

United States Geological Survey

Programs in Kentucky



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 U.S. Geological Survey (USGS), which has offices in every State and Commonwealth, collects, compiles, and disseminates data on water, energy, and mineral resources in the State of Kentucky. The long-term earth science information base of the USGS is a valued resource to the public and private sectors, academia, State and local agencies, and other Federal agencies. This Fact Sheet describes a few of the USGS activities in Kentucky.

Coal Availability

The availability of environmentally acceptable and reliable energy sources is an important issue for Federal, State, and local planners. Conventional Federal and State coal-resource estimates may not account for the multitude of societal and physical constraints to mining that have led planners to overestimate the future supply of our Nation's coal.

A cooperative program between the USGS and the Kentucky Geological Survey (KGS) was initiated in 1988 to identify current (1995) major constraints and to estimate the amount of remaining coal resources that may be available for development under those conditions. Coal-availability studies are underway to collect, analyze, and depict data characterizing the relations between restrictions to mining and the potential development of the Nation's coal resources.

Coal Quality

The quality of coal beds and associated rocks is a major factor in the economic development of a coal bed because of environmental regulation and the effects of coal quality on technological processes and equipment. For example, high concentrations of sulfur in coal

may produce acidic mine drainage as a result of coal extraction, and acidic rain may result from atmospheric sulfate gases and particulates produced by coal combustion; conversely, sulfur in coal is beneficial in synfuel production. Coal quality affects the costs of mining and utilization, especially with respect to disposal of the generated wastes. These issues are of particular concern to the States and industry in the Appalachian and the Illinois Basins, from which much of the Nation's high-sulfur coal is produced.

Electric utilities are and will continue to be the primary consumers of coal in the United States. To comply with the provisions of the Clean Air Act Amendments of 1990, utility companies either switched to low-sulfur coal or installed sulfur dioxide emission-control equipment at their powerplants. Title III of the Clean Air Act cites 13 trace elements, which occur naturally in coal, for potential monitoring. To gain a better understanding of the fate of these elements during combustion, the USGS, the KGS, and the Kentucky Utilities Company are sampling coal-combustion byproducts, such as fly ash and bottom ash, for trace-element analysis. Flue-gas desulfurization feed limestone and scrubber residues also are being sampled. This program will provide knowledge about the distribution and movement of various elements after coal is burned (that is, are they trapped in fly ash or bottom ash or do they escape with flue gases?), as well as the effect of scrubbing on trace-element-load emissions to the atmosphere.

A key issue of interest to future coal users will continue to be the quality of coal to be mined, particularly in the Appalachian and the Illinois Basins. Working with the USGS, the KGS will be compil-

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ing information on quality of the coal of various major producing coal beds. This information will allow planners and industry to identify areas of sustainable coal production or uses of coal of specific quality for specific applications, including clean-coal combustion and synfuel production. The USGS, in cooperation with several State and Federal agencies, is providing the information that will aid Kentucky and its industry to develop cost-effective strategies to mitigate potential future environmental problems that can result from coal development.

National Coal Assessment

As the United States enters into the next century, coal will continue to exert a major influence as an energy resource. Coal usage accounts for one-third of the total energy and more than one-half of the electricity generated in the United States. Even with substantial increases in energy conservation and the use of natural gas to meet increased demands for energy, coal will continue to be a major contributor. New technologies using coal will require resources that meet strict environmental quality characteristics. Therefore, the location, quantity, and quality of the Nation's coal resources to be consumed

during the next 20 years, classified particularly by its best intended use, will be necessary information for national and regional planners. In the National Coal Assessment, the USGS will be working with the KGS to identify the location of coal resources, including coal potentially suitable for the export market, on public and private lands. The quality of these coals will be identified and characterized. Results of the National Coal Assessment are useful to Federal and State regulatory agencies, land-management agencies, and industrial and academic research teams for determining the location, quality, and quantity of producible coal.

Oil and Gas Resources

Much of Kentucky lies in the Appalachian Basin, which is a mature oil- and gas-bearing basin. The USGS, in cooperation with the KGS, is examining the subsurface geologic structure and stratigraphy to determine if there is potential for oil and gas production. As part of this effort, the USGS is supplying the KGS with seismic reflection data for the geologic feature known as the Rome Trough. These data are used for locating structures that may contain petroleum resources. The seismic reflection data also are helpful in locating buried faults that may produce earthquakes in the future.

County-Level Water-Supply Planning Mandate

In 1990, the Kentucky Legislature mandated long-range water-supply planning at the county level. Part of the responsibility of the planners is to calculate the amount of water at surface-water intakes available for use of the public-water suppliers. This water may be withdrawn by any one user at a specific site, according to the water withdrawal permit requirements of the State. Planners are required to estimate available water during normal, as well as drought conditions.

Knowledge of low-flow characteristics of Kentucky streams is important in decisions regarding water-resource planning and management. Low-flow information, needed for allocating wastewater effluent discharges to receiving waters

and for estimating surface-water availability, is vital for sustainable use.

As a result of increased demand for low-flow information, the USGS, in cooperation with the Kentucky Natural Resources and Environmental Protection Cabinet, analyzed low-flow data from the USGS streamflow-gaging network in Kentucky. By using the low-flow data, equations were derived to estimate selected low-flow characteristics for ungaged stream sites. Use of these equations will allow water-supply planners to estimate the amount of water that might be available at the site of existing or proposed intakes on a stream on the basis of flow-duration data.

National Water-Quality Assessment Program

The USGS's National Water-Quality Assessment (NAWQA) Program was established 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.

From 1987 through 1990, the USGS collected water-quality data in the Kentucky River Basin as a part of the NAWQA Program (fig. 1). The 7,000-square-mile Kentucky River Basin is Kentucky's most densely populated major river basin. The Kentucky River and its tributaries are used extensively for municipal and industrial water supply, recreation, and wastewater discharge and assimilation. The river provides more than 95 percent of the drinking-water supply in the Basin.

The NAWQA Program study provides vital physical, chemical, and biological water-quality data to State and local officials charged with water-use planning and water-quality management. Although the Kentucky River Basin study is inactive



Figure 1. National Water-Quality Assessment study unit area in Kentucky.

(1995), it is expected to be reactivated in 1997. Analyses of land-use and water-quality changes in the Basin through time, based on data collected during the initial and all subsequent intensive study periods, will be possible.

Earthquake Hazards

Researchers from the University of Kentucky, in cooperation with the USGS, are using geotechnical and seismological techniques to investigate the effects of soils on ground-motion seismograph sites in western Kentucky and adjacent Tennessee; these sites are in the New Madrid seismic zone. The data are useful for predicting the types of motions that may be experienced by buildings in the region as a result of an earthquake. The results from these site investigations also can be used to test predictions of ground motions made by use of numerical models.

Effects of Urban Runoff

As parts of Kentucky have become more urban, farms have been replaced by residential development, business and industrial facilities, shopping centers, streets, and parking lots. Associated with urbanization are changes in the types and quantities of contaminants discharged into the surface waters of the State. Storm runoff can wash contaminants, which accumulate during dry periods, into urban drainage systems and affect the surface-water quality of many streams and drainage channels. Many contaminants in urban runoff are primarily byproducts of human activity and include organic debris, sediments, nutrients, petroleum-based products, and such potentially toxic chemicals as trace elements, heavy metals, and pesticides.

Urban planners and managers need information on the quantity and quality of runoff to make adequate plans for the effects of storm runoff from urban areas. The constituents that contribute to the total stream load are from both point and nonpoint sources. Nonpoint-source contaminants generally are transported to receiving waters in runoff resulting from storms. Estimates of loads of constituents in storm runoff provide a measure of effects of nonpoint-source contaminants on water quality. Estimates of annual

storm loads and average concentrations of selected constituents are required as part of the National Pollutant Discharge Elimination System permit for discharges from municipal separate storm-sewer systems.

The USGS and the Louisville and Jefferson County Metropolitan Sewer District (MSD) cooperated to assess the quality of stormwater in Jefferson County, Louisville, which is in Jefferson County, is the largest city and most densely populated area in the State (fig. 2). Relations between the quality of storm runoff and the types of land use in basins of the county have been developed to provide the MSD with a method to estimate the quantity and quality of the runoff from the stormwater outfalls in the county and to define baseline conditions before implementation of best-management practices for selected basins.

Effects of Nonpoint-Source Pollution on Surface and Ground Waters

Most nonpoint-source pollution problems begin with land-based human activities. Land use and surface-water quality are recognized as being closely related and an integral part of an ecosystem. Acidic drainage from coal mining, chlorides associated with oil and gas drilling, and siltation and nutrients from agricultural activities are examples of nonpoint-source pollution that impair aquatic life in the streams. As reported in the 1994 Kentucky Report to Congress on Water Quality, nonpoint-source pollution affects the water quality of about three times as many miles of Kentucky streams as do point sources. Nonpoint-source pollution has had a major effect on the water quality of 3,836 miles of the State's streams



Figure 2. City of Louisville and Jefferson County, Kentucky.

and a minor effect on 1,523 miles of the streams.

Nonpoint-source pollution also affects ground water. Chemicals on the land surface in a ground-water-recharge area can contaminate the ground water. These chemicals can be transported far from their land-surface origin. More than one-half of the aquifer systems in the State are in karst regions. These aquifers are highly susceptible to contamination because of the direct flow path of surface water into the subsurface by way of sinkholes and sinking streams.

The USGS has studied the ground water systems in Kentucky extensively. These studies have provided much information and increased the knowledge on how nonpoint-source pollutants can migrate in ground-water environments. An example is a recent study by the USGS, in cooperation with the Office of Surface Mining Reclamation and Enforcement, to determine how ground water moves through fractures in a ridge-and-valley setting in Appalachian coal fields. In the study, dye-tracer tests were done from 1985 to 1992 to investigate the movement of ground water in coal-bearing strata at a ridge-and-valley site near Fishtrap Lake in Pike County.

The results of the dye-tracer tests indicated that fractures provide flow routes for ground water within the ridge. The tests indicated that ground water generally moved rapidly from wells near the ridgetop to wells near the valley floor. The rate of movement was estimated to be as much as 36 feet per day. If the dyes used in these tests are thought of as contaminants in ground water, then test results clearly demonstrate the potential movement of contaminants from the ridgetops to the valley floor.

Ground-Water Protection Mandates

Until the 1993 session of the Kentucky Legislature, there were no comprehensive mandates with regard to the protection of ground-water resources of the State. The new legislation requires the Kentucky Natural Resources and Environmental Protection Cabinet (KNREPC) to adopt administrative regulations to pro-

tect the waters of the Commonwealth. These regulations establish the requirement to prepare and implement ground-water-protection plans to ensure protection for all current and possible future uses of ground water and to prevent ground-water pollution. These mandates place the responsibility on each county to develop a ground-water-protection plan to identify possible sources of pollutants to wells and to establish differential management strategies to protect ground water.

The USGS, in cooperation with the KNREPC and the University of Louisville, conducted a study to define the geohydrology of a 949-square-mile area in western Kentucky. Geographic information system software was used to analyze spatial data to determine the direction of regional ground-water flow. State personnel can use results from the study in the formulation of county ground-water-protection plans.

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. Kentucky is covered by 779 maps at this scale, which is found to be 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.

The USGS is working with the KGS to revise 1:24,000 scale topographic maps, which are used by the KGS as a base for geologic mapping. The USGS also is working with the State Mapping Advisory Council and the Kentucky Geographic Information Systems Advisory Council to produce a demonstration package of geographic information system data types. The package is useful as an educational and informational tool.

Geologic Mapping

Mapping by the USGS, in cooperation with the KGS and the Kentucky Department of Mines and Minerals, will result in a revision of coal-bed correlations in eastern Kentucky. Reliable coal-bed data are needed for energy-resource evaluation by various Federal and State agencies for planning and other general purposes.

Earth Observation Data

Through its Earth Resources Observation Systems Data Center near Sioux Falls, South Dakota, the USGS distributes a variety of aerial photographs and satellite-image data products that cover Kentucky. Mapping photographs of some sites date back about 40 years. Satellite images dating from 1972 can be used to study changes in regional landscapes.

Collection of Hydrologic Data

Kentucky has 89,431 miles of streams in 13 major river basins. These rivers supply water to most of the 3.5 million people in the State. The USGS, in cooperation with more than 30 local, State and Federal agencies, collects streamflow and (or) water-quality data (fig. 3) at sites throughout the State. These data are critical for the daily administration and management of

water resources, determining the severity of droughts, characterizing and predicting conditions during floods, and monitoring the effects of human activities on streamflow and water quality. The data also are essential to interpretive studies that provide information for making decisions about water issues that affect the State's residents.

Cooperative Programs

The USGS cooperates with many State and local agencies. A few examples not referenced above are Kentucky State University, the Kentucky Transportation Cabinet, the University of Louisville, the city of Elizabethtown, the Owensboro Municipal Utilities, the Kentucky Tourism Cabinet, the Department

of Fish and Wildlife Resources, and the Purchase Area Development District.

USGS scientists teach classes on principles and application of the geographic information system and basin and ground-water modeling at local universities and colleges. In addition to providing data, information, and expertise within the State, USGS employees in Kentucky serve on many Federal, State, and local advisory committees and task forces.

The USGS provides support to the Kentucky Water Resources Research Institute, which conducts a program of research, education, and information and technology transfer.

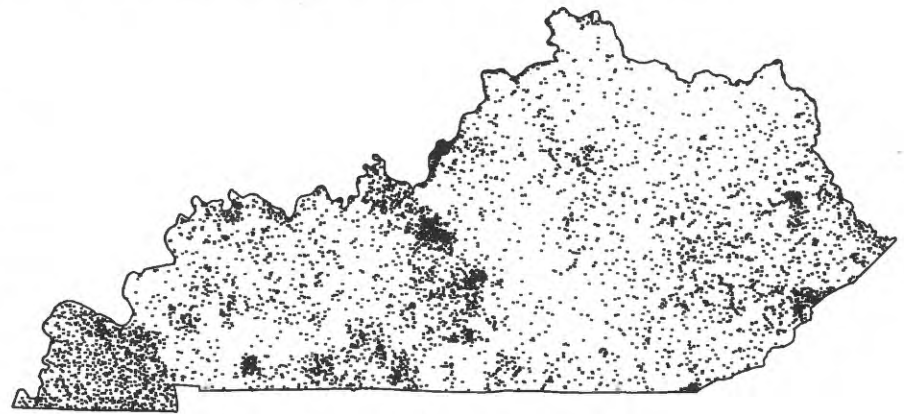


Figure 3. Historical water-quality data-collection sites in Kentucky.

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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.