



Comparison of methods for measuring vertical hydraulic properties in a sedimentary rock aquifer

Kent Novakowski and Jessica Worley

Dept. of Civil Engineering, Queen's University, Kingston, Ontario, Canada (kent@civil.queensu.ca)

The characterization of groundwater flow in fractured bedrock aquifers is presently based on a variety of hydraulic testing methods. Pumping tests are often employed, the interpretation of which are based on models derived for porous media environments that do not fully represent the complexities of fractured rock settings. In this paper, we measure aquifer properties using a variety of testing methods in order to evaluate which methods are best capable of producing reliable parameter estimates. The study was performed in a fractured sedimentary rock aquifer using four different field methods: constant head tests conducted using a straddle-packer system, pulse interference tests conducted under open-hole conditions, 12-hour isolated interval pumping tests and 48-hour open-hole pumping tests. Using the results of the constant head tests as the most reliable method for estimation of hydraulic conductivity and specific yield, the results obtained using the other three methods were compared with particular emphasis on the estimation of vertical hydraulic parameters in this setting. The effects of test measurement scale on hydraulic parameter estimates were also investigated. Evaluation of the open-hole pumping test data was performed using an analytical model that accommodates multiple horizontal fractures and a connection to a free surface boundary. The comparison shows that estimates of horizontal hydraulic conductivity were not dependent on test method with all methods providing equivalent results. Open-well pumping tests, however, were found not to reliably estimate values of vertical hydraulic conductivity and specific yield for this setting. Alternatively, pulse interference tests conducted under open-hole conditions may offer a less time-intensive option to constant head injection tests for determining vertical hydraulic parameters in a sedimentary rock setting.