Unit 15 Physical Hydrometerorology

1. Graduate students: Two rows of wells exist parallel to the road between a road and a river. They are 2 km away from each other, with the first row of wells being close to the road. The hydraulic conductivity of the soil is 10^{-3} m/s. The aquifer is 100 m thick and 1000 m wide. Its porosity is 0.3. Near the road and near the river, the hydraulic head of all wells is 200 m and 150 m, respectively. A truck with heating fuel went into a ditch on the side of the road. The fuel container broke open and some of the heating fuel entered the ground. The contaminated water is flowing towards the river. The emergency manager orders that the wells near the river are used to pump the contaminated water away so it wouldn't reach the river.
    a. How high must be the pump rate at least to make his/her plan work?
    b. You are to calculate the minimum pump rate. Which law would you apply? How much is this rate?
    c. S/he wants to know how much time will pass after the accident until the contaminated water will reach the second row of wells that are close to the river.

2. Undergraduate students: At a water elevation of 6391 ft, a lake with surface area 48,100 acre has a volume of 2,939,000 ac-ft. Annual inputs to the lake include 8 inch of direct precipitation, runoff from gauged streams of 150,000 ac-ft per year, and ungauged runoff and groundwater inflow of 37,000 ac-ft per year. Evaporation is 45 inch per year.
    a. Set up a water budget showing inputs, in ac-ft per year and outputs in ac-ft per year.
    b. Does the input balance the output?
    c. Will the mean lake level rise or fall from its current level on the long-term?
    d. What would be the lake surface area when the inputs balance the outputs under the assumption that the volume of gauged and ungauged runoff and ground-water inflows remain constant despite the change in lake-surface area.
    e. What is the residence time for water in the lake when the water surface is at 6391 ft?