Summary of Nitrogen, Phosphorus, and Suspended-Sediment Loads and Trends Measured at the Chesapeake Bay Nontidal Network Stations: Water Year 2014 Update

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Changes in nitrogen, phosphorus, and suspended-sediment loads in rivers across the Chesapeake Bay watershed have been calculated using monitoring data from the Chesapeake Bay Nontidal Water-Quality Monitoring Network (NTN). These results are used to help assess efforts to decrease nutrient and sediment loads being delivered to the bay. Additional information for each monitoring station is available through this USGS Web site in order to provide the State, Federal, and local partners, as well as the general public, ready access to a wide range of data for nutrient and sediment conditions across the Chesapeake Bay watershed.

The results are summarized for

1. loads delivered directly to the tidal waters; specifically, the River Input Monitoring (RIM) stations,
2. trends in loads at the RIM stations, and
3. patterns in loads at each monitoring station in the bay watershed (that are part of the Chesapeake Bay Program [CBP] NTN).

What are the patterns in loads delivered to tidal waters from the RIM stations?

The USGS combined the load results from the RIM stations shown in figure 1 to quantify the total nitrogen, phosphorus, and suspended-sediment loads delivered from the watershed to tidal waters. Together, the nine RIM stations reflect loads delivered from 78 percent of its 64,000-square-mile watershed.

River flow and loads to tidal waters

- Estimated annual-mean streamflow entering the Chesapeake Bay in 2014 was 81,300 cfs, about 3 percent (2,738 cfs) above the long-term (1937-2015) annual-mean streamflow (fig. 2).
- In 2014, the combined loads from the nine RIM stations were as follows:
    - Total nitrogen (TN): 189 million pounds (Mlb), 21 Mlb less than the long-term average for 1985-2014 (fig. 3).
    - Total phosphorus (TP): 12.2 Mlb, 1.5 Mlb less than the long-term average for 1985-2014 (fig. 4).
    - Suspended sediment: 3.58 million tons (Mton), 1.41 Mton less than the long-term average for 1985-2014 (fig. 5).

The Chesapeake Bay Program uses the RIM loads and estimates loads from the remaining unmonitored areas to compute a total nutrient and sediment load to the bay.

What are the trends in loads delivered to tidal waters from the RIM stations?

Trends in loads from the nine RIM stations are flow-normalized (see methods section of this Web site) to account for the changes in river flow to better understand changes related to land-use change activities in the watershed. Changes in loads for nitrogen, phosphorus, and suspended sediment are provided for two time periods: 1985-2014 (long term) and 2005-2014 (short term) (table 1). Decreasing loads are classified as improving conditions, while increasing loads are classified as degrading conditions.

Changes in total nitrogen loads

- Long-term trends in total nitrogen loads indicate improving conditions at the majority of the stations, including the five largest rivers. The Choptank River is the only station whose data indicate degrading conditions.
- Short-term trends in total nitrogen loads indicate improving conditions at only 3 stations and degrading conditions at 4 stations. Data from the Susquehanna and James stations indicate no discernable short-term trends.

Changes in total phosphorus loads

- Long-term trends in total phosphorus loads indicate improving conditions at 4 stations and degrading conditions at another 4 stations.
- Short-term trends in total phosphorus loads indicate improving conditions at only the Potomac and Patuxent stations, degrading conditions at 4 stations, and no discernable change in conditions at the 3 remaining stations.

Changes in suspended-sediment loads

- Long-term trends in suspended-sediment loads indicate improving conditions at 4 stations, degrading conditions at 3 stations, and no discernable change in conditions at 2 stations.
- Short-term trends in suspended-sediment loads are indicate improving conditions at 3 stations; degrading conditions at 5 stations, and no discernable change in conditions at the Susquehanna station.

Table 1. Summary of long-term (1985-2014) and short-term (2005-2014) trends in nitrogen, phosphorus, and suspended- sediment loads for the River Input Monitoring stations.
[Improving or degrading trends classified as likelihood estimates greater than or equal to 66 percent]

Monitoring station	Total nitrogen load		Total phosphorus load		Suspended-sediment load	
	Long term	Short term	Long term	Short term	Long term	Short term
SUSQUEHANNA RIVER AT CONOWINGO, MD	Improving	No trend	Degrading	Degrading	Degrading	No trend
POTOMAC RIVER AT WASHINGTON, DC	Improving	Improving	Improving	Improving	Improving	Improving
JAMES RIVER AT CARTERSVILLE, VA	Improving	No trend	Improving	Degrading	Degrading	Degrading
RAPPAHANNOCK RIVER NR FREDERICKSBURG, VA	Improving	Improving	No trend	No trend	No trend	Improving
APPOMATTOX RIVER AT MATOACA, VA	Improving	Degrading	Degrading	Degrading	No trend	Degrading
PAMUNKEY RIVER NEAR HANOVER, VA	No trend	Degrading	Degrading	No trend	Degrading	Degrading
MATTAPONI RIVER NEAR BEULAHVILLE, VA	Improving	Degrading	Improving	No trend	Improving	Improving
PATUXENT RIVER NEAR BOWIE, MD	Improving	Improving	Improving	Improving	Improving	Degrading
CHOPTANK RIVER NEAR GREENSBORO, MD	Degrading	Degrading	Degrading	Degrading	Improving	Degrading

What are the patterns in loads and trends across the nontidal monitoring network (2005-14)?

The USGS computes load and trend results from the NTN to display (1) the range in loads of nitrogen, phosphorus, and suspended sediment; and (2) the trends in these loads. The majority of the NTN sites whose data were used for the analysis had data collected since 2005 (fig. 6 and table 2). To facilitate the comparison of loads and trends between sites, load results from each NTN station are normalized by the respective drainage area to present the results as per-acre loads (also known as yield). The total number of NTN stations analyzed for total nitrogen, total phosphorus, and suspended-sediment load and trends varies because of the presence or absence of targeted water-quality samples collected during stormflow conditions (see Chanat and others, 2015).

Patterns in total nitrogen loads

- Total nitrogen loads range from 1.19 to 33.4 pounds per acre (lb/acre; fig. 7), and the average load is 7.33 lb/acre.
- Twice as many stations show improving trends as those showing degrading trends

    - 44 of 81 (54 percent) stations have improving trends, with load reductions ranging from about 0.10 to 5.07 lb/acre.
    - 22 of 81 (27 percent) stations have degrading trends, with load increases ranging from about 0.04 to 1.21 lb/acre.
    - 15 of 81 (19 percent) show no discernable trends.

Patterns in total phosphorus loads

- Total phosphorus loads range from 0.13 to 2.31 lb/acre (fig. 8), and the average load is 0.52 lb/acre.
- Over three times as many stations showing improving trends as those showing degrading trends

    - 41 of 60 (68 percent) stations have improving trends, with load reductions ranging from about 0.01 to 1.08 lb/acre.
    - 12 of 60 (20 percent) stations have degrading trends, with load increases ranging from about 0.01 to 0.43 lb/acre.
    - 7 of 60 (12 percent) have no discernable trends.

Patterns in suspended-sediment loads

- Suspended-sediment loads range from 18 to 2,210 lb/acre (fig. 9) and the average load is 482 lb/acre.
- There are ten more stations showing improving trends compared to the number of stations showing degrading trends.

    - 29 of 59 (50 percent) stations have improving trends, with load decreases ranging from 8.11 to 1,490 lb/acre.
    - 19 of 59 (30 percent) stations have degrading trends, with load increases ranging from 4.75 to 341 lb/acre.
    - 11 of 59 (20 percent) have no discernable trends.

The Chesapeake Nontidal Monitoring Network and Role of USGS

The Chesapeake Bay Nontidal Water-Quality Monitoring Network is a partnership implemented among the States in the watershed, the U.S. Environmental Protection Agency, the USGS, and the Susquehanna River Basin Commission. A network of monitoring stations has been established and is sampled using standardized protocols and quality-assurance procedures designed to measure pollutant loads and changes in pollutant loads over time. The initial network formed around 1985 with coordinated monitoring at the nine RIM stations. In 2004, the CBP formalized the network, and a period of expansion followed. In 2010 and 2011, the network was further expanded to address the needs of the Total Maximum Daily Load (TMDL). The network currently has 117 sites designed to measure changes in nitrogen, phosphorus, and suspended sediment in the Chesapeake Bay watershed. Through this partnership, nitrogen, phosphorus, and suspended-sediment loads and trends are determined based on (1) continuous streamflow monitoring, (2) extensive water-quality sampling, and (3) advanced statistical analysis. The USGS computes the loads and trends and present this information through this Web site.

Additional Information

- Maps of the load and trend in load results are available as
  - Downloadable PDF Maps
  - An Interactive Map
- Tabular results for each station are available in the **Download** section of the navigation menu on this Web site.

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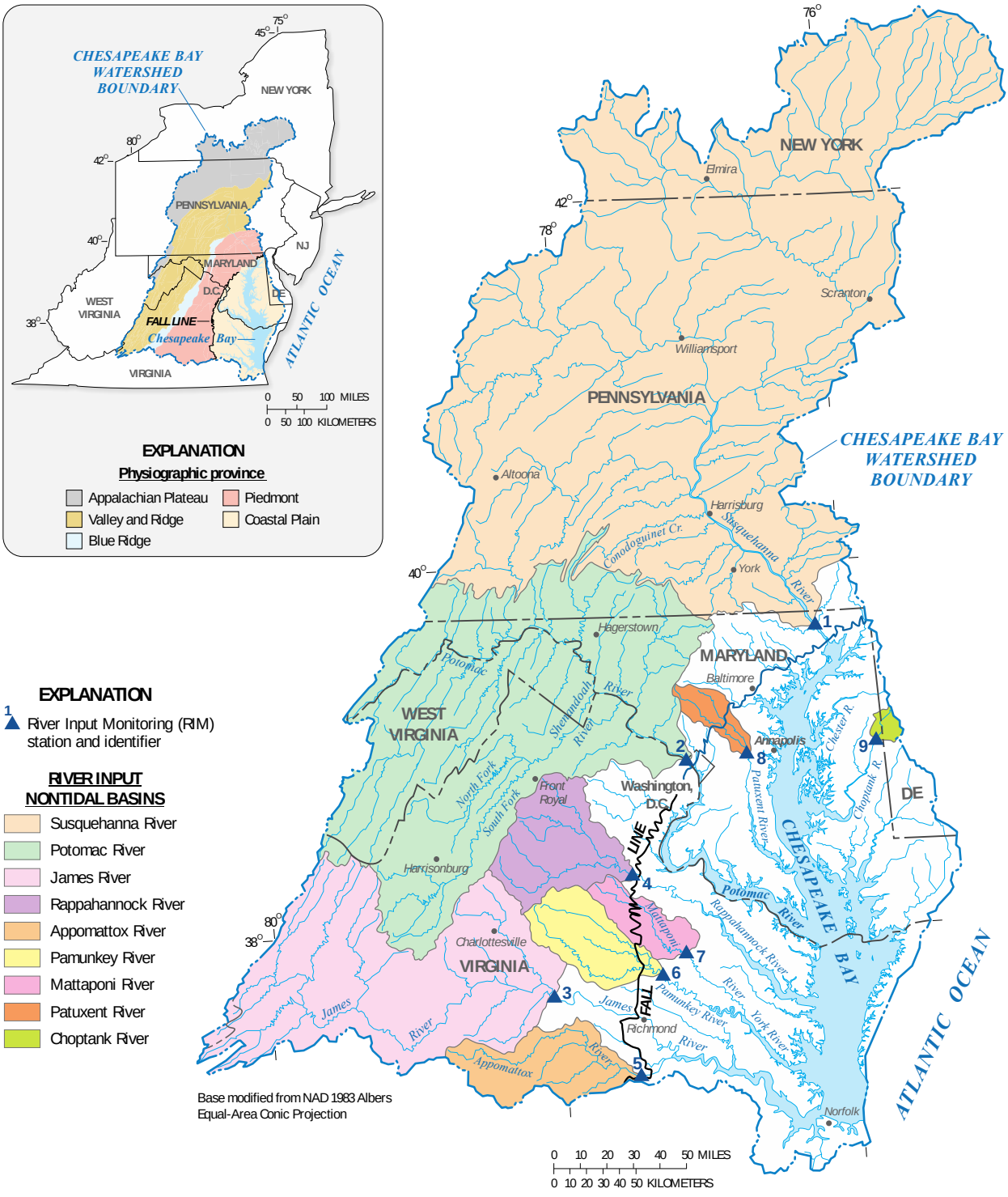

Figure 1. Location of the 9 River Input Monitoring (RIM) stations in the Chesapeake Bay watershed. Station numbers and names are provided in table 2.

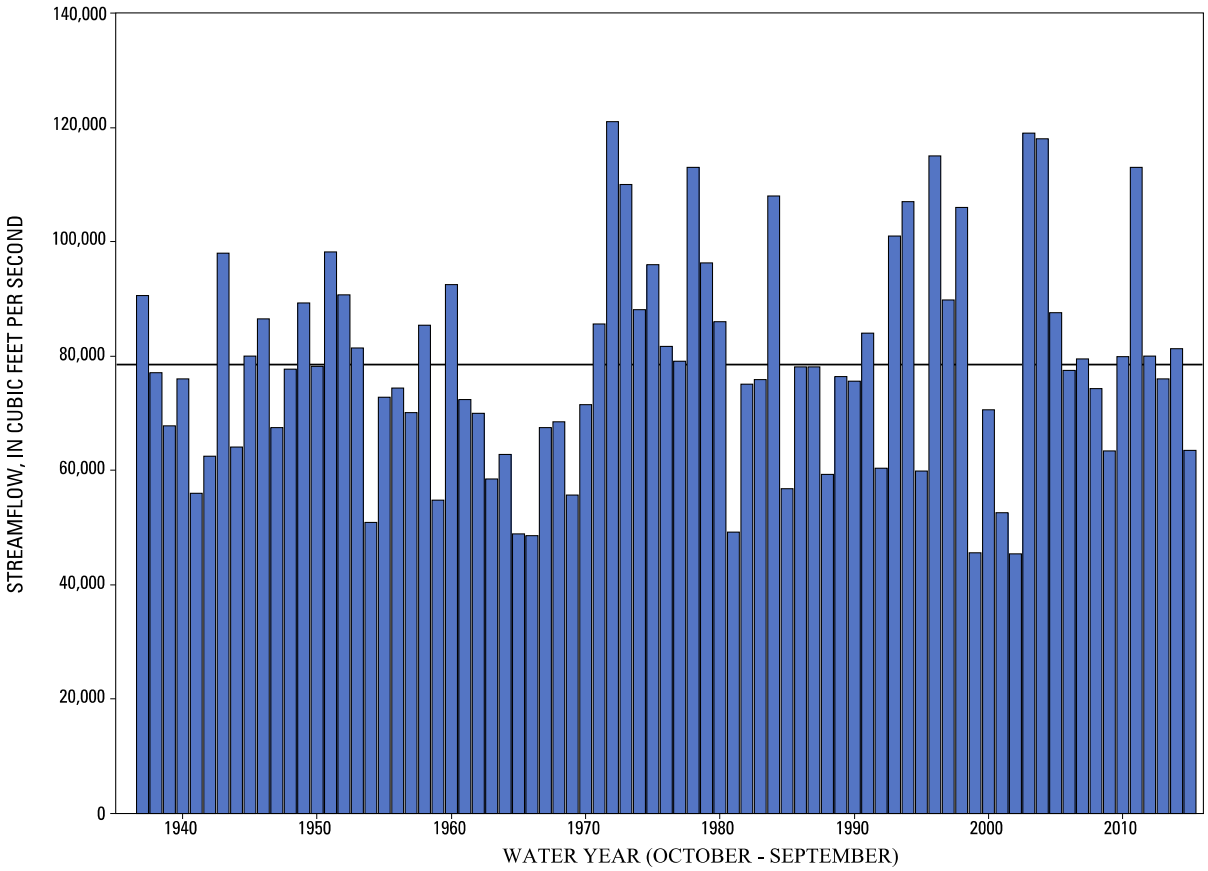

Figure 2. Estimated annual-mean streamflow entering Chesapeake Bay. Black line represents the average annual-mean streamflow of 78,563 cubic feet per second. Source http://md.water.usgs.gov/waterdata/chesinflow/wy/

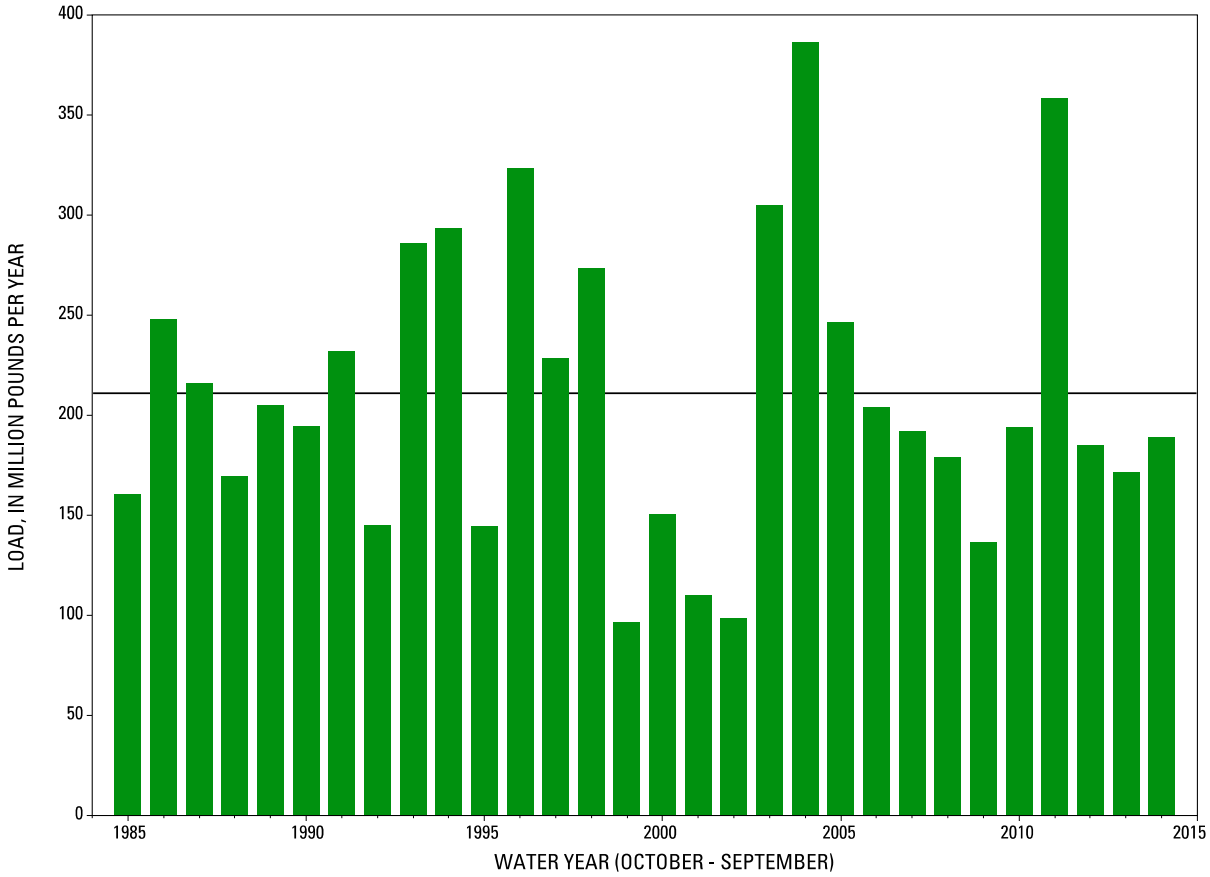

Figure 3. Combined annual total nitrogen load delivered from the nine River Input Monitoring stations to the Chesapeake Bay. Black line represents the mean annual combined load of 210 million pounds per year.

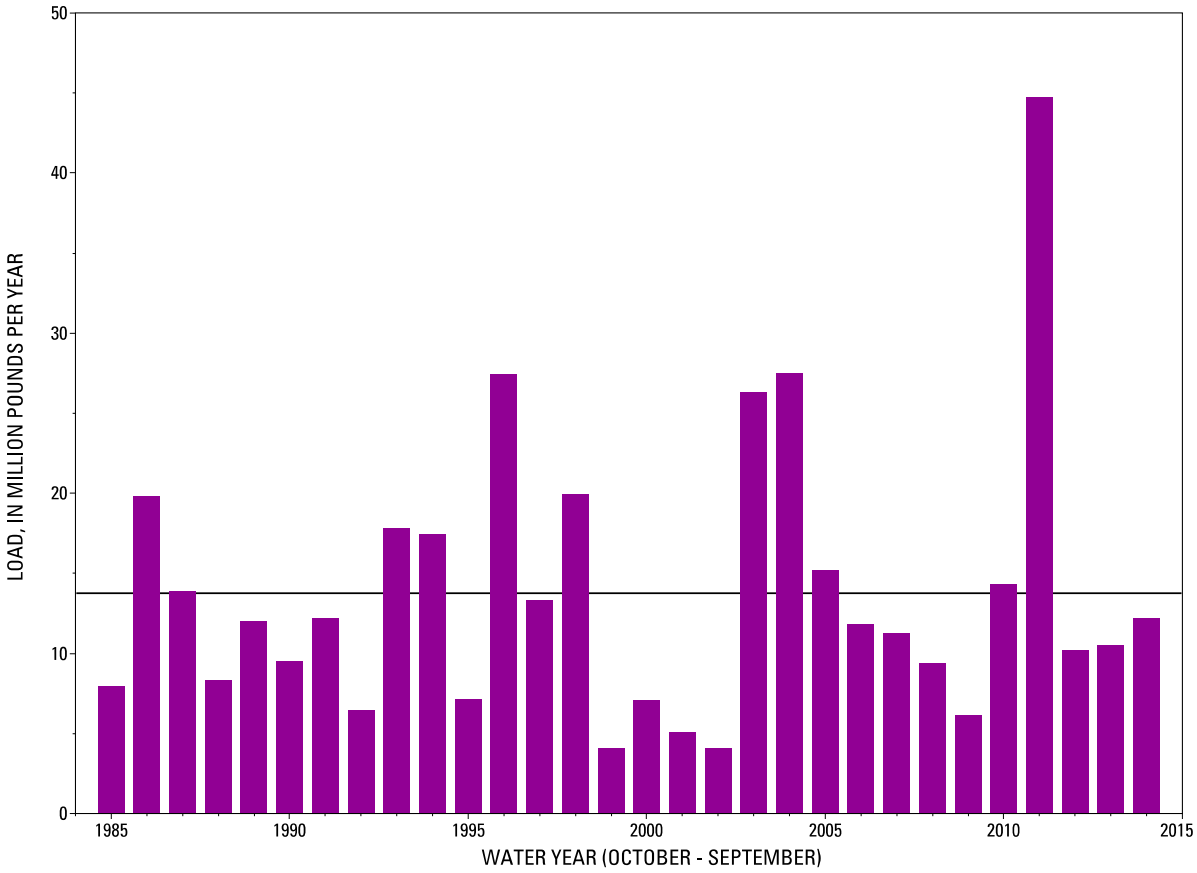

Figure 4. Combined annual total phosphorus load delivered from the nine River Input Monitoring stations to the Chesapeake Bay. Black line represents the mean annual combined load of 13.7 million pounds per year.

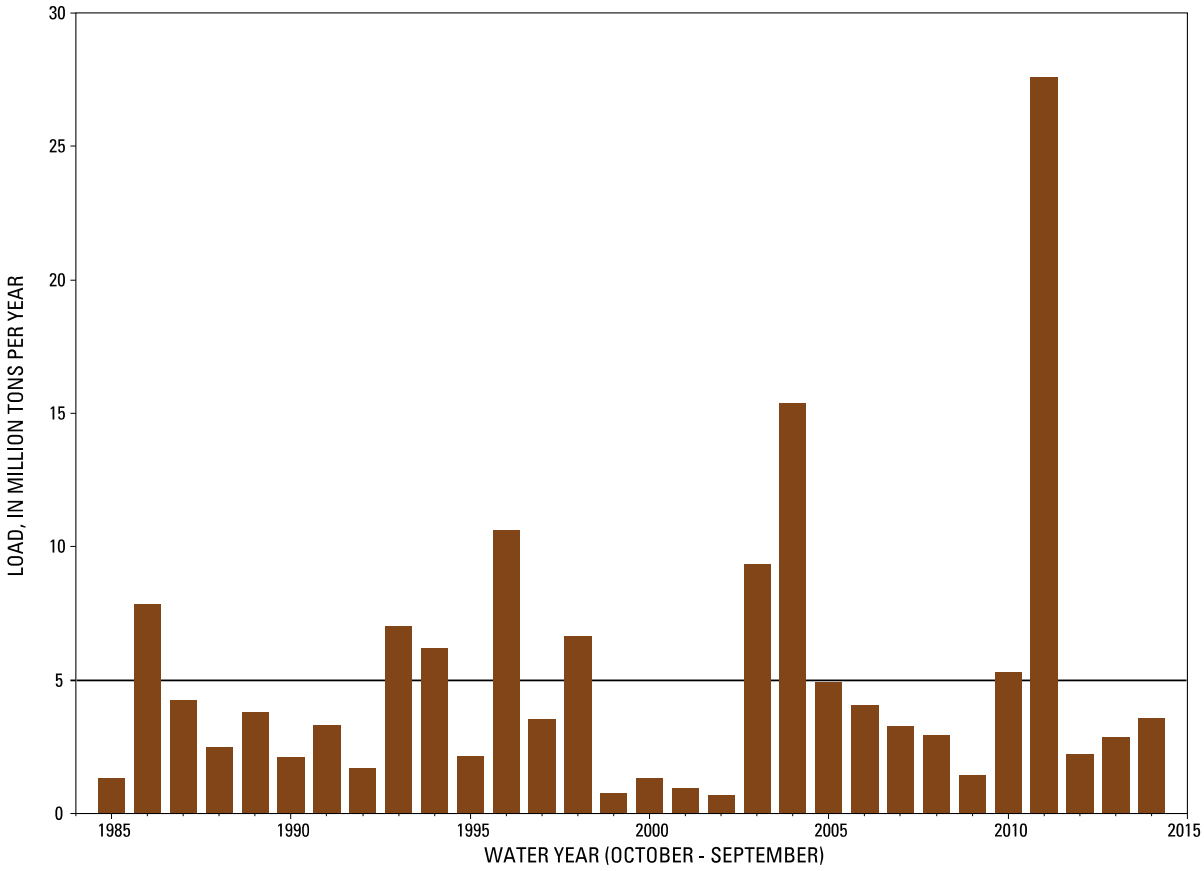

Figure 5. Combined annual suspended-sediment load delivered from the nine River Input Monitoring stations to the Chesapeake Bay. Black line represents the mean annual combined load of 4.99 million tons per year.

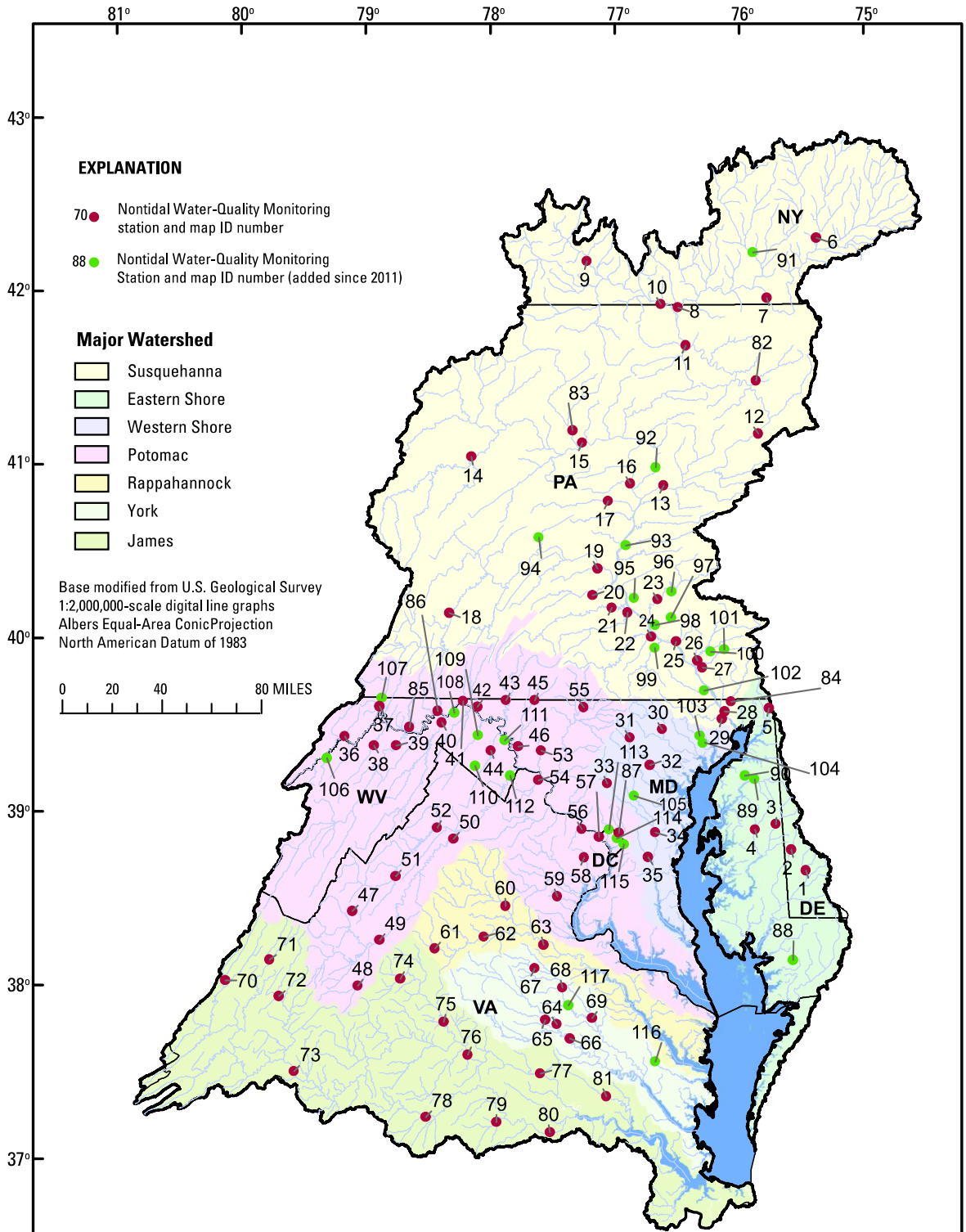

Figure 6. Chesapeake Bay nontidal network. Stations represented by a marron circle were included in the analysis of loads and trends; while, stations represented by green circles have fewer than 5 years of monitoring data and were not considered for load and trend computations.

Table 2. Chesapeake Bay nontidal monitoring stations. Load computations performed at all stations with a START DATE prior to 2011. Trend computations performed at all stations with START DATE prior to 2007.

[Bold stations represent the nine River Input Monitoring stations, mi^2, square mile.]

Map ID	USGS station number	USGS station name	Major watershed/region	Drainage area (mi^2)	Monitoring data	
					Start date	End date
1	01487000	NANTICOKE RIVER NEAR BRIDGEVILLE, DE	Eastern Shore	75	1998	2014
2	01488500	MARSHYHOPE CREEK NEAR ADAMSVILLE, DE	Eastern Shore	47	2005	2014
3	**01491000**	**CHOPTANK RIVER NEAR GREENSBORO, MD**	**Eastern Shore**	113	**1985**	**2014**
4	01491500	TUCKAHOE CREEK NEAR RUTHSBURG, MD	Eastern Shore	85	2005	2014
5	01495000	BIG ELK CREEK AT ELK MILLS, MD	Eastern Shore	52	2005	2014
6	01502500	UNADILLA RIVER AT ROCKDALE NY	Susquehanna	520	2005	2014
7	01503000	SUSQUEHANNA RIVER AT CONKLIN NY	Susquehanna	2,232	2006	2014
8	01515000	SUSQUEHANNA RIVER NEAR WAVERLY NY	Susquehanna	4,773	2005	2014
9	01529500	COHOCTON RIVER NEAR CAMPBELL NY	Susquehanna	470	2006	2014
10	01531000	CHEMUNG RIVER AT CHEMUNG NY	Susquehanna	2,506	2005	2014
11	01531500	SUSQUEHANNA RIVER AT TOWANDA, PA	Susquehanna	7,797	1985	2014
12	01536500	SUSQUEHANNA RIVER AT WILKES-BARRE, PA	Susquehanna	9,960	1989	2014
13	01540500	SUSQUEHANNA RIVER AT DANVILLE, PA	Susquehanna	11,220	1985	2014
14	01542500	WB SUSQUEHANNA RIVER AT KARTHAUS, PA	Susquehanna	1,462	2005	2014
15	01549760	WB SUSQUEHANNA RIVER AT JERSEY SHORE, PA	Susquehanna	5,225	2006	2014
16	01553500	WEST BRANCH SUSQUEHANNA RIVER AT LEWISBURG, PA	Susquehanna	6,847	1985	2014
17	01555000	PENNS CREEK AT PENNS CREEK, PA	Susquehanna	301	2005	2014
18	01562000	RAYSTOWN BRANCH JUNIATA RIVER AT SAXTON, PA	Susquehanna	756	2005	2014
19	01567000	JUNIATA RIVER AT NEWPORT, PA	Susquehanna	3,354	1985	2014
20	01568000	SHERMAN CREEK AT SHERMANS DALE, PA	Susquehanna	207	2005	2014
21	01570000	CONODOGUINET CREEK NEAR HOGESTOWN, PA	Susquehanna	470	2005	2014
22	01571500	YELLOW BREECHES CREEK NEAR CAMP HILL, PA	Susquehanna	213	2005	2014
23	01573560	SWATARA CREEK NEAR HERSHEY, PA	Susquehanna	483	2005	2014
24	01574000	WEST CONEWAGO CREEK NEAR MANCHESTER, PA	Susquehanna	510	2005	2014
25	01576000	SUSQUEHANNA RIVER AT MARIETTA, PA	Susquehanna	25,990	1987	2014
26	01576754	CONESTOGA RIVER AT CONESTOGA, PA	Susquehanna	470	1985	2014
27	01576787	PEQUEA CREEK AT MARTIC FORGE, PA	Susquehanna	148	2005	2014
28	**01578310**	**SUSQUEHANNA RIVER AT CONOWINGO, MD**	**Susquehanna**	27,100	**1985**	**2014**
29	01580520	DEER CREEK NEAR DARLINGTON, MD	Western Shore	164	2006	2014
30	01582500	GUNPOWDER FALLS AT GLENCOE, MD	Western Shore	160	1985	2014
31	01586000	NORTH BRANCH PATAPSCO RIVER AT CEDARHURST, MD	Western Shore	57	1985	2014
32	01589300	GWYNNS FALLS AT VILLA NOVA, MD	Western Shore	32	2003	2014
33	01591000	PATUXENT RIVER NEAR UNITY, MD	Western Shore	35	1985	2014
34	**01594440**	**PATUXENT RIVER NEAR BOWIE, MD**	**Western Shore**	348	**1985**	**2014**
35	01594526	WESTERN BRANCH AT UPPER MARLBORO, MD	Western Shore	90	2006	2014
36	01599000	GEORGES CREEK AT FRANKLIN, MD	Potomac	72	1985	2014
37	01601500	WILLS CREEK NEAR CUMBERLAND, MD	Potomac	247	1985	2014
38	01604500	PATTERSON CREEK NEAR HEADSVILLE, WV	Potomac	221	2006	2014
39	01608500	SOUTH BRANCH POTOMAC RIVER NEAR SPRINGFIELD, WV	Potomac	1,461	2006	2014
40	01611500	CACAPON RIVER NEAR GREAT CACAPON, WV	Potomac	675	2006	2014
41	01613095	TONOLOWAY CREEK NEAR HANCOCK, MD	Potomac	111	2006	2014
42	01613525	LICKING CREEK AT PECTONVILLE, MD	Potomac	193	2006	2014
43	01614500	CONOCOCHEAGUE CREEK AT FAIRVIEW, MD	Potomac	494	1985	2014
44	01616500	OPEQUON CREEK NEAR MARTINSBURG, WV	Potomac	273	2006	2014
45	01619000	ANTIETAM CREEK NEAR WAYNESBORO, PA	Potomac	93	2006	2014
46	01619500	ANTIETAM CREEK NEAR SHARPSBURG, MD	Potomac	281	1985	2014
47	01621050	MUDDY CREEK AT MOUNT CLINTON, VA	Potomac	14	1994	2014
48	01626000	SOUTH RIVER NEAR WAYNESBORO, VA	Potomac	127	1985	2014
49	01628500	S F SHENANDOAH RIVER NEAR LYNNWOOD, VA	Potomac	1,079	1985	2014
50	01631000	S F SHENANDOAH RIVER AT FRONT ROYAL, VA	Potomac	1,634	1985	2014
51	01632900	SMITH CREEK NEAR NEW MARKET, VA	Potomac	94	1985	2014
52	01634000	N F SHENANDOAH RIVER NEAR STRASBURG, VA	Potomac	770	1985	2014
53	01637500	CATOCTIN CREEK NEAR MIDDLETOWN, MD	Potomac	67	1985	2014
54	01638480	CATOCTIN CREEK AT TAYLORSTOWN, VA	Potomac	89	1985	2014
55	01639000	MONOCACY RIVER AT BRIDGEPORT, MD	Potomac	173	1985	2014
56	01646000	DIFFICULT RUN NEAR GREAT FALLS, VA	Potomac	58	1985	2014
57	**01646580**	**POTOMAC RIVER AT CHAIN BRIDGE, AT WASHINGTON, DC**	**Potomac**	11,570	**1985**	**2014**
58	01654000	ACCOTINK CREEK NEAR ANNANDALE, VA	Potomac	24	1991	2014
59	01658500	S F QUANTICO CREEK NEAR INDEPENDENT HILL, VA	Potomac	8	1994	2014
60	01664000	RAPPAHANNOCK RIVER AT REMINGTON, VA	Virginia	619	1985	2014
61	01665500	RAPIDAN RIVER NEAR RUCKERSVILLE, VA	Virginia	115	2003	2014
62	01667500	RAPIDAN RIVER NEAR CULPEPER, VA	Virginia	468	2005	2014
63	**01668000**	**RAPPAHANNOCK RIVER NEAR FREDERICKSBURG, VA**	**Virginia**	1,595	**1985**	**2014**

Table 2. Chesapeake Bay nontidal monitoring stations. Load computations performed at all stations with a START DATE prior to 2011. Trend computations performed at all stations with START DATE prior to 2007.

[Bold stations represent the nine River Input Monitoring stations, mi^2, square mile.]

Map ID	USGS station number	USGS station name	Major watershed/region	Drainage area (mi^2)	Monitoring data	
					Start date	End date
64	01671020	NORTH ANNA RIVER AT HART CORNER NEAR DOSWELL, VA	Virginia	462	1985	2014
65	01671100	LITTLE RIVER NEAR DOSWELL, VA	Virginia	107	2001	2014
66	**01673000**	**PAMUNKEY RIVER NEAR HANOVER, VA**	**Virginia**	1,078	**1985**	**2014**
67	01673800	PO RIVER NEAR SPOTSYLVANIA, VA	Virginia	78	1987	2014
68	01674000	MATTAPONI RIVER NEAR BOWLING GREEN, VA	Virginia	256	1985	2014
69	**01674500**	**MATTAPONI RIVER NEAR BEULAHVILLE, VA**	**Virginia**	603	**1985**	**2014**
70	02011500	BACK CREEK NEAR MOUNTAIN GROVE, VA	Virginia	134	1985	2014
71	02015700	BULLPASTURE RIVER AT WILLIAMSVILLE, VA	Virginia	110	1985	2014
72	02020500	CALFPASTURE RIVER ABOVE MILL CREEK AT GOSHEN, VA	Virginia	141	1999	2014
73	02024752	JAMES RIVER AT BLUE RIDGE PKWY NR BIG ISLAND, VA	Virginia	3,076	2006	2014
74	02031000	MECHUMS RIVER NEAR WHITE HALL, VA	Virginia	95	1985	2014
75	02034000	RIVANNA RIVER AT PALMYRA, VA	Virginia	663	1985	2014
76	**02035000**	**JAMES RIVER AT CARTERSVILLE, VA**	**Virginia**	6,252	**1985**	**2014**
77	02037500	JAMES RIVER NEAR RICHMOND, VA	Virginia	6,753	1985	2014
78	02039500	APPOMATTOX RIVER AT FARMVILLE, VA	Virginia	302	1985	2014
79	02041000	DEEP CREEK NEAR MANNBORO, VA	Virginia	158	1991	2014
80	**02041650**	**APPOMATTOX RIVER AT MATOACA, VA**	**Virginia**	1,342	**1985**	**2014**
81	02042500	CHICKAHOMINY RIVER NEAR PROVIDENCE FORGE, VA	Virginia	251	1985	2014
82	01534000	TUNKHANNOCK CREEK NEAR TUNKHANNOCK, PA	Susquehanna	383	2007	2014
83	01549700	PINE CREEK BL L PINE CREEK NEAR WATERVILLE, PA	Susquehanna	944	2007	2014
84	01578475	OCTORARO CREEK NEAR RICHARDSMERE, MD	Susquehanna	177	2007	2014
85	01609000	TOWN CREEK NEAR OLDTOWN, MD	Potomac	148	2007	2014
86	01610155	SIDELING HILL CREEK NEAR BELLEGROVE, MD	Potomac	102	2007	2014
87	01651000	NORTHWEST BR ANACOSTIA RIVER NR HYATTSVILLE, MD	Potomac	49	2007	2014
88	01486000	MANOKIN BRANCH NEAR PRINCESS ANNE, MD	Eastern Shore	5	2011	2014
89	01493112	CHESTERVILLE BRANCH NEAR CRUMPTON, MD	Eastern Shore	6	2011	2014
90	01493500	MORGAN CREEK NEAR KENNEDYVILLE, MD	Eastern Shore	13	2011	2014
91	01511500	TIOUGHNIOGA RIVER AT ITASKA, NY	Susquehanna	730	2012	2014
92	01553700	CHILLISQUAQUE CREEK AT WASHINGTONVILLE, PA	Susquehanna	51	2012	2014
93	01555500	EAST MAHANTANGO CREEK NEAR DALMATIA, PA	Susquehanna	162	2012	2014
94	01565000	KISHACOQUILLAS CREEK AT REEDSVILLE, PA	Susquehanna	164	2012	2014
95	01571000	PAXTON CREEK NEAR PENBROOK, PA	Susquehanna	11	2012	2014
96	01573160	QUITTAPAHILLA CREEK NEAR BELLEGROVE	Susquehanna	74	2012	2014
97	01573695	CONEWAGO CREEK NEAR BELLAIRE, PA	Susquehanna	21	2011	2014
98	01573710	CONEWAGO CREEK NEAR FALMOUTH, PA	Susquehanna	48	2011	2014
99	01575585	CODORUS CREEK NEAR PLEASUREVILLE, PA	Susquehanna	267	2012	2014
100	15765195	BIG SPRING RUN NEAR MYLIN CORNERS, PA	Susquehanna	2	2011	2014
101	01576767	PEQUEA CREEK NEAR RONKS, PA	Susquehanna	70	2012	2014
102	01577500	MUDDY CREEK AT CASTLE FIN, PA	Susquehanna	133	2013	2014
103	01581752	PLUMTREE RUN NEAR BEL AIR, MD	Western Shore	3	2012	2014
104	0158175320	WHEEL CREEK NEAR ABINGDON, MD	Western Shore	1	2011	2014
105	01593500	LITTLE PATUXENT RIVER AT GUILFORD, MD	Western Shore	38	2011	2014
106	01595300	ABRAM CREEK AT OAKMONT, WV	Potomac	43	2012	2014
107	01601100	WILLS CREEK AT ELLERSLIE, MD	Potomac	185	2012	2014
108	01613030	WARM SPRINGS RUN NEAR BERKELEY SPRINGS, WV	Potomac	7	2011	2014
109	01614000	BACK CREEK NEAR JONES SPRINGS, WV	Potomac	235	2012	2014
110	01616400	MILL CREEK AT BUNKER HILL, WV	Potomac	18	2011	2014
111	01618100	ROCKYMARSH RUN AT SCRABBLE, WV	Potomac	16	2011	2014
112	01636500	SHENANDOAH RIVER AT MILLVILLE, WV	Potomac	3041	2013	2014
113	01648000	ROCK CREEK AT SHERILL DRIVE AT WASHINGTON, DC	Potomac	62	2013	2014
114	01651770	HICKEY RUN AT NEW YORK AVENUE AT WASHINGTON, DC	Potomac	1	2013	2014
115	01651800	WATTS BRANCH AT WASHINGTON, DC	Potomac	3	2013	2014
116	01669520	DRAGON SWAMP AT MASCOT, VA	Virginia	109	2011	2014
117	01674182	POLECAT CREEK AT ROUTE 301 NEAR PENOLA, VA	Virginia	49	2012	2014

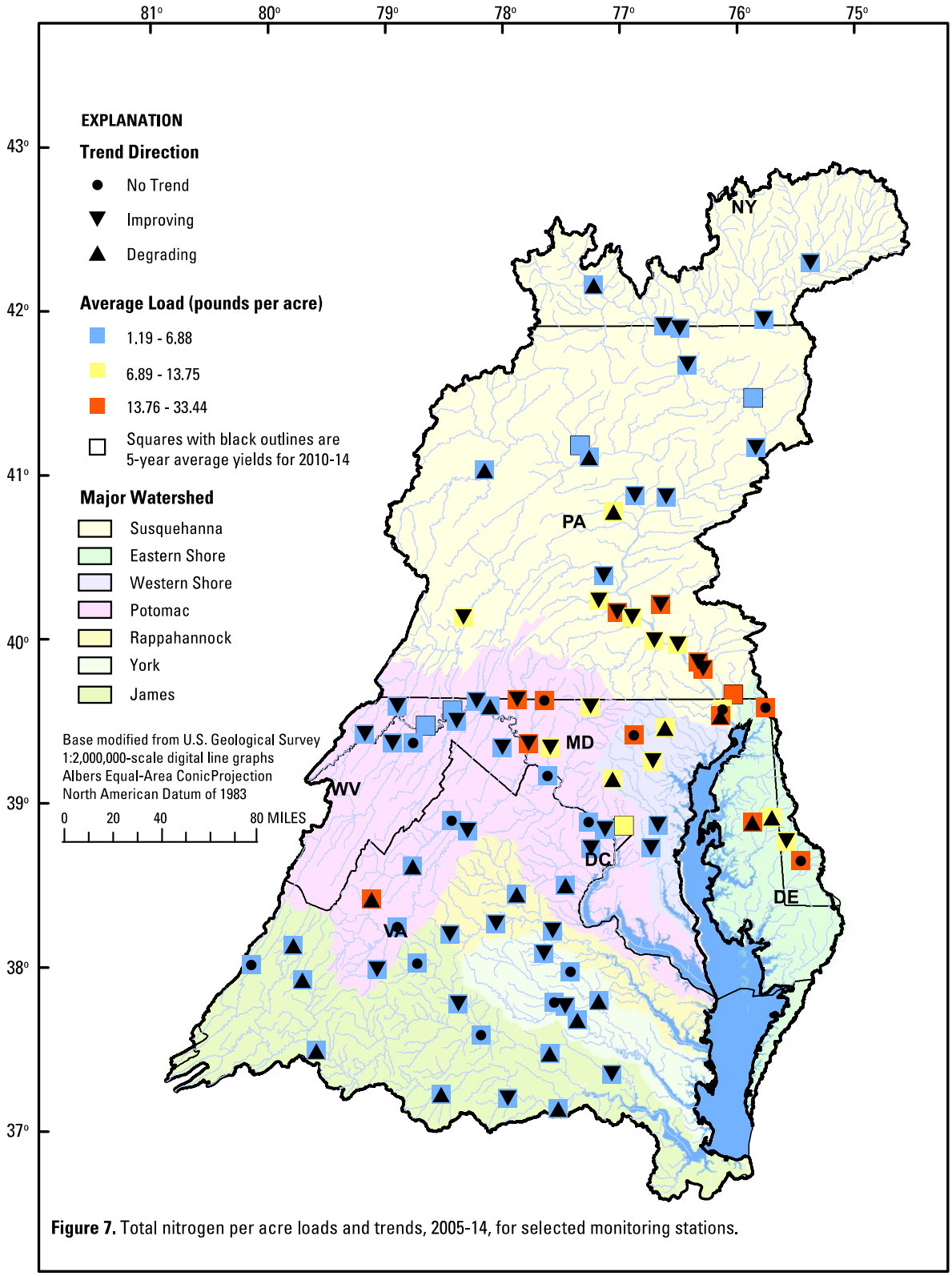

Figure 7. Total nitrogen per acre loads and trends, 2005-14, for selected monitoring stations.

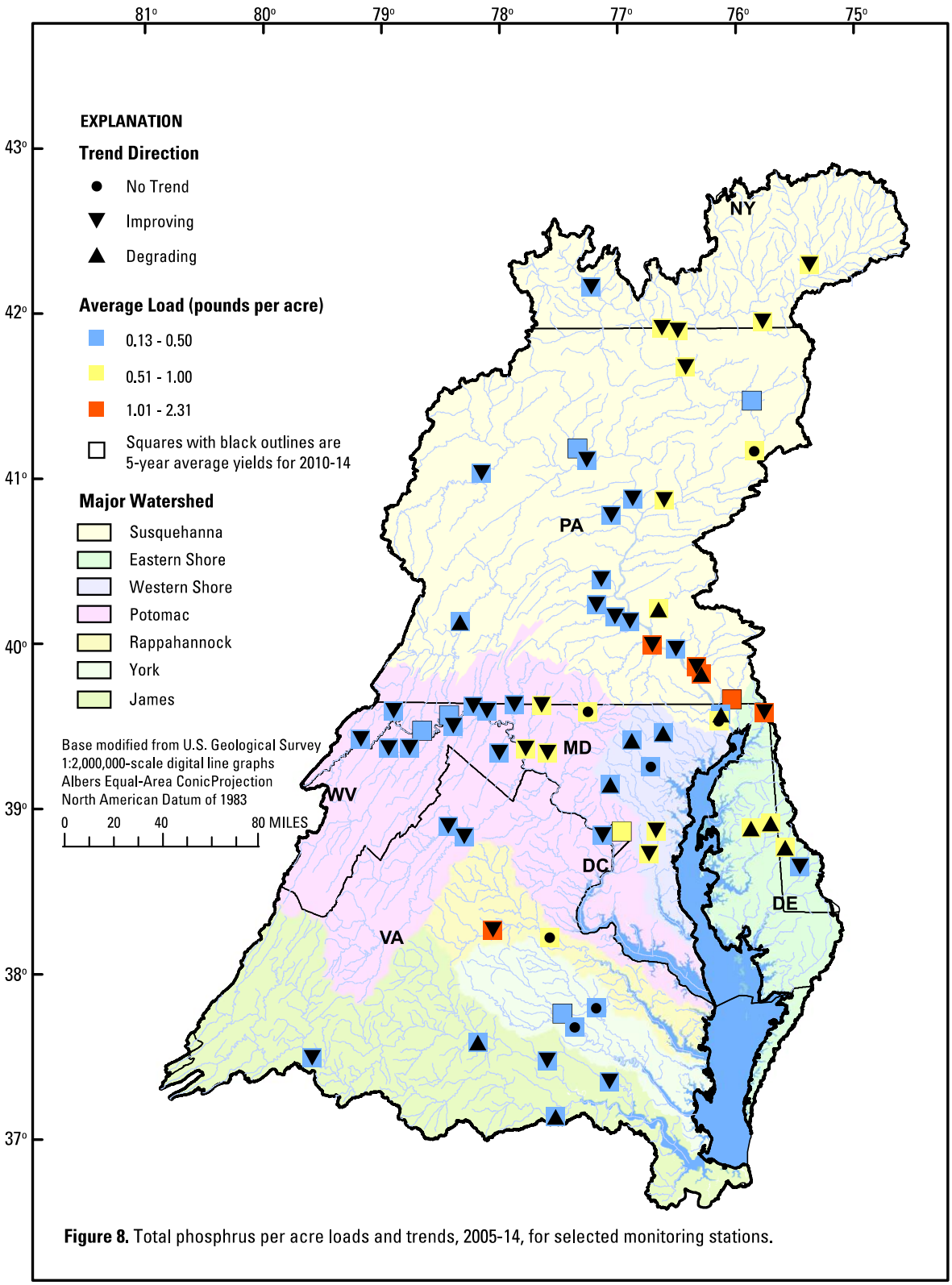

Figure 8. Total phosphrus per acre loads and trends, 2005-14, for selected monitoring stations.

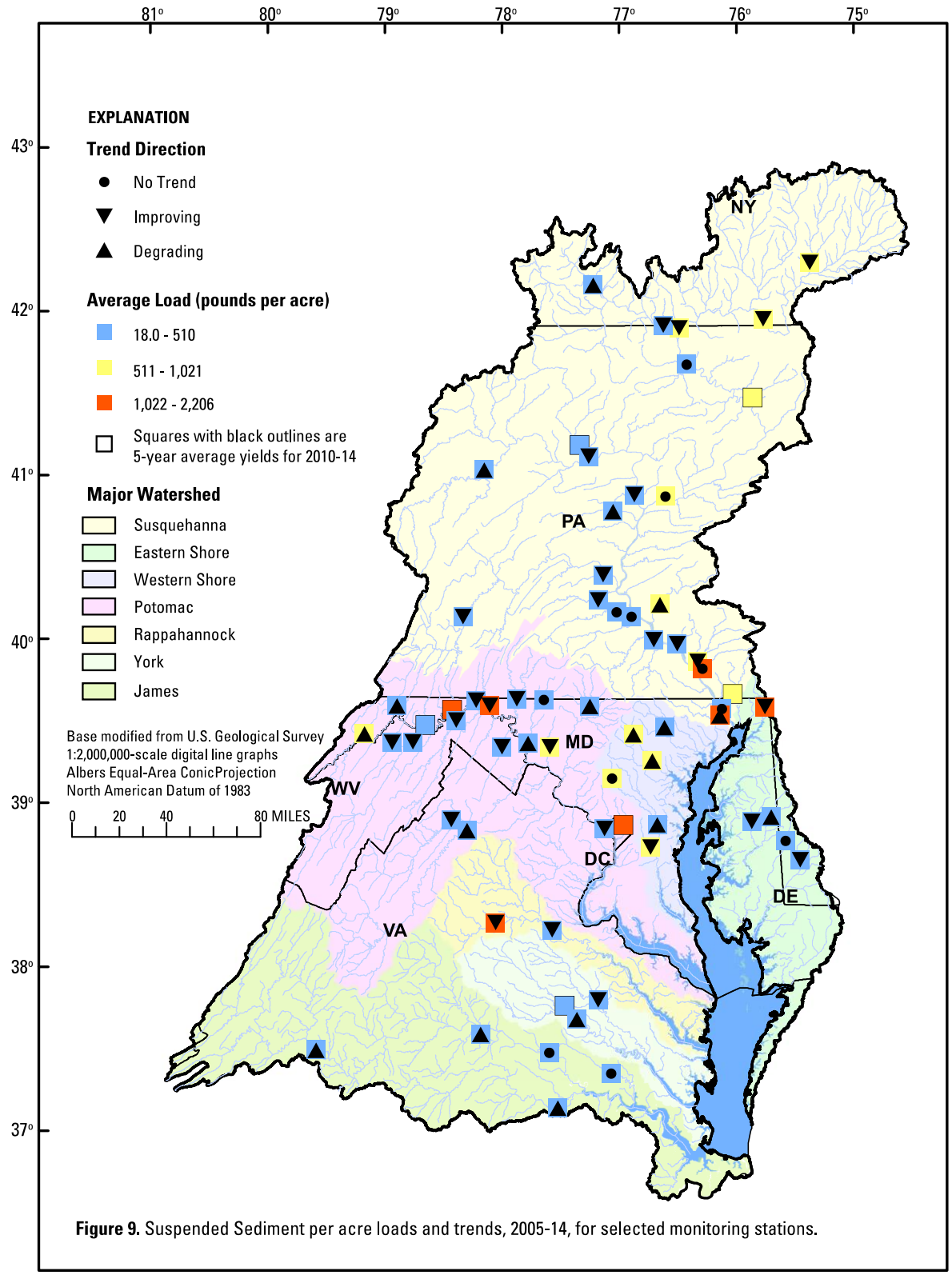

Figure 9. Suspended Sediment per acre loads and trends, 2005-14, for selected monitoring stations.