U.S. Department of the Interior
U.S. Geological Survey

Fact Sheet 103-96

STATEWIDE FLOODS IN PENNSYLVANIA, JANUARY 1996

SYNOPSIS

Rivers and streams throughout Pennsylvania (fig. 1) experienced major flooding during January 1996. Flood stages (water-surface heights) and discharges (flows) in many of the Commonwealth's waterways were measured by the U.S. Geological Survey (USGS) and approached or exceeded record levels established during previous floods. Setting the stage for the flooding was an unusually cold beginning to the winter of 1995-96, which resulted in the early formation of ice in streams statewide. The anomaly of early ice was followed by a sequence of unusual meteorological events in January 1996, which, in many areas, resulted in the most widespread and severe flooding since that produced by tropical storm Agnes in June 1972. Locally, the flooding was the worst since August 1955 and, in some areas, since March 1936. In approximately 50 localities throughout Pennsylvania, flood effects were magnified when ice jams caused temporary damming of stream channels, resulting in the rapid rise of water levels and the subsequent overflow of water and ice onto flood plains. During the floods, the USGS collected stream-stage information on a near real-time basis at 189 streamflow-gaging stations across the Commonwealth. This information was used by various Federal, State, and local agencies to prepare flood forecasts and develop plans for emergency response.

METEOROLOGICAL CONDITIONS AND FLOODS

The January 1996 floods were caused by an unusual combination of heavy rain, unseasonably high temperatures, high winds, and the resultant rapid melting and runoff from thick snowpack. On January 16, 1996, about 1 week after the "Blizzard of 1996" dumped as much as 40 inches of snow in some parts of Pennsylvania, snowpack with water equivalents of 3 to 5.5 inches remained on the ground, according to the National Weather Service. Beginning on January 19, conditions favorable for flooding developed when rainfall, locally in excess of 3 inches and accompanied by temperatures as high as 62°F and winds gusting to 38 miles per hour, moved over the Commonwealth and saturated the snowpack. The intense rainfall, combined with water from the rapidly melting snowpack, resulted in the generation of large volumes of runoff that moved quickly toward rivers and streams. Small and large watersheds responded rapidly to the intense rainfall and rapid snowmelt events, and, consequently, stages and discharges in streams and rivers throughout Pennsylvania peaked during the short time span of January 19-21.

The floods produced by the rainfall and rapid meltdown exacted a heavy toll in Pennsylvania. Twenty lives were lost and many waterfront communities were so severely flooded that evacuations and curfews were ordered by local authorities. Sixty-nine bridges maintained by either the Pennsylvania Department of Transportation or by municipalities were destroyed or closed until inspections could verify their safety. By January 23, all 67 counties in Pennsylvania had been declared Federal disaster areas eligible for emergency relief. Preliminary estimates placed the economic loss in Pennsylvania, resulting from the blizzard and floods, at more than $1 billion.

The major drainage basins in Pennsylvania—the Ohio, Susquehanna, and Delaware (fig. 1)—all experienced major flooding during January 1996. Flooding was particularly severe in parts of the Susquehanna and Ohio River Basins. A comparison of peak stages

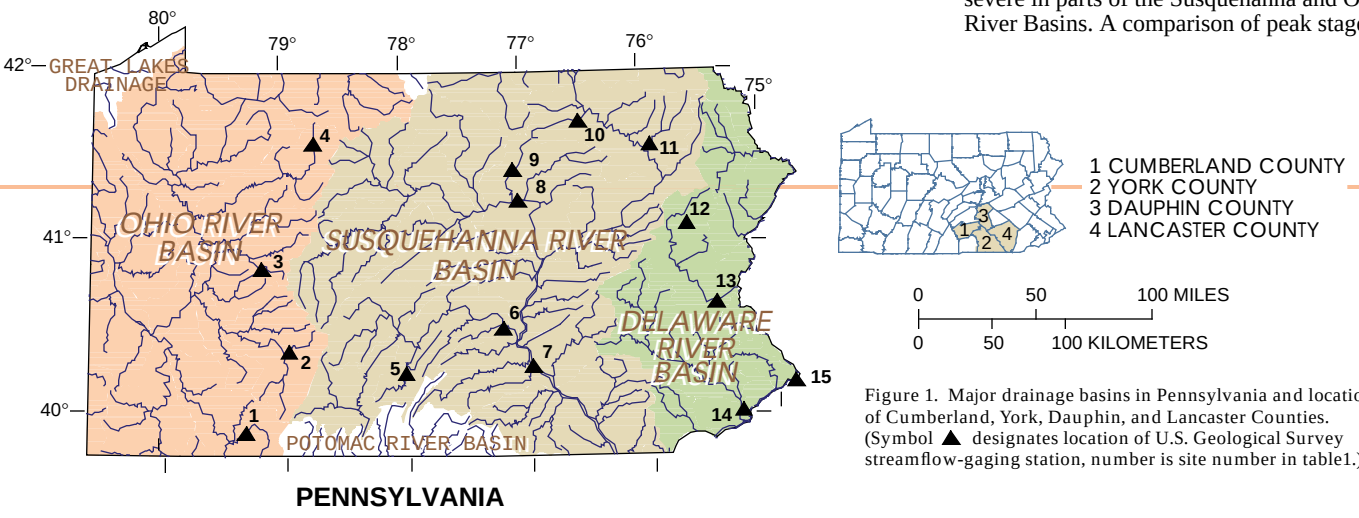

Figure 1. Major drainage basins in Pennsylvania and location of Cumberland, York, Dauphin, and Lancaster Counties. (Symbol ▲ designates location of U.S. Geological Survey streamflow-gaging station, number is site number in table1.)

Table 1. Peak stages and discharges during January 1996 and previously known for key U.S. Geological Survey streamflow-gaging stations in Pennsylvania

Site number on map	USGS station number and name		Drainage area (square miles)	Beginning year of record	Maximum during January 1996			Maximum flood previously known		
					Date	Stage (feet)	Discharge (cubic feet per second)	Date	Stage (feet)	Discharge (cubic feet per second)
1	03079000	Casselman R. at Markleton	382	1920	1/19/96	13.06	40,500	10/15/54	14.06	50,000
2	03041000	L. Conemaugh R. at E. Conemaugh	183	1939	1/19/96	19.78	Currently unknown	7/20/77	18.85	40,000
3	03034500	L. Mahoning Cr. at McCormick	87.4	1939	1/19/96	13.68	6,790	6/23/72	13.20	6,200
4	03028000	W. Br. Clarion R. at Wilcox	63.0	1953	1/19/96	10.23	5,590	9/28/67	10.01	5,490
5	01564500	Aughwick Creek near Three Springs	205	1938	1/19/96	20.71	Currently unknown	6/22/72	19.20	23,700
6	01567000	Juniata R. at Newport	3,354	1899	1/20/96	24.69	103,000	3/19/36	34.24	190,000
7	01570500	Susquehanna R. at Harrisburg	24,100	1890	1/21/96	25.08	569,000	6/24/72	32.57	1,020,000
8	01551500	W. Br. Susquehanna R. at Williamsport	5,682	1895	1/20/96	26.71	180,000	6/23/72	34.75	279,000
9	01550000	Lycoming Creek near Trout Run	173	1913	1/19/96	22.6	Currently unknown	6/22/72	20.19	25,900
10	01532000	Towanda Creek near Monroeton	215	1914	1/19/96	20.71	Currently unknown	6/22/72	16.90	74,000
11	01534000	Tunkhannock Creek near Tunkhannock	383	1914	1/19/96	19.97	Currently unknown	3/15/86	15.77	32,200
12	01447720	Tobyhanna Creek near Blakeslee	118	1961	1/19/96	11.61	8,420	9/27/85	12.33	9,190
13	01453000	Lehigh R. at Bethlehem	1,279	1941	1/20/96	16.88	43,300	5/23/42	25.90	92,000
14	01474500	Schuylkill R. at Philadelphia	1,893	1931	1/19/96	13.36	76,800	6/23/72	14.65	103,000
15	01463500	Delaware River at Trenton, N.J.	6,780	1913	1/20/96	22.20	179,000	8/20/55	28.60	329,000

and discharges for the January 1996 floods with peak stages and discharges for the maximum flood previously known, for key USGS streamflow-gaging stations across the Commonwealth, is presented in table 1.

Susquehanna River Basin

The Susquehanna River Basin was hit hard by the January 19-21 floods. Record-breaking stages and discharges were documented at USGS streamflow-gaging stations on Aughwick Creek near Three Springs, Lycoming Creek near Trout Run, Towanda Creek near Monroeton, and Tunkhannock Creek near Tunkhannock. Flood stages and discharges in the Susquehanna River, the single largest tributary to Chesapeake Bay, were the highest recorded since tropical storm Agnes in June 1972 (fig. 2) and surpassed the high levels recorded during the freshets of April 1993. At Harrisburg, the peak stage reached 25.08 feet, and the peak discharge reached 569,000 cubic feet per second (4.26 million gallons per second). In comparison, during tropical storm Agnes, the peak stage was 32.57 feet, and the peak discharge was 1,020,000 cubic feet per second (7.63 million gallons per second).

The hydrograph, or graph of the water-surface height as a function of time, for the Susquehanna River at City Island in Harrisburg (fig. 2) shows two rapid water-level rises on January 19-20. These rapid rises resulted from the water-damming effects of ice jams downstream from City Island. On January 19, the first rise, about 16 feet in 15 hours, was followed by a 2-foot drop in water level and then by a subsequent 5-foot rise. This rate of rise is the greatest recorded for the Susquehanna River at Harrisburg since record keeping began there in 1890. On January 20, concurrent with the second peak, two spans of the Walnut Street bridge, which dates to 1888, were lifted off their piers by ice and carried downstream into the Market Street bridge. Over a 27-hour span from January 19 to January 20, 1996, floodwaters from the Susquehanna River inundated parts of Cumberland, York, Dauphin, and Lancaster Counties (fig. 1). Many communities on tributaries to the Susquehanna River also were flooded as a result of ice jams in the tributaries and in the Susquehanna River.

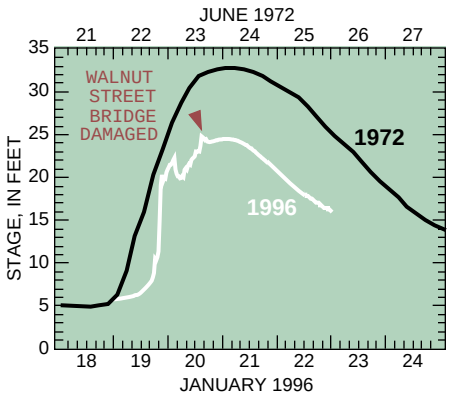

Figure 2. Comparison of river stages at U.S. Geological Survey streamflow-gaging station on Susquehanna River at Harrisburg, Pa., June 21-27, 1972, and January 19-23, 1996. Rapid rises on January 19 and 20 caused by downstream ice jams.

In the Lycoming Creek Basin of north-central Pennsylvania, the USGS streamflow-gaging station near Trout Run recorded a flood stage of approximately 22.6 feet, which is more than 2 feet higher than the flood stage during tropical storm Agnes. Along Lycoming Creek, the flooding claimed six lives and caused millions of dollars in damage.

Ohio River Basin

In the Ohio River Basin, record-breaking stages and discharges were recorded at USGS streamflow-gaging stations on the Little Conemaugh River at East Conemaugh, Little Mahoning Creek at McCormick, and West Branch Clarion River at Wilcox. In Pittsburgh, severe flooding developed when the Allegheny and Monongahela Rivers crested within 5 hours of each other. The compounding effects of this rare, near-simultaneous cresting at the confluence of the Allegheny and Monongahela Rivers resulted in a rapid rise in stage and inundation of Point State Park and parts of the Three Rivers Stadium parking lot.

Delaware River Basin

Although stages and discharges in the Delaware River Basin did not exceed historical maximums, USGS streamflow-gaging stations recorded the third-highest peak in 34 years on Tobyhanna Creek near Blakeslee, the sixth-highest peak in 54 years on the Lehigh River at Bethlehem, and the highest peak on the Schuylkill River at Philadelphia since tropical storm Agnes in 1972. The USGS streamflow-gaging station on the Delaware River at Trenton, New Jersey, recorded a flood stage of 22.20 feet, the highest stage recorded since the flood caused by Hurricanes Connie and Diane in August 1955.

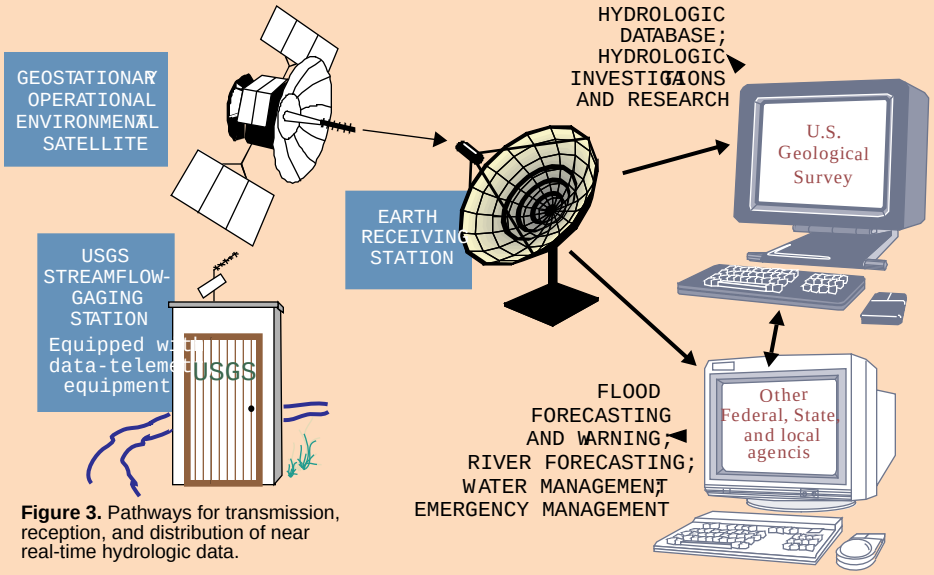

Figure 3. Pathways for transmission, reception, and distribution of near real-time hydrologic data.

THE STREAMFLOW-MONITORING NETWORK IN PENNSYLVANIA

The USGS operates a network of 229 continuous-record, streamflow-gaging stations on rivers and streams throughout Pennsylvania. These and other hydrologic-monitoring stations are operated and maintained in cooperation with the Pennsylvania Department of Environmental Protection, the U.S. Army Corps of Engineers, the National Weather Service, the Delaware River Basin and the Susquehanna River Basin Commissions, Chester County, and various other Federal, State, and local agencies. At 189 of the continuous-record stations, the recorded stream stages are transmitted on a near-real-time basis by way of satellite telemetry (fig. 3) to the USGS computer in Lemoyne and to other Federal, State, and local agencies in Pennsylvania.

During normal streamflow conditions, the stations transmit stream-stage data every 4 hours; during floods, the data are transmitted on average every 15 minutes. As part of the Flood Forecast and Warning System, the National Weather Service uses the data from 38 stations in Pennsylvania to predict flood heights and timing in the Susquehanna River Basin. The Corps of Engineers uses the data to manage flood-control reservoirs. The Pennsylvania Emergency Management Agency and many county emergency-management agencies use the data to initiate evacuations and manage emergency response. Like other man-made structures located near streams, the USGS streamflow-gaging stations are susceptible to flood damage. All the stations in Pennsylvania, however, with the exception of two that were completely inundated, operated throughout the January 1996 floods and thus provided data critical to monitoring flood conditions, issuing flood forecasts, and managing the emergency conditions resulting from the floods.

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