

Estimation and optimization of transient seepage with free surface

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Abstract

Single sink depths providing maximum ground-water table decrease during a fixed time interval within a selected area are found for the 2-D and 3-D cases. The curve of the maximal phreatic surface position (underflooding curve) in the aquifer from flood induced variation in water level of the ground-water reservoir is calculated. Well-known analytical solutions based on nonlinear and linear potential theories and the Dupuit-Forchheimer approximation are applied to calculate the objective function, decision variables, and boundary of the fully saturated zone. In the linear case, an explicit analytic solution gives the unique maximum of the water table decrease at the compliance point for a given pumping duration. For small values of sink depth, the linear approach is invalid. In the nonlinear case, complex analysis and series expansions are used. For small values of drain depth, the series technique becomes untenable. For the reservoir-aquifer problem the spreading phreatic surface is a rotating straight line and the underflooding curve is a parabola. © ASCE.

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