

# August and September 2011 Rainfall and Flooding in the Lehigh Valley

Travis Bartholomew, EIT

Geoff Reese, PE

September 29, 2011

# Return Periods

- What is a return period?
- What is a recurrence interval?
- How are they related?
- Important return periods
  - 2-year: “Bankfull” conditions
  - 100-year: usually largest flood event controlled

# Rainfall Events

- 4 major rainfall events in the last 2 months
  - August 13-14
  - August 27-28 (Hurricane Irene)
  - September 5-8 (Hurricane Lee)
  - September 23
- Hurricanes caused both the Lehigh and Delaware River to crest flood stage twice within two weeks
  - Flood stage defined as the point at which “overflow of the natural banks of a stream begins to cause damage in the reach in which the elevation is measured”

# Rainfall Statistics

- Wettest August on record at Allentown – 13.47” of rain (previous record was 12.10” in 1955)
- Wettest month on record at Allentown (previous record was 13.16” in October 2005)
- Wettest meteorological summer (June-August) on record at Allentown – 22.17” (previous record was 22.04” in 1928)

# More Rainfall Statistics

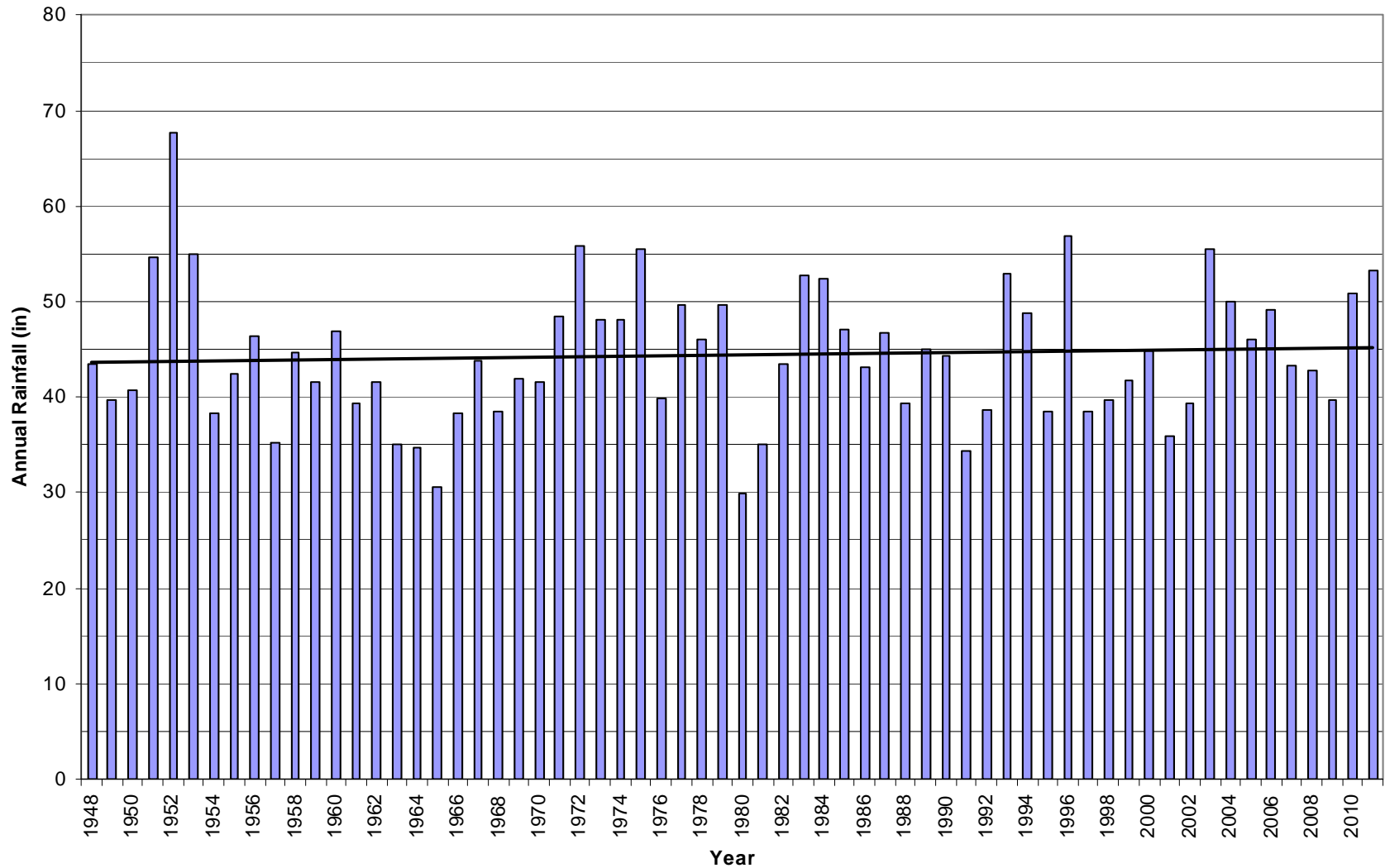
Month	Rainfall	Avg.
Jan	2.67	3.50
Feb	3.53	2.75
Mar	6.43	3.56
Apr	5.98	3.49
May	4.37	4.47
Jun	4.76	3.99
Jul	3.94	4.27
Aug	13.47	3.69
Sep*	8.01	3.07
Total	<b>53.16</b>	32.79

\*Through 9/21/11

Avg. Annual Rainfall @ Allentown:

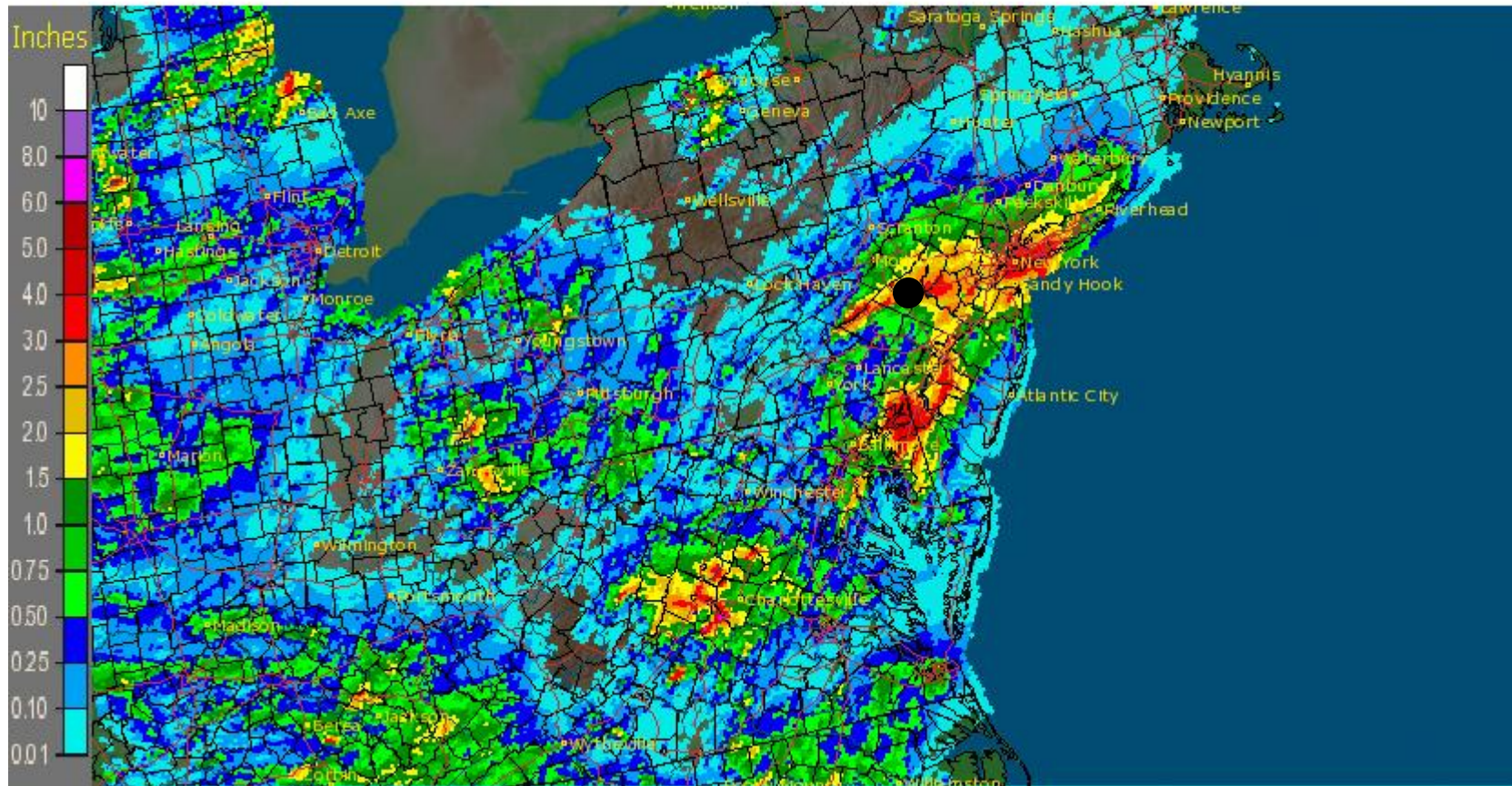
**45.17**

# Updated Annual Rainfall

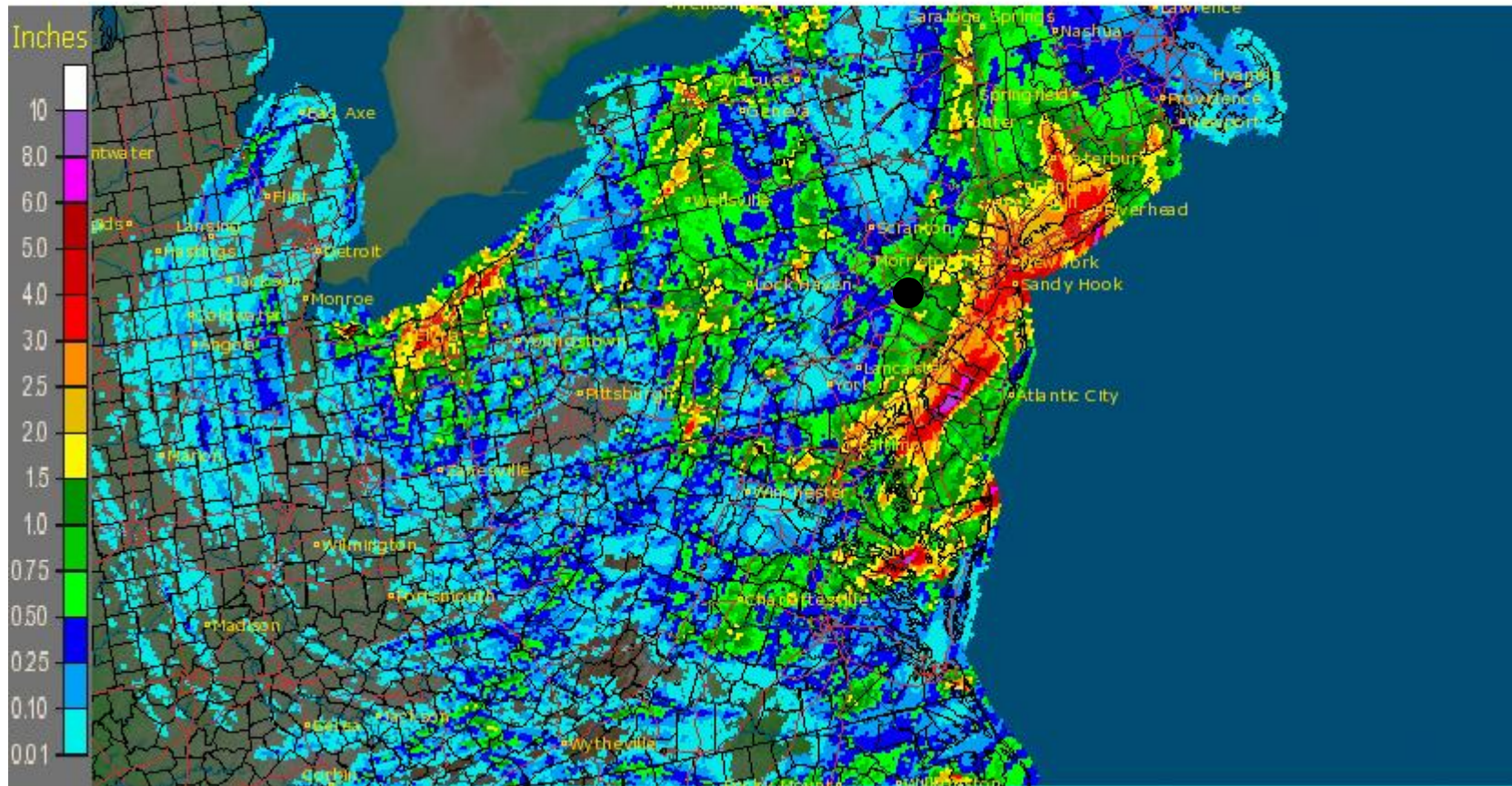


\*2011 rainfall through 9/21/11

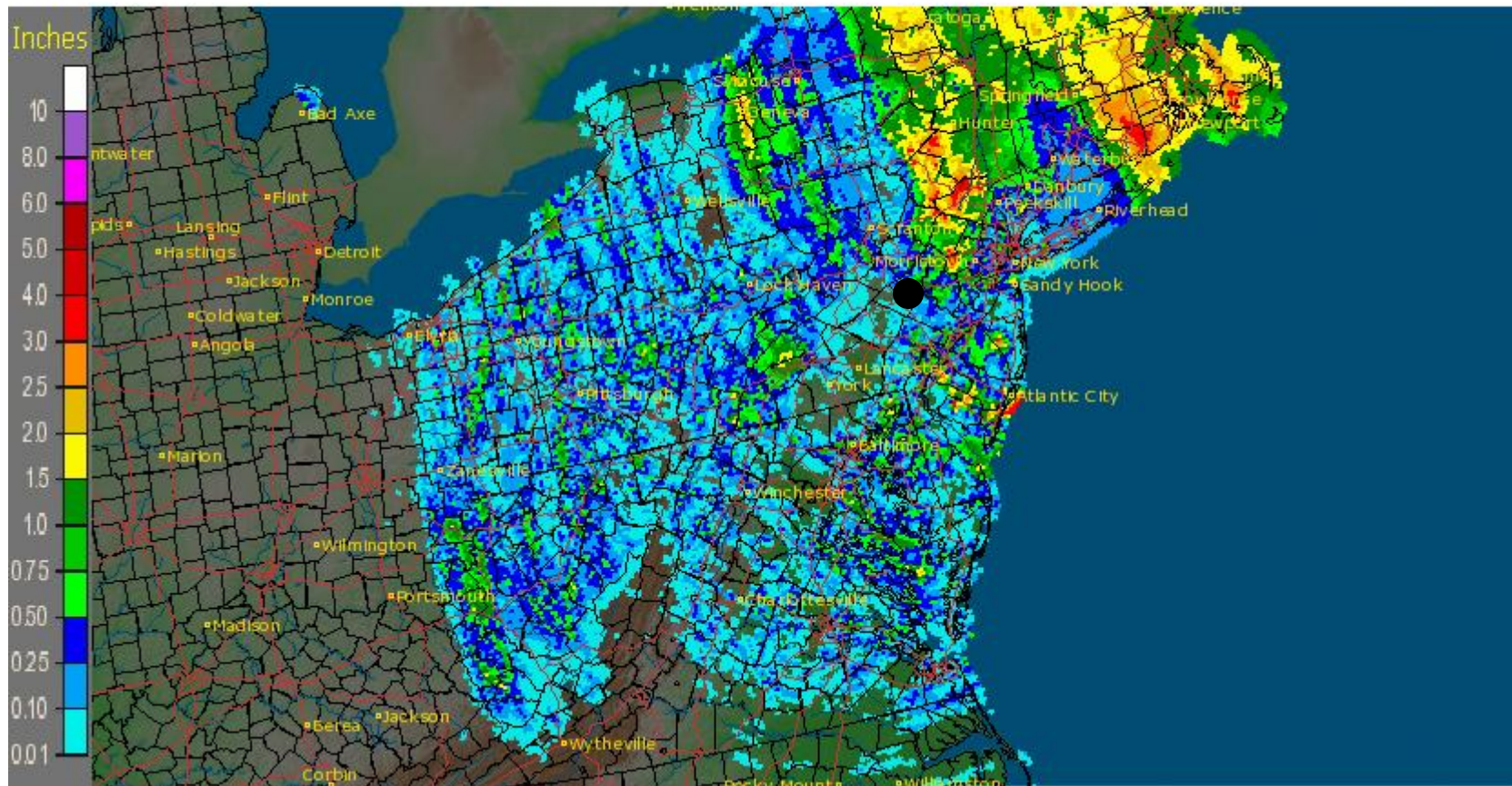
Middle Atlantic RFC State College, PA: 8/14/2011 1-Day Observed Precipitation  
Valid at 8/14/2011 1200 UTC- Created 8/16/11 23:30 UTC



Middle Atlantic RFC State College, PA: 8/15/2011 1-Day Observed Precipitation  
Valid at 8/15/2011 1200 UTC- Created 8/17/11 23:30 UTC



Middle Atlantic RFC State College, PA: 8/16/2011 1-Day Observed Precipitation  
Valid at 8/16/2011 1200 UTC- Created 8/18/11 23:30 UTC

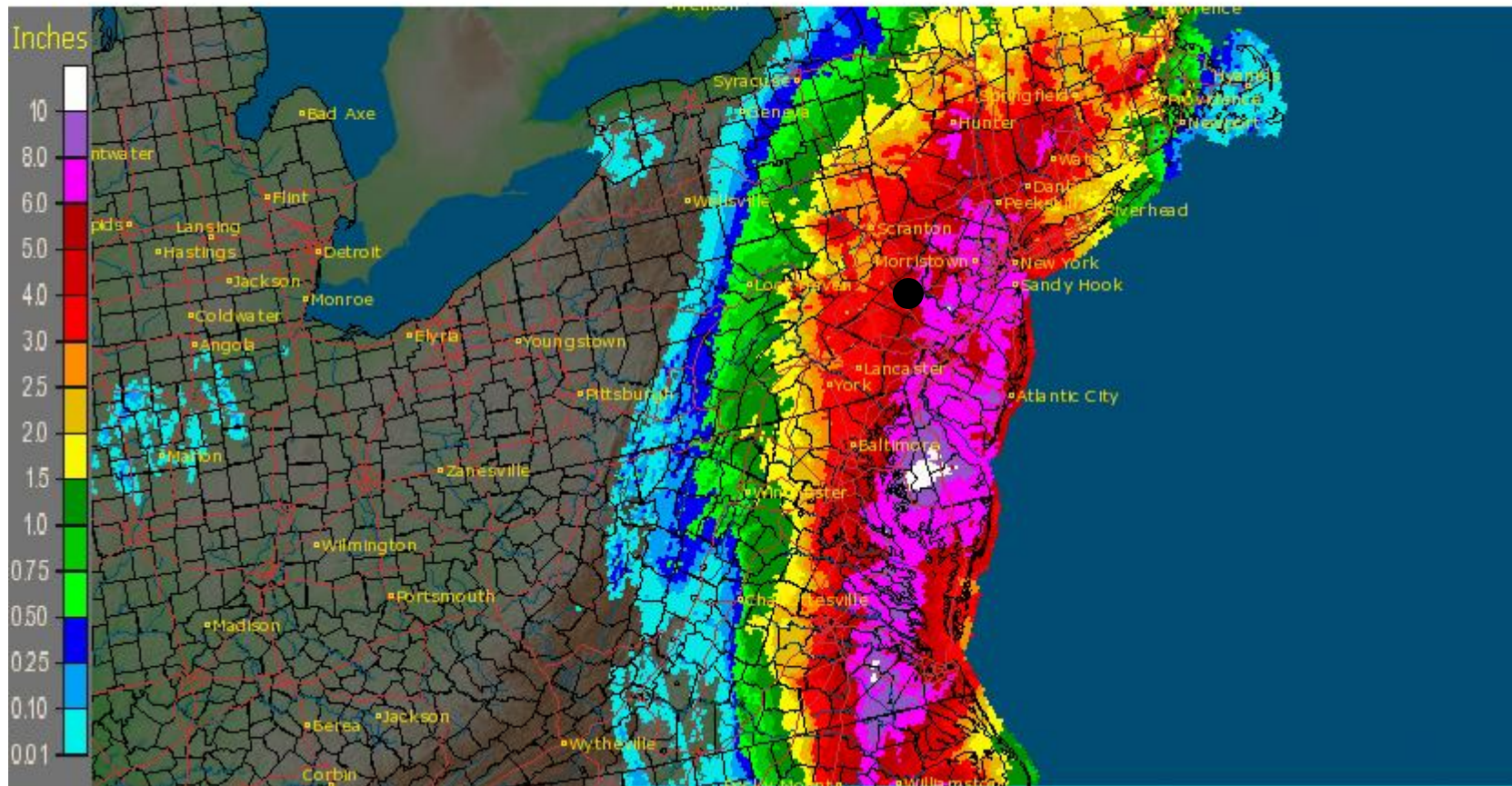


# August 13-14 Storm

- Allentown
  - 3.57” in 24 hours (2-year storm)
  - 4.13” in 48 hours (5-year storm)
- Mt. Pocono
  - 1.49” in 24 hours (<1-year storm)
- Binghamton
  - 0.34” in 24-hours (<1-year storm)
- Newark
  - 6.40” in 24 hours (25-year storm)



Middle Atlantic RFC State College, PA: 8/28/2011 1-Day Observed Precipitation  
Valid at 8/28/2011 1200 UTC- Created 8/30/11 23:30 UTC



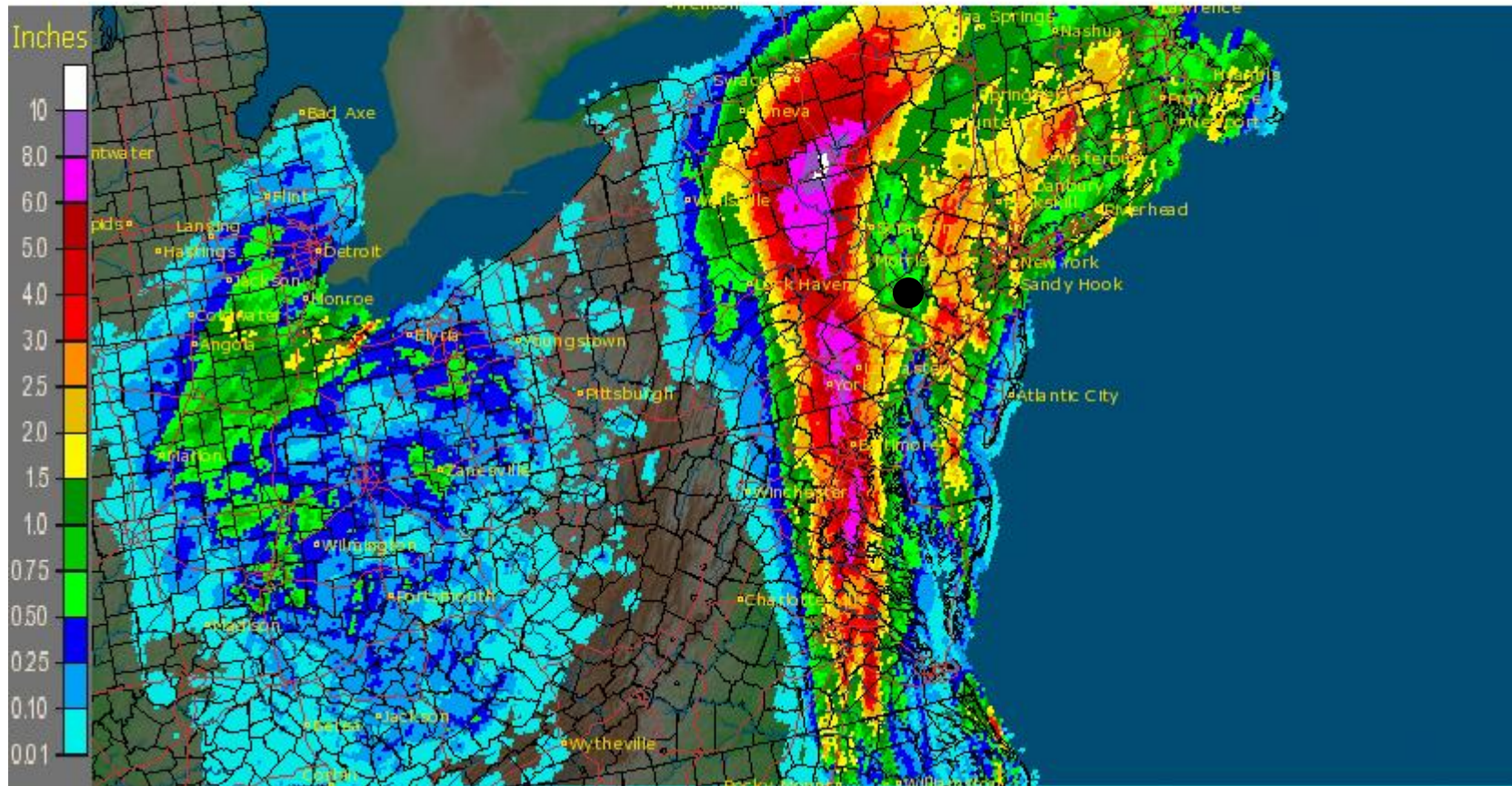
# Hurricane Irene

- Allentown
  - 5.00” in 24 hours (10-year storm)
- Mt. Pocono
  - 5.17” in 24 hours (10-year storm)
- Binghamton
  - 2.71” in 24 hours (2-year storm)
- Newark
  - 8.42” in 24 hours (100-year storm)
- 0.5-1.0” storm 2 days prior helped saturate the soil





Middle Atlantic RFC State College, PA: 9/8/2011 1-Day Observed Precipitation  
Valid at 9/8/2011 1200 UTC- Created 9/10/11 23:30 UTC



# Hurricane Lee

- Allentown
  - 2.89” in 24 hours (2-year storm)
  - 4.34” in 48 hours (5-year storm)
  - 5.88” in 72 hours (10-year storm)
  - 7.00” in 96 hours (25-year storm)
- Mt. Pocono
  - 2.16” in 24 hours (<1-year storm)
  - 4.31” in 96 hours (2-year storm)

# Hurricane Lee (continued)

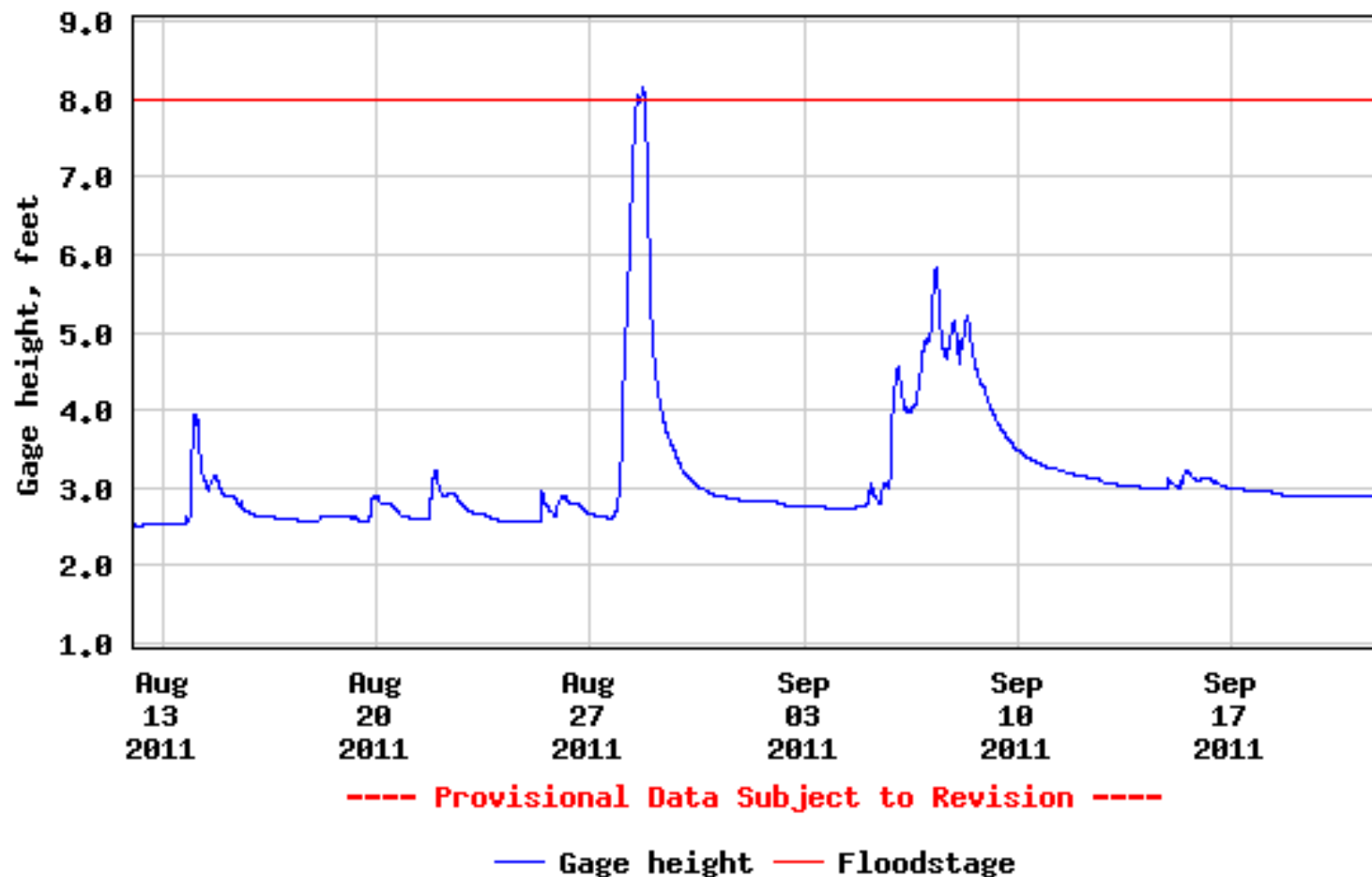
- Binghamton
  - 7.49” over 24 hours (100-year storm)
  - 9.83” over 96 hours (100-year storm)
  - Note: NY NOAA data has not been updated since 1961
- Newark
  - 3.18” over 24 hours (2-year storm)
  - 5.03” over 72 hours (5-year storm)

# Flooding From Irene and Lee

- Irene produced a short, intense burst of rainfall
  - Local streams effected more by Irene than Lee
  - Little Lehigh Creek crested flood stage at the 10<sup>th</sup> St bridge
- Lee produced a larger amount of total rainfall, but was spread over several days
  - Rivers affected more by Lee than Irene

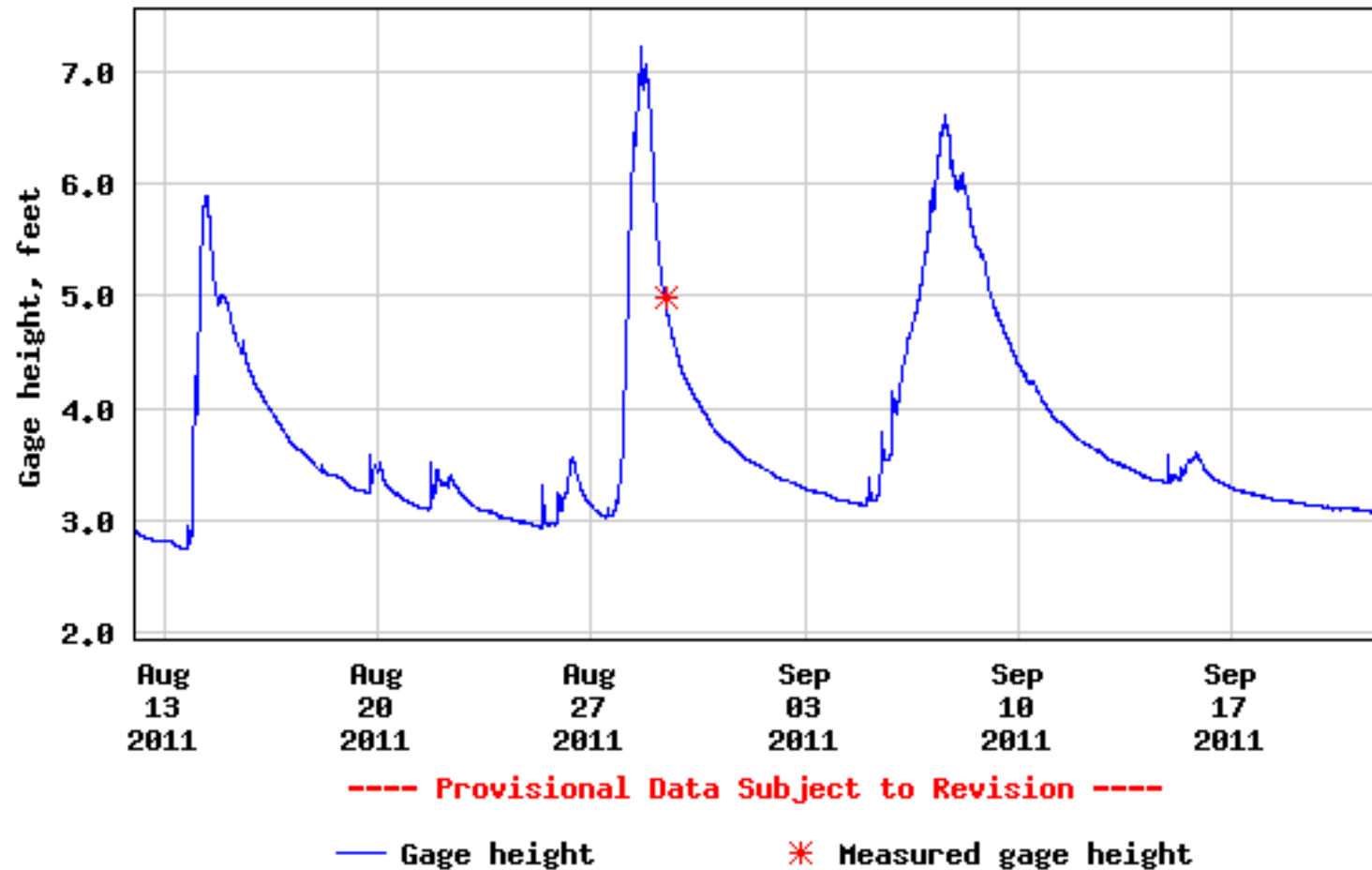


### USGS 01451650 Little Lehigh Creek at Tenth St. Br. at Allentown



Highest Recorded Stage (Oct. 2005) = 11.05 feet

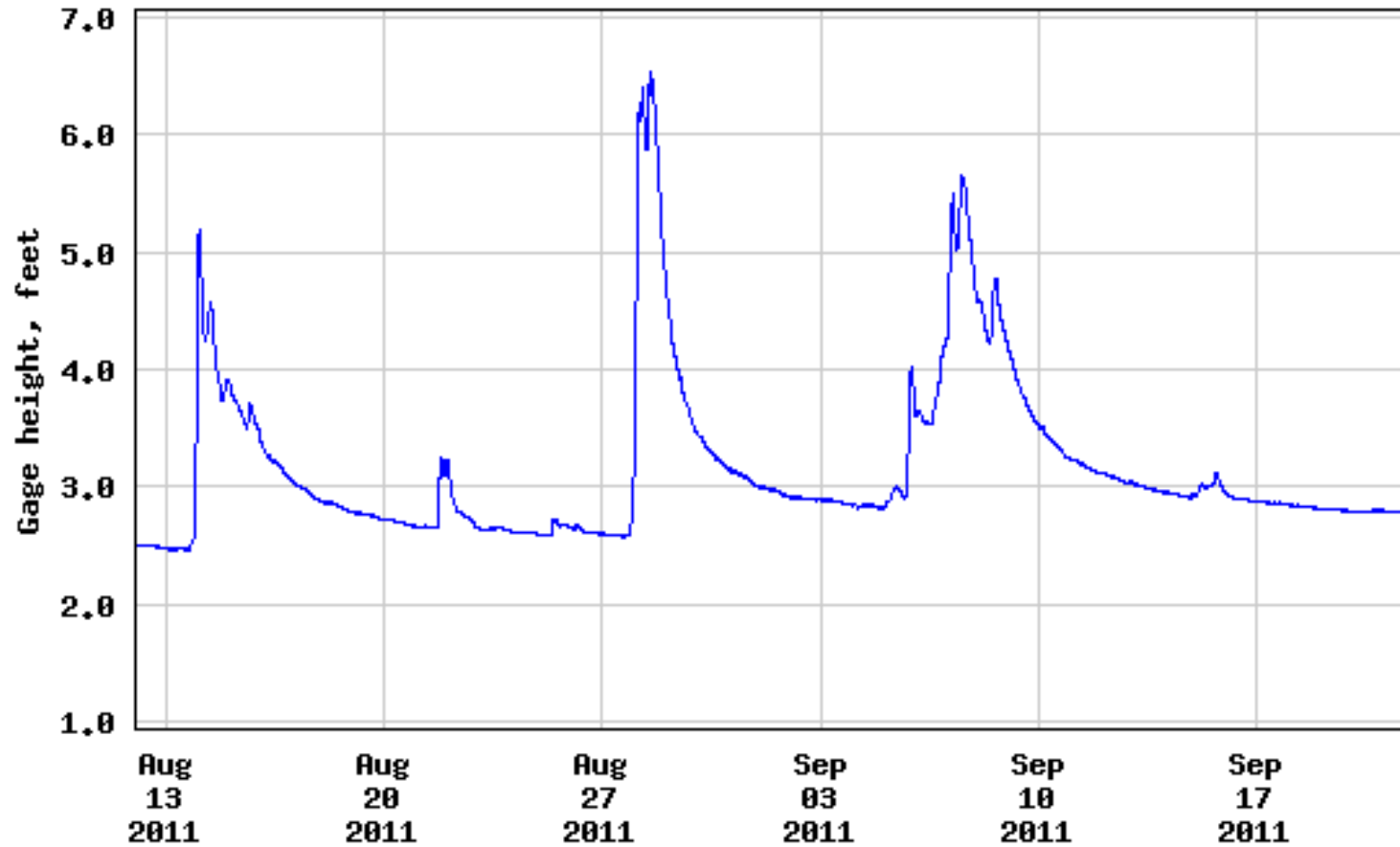
### USGS 01452000 Jordan Creek at Allentown, PA



Highest Recorded Stage (June 1972) = 11.61 feet



### USGS 01452500 Monocacy Creek at Bethlehem, PA

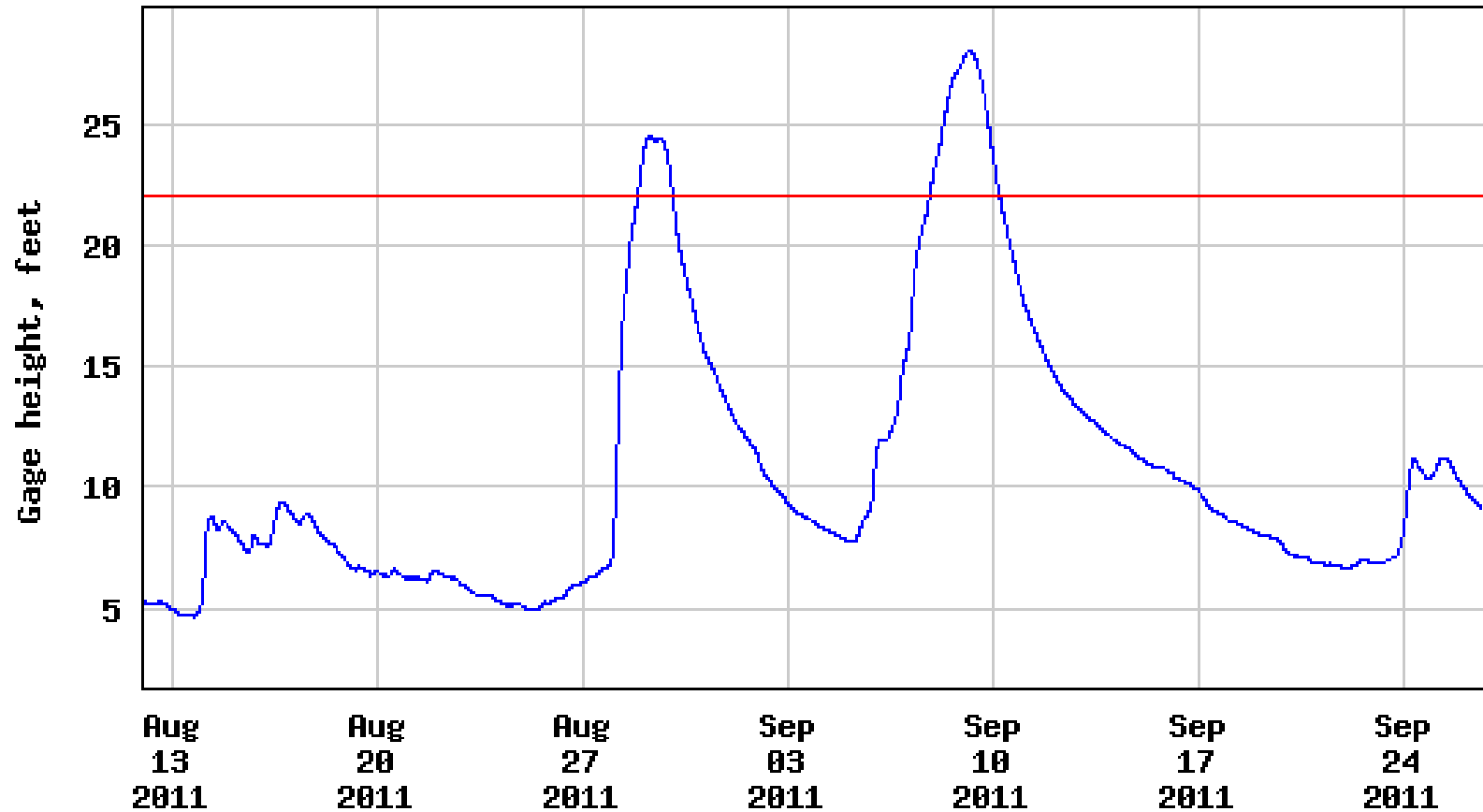


----- Provisional Data Subject to Revision -----

Highest Recorded Stage (September 2004) = 9.85 feet



## USGS 01457500 Delaware River at Riegelsville NJ



----- Provisional Data Subject to Revision -----

— Gage height

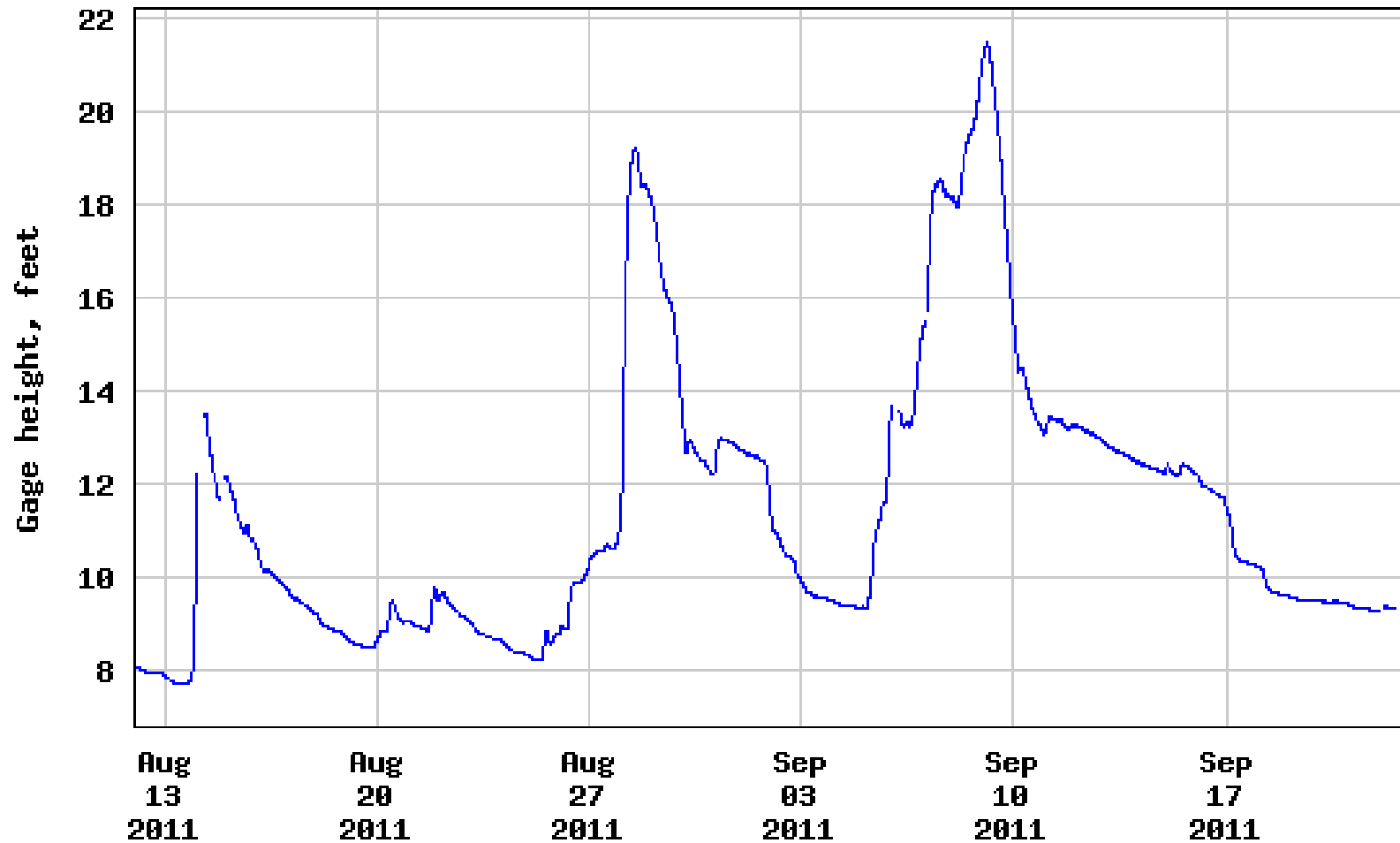
— NMS Flood Stage

# Delaware River Historical Floods @ Riegelsville

Rank	Date	Stage
1	8/19/1955	38.85
2	10/10/1903	35.90
3	4/4/2005	34.07
4	6/29/2006	33.62
5	3/19/1936	32.45
6	9/19/2004	30.95
7	1/20/1996	28.72
8	<b>9/9/2011</b>	<b>28.06</b>
9	5/24/1942	27.50
10	4/1/1940	26.47
11	12/12/1952	25.40
12	3/16/1986	25.16
13	8/25/1933	25.00
14	<b>8/29/2011</b>	<b>24.56</b>
15	5/30/1984	24.46
16	6/30/1973	24.36
17	10/1/1924	24.20
18	4/17/1983	24.17
19	4/1/1951	24.03
	4/17/2007	21.56
	3/10/2008	20.90
	12/13/2008	18.65
	3/15/2010	16.15



### USGS 01454700 Lehigh River at Glendon, PA



----- Provisional Data Subject to Revision -----

Flood Stage is approx. 19 feet

# Lehigh River Historical Floods @ Glendon

Rank	Date	Stage
1	6/28/2006	27.93
2	4/3/2005	27.86
3	9/19/2004	26.60
4	6/23/1972	24.86
5	1/25/1979	22.44
6	<b>9/8/2011</b>	<b>21.45</b>
7	4/16/1983	21.34
8	9/9/1987	20.82
9	1/20/1996	20.50
10	6/29/1973	19.79
11	4/3/1970	19.68
12	1/27/1976	19.29
13	7/29/1969	19.24
14	<b>8/28/2011</b>	<b>19.20</b>
15	9/27/1985	19.10
	3/5/2008	17.69
	12/12/2008	17.12
	4/16/2007	15.22
	1/26/2010	14.12

# NY Reservoir Operation

- DRBC changed Spill Mitigation program for the reservoirs in the upper Delaware River watershed after 2006 floods
- Between 15-20% of the reservoirs' total storage volume would have been open for the major events
- DRBC noted that flooding would not be prevented, but may be lessened in areas immediately downstream of reservoirs
  - No data yet as to whether this was effective