Groundwater Flow and Contaminant Transport Modeling
Spring Fall 2016/2017

Homework #2
Determination of well-head protection area of a municipal well

Hydrogeological conditions:

A shallow well (Total depth of 50 m) is used for municipal water supply. The data sheet of the well is attached. The sheet is in Hungarian but the explanation of the listed data is commented in English.
Based on the prescriptions of the authorities the volume of $t \leq 50$ and 5 years, 6 months and 20 days transit-times to well screens is to be determined. In case the 3D volumes of different transit times reach the surface the surface area of the influence zones is also to be determined.
The region the well is situated is a typical recharge zone where the vertical hydraulic gradient is 40 cm/100 m, the horizontal hydraulic gradient is 1.5m/km (direction (azimuth) can be freely chosen by the student). The average long term production rate of the well is 450 dm^3/min.
There are no additional wells in the surroundings therefore the well can be considered as a single (stand-alone) well.

Tasks to be solved:

1. Calculate the hydraulic conductivity of the aquifer using Dupuit-Thiem iteration
2. Determine the potential filed that fits the horizontal hydraulic condition prescriptions
3. Calculate the potential in each layer using the given vertical hydraulic gradient
4. Make the model of the well end its surroundings. Use the real-world coordinates of the well. The other hydraulic parameters of the aquifer can be freely chosen but the different parameters (horizontal and vertical hydraulic conductivity, effective porosity) should be coherent to each other.
5. Run the model and determine the 20 d, 6 months, 5 and 50 years areas of influence using the long term production rates at 6 months, 5 and 50 years, the daily maximum production rate of 520 dm^3/min at 20 days. Determine the vertex coordinates of the polygon describing the boundary of the influence and also the top and bottom levels (as altitude of horizontal planes) of the zones.
6. Check if the zones of influence reach the surface. If yes, then determine the coordinates of the polygon vertexes.
7. Prepare a short report

Materials to be presented:

In printed form a short report of the problem with

- the description of the model
- the calculation of hydraulic conductivity
- the details of the chosen data
- graphic presentation of potential fields, pathlines
- the description of influence zone boundaries
- the evaluation of results

Digitally (only at the end of semester)

- report in document form
- total dataset
- plots in graphical form