

Multilayer Analytic Element Modeling of Radial Collector Wells

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Abstract

A new multilayer approach is presented for the modeling of ground water flow to radial collector wells. The approach allows for the inclusion of all aspects of the unique boundary condition along the lateral arms of a collector well, including skin effect and internal friction losses due to flow in the arms. The hydraulic conductivity may differ between horizontal layers within the aquifer, and vertical anisotropy can be taken into account. The approach is based on the multilayer analytic element method, such that regional flow and local three-dimensional detail may be simulated simultaneously and accurately within one regional model. Horizontal flow inside a layer is computed analytically, while vertical flow is approximated with a standard finite-difference scheme. Results obtained with the proposed approach compare well to results obtained with three-dimensional analytic element solutions for flow in unconfined aquifers. The presented approach may be applied to predict the yield of a collector well in a regional setting and to compute the origin and residence time, and thus the quality, of water pumped by the collector well. As an example, the addition of three lateral arms to a collector well that already has three laterals is investigated. The new arms are added at an elevation of 2 m above the existing laterals. The yield increase of the collector well is computed as a function of the lengths of the three new arms.

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