The Savoy Experimental Watershed
A long-term research site for karst hydrogeology

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WEST of Fitron and Blanchard Spring Caves, a research site has been established in the southwestern Ozark region of Arkansas for studying the flow and transport of water in a mantled-karst setting (Fig. 5.50). The Savoy Experimental Watershed (SEW) is a Division of Agriculture property of the University of Arkansas about 15 km west of the campus. It encompasses about 12.5 km² of mostly forest and rolling pasture. The karst at SEW is mantled with a varied thickness of insoluble clay and chert that masks many of the surface landforms of traditional karst. The presence of disappearing streams, small caves, numerous springs, and troglobitic species in the groundwater attest to the fact that this is indeed part of a dynamic, rapid-flow karst system.

SEW includes a diverse group of collaborators, including university researchers, scientific and regulatory agencies, cavers, biologists, hydrologists, soil scientists, geologists, ecologists, engineers, and conservation groups who have banded together to share expertise, methods, and resources to better understand this environment, and especially the flow and transport within the shallow aquifers that drain the site. Since the establishment of SEW in 1996, researchers and classes have established an infrastructure of wells, weirs, flumes, interception trenches, gaging stations, a weather station, watershed runoff plots (Fig. 5.51), lysimeters, infiltrometers, automated samplers, and continuous water-level monitoring sites. There are also three state-of-the-art animal science research facilities on the property. The facility has provided field data for more than 20 theses and dissertations, and more than 30 professional presentations and peer-reviewed publications. Three field conferences have been hosted at SEW, and on alternate summers a 6-week Field Hydrogeology course attracts students from around the U.S. and the world.

Because human development and animal production have such an impact on water contamination in most karst regions of the world, a major focus of research at SEW is to determine the impact of human activity and animal production on groundwater quality in these and similar karst settings. Other goals have been to develop and test new tools and procedures for studying karst hydrogeology, and to assess the processes and controls that govern karst aquifer behavior at field scale. The following examples illustrate the range of topics studied at SEW:

Example 1: Use of innovative tracing techniques to characterize subsurface flow. To determine the capacity of groundwater to carry microbes, native bacteria have been mixed with rare chemicals (e.g., europium), which are incorporated into the living cells. Europium-tagged bacteria are reintroduced into sinking streams, and their transport is monitored as they move through the flow system to the springs. Europium is detected in a nuclear reactor. The tagged bacteria are transported, temporarily deposited, and re-suspended during flood pulses in the karst conduits. Such studies allow the tracking of pathogens and determining when they are most prevalent.

Example 2: Assessing the role of hydrologic heterogeneity and anisotropy in impacting water quality. Input of surface water from lands that have been used to raise animals can be a source of aquifer contamination, and understanding the distribution of fractures, conduits, and bedding planes that conduct most of the flow helps us interpret spring-flow records where the springs are the only source of hydrogeologic information. For example, temperature records from Langle Spring and Copperhead Spring, taken at 15-minute intervals, show that these two nearby springs have distinctive and different thermal signatures (Fig. 5.52). Copperhead Spring shows overall greater changes in daily temperature fluctuation, indicating a nearby source of rapid recharge from surface sources. SEW has been intensively studied, and knowing details of the system allows us to extrapolate hydrogeologic observations to areas where spring responses are the only sources of data, thereby optimizing our resource management.

Example 3: Variability of hydrogeologic budgets in karst terranes. Weirs at SEW allow us to quantify spring discharge accurately; and on the basis of measurements during different seasons and at different times of day, we have documented groundwater loss to transpiration by vegetation. During summer afternoons, more than 10% of the spring flow may be “pumped” by trees and converted into water vapor. At night, and during winter months, less than 1% of the spring flow is evaporated or transpired. Such information helps us better manage water resources by making sure we do not create deficits when water supplies are stressed by natural conditions.

Example 4: What is the ultimate carrying capacity for humans and animals on karst lands? The questions that we want to answer in karst are related to very practical problems: How many homes with septic systems can we build before the water quality becomes degraded? How many animals can we graze on certain pieces of property before we damage our overall resource? How much stress by humans will the natural karst system support? The answers obviously vary for different areas, but by thoroughly knowing one karst area like SEW, we can understand the major processes and can apply this knowledge to making us better stewards of karstlands elsewhere.

For more information about the Savoy Experimental Watershed, please log on to http://comp.uark.edu/savoyres.