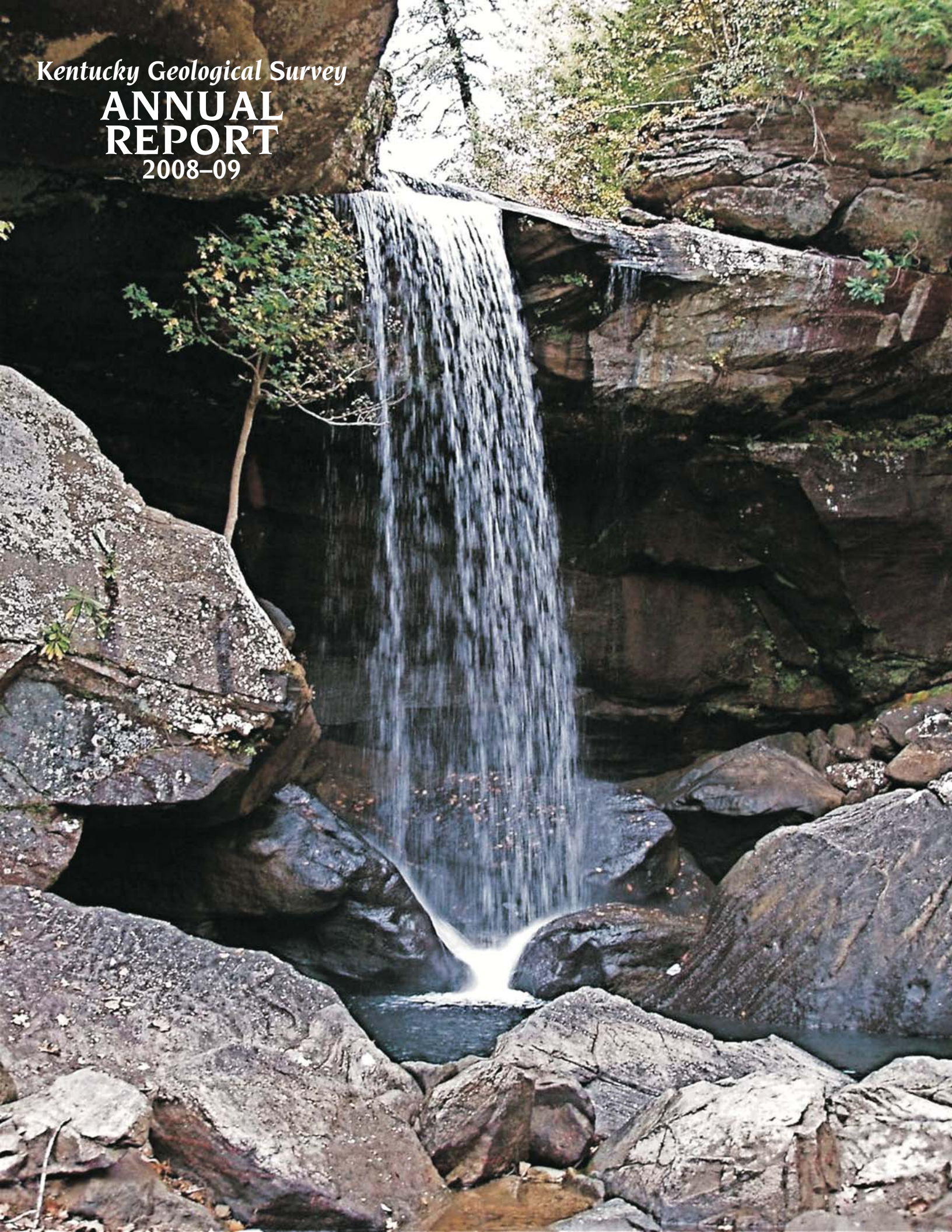
Kentucky Geological Survey

ANNUAL REPORT 2008–09



OUR MISSION

is to increase knowledge
and understanding of the mineral,
energy, water resources, geologic hazards,
and geology of Kentucky for the benefit
of the commonwealth and nation.

Cover photo:
Eagle Falls at Cumberland Falls State Resort Park by James Pulliam, an avid amateur photographer whose daughter, Carrie Pulliam, has worked at KGS for 6 years. Eagle Falls flows over Pennsylvanian sandstone into the Cumberland River just below Cumberland Falls.

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Contents:

The KGS work in geologic storage and enhanced oil recovery is of course tied to government actions taken for climate change. These stories are still unfolding. We will stay tuned.

In the 2008-09 fiscal year, public service reached new heights with data distribution at an all-time high, and research reached new depths with a borehole into the Precambrian at 8,126 feet. Research on geologic storage of CO_2 was a big part of the research program for KGS, but research on earthquakes, landslides, geologic mapping, and water resources was also important. This annual report of the Kentucky Geological Survey is a summary of the projects and accomplishments of this organization over the past fiscal year. People interested in the Kentucky Geological Survey, its programs, and educational outreach can find an abundance of information on the KGS Web site. The Web site is a portal into maps, publications, geologic data for Kentucky, and recent presentations made by our staff members.

KGS is a mandated program of the State of Kentucky and operates as a research center of the University of Kentucky under the vice president for research. The serious questions concerning energy, water, global climate, and hazards confronting our state, nation, and the world create a situation where geological surveys are more important to society than ever before.

This annual report comes at a very difficult time in the country, with ongoing recession, rising unemployment, decreasing revenues, and great economic uncertainty in the state, nation, and world. A 2008 survey of top economists showed most of them believed the economy was then in a recession that would continue through 2009. As of the fourth quarter of 2009, at the time of this writing, the stock market is again above 10,000, a positive sign, but unemployment is above 10 percent and the outlook is uncertain. The KGS budget could face cuts once again in the 2009-10 fiscal year, but with the Kentucky General Assembly beginning its session in January 2010, there is no clear sign at this time what the State's, university, or KGS budget will be.

The U.S. House of Representatives passed the Markey-Waxman Bill, which is energy legislation containing provisions for a cap-and-trade system to control carbon emissions. Commercialization of geologic storage will likely not advance beyond the pilot phase until there is some type of mandated regulatory control. The EPA has designated CO_2 as a hazardous air pollutant, setting the stage for regulatory controls by the EPA if Congress does not enact legislation. The UN climate change conference, Conference of the Parties to the UN Framework Convention on Climate Change, will take place in December 2009. Although there has been much build-up and publicity in the U.S. media, there will be no action in the Senate to advance the Markey-Waxman Bill, so our country's position at the conference is as yet unknown. President Obama is, however, expected to be at the conference in person. The KGS work in geologic storage and enhanced oil recovery is of course tied to government actions taken for climate change. These stories are still unfolding. We will stay tuned.

One of the important measures demonstrating KGS's progress and effectiveness is numbers for sponsored projects. In 2008-09,

KGS had *19 funded projects* for a total grant funding of *$2.1 million*. KGS produced *10 new publications*. The KGS Web site continues to be a valuable tool used by many industries, government agencies, and private citizens to gather geologic information. Last year, users conducted *223,120 online database* searches for petroleum, coal, and water data. Most of the data and publications that KGS provides can be downloaded free from our Web site, and over 1.2 million such downloads took place last year. Users can also view KGS data on interactive Web maps, especially our signature interactive geologic maps. KGS database and map Internet functions serve over 1,000 users a day. The KGS Well Sample and Core Library accommodated *1,540 visitors* and added *700,000 feet of core* from *252 wells*. KGS added one new staff member in the year ending June 30, 2008.

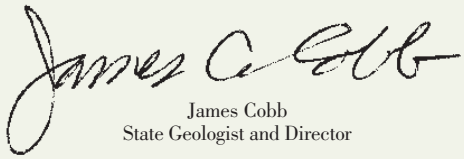
In the 2007 special session, the Kentucky General Assembly passed HB-1, establishing tax incentives for alternative-fuel and renewable-energy plants to locate in Kentucky and provided funds for research. HB-1 appropriated $5 million for the Kentucky Geological Survey to investigate CO_2 storage in deep geologic reservoirs, enhanced oil recovery, and enhanced Devonian gas recovery. Research mandated by this bill was a major focus for KGS during 2008-09.

The deep geologic storage project in Hancock County in the Western Kentucky Coal Field raised over $9.5 million to match State and KGS funds, for a total project budget of $10.8 million. The well was successfully completed, and CO_2 was injected in the summer of 2009. The geologic and engineering characteristics of the deep rock formations are being determined from the data obtained during the course of this research. The scope of work and detailed research make this one of the most comprehensive projects of its kind in the United States. It is also one of the largest, if not the largest, nonfederal carbon storage test project in the United States. The Sugar Creek enhanced oil recovery project in Hopkins County in western Kentucky is showing that injecting CO_2 to enhance oil production holds promise as a feasible technology. The project is only about a quarter of the way to completion and has injected 2,000 tons of CO_2 of an ultimate 8,000 tons. A second enhanced oil recovery project is under way at the Euterpe Field in Henderson County. Future projects are planned on deep geologic storage in eastern Kentucky and enhanced gas production in Pike County.

The Precambrian Era is the time in the very distant geologic past when only primitive organisms such as algae lived on Earth. In Kentucky, the rocks of the Precambrian are very deep, covered by more than a mile of Paleozoic strata. Therefore, getting a sample or core of these rocks is extremely rare in Kentucky. Because of the excitement surrounding the core of Precambrian rock from the Hancock County well, we shared pieces of the core with Gov. Beshear, UK President Todd, UK Vice President Tracy, Rep. Rocky Adkins, Sen. Robert Stivers, and our partners on the project from ConocoPhillips, E.On U.S., and Peabody Energy. All seemed genuinely pleased to receive their piece of Kentucky's very ancient geologic past.

Research continued on seismic hazard analysis for Kentucky and on the KGS/UK exchange program with the Lanzhou Institute of Seismology in Gansu Province, China. Director Lanmin Wang visited KGS and UK in the spring, and presented a talk on the devastating Sichuan earthquake of May 2008.

KGS staff testified for a number of legislative committees and consulted with State officials in a number of different departments. KGS maintained the State's groundwater monitoring network, seismic monitoring network, well sample and core library, and groundwater data repository, all part of our mandate. We continued in an advisory role for the Kentucky Energy and Environment Cabinet and produced two dozen articles and press releases in the news media. The details of these and many other activities are described in greater detail in this annual report.



James Cobb
State Geologist and Director

KGS has been active in major projects related to carbon storage and use of CO_2 for enhanced oil and gas recovery.

Western Kentucky Deep Storage Test

Drilling of the Marvin Blan No.1 well in Hancock County, Ky., to test the potential for permanent storage of carbon dioxide in deep western Kentucky formations, began on April 24 and was completed on June 15, reaching a total depth of 8,126 feet. Three primary carbon storage reservoirs of the Knox Group were identified. St. Peter and Mount Simon Sandstones, potential carbon storage reservoirs being tested elsewhere in the Illinois Basin, were not present in this well. **Rick Bowersox** of the Energy and Minerals Section and Henderson office manager **Dave Williams** served as principal investigators on the Hancock County effort. Injection of carbon dioxide and brine was scheduled for the summer of 2009.

ConocoPhillips, E.ON US, Peabody Energy, and the Tennessee Valley Authority formed the Western Kentucky Carbon Storage Foundation to provide additional funding and technical services to the project. The Illinois Department of Commerce and Economic Opportunity also provided funding.

Cores were taken in the New Albany, Maquoketa, Black River, and Knox formations; 30 feet of core was also taken in the Precambrian Middle Run Sandstone at the bottom of the well. The U.S. Department of Energy provided funding for the Precambrian core.

Other project partners include the Kentucky Energy and Environment Cabinet; Schlumberger Carbon Services; Geo Consultants LLC; Smith Management Group; Wyatt, Tarrant, and Combs, LLC; and Kentucky Syngas LLC. ⌘

Enhanced Oil Recovery—Sequestration

Carbon dioxide injection began on May 11 at the Sugar Creek enhanced oil recovery and sequestration project in Hopkins County. The project is jointly administered by the state geological surveys of Kentucky and Illinois and the operator of the oil field, Gallagher Drilling Inc. In addition to Kentucky House Bill 1 funding, the project also receives support from the U.S. Department of Energy through the Midwest Geological Sequestration Consortium, which includes the Kentucky, Indiana, and Illinois surveys. Though a mature technology elsewhere in the United States, CO_2-EOR has not been used extensively in the

Aerial view of the completed Marvin Blan No. 1 well in Hancock County.

Courtesy W.C. Ging and Sandia Technologies, LLC.

The rig used for drilling the western Kentucky deep carbon storage test well is set up at the Hancock County site.

Glynn Beck, Brack Wimmer of the Illinois Survey and Kathy Takacs take brine samples for the Sugar Creek project in Hopkins County.

Illinois Basin, largely because of the cost of CO_2.

Marty Parris is principal investigator for the KGS portion of the Sugar Creek project. By late June, about 1,500 tons of CO_2 was injected about 1,850 feet deep into the Mississippian Jackson Sandstone through a single injection. The project goal is to inject 8,000 tons of CO_2 during a period of about a year.

Water and gas chemistry data are being collected by KGS researchers **Glynn Beck** and **Kathy Takacs** to determine how long the reservoir fluid stays reactive once CO_2 injection ends, and whether the reactions produce any discernible changes in the properties of the reservoir or seal rocks. ⌘

Devonian Shale Sequestration

Low-permeability, organic-rich, fractured Devonian black shales underlie about two-thirds of the state and account for nearly 75 percent of Kentucky's natural gas production. Evidence suggests that CO_2 is preferentially adsorbed in the shale, making possible both long-term CO_2 storage and enhanced natural gas recovery. Two ongoing projects are investigating this possibility.

The Pike County Fiscal Court nominated a natural gas well along Burke Branch as a potential CO_2 injection test site. The nominated well is a cased-hole completion, preventing acquisition of additional data for shale characterization and injection project design. But data from similar wells were provided by Rosewood Resources, the Midwest Regional Carbon Sequestration Partnership, and Chesapeake Appalachian. These data have been compiled into a reservoir model for simulating CO_2 injection and enhanced gas recovery at the Pike County site.

Two injection scenarios were investigated: continuous injection (a CO_2 "flood") and a CO_2 "huff and puff," in which CO_2 is injected and allowed to dissipate and dissolve before more natural gas is recovered. Preliminary analysis of the simulation suggests continuous injection of CO_2 results in the higher natural gas recovery. An injection test project will be designed based on these results.

In western Kentucky, the Devonian New Albany Shale is an emerging natural gas play with potential for long-term storage of CO_2. Thirty feet of full core was acquired from the Marvin Blan No. 1 deep storage test well to better characterize Illinois Basin shale for CO_2 storage and as a seal for deeper storage zones. This core is being sampled and analyzed to determine its properties. ⌘

Rough Creek Graben Consortium

A 2-year study on the Cambrian geology and petroleum potential of the Rough Creek Graben region of the southern Illinois Basin approached completion. This study was funded by a consortium of 12 petroleum exploration companies, the Kentucky Energy and Environment Cabinet, and KGS. It included analysis and geologic interpretation of 69 two-dimensional seismic lines (totaling nearly 1,000 miles of data), 10 regional cross sections constructed from well data, and laboratory analyses of 25 sets of

Cambrian well cuttings from Rough Creek Graben wells. In addition, a database was created with information on 8,056 Knox Group and deeper wells across seven states. Of these wells, 1,723 have stratigraphic "tops" interpretations and 550 have digital well log data.

As part of the terms of the Consortium agreement, the final report of the Rough Creek Graben study will be confidential for 24 months following the end of the project. At that point (fall 2011), the results of the study will become public and will be published by KGS. ⌘

Coalbed Methane in Eastern Kentucky

A study of the coalbed methane potential of Breathitt Group coals from the Johnson-Martin-Floyd County area was completed in June. This study, overseen by **Cortland Eble,** was funded by the Kentucky Energy and Environment Cabinet, with the assistance of a local coal company. Although gas contents were modest in terms of volume (less than 60 standard cubic feet per ton), the sampled gas was very high in methane content, relative to other gases. A second Breathitt Group drill core was collected from Letcher County in cooperation with another coal company with operations throughout eastern Kentucky. Gas contents were fairly high for eastern Kentucky (more than 100 scf/ton), although much of the gas was categorized as residual, and was liberated only after the core was crushed. Depending on gas prices, coals such as these may ultimately prove to be economic for coalbed methane extraction.

One other coal bore was sampled in McLean County in western Kentucky. In this core, which was also donated by a local coal company, the Springfield coal gave off a significant amount of gas (more than 80 scf/ton) that was relatively pure methane (more than 90 percent). At this location, the roof shale, which was highly carbonaceous, also produced a fair amount of gas (more than 40 scf/ton). These data are consistent with an earlier KGS study done to evaluate the gas potential of western Kentucky coal beds ("Resource Assessment and Production Testing for Coal Bed Methane in the Illinois Basin: Final Report"). ⌘

Soil Gas Chemistry Investigations

Marty Parris was the principal investigator on a project that characterized soil gas chemistry in settings in eastern Kentucky having variable degrees of human disturbance and different types of near-surface geology. The goals of the project were to characterize soil gas chemistry and flux and determine if such measurements could be used as a monitoring tool for carbon storage projects. The project was funded by the U.S. Department of Energy and the Kentucky Energy and Environment Cabinet, and final technical reports for the project were submitted to these agencies in August 2009. ⌘

Regional Carbon Sequestration Potential and CO_2 Enhanced Oil Recovery in Kentucky

One of the first broad regional appraisals of carbon storage and enhanced oil recovery potential in Kentucky was completed by Energy and Minerals staff in May. Funded by the State, it focused on four major areas: (1) a geologic evaluation of the potential to use CO_2 for enhanced oil recovery, (2) an evaluation of subsurface brine geochemistry and implications for CO_2 sequestration, (3) a broad geologic framework evaluation of CO_2 storage potential with an emphasis along some of the state's major river corridors, and (4) a geologic evaluation of CO_2 storage potential for nominated coal gasification sites. The report will be posted on the Kentucky Energy and Environment Cabinet Web site (www.eec.ky.gov) and will be released as a KGS publication in the near future.⌘

Evaluation of State-Owned Lands for Oil and Gas Potential

The 2009 regular session of the Kentucky General Assembly called for KGS to collect data on State-owned lands and assess their oil and gas resources; **Brandon Nuttall** is leading the project to accomplish this. A criteria-based framework was defined using tract size, proximity to developed areas and production zones, and surface access restrictions. A model for a generalized assessment of revenue potential was compiled from recent Kentucky oil and gas production data. Information was gathered from several State agencies and universities to be integrated to the extent possible into a single geographic information system to facilitate the assessment. The findings will be issued before the 2010 session of the Kentucky General Assembly convenes. ⌘

The expertise of KGS Water Resources Section staff helps Kentucky agencies monitor the state's waters and provide communities with clean water supplies.

Identifying Raw-Water Supplies

The Water Resources Section is helping small Kentucky communities look to groundwater sources for public water supplies. In eastern Kentucky, they continued their work with the city of Evarts in Harlan County to develop groundwater supplies by testing production and quality in two newly drilled wells and analyzing general groundwater conditions for future planning. An aquifer test was completed for the city of Campton in Wolfe County. Hydraulic and water chemistry data were used by the city's consulting engineer to successfully apply for funds to build a new water treatment plant. Both of these sites target sandstone units of Early Pennsylvanian age and used remotely sensed data and field observations to site new wells in fracture zones that tend to produce more groundwater than in surrounding areas.

▲ Jim Dinger measures groundwater flow from a discharge pipe during a pumping test of a sandstone aquifer in Campton.

◀ Bart Davidson connects galvanized steel pipe to a water pump while performing an aquifer test at an Evarts well.

At Greenville, in Muhlenberg County, section staff conducted a pumping test for a new municipal well approximately 850 feet deep. Water-quality data were collected and reported to a consulting engineer, along with hydraulic analyses. KGS continues to provide information to Marion in Crittenden County on the use of abandoned underground fluorspar mines as potential water supplies. In addition, KGS assisted the city of Sturgis in conjunction with the Kentucky Rural Water Association by sampling a monitoring well installed in the Union County community to assess the groundwater quality of a proposed municipal well site. ⌘

Groundwater Conditions in the Cumberland Gap Tunnel

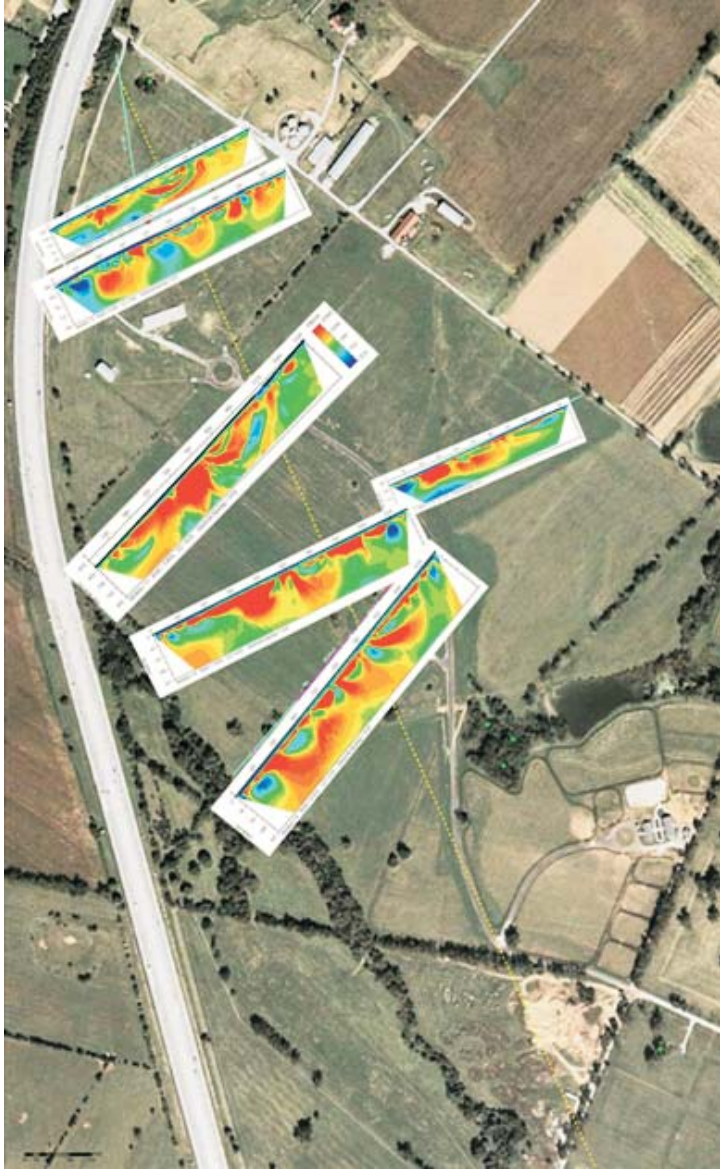
KGS completed installation of 23 new monitoring wells in the Cumberland Gap Tunnel and completed one round of sampling of 50 wells for water quality. Chemical analyses are being modeled to further

delineate the problem with the limestone aggregate roadbase dissolving in certain areas in both the northbound and southbound tunnels. Remediation is being considered by the Kentucky Transportation Cabinet. This project is in coordination with the Transportation Cabinet, the Cumberland Gap Tunnel Authority, the Federal Highways Administration, the University of Kentucky Transportation Center, and Vaughn and Melton Engineers Inc. ⌘

Assessment of the Effect of CO_2 Injection on Local Groundwater Quality

KGS Water Resources staff conducted shallow groundwater monitoring for two carbon storage projects overseen by the Energy and Minerals Section. One project, in Hancock County, investigated the feasibility of injecting CO_2 into deep saline aquifers. The second project, in Hopkins County, researched the feasibility of injecting CO_2 into an oil-producing formation to enhance oil recovery while also storing the carbon dioxide. The shallow groundwater was sampled to characterize the local water quality and assess any changes in quality that may be associated with CO_2 injection. Groundwater sampling in Hancock County will continue through 2012 and in Hopkins County through 2010. (More information on these projects can be found on page 4.) ⌘

▼ LaHousine Hanich, Junfeng Zhu, and Randy Paylor prepare to conduct an electrical-resistivity test in the Cane Run watershed. The test sends electric current through metal stakes in the ground to help locate underground conduits that may contain groundwater.



▲ An aerial photograph of the Cane Run study area with cross-sectional diagrams of electrical-resistivity tests overlying the area. Areas in blue represent possible underground conduits.

Cane Run Watershed

Section staff continued their efforts to locate sites to monitor the underground conduit through which the Cane Run watershed usually flows from Lexington to Royal Springs, the main water supply for Georgetown, in Scott County. Cane Run is one of four watersheds that the State Division of Water has focused on for cleanup in its nonpoint-source pollution program. Electrical-resistivity and spontaneous-potential geophysics were used to help pinpoint the location of the active conduit at

three locations. Additional monitoring wells will be drilled in the future at selected sites. This work is being carried out in cooperation with the University of Kentucky's College of Agriculture and Department of Earth and Environmental Sciences. ⌘

Selenium Concentrations in the Aquatic Environment

Statistical analysis of selenium concentrations in water and fish tissue from the Eastern Kentucky Coal Field continued, and a report summarizing the findings is being written. With funding from the Kentucky Division of Water, 13 sites were sampled in 2007 and 2008. The samples include 37 water samples, 25 sediment samples, and 29 fish tissue samples, for which seven forms of selenium were analyzed; standard chemical analyses were also performed to help define the hydrogeochemical environment. The sampling program was requested by the Division of Water because of a hypothesis that groundwater moving through bedrock and areas of coal-mine spoil dissolves selenium concentrated in the coals during formation. The groundwater eventually discharges to surface waters, where selenium may metabolize and bioaccumulate into toxic forms and concentrations in the food web. ⌘

Karst Activities

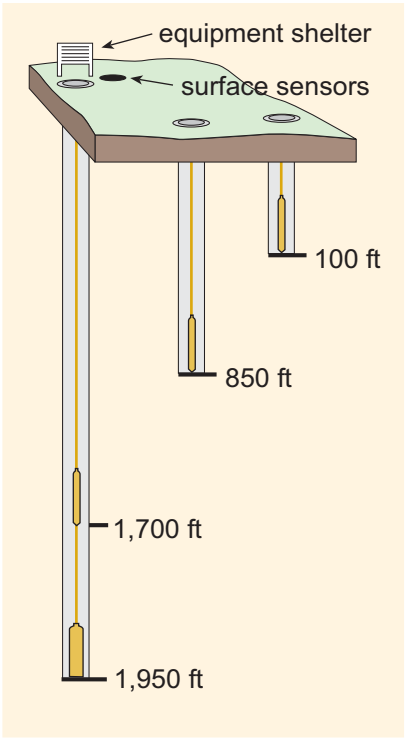
KGS staff completed a project for the Transportation Cabinet to assess the potential consequences of routing overland runoff from one karst groundwater basin to another along the extension of the Edward T. Breathitt Pennyrile Parkway in southern Christian County. The Tell City karst groundwater basin map was completed in cooperation with the Division of Water, and is scheduled for release in the near future. The map covers parts of Kentucky around the Owensboro area. Work continues on developing maps depicting the probability of cover-collapse sinkholes occurring. A model ordinance for guiding development in karst terrain was completed by Jim Currens and delivered to over 70 Kentucky fiscal courts and planning agencies. Currens received a University of Kentucky Commonwealth Collaboratives grant for this project. ⌘

▼ Jim Currens looks over an excavated area along the extension route of the Edward T. Breathitt Pennyrile Parkway in Christian County while searching for dye-injection sites.

Monitoring and understanding the earthquake hazard in the central United States remains the top priority of the Geologic Hazards Section.

KGS and the University of Kentucky's Department of Earth and Environmental Sciences jointly operate the Kentucky Seismic and Strong-Motion Network of 26 recording stations located throughout Kentucky. The network monitors earthquakes in the central United States and records larger earthquakes around the world. It consists of 19 short-period (weak-motion) seismometers and 10 strong-motion accelerometers, including two-vertical strong-motion arrays. Continuous near-real-time recordings from 12 of the instruments can be viewed on the KGS Web site at www.uky.edu/KGS/geologichazards/equake3.htm.

Jonathan McIntyre guides students through an online search for earthquake information during the 2008 KGS open house.



The Central U.S. Seismic Observatory includes a 1,950-foot borehole into bedrock, two existing boreholes, and a surface vault.

The strong-motion instruments recorded 41 earthquakes in the region during the fiscal year. Several hundred earthquakes from around the world were recorded by the weak-motion instruments. Two earthquake epicenters were located in Kentucky: a 3.2-magnitude earthquake on January 27, 2009, near Williamsburg, and a 2.3-magnitude earthquake on May 8, 2009, near Barbourville. ⌘

Instruments Built for Deep Seismic Observatory

Completion of the Central U.S. Seismic Observatory in Fulton County took a major step forward as strong-motion accelerometers and medium-period seismometers were built by EENTEC of St. Louis for the observatory. **Jonathan McIntyre** of the Geologic Hazards Section has managed the instrumentation phase of the project.

The observatory consists of three cased boreholes and a surface vault. The deepest borehole was drilled to 1,950 feet through the sediment overburden and into bedrock. Two existing boreholes comprising the vertical strong-motion array will be incorporated into the seismic observatory. A variety of broadband and strong-motion instruments will be placed in the boreholes and at the ground surface. The surface vault is 36 inches in diameter, encased in concrete extending to a depth of 4 feet below ground surface.

The observatory, at Sassafras Ridge near the most active part of the New Madrid Seismic Zone, should provide the maximum amount of data in the shortest period of time. The array of instruments will allow the measurement of strong motions from the bedrock through the soil column to the surface, allowing monitoring of how soil changes earthquake waves as they propagate to the surface. KGS will be the only research entity with this capability in the region. The observatory will be fully operational in the next fiscal year. ⌘

Chinese Partners Give Lectures at KGS

Two Chinese researchers who have been involved in an international earthquake partnership

Lanzhou Institute of Seismology Director Lanmin Wang presents a traditional Buddhist figurine from the Tang Dynasty to University of Kentucky Vice President for Research Jim Tracy during Wang's visit in April as part of the earthquake research exchange with KGS.

with KGS visited the Survey on the University of Kentucky campus on April 27. Lanmin Wang, who directs the Lanzhou Institute of Seismology in China's Earthquake Administration, talked about effects and lessons learned from the 8.0-magnitude earthquake that struck Sichuan, China, in May of 2008. Zhijian Wu, who spent a year as a visiting scholar at KGS, gave a brownbag lunch presentation on his research into preventing the thawing of permafrost under the railbed of the Quinghai-Tibet Railway. ⌘

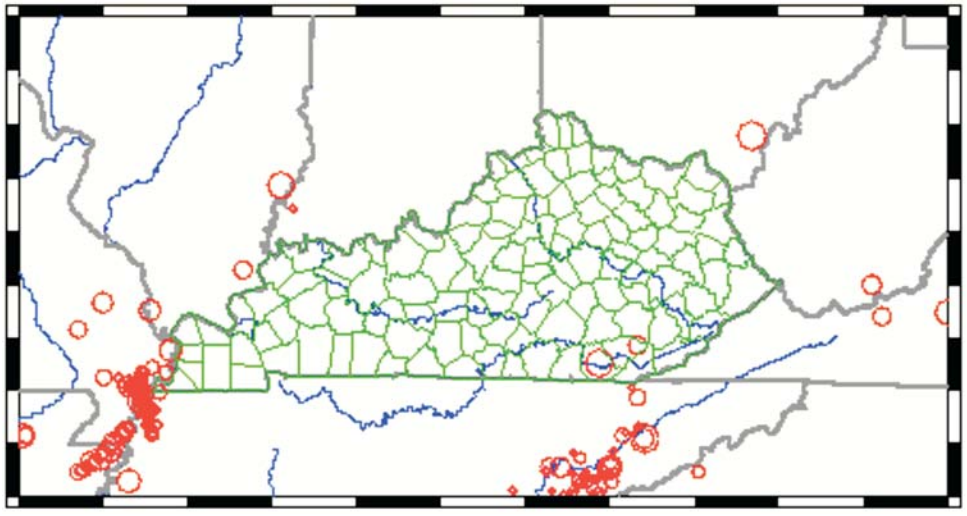
Hazard Assessment

There is little doubt that earthquakes pose a hazard to Kentucky, and the task of developing policies to mitigate seismic hazards is challenging. Although the lack of strong earthquakes from which to gather data adds to the challenge, assessing seismic hazards is the basis for developing effective policies and measures.

For example, the national seismic hazard maps, produced by the U.S. Geological Survey, have been the basis for development of many national policies, such as building codes. Therefore, seismic hazard assessment and maps must be scientifically sound. KGS has determined, however, that there are problems with the national seismic hazard maps: (1) the methodology (i.e., probabilistic seismic hazard analysis) is flawed, (2) some input models are not consistent with modern earthquake science, and (3) there is much confusion about the national hazard maps.

These problems have led to poor mitigation policies in western Kentucky, where seismic design and regulations based on the national hazard maps are more stringent than those in San Francisco or Los Angeles.

Research and discussions with federal agencies and other organizations have resulted in some changes in the use of the national seismic hazard maps. The Building Seismic Safety Council did not recommend using the 2008 national seismic hazard maps for the new edition of the National Earthquake Hazards Reduction Program's "Recommended Provisions for Seismic Regulations for New Buildings and Other Structures." The USGS has also stated on its Earthquake Hazards Program Web site (earthquake.usgs.gov/hazards/products/conterminous/2008/disclaimer.php) that "the 2008 USGS hazard maps should not be substituted for the model building code design maps nor should they be used with ASCE/SEI 41 or 31 for seismic rehabilitation or evaluation." ASCE/SEI 41 and 31 are publications of the American Society of Civil Engineers' Structural Engineering Institute. ⌘



Earthquakes recorded in the region from the Kentucky Seismic and Strong-Motion Network and other cooperative networks in the central United States. The largest recording in the region for the fiscal year was the April 24, 2009, southeastern Ohio earthquake near Oak Hill, Ohio, with a magnitude of 3.4.

Carbon Storage Test Well Drilled in Hancock County

The project to drill a deep well in the Western Kentucky Coal Field to test the permanent geologic storage of carbon dioxide took just 2 years from passage of legislation mandating the work in August 2007 to clearing of the site when drilling and injection was completed in 2009.

After private partners had been recruited to participate in the project, planning started and preliminary field work, such as gathering seismic-reflection data, got under way.

The site on a Hancock County farm was graded and prepared for drilling, and a drill rig arrived in April of 2009. The drilling to a depth of 8,126 feet started on April 23 and took 63 days. Sections of core were taken from five formations in the well for analysis.

While the drilling was under way, the project partners opened the site for a tour in May 2009, drawing about 50 people.

On August 19, 2009, 300 tons of carbon dioxide was successfully injected into the well, demonstrating that the Knox Dolomite could permanently store carbon dioxide.

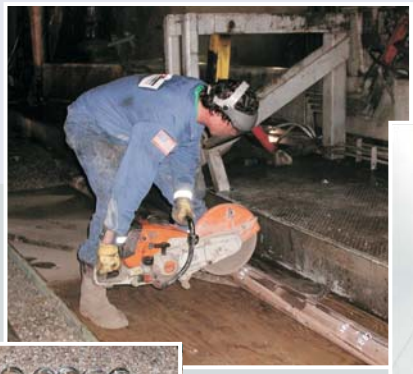
The testing rig was removed and the site cleared of equipment by late summer of 2009. ⌘

Seismic reflection

Site preparation

Drill rig arrives

Site tour



Core sections taken

Injection day

Drilling operations

The test site after operations

Public Outreach

KGS staff share their knowledge and expertise through a variety of outreach events.

Oil and Gas Exploration Property Owners' Evening in Western Kentucky

In April, **Rick Bowersox** and **Brandon Nuttall** of the Energy and Minerals Section spoke at a property owners' workshop organized in Elkton by the University of Kentucky Agricultural Extension Service for Todd County.

The topic was leasing mineral rights for oil and gas exploration. Nuttall discussed the geology of the region and its oil and gas capacity, and Bowersox shared his 25 years of experience in the oil and gas industry. A lawyer with experience in leasing mineral rights also spoke at the meeting. ⌘

▲ Rick Bowersox spoke at a property owner's workshop.

Public Meeting and Site Tour Held in Hancock County on CO_2 Research

KGS and its partners in the Hancock County deep carbon storage test held their second public outreach meeting on the project in Hawesville on October 27. About two dozen people, including members of the county fiscal court, attended. They listened to presentations on the project and asked questions about its effects in the area. KGS Director **Jim Cobb** updated the audience on the project's status, and Western Kentucky Office Manager **Dave Williams** spoke about activities Hancock County residents would see in the vicinity of the deep well site.

In May, a tour of the site was organized for the media and project partners. Hancock County Judge Jack McCaslin, Kentucky Rep. Rocky Adkins, and Energy and Environment Cabinet Secretary Len Peters were among those who spoke to the gathering. About 50 people were bused to the site for a tour of the drilling platform and site operations, and temporary buildings where data on the injection activities was to be gathered when the carbon dioxide injection phase began. ⌘

▲ Kathy Takacs and Steve Greb at the CAER Energy Fair.

CAER Energy Fair

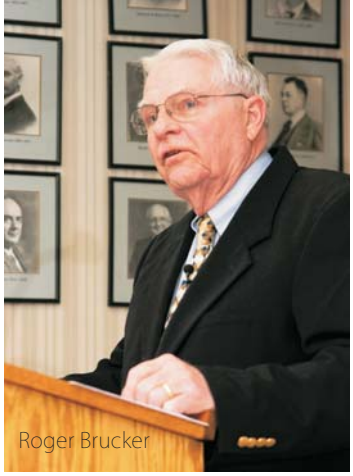
KGS staff is asked to make presentations or prepare demonstrations for a variety of professional, civic, and educational events each year. **Kathy Takacs** and **Steve Greb** of the Energy and Minerals Section, above, talked to school children about carbon dioxide and energy-related topics at an energy fair in January sponsored by UK's Center for Applied Energy Research. ⌘

Annual Seminar, May 15

About 120 people gathered for the 49th KGS Annual Seminar on May 15. KGS researchers and their colleagues with State government agencies and the University of Kentucky spoke on projects they have developed together. The theme of the seminar was "Geoscience for the Citizens of Kentucky." Speakers included UK Vice President for Research Jim Tracy, Kentucky Energy and Environment Cabinet Secretary Len Peters, and others from several state agencies. ⌘

Roger Brucker, Haney Distinguished Lecture

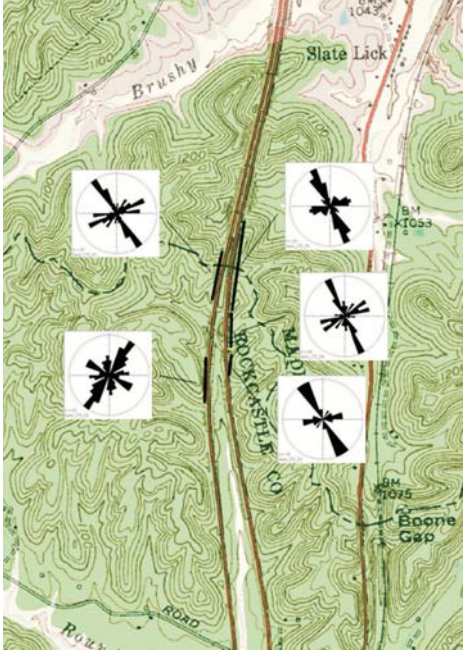
The speaker for the 2009 Donald C. Haney Distinguished Lecture in March was cave explorer Roger Brucker. The author or co-author of four books on cave topics, Brucker told 85 people gathered at the Mining and Mineral Resources Building about the history of the mapping of Mammoth Cave and colorful stories about the people who mapped the world's longest cave system. Brucker is a co-founder of the Cave Research Foundation. ⌘


Roger Brucker

Open House

KGS and other organizations set up displays for the annual open house on the evening of October 15, 2008. Dozens of students and their parents from Fayette and surrounding counties came to view exhibits and demonstrations on rocks and minerals, fossils, meteorites, carbon dioxide, mapping, exotic animals, and other earth science topics. The event is held each year in conjunction with the observance of Earth Science Week, which is sponsored nationally by the American Geological Institute. ⌘

Mapping still matters on issues ranging from hazards to water resources.



▲ Rose diagrams depicting the orientation of fractures in the Berea area cataloged by Steve Martin.

The Kentucky Geological Survey and a variety of State and local agencies constantly need new or refined geologic mapping of the state. KGS's geologic mapping mission is to develop detailed (1:24,000-scale) geologic maps for Kentucky that are suitable for defining geologic hazards, developing economic resources, understanding groundwater flow and quality, geotechnical and land-use planning, and other soil- and landscape-related activities.

The KGS Geologic Mapping Section, led by **William Andrews,** works to meet those needs with a variety of products. The section has been working for several years on geologic mapping funded by the annual U.S. Geological Survey STATEMAP program and Kentucky agencies. The STATEMAP program continues to be the primary funding source for KGS geologic mapping projects. During the fiscal year, KGS received $208,000 from STATEMAP to support new Quaternary geologic mapping in both eastern and western Kentucky.

KGS field mappers **Ron Counts** and **Scott Waninger** completed new mapping in the Kentucky parts of four 7.5-minute quadrangles in Union County. This work will contribute to efforts to assess seismic hazards and geotechnically characterize the unconsolidated deposits in western Kentucky. **Matt Crawford** and **Mike Murphy** completed new mapping of the Quicksand 7.5-minute quadrangle in Breathitt County, which will provide a foundation for slope-stability modeling in the eastern part of the state. **Steve Martin** maintains a database of subsurface information related to the mapping projects; the data were harvested from KGS coal, petroleum, and water databases.

The Geologic Mapping Section also continued to support two student mapping projects in Kentucky, which are funded by the U.S. Geological Survey's EDMAP program. Morehead State University and Northern Kentucky University each have students doing mapping projects similar to the KGS STATEMAP project in eastern Kentucky. KGS personnel are supplying data and field support for the student mappers.

Steve Martin continued to develop a fracture mapping database supported by the Kentucky Transportation Cabinet. He is examining orientation and spacing of fractures in roadcuts and natural outcrops in selected areas of central and eastern Kentucky. The information will be useful for a variety of projects from slope design for road projects to water and petroleum exploration. Matt Crawford has continued to develop a comprehensive landslide inventory and database, in cooperation with **John Kiefer, Jerry Weisenfluh,** and the KGS Web page design team. The new database will store and catalog information about the location, size, movement, and damages associated with landslides across Kentucky. ⌘

▲ Ron Counts and Mike Murphy use an augur to bore to bedrock in Henderson County as part of a mapping project.

KGS provides research and service to communities through its Western Kentucky office.

KGS staff in the western Kentucky office in Henderson do both research and community service in the western part of the state. Office manager **Dave Williams** has been active in the effort to drill a deep well for carbon storage in Hancock County, serving as a co-principal investigator on that effort. He acted as a liaison for KGS and its project partners with the property owner and was present at the site for the start of critical phases.

▲ Dave Williams points out features of the drilling operation at the deep carbon storage test site during a tour of the site in April.

(For more on this project, see page 4.) Williams also collects coal data, assisting coal and petroleum companies with information on the geology of western Kentucky.

Glynn Beck continues work on health-related water studies in the region. A survey was sent to 550 families who use groundwater for domestic water supply, in a cooperative project with the University of Kentucky College of Public Health. It seeks to determine if there are links between the health of those families and elevated nitrate and herbicide concentrations and the presence of bacteria (total coliform and *E. coli*) in the well water. Further surveys are planned for later in 2009.

Beck also conducted well and spring sampling along with gas sampling for the Hancock County carbon storage project. He also took water samples from production, domestic, and monitoring wells associated with the Sugar Creek enhanced oil recovery project in Hopkins County. In an effort to help locate supplemental water supplies for the cities of Greenville, Sturgis, and Marion, Beck sampled water in test wells and aquifers. The KGS Water Resources Section and the Kentucky Rural Water Association are also involved in these projects.

▲ Glynn Beck gathers water well data in connection with the Hancock County carbon storage test.

Ron Counts continued mapping work in western Kentucky with the Geologic Mapping Section and was one of several KGS staff members involved in developing data for the Kentucky portion of "Surficial Geologic Map of the Evansville, Indiana, and Henderson, Kentucky, Area," published by the USGS during the year. He applied for a federal grant to continue work on a fault scarp found in the Uniontown area the previous year. Preliminary investigations suggest the fault is between 3,500 and 4,000 years old. ⌘

▲ Ron Counts and Scott Waninger examine an erratic found in western Kentucky. An erratic is a rock fragment carried from its original location by glacial ice thousands of years earlier.

Analyses done at the KGS Laboratory assist the research by Survey staff and UK students.

KGS Laboratory Manager **Henry Francis** retired in January 2009 after managing the facility since April 1988. During that time, he won recognition for his service to his profession, receiving a 2008 Award of Merit from the Committee on Coal and Coke of ASTM International (originally known as the American Society for Testing and Materials). It is ASTM's highest honor for individual contributions to standards activities. Francis continues to work part-time for the KGS laboratory and a coal lab operated by the University of Kentucky's Department of Mining Engineering. **Jason Backus** became laboratory manager upon Francis's retirement.


Henry Francis

The KGS laboratory's capabilities are important for energy-related projects conducted by the Survey's Energy and Minerals Section and its partners. The lab analyzed water samples taken at a Hancock County site where a deep well was drilled in 2009 to test permanent geologic carbon dioxide storage in the Western Kentucky Coal Field. Lab staff also assessed water samples and samples from an enhanced oil recovery project in Hopkins County. (For more information, see the Energy and Minerals Section, page 4.)

The laboratory analyzed samples from the Cumberland Gap Tunnel, where staff in the KGS Water Resources Section is helping to determine the cause of subsidence in the road surface. (More on that project can be found on page 7.)

Staff also analyzed samples from streams across Kentucky collected by Kentucky Water Watch program volunteers, whose work focuses on monitoring and protecting the quality of the state's streams, rivers, lakes, and wetlands.

The lab acquired several new instruments during the year. One is a new inductively coupled argon plasma optical emission spectrometer, used for analyzing total and dissolved metals. Also new is a differential scanning calorimetry and thermogravimetric analyzer unit. It characterizes heat flow and weight changes associated with transitions and reactions over a temperature range from ambient to 1,500 degrees Celsius. The laboratory also added a carbon dioxide ion selective electrode to assist in CO_2 analyses.

▲ Jason Backus sets up a new inductively coupled argon plasma emissions spectrometry instrument. Many water samples are analyzed by the laboratory on this instrument, which detects metals.

Both graduate and undergraduate students at the University of Kentucky used the laboratory's X-ray diffraction instrument for research toward their degrees in a wide range of disciplines, including geology, chemistry, chemical engineering, and agriculture. Students also performed laboratory work with plant fibers and nanoparticles. ⌘

▼ Andrea Connor analyzes water samples gathered for the Sugar Creek enhanced oil recovery project in Hopkins County.

The Well Sample and Core Library is the only facility of its kind in Kentucky.

Preservation, accessibility, and utilization of samples and cores are the major objectives of the KGS Well Sample and Core Library. Data and materials stored at the facility from over 25,000 locations across Kentucky are important for the discovery and exploration of energy sources and minerals, research for a cleaner environment, and an improved understanding of Kentucky's geologic history.

Preserving geoscience data and making them available has many benefits. There is a constant need to reexamine samples as new geologic and engineering concepts evolve and as new technology and methods of examination and interpretations emerge. Field work, data acquisition, and research can be costly, time consuming, and dangerous. The library makes available historical data, literature, previously analyzed sample data, geophysical logs, core data, geochemical analyses, and samples. The database of samples and cores can be accessed at the library's page on the KGS Web site.

ACTIVITIES SUMMARY
for FISCAL YEAR 2008-09

- Over 650 telephone requests for information were received.
- More than 1,540 researchers, geologists, consultants, students, academics, operators, and the public visited the facility for a total of 2,583 visits.
- More than 285,000 feet of core and well cuttings were examined.
- Approximately 700,000 feet of core from 252 wells was added to the collection.

The KGS Well Sample and Core Library remains the only such facility in Kentucky. Its samples and cores are of great value for training at all levels of education, and continued training of working professionals. The data provide opportunities for research, exploration, development, reports, theses and dissertations for graduate students, class projects, and lab exercises while training and educating new generations of professionals who will need such data.

It is hoped that discoveries resulting from use of this material and data will lead to economic prosperity and energy independence, resulting in greater national security, a cleaner environment, and clean and efficient energy. ⌘

Cores and samples stored at the library come from locations across Kentucky.

▼ Academic researchers, exploration companies, and others regularly visit the Well Sample and Core Library to gather information from the stacks of cuttings and cores.

KGS helps Kentucky's Transportation Cabinet organize geotechnical data and track costs relating to geologic hazards.

▲ Kentucky's Transportation Cabinet regularly repairs structures, such as this overpass, that are damaged by geologic hazards, including landslides and sinkholes.

Geotechnical Data Added to KGS Web Site

KGS staff completed a 3-year project to help the Kentucky Transportation Cabinet's Geotechnical Branch convert its data into electronic formats for Web distribution. The project had three phases: cataloging historical design reports, developing a project tracking system, and building an enterprise database for supporting data such as analyses of drillholes, soil, and rocks. The reports and data are extremely useful to geologists and engineers alike, because they contain information about depth to bedrock, soil classifications, rock strength and durability parameters, water table readings, and fracture measurements.

▲ This map of the Paintsville area, highlighting road segments with repetitive repair costs, is an example of the graphics KGS staff is creating to help the Transportation Cabinet track locations of high costs from geologic hazards.

All the data are now available on the KGS Web site at kgs.uky.edu/kgsmap/kytcLinks.asp, where three services are provided. The first is a catalog of completed project reports, which can be downloaded. The second is a search function for information on drillholes by specified geographic and stratigraphic criteria along with limiting criteria based on the presence of various kinds of tests. (For example, users could search for holes penetrating the High Bridge Formation that have allowable bearing capacity data). The search produces a list of projects containing holes that match the criteria and provides links to associated logs and analysis reports. The database contains over 7,000 historical reports dating from 1956 to the present and information on over 3,000 holes from projects beginning in 2007. The third service allows users to search for these data using an online map. This project was supported by Federal Transportation State Planning and Research Program funds administered by UK's Transportation Research Center.

The Costs of Geologic Hazards

A new project began during the fiscal year to investigate the costs of geologic hazards affecting Kentucky's transportation network. The Kentucky Transportation Cabinet tracks all the maintenance costs related to highways in its Operations Maintenance System database. Each cost is associated with a particular activity, such as pavement patching, ditch cleaning, and rock removal, and is assigned to a specific segment of highway using mile-point indicators. A number of the maintenance codes directly relate to issues of landslides, rockfalls, and sinkholes. KGS will prepare the data in a geographic information system for spatial analysis and investigate the geologic context for areas of high and repeated costs. This project will inform Transportation officials about geologic units and areas of recurring hazard problems, and help planners avoid or mitigate these issues.

KGS Geologic Mapping Section staff are currently implementing a landslide inventory for the state, and the two projects will benefit from shared results. ⌘

The production of useful maps and Web-based information remains a priority with KGS.

KGS staff published 16 new reports and maps during 2008-09. Among the highlights:

- A new series of river basin maps was initiated by **Dan Carey** to provide a graphical view of Kentucky watersheds. Maps were prepared for the Green/Tradewater, Kentucky, Licking River, and Upper Cumberland River basins. The target audience includes those engaged in research and other water-related projects. These maps are especially useful for members of Kentucky Water Watch, who regularly take stream samples for monitoring water quality.
- A variety of publications related to natural hazards was produced. They include a report on pyrite oxidation affecting foundations ("Foundation Problems and Pyrite Oxidation in the Chattanooga Shale, Estill County, Kentucky") by **Warren Anderson** and regional hazard maps and seismic assessment reports.
- Two new 1:100,000-scale geologic maps were released for the Tell City and Irvine 30 x 60 minute quadrangles, bringing the total in this series to 16.

Web Statistics

Online data dissemination is critical to the KGS mission, so the Survey added four new computer servers to increase speed and reliability of its services.

Public use of the KGS Web site for obtaining geologic information for a wide range of applications continues to grow unabated. In 2008-09, over 250,000 database searches were conducted by 80,000 unique users. The daily number of searches increased dramatically from around 300 to 1,000 during the fiscal year. This resulted in about 18,000 tabular data downloads during the year and more than 2 million file downloads, such as files associated with the large collection of oil and gas records available on the KGS Web site. A number of new features and enhancements have also been added this past year.

Geologic Descriptions

During the digitizing of the geologic quadrangle maps, all the explanation material was also converted to a database. That information is now accessible as a searchable database at kgs.uky.edu/KGSLitho/Search.asp. Users can specify different kinds of descriptions of interest, along with keywords and one or more geographic or stratigraphic limiting terms. For example, a user could search for the word "chert" in lithologic descriptions in Mississippian units in Pulaski County. The service would return a statewide map highlighting quadrangles where the criteria were met, as well as a listing of all the descriptions organized by map source.

Coal Borehole Documents

During the past 2 years, KGS staff has been scanning the original documents relating to the coal borehole database, including drillers' and geologists' logs and quality analyses. That effort is 95 percent complete, and the documents can be accessed from the second column of the borehole results page.

Oil and Gas Production Plots

KGS maintains two databases related to oil and gas production statistics. A new service was added to interactively create graphs of these statistics for specified areas, time periods, and commodities. Once the graph is generated, the underlying data can be downloaded to the user's computer.

Gathering Lines

The Kentucky Division of Oil and Gas compiles information submitted by operators about the location of "gathering lines," or pipelines used to transport crude oil and gas from drilling operations in the state. This past year the Kentucky Legislature required the Division to make this information available on the Web, and KGS was asked to assist. The lines have been added to the interactive gathering lines map at kgs.uky.edu/kgsweb/datasearching/OilGas/GatherLineSrch.asp for display and query and will be added to the KGS oil and gas information map. ⌘

Awards and Recognition

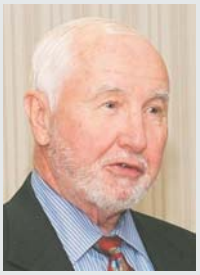
Brandon Nuttall received the 2009 Robert G. Alley Serviceman of the Year Award from the Kentucky Oil and Gas Association. It credits Nuttall for his work compiling oil and gas well records for the KGS Web site.

William Andrews was named 2009 Geologist of the Year by the Kentucky Section of the American Institute of Professional Geologists. KGS staff and colleagues at Morehead State University nominated him for the award.

Dan Carey received the 2008 **John C. Frye Memorial Award in Environmental Geology** for the series, Generalized Geologic Maps for Land-Use Planning, published during the past few years. This award is given jointly by the Geological Society of America and the Association of American State Geologists.

Steve Greb was elected a **GSA Fellow** at the Geologic Society of America's annual meeting. Fellowship is an honor bestowed on the best of the geologic profession once a year at the GSA Spring Council meeting.

Director Jim Cobb received the first **AASG Presidential Recognition Award**. Assistant State Geologist John Kiefer nominated Cobb for the recognition, citing a number of Cobb's projects and achievements for AASG, particularly serving as editor for the publication of "Association of American State Geologists Centennial History: 1908–2008."

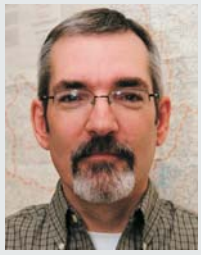


Donald C. Haney received the **AASG Distinguished Service Award,** given to those who "have worked to advance the science and practical application of geology and the related earth sciences."

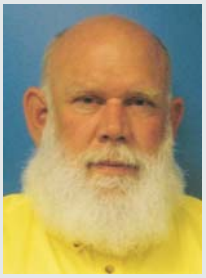
Dave Williams was recognized with the **Gordon H. Wood Jr. Memorial Award** from the Eastern Section of the AAPG. The award notes his "dedicated service with the Kentucky Geological Survey and providing geologic service to private companies, state and federal agencies, and the public in western Kentucky for 33 years."

Mike Solis received the **Energy Minerals Division Best Poster Award** for the poster "Analyzing Deep Coal Resources of Eastern Kentucky for Their Carbon Sequestration Potential" at the annual meeting of the Eastern Section of the American Association of Petroleum Geologists.

Matt Crawford and **Terry Hounshell** received the best poster award at the 2008 Kentucky GIS Conference, sponsored by the State's Office of Technology. Their entry was the new map, "Geology of Mammoth Cave National Park, Kentucky." The poster included graphics by Designer **Collie Rulo.**



Randy Paylor was elected to a 3-year term on the board of directors of the 15,000-member National Speleological Soc., headquartered in Huntsville, Ala.



Patrick Gooding was reappointed for a fifth term as the chairman of the Credentials Committee of the House of Delegates of the American Assoc. of Petroleum Geologists.

Jerry Weisenfluh was named KGS associate director effective September 1, 2008. His new duties include oversight and monitoring of KGS research programs, strategic planning for the Survey and serving as liaison with State agencies and other state geological surveys.

John Kiefer retired in June as assistant state geologist after 30 years at KGS. During his career he worked at the Alabama Geological Survey, and a geotechnical engineering company, and taught at the University of Illinois and Eastern Kentucky University. He joined the Survey in July 1979, and headed the Water Resources Section.

Jim Drahovzal, who retired in 2006 as head of the Energy and Minerals Section, received the **Honorary Membership Award** from the Eastern Section of the AAPG to recognize more than 40 years of distinguished achievement in the energy industry and public service and his dedicated leadership in AAPG and its Eastern Section.

KGS Staff 2008–09

State Geologist's Office

Cobb, Jim
State Geologist / KGS Director
Kiefer, John
Assistant State Geologist
Weisenfluh, Jerry
Associate Director
Haney, Don
State Geologist Emeritus
Lynch, Mike
Technology Transfer Officer
Hower, Judy
Temporary Technician

Administrative Section

Silvers, Jackie
Administrative Staff Officer II
Long, Mandy
Administrative Support Associate I
Phillips, Gwen
Staff Support Associate II
Graening, Kati
Student Worker

Energy and Minerals Section

Harris, Dave
Section Head
Anderson, Warren
Geologist V
Bowersox, Rick
Geologist IV
Drahovzal, Jim
Temporary Professional
Eble, Cortland
Geologist V
Greb, Steve
Geologist V
Hickman, John
Geologist IV
Nuttall, Brandon
Geologist V
Parris, Marty
Geologist V
Potts, Candace
Student Worker
Schumacher, Anne
Student Worker
Solis, Mike
Geologist I
Takacs, Kathy
Geologist I
Webb, Donna
Temporary Technician

Geologic Hazards Section

Wang, Zhenming
Section Head
Ditty, Melissa
Student Worker
McIntyre, Jonathan
Geologist IV
Woolery, Ed
Temporary Professional

Geoscience Information Section

Cordiviola, Steve
Section Head
Adams, Elizabeth
Student Worker
Banks, Roger
Stores Supervisor
Briland, Sarah
Geologic Technician
Ellis, Mike
Computer Support Specialist
Farwell, Mike
Student Worker
Hounshell, Terry
Chief Cartographic Illustrator
McElhone, Jim
Information Technology Manager I
Pulliam, Carrie
Geologist II
Rulo, Collie
Senior Graphic Design Technician
Smath, Meg
Geologist III
Smath, Richard
Geologist III
Thompson, Mark
Information Technology Manager I
Trapp, Fielding
Student Worker
Ulanday, Joe
Temporary Employee
Watson, Anna
Geologist II

Geospatial Analysis Section

Weisenfluh, Jerry
Section Head / Associate Director
Carey, Dan
Geologist V
Combs, Megan
Student Worker
Curl, Doug
Geologist III
Fedorchuk, Nick
Temporary Technician
Floyd, Julie
Student Worker
Hunt, Heather
Student Worker
Lambert, Jason
Student Worker
Overfield, Bethany
Geologist II
Paschall, Tony
Student Worker
Sergeant, Rick
Geologist IV
Sparks, Tom
Geologist III
Wang, Rebecca
Information Systems Technology Support Specialist III

Geologic Mapping Section

Andrews, William,
Section Head
Crawford, Matt
Geologist III
Martin, Steve
Geologist III
Murphy, Mike
Geologist II
Rivers, Monte
Temporary Technician

Laboratory Services

Francis, Henry
Scientist II / Laboratory Manager
(until 1/1/09)
Backus, Jason
Scientist II / Laboratory Manager
(1/1/09)
Conner, Andrea
Scientist I
Mock, Steve
Scientist I

Water Resources Section

Dinger, Jim
Section Head
Currens, Jim
Geologist V
Davidson, Bart
Geologist IV
Fisher, Steve
Geologist V
Fogle, Alex
Geologist III
Guo, Lifeng
Geologist IV
Paylor, Randy
Geologist II
Webb, Steve
Geologist II
Zhu, Junfeng
Geologist V

Well Sample and Core Library

Gooding, Patrick
Geologist IV / Manager
Daniel, Ray
Principal Research Analyst
Pinkston, Ryan
Research Analyst

Western Kentucky Office at Henderson

Williams, Dave
Section Head
Beck, Glynn
Geologist IV
Berdine, Jane
Staff Support Associate I
Counts, Ron
Geologist III (Geologic Mapping Section)
Waninger, Scott
Geologist I (Geologic Mapping Section)

Summary of Grants and Contracts
Fiscal Year 2008-09

A. Participation of KGS in Grants and Contracts Funded by Local, State, and Federal Agencies as Well as Industry.

1. "Computerized Coal Resources Data for the National Coal Resources Data System." Budget period 7/1/08–6/30/09. Award $15,000 as funding for an additional year of multi-year projects on coal resources data. Total award to date $1,419,614. Funding agency—U.S. Geological Survey.

2. "Quarternary and Surficial Geological Mapping for Geotechnical and Geophysical Applications in Kentucky." Award of $218,452 for budget period 7/1/08–6/30/09. This is the 13th year of funding of the National Mapping Project. Total award to date $2,470,049. Funding agency—U.S. Geological Survey.

3. "Communications Specialist Liaison for the Kentucky Board of Registration for Professional Geologists." Budget period 7/1/08–6/30/09. Award $15,000. Funding agency—Kentucky Board of Registration for Professional Geologists.

5. "Groundwater Education, Training, and Technology Transfer." Budget period 7/1/03–6/30/10. Current year no additional funding. Total award $450,000. Funding agency—Kentucky Natural Resources and Environmental Protection Cabinet.

6. "Midwest Geological Sequestration Consortium." Budget period 10/1/05–11/30/08. Current year prorated $40,353. Total award $498,405. Funding agency–U.S. Department of Energy through the Illinois State Geological Survey.

7. "Operation of the Mid-American Integrated Seismic Network–UK." Current year prorated $92,139 with total award of $163,975 for budget period 2/1/07-1/31/10. Includes $55,800 scope award for equipment. Funding agency—U.S. Geological Survey.

8. "A Systems Approach to Identifying Exploration and Development Opportunities in the Illinois Basin: Digital Portfolio Plays in Under-Explored Lower Paleozoic Rock." Budget period 9/24/05–9/23/08 with total award of $197,498. Current year prorated $16,458. Funding agency—U.S. Department of Energy through University of Illinois.

9. "Geochemical Analysis of Surface and Shallow Gas Flux and Composition over a Proposed Carbon Sequestration Site in Eastern Kentucky." Project period 7/15/05–12/13/08 with total award of $277,989. Current year pro-rated $6,619. Funding agency—U.S. Department of Energy.

10. "Southeastern Kentucky: Coals as CO_2 Sequestration Reservoirs" (part of Southeast Regional Carbon Sequestration Partnership Phase 2 Project). Current year award $12,574. Project period 10/1/05–9/30/09. Total award of $66,000. Funding agency—Virginia Polytechnic Institute and State University.

11. "Kentucky Part of Phase 2 of the Midwest Regional Carbon Sequestration Partnership." Project period 10/1/05–9/30/09. Total award $283,232. Current year prorated $71,433. Funding agency—U.S. Department of Energy.

12. "Hydrogeochemistry of Tunnel Roadbed Subsidence." Current year prorated $31,367. Budget period 7/1/07–12/31/08. Total award $94,100. Funding agency—Tunnel Management Inc.

13. "Integrating Geotechnical Drillhole Data with Geologic Information." Budget period 7/1/06–6/30/09. Total award $375,000. Current year award $125,000. Funding agency—Kentucky Transportation Cabinet.

14. "Selenium Occurrence and Bioaccumulations in the Eastern Kentucky Coal Fields." Budget period 2/16/07–6/30/09. No cost extension for current year. Total award $69,845. Funding agency—Kentucky Department of Environmental Protection.

15. "Rough Creek Graben Consortium." Budget period 8/1/07–6/30/09. Current year award $62,862. Total award $127,031. Funding agency—Kentucky Energy and Environment Cabinet.

16. "Rough Creek Graben Deep Gas Consortium." Budget period 3/1/07–2/28/09. Total award $247,340. Current year prorated $82,447. Funding agency—multiple industry sponsors.

17. "Inventory of Current Collection Resources and Data Preservation at the Kentucky Geological Survey." Budget period 7/1/07–9/30/08. Current year award $5,000. Total award $10,000. Funding agency—U.S. Geological Survey.

18. "Research into Enhanced Oil and Gas Recovery Carbon Dioxide" HB1. Project period 10/15/07–6/30/11. Total award $5,000,000. Current year prorated $1,250,000. Funding agency—Kentucky Energy and Environment Cabinet.

19. "Nutrient Analysis of Mountain Bioregion Streams in Eastern Kentucky." Budget period 5/22/08–4/30/09. Total award $48,169. Current year prorated $40,141. Funding agency—Kentucky Natural Resources and Environmental Protection Cabinet.

20. "Kentucky Coal and Shale Analyses in Support of Southeastern Regional Carbon Sequestration." Budget period 6/15/08–6/30/09. Total award $12,500. Funding agency—Kentucky Energy and Environment Cabinet.

21. "National Catalog Metadata Submissions for Kentucky Sites." Budget period 9/1/08–8/31/09. Total award $24,647. Funding agency—U.S. Geological Survey.

22. "CAER and KGS Advisory Support of State Energy-Related Issues." Project period 9/15/08–6/30/09. Total award $59,000. Funding agency—Kentucky Energy and Environment Cabinet.

23. "Midwest Geological Sequestration Consortium—Phase II and III." Budget period 7/1/08–12/17/09. Total award $115,890, which includes $9,601 scope award. Current year prorated $70,859. Funding agency—U.S. Department of Energy through the Illinois State Geological Survey.

24. "Kentucky Coal and Shale Analysis for the Southeast Regional Carbon Sequestration Partnership (SECARB)." Budget period 8/25/08–9/30/09. Total award $50,000. Funding agency—Marshall Miller and Associates.

25. "Mapping Karst Groundwater Basin Boundaries along the E.T. Breathitt Pennyrile Parkway." Budget period 4/1/09–6/30/09. Total award $29,062. Funding agency—Kentucky Transportation Cabinet.

B. Participation in Grants Administered by Other Units of the University of Kentucky.

1. "A Model Ordinance for the Guidance of Development on Karst Land." Project period 1/1/08–6/30/09. Total award $10,000. Current year prorated $7,000. Funding source—UK Commonwealth Collaboratives.

Total Amount of Grants and Contracts Awarded:

$2,337,913

Federal: $654,901

State: $1,600,565

Other/Private: $82,447

Editor: Mike Lynch
Copy Editor: Meg Smath
Design and Layout: Collie Rulo