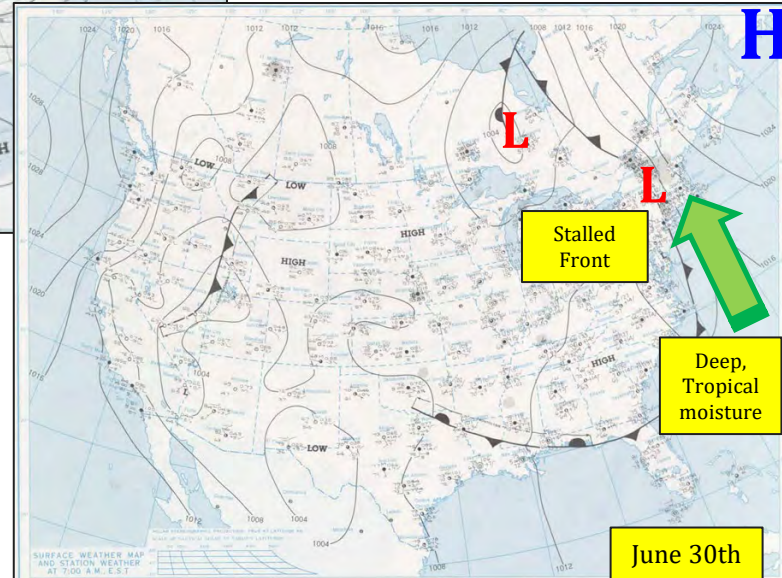
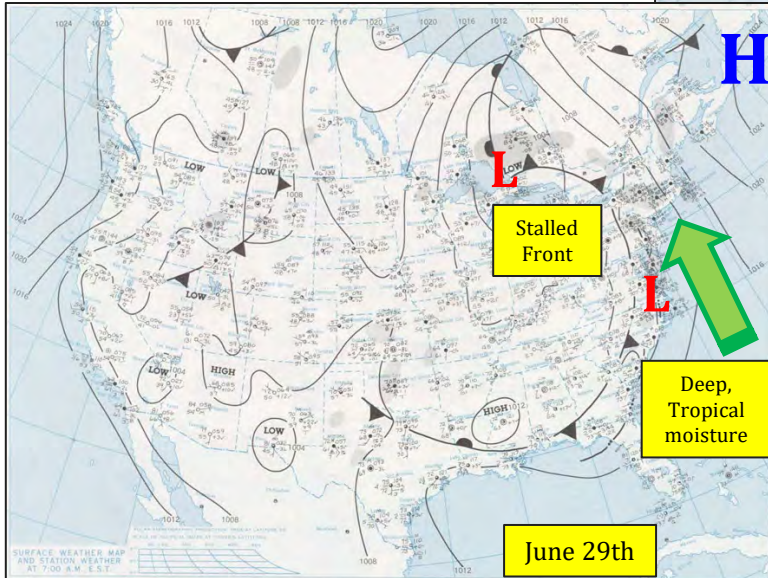
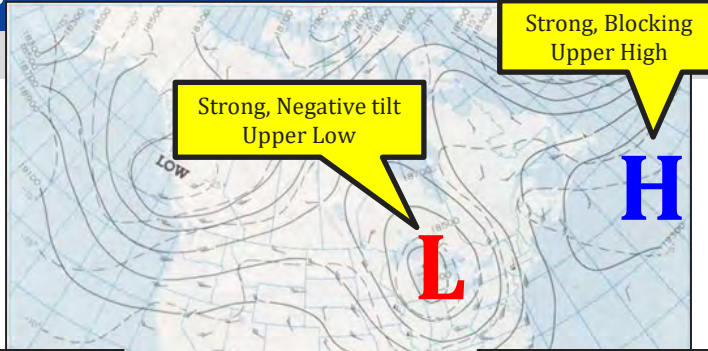




June 29-30, 1973

Nearly Identical Upper and Lower Atmospheric Conditions

- **Unseasonably Strong Blocking Pattern, similar to Cool Season (Oct-Apr).**
- Stalled movement, development of surface wave along the front.
- **Deep Tropical Moisture**

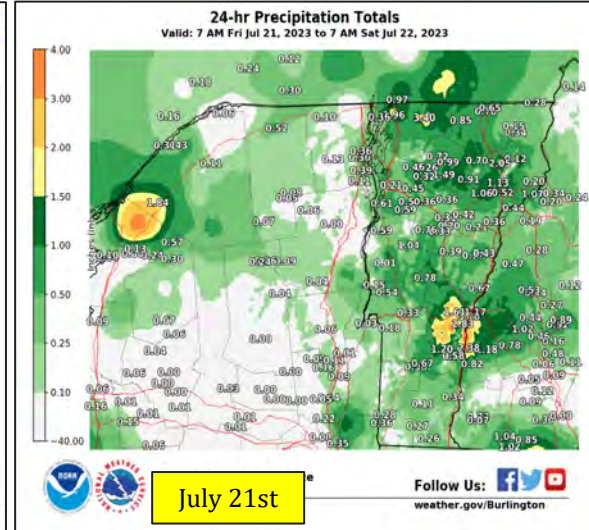
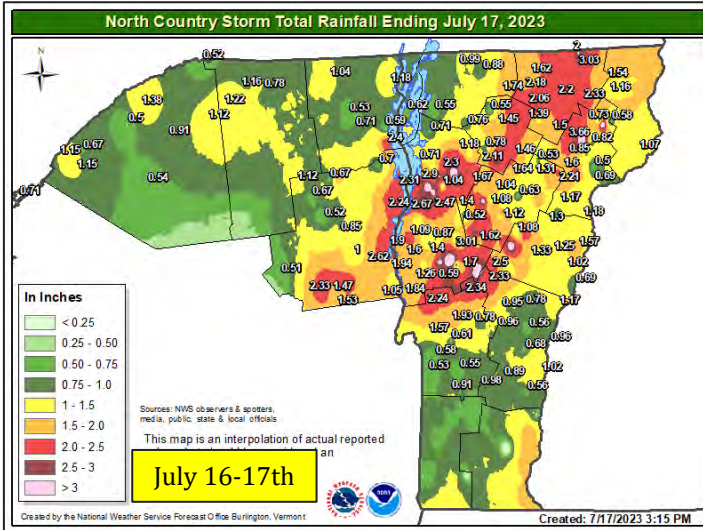
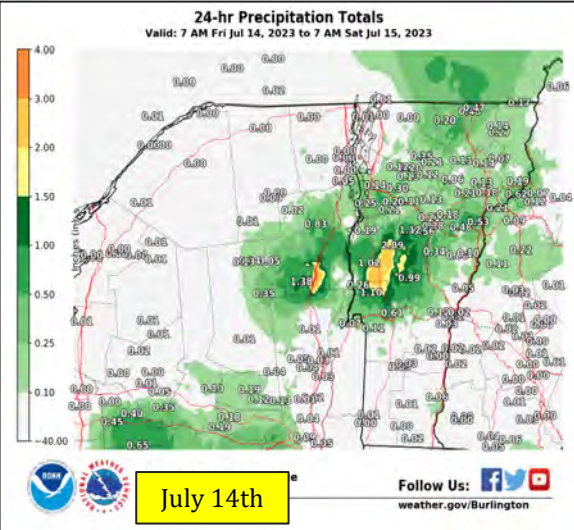


National Oceanic and Atmospheric Administration

U.S. Department of Commerce



Other Dates of Heavy Rainfall (with > 2 inches reported)



- Ripton - 3.42"
- Salisbury 3.02"
- Ripton - 2.81"
- E. Middlebury - 2.50"
- Lake Dunmore - 2.18"
- Middlebury - 1.80"
- Brandon - 1.76"
- Hancock - 1.41"



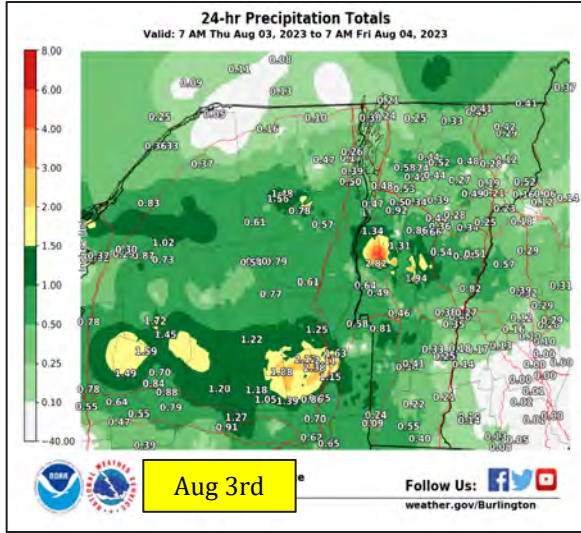
- Wheelock - 4.45"
- Ripton - 4.14"
- Burke Hollow - 3.89"
- Charlotte - 3.89"
- Hancock - 3.88"
- Richmond - 3.45"
- Hinesburg - 3.25"
- Williston - 3.15"
- Brookfield - 3.15"
- Danville - 3.07"
- Derby - 3.03"
- Warren - 3.01"
- Stowe - 2.97"
- Eden - 2.81"
- Albany - 2.56"
- Williamstown - 2.55"
- Braintree - 2.50"
- Morrisville - 2.41"

2-Day Totals

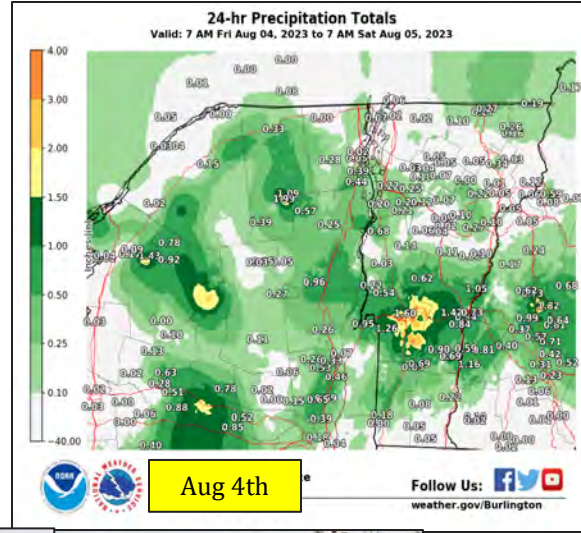
- Windsor - 3.79"
- Reading - 3.40"
- N Hartland - 3.10"
- Plymouth - 2.93"
- W Windsor - 2.72"
- Woodstock - 2.64"
- S Pomfret - 2.56"
- Cornish - 2.36"
- Sutton - 2.05"
- Brownsville - 1.97"
- Swanton - 1.96"
- Enosburg - 1.86"
- Braintree - 1.66"
- Woodstock - 1.61"
- Wheelock - 1.57"
- Craftsbury - 1.57"



Other Dates of Heavy Rainfall



Swift Water
Rescue in
Middlebury



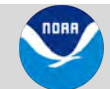
- Middlebury – 6.12"
- Middlebury – 5.65"
- Middlebury – 5.55"
- Middlebury – 4.29"
- Ripton – 3.11"
- E Middlebury – 2.98"
- Hancock – 2.88"
- Ferrisburg – 2.05"
- New Haven – 1.96"



Urban Flooding
in Rutland



- Rutland – 4.37"
- Mendon – 3.78"
- Rutland – 3.67"
- E Wallingford – 3.48"
- N Clarendon – 3.31"
- Rutland – 3.10"
- W Rutland - 2.44"
- W Bridgewater – 2.22"
- Killington – 2.13"
- Bridgewater – 2.06"





StormReady - <https://www.weather.gov/stormready/>



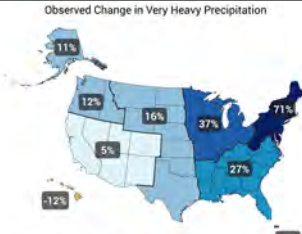
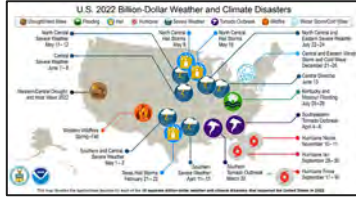
• **Extreme Weather Events have increased and will continue to increase. Are you Storm Ready?**

• Being part of a Weather-Ready Nation is about preparing for your community's increasing vulnerability to extreme weather and water events.

• The StormReady program uses a grassroots approach to help communities develop plans to handle all types of extreme weather.

• The program encourages communities to take a **new, proactive approach to improving local hazardous weather operations** with guidance on how to improve their hazardous weather operations.

• Application process has been streamlined considerably.



Since 1958: 55-70% Increase

SEVERE WEATHER PLAN

SCOPE

Portland Regional Medical Center (PRMC)

PURPOSE

The purpose of this plan is to clearly outline the different thresholds and recommended actions for different types of severe weather events. This is an incident-specific response plan used to supplement the emergency management procedures outlined in the PRMC Emergency Operations Plan (EOP) and other plans as indicated by the nature of the incident.

POLICY

1. Activation of the plan - This plan will be activated as needed in response to severe weather events.
2. The PRMC Emergency Operations Center (EOC) and the Incident Management Team (IMT) will be activated at this time.
 - a. Key Personnel:
 - i. DIT and Department Leaders
 - ii. Weather Watcher(s)
 - iii. Support Services staff
 - b. All responsibilities for implementation of the Severe Weather Plan will be carried out in the accordance with the PRMC EOP.

DEFINITIONS

Routine weather monitoring - Weather monitoring that occurs on a day-to-day basis.

Hazardous weather monitoring - Weather monitoring that occurs directly before, during, and directly after a severe weather event.

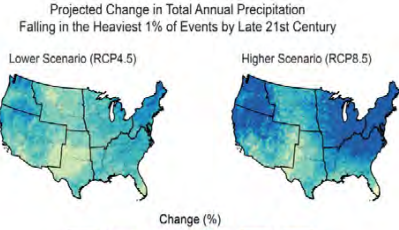
Severe/extreme weather event - Extreme weather or extreme climate events includes unexpected, unusual, severe, or unusual weather. This could include but is not limited to dense fog, flash flooding, extreme heat, high wind, lightning, thunderstorms, tornadoes, snow, ice, wind chill, and extreme cold.

Shelter in Place (SIP) - A procedure used to take immediate shelter in a current location or refuge area.

Watch - A watch is used when the risk of a hazardous weather or hydrologic event has increased significantly, but its occurrence, location or timing is still uncertain. It is intended to provide enough lead time to those who need to set their plans in motion can do so. A watch means that hazardous weather is possible. People should have a plan of action in case a storm threatens, and they should listen for later information and possible warnings especially when planning travel or outdoor activities.

Advisory - An advisory is issued when a hazardous weather or hydrologic event is occurring, imminent or likely. Advisories are for less serious conditions than warnings; that cause significant inconvenience and if caution is not exercised, could lead to situations that may threaten life or property.

Warning - A warning is issued when a hazardous weather or hydrologic event is occurring, imminent or likely. A warning means weather conditions pose a threat to life or property. People in the path of the storm need to take protective action.



Change (%)



30-40% increase in Heaviest 1% Rainfall Events*





Questions?

- NWS Burlington webpage – www.weather.gov/btv
- **If you need to reach a forecaster 24/7, then please use the following contacts.**
 - 802-658-0150 or 802-658-0207
 - nwsbtv.info@noaa.gov
- Scott Whittier – scott.whittier@noaa.gov

