# **Aquaseca: Model Scenarios 1-4**

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## Exercise

Build a model representative of the Aquaseca basin to analyze the effects of the proposed GroMore development. The following scenarios were run to compare pre and post development effects on the basin’s hydrology. All scenarios were run without the propose agricultural development.

1. Run the model as steady state with no pumping from the town's well.
2. Run the model as transient for 25 years with no pumping from the town's well. Recharge occurs at a constant rate all year, but ET takes place from April through September (inclusive) at the rate given in the problem description.
3. Build the pre-development model with seasonality and extend the run time to 100 years PLUS your burn in time. This represents the 100 years that the town has been pumping to date. There was no pumping during the pre-development period. The town's water demand has increased exponentially, with the pumping rate changed every 10 years following the equation: Q = 1.5 \* t^1.5, for Q in m3/day and t in years. To avoid confusion, the pumping rate is zero for the burn-in time (I'll assume 25 years, here). Then, on April 1 of year 25, the pumping increases to 47 m3/day. On April 1 of year 35 it increases to 134 m3/day. Then, on a 10-year schedule, it continues to: 246; 379; 530; 697; 878; 1073; and 1281 m3/day. This model defines the system at the current time - remember, the town has been pumping for 100 years already.
4. Project your post-development model with seasonality an additional 100 years into the future. (Remember to project the town's water demand, too!) Compare this model with your pre-development model with seasonality.

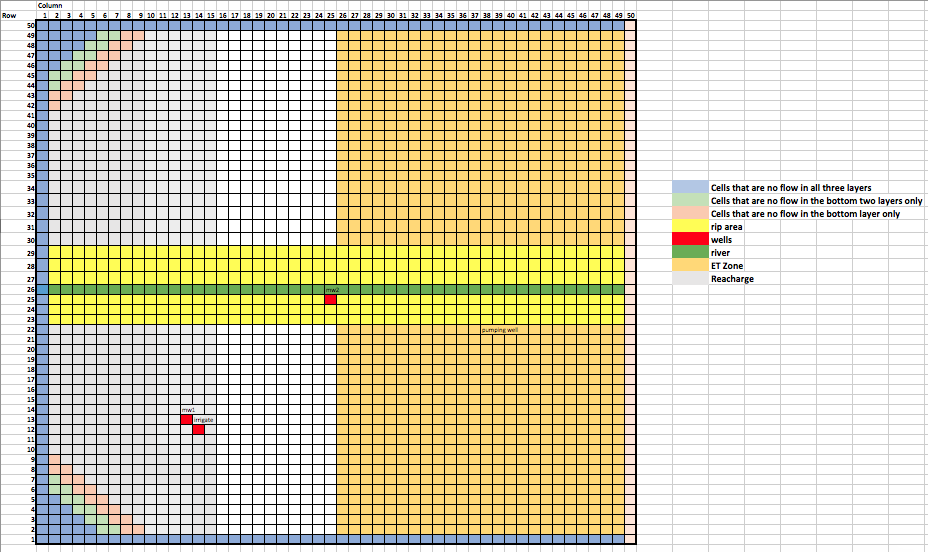
**Questions:**

1. Calculate the flux from the stream to the groundwater. Also show a reverse particle track map to identify the source of the water to the stream. Finally, report the water level at the monitoring wells and at the town's well (even though it isn't pumping for this scenario).
2. How long does it take for the model to reach a cyclical steady state (annual variations, but no trends)? Use monthly water levels at the monitoring wells to support your conclusion. This is the required 'burn in' time of your model.
3. What are your observations from this scenario?
4. How can you quantify the impacts of the town's water extraction on the hydrologic system? Describe your metrics as precisely as you can and quantify the impact(s).

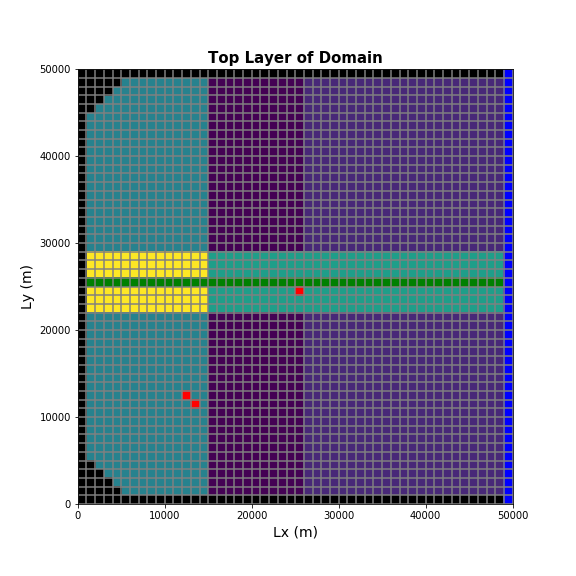
## Solution

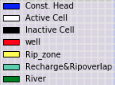
**Model setup:**

Refer to the ipython notebook to view all the steps in the model setup.



*Figure 1: Target Domain setup*





*Figure 2: Model Map View of Domain*

**Results:**

1. The flux of water entering the aquifer from the stream is 13,021 m/d. As shown in the Table 1, the starting head values at the wells decrease as we move from the left to right in the domain.

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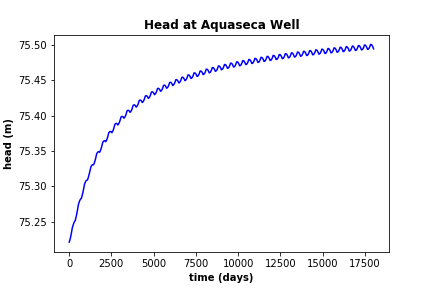
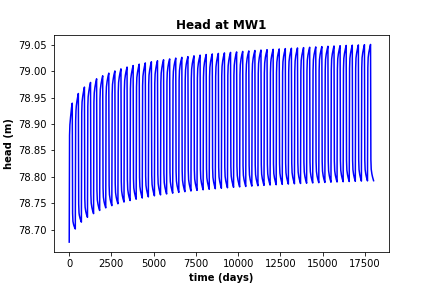
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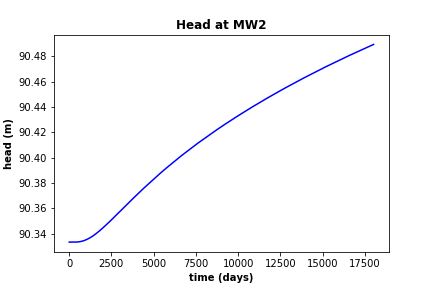
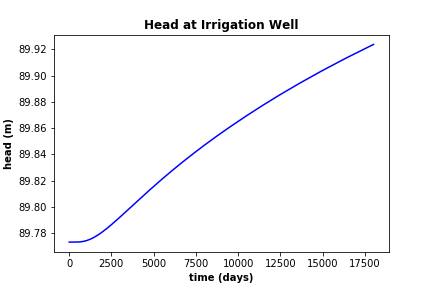
*Figure 3*. Particle path lines exiting into the river are shown above.

*Table 1*. The head values at the Aquaseca and monitoring wells are displayed below.

|  |  |
| --- | --- |
| Well ID | Head (m) |
| Well 1 (Aquaseca well) | 75.34 |
| Well 2 (Monitoring well 1) | 78.68 |
| Well 3 (Monitoring well 2) | 90.33 |

1. The head in the 4 wells (Aquaseca, Monitoring Well 1&2, and Proposed Irrigation Well) over 50 years with seasonal fluctuations pre-development.





*Figure 4 (a-d): Head plots for the 4 wells (Aquaseca, Monitoring Well 1&2, and Proposed Irrigation Well) for 50 years with seasonality (180 days of ET and 180 days of no ET each year).*

Over 50 years there is still a slight upward trend in all the wells; however, the year to year increase is minimal. The MW1 and Aquaseca supply well both flatten out by year 35 and that is considered our “burn time” for the system to reach a near steady state with seasonal variations.

Scenarios 3&4. Increased Pumping every decade projected out 200 years. The head at the pumping well has dropped roughly 1.5 feet over the first 100 years and an additional 2 feet projected in the next 100 years.

