

The KENTUCKY Ground-Water Monitoring NETWORK



Pennyroyal Perspective (Mississippian Plateaus)

Interagency Technical Advisory Committee

University of Kentucky Water Resources Research Institute
 Kentucky Geological Survey
 Kentucky Department for Environmental Protection
 Division of Water
 Division of Waste Management
 Kentucky Department for Surface Mining Reclamation
 and Enforcement
 University of Kentucky College of Agriculture
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 of Mines and Minerals
 Kentucky Ground-Water Association

Network

Citizens of the Commonwealth are dependent upon clean, reliable ground-water resources. According to the 1990 U.S. Census, about one in four Kentuckians (approximately 900,000) uses ground water from wells and springs in their homes, schools, and businesses. All of Kentucky's streams and rivers are sustained by ground water during periods of low rainfall.

Information on the quality and quantity of ground-water resources in Kentucky is inadequate for most uses. Baseline information is needed by industry and government agencies for public policy matters. This information includes documentation of the wide-ranging natural variability of ground-water quality in each region. Just as important, identifying subsurface zones that have different ground-water quality will in many cases reduce costs and raise the likelihood of obtaining an adequate ground-water supply for the homeowner, agriculture, municipalities, and industry.

A Kentucky Ground Water Consensus Group, with representation from State, Federal, local, industrial, and public interests, was established in 1993 to consider State needs in this vital area. One of their recommendations was to establish a ground-water monitoring network to be administered by the Kentucky Geological Survey. The goals of this network are to characterize and monitor the occurrence, quantity, and quality of Kentucky's ground water, and to support a data base that is readily available to the public, and upon which reliable policy decisions can be based. Legislation will be introduced in the 1996 session of the Kentucky General Assembly for statutory authority for such a network.

Coordination

An interagency advisory board is developing a framework for the Network. This framework will be used to coordinate with other data-collection efforts in the State and build an appropriate information base on ground-water resources.

Increased coordination of ground-water data collection and data reporting among agencies is a priority. This will limit redundant efforts, make certain that data from various sources are available for use, and assure that the information collected by this network can be used for multiple purposes.

First step

Information in the Kentucky Ground-Water Data Repository, housed at the Kentucky Geological Survey, is being summarized by the KGS. State agencies are required (KRS 151:035) to provide non-proprietary ground-water information to the Repository; this procedure centralizes the information for more efficient public access. However, the water-quality analyses that are now available are poorly distributed across the State, and most lack enough data on elements, ions, and organic chemicals to sufficiently characterize the quality of ground water for human use. Some preliminary findings concerning ground water in the Blue Grass and Knobs Regions are provided in this pamphlet.

Collection

Wide gaps in existing ground-water data for Kentucky need to be filled. Collection and annual reporting of standardized information will be a major contribution of the Network. New information will be stored in the data repository and made available for public use.

Summaries and characterization

The location and character of the State's ground-water resources will be determined, and the information will be accessible. Characterization of the aquifers will include defining well yield, normal variations in ground-water quality, and ground-water flow systems that directly influence water quality.

Pennyroyal (Mississippian Plateaus)

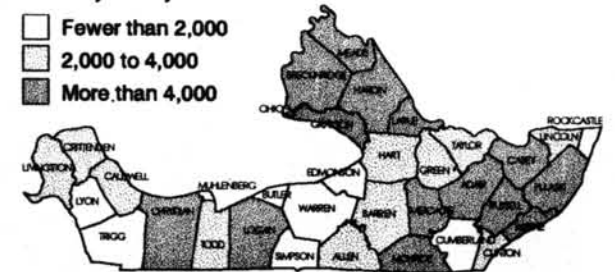
Approximately 105,000 people in the Pennyroyal Region are served by 45,000 private wells (U.S. Census, 1990). Approximately 180,000 additional people at homes, schools, and businesses use ground water from high-yield springs or wells that is piped by public-water systems.

Distribution of private-well users

Most counties in the Pennyroyal have over 2,000 domestic-well users, and 11 counties have over 4,000 users. The figure below shows the approximate number of private water-well users in each county (U.S. Census, 1990). The 180,000 people using piped ground water from public supplies are distributed among 19 counties in the region.

Number of domestic well users by county

- Fewer than 2,000
- 2,000 to 4,000
- More than 4,000



Aquifers

Rock units and sediments that yield enough water to supply a household well are called aquifers. There are four major types of aquifers in the Pennyroyal: (1) karst (or conduit flow), (2) fractured shales and siltstones, (3) fractured sandstones, and (4) sand and gravel deposits (alluvium) along the Ohio and other rivers. The fractured shale and siltstone aquifers yield water that moves through fractures. The fractured

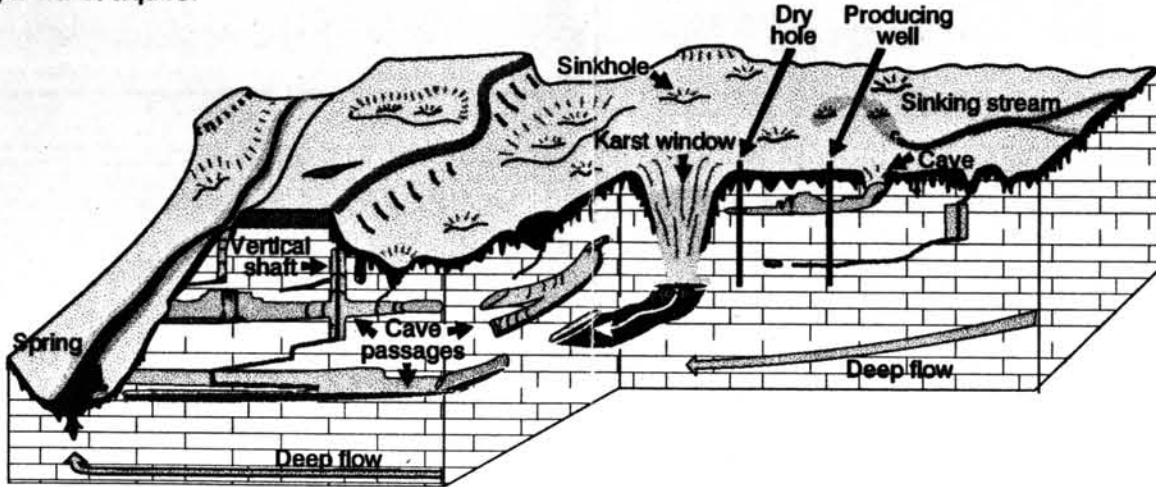
sandstone aquifers also yield water from open fractures and openings between sand and gravel grains. The alluvium aquifers along rivers yield water from openings between grains of sand or gravel. Most wells in the region are less than 150 feet deep.

Karst aquifers are created when part of the limestone bedrock is slowly dissolved by moving ground water. The enlarged openings in the rock form sinkholes, sinking streams, caves, and springs. Roughly one-quarter of the State is intensively karstified, and most of this area is in the Pennyroyal. The block diagram below shows the kinds of karst features that are frequently found in the Pennyroyal.

Drilling a well for a ground-water supply in the Pennyroyal is often a hit-or-miss proposition. In the karst and fractured-shale aquifers, only wells completed into conduits or enlarged fractures yield a reliable and adequate supply. These features are small targets for a well driller compared to widespread sand or gravel layers.

Springs are the traditional source of water in karst areas. Today many springs are used for livestock, public water utilities, and industry.

Schematic diagram of a Pennyroyal karst aquifer



Condition of supplies

The quality of ground-water supplies in the Pennyroyal is highly variable because of the exceedingly variable geology. Many supplies are adequate for household use. However, aquifers in fractured shales may produce water laden with high concentrations of iron, sulfate, and other dissolved minerals. Wells in karst aquifers produce hard water (water with a high calcium concentration). Sand and gravel aquifers near rivers often have softer water supplies. Karst springs and wells drilled into conduits produce muddy water during storms. Karst aquifers are also vulnerable to contamination by human activities. Salty water lies below fresh ground water, and deep wells frequently encounter salty water or water containing hydrogen sulfide.

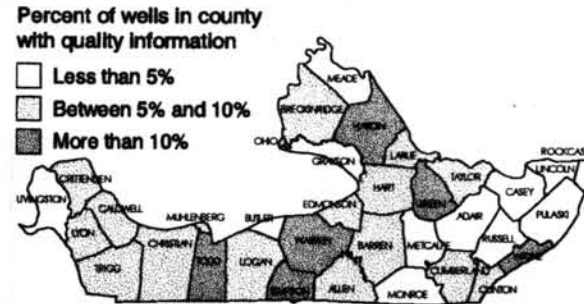
How much information is available?

As part of the KGS summary of information in the Ground-Water Data Repository, the number of wells and springs tested in three important categories of water quality was compared with the total number of private wells in the Pennyroyal. The categories are bacteria content, man-made organic chemicals, and major ions (the most abundant elements and ions that influence ground-water quality). The table at right shows that information is available for at most three out of 100 wells in any of the three categories.

Information in the Ground-Water Data Repository as of June 1995		
Category of wells and springs	Number of wells and springs in region	Percentage of wells and springs in region
Total wells in region	44,700*	100.0%*
Records in Repository	4,674	10.5%
Records with any quality analyses	2,501	5.6%
Bacteria analyses	27	0.1%
Organic analyses	580	1.3%
Major-ion analyses	1,515	3.4%

*U.S. Census Bureau, 1990—Household wells only

A spring or well was included in the count even if only one compound or ion of the hundreds possible was measured. The following figure shows how this information is distributed among the counties in the Pennyroyal.



There are thousands of karst springs in the Pennyroyal. Only springs used for public water supplies, and some of the larger springs in the Mammoth Cave, Bowling Green, and Elizabethtown areas, have had their recharge areas mapped. Springs and wells with a history of contamination have the most complete data, but only a fraction have had samples adequately analyzed.

Improving the information base

The most urgent need is to locate and characterize springs with potential for water supplies, determine the areas that supply ground-water to springs, and determine trends of water quality over time. Routine analysis of samples from typical wells and springs is needed to characterize ground-water quality for the use and benefit of the public.

The most valuable ground-water data that are recorded on paper should be computerized and transferred to the Ground-Water Data Repository. Selected ground-water data submissions to State agencies should be in a computerized format, where possible.

The Network is coordinating its activities with other data-collection activities in the State. An interagency advisory board is creating a framework for data collection by the Network, and will provide continued input as to the most-needed ground-water information. The Network will fill many gaps in the data to provide baseline information.

The Kentucky Ground-Water Monitoring Network will characterize the quality and quantity of ground-water resources in each region. Summaries will include the horizontal and vertical patterns of ground-water quality and quantity. Information will be available in reports, including annual reports. Raw data will be available in various formats through the Kentucky Ground-Water Data Repository.

For more information, contact Jim Dinger at the Kentucky Geological Survey, (859) 257-5500 ext. 163.