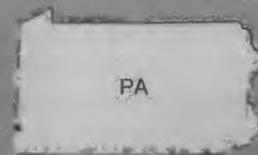


United States Geological Survey Programs in Pennsylvania



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.

Environmental and Human Health Issues

Major environmental and human health issues in Pennsylvania include the following:

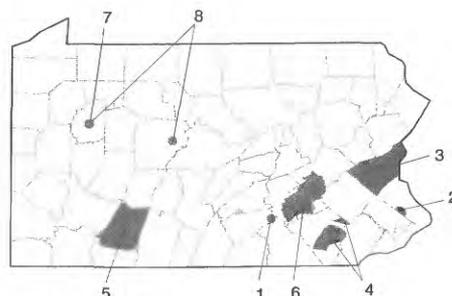
- Contamination of the environment by hazardous wastes
- Adequacy of good-quality water supplies
- Nutrient input to streams and estuaries
- Effects of coal mining, oil and gas production, and agriculture on the environment
- Atmospheric deposition (acid rain)

This fact sheet describes how the U.S. Geological Survey (USGS) is addressing these and other issues.

Contamination of Water by Hazardous Wastes

The USGS, in cooperation with the U.S. Department of Defense (DOD) and the U.S. Environmental Protection Agency (USEPA), has studied the distribution, fate, and transport of hazardous wastes at numerous sites in Pennsylvania. For example, a USGS study for DOD at the U.S. Navy Ships Parts Control Center in Cumberland County (fig. 1, site 1) quantified stream-flow and contaminated sediment losses to sinkholes in a stormflow-drainage channel.

In the Hatboro area of Bucks and Montgomery Counties, the USGS, in cooperation with the USEPA, conducted a study of ground-water contamination centered around an industrial area established before 1945 (fig. 1, site 2). The area is underlain by the Stockton Formation, which consists of sandstone and siltstone. Most public-supply, industrial, and monitoring wells drilled before 1991 are open boreholes that obtain water from several water-bearing zones. These wells commonly short circuit the



EXPLANATION

1. U.S. Navy Ships Parts Control Center
2. Hatboro area
3. Lehigh-Northampton Counties
4. Lancaster County
5. Stonycreek River Basin
6. Swatara Creek Basin
7. Clarion County
8. Clarion and Clearfield Counties

Figure 1. Locations of example U.S. Geological Survey studies.

ground-water-flow system and act as conduits for the transport of contaminants between water-bearing zones (fig. 2).

USGS scientists used a combination of borehole-geophysical methods, measurements of vertical borehole flow, and analyses of borehole-fluid samples to identify and assess aquifer cross-contamination in the Hatboro area. Borehole-geophysical methods were used to identify zones of fluid movement, and borehole-flow mea-

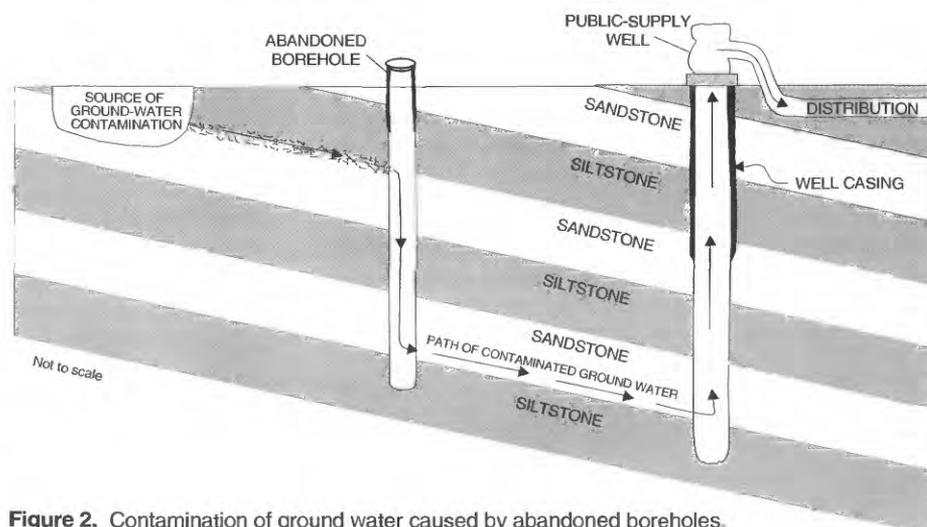


Figure 2. Contamination of ground water caused by abandoned boreholes.

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surements provided data on the direction and rate of fluid movement. Sampling and chemical analysis showed that the downward-moving borehole fluid was contaminated with volatile organic compounds. In nine open boreholes, about 15 gallons per year of these compounds were moving downward from the contaminated upper part of the aquifer to the lower part of the aquifer, which is tapped by public-supply wells. Trichloroethylene, which is an industrial degreaser, accounts for 94 percent of the compounds. In response to the study results, five of the sampled boreholes plus four others, were cased and screened. The remaining four sampled

boreholes were reconstructed by the USGS so that they are now open only to a single water-bearing zone. The aquifer cross-contamination problem caused by known boreholes and the associated threat to ground-water quality was eliminated.

Geologic and Hydrologic Mapping

Bedrock and surficial geologic maps and hydrologic maps are prepared by the USGS. These maps are essential for studies of water contamination, resource availability, environmental effects of mineral extraction, hazard mitigation, and land-use management.

Wellhead Protection

The USGS has assisted the Pennsylvania Department of Environmental Resources in implementing a wellhead-protection strategy by providing an evaluation of methods used to delineate areas contributing water to wells in various hydrologic settings. This effort helps local jurisdictions develop regulations to protect public ground-water supplies from contamination. For example, the Lehigh-Northampton County Joint Planning Commission, with assistance from the USGS, has developed a wellhead-protection strategy (fig. 1, site 3). Geologic maps have been used to prepare several geographic information system data layers, including a regional pollution-potential map. Additionally, USGS publications are used for the Commission's public outreach activities.

Effects of Agricultural Practices on Water Quality

Agriculture is a source of sediment, nutrients, and herbicides to water resources. USGS studies in agricultural areas in the lower Susquehanna River Basin, which drains to Chesapeake Bay, have documented accelerated erosion of cropland and streambanks, high concentrations of nitrogen and phosphorus in streams that create conditions detrimental to aquatic life, and elevated concentrations of nitrogen and herbicides in ground water that pose potential human and livestock health hazards.

A USGS study in Lancaster County

(fig. 1, site 4) showed that in ground water in areas underlain by carbonate rock, where intensive agricultural practices are concentrated, the criterion for nitrate in ground water was exceeded in about 75 percent of the wells sampled, and the herbicide atrazine was present in low concentrations in about 40 percent of the wells sampled. Concentrations of nitrogen and phosphorus in the streams were consistently greater than concentrations known to cause eutrophic conditions, and concentrations of nitrate and herbicide commonly exceeded criteria for drinking water. Ground-water discharge contributed about 65 percent of the nitrogen in streamwater. About 75 percent of the phosphorus and more than 95 percent of the sediment in the stream were from storm runoff. The effects of agriculture on yields of nitrate and total phosphorus in selected streams is shown in figure 3. Reservoirs on the Susquehanna River have helped to trap some of the sediment, nitrogen, and phosphorus before it enters Chesapeake Bay. However, USGS data indicate that all the mainstream reservoirs are nearly filled with sediment and thus cannot continue to trap pollutants

indefinitely.

The USGS evaluated agricultural-management practices in the Conestoga River headwaters in Lancaster County as part of a national U.S. Department of Agriculture program supported by many Federal, State, and local agencies, such as the USEPA, the Pennsylvania Department of Environmental Resources, and the Lancaster County Conservation District. At a farm field where pipe-outlet terraces were constructed, USGS scientists found reduced soil erosion, but nitrogen and phosphorous losses to surface runoff did not differ significantly before and after terracing. However, concentrations of nitrate in water in four of the six wells at this site increased following terracing. At a nearby farm field, implementation of nutrient management, which is a practice of balancing fertilizer applications with crop needs, resulted in a 25-percent reduction in fertilizer applications. Concentrations of nitrate in water from three of four wells at this site decreased after nitrogen applications decreased. Nutrient management also stopped the upward trend in concentrations of nitrate in surface water.

Coal Mine Discharges

Acidic drainage from abandoned and active coal mines has contaminated thousands of miles of streams and associated ground water in Pennsylvania and is the most extensive water-pollution problem in the State. Elevated concentrations of sulfate and metals make the water unfit for most uses and are toxic to aquatic organisms. USGS studies have documented the extent of surface- and ground-water contamination associated with bituminous coal mining in western Pennsylvania and anthracite coal mining in eastern Pennsylvania and have evaluated the effects of mining and reclamation practices and water-treatment methods intended to reduce contamination. These studies have been supported by funds and services from the U.S. Environmental Protection Agency, the Office of Surface Mining, the Pennsylvania Department of Environmental Resources, the Philadelphia Water Department, and the Somerset County Conservation District. Coal companies and the Pennsylvania State University also have participated in these studies.

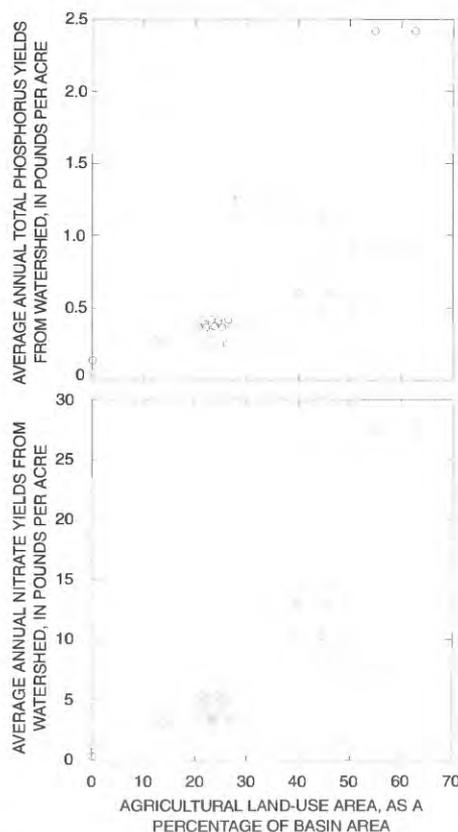


Figure 3. Average annual dissolved nitrate and total phosphorus yields as a function of agricultural land-use area in selected streams in the Susquehanna River Basin.

USGS studies provide a basis for identifying discharges and selecting remedial actions. In the Stonycreek River Basin in Somerset and Cambria Counties (fig. 1, site 5), a streamflow model that simulates chemical reactions is being tested to determine the cumulative downstream effects of treatment of selected discharges in the basin. In the Swatara Creek Basin in Schuylkill County (fig. 1, site 6), chemical reactions within different mine-drainage treatment systems are being evaluated to resolve uncertainties about the optimum design of treatment systems.

A recent USGS study evaluated the effects of selective handling of acid-forming materials on ground-water quality at a surface coal mine in Clarion County (fig. 1, site 7). Potentially acidic rock was segregated during mining and subsequently buried in mine backfill as compacted layers below the plant root zone but above the water table. Selective handling did not significantly affect concentrations of metals in ground water at the mine studied.

USGS studies also have evaluated the effects of surficially applied alkaline materials and sewage sludge on ground-water quality at four mines in Clarion and Clearfield Counties (fig. 1, site 8). Additions of alkaline materials typically were inadequate to neutralize acidity from oxidation reactions within the mine spoil. Research into procedures for preventing acid-forming oxidation reactions by adjusting quantities and combinations of alkaline additives and nutrients is continuing.

National Water-Quality Assessment Program

The long-term goals of the National Water-Quality Assessment (NAWQA) Program of the USGS are to describe the status and trends in the quality of a large representative part of the Nation's surface- and ground-water resources and to identify the natural and human factors that affect their quality. The NAWQA Program will produce a wealth of water-quality information that will be useful to policymakers and water managers at the local, State, and national levels.

Three NAWQA Program studies are underway for river basins in Pennsylvania—the lower Susquehanna, the Poto-

mac, and the Ohio (Allegheny and Monongahela) (fig. 4). A NAWQA Program study of the Delaware River Basin (fig. 4) is scheduled to begin in 1997. Communication and coordination among the USGS and other water-resource agencies are key components of the NAWQA Program studies. As the results of these studies become available, they will be disseminated in a variety of technical and nontechnical reports to local, State, and Federal agencies and the public.

One critical requirement of the NAWQA Program is up-to-date information on land use/land cover to determine their influence on water quality. The USGS, in cooperation with several other Federal agencies, is acquiring satellite image data for the entire United States. After these data are processed according to a consistent standard, they are forwarded to NAWQA Program projects, as well as to other water-resource agencies, for water-quality research and related applications.

Coal Availability

Conventional Federal and State coal-resource estimates do not account for the multitude of societal and physical restrictions to mining that could limit it or affect costs. Consequently, a cooperative program between the USGS and the Pennsylvania Topographic and Geologic Survey was initiated in 1991 to identify and delineate current major restrictions and to estimate the amount of coal reserves that may be available, given those restrictions. Coal-availability data are stored in a national geographic information system that can be used to efficiently analyze and depict the data.

Effects of Federal Rulemaking on Coal Markets

The U.S. Department of Interior, Office of Surface Mining (OSM), is



Figure 4. National Water-quality Assessment Program study areas in Pennsylvania.

establishing a Federal rule for Valid Existing Rights that could affect access to coal in environmentally sensitive areas and determine whether underground mining should be prohibited in such areas. The USGS will provide coal-resource assessment and economic analysis to OSM to support the rulemaking. Specifically, the USGS is performing work in the following subject areas:

- *Assessment of coal resources in environmentally sensitive areas.*—The rulemaking could change access to privately owned surface minable coal resources in environmentally sensitive areas. These areas are in National Parks, Wilderness Areas, Wild and Scenic Rivers, Wildlife Refuges, National Trail Systems, National Recreation Areas, National Forests, state and local parks, and National Historic Sites.

- *Assessment of deep coal resources in areas where OSM rulemaking could limit longwall mining.*—The USGS and the Pennsylvania Topographic and Geologic Survey are working together to gather data that can be used to show the effects of such a rule. Also, a comparison of economic costs for longwall mining and for the next best mining method will be made as a basis for assessing the cost of the rulemaking.

National Coal Assessment

Coal is the source of one-third of the total energy used and more than one-half of the electricity generated in the United States. Even with increased energy conservation and the use of natural gas to meet increased demand, coal will continue to be a major energy source. New technologies require coal of very specific quality. The USGS works with the Pennsylvania Topographic and Geologic Survey to identify the location, quantity, and quality of coal resources on public and private lands in Pennsylvania, including coal suitable for export.

Mineral-Resource Assessment

The USGS is conducting a mineral-resource assessment of the Eastern United States, including Pennsylvania. Planned products will include maps delineating areas favorable for different

kinds of mineral resources and tables listing known and estimated undiscovered mineral resources. Some data sets will be useful for environmental purposes, including determining the occurrence of toxic elements. This information is used by Federal and State agencies to evaluate human-induced contamination and to provide baseline data for environmental remediation. Data from the assessment and software to produce graphic images and printouts will be made available on CD-ROM.

National Mapping Program

Among the most popular and versatile products of the USGS are its topographic maps at the scale of 1:24,000 (1 inch on the map represents 2,000 feet on the ground). These maps depict basic natural and cultural features of the landscape, such as lakes and streams, highways and railroads, boundaries, and geographic names. Contour lines are used to depict the elevation and shape of terrain. Pennsylvania is covered by 880 maps at this scale, which are useful for civil engineering, land-use planning, natural-resource monitoring, and other technical applications. These maps have long been favorites with the general public for outdoor uses, including hiking, camping, exploring, and back-country fishing expeditions.

Collection of Hydrologic Data

Pennsylvania has three major river basins—the Ohio, the Susquehanna, and the Delaware. These river basins supply water to users within Pennsylvania, New York City, parts of New Jersey, and many downstream states. The USGS, in

cooperation with local, State, and Federal agencies, collects streamflow, ground-water, and water-quality data at sites throughout Pennsylvania (fig. 5). These data are critical for day-to-day administration and management of water resources, for determining the extent and severity of droughts, for characterizing and predicting conditions during floods, and for monitoring the effects of human activities on water resources. The data also are essential to interpretive studies that provide information for making decisions about water issues that affect millions of people.

Cooperative Programs

The USGS cooperates with more than 30 local, State, and Federal agencies in Pennsylvania. Cooperators include State agencies, counties, municipalities, basin commissions, water authorities, universities, and Federal agencies. Cooperative activities include water-resources-data

collection, interpretive water-availability and water-quality studies, mineral-resource assessments, mapping, and studies of scour at more than 16,000 highway bridges over water. When local and State agencies are involved, activities typically are funded on a 50:50 matching basis. In addition to the agencies already mentioned, the USGS cooperates with the U.S. Army Corps of Engineers, the Chester County Water Resources Authority, the Delaware River Basin Commission, the Susquehanna River Basin Commission, and the Pennsylvania Department of Transportation, to name only a few.

The USGS provides support to the Environmental Resources Research Institute of the Pennsylvania State University, which conducts a program of research, education, and information and technology transfer.



Figure 5. Water-quality-data sites in Pennsylvania.

For more information contact any of the following:

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Lemoyne, Pennsylvania 17043
(717) 730-6900

For map information
Chief, Mapping Applications Center
567 National Center
Reston, Virginia 22092
(703) 648-6002

For geologic information
Assistant Chief Geologist
953 National Center
Reston, Virginia 22092
(703) 648-6660

Center for Environmental Geochemistry
and Geophysics
Denver Federal Center, Mail Stop 973
Denver, Colorado 80225
(303) 236-3301

Additional earth science information can be found by accessing the USGS "Home Page" on the World Wide Web at "<http://www.usgs.gov>".

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