

THE UNIVERSITY OF ARIZONA GRADUATE COLLEGE

Undergraduate Research **Opportunities Consortium**

Introduction

- Pima County Regional Flood Control District (PCRFCD) manages stormwater detention basins in Pima County to mitigate flooding.
- The Rita Ranch Detention Basin is located 12 miles southeast of downtown Tucson, Arizona.
- A lack of sensors in the basin means that the inflow and outflow are currently unknown.
- It is unclear if the basin contributes to aquifer recharge.
- The objective of this project is to determine if this basin can contribute to aquifer recharge.



Basin location in Arizona



Rita Ranch Detention Basin

Methods

- Data were obtained from PCRFCD on the basin dimensions and ponding during discrete storm events to construct a precipitation-to-ponding curve.
- Soil column was constructed with well log data and field-gathered soil properties using HYDRUS-1D, which models infiltration behavior in a soil column.
- Daily vegetation transpiration parameters and meteorologic data from 2011-2023 were used as atmospheric boundary inputs.
- Any moisture exiting the bottom of the soil column was considered as feasible recharge.
- Three hypothetical scenarios were modeled and analyzed for this study.



- Scenario 1: Soil column with velvet mesquite vegetation.
- Scenario 2: Soil column without vegetation.
- Scenario 3: Soil column without vegetation and with the top 1 meter of soil column replaced with sand.

Schematic HYDRUS soil column

Recharge Feasibility of Tucson Stormwater Infrastructure

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The cumulative amount of water leaving for the bottom boundary of the modeled soil column which is set at 15 meters in depth, one meter beneath the average tap root length of a velvet mesquite.





Times of rates of moisture exiting the bottom of the soil column.

- Scenario 1: 9.9% of total water input contributes to potential recharge
- Scenario 2: 83.5% of total water input contributes to potential recharge
- Scenario 3: 97.7% of total water input contributes to potential recharge



Basin ponding event magnitude and time.







Discussion

• The study's main limitation is the simplified precipitation-to-ponding height input used for the soil column water input.

• Assumption is made that any water exceeding 15 meters in depth, the average tap root length of velvet mesquite contributes to potential recharge.

• Water table is located at ~90 meters in depth. • Future research will incorporate HEC-HMS for watershed modeling to provide more accurate input for HYDRUS.

• Despite being in its early stages, the study's data can guide PCRFCD in optimizing the basin's potential as stormwater recharge infrastructure

• Stormwater collection and retention are vital for sustainable water management in semi-arid regions like Tucson.



Evidence of aquifer depletion from the disappearance of the Santa Cruz riparian corridor.

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