

SIMULATION OF THREE-DIMENSIONAL VARIABLE-DENSITY GROUNDWATER FLOW AND OPTIMIZATION OF GROUNDWATER USE IN A COASTAL AREA

L.H. Motz¹ and R. Yurtal²

ABSTRACT

Groundwater use in coastal areas often is limited by high concentrations of chlorides and total dissolved solids (TDS) that may exceed maximum contaminant levels. Simulation of groundwater use in such areas requires consideration of seawater intrusion, and optimization of groundwater use can involve maximizing the total pumping rate subject to hydraulic, water-quality, economic, and environmental constraints. Variable density models that couple the groundwater flow equation with the contaminant transport advection-dispersion equation can be utilized to simulate an aquifer system in a coastal area. The response of the aquifer system to pumping can be linked to an optimization model by means of the response matrix method, in which influence coefficients representing the responses of hydraulic heads and TDS concentrations to pumping are determined. In this investigation, the variable density, finite-difference numerical code SEAWAT (Guo and Langevin, 2002) was used to create a three-dimensional representation of the coastal aquifer system in the Goksu Delta at Silifke, Turkey. In the model, pumping occurs from specified municipal and agricultural wells, and aquifer response coefficients were generated at these well locations using the groundwater model. A linearized optimization model was constructed under steady-state conditions to maximize the total pumpage from these wells subject to water demands and TDS and drawdown limitations. The General Algebraic Modeling System (GAMS) code was used to execute the optimization model, and a trade-off curve was constructed to relate the maximum pumping rate at each well to maximum allowable TDS concentrations.

Keywords: coastal aquifers; Goksu Delta; groundwater management; numerical modeling; saltwater/freshwater relations; Turkey

Corresponding author: Louis H. Motz, Associate Professor, Department of Civil and Coastal Engineering, 124 Yon Hall, University of Florida, Gainesville, Florida 32611 U.S.A.
email: lmotz@ce.ufl.edu

¹University of Florida, U.S.A.

²Çukurova University, Turkey