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HWRS582 GW Mod

1/18/21

Challenge #1

1. Steady state means constant head boundaries and constant flux – in other words the q values should be the same in each cell.

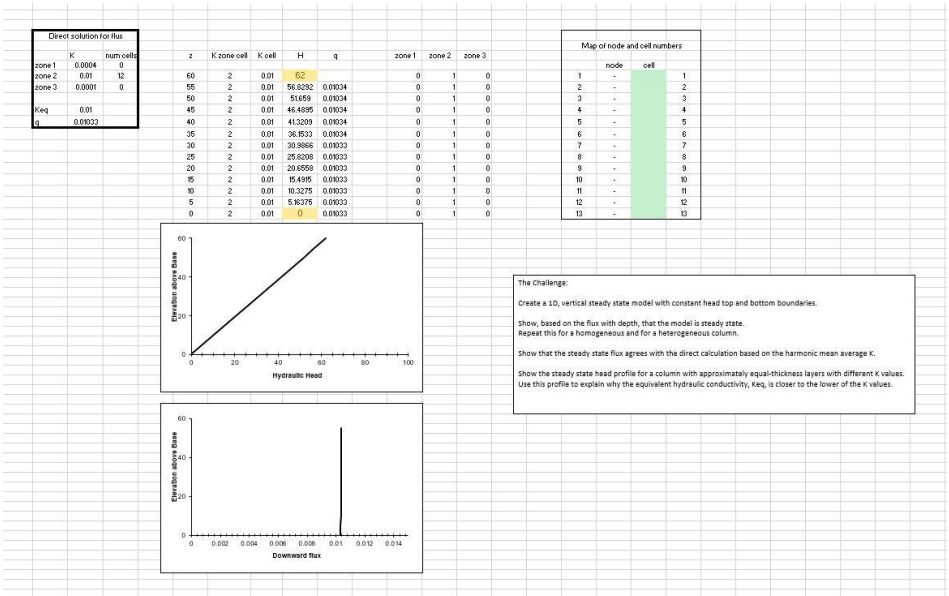


Figure 1 Steady State Homogeneous Model

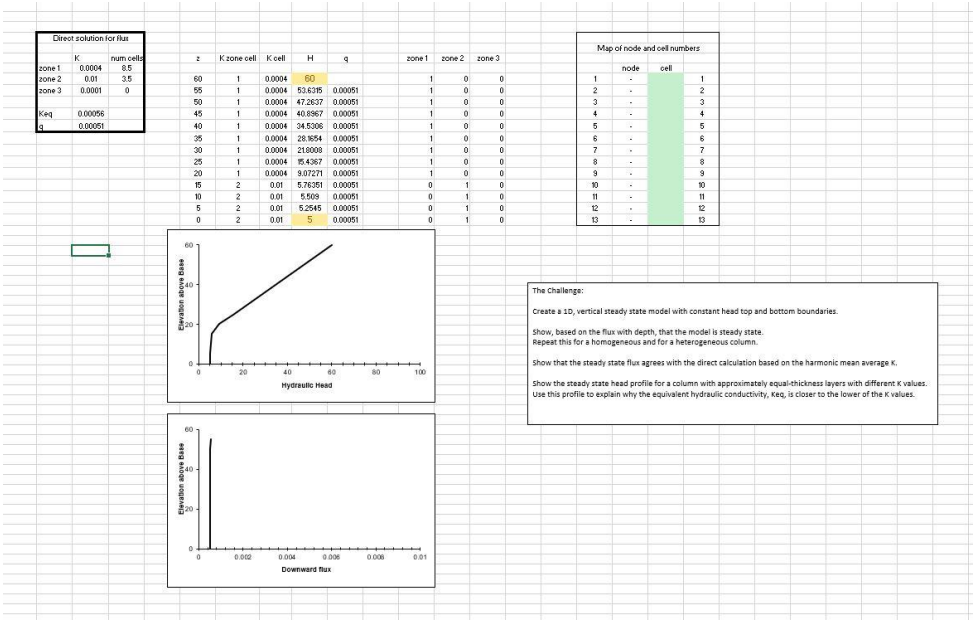


Figure 2 Steady State Heterogenous Model

2. Harmonic mean average Kavg = L/((la/Ka)+(lb/Kb)+(lc/Kc)) in which low permeability dominates:

$$K = \frac{L_{tot}}{\frac{l_a}{K_a} + \frac{l_b}{K_b} + \frac{l_c}{K_c}} = \frac{60}{\frac{60-20}{0.0004} + \frac{20}{0.01} + 0} = 0.00058 \approx 0.00056$$

$$q = K * \frac{dH}{dz} = 0.00058 * \frac{60-5}{60} = 0.000539 \approx 0.00051\ units/time$$

Using Figure 2 above, we see that the flux q can be calculated using the Harmonic Mean Average. The values are very close but not exactly the same.

3. Show the steady state head profile for an aquifer with equal thickness layers that have different K values. Use the head profile to explain WHY the equivalent hydraulic conductivity, Keq, is closer to the lower of the two K values.

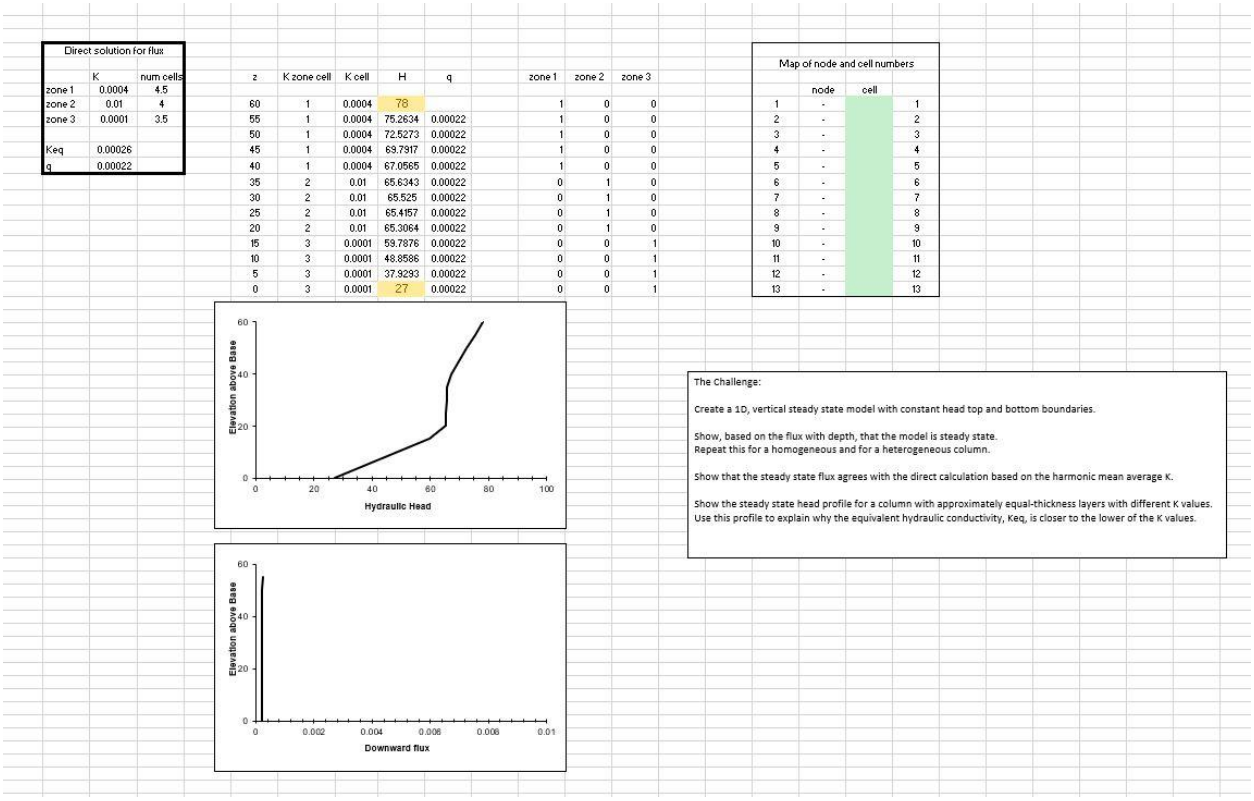
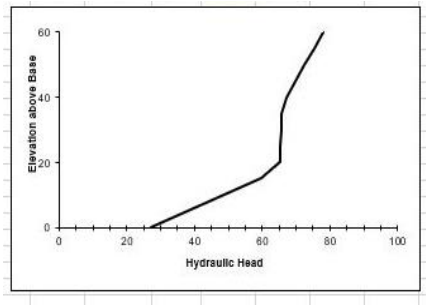


Figure 3 Steady State with equal thickness layers



z	K zone cell	K cell	H	q
60	1	0.0004	78	
55	1	0.0004	75.2634	0.00022
50	1	0.0004	72.5273	0.00022
45	1	0.0004	69.7917	0.00022
40	1	0.0004	67.0565	0.00022
35	2	0.01	65.6343	0.00022
30	2	0.01	65.525	0.00022
25	2	0.01	65.4157	0.00022
20	2	0.01	65.3064	0.00022
15	3	0.0001	59.7876	0.00022
10	3	0.0001	48.8586	0.00022
5	3	0.0001	37.9293	0.00022
0	3	0.0001	27	0.00022

The equivalent hydraulic conductivity takes the harmonic average for a soil column in which flow is perpendicular to the layers. Because Keq is the average value over the entire soil column, Keq is smaller to represent the flow in the slowest zone/layer.