USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

Title: Spatial and Temporal Variability in Seepage Fluxes Between Contaminated Aquifers and Tributary Streams

Duration**:** 9/30/96 to 9/30/97

Fiscal year 1996 Federal funds:$16,118 (total and direct)

Non-Federal funds allocated: $32,629 (total) ($17,043 [direct] + $15,586 [indirect])

Principal investigators and institutions**:**

Dr. Alan E. Fryar and Dr. David L. Brown, University of Kentucky

Dr. David B. Wennet and Dr. Todd C. Rasmussen, University of Georgia

Congressional district of university performing research: 6th (Kentucky)

Statement of the critical regional water problems:

We propose a field study of seepage fluxes between Bayou and Little Bayou Creeks, tributaries to the Ohio River in McCracken County, Kentucky, and adjoining contaminated aquifers within the Continental Deposits. This proposal addresses two regional research priorities identified in the call for proposals: (1) potential water-quality degradation by subsurface disposal of toxic wastes and (2) surface- and ground-water interaction. Past waste-disposal practices at the Paducah Gaseous Diffusion Plant (PGDP), a Superfund site, have resulted in solute plumes of trichloroethene and radioactive technetium-99 extending several kilometers in the Regional Gravel Aquifer toward the Ohio River. Previous studies have suggested that infiltration from Bayou and Little Bayou Creeks occurs adjacent to PGDP and that ground-water discharge occurs downstream, but spatial and temporal variability in seepage fluxes has not been examined in detail. Understanding the potential for mobilization of contaminants by infiltration from the creeks and for discharge of contaminated ground water to the creeks is important for ecological risk assessment and effective hydraulic containment of the plumes. The proposed work is likely to be broadly relevant: our literature review indicates that the coupling of ground-water and tributary flow in contaminant transport to rivers has been overlooked.

We will integrate hydraulic, thermal, and hydrochemical approaches to delineate seepage along Bayou and Little Bayou Creeks. Nests of stream-bed and streambank piezometers and seepage meters will be installed. Several piezometers will be instrumented with pore-pressure sensors and dataloggers to provide continuous hydraulic-head monitoring. Along each creek, we will episodically (during storm events) and seasonally monitor hydraulic

gradients, stream-flow rates, surface-water and sediment temperatures, and specific conductance (SC) and chloride concentrations in surface water. We will concurrently measure ground-water temperature and hydrochemical parameters (pH, Cl^-, SC, and dissolved oxygen) at piezometer nests. We will also analyze samples from stream-bank piezometers and rainfall collectors for major solutes and oxygen-18. We will use temperature, Cl^-,H_4Si0_4", oxygen 18, and residual alkalinity as quasiconservative tracers to delineate mixing of water from various sources.

We will integrate our results with water-quality and water-level data from adjoining wells monitored by Lockheed Martin Energy Systems (LMES); stream water-quality data collected by LMES; with USGS water-level data from the creeks and the Ohio River;. and with climatic data from the National Weather Service station at Barkley Airfield, ~6 km southeast of PGDP. Our results will be used to evaluate a steady-state numerical model of ground-water flow in the vicinity of PGDP, and they should be qualitatively applicable to other contaminated watersheds adjoining southeastern U.S. rivers.