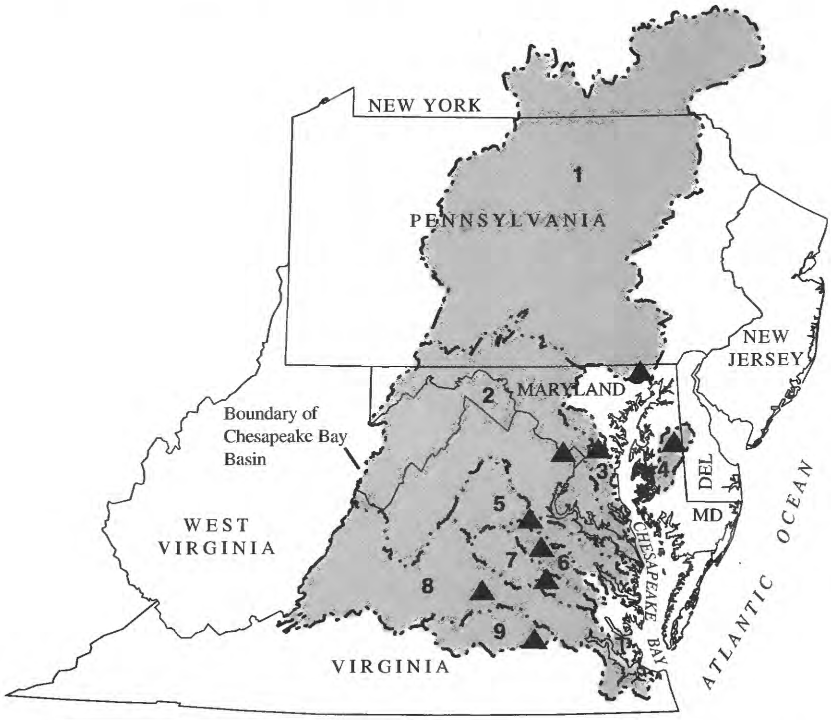
Fact Sheet

United States Geological Survey
Chesapeake Bay:
Measuring Pollution Reduction

The USGS provides maps, reports, and information to help others meet their needs to manage, develop, and protect America's water, energy, mineral, and land resources. We help find natural resources needed to build tomorrow, and supply scientific understanding needed to help minimize or mitigate the effects of natural hazards and environmental damage caused by human activities. The results of our efforts touch the daily lives of almost every American.

The Chesapeake Bay is the Nation's largest and most productive estuary. The economic, commercial, and recreational values of the Bay are threatened, however, by pollution entering it from its major tributaries. Each year, runoff from city streets, fertilizer-laden waters from farmlands, outflows from sewage-treatment plants, and airborne pollution carry large amounts of nitrogen and phosphorus into the rivers and ultimately the Bay. Nitrogen and phosphorus, also termed "nutrients," are pollutants because they nourish algal blooms that deprive Bay grasses of sunlight and deplete water of oxygen. This, in turn, kills fish and other plants and animals that make their home in the Bay, thereby affecting the commercial and recreational industries of Chesapeake Bay.

The U.S. Geological Survey (USGS), in cooperation with the Maryland Department of the Environment, the Metropolitan Washington Council of Governments, and the Virginia Department of Environmental Quality, is studying the amount of nutrient pollution that enters Chesapeake Bay annually from its major tributaries (fig. 1). Results of the study are used to determine whether steps taken to reduce the amount of pollution entering the Bay are working.



	RIVER BASIN	TRENDS (1985 — 93) Nitrogen	Phosphorus
1	SUSQUEHANNA	▲	▼
2	POTOMAC	▲	▼
3	PATUXENT	▼	▼
4	CHOPTANK	▲	—
5	RAPPAHANNOCK	—	—
6	MATTAPONI	*	*
7	PAMUNKEY	—	—
8	JAMES	—	▲
9	APPOMATTOX	*	—

EXPLANATION
- ▲ River sample sites
- ▲ Increase
- ▼ Decrease
- — No change
- * Insufficiant data

Figure 1. Location of major tributaries to Chesapeake Bay and sample sites and trends in nitrogen and phosphorus levels in each tributary.

How Much Nutrient Pollution Enters the Bay Each Year From Its Major Tributaries?

The Bay's nine largest tributaries contribute 93 percent of the total fresh water to Chesapeake Bay. The Susquehanna River is the Bay's largest tributary and, on average, contributes more than one-half of the freshwater that enters the Bay. The Potomac and the James Rivers are the next two largest tributaries entering the Bay. From 1990 through 1992, 600 million pounds of nitrogen entered Chesapeake Bay from its nine major tributaries. Most of that nitrogen (97 percent) came from the Susquehanna, the Potomac, and the James Rivers (fig. 2).

The largest amount of nitrogen entering the Bay is contributed by the Susquehanna River, which drains some of the most productive agricultural land in the Nation. The sources of nutrient pollution from agricultural land are fertilizer and animal waste. In general, the amount of nitrogen entering the Bay from each tributary is related to the area of agricultural land drained by that tributary and its contribution of water to the Bay.

Approximately 30 million pounds of phosphorus entered the Bay from its nine major tributaries from 1990 through 1992. About 90 percent of that amount came from the Susquehanna, the Potomac, and the James Rivers (fig. 2). The levels of phosphorus from the Potomac and the smaller rivers are related to their contribution of water to the Bay. Phosphorus lev-

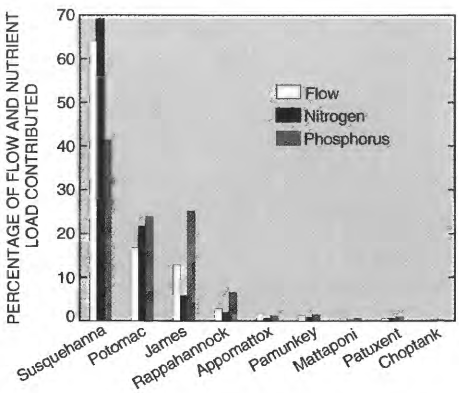


Figure 2. Relative contributions of flow and nutrient load from tributaries entering Chesapeake Bay, 1990–92.

els entering the Bay from the Susquehanna River are low in comparison to its water contribution. Phosphorus, which is bound to soil particles, gets trapped behind a series of dams in the river. The high level of phosphorus entering the Bay from the James River compared to its water contribution may be related to discharge from sewage-treatment plants.

What Is Being Done to Reduce Nutrient Pollution?

In 1987, the District of Columbia; the States of Maryland, Virginia, and Pennsylvania; and the Federal Government signed an agreement to reduce the amount of nitrogen and phosphorus entering the Bay by 40 percent by 2000. The pollution-reduction target was developed to improve and maintain the water quality of Chesapeake Bay and to ensure the productivity of the Bay's resources. Various pollution-reduction strategies were put into place by the States, including statewide bans on detergents with phosphorus; control of runoff from urban areas, farmland, and pastures; improvements in sewage treatment; and preservation of forest and wetlands, which act as buffers to nutrient-pollution inputs.

How Is Nutrient-Pollution Reduction Being Determined?

Water samples are collected from the Bay's nine largest tributaries to evaluate pollution-reduction strategies and to determine whether the goal of a 40-percent reduction in nitrogen and phosphorus is being met. The water samples are analyzed to determine the concentrations of nitrogen and phosphorus in each river. These concentration data are used along with continuous streamflow data collected at USGS stream-gaging stations on each tributary to estimate the total amounts of nitrogen and phosphorus transported each year to the Bay. Continuous monitoring provides a method to identify changes in concentrations and amounts of nutrients that have occurred over the years in response to pollution-reduction programs.

Are the Steps Taken to Reduce Nutrient Pollution Working?

Pollution-reduction measures are evaluated by comparing concentrations of nitrogen and phosphorus in water samples that have been collected for a long period of time. If reduction measures are working, then nutrient pollution should decrease. Water samples from 1985 to 1993 show a general decrease in phosphorus levels and a general increase in nitrogen levels (fig. 1).

Pollution-reduction strategies are having a positive impact on phosphorus levels in the Susquehanna, the Potomac, and the Patuxent Rivers. Controls directed at reducing agricultural and urban erosion also contribute to the lower phosphorus levels seen in these tributaries.

Despite the success of phosphorus-reduction efforts in the Susquehanna, the Potomac, and the Patuxent Rivers, nitrogen is increasing in the Susquehanna and the Potomac Rivers, although the data indicate that the rate of increase has slowed significantly. The increase in nitrogen is probably caused by the continued use of nitrogen fertilizer on lawns and cropland, growing agricultural animal populations and associated wastes, and atmospheric deposition of nitrogen from industrial and automotive air pollution. Much of the nitrogen from these sources dissolves in water and slowly moves underground through the soil and into the ground water, where it discharges into rivers and eventually the Bay. The effect of nitrogen reduction may take decades to see because of the slow movement of nitrogen in the ground water. As a result, the effect of nitrogen-control efforts will take much longer to appear in the rivers than the effects of controlling phosphorus, which is attached to soil particles and is transported primarily in surface-water runoff. In the case of the Patuxent River, nitrogen is decreasing primarily because of improved technology at the eight major sewage-treatment plants that discharge to the river.

Although progress has been made in reducing phosphorus and nitrogen in some rivers, continued reductions will have to be made to offset increases in population growth in the Chesapeake Bay Basin. Continued water-quality monitoring of the rivers will be needed to assess the effectiveness of new technology and strategies aimed at reducing nutrient pollution, thereby restoring the economic, commercial, and recreational productivity of Chesapeake Bay.

—Linda D. Zynjuk

For more information contact any of the following:

Chesapeake Bay Program Coordinator
U.S. Geological Survey
208 Carroll Building
8600 LaSalle Road
Towson, Maryland 21286
(410) 512-4900

Additional earth science information can be found by accessing the USGS "Home Page" on the World Wide Web at "http://www.usgs.gov" or by calling 1-800-H2O-9000 (1-800-426-9000).

For more information on all USGS reports and products (including maps, images, and computerized data), call 1-800-USA-MAPS.

U.S. Department of the Interior
U.S. Geological Survey
Fact Sheet FS-055-95

☆ U.S. GOVERNMENT PRINTING OFFICE: 1995--647-571