A square grid of drainage wells spaced 2000 m apart maintain the water table at a minimum depth of 2 meter in a large alluvial plain located on a humid coast. An aquiclude is found at a depth of 17 m and the soil hydraulic conductivity is 80 m/day. The wells each have a diameter of 0.6 m. Assuming the drainage well field to have been properly designed and the wells efficiently operated, estimate the recharge rate (cm/yr) in the region

What is the pumping rate [m³/day]
What is the groundwater depth in between two wells (at r=1000m)?

Solution

The longest distance between 2 wells will result in the lowest drawdown. This will have to be 2 m below soil surface.

Use equation

\[ Q = \frac{\pi K (h_0^2 - h_e^2)}{\ln\left(\frac{r_e}{r_w}\right) - \frac{1}{2}} \]

\[ r_w = 0.5 \times D = 0.3 \text{ m} \]
\[ K = 80 \text{ m/day} \]
\[ h_e = 17 - 15 = 2 \text{ m} \]
\[ h_w = 1/3 \times 15 = 5 \text{ m} \quad \text{(from the assumption of economic efficiency - see handout)} \]
\[ r_e = 0.5 \times \sqrt{(2000^2 + 2000^2)} = 1414 \text{ m} \quad \text{(the diagonal between two wells, and } r_e \text{ is half that distance)} \]

Filling in the right numbers and converting to cm/year gives
\[ w = 36.7 \text{ cm/yr} \]
\[ Q = 3615 \text{ m}^3/\text{day} \]

drawdown for 1 well = \( h_e - h_{1000m} \)
\[ h_{1000m} = 14.7 \text{ m} \]
\[ s_{1000m} = 0.3 \text{ m due to one well. We have two wells affecting this location though, thus the total drawdown = 0.6 m. The original water table depth was at 2 meter below soil surface. With the drawdown of 0.6 m we now have a new water table depth at 2.6 m} \]