Investigation of Analytical and Numerical Models for Simulating Surface Water/Groundwater Interaction

Garey Fox[1]
Doctoral Candidate, Water Resources, Hydrologic, and Environmental Sciences Division, Department of Civil Engineering, Colorado State University, Fort Collins, Colorado

Deanna Durnford
Professor, Water Resources, Hydrologic, and Environmental Sciences Division, Department of Civil Engineering, Colorado State University, Fort Collins, Colorado

Abstract. Conjunctive use of groundwater and surface water has become a critical issue in the management of water resources in the western United States. However, water rights decisions are typically based on analytical solutions that oversimplify actual conditions. These analytical models neglect important characteristics such as streambed clogging, stream partial penetration and aquifer heterogeneity. Hunt (1999) developed an analytical model that incorporates the effects of streambed clogging and stream partial penetration. This paper presents a comparison of Hunt's analytical solution with analytical solutions based on the Theis (1941) equation typically used for water rights administration and a numerical groundwater model for conditions characteristic of several alluvial aquifer systems. Conclusions are made concerning the importance of incorporating streambed parameters, differences between the models, and the usefulness of Hunt's more complex solution in modeling groundwater/surface water interactions. Accurate estimates of streambed clogging were found to be important in that Hunt's analytical solution was sensitive to the degree of conductivity contrast between the aquifer and streambed. Drawdown calculated using Hunt's analytical model more closely resembled MODFLOW numerical simulations of drawdown than those from the Theis analytical solution. However, stream leakage predictions, compared to MODFLOW results, were over predicted by Hunt's analytical model. This paper also illustrates the use of Hunt's equation to estimate stream/aquifer parameters by a matching point method.

[1] Doctoral Candidate, Water Resources, Hydrologic and Environmental Sciences Division
Civil Engineering Department
Colorado State University
Fort Collins, CO 80523-1372
Tel: (970) 472-1554
e-mail: gfox@engr.colostate.edu