Stochastic and Well Optimization Modeling to Evaluate Injection Potential of a California Oilfield.

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Biographical Sketch

Jeffrey Anderson has 21 years of hydrogeology and engineering geology experience with the petroleum industry. While employed by Shell Oil Company during the 1980's, Mr. assisted in identifying and evaluating long-term solutions for disposal of excess produced water for several giant oilfields in California. As a consulting groundwater hydrologist, Jeff has helped oil and gas companies develop cost effective, practical, and environmentally sound solutions for disposal of excess produced water. Jeffrey holds a BS in Geological Engineering from the University of Minnesota and an MS in Civil Engineering, with a specialty in Groundwater Hydrology, from Colorado State University.

Introduction and Background

An innovative numerical modeling approach was developed to evaluate injection potential at an oilfield for a major oil company. Stochastic and optimization models were used to most cost effectively evaluate the produced water disposal capacity of deep well injection into a Miocene sandstone formation.

The company is exploring long-term produced water disposal alternatives in one of its major assets in California. These alternatives consist of treat and reuse, aquifer recharge, shallow injection and deep well injection.

Numerical Modeling Approach

Due to the lack of data available in the study area, a probabilistic/stochastic modeling approach was judged appropriate for developing a practical range of possible outcomes and to quantify parameter uncertainty. A stochastic model was developed using the Groundwater Vistas processor and the Stochastic MODFLOW code. This involved developing suitable ranges of boundary conditions, fault conductivity, hydraulic conductivity and leakance. The stochastic model was run 1,000 times to ensure that the realizations generated were reasonable and of equal probability.

The MODOFC code was employed to evaluate total injection capacity and location of wells to satisfy pressure constraints of less than hydrostatic over four years of forecast injection. Multiple pressure constraints were included in the optimization subroutine.

Summary and Conclusions

An innovative evaluation tool was developed, for less than the cost to drill a pressure observation well, which allows for critical analysis to be performed under conditions of limited data and uncertainty that can be applied successfully at other injection sites.

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