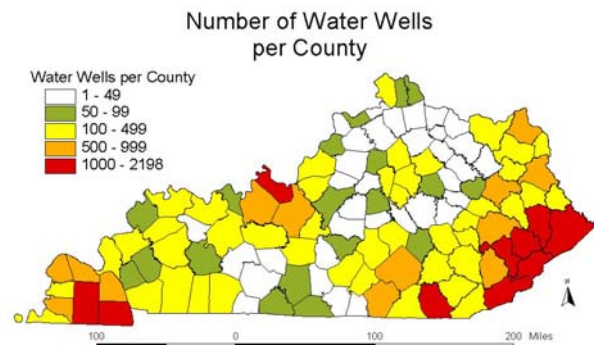
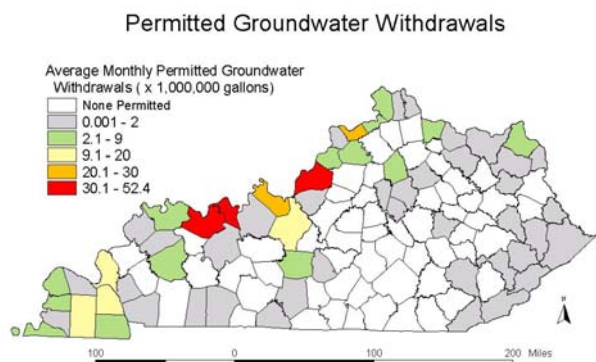


KENTUCKY'S GROUNDWATER

Importance of Groundwater as a Resource: Kentucky's groundwater is an important source of drinking water for more than a million Kentuckians, as well as a source of water for industry and irrigation. An estimated **1,292,744** Kentuckians are served by **211** public water systems (PWSs) that rely on groundwater, in whole or part, as their source. An additional **529,000** rural Kentuckians not connected to public water systems rely on private wells or springs for their drinking water. Groundwater also contributes significant recharge to streams. Protection of this resource is crucial to Kentucky's economy, public health and the environment.

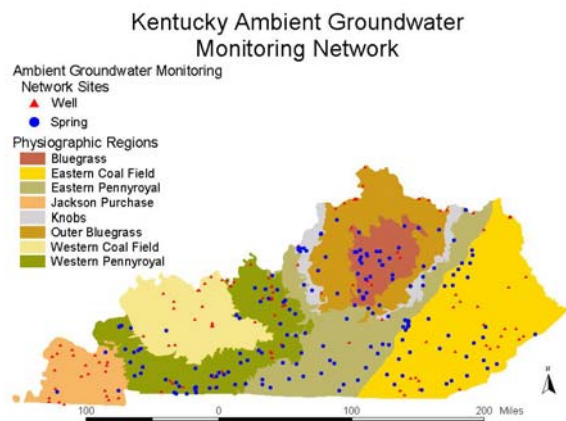
natural springs. Households that depend upon private water wells for their drinking water are most numerous in Eastern Kentucky and in the Jackson Purchase; these two regions account for about 75 percent of all new well construction in the state.



Availability and Use: Naturally occurring potable groundwater is found throughout Kentucky, although quantities available for use vary considerably as controlled by regional geologic characteristics. Kentucky's groundwater resources exist in four aquifer types: alluvial deposits, karst flow systems, unconsolidated sediments of the Jackson Purchase area and fractured bedrock. High-yielding alluvial deposits are typical of the Ohio and Mississippi river valleys that comprise Kentucky's northern and western borders. Karst occurs in approximately 50 percent of Kentucky and is characterized by numerous shallow conduit-flow systems of generally limited extent. The most extensive karst aquifers are in the Pennyroyal region of western Kentucky. Karst aquifers are present, but less well developed, in the Inner Bluegrass region. The availability of groundwater in karst areas is highly variable and generally supports public and domestic supplies. Locally, it may support agriculture and industry. In the Western and Eastern Coal Field regions, wells in fractured sedimentary rocks generally provide sufficient water for domestic use. The unconsolidated sediments of the Jackson Purchase region are prolific aquifers, supporting widespread domestic, industrial, agricultural and public water systems.

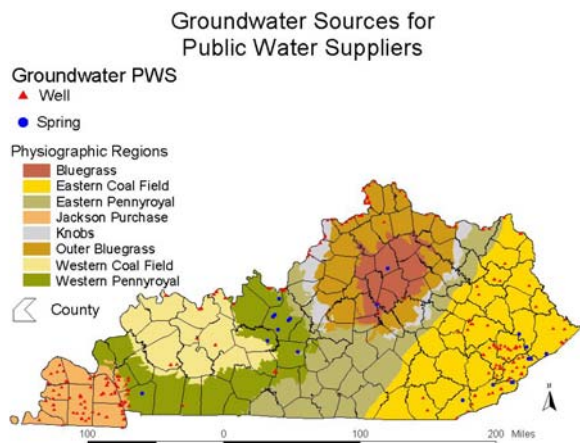
Groundwater Quality Monitoring: The Division of Water has collected and analyzed more than 2900 groundwater samples at over 400 sites to characterize ambient groundwater conditions and non-point source impacts to groundwater. Sites are sampled from one to six times per year, based on aquifer type and monitoring goals. Water quality parameters evaluated include nutrients, major inorganic ions, metals, pesticides and volatile organic compounds, including MTBE. Analysis of groundwater for pathogens is a major logistical challenge. The division is beginning to address this gap in data.

In 2004, 35 percent of PWSs in Kentucky depended upon groundwater, in whole or part, as a source, withdrawing more than 70 million gallons per day total. The majority of PWSs use groundwater withdrawn from the alluvial deposits along the Ohio River and unconsolidated sediments in the Jackson Purchase. PWSs in Eastern Kentucky are supplied by water wells and a number of PWSs in the Pennyroyal and Bluegrass utilize



Wellhead Protection Program: Kentucky's Wellhead Protection Plan program requires that PWSs that rely on groundwater develop a wellhead protection (WHP) plan for their source water. A WHP plan is designed to delineate the recharge area of the well(s) or spring(s), identify the potential contaminant sources in the recharge area, and implement groundwater protection strategies for these areas. Kentucky's WHP program is a fundamental part of its Source Water Assessment Program (SWAP), as required by the 1996 Amendments to the Safe Drinking Water Act. Kentucky has been a national leader in source water protection and was the first state in the nation to have its SWAP approved by EPA.

Groundwater Protection Plan Program: Kentucky's Groundwater Protection Plan regulation requires that entities conducting activities that have the potential to pollute groundwater develop and implement a groundwater protection plan. The plan includes pollution prevention activities such as preventive maintenance and best management practices; spill response plans, record keeping, training, and regular inspections to ensure that the protective practices are in place and functioning properly. Kentucky's Agriculture Water Quality BMPs help prevent pollution of the waters of the Commonwealth.



Contamination Issues: Groundwater quality in Kentucky is generally good; water quality is directly related to land use, geology, groundwater sensitivity and well construction. Non-point source impacts on groundwater quality from anthropogenic sources occur primarily from nutrients and pesticides and result primarily from agricultural activities.

Nitrates are a wide-spread concern, especially in shallow wells constructed in alluvial and coastal plain aquifers. Nitrates impact these aquifers largely because recharge in these areas is significantly rapid that attenuation of nitrates is not complete in the upper soil horizons. Agricultural activities, including fertilizer application, manure storage and application, and animal feeding operations are the principle sources of nitrates for these aquifers. Elevated nitrates have affected a small number of PWSs relying on groundwater. In addition, preliminary data indicate that shallow, private wells may be more likely to have elevated levels of nitrates.

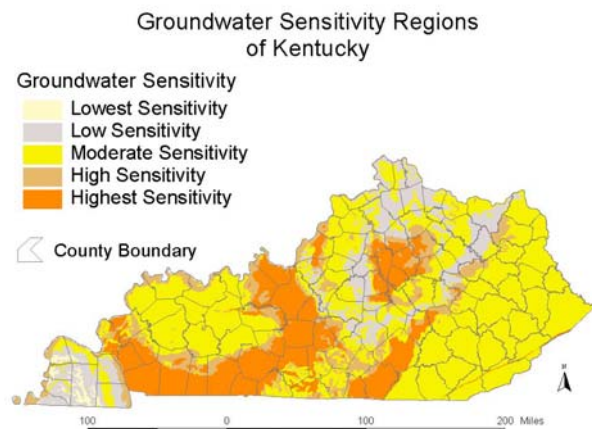
Pesticides are also a concern, principally in karst regions, the only areas of the state where pesticides are routinely detected in groundwater samples. Pesticides bypass soil attenuation processes in karst areas and contribute to elevated levels in karst groundwater systems. These aquifers, in turn, redistribute this pesticide-laden water to surface water systems in an efficient fashion, as groundwater and surface water in karst systems are in direct communication. Pesticides in groundwater have largely been a seasonal issue, but detections and significant concentrations are not limited to application season. Elevated levels of atrazine are most common. Elevated levels of atrazine in groundwater and surface water recently resulted in compliance problems for two PWSs in western Kentucky.

Urban sprawl and urban storm-water runoff impact karst aquifers. Sprawl threatens some karst aquifers, particularly where new growth does not coincide, as is common, with extension of sewers. The additional hydrological loading resulting from concentrated use of septic systems exasperates collapse potentials, and the increased hydrologic, pathogen and nutrient loading commonly has dramatic effects on groundwater

quality in karst basins. Improper storm-water injection in karst areas also impacts local karst groundwater quality.

High levels of naturally occurring iron and sulfur continue to impact private wells, producing aesthetic problems for well owners in many parts of the state, especially eastern Kentucky. Bacteria occurrence remains common in wells, usually indicating potential sanitary problems. The high levels of iron, sulfur and bacteria commonly result from a lack of proper well maintenance, and in most circumstances, are preventable and treatable.

Local contamination from landfills, USTs, Superfund and hazardous waste sites remain a concern as much for Kentucky as other states. However, no widespread impacts or negative trends on water quality resulting from waste sites have occurred in Kentucky. MTBE, BTEX, EDB and 1,2 DCA occurrence is limited to contaminated sites, and MTBE occurs only in very low concentrations in urban karst springs from storm-water runoff. Disruption of groundwater use because of contamination has occurred locally, but has been uncommon. There are currently **2746** sites with known or suspected groundwater contamination, including **2431** UST sites, **45** solid waste sites, **228** state and federal Superfund sites, and **42** hazardous waste sites with groundwater contamination. The department is tracking contaminated groundwater sites and the condition of groundwater at these sites. Kentucky has recently developed a broad-based remediation program that applies to contaminated sites, including brownfields. This program should significantly reduce the number of contaminated sites over the next several years.



What is needed? Although Kentucky is among the nation's leaders in coordinating its groundwater activities through its Interagency Technical Advisory Committee, additional resources are necessary to improve efforts to characterize Kentucky's groundwater. Routine monitoring should expand to better capture regional and temporal trends, and conduct additional aquifer characterization for pathogens, pharmaceutically active compounds and other emerging pollutants. In addition, Kentucky needs to expand mapping of some aquifers to better assess aquifer quantity. Kentucky has recently invested significant resources to implement new technologies and consolidate data management. Kentucky also needs to expand groundwater education and public outreach.