HYDROGEOPHYSICAL CHARACTERIZATION ALONG THE TALLAHATCHIE RIVER IN THE MISSISSIPPI ALLUVIAL PLAIN WITH IMPLICATIONS FOR NATURAL AND ENHANCED AQUIFER RECHARGE

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Groundwater from the Mississippi River Valley alluvial aquifer (MRVAA) is the primary source for agricultural irrigation across the lower Mississippi Alluvial Plain (MAP) that covers portions of Arkansas, Louisiana, Mississippi, Missouri, and Tennessee. Demand for groundwater has outpaced recharge in many areas of Arkansas and Mississippi and has resulted in widespread, consistent declines in water levels. Magnitude and timing of recharge to the alluvial aquifer from major river channels in the region are primary sources of uncertainty and key components needed to manage the aquifer resource. Variability in bed sediments along the rivers' longitudinal profile has recently been mapped based on riverbed conductance measured using geophysical methods to identify reaches where a river and the alluvial aquifer are connected.

In this study an irrigation well that fully penetrates the MRVAA and is located along the banks of the Tallahatchie River near Money, MS was selected to investigate the degree of connection between the river and the aquifer. Subsurface geophysical characterization was accomplished using terrestrial and waterborne continuous resistivity profiling (CRP), electrical resistivity tomography (ERT) and nuclear magnetic resonance (NMR) measurements. A field-scale three-dimensional hydrogeophysical framework of the river-aquifer system was developed using the terrestrial CRP and ERT data. Grain-size analysis of borehole samples was used to relate resistivity to soil texture to produce a simplified three-layer framework for subsequent numerical modeling. Waterborne CRP measurements show moderate to high resistivities throughout the Tallahatchie River, and these values were used to correlate riverbed sediments to adjacent model layers created from the terrestrial data. The resulting high-resolution hydrogeological framework will be used to analyze aquifer response to a constant rate pumping test (150 liters per second for 72 hours) with continuous data from 15 monitoring wells installed in a radial configuration from 5 meters to 300 meters from the irrigation well.