Dynamics of Negative Hydraulic Barriers to Prevent Seawater Intrusion

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ABSTRACT

Negative hydraulic barriers, which pump at the shore intercepting inflowing saltwater, are proposed as a corrective measure for seawater intrusion in aquifers where groundwater is the main water resources and restrictions on pumping are not feasible. Negative barriers prevent saltwater from moving inland and protect freshwater supply wells. While this barrier is pumping saltwater intrusion does not proceed further. The main drawback of negative hydraulic barriers is that wells end up pumping much more freshwater than saltwater, thus contaminating freshwater resources. To minimize the mixing process we propose a double-negative barrier system with two extraction wells. In this system one of the wells pumps freshwater and the other one saltwater, without mixing between them, controlling the saltwater intrusion and decreasing the piezometric head in the area. A careful analysis is required to bound the possible effects of this negative hydraulic barriers on the flow field. The approach suggested here uses three-dimensional variable density flow and transport simulations to study the sensitivity of the system by means of a set of dimensionless numbers which summarize the overall behavior of this system. Different sets of simulations have been carried out varying each of the dimensionless numbers each time to asses their effect. These dimensionless numbers depend on magnitudes such as the amount of water that should be extracted and the distance of the wells to the sea. We used the algorithm of *Furnival and Wilson Jr* (1974) to identify the parameters that best explain the dynamics of the system. An empirical expression is being developed by a regression model that describes how (combinations of) the defined dimensionless numbers control the salinity of pumping wells in the presence of hydraulic barriers.

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