GLY 5826

Assignment 8:

We wish to simulate temporal changes in the confined aquifer heads between two reservoirs (shown below). Assume the aquifer is 100 m long, has a T of 0.02 m^2 min^{-1}, and a storage coefficient of 0.002. The head is initially uniform at 16 m (i.e., the initial condition is $h|_{x,0}$ = 16 m) and drops to 11 m at x = 100 at time 0 (i.e., the boundary conditions are $h|_{0,t}$ = 16 m and $h|_{100,t}$ = 11 m).

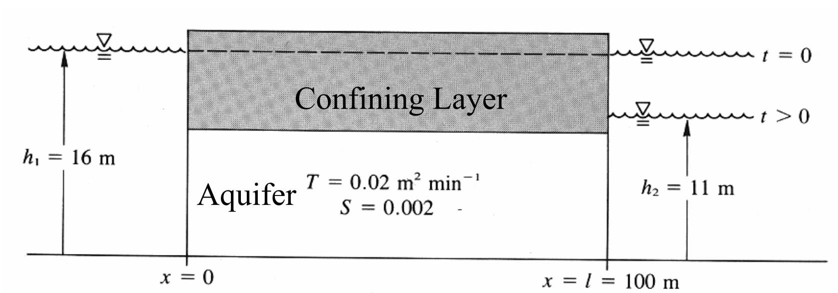

Figure 1. Wang and Anderson, 1982. Introduction to Groundwater Modeling. W. H. Freeman and Company, San Francisco. 237 pp.

Analytical solution of 1-D Transient Ground Water Flow Equation

Carslaw and Jaeger (1959) offer an analytical solution to the 1-D transient equation for uniform fixed initial temperature (initial head) and an instantaneous change in temperature (head) at distance L:

$$h\big|_{x,t} = h\big|_{0,t} + \frac{\left(h\big|_{L,t>0} - h\big|_{0,t}\right)x}{L} + \frac{2}{\pi}\sum_{n=1}^{\infty}\frac{\left(h\big|_{L,t>0} - h\big|_{0,t}\right)\cos(n\pi)}{n}\sin\left(\frac{n\pi x}{L}\right)e^{-Tn^2\pi^2 t/(SL^2)} \qquad (1)$$

Assignment

1. Program the analytical solution in Matlab. Sum the series until the change in the sum becomes insignificant.

2. Create a spreadsheet to solve the 1-D transient ground water flow equation using the explicit method. Plot the distance versus head for at least 4 evenly-spaced times including one time near steady state. Plot the numerical solutions as open symbols and, using the analytical solution from problem 1, plot the corresponding analytical solutions as lines. Indicate the value of the stability parameter in your solution.