We appreciate the review by referee #1 who stated that while the methods are sound, there are comments and concerns to be addressed in the manuscript. These comments and concerns are addressed, and changes to the manuscript are proposed to further clarify contributions.

Comment #1: Starting on line 189, the authors write that the EPIC model was applied in this study using daily or larger time steps. This approach has some implications when determining water budgets. For example, consider a brief but intense rainfall event (e.g., < 2 hours). Further assume that the incoming flux of the rainfall was intense enough that some of the soils could not fully adsorb it, resulting in runoff to the stream. In the model, this rain flux would be averaged over at least 24 hours, likely resulting in a larger portion of rainfall being partitioned into recharge instead of runoff. This potential error is cumulative over time and can result calculated recharge values that are higher than actual values.

Response #1: The EPIC model was applied for this study using daily time steps. As noted, EPIC does not have the ability to use the hourly data that exists from weather stations. We agree that this effectively limits the ability of the model to partition precipitation between runoff and recharge for extreme precipitation events over very short periods of time.

This issue was addressed by Wang et al. (2006), who evaluated the ability of EPIC to reproduce field measurements of mean annual runoff. They concluded that daily differences in the partitioning of precipitation into runoff between EPIC model outputs and field measurements may be attributed to "The daily time step, where the input is the daily total precipitation, might be the possible reason for the deviations." And yet, they found that "The simulated annual runoff vs. annual precipitation ratios ranged from 15% to 37%, close to the observed runoff vs. precipitation ratios of 13% to 40%", and "The simulated 4-year average annual runoff was consistent with observed values, as shown by the PE [Prediction Error] values of less than 5%." Thus, the daily variations did not lead to cumulative errors in long-term water balance.

Our manuscript uses the long-term water balances for estimates of recharge. We believe that this concern should be addressed by updating the manuscript to justify the use of a modeling tool with daily time steps.

Proposed change to manuscript: We propose to clarify this by adding the following sentence immediately after line 250.

"While the daily time steps of EPIC may miss extreme runoff events for short duration precipitation events, the ability of EPIC to reproduce field measurements of mean annual runoff has been substantiated by Wang et al. (2006)."

We will also add this new reference to the bibliography:

X. Wang, R. D. Harmel, J. R. Williams, W. L. Harman, (2006) Evaluation of EPIC for assessing crop yield, runoff, sediment and nutrient losses from watersheds with poultry litter fertilization, *Transactions of the ASABE*, 49(1): 47−59.

Comment #2: What was the rationale for using a constant head boundary condition set to 20 m below the land surface along the lateral boundary of the MODFLOW model?

Response #2: To establish the boundary for the MODFLOW model, we performed two steps. First, we ran a model with the same aquifer properties, etc. using SPLIT. This program is based upon the Analytic Element Method and uses an infinite domain with rivers outside the MODFLOW domain. The SPLIT model predicted values of head approximately 20m below land surface at the boundary of our MODFLOW model. Secondly, we ran the MODFLOW model with different sized domains. We found only small changes in the groundwater elevations locally at Konza as the model domain was further extended, leading us to conclude that the model domain was large enough to reproduce the regional flow field about Konza.

Proposed change to manuscript: We propose to clarify this by adding the following sentence at line 295.

"This boundary condition reproduces previous regional modeling results in an infinite domain (Yang et al. 2010), and the size of the model domain was chosen such that model predictions at Konza were not significantly changed by further enlarging the model domain."

Comment #3: Are there any implications to be aware of or potential errors introduced into this work because the MODFLOW model only had one layer (i.e., ran in 2-D mode)?

Response #3: A one layer model will correctly reproduce the vertically integrated flux over all layers in a model. Thus integrating the horizontal components of the specific discharge in the z-direction gives the correct discharge per width summed across all layers. A one layer model does not partition this discharge per width within individual layers. Thus, the one layer model gets the overall flow right, but does not partition it within individual layers. We should also note that the geology of sandwich carbonate aquifers makes it challenging to use multi-layer models.

Proposed change to manuscript: We propose to further clarify this by replacing the sentence

"This assumption was adopted previously in the nearby Mill Creek watershed by York et al. (2002)."

on line 265 with

"While this assumption does not partition the horizontal components of specific discharge within individual layers, it does correctly reproduce the vertically integrated specific discharge across all layers, and such a one-layer model was previously adopted in the nearby Mill Creek watershed by York et al. (2002)."

Comment #4: The text starting on line 370 could be interpreted as the authors saying that most of the recharge is taking place in river valleys and foot slopes. Conversely, Freeze and Cherry (1979) state that the only immutable law is that highlands are recharge areas and lowlands are discharge areas. I do not think the authors are trying to disagree with what Freeze and Cherry wrote but this portion of their text should be clarified.

Response #4: No, we are not. This section was attempting to articulate that recharge is larger in flatter regions and smaller in steeper regions for a given soil.

Proposed change to manuscript: We propose to change

"On Konza, higher rates of recharge are observed in areas that are relatively flat, which occurs in the river valley and foot slopes of Kings Creek and to the south on benches between terraces. Likewise, lower recharge rates are observed in areas where the soil slope is steeper, which occurs on the side slopes. These patterns that exist at Konza are observed across the soil types and slopes in the region."

to the following:

"For a given soil type, recharge is larger where the slope is relatively flat, which occurs at Konza in the river valley and foot slopes of Kings Creek and to the south on benches between terraces (see photos in figures 1a and 1b). Likewise, lower recharge rates occur when the soil slope is steeper, which occurs on the side slopes. These patterns that exist at Konza are observed across the soil types and slopes in the region."

Comment #5: A comparison of Figures 5 and 8 seems to indicate that the EPIC and MODFLOW simulation results are in conflict. For example, Figure 5 clearly indicates that there is a zone of significant recharge all along the floodplain of the Kansas River (which by itself might be questionable). However, Figure 8 seems to show that the water table is higher than the land surface over large portions of this region. It does not seem possible to have recharge in a discharge zone. Please clarify.

Response #5: This is a very astute observation, and deserves some elaboration. EPIC is influenced by water movement through soil layers near the surface. Once percolation seeps past the lower soil layer it is lost to the soil profile and will eventually seep downward to the groundwater. The referee is correct that EPIC should be applied in recharge zones.

The Kansas River has a floodplain and banks with height of a few meters. Groundwater in observation wells near the river has approximately the same elevation as the river. Thus, depth to water near the river and outside the floodplain is a few meters. Depth to water in the floodplain is close to zero (yet still positive since the soils are dry except during flood events). A few small seeps and damp regions exist along portions of the base of the limestone bluffs where they meet alluvium, but the ground is largely dry, indicating that the depth to water is shallow at the edges of the alluvium. This is what the model is predicting, close to zero depth to water in the Kansas River valley, yet dry soils. This is also observed in at the agronomy fields of Kansas State University at Ashland Bottoms, just north of Konza and south of the Kansas River. These fields are recharge zones. Therefore, we believe our assumption of recharge across the Kansas River Valley in Figure 5 is correct.

The color coding of the cells in Figure 8 indicates that the depth to water in the Kansas River valley are largely in the legend classes between -1.9 and 6.0. Most of the Kansas River valley has positive depth to water, with small negative depth to water occurring close to the river and close to edges of the river valley. This is where we expect to find baseflow to rivers and small springs.

Proposed change to manuscript: We believe our conceptual and numerical models are correct. We did not specifically discuss the Kansas River valley in the manuscript, but believe a few words will help to clarify interpretation of model results. We propose to modify the sentence beginning on line 442.

“These results provide a good match with field observations where baseflow becomes established downriver from the gauging station …”

to address the Kansas River as follows:

“Regionally, the depth to water illustrates recharge zones in the hills, discharge zones in the streams, and shallow depth to water in the floodplains and valleys of the Kansas and Neosho Rivers. These results provide a good match with field observations where baseflow becomes established downriver from the gauging station …”

Comment #6: Including the stream networks in Figures 7 and 8 makes the figures too busy. Please consider removing.

Response #6: We agree that these figures appear busy. We tried making these figures without the streams present and it was difficult to interpret the relation between streams, groundwater elevation and depth to water.

Proposed change to manuscript: We propose to work with the copy editors to resolve this. In particular, we will try submitting revised figures where the stream network is semi-transparent.

Comment #7: The word discharge should be replaced with recharge on line 457.

Response #7: Yes, thank you, we agree.

Proposed change to manuscript: The wording will be changed as requested.