USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

Proposal to the Water Center/Environmental Programs, University of Nebraska-Lincoln
Application for

the U.S. Geological Survey Water Resources Competitive Grants Program

Title: Determination of Aquifer and Aquitard Hydraulic Properties and Their Role

in Streamflow Depletion

Focus Categories: GW, MOD, MET

Keywords: Surface-water/groundwater relationships, Conjunctive use, Groundwater modeling, Aquifer test, Hydraulic parameters, Stream-aquifer interactions

Duration: Start: September 1, 1998

End: August 31, 2001 (expected)

Federal Funds Requested: $50,000

Non-Federal (Matching) Funds Pledged: UNL funds: $160,659

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Congressional District: First District

Critical Regional and State Water Problems

One of the current water-use issues in Nebraska is water conservation along the Platte River valley. Groundwater withdrawal for irrigation, domestic use, and industry has reduced streamflows and consequently threatened the survival of some wildlife and their habitats. Development of an optimal conjunctive water use plan is urgent in this area and is of great interest to Nebraska, Colorado, and Wyoming as well as the U.S. Department of Interior, local agencies and different water-use groups. To address the water-use problem, computer modeling techniques are needed to simulate the hydrologic processes between stream and aquifer or aquitard systems. Such techniques have been used by several states in this region to evaluate streamflow depletion due to groundwater withdrawal. In the Platte River valley, most streams partially penetrate the aquifers or aquitards. Groundwater flow near a stream-aquifer interface is three-dimensional, and the vertical component can be very significant. Our preliminary analysis indicates that the aquifer anisotropy is one of the most sensitive parameters in the analysis of the stream and aquifer relationships. Thus, determination of the vertical and horizontal hydraulic conductivity is a first and important step in the study of stream-aquifer interactions.

However, because of the uncertainty of data on the hydraulic properties, particularly the lack of the vertical hydraulic conductivity of aquifers and aquitards, application of modeling techniques could be limited. Traditionally, groundwater flow is considered horizontally dominated, and most field investigations have been conducted to measure the aquifer transmissivity. As a result, the vertical hydraulic conductivity is often less available to a researcher wanting to analyze three-dimensional groundwater flow.

Hydraulic property data on aquitards are even fewer. Previous field tests by numerous researchers along the Platte River valley provided horizontal hydraulic conductivity of aquifers. However, data on vertical hydraulic conductivity of aquifers are not reliable. No tests have been conducted to measure the aquitard's hydraulic properties. To maximize the potential use of computer modeling techniques in the study of streamflow depletions, scientifically designed field tests need to be conducted to measure reliably the hydraulic properties of aquifers and aquitards

Expected Results and Benefits

The project consists of two parts: field investigation and numerical analysis. The important outputs from the field investigation will include pumping and recovery test data from an aquifer and an aquifer-aquitard system. These data will then be used to determine the hydraulic property values of the aquifer and aquitard layers. In order to collect high quality data, a new methodology will be used in the design of monitoring well networks and advanced instruments will be used to measure water levels during pumping and recovery tests. The calculated hydraulic properties will then be used in the numerical analysis of streamflow depletion. The analyses will show how the aquifer anisotropy and the aquitard hydraulic conductivity affect the stream-aquifer interactions. The analyses will identify additional hydrogeological variables, which are important in the evaluation of streamflow depletion. Practically, the project will provide important information for the development of water-use plans along the Platte River valley in Nebraska, which are of interest to multiple states and local water-use groups. Results will be published in journal articles.