Spring 2010 Floods and Beyond
Impacts of Increased Rainfall and Flooding

David R. Vallee
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http://weather.gov/nerfc

Providence Street – West Warwick, RI at 1030 am Wednesday 3/31/10
Outline

- A bit about the Northeast River Forecast Center
- What ingredients brought us to such a remarkable flood event in March 2010?
- Historical Perspective
- What does this all mean in light of climate change scenarios?
Major river basins include Genesee, Hudson, Mohawk, Housatonic, Connecticut, Merrimack, Blackstone, Pawtuxet, Kennebec, Penobscot and Saint John.

~180 forecast points

**Staffing profile:**
- HIC, SCH and DOH
- 4 Senior Hydrologists & 1 Senior HAS
- 3 Hydrologists & 2 HAS
- 1 ASA/Hydro Tech
Calibrate and implement a variety of hydrologic and hydraulic models to provide:

- River flow and stage forecasts at 180 locations
- Guidance on the rainfall needed to produce Flash Flooding
- Ensemble streamflow predictions
- Ice Jam and Dam Break support
- Water Supply forecasts
- Partner with NOAA Line Offices to address issues relating to Hazard Resiliency, Water Resource Services, Ecosystem Health and Management, and Climate Change

Moderate flooding - Connecticut River at Portland, CT.
Click on “Self Brief Page”

http://www.weather.gov/nerfc

NERFC Hydromet Self-briefing Page
So what brought us to the tipping point during the last week of March 2010?

- It was not caused by
  - One single Nor’easter or one Coastal Storm
  - Snowmelt
  - Improper water management
So what brought us to the tipping point?

- It was caused by:
  - The atmospheric river – “energized” by El Nino
  - Blocking high pressure over Greenland
  - A sequence of heavy rainfall events over 5 weeks
  - Record monthly rainfall totaling 12-18 inches
    - Axis of each event over Pawcatuck & Pawtuxet Valleys
  - Saturated ground
  - A “chuck-full” Scituate Reservoir
    - Designed for Water Supply not Flood Control!
  - Swollen streams and ponds running well above normal
  - The lack of nature’s grasses, flowers and trees
    - Pre-growing season – no Evapo-transpiration to help us out
Major to Record flooding across southeast New England

Northeast Flooding
2010–03–28 to 2010–04–05

Major Flood
Moderate Flood
Minor Flood
The Blackstone Response

Dodged a huge bullet – as heaviest rains stayed south of the basin
Considerable flooding on mainstem and many small streams
The Pawtuxet’s Record Response

Dramatic “urban response” in the lower basin followed by record reservoir flows from Scituate Reservoir
Pawcatuck Basin – similar responses

Pawcatuck River – Wood River Junction

Pawcatuck River – Westerly, RI
Historical Footnotes

- Extremely rare to set two record flood elevations in two weeks – as was done on the Pawtuxet
- Consider this fact:
  - The *storms* in March 2010 dumped over 16 inches of rain
  - The record Flood for the Blackstone in 1955 was the result of over 10 inches in **ONE DAY** with over 14 to 16 inches of rain in 1 week in Woonsocket northward through the head waters in Worcester.
- Fits pattern of more intense heavy rainfall events which have been impacting the Northeast since the mid 1990s.  
The Basin itself...many twists/turns and tremendous urbanization of the lower watershed post 1968 – which corresponds to the jump in flood frequencies
Pawtuxet River Flood Frequency

Monthly Flood Frequency and Mean Monthly Flow for the Pawtuxet River at Cranston, RI 1940 - 2007

- Flood stage = 9.0 feet
- New Flood of Record: 20.79 feet on March 31, 2010
- Previous Flood of record: 14.5 feet on June 7, 1982

Period of record: 1940 - 2007
Number of floods: 29

Number of Floods per Year by Flood Category for the Pawtuxet River at Cranston, RI 1940 - 2007

- Minor floods (9 - 10.99 feet) over period of record: 17
- Moderate floods (11.00 - 12.99 feet) over period of record: 8
- Major floods (13 feet or more) over period of record: 4

Post Mall and I-95 construction

Flood of record: 14.50 feet on June 7, 1982
Blackstone River Flood History

Monthly Flood Frequency and Mean Monthly Flow for the Blackstone River at Woonsocket, RI 1929-2005

Flood stage = 9.0 feet  Flood of record: 21.8 feet on Aug. 19, 1955

Period of record: 1929-2005
Number of floods: 30

Data provided by
USGS

Number of Floods per Year by Flood Category for the Blackstone River at Woonsocket, RI 1929-2005

Minor floods (9 - 11.99 feet) over period of record: 22
Moderate floods (12 - 15.99 feet) over period of record: 7
Major floods (16 feet or more) over period of record: 1

Post USACE Flood Control Product Construction

Flood of record: 21.8 feet on August 19, 1955
Rhode Island Temperature Trend

Annual Temperature
Providence, RI 1961-2010

\[ y = 0.0548x - 57.812 \]

Mean Temp = 51.0
Prediction for the year 2020:
Annual Temperature = 52.9

Courtesy of Ryan Vallee
Class of 2015 NCMC
Rhode Island Precipitation Trend

Annual Precipitation
Providence, RI 1961-2010

\[ y = 0.1237x - 199.47 \]
Mean = 46.23
Prediction for the year 2020:
Annual Precipitation = 50.40
Rhode Island Seasonal Snowfall Trend

Seasonal Snowfall
Providence, RI 1961-2010

\[ y = -0.152x + 341.67 \]

Mean = 39.97
Prediction for the year 2020:
Snowfall = 34.63

Courtesy of Ryan Vallee
Class of 2015 NCMC
Climate Change Scenarios:
Shorter snow season – less days with snow on the ground
Climate Change Scenarios:
Increase in 1 inch and 2 inch rainfall events

1 inch events (1947-2007)

2 inch events (1947-2007)

Spierre et al., 2008
There has been a shift in Return Frequency
Most significant in the 25 to 100 yr recurrence interval.

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<td>Event in years</td>
<td>Inches in 24 hours</td>
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<tr>
<td>2</td>
<td>3.25</td>
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<tr>
<td>100</td>
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<td>8.70</td>
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Physical implications:

- Impacts on the floodplain, land use, infrastructure, dam spillway requirements, drainage requirements, non-point source runoff, bridge clearances, “hardening” of critical facilities in the floodplain, property values etc...
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