Enhancing Tribal Water Supplies through Recharge

A joint presentation by the Arizona Institute for Resilience:

Marlana Hinkley, Center for Climate Adaptation Science & Solutions

Daniel Sestiaga Jr. (Ft. Yuma Quechan), Indigenous Resilience Center

Session Goals

Goals:

- Offer relevant information to support your challenges and priorities related to enhancing groundwater supplies
- Provide an opportunity for peer-learning through small group discussions
- Learn how we can be in service to your Tribe/community

Agenda

- Introductions & initial discussions in breakout groups (15 min)
- Motivation and objectives of the ATUR project (5 min)
- Overview of ATUR findings (15 min)
- Discussion: Supporting your priorities (15 min)

Introductions

Daniel Sestiaga Jr.

- Assistant Director, Indigenous Resilience Center
- Ft. Yuma Quechan Tribe
- Have been working with RTOC through IRes and the WEST EJ Center

Marlana Hinkley

- ATUR Engagement Lead
- MS / MPA Student at the UofA
- Former IHS Engineer

Introductions

Please introduce yourself!

Name, Position, Tribe, and what word describes your energy today?

Initial Breakout Group Discussions

Discussion prompts for small groups with optional share-out:

- What challenges does your Tribe/community experience related to water supply availability (drinking water, cultural needs, plant and wildlife needs, etc.)?
- How is your community or Tribe working to adapt to these challenges?
- What support would you like in overcoming these challenges?

ATUR Project Motivation & Objectives

Climate Change Impacts to Arizona's Water Supplies

↑ Temp.

↓ Overall precip.

↓ Snowpack

↓ Supply

Over 95% of precipitation that falls as rain or snow in Arizona evaporates before it enters a stream or recharges the groundwater

Observed Changes in Annual Temperature and Precipitation

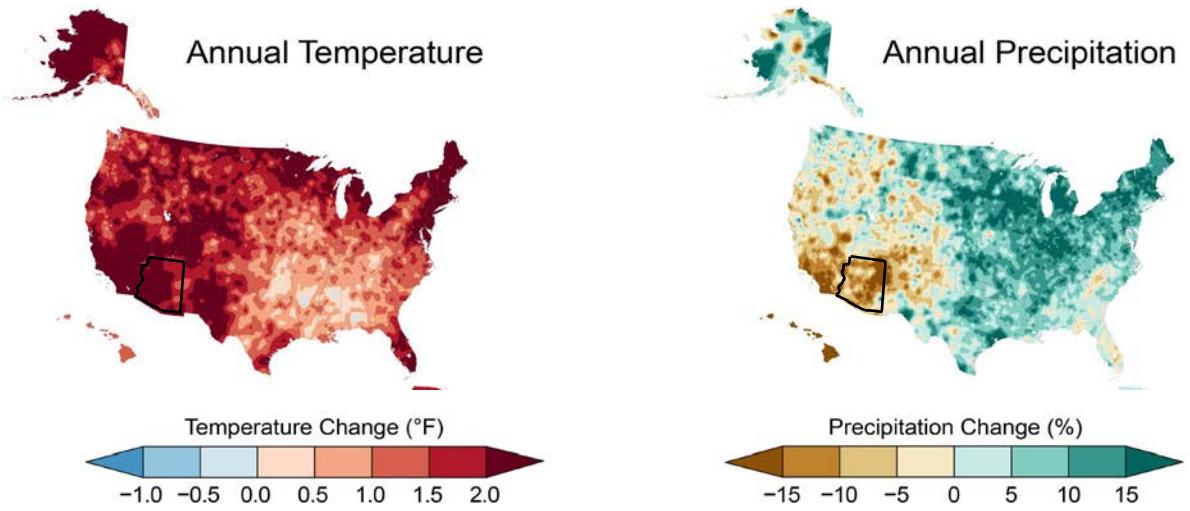

Figure adapted from NCA5 Chap 2, Figure 2.4: Observed changes in annual average temperature and precipitation from 2002-2021 compared to 1901-1960.

ATUR Project Motivation & Objectives

Declining Groundwater Supplies in Arizona

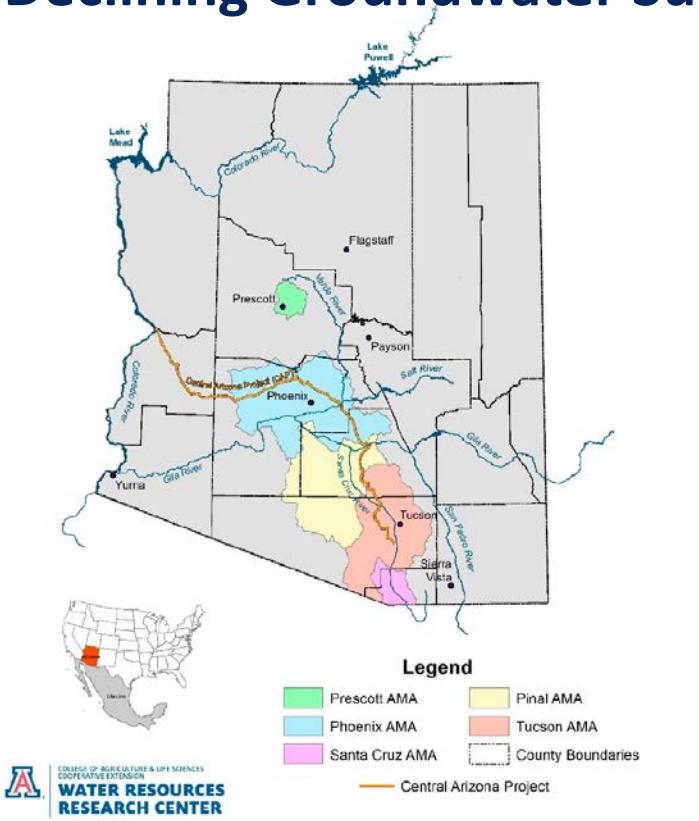

Figure Credit: Bernat et al. (2023)

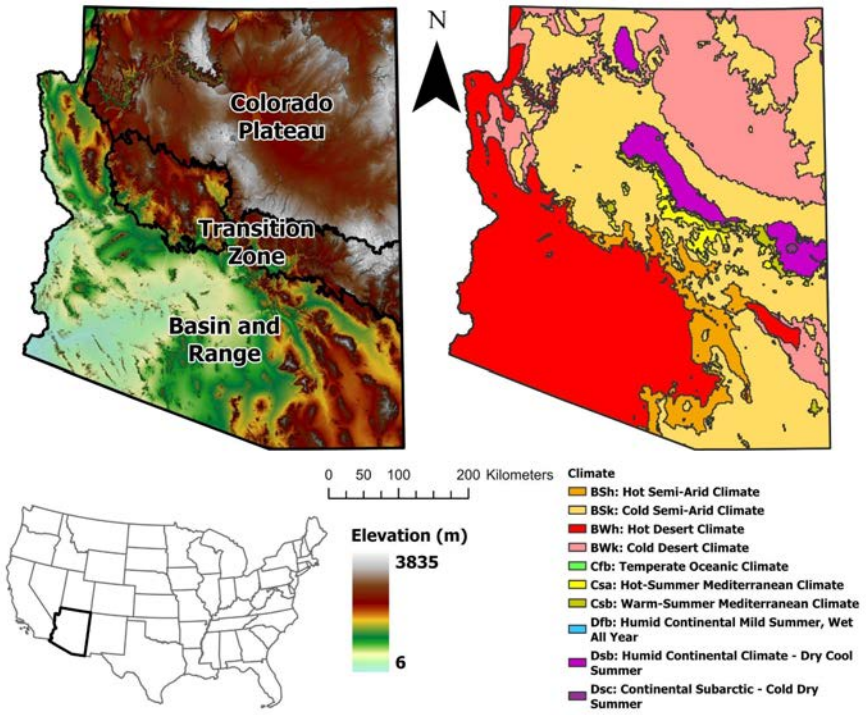

Figure Credit: Gupta et al., 2025 (in review)

ARIZONA DEPARTMENT of WATER RESOURCES EST. 1980

How states dependent on the Colorado River are struggling to strike a long-term agreement

Nation Aug 14, 2024 1:22 PM EDT

ARIZONA GOVERNMENT ENVIRONMENT GOVERNOR KATIE HOBBS WATER

New Arizona bill aims to curb groundwater decline and protect rural farmers

The Rural Groundwater Management Act (RGMA) could reshape Arizona's water future.

by Katya Mendoza

Study Shows Groundwater Gains in Arizona Yet Climate Risks Still Threaten Water Supply

MARCH 31, 2025

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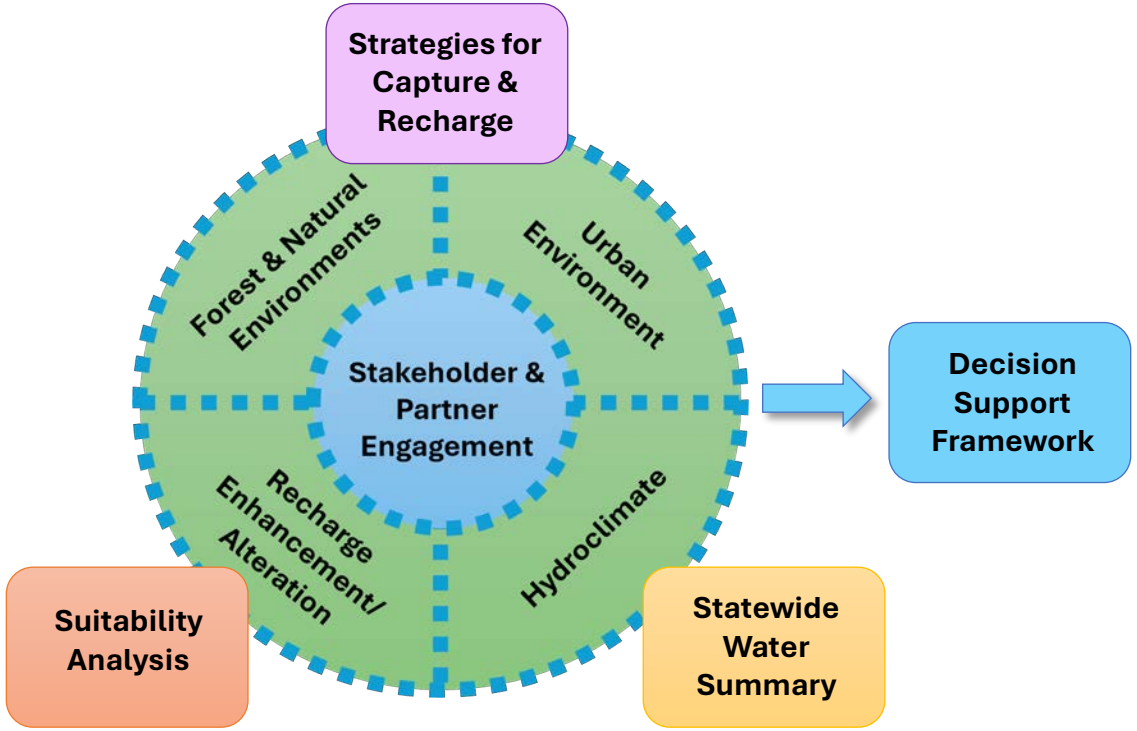
ATUR Project Motivation & Objectives

Arizona Tri-University Recharge & Water Reliability Project (ATUR)

Applied hydrologic research at a statewide scale

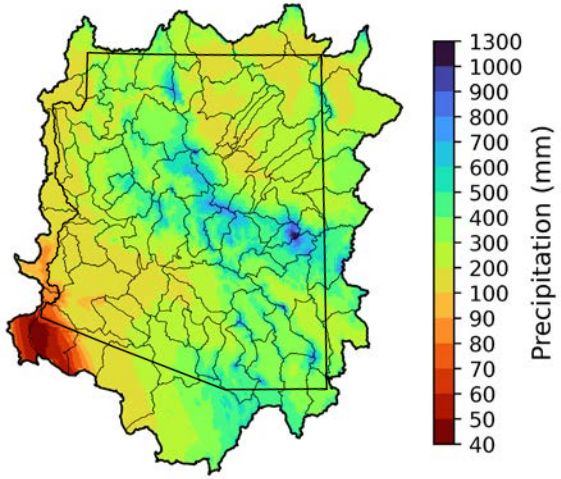
Objective: Identify where and how water that would have otherwise evaporated can be captured and recharged to support groundwater supplies now and in the future



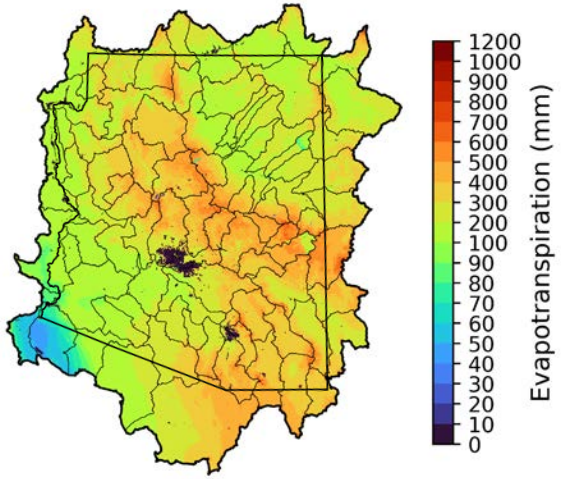
ATUR Findings: Statewide Water Summary

Water available for capture and recharge

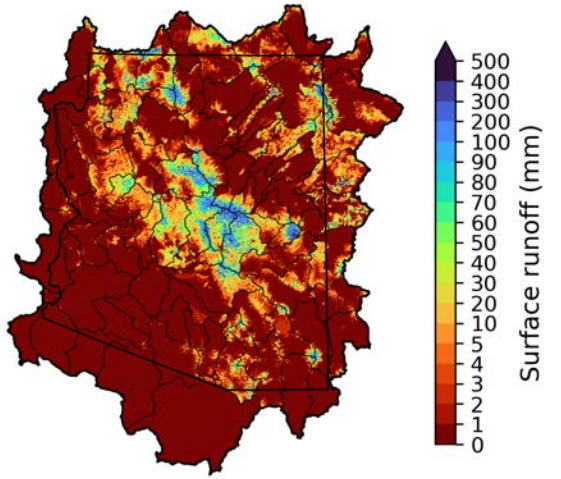
Long-term mean (1981-2020) annual precipitation



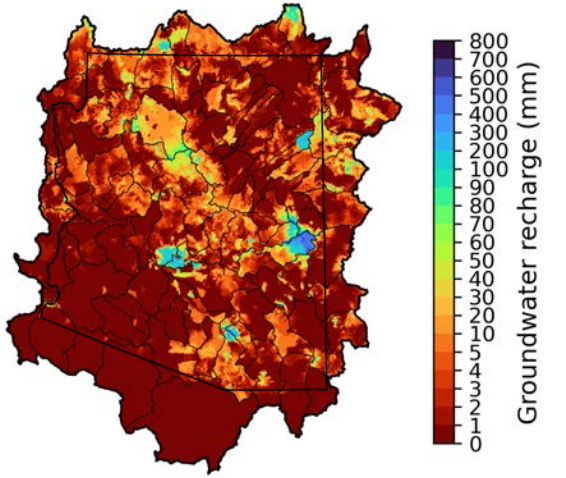
Long-term mean (1981-2020) annual evapotranspiration



Long-term mean (1981-2020) annual surface runoff



Long-term mean (1981-2020) annual groundwater recharge



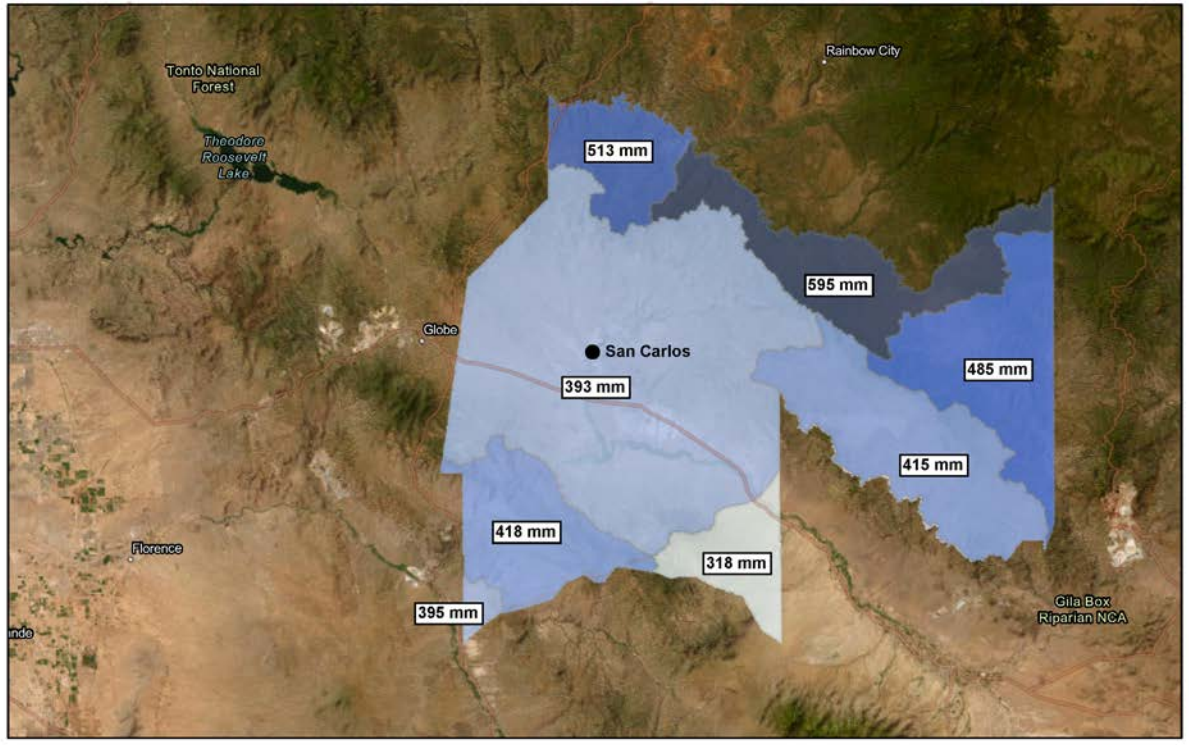
Precipitation = Evapotranspiration + Surface Runoff + Recharge

Quantifying each of these terms is critical to identifying water available for capture and recharge.

Work in progress: understanding how climate change will impact the natural water balance.

ATUR Findings:
Statewide Water Summary

Mean Annual Precipitation (mm) - San Carlos Apache Reservation Groundwater Basins



Mean Annual Precipitation in SCAT Groundwater Basins

>600 mm

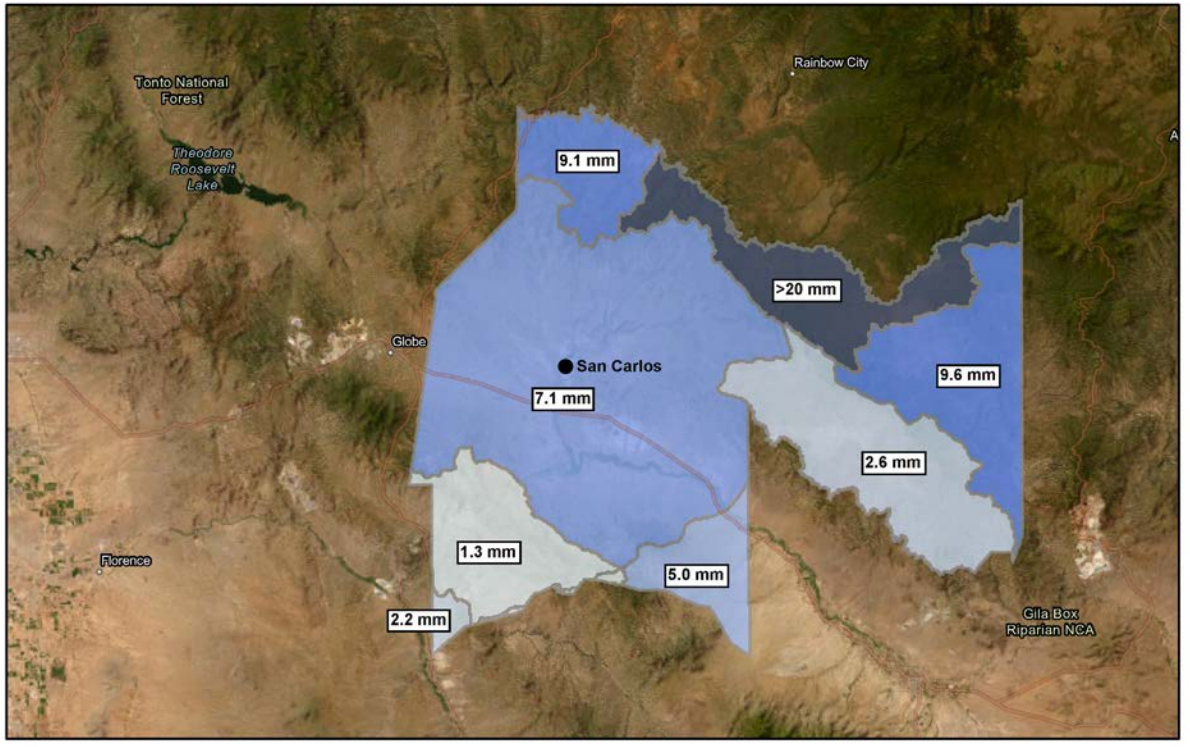
<300 mm

0 5 10 20 mi

0 10 20 40 km

Earthstar Geographics, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, (c) OpenStreetMap contributors, and the GIS User Community

Mean Annual Recharge (mm) - San Carlos Apache Reservation Groundwater Basins



Mean Annual Recharge in SCAT Groundwater Basins

>20 mm

0 mm

0 5 10 20 mi

0 10 20 40 km

Earthstar Geographics, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, (c) OpenStreetMap contributors, and the GIS User Community

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ATUR Findings: Recharge Suitability

Surface & subsurface conditions suitable for recharge

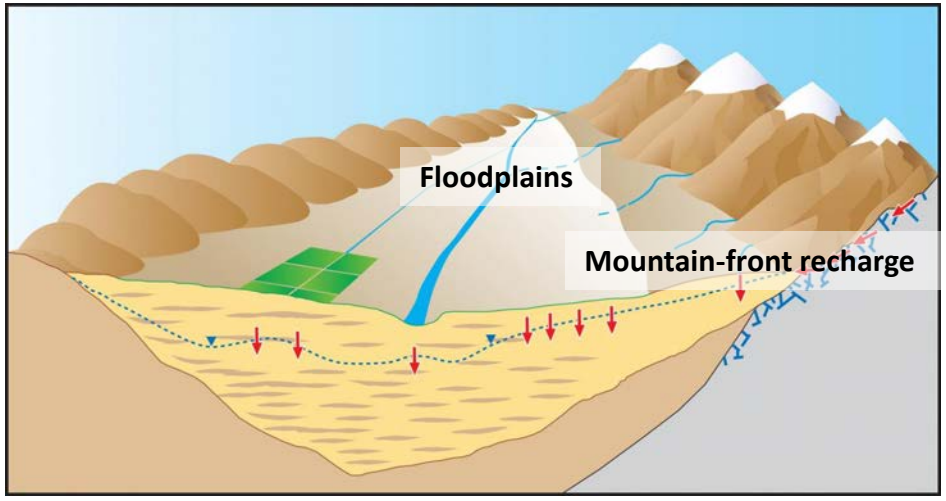

Figure adapted from Meixner et al. (2016)

Karst (Limestone) Topography

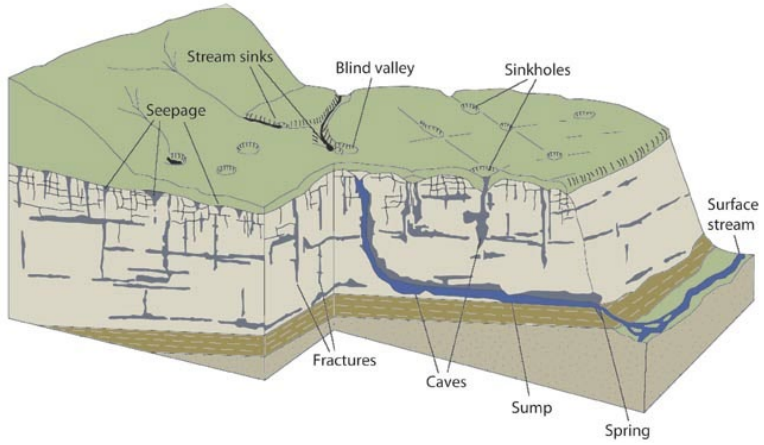

Figure adapted from Runkel et al. (2003)

Faults

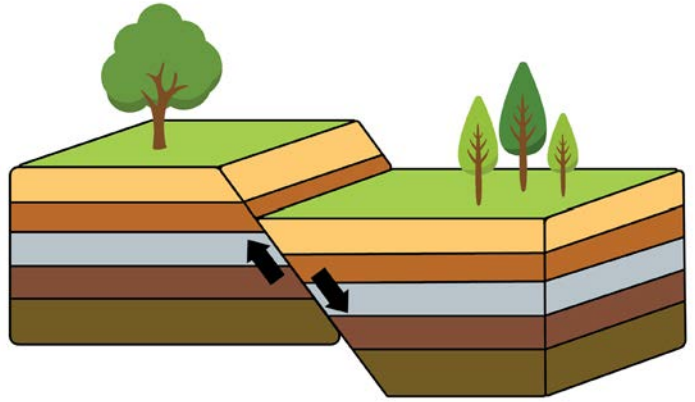

Figure from USGS (https://www.usgs.gov/media/images/normal-fault)

ATUR Findings: Recharge Suitability

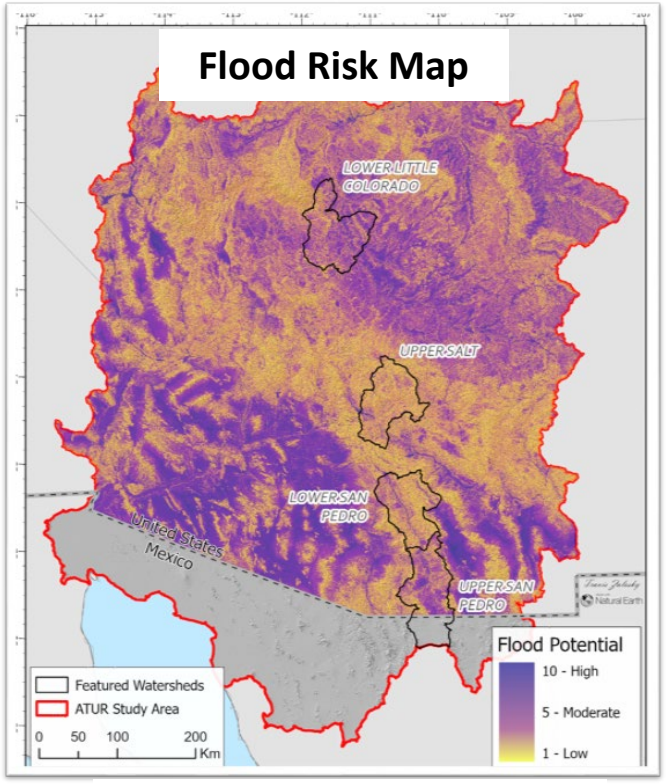

Figure from Zalesky et al., 2025 (in prep.)

Statewide flood risk map based on topography that agrees with FEMA 100-year floodplain mapping.

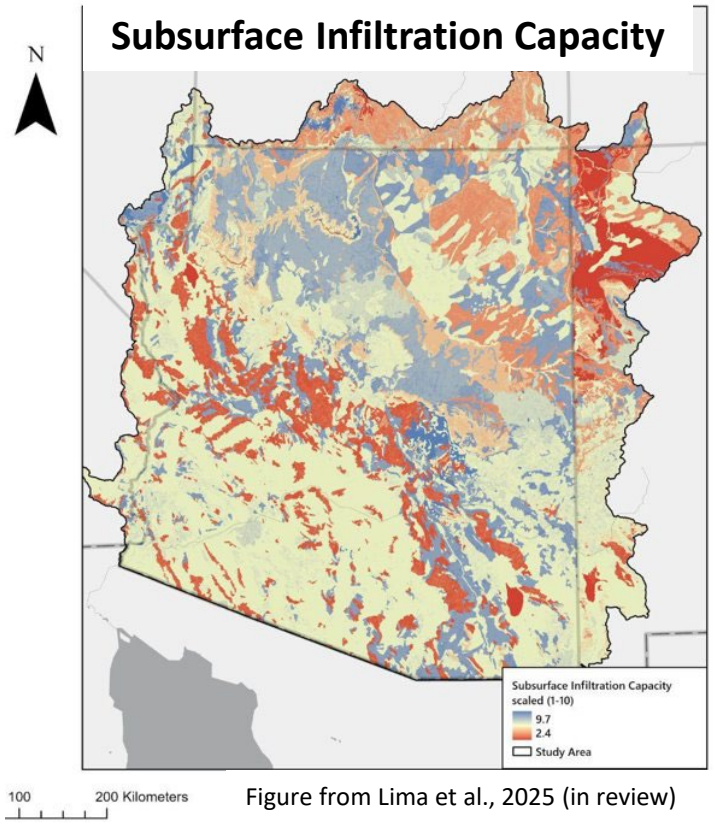

Figure from Lima et al., 2025 (in review)

Index that describes capacity for water to infiltrate into the soil. Considers soil properties, faults, and karst (limestone) topography.

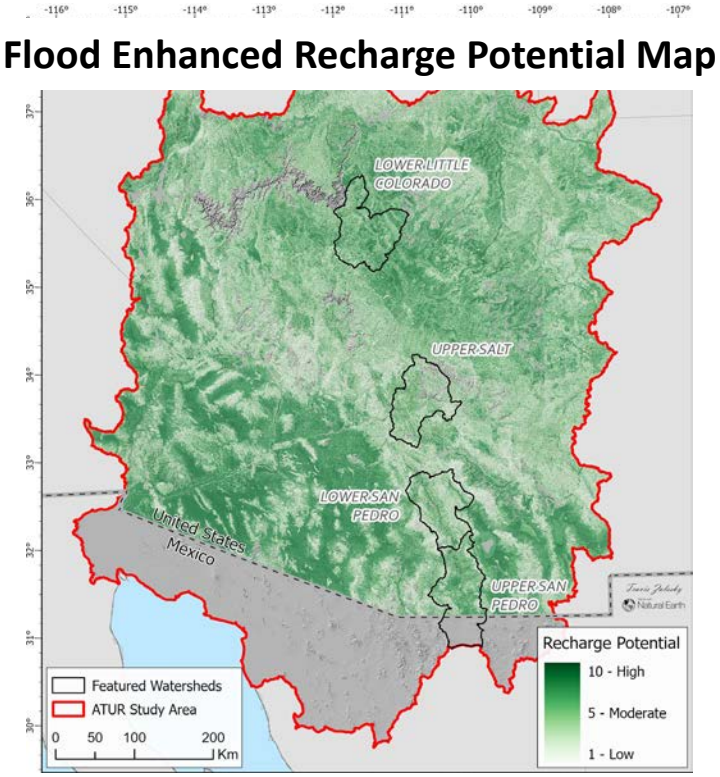

Figure from Zalesky et al., 2025 (in prep.)

Statewide flood enhanced recharge potential map combines flooding, soil, and geologic properties to show where recharge potential from flooding is highest statewide.

ATUR Findings: Recharge Suitability

Statewide map showing suitability for ponderosa pine forest thinning to enhance groundwater recharge based on vegetation density, soil properties, topography, and other factors.

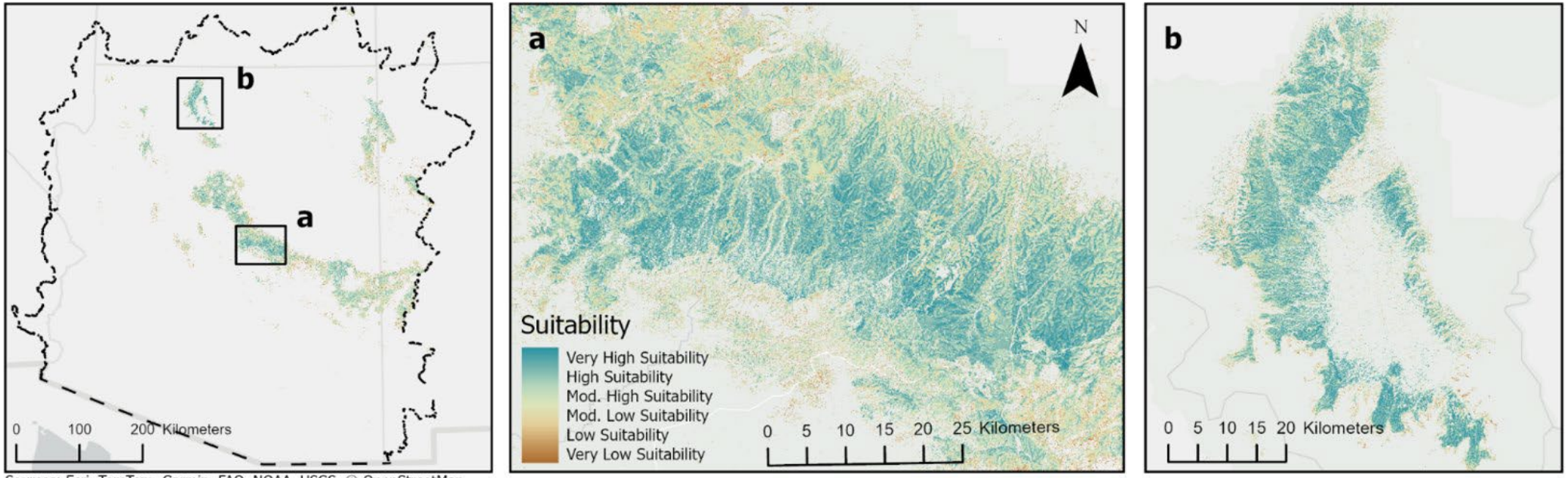

Figure from Lima et al., 2025 (in review)

ATUR Findings: Capture & Recharge Strategies

Capture and recharge water that would otherwise be lost through evaporation

Natural Landscapes:

- Flood enhanced recharge
- Tree thinning & invasive vegetation management
- In-channel rock check dams
- Use of old stock ponds/berms to slow water down
- Capture of runoff from hillslope roads
- Improving watershed conditions to slow runoff & improve infiltration

Photo of in-channel interventions, Douglas Ranger District from Norman (2020)

Photo of Rio de Flag Flood Control Project from Gupta et al., 2025 (in prep)

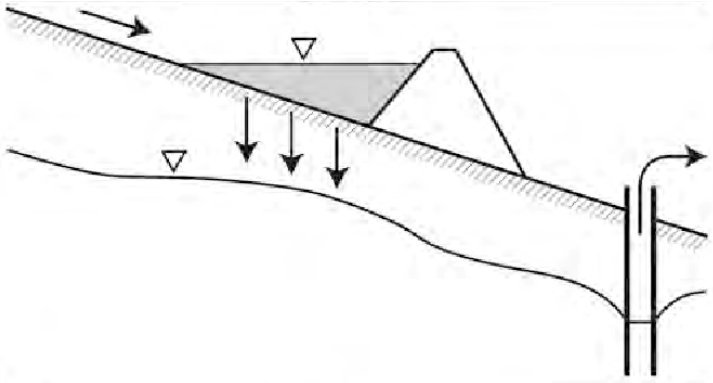

Figure of recharge from check dams or earthen stock ponds (Vanderzalm et al., 2018)

ATUR Findings: Capture & Recharge Strategies

Capture and recharge water that would otherwise be lost through evaporation

Urban Environments:

- Incorporating recharge into stormwater management efforts
- Drywells
- Retention/Detention basins
- Green stormwater infrastructure

Retention/Detention basin with drywells used as a flood control strategy to capture and direct stormwater for recharge in Chandler, AZ. Photo taken by Tianfang Xu

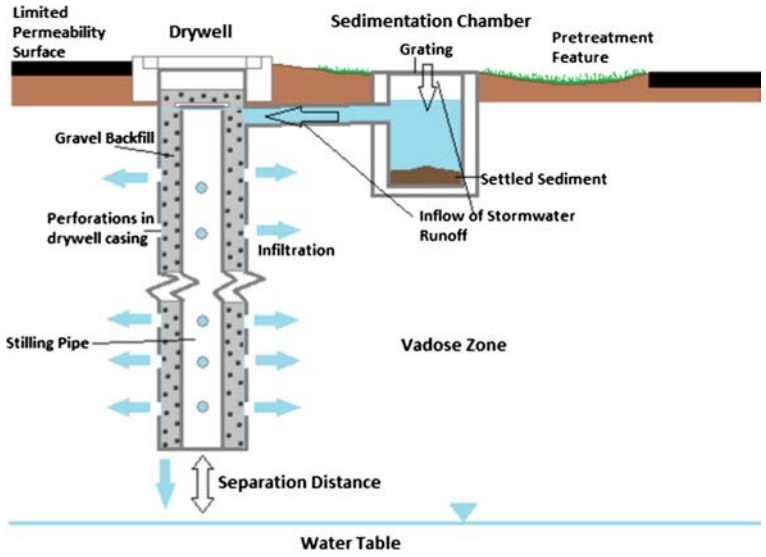

Diagram of a drywell from Edwards et al. (2016)

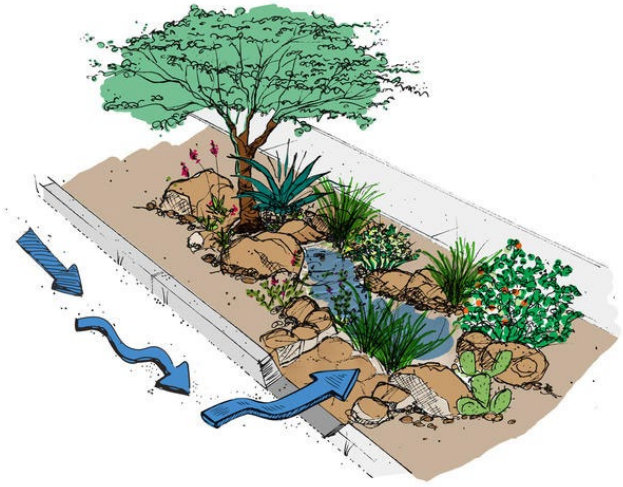

Figure of GSI from Watershed Management Group (https://watershedmg.org/learn/resources/GSI)

Breakout Groups Discussion

We want to be in service and support your challenges and priorities.

<u>Discussion prompts for small groups with optional share-out</u>:

- How can you use this information to improve water supply availability for your community?
- What are our next steps to be able to serve as a resource and support your priorities?
  Examples:
  - Follow-up meetings with specific environmental or land management departments
  - Provide maps and figures for reports/grant-writing
  - Youth engagement around water resources education

Thank you!

Contact:
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dsestiaga@arizona.edu

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Please feel free to visit our website for more information:
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