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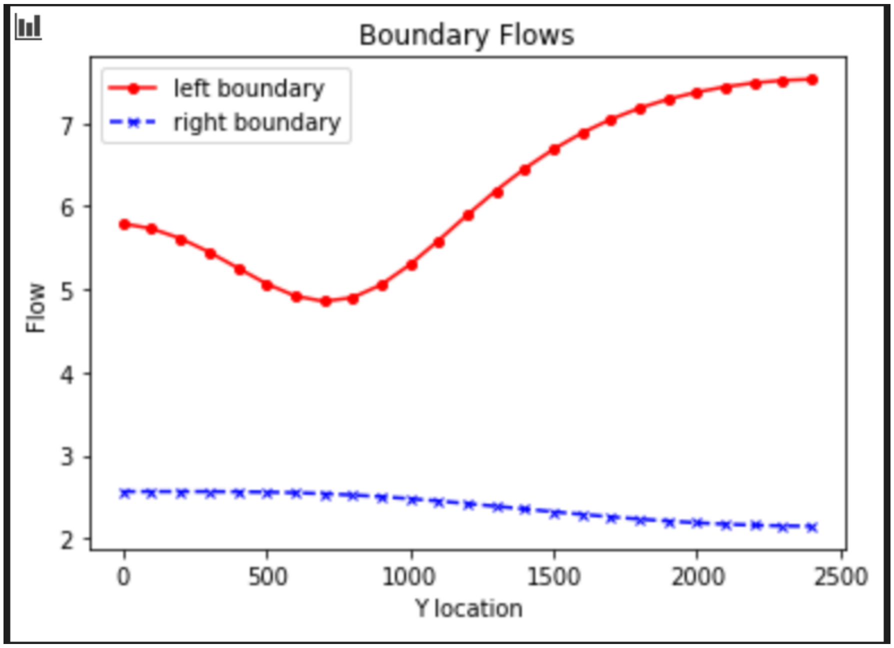
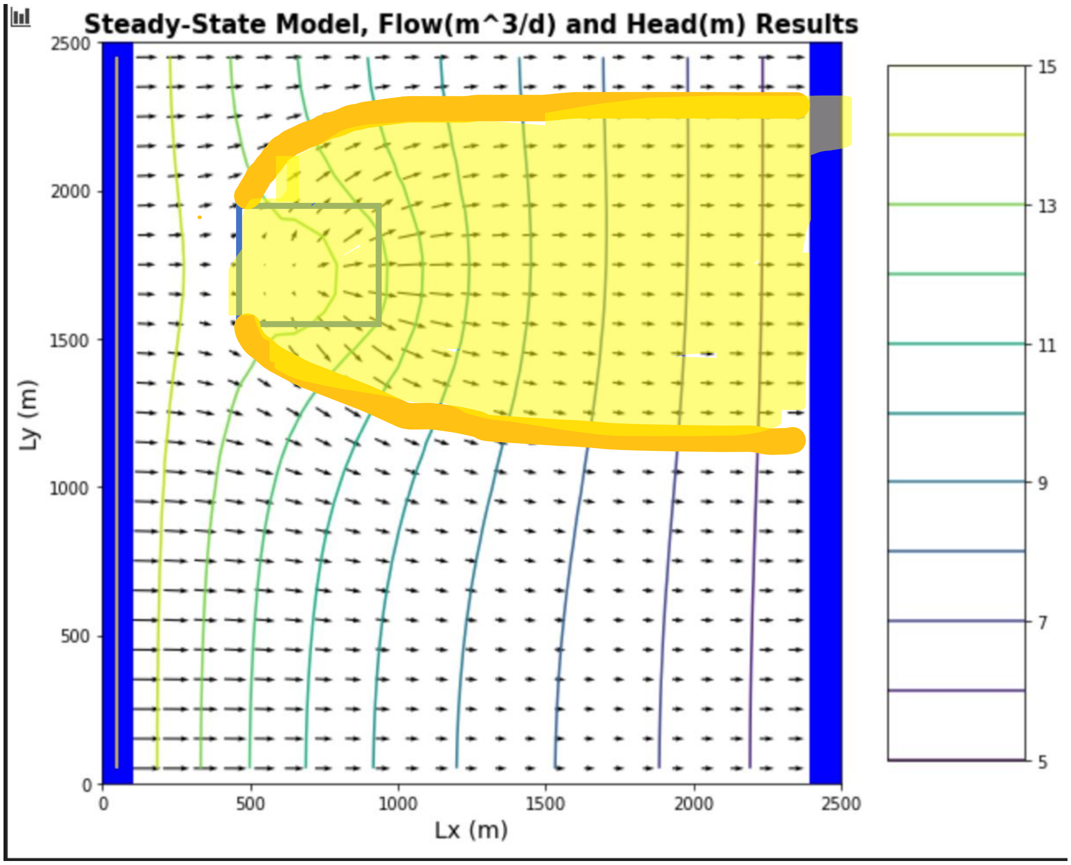
Grouped with Sierra and Jason

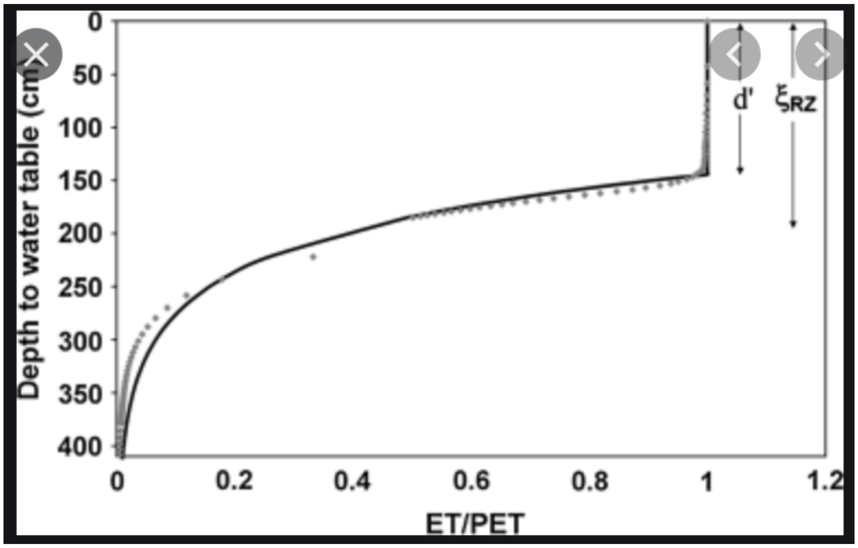
The Challenge: Transpired



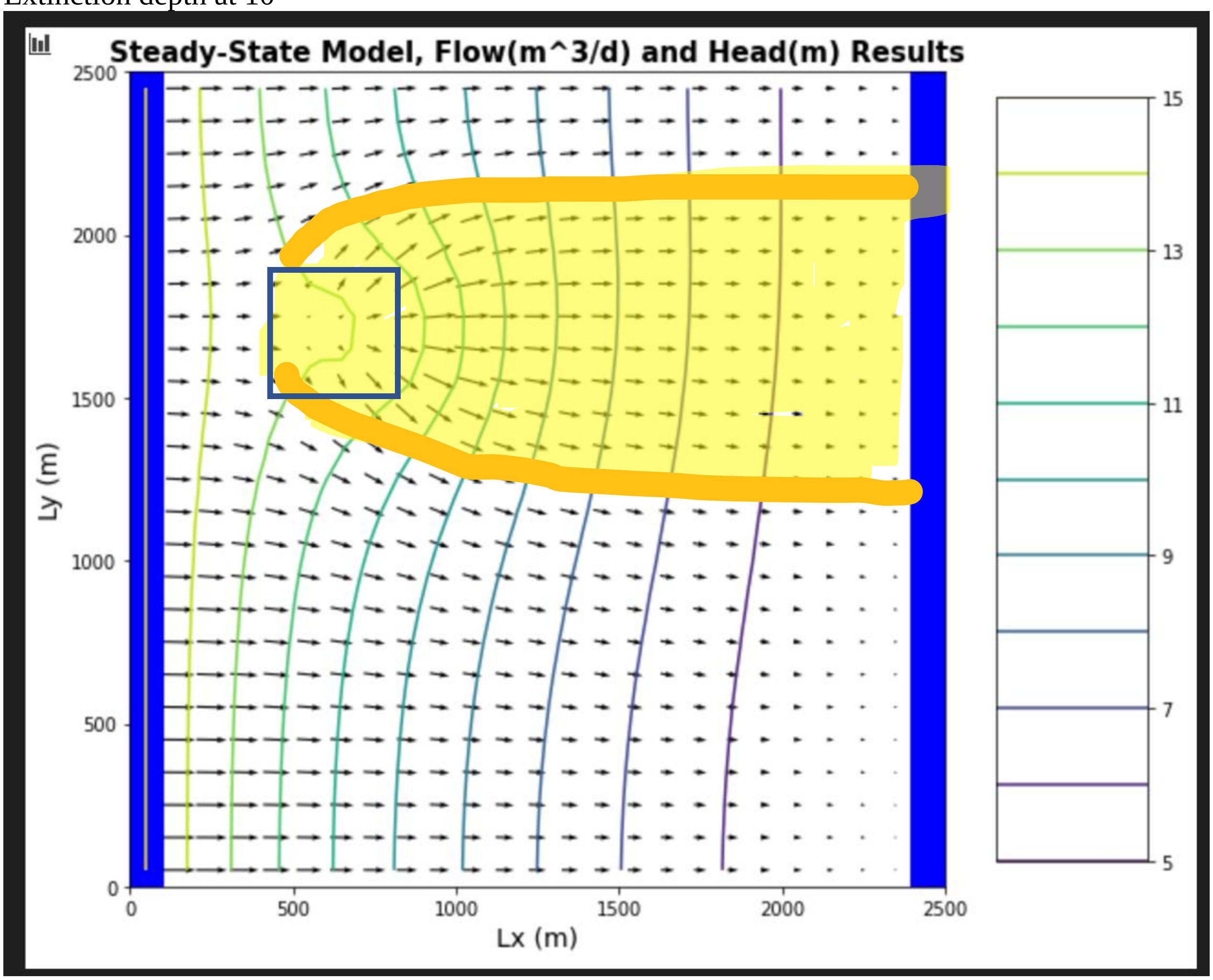


a. **For the initial boundary head values and recharge and ET rates, establish the flow across the boundary versus y-distance along the left (15 m) and right (5 m) boundaries. Plot the equipotential and flow vectors in plan view and outline (hand draw) the area that would be affected by recharge (i.e. if it were contaminated). Also show a contour plot of the steady state ET flux in plan view.**
b. **Change the extinction depth. What impacts does this have?**

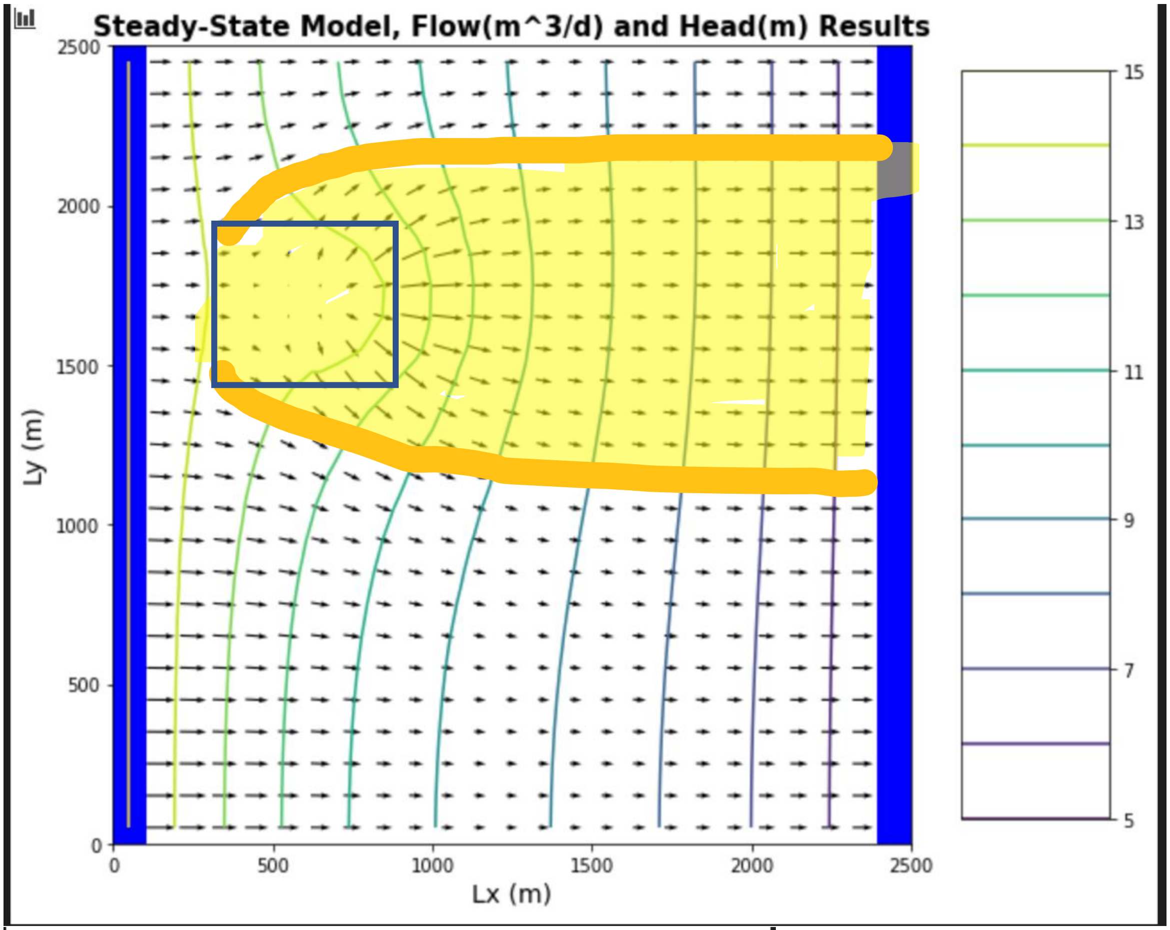
The depth of the extent where roots reach below the ground surface is called extinction depth. I notice that the larger the extinction depth, the smaller the area of recharge is and vice versa. We can see this in the graphs with an extinction depth value of 10 and 1. The extinction depth value of 10 shows a smaller area of recharge as the arrows are larger more towards the center of the recharge space. The extinction depth value of 1 shows a larger area as the equipotential arrows are larger further outside of the recharge space. This explains to us that the “roots” or the are reaching further down in the ground. Also, from the boundary flow graph, we can see that there is more of a drop in recharge coming from the left boundary where the localized area is. (Sierra, re-worded by Danielle)

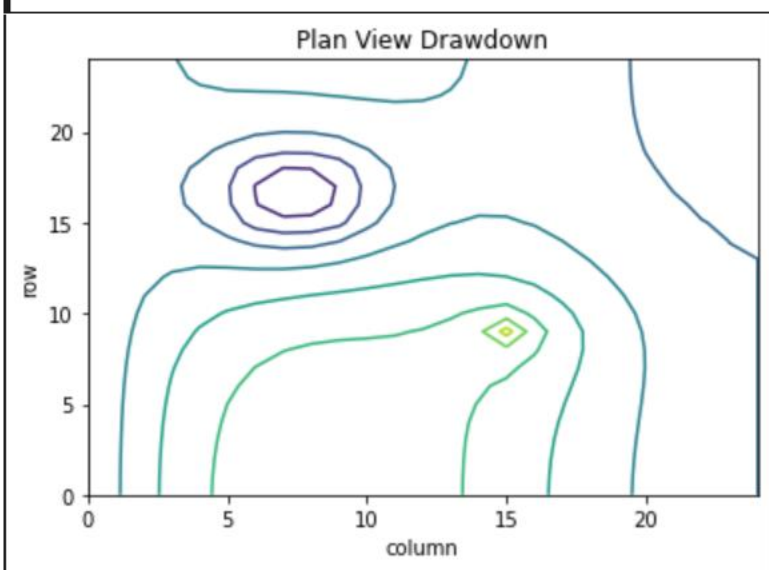


Extinction depth at 10



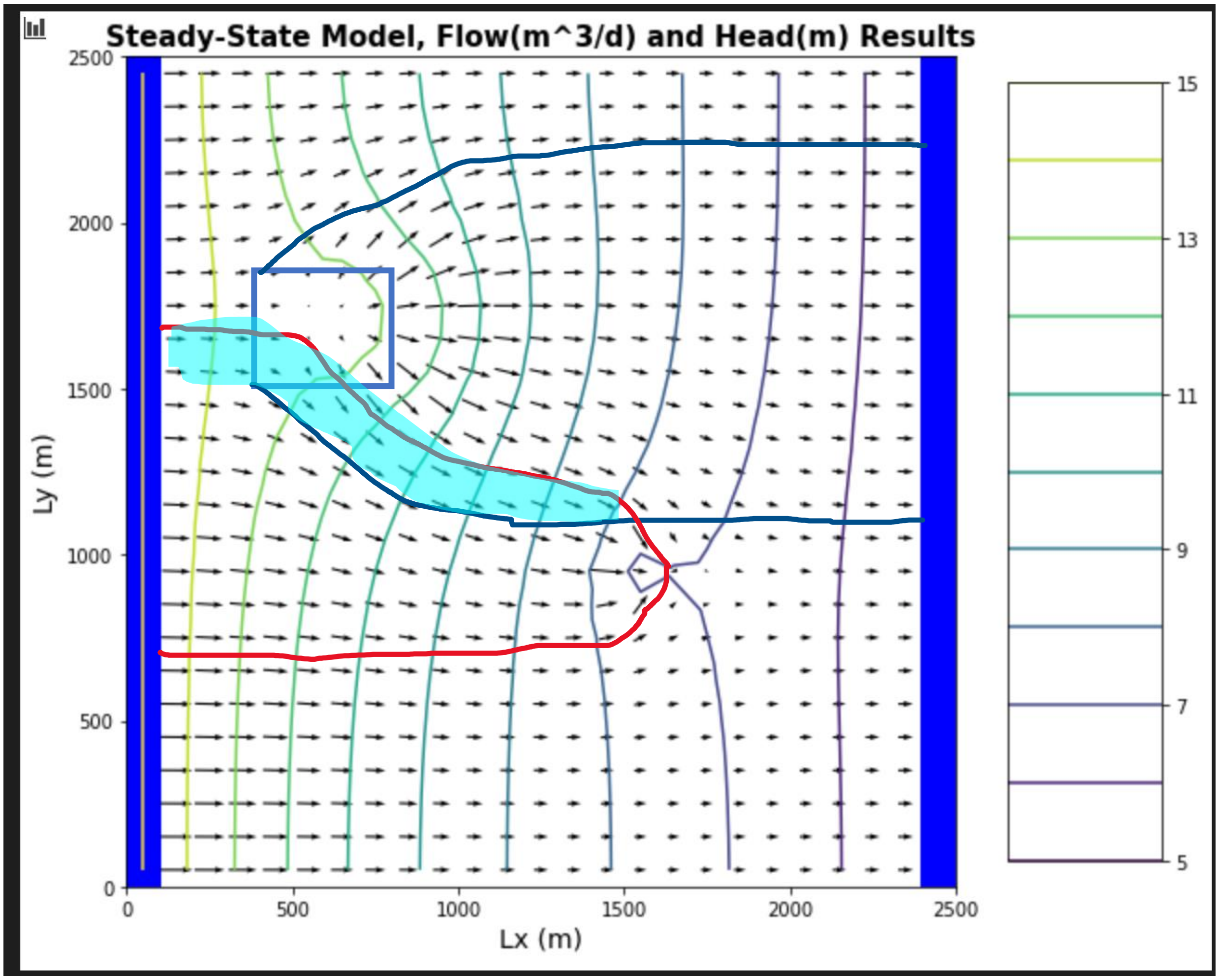
Extinction depth at 1→ at 0 modflow does not run

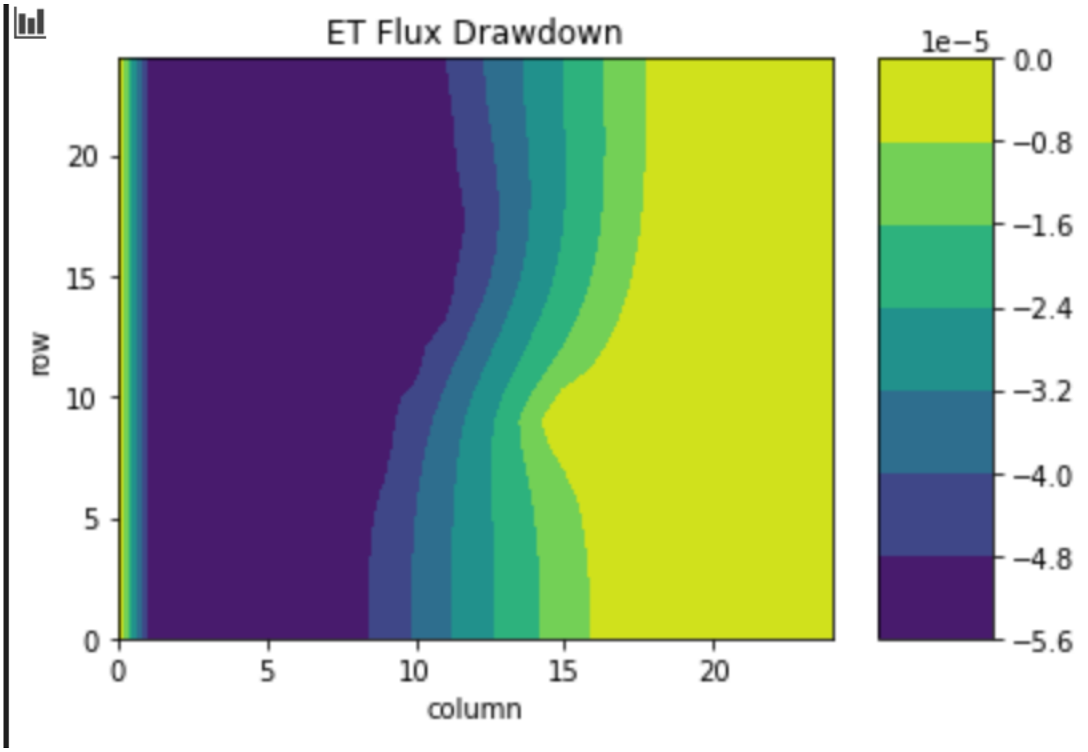

Steady-State Model, Flow(m^3/d) and Head(m) Results
Ly (m)
Lx (m)
0
500
1000
1500
2000
2500
15
13
11
9
7
5


Plan View Drawdown
row
column
0
5
10
15
20

c. Explain, conceptually, how MODFLOW is representing ET. How does this compare to your intuitive understanding of ET in the real world?

MODFLOW represents ET by the extinction value. MODFLOW demonstrates the ET as an array and adds the ET zone with the background ET, where it assigns an ET value for the ET zone. My understanding of ET in the real world is that water is evaporated from soil and by transpiration of plants that get transferred to the atmosphere. And below the surface, ET can happen through the plant roots. Root depth and distribution vary from plant to plant and therefore can have different ET values. (Danielle)





d. Now start the well pumping, extracting 20 m3/day. How does the well change the zone that is affected by the recharge area? How does it affect the ET map? Write a mass balance for the well - how much water is coming from a boundary? How much is originating as recharge? How do you account for the impact of ET on this mass balance? At steady state, what are the effects of 'capture' by the well?

When the pumping of the well is added, the zone effected by recharge would change. The well could be acting as extinction depth, which would be close to the extinction depth at 10 above, which means that the recharge would be decreased. Potentially, the area round the well would have less ET because the water table decreases exponentially toward the cone of depression. The effects of capture by the well would be decreased because of the ET.

Qin=Qout

In:

Recharge=5e-4 m/day(flux)

Out:

ET=5e-5 m/day(flux?)

Well=20 m^3/day (Q)

(Jason)

From class:

When the pumping of the well is added, the zone effected by recharge would change. The well could be acting as extinction depth, which would be close to the extinction depth at 10 above, which means that the recharge would be decreased.

$Qwell = Q_{boundary} + Q_{recharge} – Q_{ET}$
Q_{well} = 20 m^3/day, given
$Q_{boundary}$ = summing up the flow across the y-axis which is given to us by code.
$Q_{recharge}$ = the recharge flux times 1/5 area of the recharge square area.
Q_{ET} = calculated through algebra using other variables or by pulling out the ET map data by knowing area of each cell and including the areas of the cells within the capture zone. We are going to sum the ET flux over the surface area of the capture zone. The amount of water that goes in. We have ET or not, we end up bringing in more water across the boundary in order to satisfy the ET water loss that happens as water is flowing towards the well. We have to satisfy what the well is drawing and what water is going away towards the well.

~~We can find the concentration in the well using mass balance by using contaminant in ag area, we know concentration at boundary is zero, c =1 at recharge and c=0 at $Q_{boundary}$. Water flux is ET and mass flux is 0.
$(C_{well})*Q_{well} = (0)Q_{boundary} + (1)*Q_{recharge} – (0)*Q_{recharge} – (0)*Q_{ET}$

Q_{ET} is not increasing concentration. We would think it would because we are taking out the water but not solute. If we keep the pumping rate the same and increase ET, we need to bring more fresh water in from the boundary. The input of mass with recharge is a constant no matter what the recharge is. As we increase the ET with pumping rate and recharge rate the same, we have to increase how much water comes in across the boundary.~~

Capture of a well is found through this:
The sources of water the well is capturing is the change in flow from the left boundary, DQ_{left}, as the right boundary, DQ_{right} captures the water, with DQ_{ET} added in.

$Q_{well} = DQ_{left} -DQ_{right} + DQ_{ET}$

More ET before you start pumping a well as we decrease the water table level/area of water in aquifer and the ET is a function of how deep the water table is as plants are impacted by this on the ground surface. Modflow calculates this as a linear decrease in ET. No ET is below extinction depth. Zone that is impacted (plants are impacted) is not described by capture zone of the well. We would sum the whole domain of the change in ET to calculate the ET of the mass balance of this system. Additionally, for the boundaries, with pumping, we see an increase in flow in the left boundary and a decrease in outflow on the right boundary of the boundary flows chart. We would make these rates by grabbing the difference of with and without the well for each left and right boundary. The reduction in ET, the increase in input from the inflow boundary, the decrease in outflow boundary is all capture. So in terms of capture and capture zones, we have the zone of influence where pressure head changes, zone of capture where particles that will eventually end up in well, and we have capture where we have these inputs and outputs.