

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

The safety, health, and economic well being of West Virginia's citizens are important to the U.S. Geological Survey (USGS), which is involved in water, resource, mapping, and land-use issues in many parts of the State. Through cooperative programs with many State and local agencies, the USGS is studying coal extraction and its effects and assessing water quality and mineral potential. Through national programs, citizens of West Virginia have access to the thousands of map, book, and digital products of the USGS. This Fact Sheet details some of the programs and activities of the USGS in West Virginia.

## Resource Assessments

Coal accounts for between 20 and 25 percent of the total energy used and more than 50 percent of the electricity generated in the United States. Coal from Appalachian Basin fields in West Virginia is a major resource for the Nation. Assessment of potential coal development recognizes both physical constraints and societal restrictions on mining. Since 1988, the USGS, in cooperation with the West Virginia Geological and Economic Survey (WVGES), has identified these restrictions as part of a national effort to analyze the relation between mining restrictions and potential coal availability.

New technologies that use coal will require resources of specific and known quality. The economics of coal utilization depend on mining and transportation costs. Coal quality affects those costs, especially with respect to waste disposal. For example, high concentrations of sulfur in coal beds and associated rocks may produce acid drainage after mining or acid rain after combustion but may be beneficial in a synthetic fuel process. The USGS, is supplying information to the WVGES, for development of cost-effective strategies to predict areas of high potential for acid production, to mitigate acidity problems, and to cleanup existing contamination.

Since 1975, the USGS, in cooperation with the WVGES, has evaluated and correlated data from drill holes, mines, and outcrops by using the National Coal Resources Data System. The USGS regularly provides the WVGES with fossil and mineral analyses of key strata to identify coal beds better. The location and quality of coal resources throughout the State will be identified in the National Coal Assessment.

A natural gas accumulation of regional dimensions may exist in the deep sandstone reservoirs in western West Virginia and other parts of the Appalachian basin. According to the 1995 USGS National Assessment of United States Oil and Gas Resources, several tens of trillions of cubic feet of gas may be recoverable from this continuous-type accumulation. Recognizing the potential of this large energy resource, the USGS has begun a multiyear study in West Virginia and adjoining States to increase understanding of the nature, size, and origin of the continuous-type accumulation.

## Effects of Resource Extraction

Coal mining and other forms of resource extraction, including logging or drilling for

**Index of Subjects**

- Resource Assessments
- Effects of Resource Extraction
- National Water-Quality Assessment
- New River Gorge
- Streamflow Monitoring
- Effects of Navigational Dams on Reaeration of the Ohio River
- Water-Resources Appraisal of the Canaan Valley
- Rural Water Supply and Sanitation
- Mineral Assessments
- Geologic Mapping
- Topographic Mapping
- Earth Science Information
- Fish Health and Aquatic Ecology

oil and gas, affect West Virginians in many ways. The USGS, often in cooperation with the WVGES, has completed numerous studies of the economic, hydrologic, and water-quality effects of resource extraction throughout the State. The fracturing and subsidence of rock layers that result from underground mining increase the infiltration of precipitation and streamflow and also increase the volume of water in subsurface storage (fig. 1). These changes tend to reduce flood peaks and increase base flow in streams.

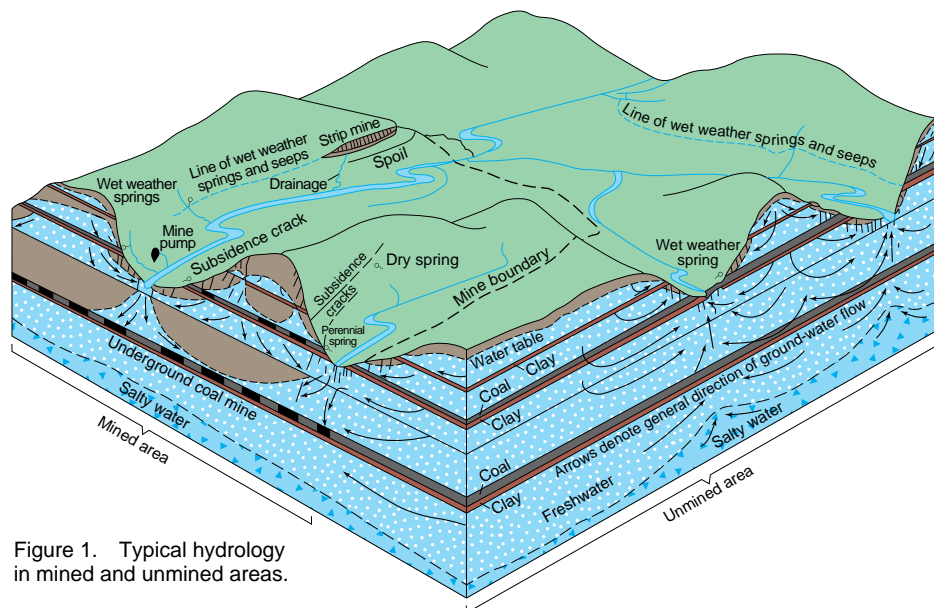


Figure 1. Typical hydrology in mined and unmined areas.

Water in mined areas generally has high concentrations of dissolved solids because of increased contact between the water and subsurface minerals. Where the sulfur content of the rocks is high enough, as is more common in the northern part of the State, the water becomes acidic and may contain undesirable concentrations of metals. The West Virginia Division of Environmental Protection (WVDEP) reports that acid mine drainage has affected at least 484 streams for a total of 2,852 stream miles. A recent USGS assessment of potential mineral deposits included a map that shows the distribution of acid stream water. In some rivers, acid drainage kills all living creatures; in others, fish are able to live for a few weeks or months but are unable to reproduce. Expanding suburbs in the Deckers Creek Basin near Morgantown are affected by the area's history of acid mine drainage. USGS sampling in the Basin during 1993–94 helped identify the most heavily affected areas and allowed the U.S. Department of Agriculture's Natural Resources Conservation Service to set priorities for restoration.

Land-surface disturbance related to resource extraction can increase erosion, cause elevated concentrations of suspended sediment in streams, and lead to deposition of sediment in reservoirs and navigable rivers. Highway construction can produce large amounts of suspended sediment from small areas, but sediment yield can be even larger in basins affected only by mining and logging, according to USGS studies done in cooperation with the West Virginia Department of Highways and the West Virginia Division of Natural Resources. Like many other hydrologic processes, suspended-sediment transport is most important under extreme conditions, which makes monitoring, analysis, and interpretation difficult. For example, during more than 4 years of study in one basin, 30 percent of the total suspended-sediment movement occurred during just four storms.

## National Water-Quality Assessment

An extensive data base of water-quality information for West Virginia has been developed through resource assessments of individual basins, studies of local prob-

lems, a series of federally funded coal hydrology studies, and long-term monitoring at several stream-gaging stations. The data base, however, is incomplete in the number of chemical and biological characteristics measured and in the limited range of sampling times and locations.

The USGS National Water-Quality Assessment (NAWQA) Program has long-term goals 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. About two-thirds of the State is included in three NAWQA Program study areas (fig. 2). Between 1992 and 1996, the Potomac River Basin will have been intensively assessed; planning began in 1994 for assessments in the Allegheny and the Monongahela and the Kanawha–New River Basins. The assessments combine a comprehensive review of existing data, wide-ranging collection of new data, and regional analysis. These assessments provide the background within which local water-quality problems can be understood and managed; they also identify the occurrence and areal distribution of potential issues of concern. During the 1990's, the Program is focusing on pesticides; nutrients, such as nitrate and phosphate; volatile organic compounds; and aquatic ecology. The three study units have local liaison committees that involve more than 100 individuals and organizations with water-quality interests and responsibilities.

## New River Gorge

The New River Gorge National River was established by the U.S. Congress in



Figure 2. National Water Quality Assessment Program study units in West Virginia.

1978 to preserve a 53-mile-long reach of the river as a free-flowing stream for public enjoyment and benefit. The National River combines scenic wilderness, fishing, and whitewater rafting. Water-resources information is essential to the wise management of the area. Whitewater boating is best when flow in the river is between 3,000 and 15,000 cubic feet per second. The flow is affected by the operation of Bluestone Dam on the New River and unregulated flow from the Greenbrier River. A study by the USGS, in cooperation with the National Park Service (NPS), found that rapid increases in flow advance through the gorge about 2 times faster at high flow than at low flow. Whitewater users can plan their trips by calling the USGS gaging station on the New River at Thurmond [(304) 465–0493]. A series of beeps reports the river stage.

The USGS computed flood elevations for 2-, 25- and 100-year floods on the New River and five tributaries within the National River boundary. The NPS is using the results to design facilities near the rivers to withstand periodic flooding and to locate other facilities outside flood-hazard areas. The USGS studied the movement of a hypothetical spill of a soluble contaminant into the New River. A major railroad parallels the River, and several major highways cross it in this reach. The study results indicate that a spill could be mitigated in predictable ways by regulating discharge from Bluestone Dam.

## Streamflow Monitoring

Stream-discharge data are needed to forecast floods, to operate reservoirs, to prove that regulatory requirements have been met, to manage navigable waterways, to plan whitewater recreation, and to supplement water-quality monitoring. The USGS currently (1996) collects records of stream stage or discharge at about 90 sites in West Virginia, including 73 sites where satellite communication links automatically relay the data to central computers. At 65 of the stream sites, telephone links also permit more frequent data access when needed. Rainfall data are relayed by satellite from 40 stream sites and 24 other sites. The data are used by the National Weather Service to forecast floods and by the U.S. Army Corps of Engineers reservoir operators to control floods, to supplement streamflow during droughts, and to

maintain whitewater for seasonal recreation on some rivers. Operators of hydroelectric powerplants use USGS data to confirm compliance with minimum-flow requirements set by the Federal Energy Regulatory Commission. The WVDEP collects water-quality data at many of the sites and uses the USGS discharge record to supplement their data.

Understanding floods and droughts is essential to planning for structures near rivers. This understanding is the result of statistical analysis of streamflow data that are available in the accumulated USGS data base. Discharge records at least 10 years long are available for 126 sites; they average 40 years, and the longest record is 115 years. Records less than 10 years long are available for an additional 105 sites. In a recent USGS study, in cooperation with the WVDEP, a method was developed to estimate low-flow characteristics for any stream in the State. This information can be used to determine the reliability of flows at a proposed public water-supply intake or how much wastewater could be discharged to a stream without damage to other water users.

## **Effects of Navigational Dams on Reaeration of the Ohio River**

New hydroelectric generators are planned for several navigation dams on the Ohio, the Monongahela, and the Allegheny Rivers. Flows through generators would reenter the rivers downstream with less turbulence and air contact than do previous flows through gates. This change could reduce reaeration, which is the movement of oxygen from the air into the water. Loss of reaeration potential could reduce the waste-assimilation capacity of the rivers and affect waste-discharge permit limits.

The USGS, in cooperation with the city of New Martinsville, is monitoring dissolved oxygen in two navigational pools on the Ohio River. The data show that discharge variations and algal growth dynamics in the pools may be as important as the characteristics of the dams in controlling dissolved oxygen. Continuation of the work is expected to lead to new methods of measuring the reaeration potential of gated navigational structures and to provide the data necessary to construct a management model of water quality and river discharge.

USGS biologists, oceanographers, and geologists are using underwater videography and sidescan sonar to characterize the river bottom near the 35 islands of the 365-mile-long Ohio River Islands National Wildlife Refuge. The work, in cooperation with the U.S. Fish and Wildlife Service and the West Virginia Division of Natural Resources, will provide a broad assessment of aquatic habitat resources for freshwater mussels and other species. Mussels are indicators of the health of the whole river. The project supports resource management on the basis of ecosystems rather than single species.

## **Water-Resources Appraisal of the Canaan Valley**

At an average altitude of 3,200 feet, the Canaan Valley is the highest valley of its size east of the Rocky Mountains. Its forests and wetlands support many plants and animals that are unusual or rare in West Virginia and the Eastern United States. The Canaan Valley's natural beauty, diverse ecology, and many recreational opportunities are enjoyed by seasonal and permanent residents and by more than 1.5 million annual visitors. To protect this area, the Canaan Valley National Wildlife Refuge was established in 1994. The USGS, in cooperation with the WVGES, WVDEP, and the West Virginia Division of Tourism and Parks, has studied the water resources of the Canaan Valley since 1990 and has begun detailed geologic mapping. The USGS recently developed a water-quality model for the upper Blackwater River, which drains the Valley, that represents the effects of physical, chemical, and biological processes on dissolved-oxygen concentrations. The model is useful to the WVDEP for analyzing the waste-assimilation capacity of the River as part of its regulation of wastewater discharges.

## **Rural Water Supply and Sanitation**

Public water supply and sewage treatment are major factors that affect economic development in many rural areas of West Virginia. More than one-half of West Virginia's population lives in rural areas, commonly in steep-sided, narrow valleys adjacent to small streams. The limited available flat land combined with dispersed population has made development

of community water supplies and sewer services difficult. Efforts to attract new industries to these areas are hampered by the lack of available water and sewer capacity. Information from USGS water-resource appraisals of several river basins and counties provide county leaders an overview of local water resources that is useful for developing plans for new community water-supply and sanitation facilities.

## **Mineral Assessments**

In response to a congressional request, the USGS, in cooperation with WVGES, completed an assessment of the State's potential for metallic and industrial minerals. The results of this assessment, which were published in a folio of 11 maps, may be used to help diversify the State's mineral industry and thereby augment West Virginia's economic development. Numerous areas where undiscovered deposits of zinc, copper, lead, uranium, and barium might occur have been delineated by using geological, geochemical, and geophysical data. This information can be used to design more detailed and site-specific follow-up studies by governmental agencies and could stimulate and assist exploration by the mining industry.

## **Geologic Mapping**

The STATEMAP component of the National Cooperative Geologic Mapping Program funds important geologic mapping in West Virginia; the Program is in cooperation with and is overseen by the WVGES. Geologic mapping is focused in the Canaan Valley area where competing environmental and industrial interests need geoscience information to make land-use decisions. Results of the mapping Program can be used to address problems, such as management of active and abandoned coal mines, as well as exploration, permitting, and environmental regulation.

## **Topographic Mapping**

The use of maps and digital cartographic data is widespread, and requirements for this information are expanding. Through the National Mapping Program, the USGS strives to ensure the availability of map data in graphic and digital forms to

the general public through timely and effective data-collection and revision procedures.

Among the most popular and versatile products of the USGS are its 1:24,000-scale topographic maps (1 inch on the map represents 2,000 feet on the ground). These maps depict the natural and cultural features of the landscape, such as lakes and streams, highways and railroads, boundaries, and geographic names. West Virginia is covered by 493 maps at this scale. These maps have long been favorites with the general public for outdoor uses, as well as with scientists and engineers for technical applications.

The USGS, in cooperation with the West Virginia Geographic Information System Technical Support Center at West Virginia University (WVU), is developing a joint program to collect and disseminate digital data from the USGS 1:24,000-scale topographic maps. The WVGES will benefit from this program by using the contour data with geologic information to analyze the coal-bearing areas better. The West Virginia Department of Tax and Revenue also will benefit from the transportation, hydrography, culture, and boundary files through WVU's geographic information system analysis capabilities. This multi-year project will result in statewide map coverage that meets national standards. The digital cartographic data are designed to provide a foundation for future regional and county projects.

The USGS, in cooperation with the U.S. Environmental Protection Agency (USEPA), is using Landsat thematic mapper satellite images to produce a general land-cover map for USEPA Region III, which includes West Virginia. This project is a prototype for generating similar land-cover maps for other parts of the United States. The Landsat land-cover map incorporates data from other sources, such as census population data and digital elevation models. Land-use and land-cover information is useful for modeling water quality, land and resource management, and assessing the health of regional ecosystems.

## Earth Science Information

The Earth Science Information Center (ESIC) provides information about the USGS and its programs, products, and

technological developments to the public. The ESIC in Morgantown was established in cooperation with the WVGES. As part of the national ESIC network, this office provides information on many earth science topics, such as cartography, geography, geology, hydrology, remote sensing, aerial photography, and land use. The office is supported by the USGS with reference materials, technical assistance, training and outreach activities, products available for purchase and access to USGS data bases.

## Fish Health and Aquatic Ecology

The USGS Biological Resources Division (formerly the National Biological Service) maintains regional offices and major research facilities in West Virginia.

The Leetown Science Center's (LSC) Fish Health Laboratory develops technologies for the detection and control of infectious diseases of cultured and wild fishes, develops bioindicators as measures of wild fish population health and early detection of adverse environmental conditions, and investigates the molecular genetics of fish and fish pathogens and the immunological response of fish.

The LSC's Aquatic Ecology Laboratory is mapping the distribution of macroinvertebrates and amphibian breeding ponds in the Canaan Valley National Wildlife Refuge and is studying the effects of watershed and riparian land use upon aquatic habitat and fisheries in mid-sized watersheds. Scientists also are involved in research, including population genetics, reproduction, distribution, and the development of statistically reliable sampling techniques, directed at restoring depleted freshwater mussels.

In collaboration with the West Virginia Department of Natural Resources, the LSC conducts research and provides assistance to resource managers in the protection and restoration of watersheds and streams impacted by land-use practices and urban and industrial pollution, including acid mine drainage.

The West Virginia Cooperative Fish and Wildlife Research Unit, which is located at the WVU in Morgantown, conducts research throughout the State on fisheries, water-quality aspects of ecosystems, and avian ecology projects.

# For More Information

USGS State representative  
11 Dunbar Street  
Charleston, WV, 25301  
304-347-5130  
Fax: 304-347-5133  
Email: [dc\\_wv@usgs.gov](mailto:dc_wv@usgs.gov)

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**

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

U.S. Geological Survey  
Fact Sheet FS-049-96