

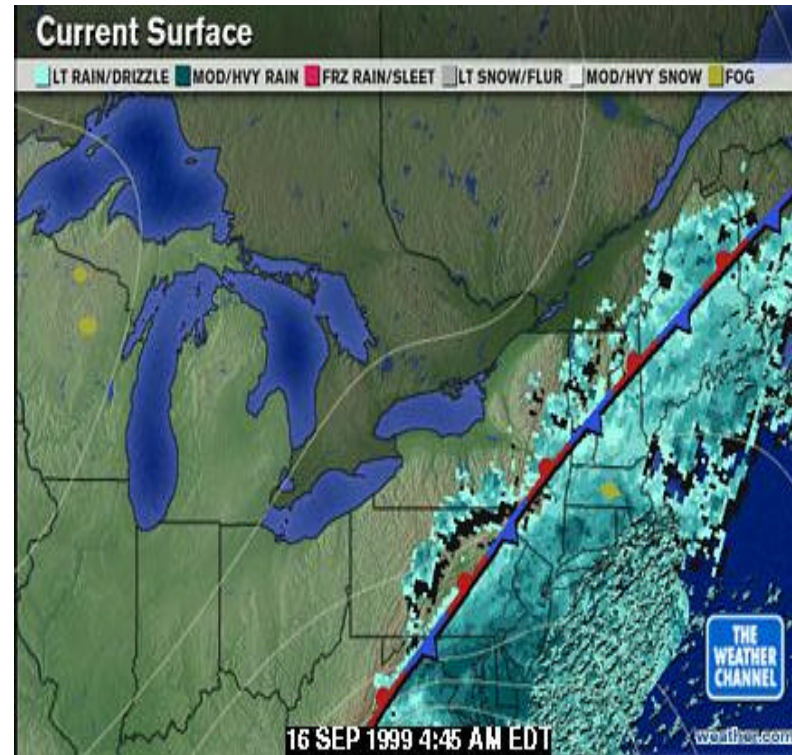
SUMMARY OF HURRICANE FLOYD IN THE DELAWARE RIVER BASIN SEPTEMBER 1999



Rainfall from Hurricane Floyd began impacting the Delaware River Basin during the early morning of Thursday, September 16, 1999. This Weather Channel map shows the track of Floyd.

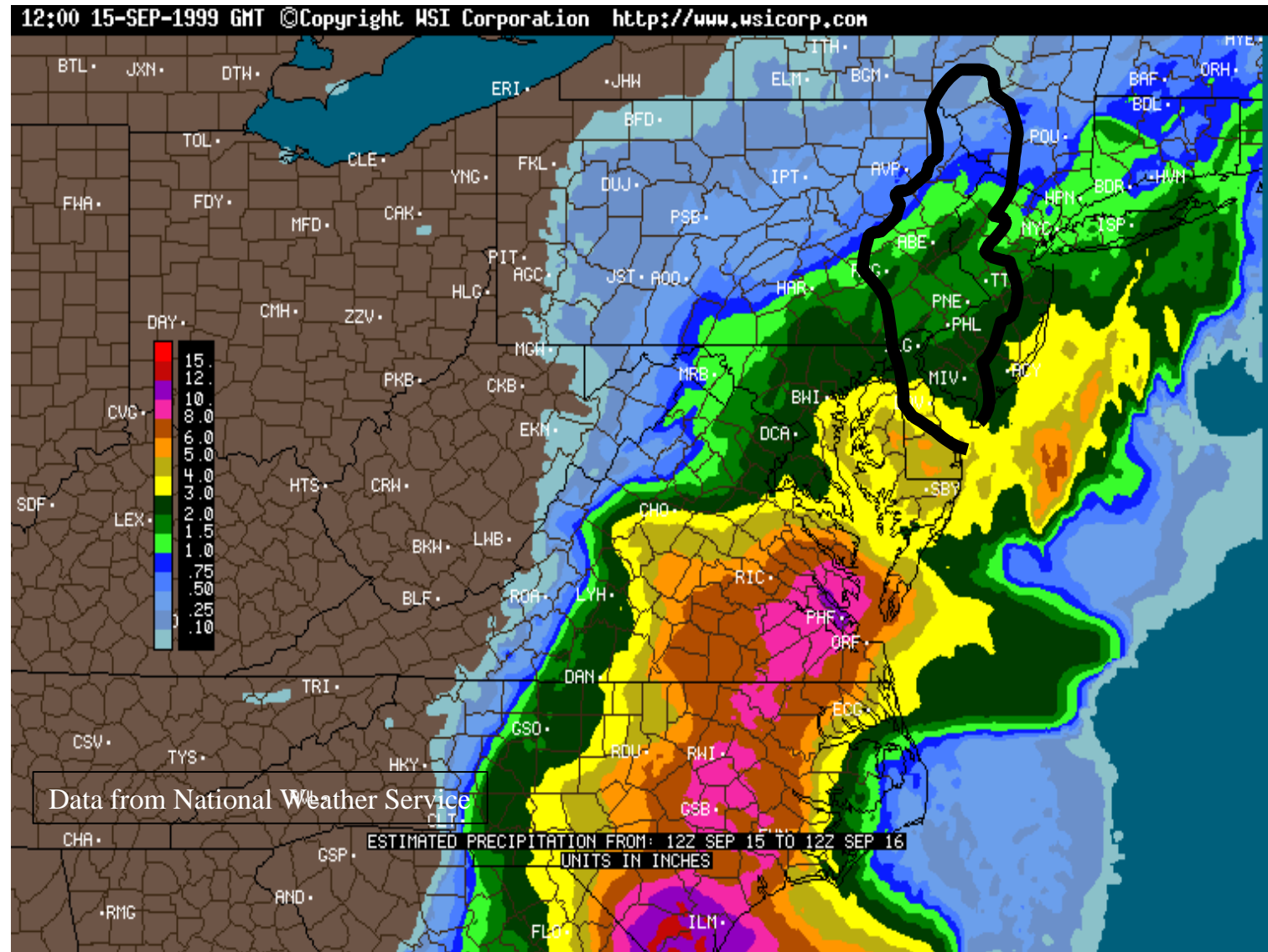


The timing of Floyd's move up the eastern seaboard coincided with the arrival of a cold front in the mid-Atlantic states and triggered heavy rainfall across the Delaware River Basin. The heaviest rain occurred in the southern half of the basin, where 6-to-10 inches of rain fell over an 18-hour period.

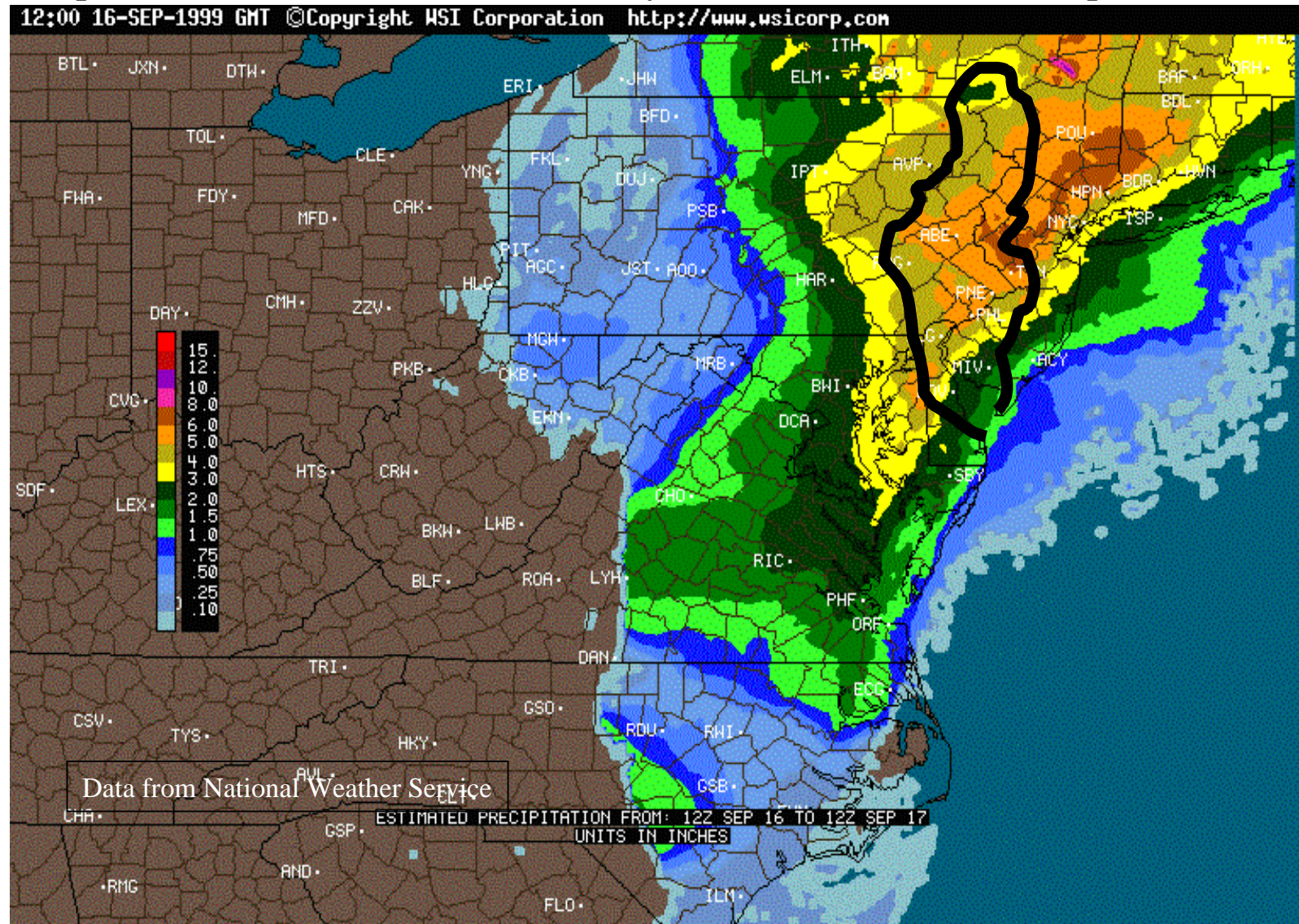


Maps from theWeather Channel

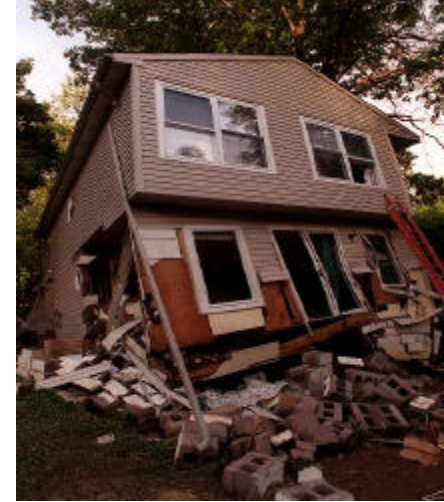
The map below, supplied by Intellicast, shows precipitation estimates through 7 a.m. on Thursday, September 16.



This Intellicast supplied map shows subsequent precipitation through 7 a.m. on September 17. Total rainfall from Floyd is the sum of the two maps.



While the main stem of the Delaware River experienced only minor flooding, extensive flood damage occurred along tributaries in the lower half of the Delaware Basin. Damage totals are expected to be in the hundreds of millions of dollars. Federal disaster assistance was approved for much of the flood-damaged area.



House in Langhorne, Pa. lifted off foundation
Photo by M. Vicar (Bucks County Courier Times)

In addition to stream-side flooding, overloaded culverts caused serious street flooding. Several deaths resulted from drivers entering flood waters which floated their cars.

The tail-end of Floyd produced a burst of 2 to 3 inches of rain in about 3 hours. This caused flash flooding that coincided with late-day rush hour traffic and produced dangerous travel conditions.

MAJOR REASONS FOR THE FLOOD DAMAGE

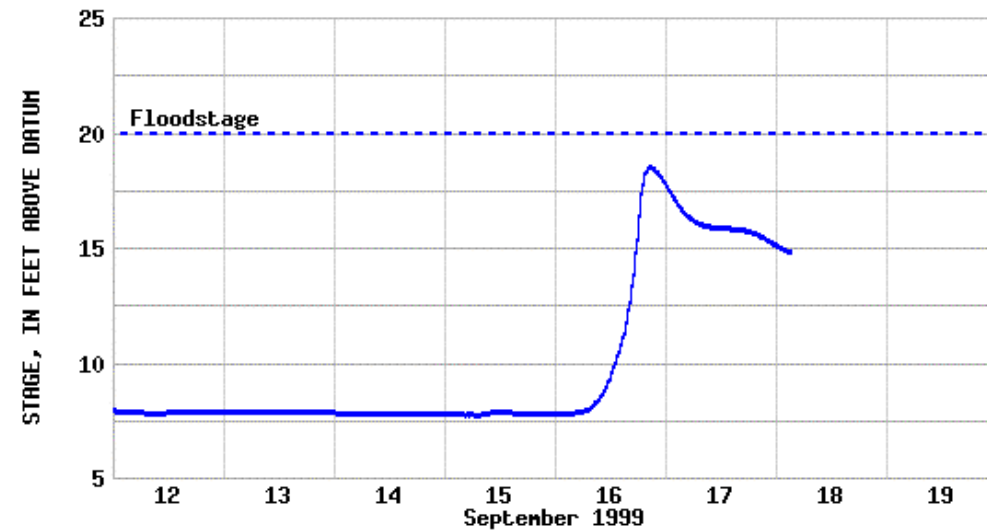
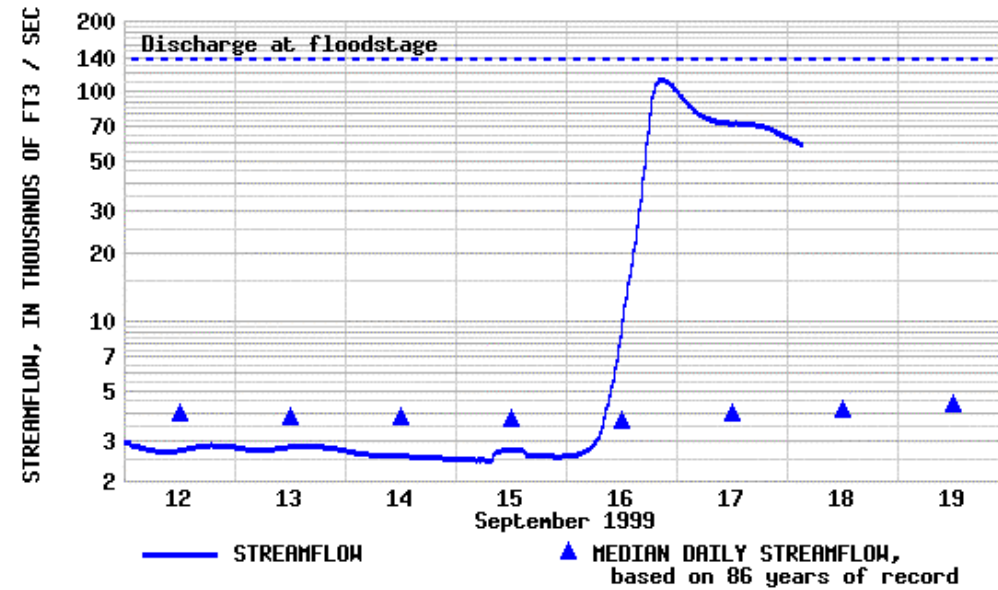
Why did flood damage occur when there were four days of warning about potential flooding from Hurricane Floyd?

- 1) People continue to live, travel, and do business in flood plains.
- 2) Despite stormwater retention basin requirements, land use change prior to these controls is a major flood producing factor in many areas. Major flood control structures reduce flood damage, but only protect some areas.
- 3) Many culverts and bridges are not sized to convey 8 inches of rainfall in 18 hours. In this case, flood damage may occur far from a flooded stream and roadways may themselves act as flooded streams. Most drivers underestimate the ability of water to float a car.
- 4) Flood waters back up sewer systems and also contaminate water supplies - especially wells which are not equipped with treatment systems.

The following is a summary of streamflow and rainfall data for Floyd.

The **Delaware River** at Trenton experienced one of its fastest increases in stage, rising 11 feet in about 8 hours. Flood waters were about a foot and a half deep along River Road in Bucks County. Some rainfall totals along the main stem Delaware were as follows:

| | |
|--------------|------------|
| Trenton | 7.5 inches |
| Belvidere | 8.9 inches |
| Montague | 7.2 inches |
| Riegelsville | 8.5 inches |
| New Hope | 9.1 inches |
| Philadelphia | 7.0 inches |



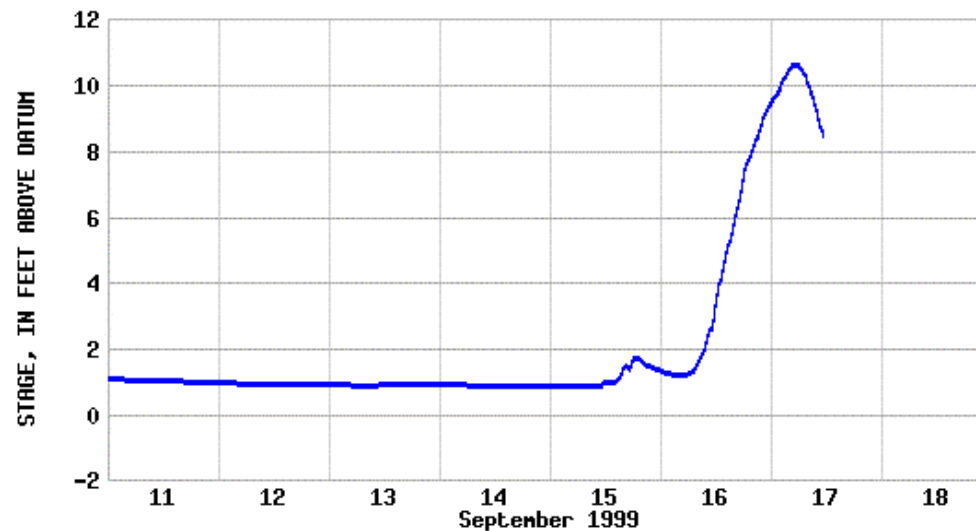
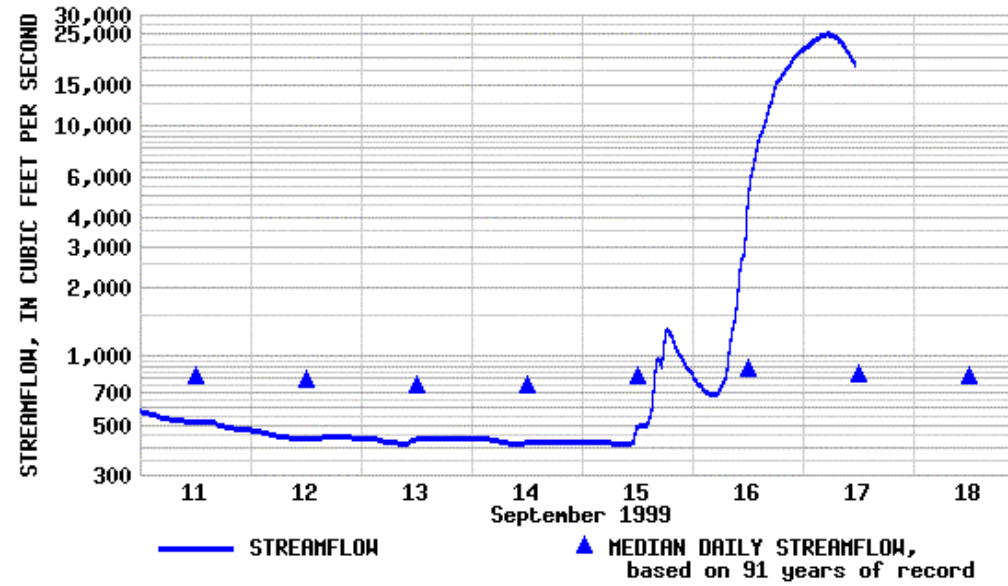
Provisional data from the U.S. Geological Survey

Rainfall data from National Weather Service

The **Lehigh River** at Bethlehem did not reach its flood stage of 16 feet. Further upstream at Walnutport, the Lehigh rose to its flood stage of 8 feet, then receded. Some rainfall totals in the Lehigh Basin are shown below.

| | |
|-----------------|------------|
| F.E. Walter Dam | 6.1 inches |
| Lehighton | 6.4 inches |
| Beltzville Lake | 3.8 inches |
| Walnutport | 6.2 inches |
| Allentown | 7.6 inches |
| Tobyhanna | 6.9 inches |

Rainfall data from National Weather Service

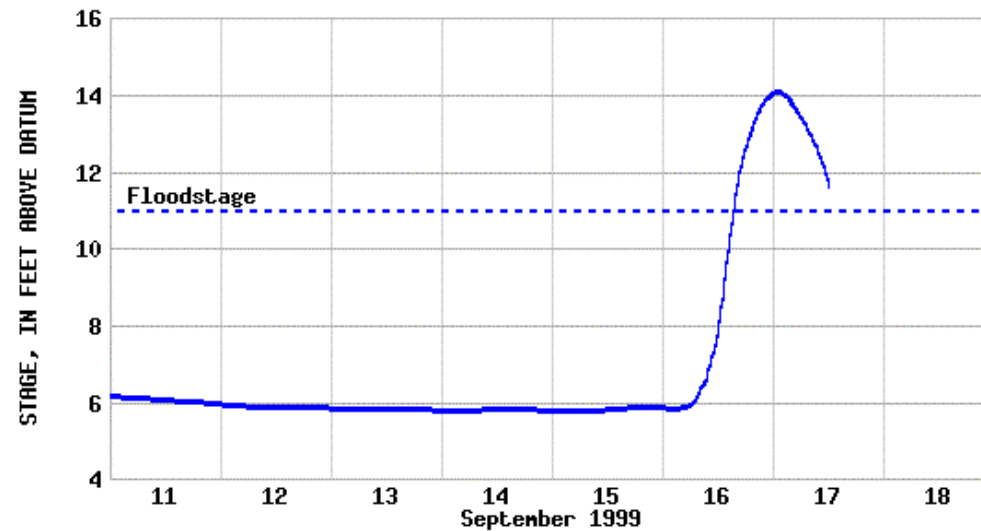
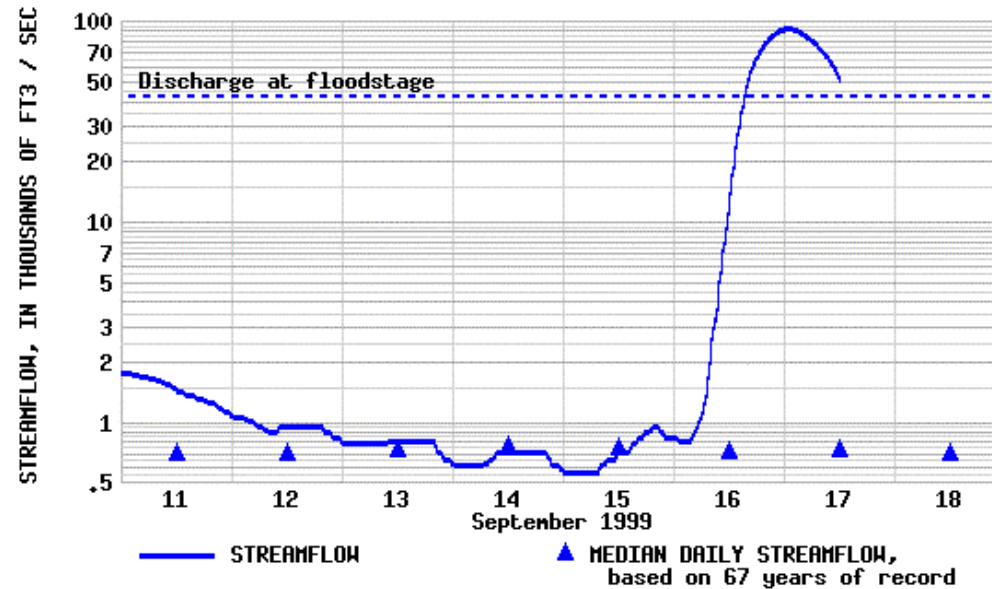


Streamflow data provided by U.S. Geological Survey

The **Schuylkill River** at Philadelphia exceeded its flood stage by over 3 feet. Serious flooding occurred along the Schuylkill and its tributaries. Parts of Manyunk and Venice Island were submerged. The following are some rainfall totals in the Schuylkill River Watershed.

| | |
|----------------|-------------|
| Tamaqua | 6.5 inches |
| Hamburg | 5.2 inches |
| Blue Marsh Dam | 6.3 inches |
| Reading | 6.9 inches |
| Valley Forge | 10.0 inches |
| Pottstown | 6.3 inches |

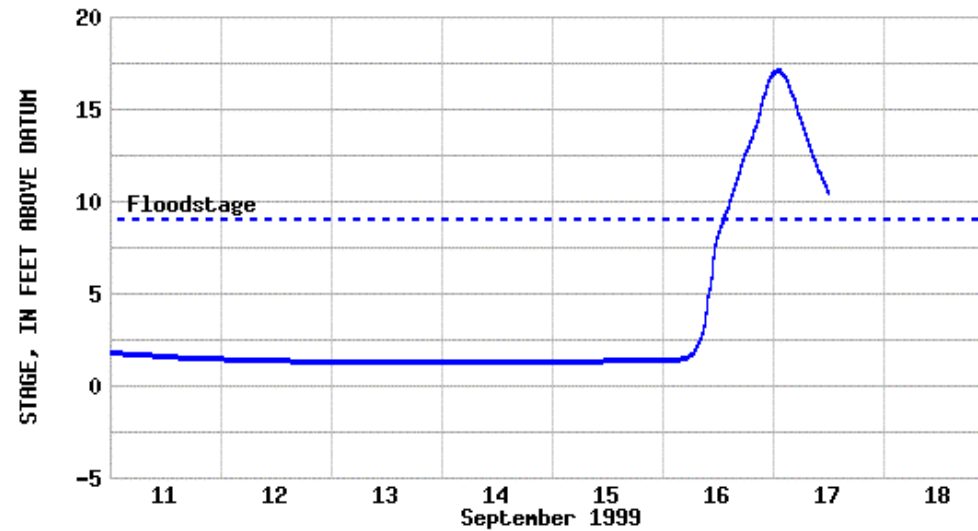
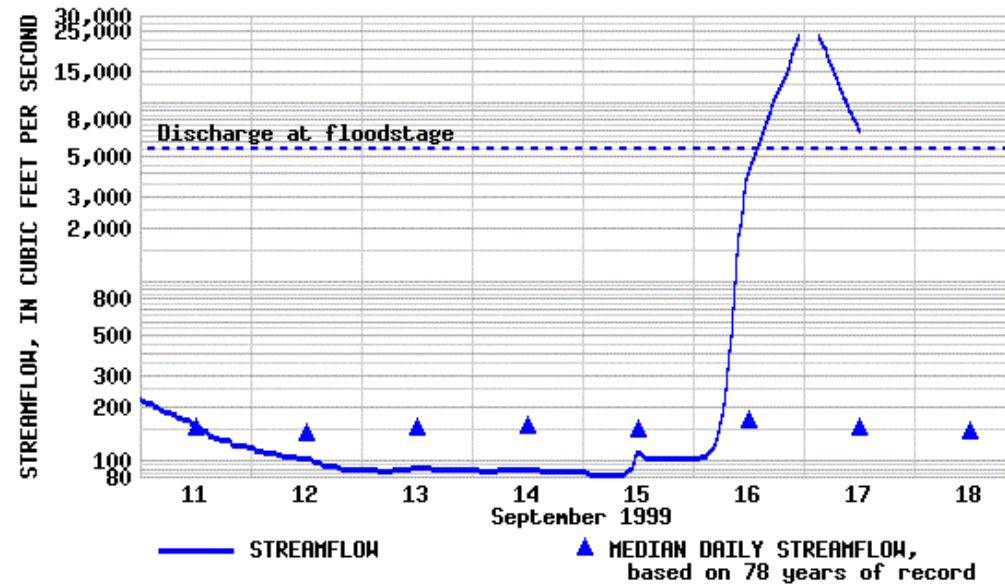
Rainfall data from National Weather Service



Streamflow data provided by U.S. Geological Survey

The **Brandywine Creek** at Chadds Ford exceeded its flood stage by 8 feet. Rainfall totals in the Christina/Brandywine Watersheds are shown below.

| | |
|-------------|------------|
| Glenmore | 6.9 inches |
| Newark | 8.7 inches |
| Wilmington | 8.3 inches |
| Honey Brook | 5.5 inches |



Rainfall data from National Weather Service

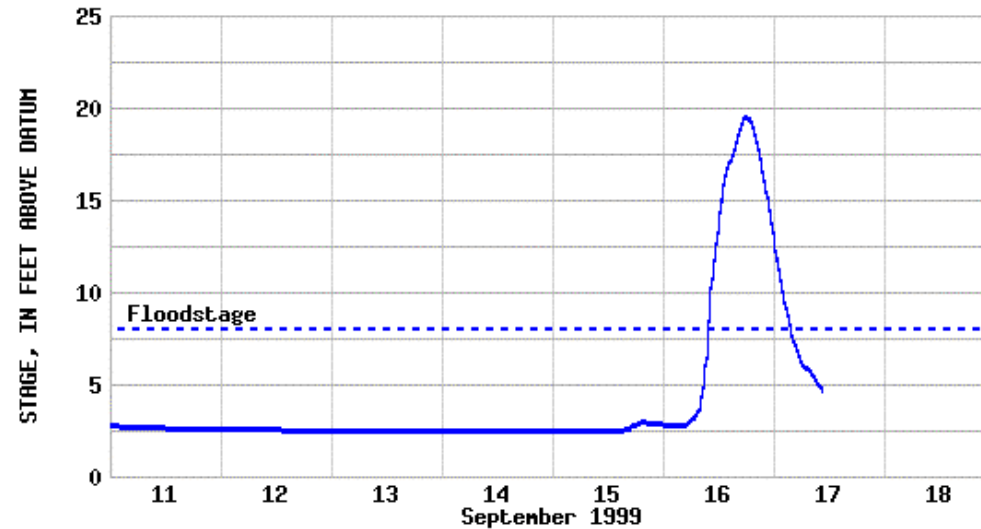
Streamflow data provided by U.S. Geological Survey

Other streams in Southeastern Pennsylvania and New Jersey experienced damaging flooding. In the Raritan River Basin in New Jersey, new flood records were set. Some other rainfall totals were as follows:

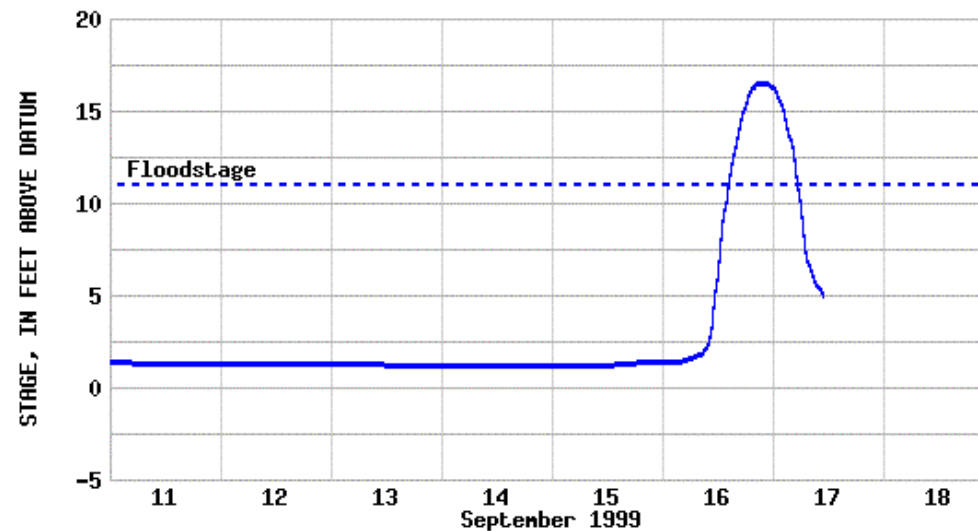
| | |
|------------------|------------|
| Sellersville Pa. | 8.1 inches |
| Willow Grove Pa. | 8.1 inches |
| N. Philadelphia | 6.6 inches |
| Marlton N.J. | 7.1 inches |
| Cherry Hill N.J. | 6.0 inches |
| Pennsauken N.J. | 7.4 inches |
| McGuire AFB | 6.0 inches |

Rainfall data from National Weather Service

Chester Creek, Pa.



Perkiomen Ck. At Graterford, Pa.



Streamflow data provided by U.S. Geological Survey

In the **Upper Delaware River Basin**, rainfall increased storage in the three New York City reservoirs. As of Monday, September 21, storage had increased by approximately 19 billion gallons to 150 billion gallons, or 55 percent of capacity. Rainfall totals for selected stations in the reservoir watersheds are shown below.

| | |
|------------------------|------------|
| Cannonsville Watershed | |
| Delhi | 5.0 inches |
| Windsor | 4.9 inches |
| Pepacton Watershed | |
| Roscoe | 5.1 inches |
| Downsville Dam | 5.5 inches |
| Neversink Watershed | |
| Ellenville | 6.8 inches |
| Claryville | 5.6 inches |

The dry conditions in the reservoir watersheds and the effects of vegetation reduced runoff to below what would be expected in winter and early spring months. It is estimated that surface runoff was about 25 percent of the rainfall total. The rainfall from Floyd combined with the effects of above normal rainfall since mid-August brought many hydrologic indicators back to normal levels throughout the Delaware River Basin.