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Willamette Basin (Circular 1161)

National Assessments

The Quality of Our Nation's Waters—Nutrients and Pesticides (Circular 1225)

Front cover: Areal view of confluence of the Allegheny and Monongahela Rivers forming the Ohio River at Pittsburgh, Pennsylvania. *(Photograph by Jim Schafer.*)

Back cover: Left, The headwaters of the Allegheny River, Potter County, Pa. *(photograph by Jim Schafer*); center, Whitewater rafting on the Cheat River, West Virginia (*photograph by Randy Robinson*); right**,** agricultural fields and forest in the hills above the Allegheny River, Armstrong County, Pa. *(photograph by Jim Schafer*).

Water Quality in the Allegheny and Monongahela River Basins

Pennsylvania, West Virginia, New York, and Maryland, 1996–98

By Robert M. Anderson, Kevin M. Beer, Theodore F. Buckwalter, Mary E. Clark, Steven D. McAuley, James I. Sams, III, *and* Donald R. Williams

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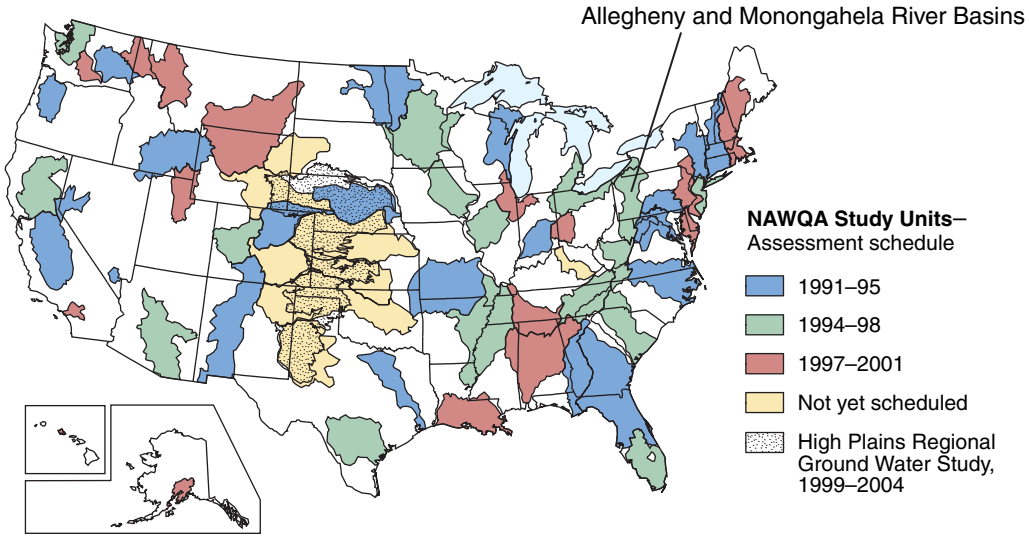
CONTENTS

THIS REPORT summarizes major findings about water quality in the Allegheny and Monongahela River Basins that emerged from an assessment conducted between 1996 and 1998 by the U.S. Geological Survey (USGS) National Water-Quality Assessment (NAWQA) Program. Water quality is discussed in terms of local and regional issues and compared to conditions found in all 36 NAWQA study areas, called Study Units, assessed to date. Findings are also explained in the context of selected national benchmarks, such as those for drinking-water quality and the protection of aquatic organisms. The NAWQA Program was not intended to assess the quality of the Nation's drinking water, such as by monitoring water from household taps. Rather, the assessments focus on the quality of the resource itself, thereby complementing many ongoing Federal, State, and local drinking-water monitoring programs. The comparisons made in this report to drinking-water standards and guidelines are only in the context of the available untreated resource. Finally, this report includes information about the status of aquatic communities and the condition of in-stream habitats as elements of a complete water-quality assessment.

Many topics covered in this report reflect the concerns of officials of State and Federal agencies, water-resource managers, and members of stakeholder groups who provided advice and input during the Allegheny and Monongahela River Basins assessment. Study-area residents who wish to know more about water quality in the areas where they live will find this report informative as well.



THE NAWQA PROGRAM seeks to improve scientific and public understanding of water quality in the Nation's major river basins and ground-water systems. Better understanding facilitates effective resource management, accurate identification of water-quality priorities, and successful development of strategies that protect and restore water quality. Guided by a nationally consistent study design and shaped by ongoing communication with local, State, and Federal agencies, NAWQA assessments support the investigation of local issues and trends while providing a firm foundation for understanding water quality at regional and national scales. The ability to integrate local and national scales of data collection and analysis is a unique feature of the USGS NAWQA Program.

The Allegheny and Monongahela River Basins are one of 51 water-quality assessments initiated since 1991, when the U.S. Congress appropriated funds for the USGS to begin the NAWQA Program. As indicated on the map, 36 assessments have been completed, and 15 more assessments will conclude in 2001. Collectively, these assessments cover about half of the land area of the United States and include water resources that are available to more than 60 percent of the U.S. population.

Stream and River Highlights

Streams and rivers in the Allegheny and Monongahela River Basins range from those of high quality that support diverse aquatic life to those that are seriously degraded and support few aquatic species and few human uses of the water. Higher quality stream reaches are generally in the northern one-third of the study area and in mountainous areas in eastern sections. These areas are dominated by forest, low-intensity agriculture, and rural communities. Urban development and coal-mining activities through much of the basins have had a significant influence on water quality and aquatic life. Industrial activity in small and large towns has resulted in contaminated streambed sediments and contaminated fish. Acid- and(or) mineral-laden mine drainage from abandoned coal mines is one of the most serious and persistent water-quality problems in the basins, limiting water use and aquatic resources.

- Sulfate concentrations were 5 times greater in streams draining mined areas than in streams draining unmined areas. Sulfate concentration is closely related to coal production in the sampled basins but not as clearly related to pH or dissolved metal concentration. (See page 6.)
- Since 1980, treatment of drainage from active and abandoned mines has generally resulted in improved water quality, with increased pH and lower metal and sulfate concentrations, but diversity and abundance of aquatic organisms remain reduced in comparison to unmined areas. (See pages 7, 20, and 21.)
- Zinc in bed sediment exceeded aquatic-life guidelines at 15 of 50 sites. (See page 9.)
- Arsenic concentrations most often exceeded aquatic-life guidelines in bed sediment in streams draining northern, once glaciated areas, and high concentrations appear to be unrelated to human activity. (See page 10.)
- Streams in forested settings are among the most diverse nationally with respect to aquatic insects among NAWQA sites sampled between 1996 and 1998. (See page 8.)
- A group of now-banned industrial chemicals, polychlorinated biphenyls (PCBs), was detected in 43 percent of sediment and fish-tissue samples. Consumption advisories are in place for several fish species because of PCB and chlordane contamination in some large river reaches. (See pages 11 and 12.)
- Some of the most degraded stream reaches have, since the early 1900s, supported few aquatic organisms. Yet, the quality of many reaches is now improving, and abundant fish and invertebrate populations include sensitive species not seen here in decades. (See page 11.)

The Allegheny and Monongahela River Basins drain 19,145 square miles of Pennsylvania, West Virginia, New York, and Maryland. About 64 percent of the study area is forested; the remainder is a patchwork of land uses. Agriculture (30 percent) is commonly low intensity pasture, dairy, and hay. Urban areas account for about 4 percent of the area, but they include many forested ridges. Coal-mining activities influence water quality in most of the study area but are not visible on this surface land-use map. (Land-use coverage is based on 1991, 1992, and 1993 land-use data.)

Major Influences on Streams and Rivers

- Surface, underground, reclaimed, and abandoned coal mines
- Impoundments and maintenance of navigation channels
- Increased urban development
- Reductions in agriculture, industrial activity, and coal production

- In sampled streams in basins dominated by urban or agricultural land, pesticides and volatile organic compounds (VOCs) were commonly detected, although generally at concentrations meeting drinking-water and aquatic-life standards and guidelines. (See pages 12–13 and 15–17.)
- Pesticide concentrations in stream water exceeded drinking-water guidelines in single samples from each of two basins, one dominated by agriculture and the other dominated by urban land use. (See pages 12 and 13.)

Ground-Water Highlights

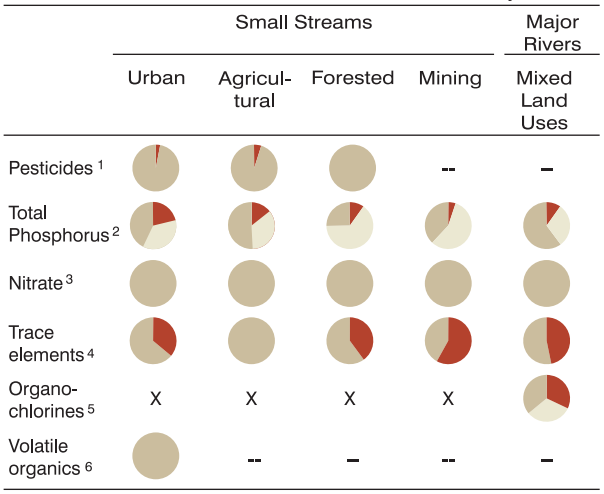
Although not regulated, the quality of water from domestic wells—the predominant water source for residents of rural areas—meets Federal standards for drinking water for most substances analyzed in this study. Ground-water supply generally meets or exceeds expectations from wells in the highly permeable glaciofluvial deposits of the valley-fill aquifers in the northwest. Ground-water supply often meets needs but can be meager from wells tapping the water-filled fractures of the fractured-rock aquifers present throughout much of the rest of the study area.

- Compared to ground water in unmined areas of the coal-bearing rocks, water in shallow private domestic wells near reclaimed surface coal mines had higher concentrations of sulfate, iron, and manganese, even after all mining and reclamation had been completed. (See pages 9 and 21.)
- Pesticides were detected more frequently in the valley-fill aquifers of the glacial sediments than in fractured-rock aquifers. (See pages 13-15.)
- Overall, VOCs were detected at very low levels in the 95 ground-water samples analyzed. Gasoline-related compounds were detected slightly more frequently and at slightly higher concentrations in ground water near reclaimed surface coal mines than near unmined areas. (See pages 16 and 17.)
- Nitrate was detected in 62 percent of sampled wells, although only one domestic-well sample exceeded the drinking-water standard for nitrate. (See pages 17 and 18.)
- Radon was detected at levels exceeding the proposed Federal drinking-water standard of 300 pCi/L (picocuries per liter) in 56 percent of the ground-water samples. The proposed alternative standard (4,000 pCi/L) was exceeded in 2 percent of the samples. (See page 19.)

Major Influences on Ground Water

- Coal mining
- Pesticide and fertilizer application
- Widespread use of gasoline and oxygenates
- Naturally occurring concentrations of radon

Selected Indicators of Stream-Water Quality



Percentage of samples with concentrations **equal to or greater than** a health-related national guideline for drinking water, aquatic life, or water contact recreation; or above the USEPA goal for preventing excess plant growth in streams

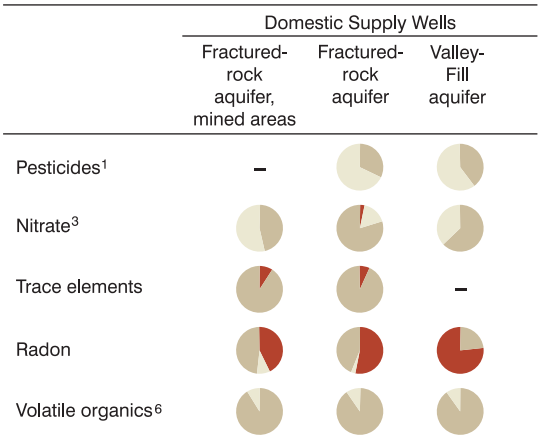
Percentage of samples with concentrations **less than** health-related national guideline for drinking water, aquatic life, or water-contact recreation; or below a national goal for preventing excess algal growth

Percentage of samples with **no detection**

-- Not assessed

X Settings with less than 4 samples are not shown

Selected Indicators of Ground-Water Quality



Percentage of samples with concentrations **equal to or greater than** a health-related national guideline for drinking water

Percentage of samples with concentrations **less than** health-related national guideline for drinking water

Percentage of samples with **no detection**

– Not assessed

[1] Insecticides, herbicides, and pesticide breakdown products, sampled in water.
[2] Total phosphorus, sampled in water.
[3] Nitrate (as nitrogen), sampled in water.
[4] Arsenic, mercury, and metals, sampled in sediment.
[5] Organochlorine compounds including DDT and PCBs, sampled in fish tissue.
[6] Solvents, refrigerants, fumigants, and gasoline compounds, sampled in water.

INTRODUCTION TO THE ALLEGHENY AND MONONGAHELA RIVER BASINS

The Allegheny and Monongahela Rivers join at Pittsburgh, Pa., forming the Ohio River. Historically, these rivers served as a transportation corridor to the West and were of strategic military significance. The Allegheny and Monongahela River Basins were at the focus of the industrial revolution in the United States. In 1990, approximately 4.2 million people lived in the area, and although the land and water uses have changed many times, the legacy of past activities is evident. Today's stream quality reflects a blend of past and present land uses and the natural quality and quantity of the water in these basins.

Topography and Geology

The Allegheny and Monongahela River Basins (ALMN) lie almost entirely within the Appalachian Plateaus Physiographic Province. The entire study area is underlain by sedimentary rocks that have been fractured in many places by folding and faulting. These rocks carry ground water in much of ALMN and are referred to as fractured-rock aquifers. The northwestern parts of the Allegheny River Basin were glaciated. The glaciers deposited sand, gravel, silt, and clay in the valleys and eroded the hills, leaving a terrain of more consistent altitude (Becher, 1999; McAuley, 1995). The glaciofluvial and alluvial deposits overlying the sedimentary rocks are generally much more permeable and comprise the valley-fill aquifers (Risser and Madden, 1994). Glaciofluvial deposits include sediments left by water flowing within, under, or out of glaciers. In contrast, the Appalachian highlands to the east and southeast have steep, high peaks, ridges, and plateaus that are deeply divided by valleys (fig. 1).

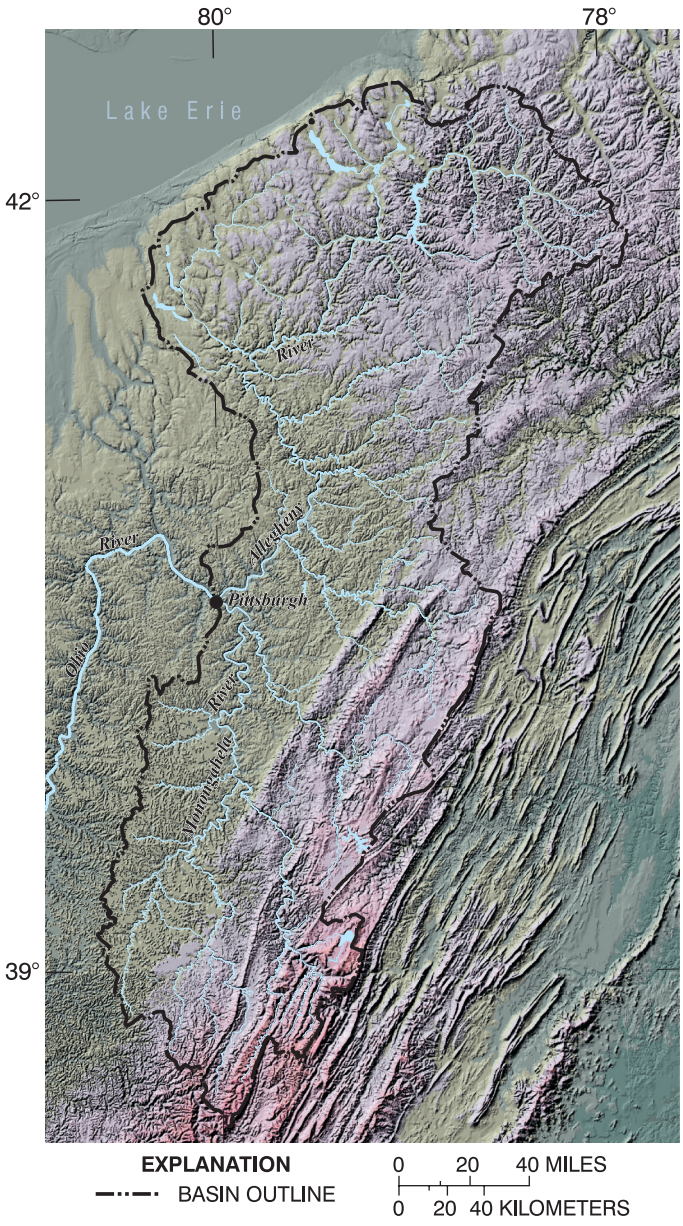


Figure 1. The Allegheny and Monongahela River Basins lie almost entirely within the Appalachian Plateaus Physiographic Province. The eastern parts of the basins are more mountainous, the west is characterized by "rolling hills," and the northwest has relatively low relief as a result of being covered by glaciers in the last ice age.The topography affects land use, exposed geologic formations, and stream habitat—all of which, in turn, affect the quality and uses of water.

Land use is limited by the rough terrain and nutrient-poor soil in much of ALMN, both of which make large agricultural fields impractical. Urban areas generally lie along river valleys. Ridgetops are commonly forested, even in otherwise urban settings.

Ecologically, the streams of these basins present a diversity of habitats. Mountainous areas are generally dominated by streams

that are very low in nutrients and remain cold all year. These streams support trout and a few other cold-water fish species but commonly include diverse aquatic-invertebrate populations. Streams along the western side of ALMN are generally warm-water systems with a much greater diversity of fish species.

Water Use

Most water (94 percent) used in ALMN is drawn from surface-water sources. In 1995, 82 percent of water withdrawn in ALMN was for industrial uses or thermoelectric power generation. Although ground-water withdrawals are proportionally small, they are important for public supply or domestic use, especially in rural areas (fig. 2).

Reservoirs have been in place in the study area for more than 150 years for flood control (fig. 3), recreation, navigation, power generation, water quality, and water supply. Nearly all major tributaries have reservoirs constructed on them. The entire length of the Monongahela River and the lower 72 miles of the Allegheny River are maintained for navigation by dams. During dry periods, low streamflows are augmented by reservoir releases to dilute degraded water (Ohio River Basin Commission, 1980).

Nonconsumptive use of the water resource also is extensive in ALMN. Some streams are managed for whitewater sports, boating, or fishing, and some high-quality stream reaches are important for conservation and management of endangered species.

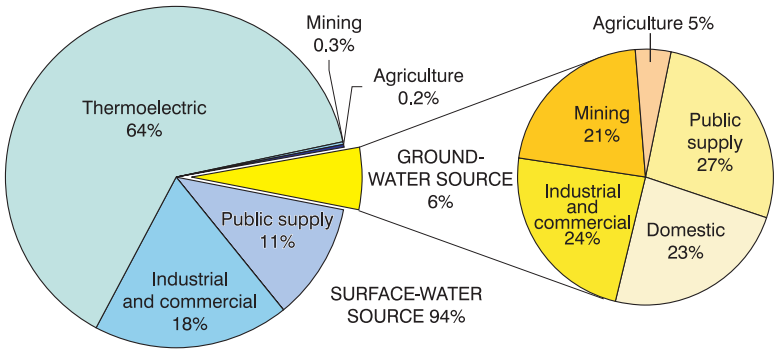


Figure 2. In 1995, water withdrawn averaged 3,284 million gallons per day. In the Pittsburgh area, nearly all water used for public supply is surface water. Ground water provides water for domestic use in most rural areas.

Hydrologic conditions

Although streamflow roughly followed normal patterns during 1996–98, flows were substantially higher or lower than normal for short periods in response to weather extremes (fig. 4). Hence, the ALMN water-quality data set includes responses to a wide range of flows while still being largely representative of normal conditions.

Figure 3. One of the most devastating floods in United States history occurred in the Allegheny River Basin on May 31, 1889. A dam upstream from Johnstown, Pennsylvania, failed. Downstream, 2,209 people were killed and thousands more were injured. (Photograph used with permission from the National Park Service.)

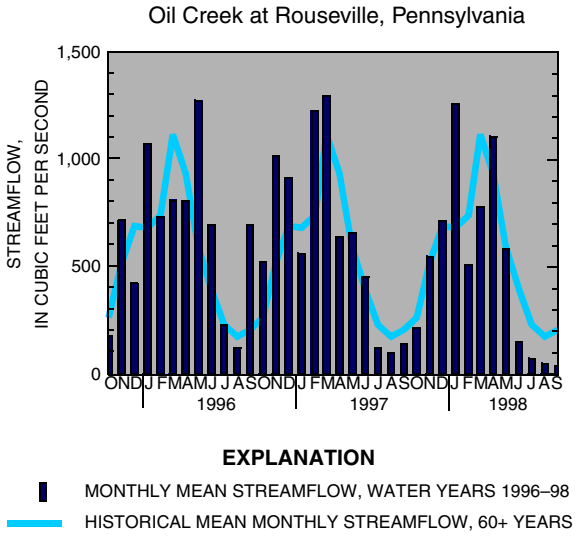


Figure 4. Streamflow was above average in 1996–97 and below average in summer 1998.