

Understanding the Effects of Agricultural Cultivation on Soil Infiltration Rates at Mundy's Landing, KY

1. Introduction

- Mundy's Landing is a property that experienced significant flooding in the past year.
- There are many soil types on the property that interact with water and flooding in different ways.
- The property contains a pasture that is used to keep cattle and is subject to the bioturbation and compaction processes caused by the animals.
- Cows of 530kg exert at least 250kPa of force onto the ground (Trimble and Mendel 1995), compacting the soil and increasing shear stress when on slopes.
- Grassland areas have lower rates of infiltration on average than that of woodland-cover zones (Atalar, Leite, and Wilcox 2025).
- Infiltrimeters are used to measure the rate at which water is absorbed into the ground.

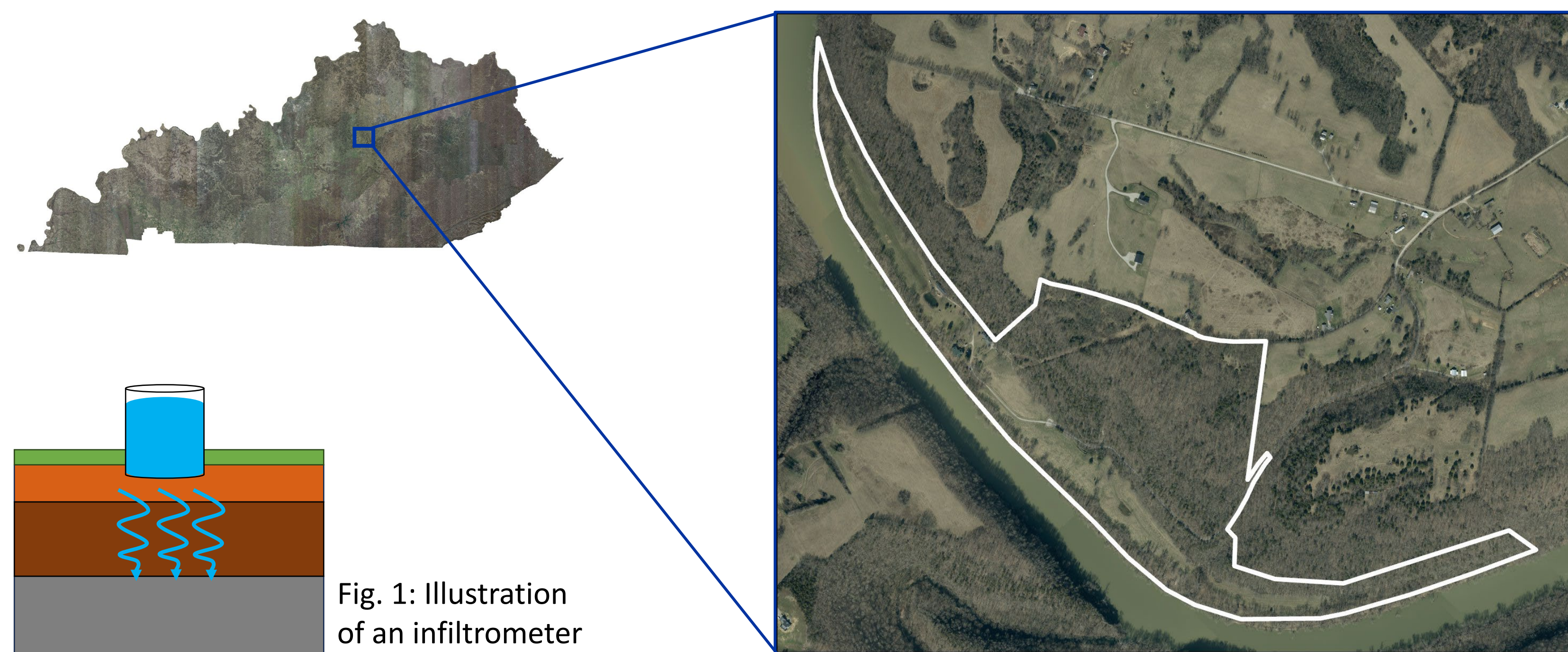


Fig. 1: Illustration of an infiltrimeter and how it works

Fig. 2: Map of the Mundy's Landing property in Woodford County

- How does agricultural livestock cultivation affect infiltration rates across different soil types at Mundy's Landing?

2. Methods

- Data was collected with an infiltrimeter
- The two soil types were Elk silt loam (ErB) and Lowell-Bluegrass silt loam (uLbiB)
 - Two measurement points were selected in the uLbiB soil and ErB soil each
- Observations were taken at 3 sites at each point on the map
- The soil moisture probe was used to take soil moisture readings at 8 of the 12 observations (sites A, C, and D) to compare to physical soil moisture calculations from soil samples
- The infiltration rates were calculated for the units of mm/hr and plotted against the total elapsed time



Fig. 3: Map of the western side of Mundy's Landing with the gold line denoting the end of the pasture.

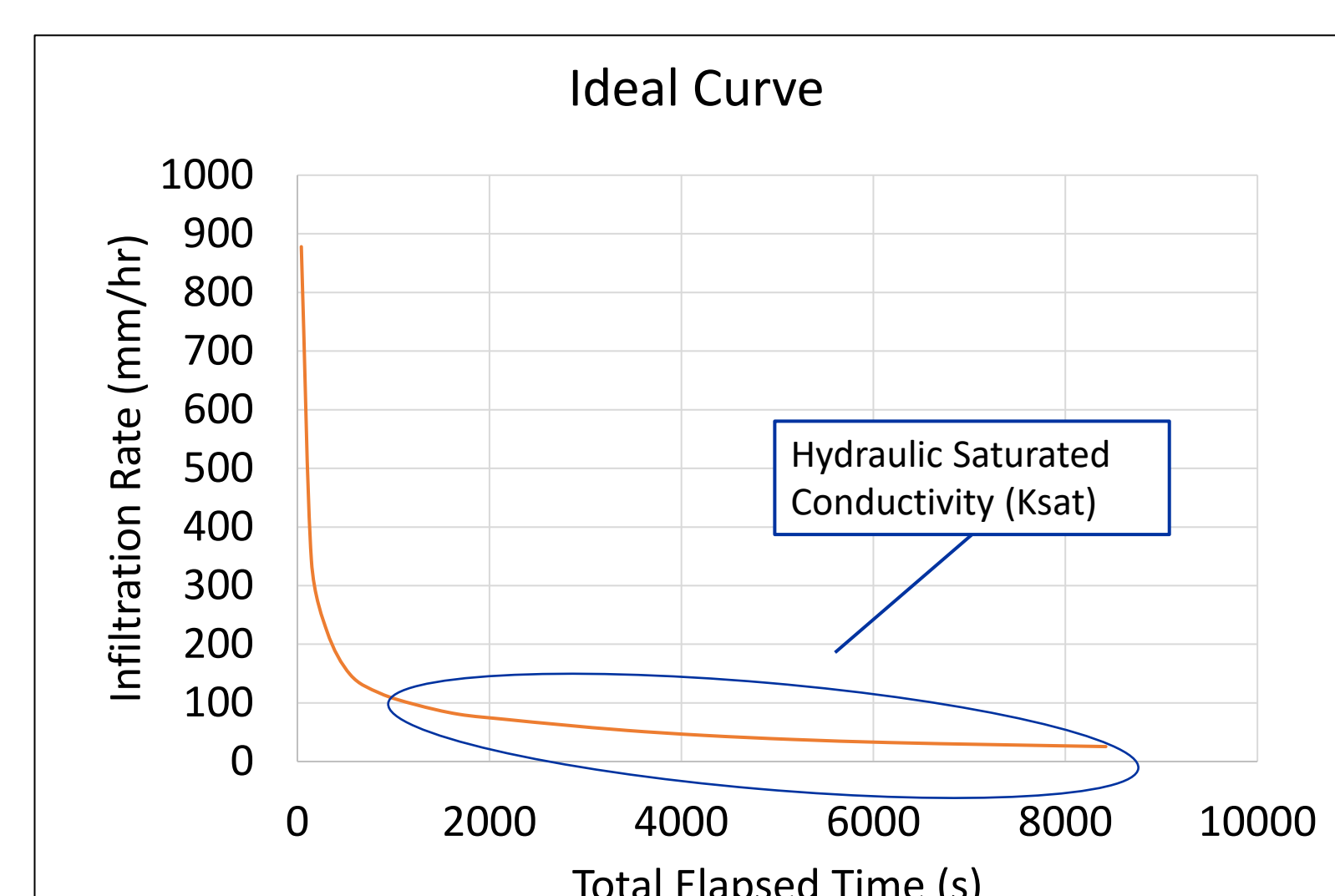


Fig. 4: Graph of the infiltration rate observations at site House and the Ksat of the site circled in blue

3. Results

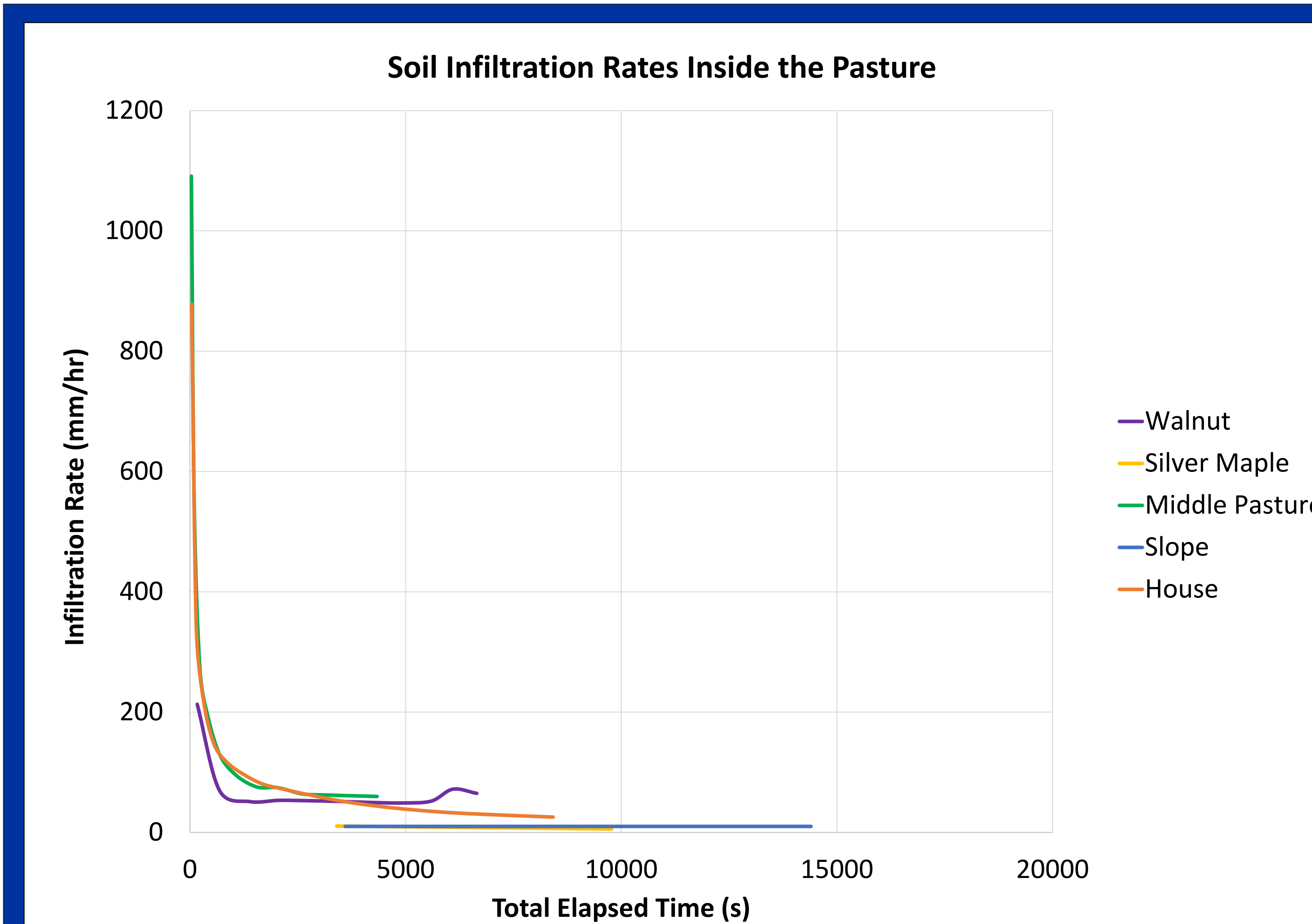


Fig. 5: Graph of the infiltration rates recorded inside of the pasture at sites Walnut, Silver Maple, Middle Pasture, Slope, and House plotted on a graph of Infiltration Rate (mm/hr) and Total Elapsed Time (s)

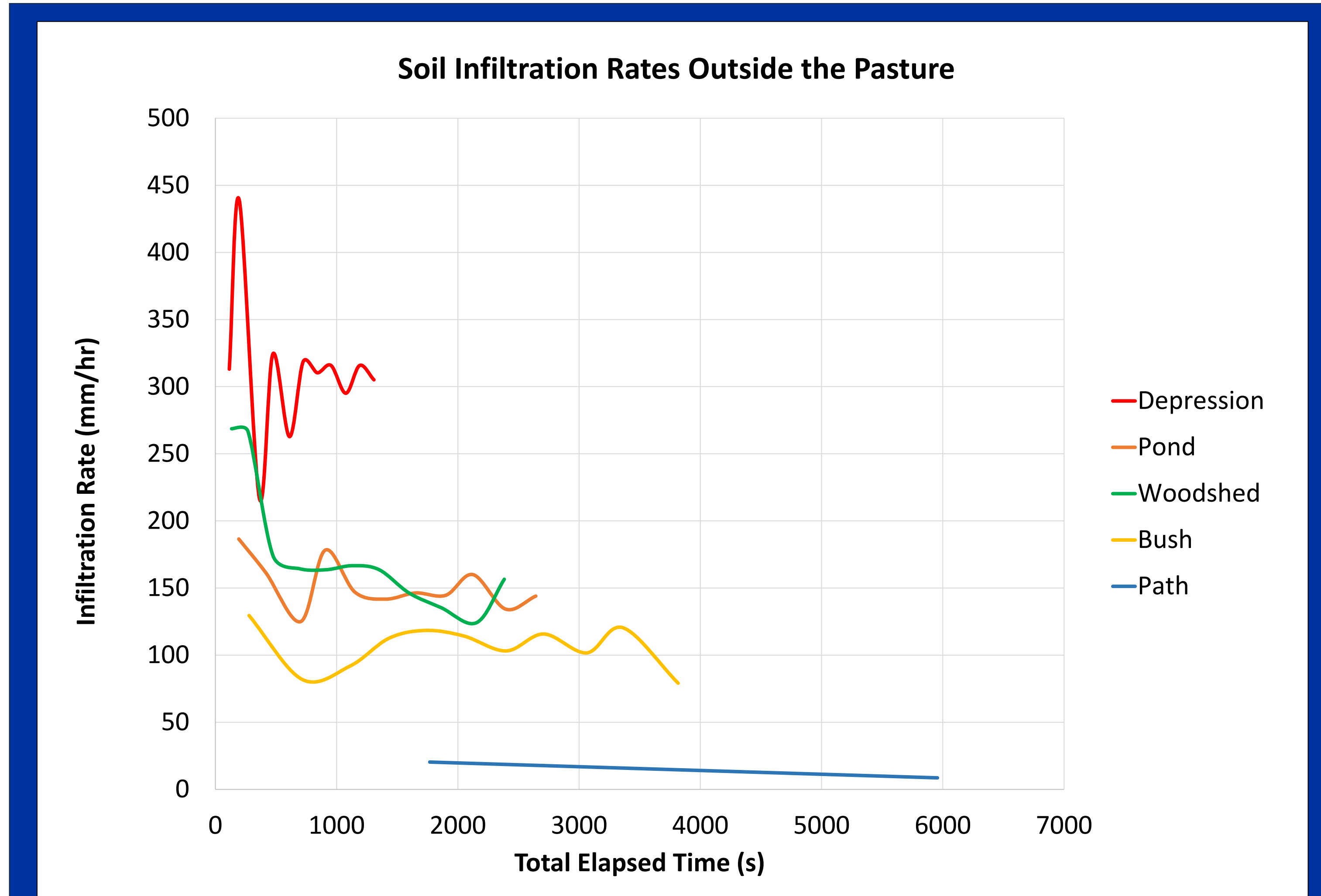


Fig. 6: Graph of the infiltration rates recorded outside of the pasture at sites Depression, Pond, Woodshed, Bush, and Path plotted on a graph of Infiltration Rate (mm/hr) and Total Elapsed Time (s)

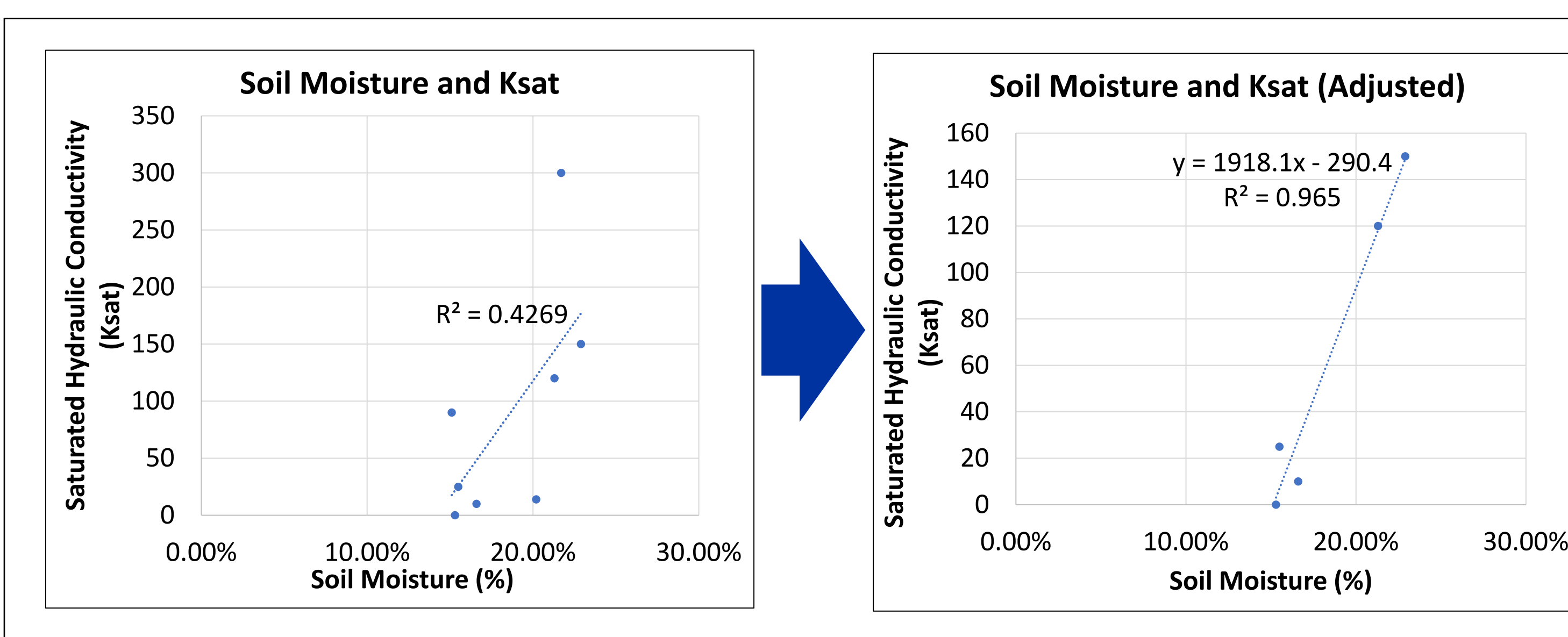


Fig. 7: Graph of the relationship between Soil Moisture and Ksat and the adjusted graph that removed outliers and raised the R^2 of the graph, showing a strong likelihood of relationship between the two variables as well as the formula for the trendline

- Soil infiltration rates are consistently higher outside of the pasture
- The data from inside the pasture is more consistent with a normal infiltration graph
- Each of the sites had 3 sets of observations taken
 - Two sets of observations showed no change across the observed time, so their infiltration rates were determined to be 0mm/hr
- Confounding factors that influenced the infiltration rates at different sites:
 - Depression: Increased infiltration
 - Path: Soil compaction reduced
 - Bush: Tree roots increased soil infiltration
- When examining the relationship between soil moisture and Ksat, there appeared to be a low likelihood of a relationship between the two ($R^2 = 0.42$), but when the sites that had strong confounding variables were removed from the graph, a stronger relationship emerged ($R^2 = 0.96$).

4. Conclusions

- Soil infiltration rates are higher on the outside of the pasture than inside the pasture in both observed soil types
 - The soil compaction caused by the presence of cattle in the pasture has lowered infiltration rates, but has created more consistent infiltration graphs
- The erratic infiltration rate graphs were caused by confounding variables
- These reliable graphs allow for a lot more accuracy in predicting the saturated hydraulic conductivity (Ksat) of the soil
- There is a relationship between soil moisture and Ksat, so with the formula $y = 1918.1x - 290.4$ we can estimate Ksat with only soil moisture values
 - Ring infiltrimeters don't work on slopes of greater than 20%, so a rough Ksat estimate could potentially be found with just a soil moisture value
 - There are limitations because of how few data points were taken to calculate the formula so it would be an estimate

5. Acknowledgements

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6. References

- Trimble, Stanley W., and Alexandra C. Mendel. 1995. "The Cow as a Geomorphic Agent — A Critical Review." *Geomorphology, Biogeomorphology, Terrestrial and Freshwater Systems*, vol. 13 (1): 233–53. [https://doi.org/10.1016/0169-555X\(95\)00028-4](https://doi.org/10.1016/0169-555X(95)00028-4).
- Atalar, Furkan, Pedro A. M. Leite, and Bradford P. Wilcox. 2025. "A Comparison of Three Methodologies for Determining Soil Infiltration Capacity in Thicketized Oak Woodlands and Adjacent Grasslands." *Water* (20734441) (Basel, Switzerland) 17 (4). <https://search.ebscohost.com/login.aspx?direct=true&AuthType=shib&db=cbt&AN=20250184073&site=ehost-live&scope=site>.