# Assessing Surface and Groundwater Interactions Between the Middle Brazos River Alluvium Aquifer and the Brazos River

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Brazos Valley
GROUNDWATER CONSERVATION DISTRICT

# Overview

1. Purpose and Motivation
2. Study Site Overview
3. Methods
4. Collected Data
5. Project Timeline

# Purpose and Motivation

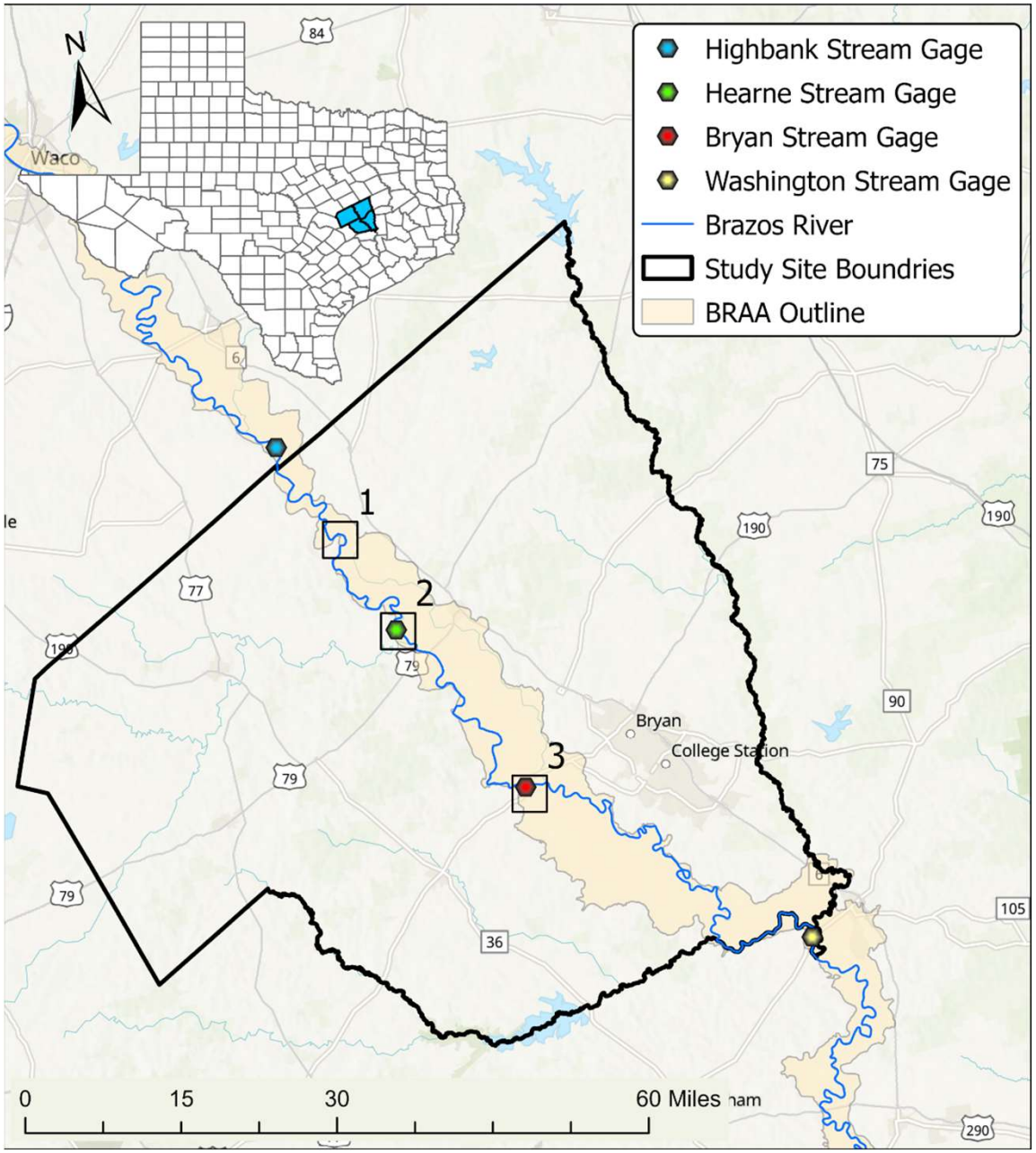
- The Brazos River Alluvium Aquifer (BRAA) is a vital resource for agricultural irrigation
- Current modeling has been limited
  - Assumed homogeneity
  - Assumed isotropy
  - Ill-defined river interaction
  - Poorly understood

# Better define the interactions between Brazos River and the BRAA

- What is the influence of seasonality?
- What is the influence of irrigation?
- What are the long term impacts of high or low water?
- What is the difference in water chemistry between the river and alluvium?

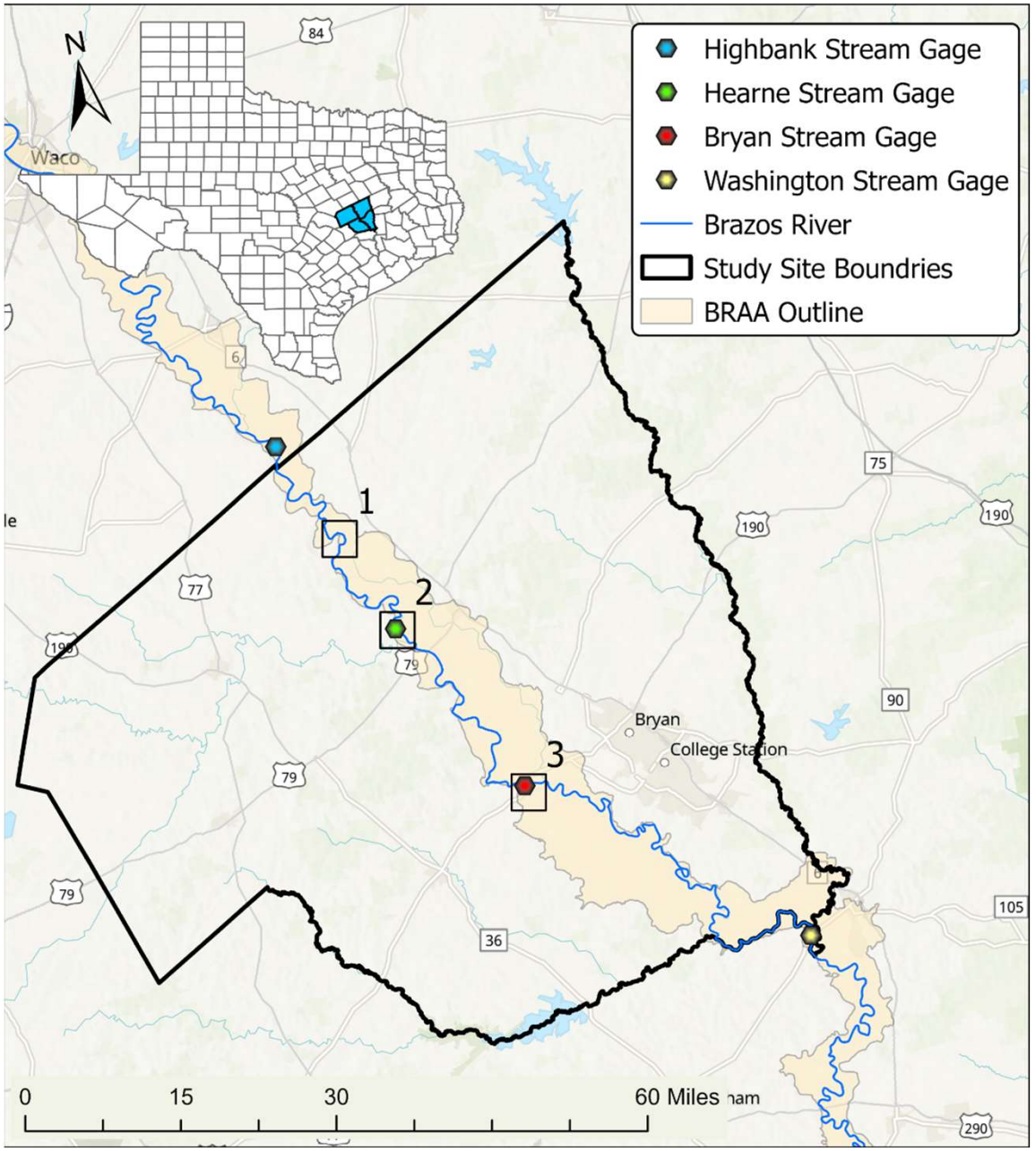
# Study Site

- Middle segment
  - Brazos, Burleson, Milam, and Robertson counties
- BRAA
  - Quaternary age
  - Unconsolidated sediment aquifer
  - Clay to gravel sized clasts



# Local Study Sites

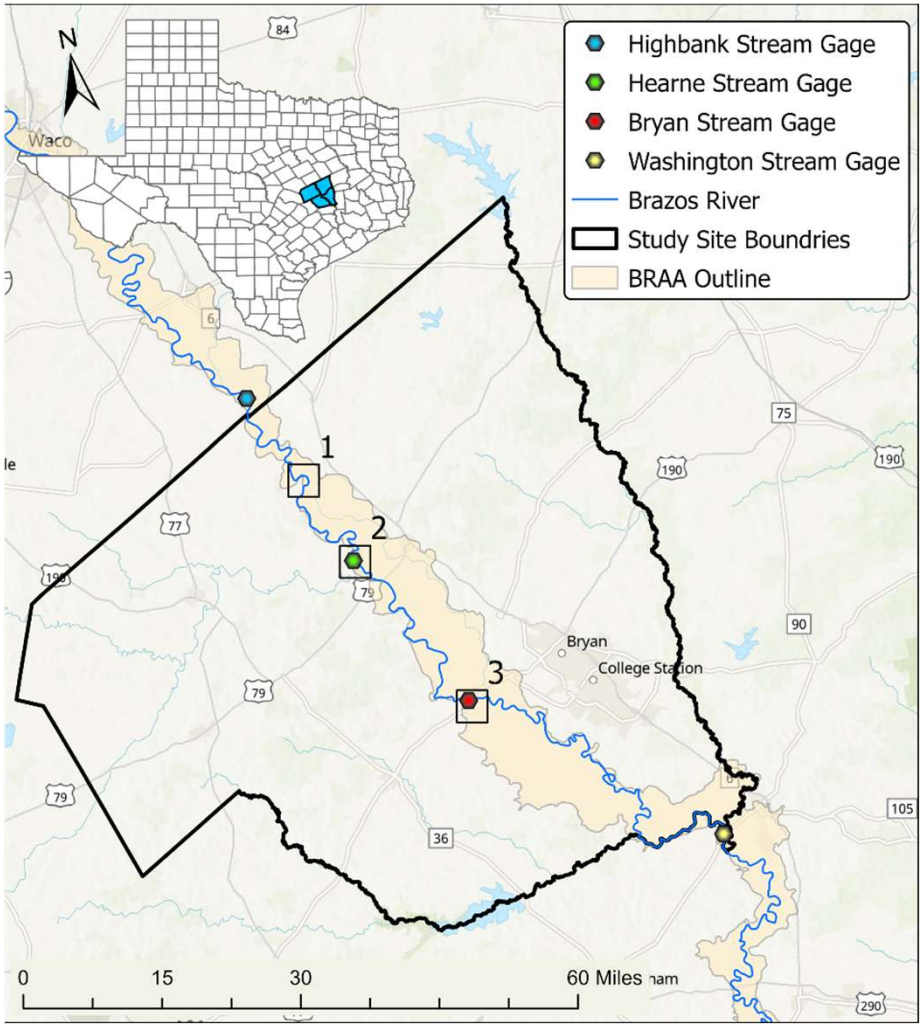
1. **Calvert**
   - Coordinate river level with AquaStrategies
2. **Hearne**
   - USGS stream gage
3. **Bryan**
   - USGS stream gage



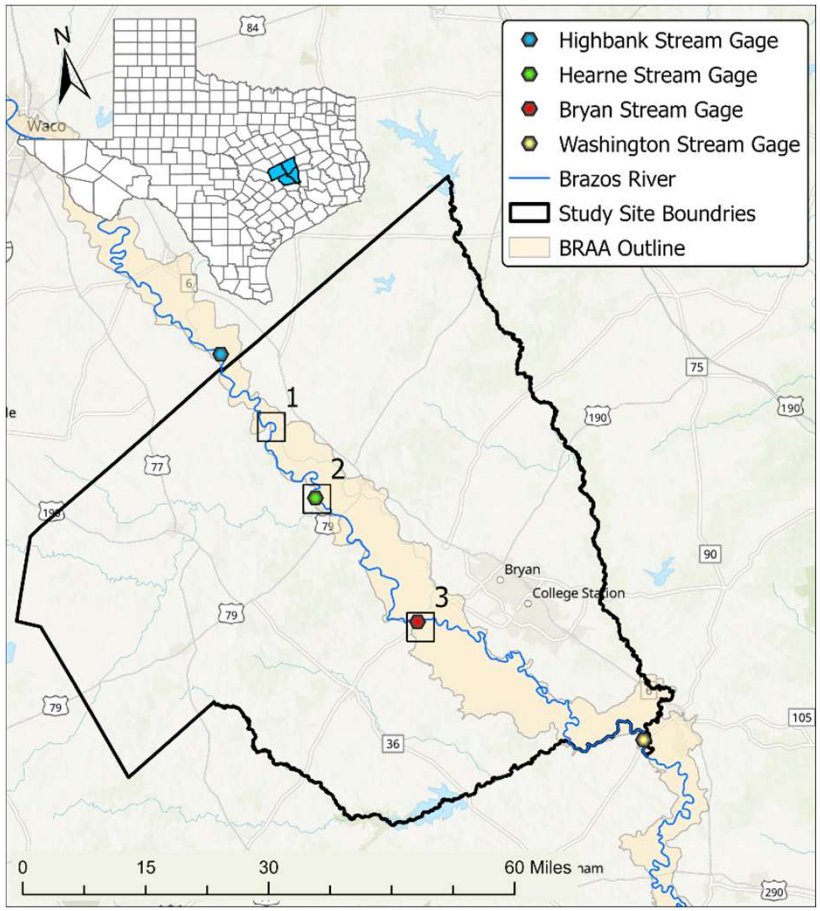
# Local Study Sites

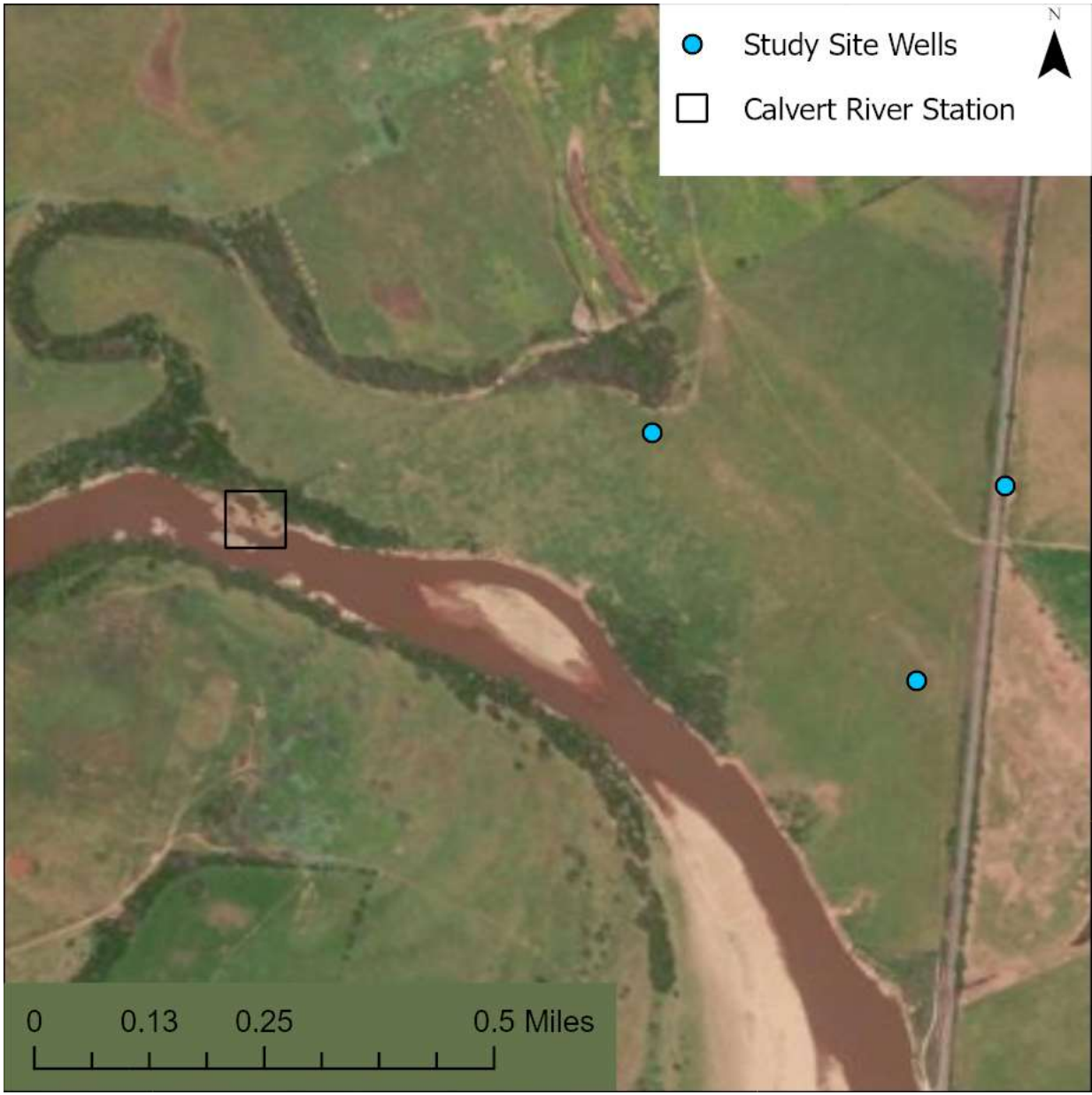
**For each site:**

- 1 water level, temp., SpC datalogger
- 1 water level and temp. datalogger
- 1 barometer for corrections
- Water quality samples
- Isotope samples
- Field measurements (DO, pH, ect.)

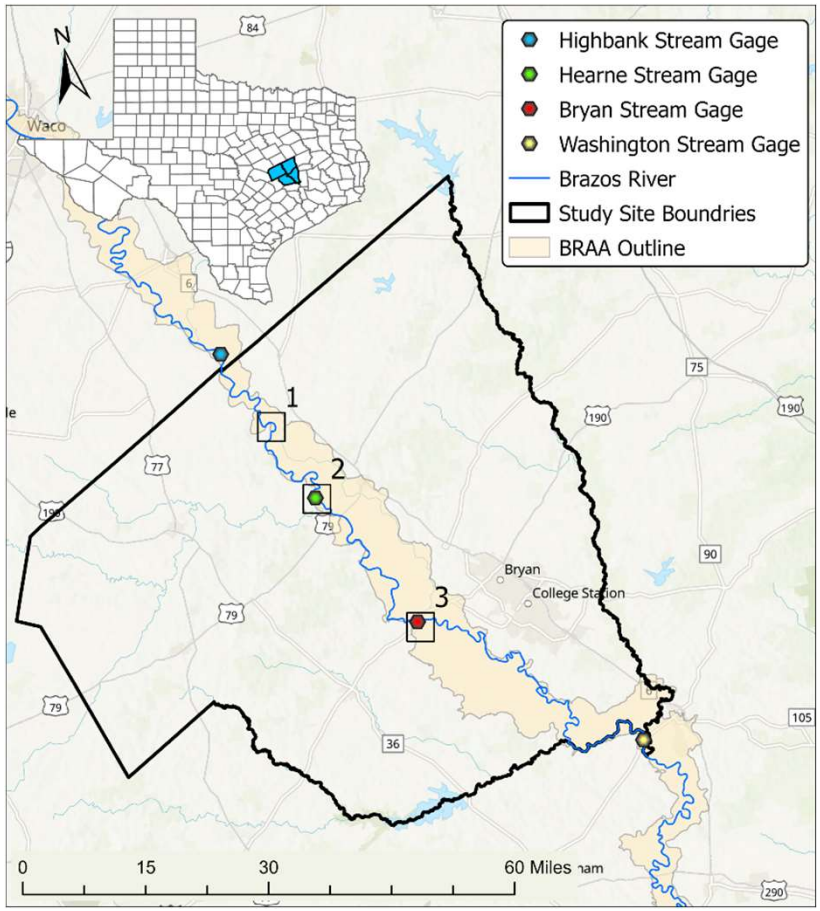


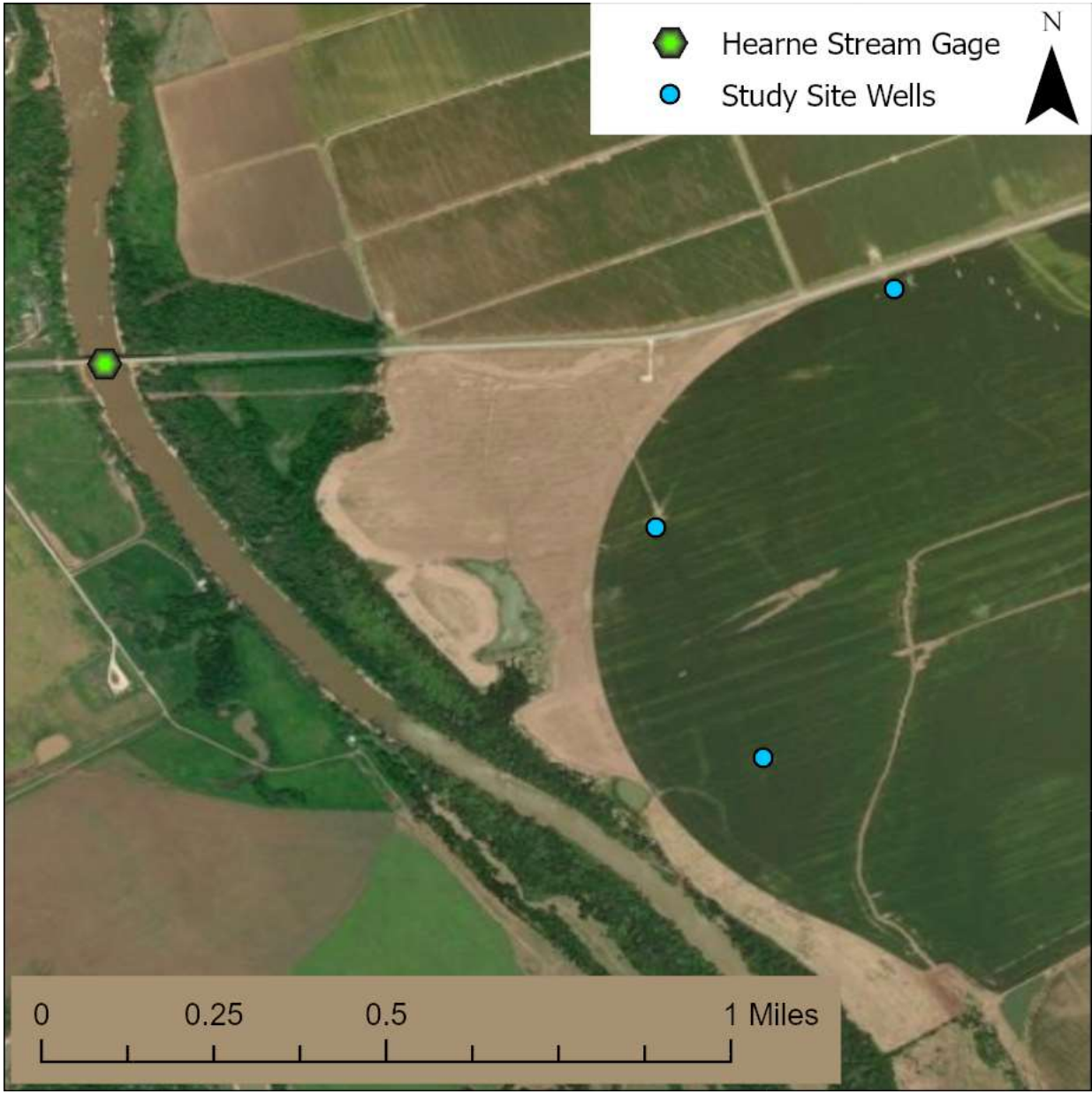
# Local Study Site: Calvert



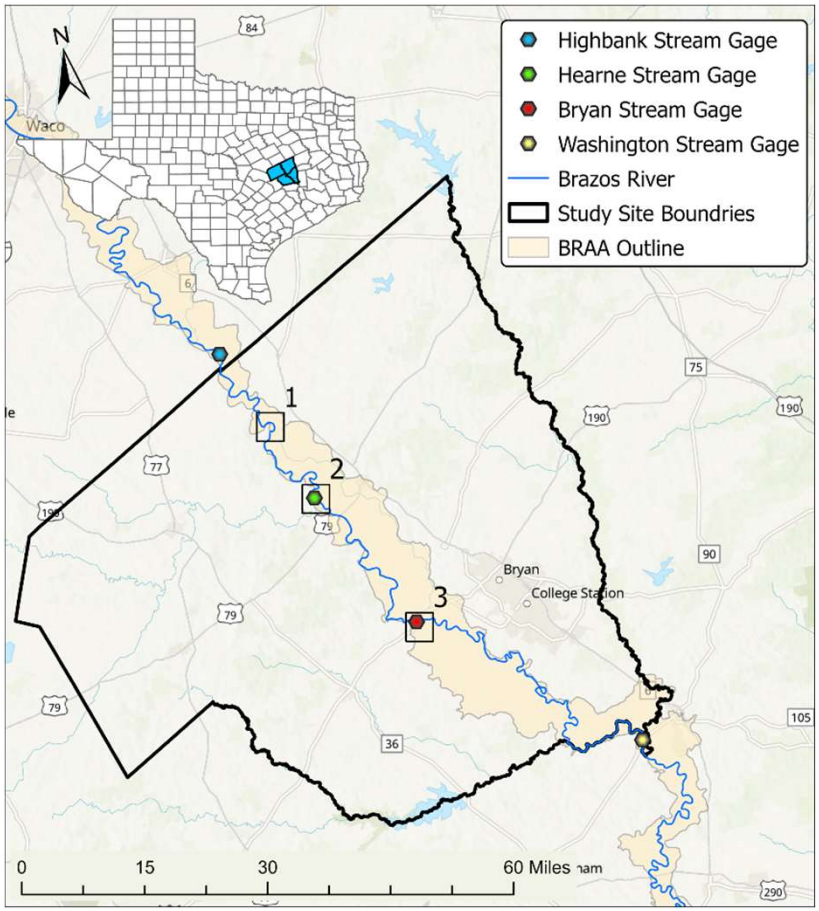



# Local Study Site: Hearne



# Local Study Site: Bryan




# Methods: Overview

Data Science

River Sampling

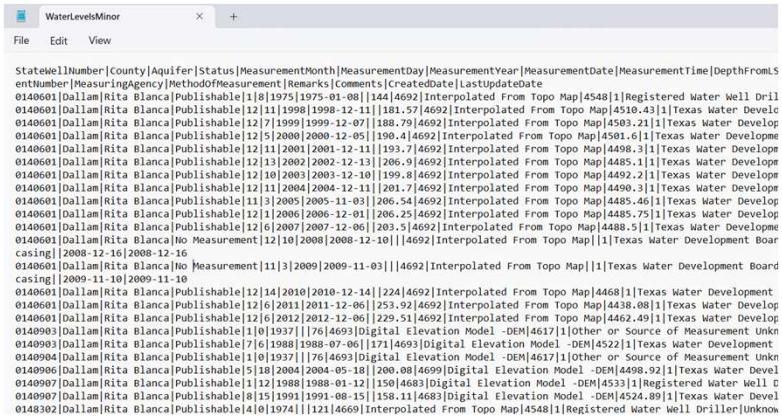
Groundwater Sampling

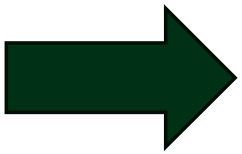
# Methods: Data Science

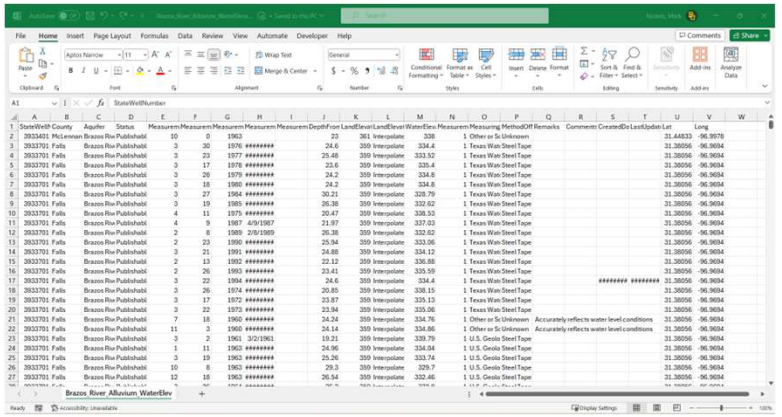
Using data from:

- The Texas Water Development Board's (TWDB) Groundwater Database (GWDB)
  - Groundwater level
  - Groundwater quality
  - Drilling lithology
- Brazos Valley and Poast Oak Savana Groundwater Conservation Districts
  - Groundwater level
- Unites States Geological Survey's (USGS) National Water Information Service (NWIS)
  - River elevation
  - River discharge

# Methods: Data Science






**Data Cleaning Goals**

- Add Lat/Long information
- Remove questionable data
- Remove duplicates
- Reorganize for usability
- Narrow to only study site

**Analysis Goals**

- Historical river/aquifer interactions
- Historical groundwater flow direction
- Historical water chemistry

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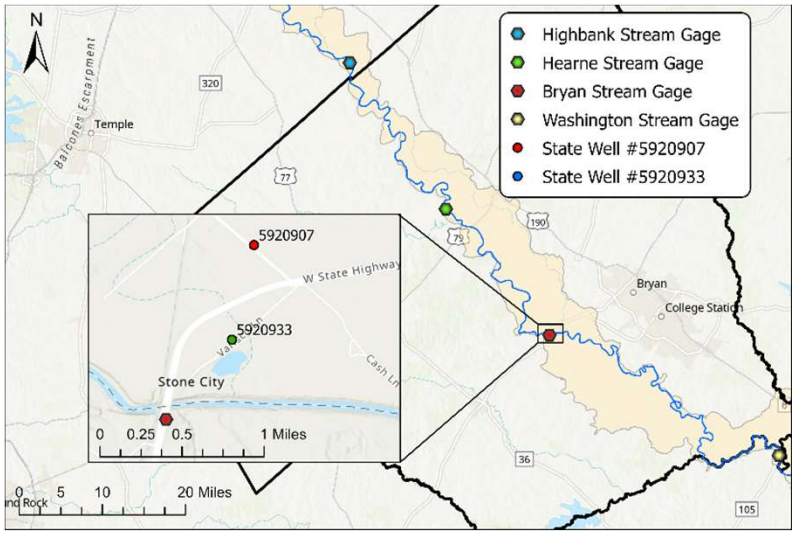


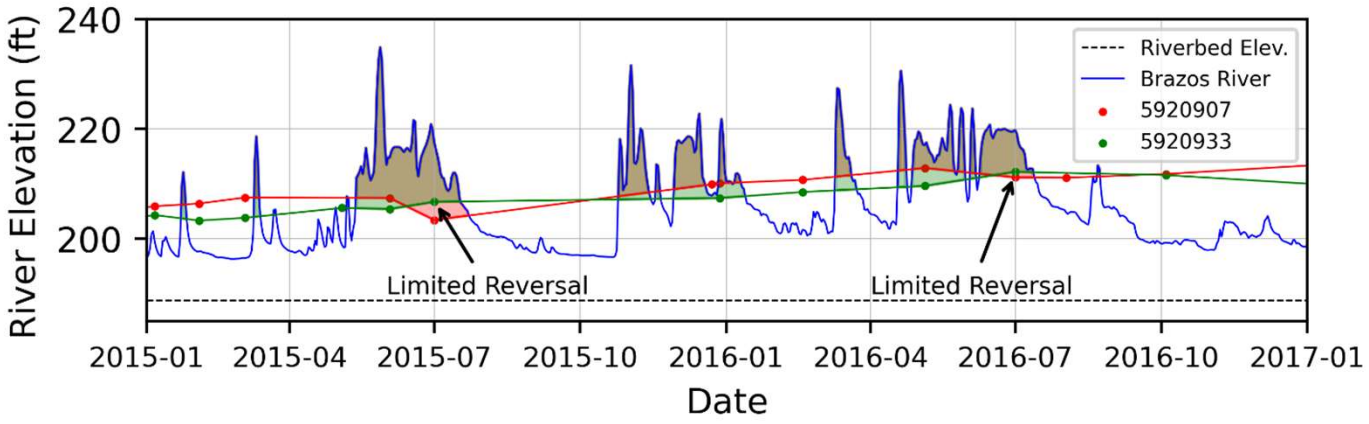


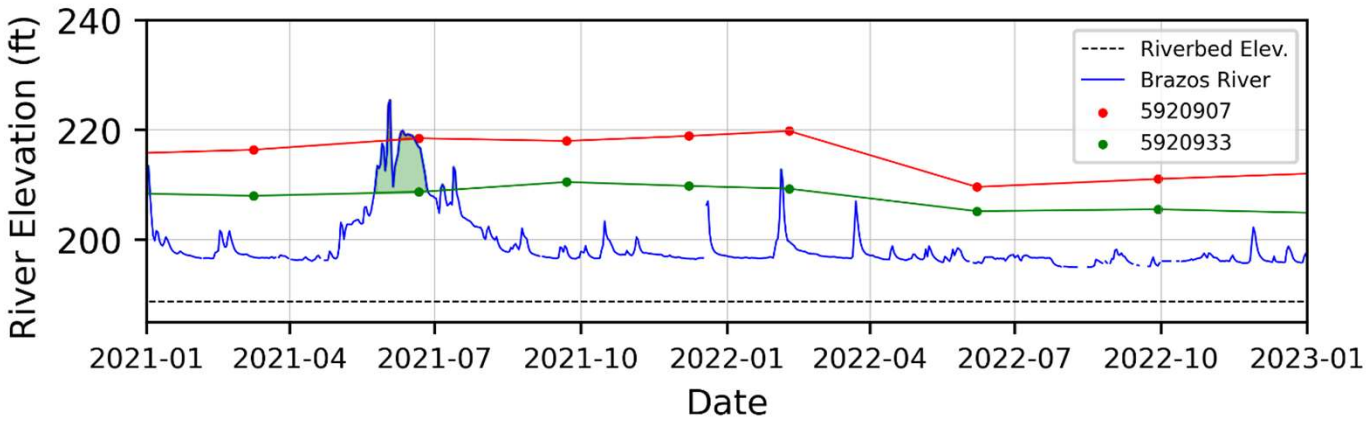

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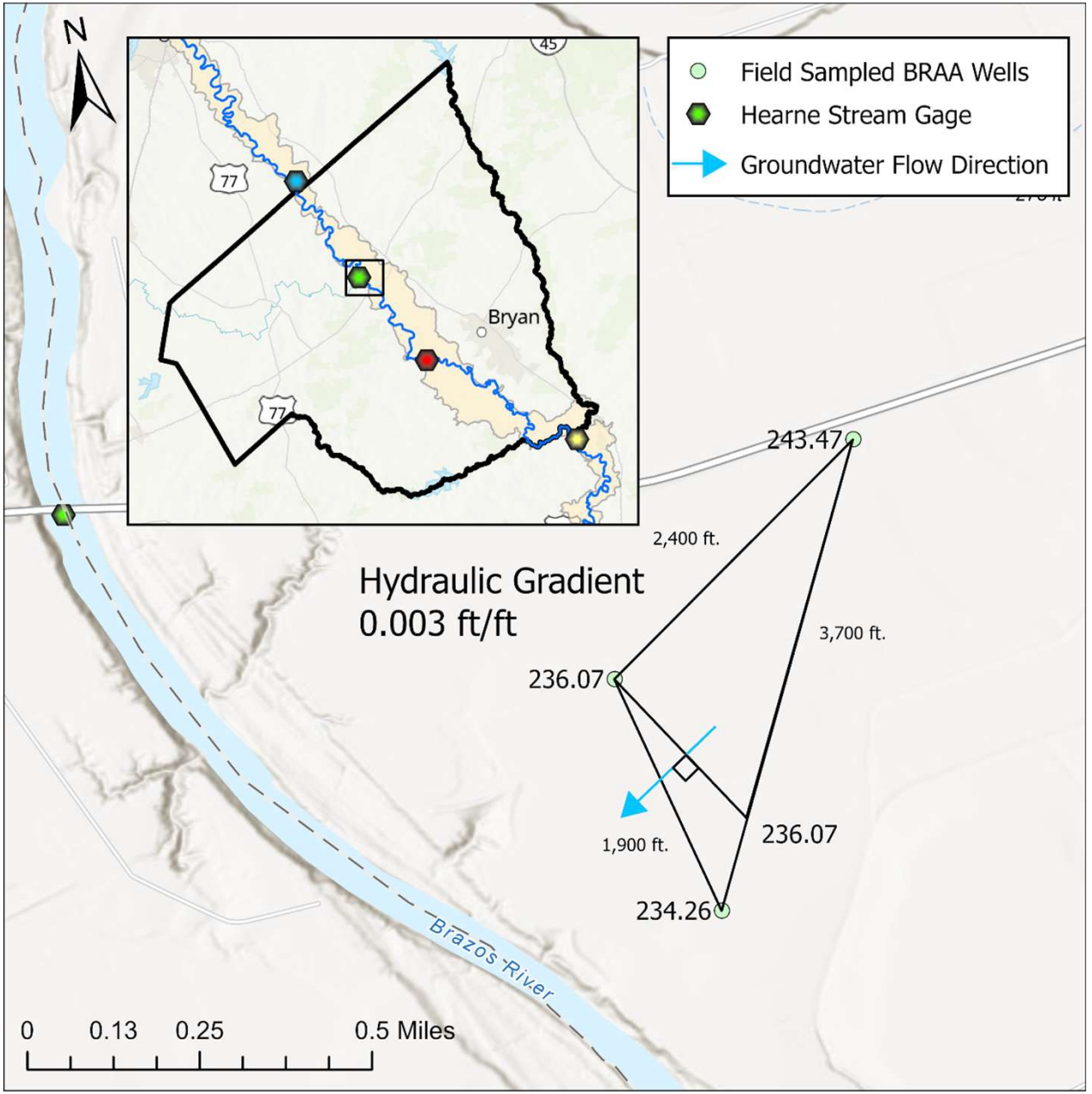

# Methods: Data Science

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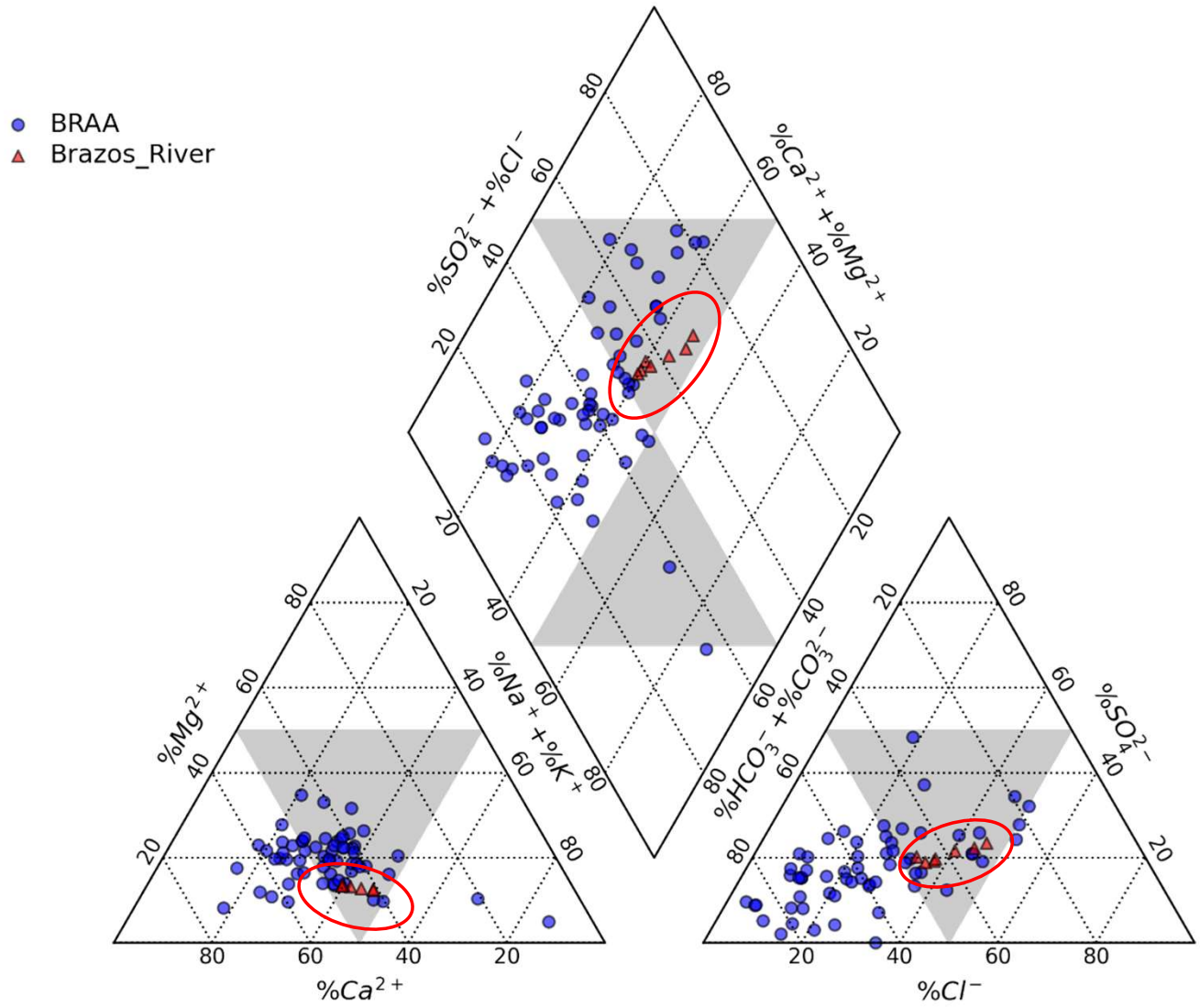
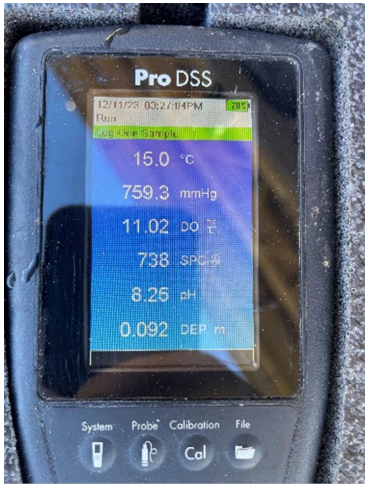


# Methods: River Sampling

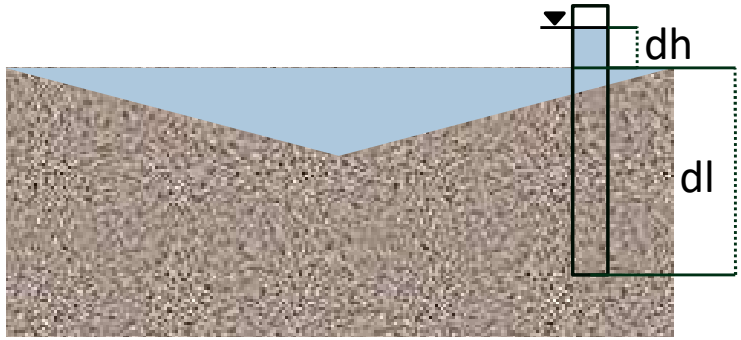
At each location:

- Water chemistry samples
  - Ionic chemistry
  - Isotope
- Field measurements
  - Temperature
  - Dissolved Oxygen (DO)
  - Specific Conductance (SpC)
  - pH
- Field alkalinity titrations

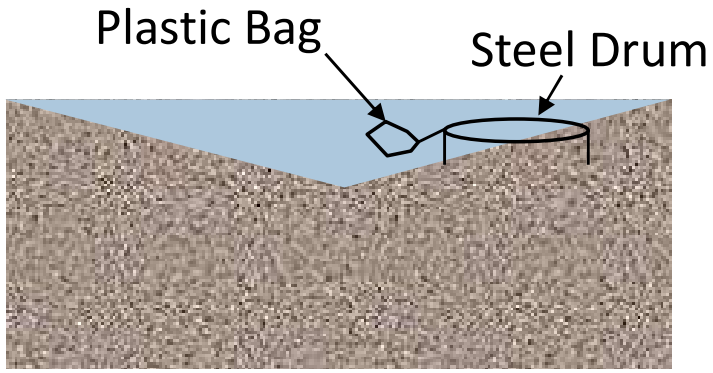



# Methods: Riverbank In/Out Flow

- Mini-Piezometers
  - Hydraulic gradient between the riverbed sediment and the river



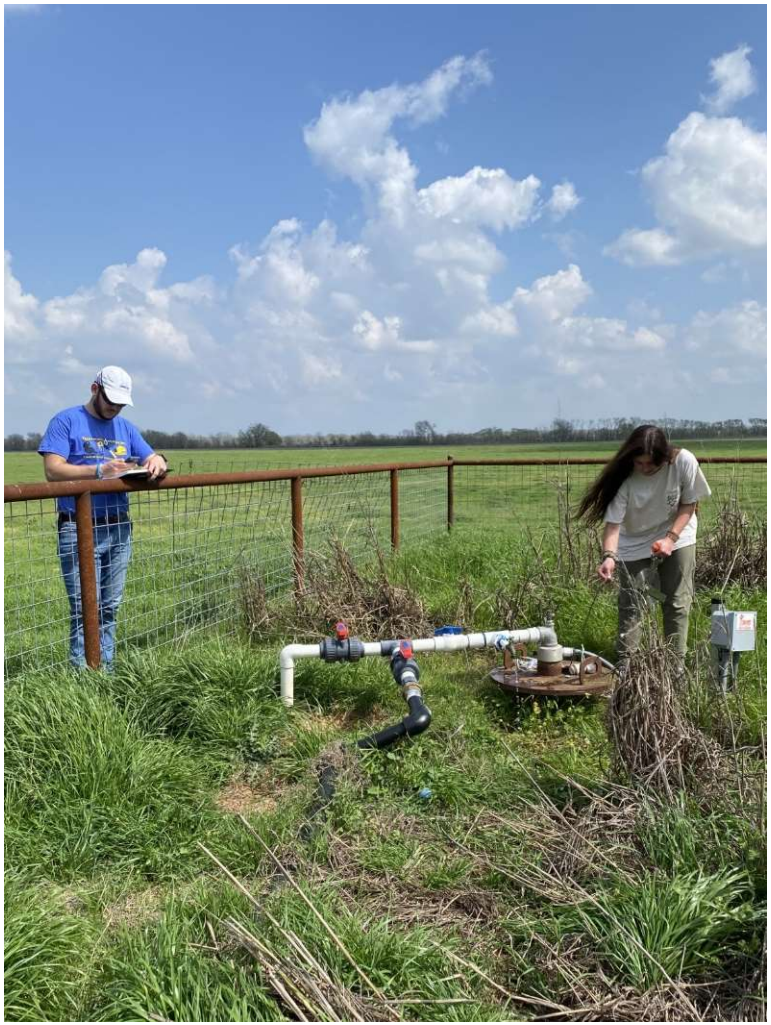

- Seepage meters
  - Flow into or out of the riverbed sediments



# Methods: Groundwater Sampling

At each location:

- Water level
  - Sonic and steel tape/E-Line
- Water chemistry samples
  - Ionic chemistry
  - Isotope
- Field measurements (bucket flow cell)
  - Temperature
  - Dissolved Oxygen (DO)
  - Specific Conductance (SpC)
  - pH
- Field alkalinity titrations



# Data Collected

- December river trip
  - 7 locations with ionic, isotopic and field data
- March sampling trip
  - 52 wells sampled for water level in pairs (Vivian's study)
  - 11 wells sampled for water quality

# Data Collected: River Chem.

| Sample_ID | As | Ca | Cl | DO | Fe | HCO3 | K | Mg | Mn | Na | NO3 | pH | SO4 | SpC | Temp |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R1 | 0.0021 | 67.6 | 112 | 10.93 | 0 | 129 | 7.22 | 12.4 | 0.0078 | 83.5 | 1.16 | 8.52 | 77.9 | 732 | 13.5 |
| R2 | 0.0022 | 68.3 | 125 | 10.63 | 0.1058 | 165 | 6.74 | 12.7 | 0.0087 | 85.1 | 0.85 | 8.29 | 86 | 782 | 13.7 |
| R3 | 0.0022 | 71.6 | 109 | 11.02 | 0 | 177 | 6.8 | 12.9 | 0.0129 | 79.5 | 0.99 | 8.26 | 79.6 | 738 | 15 |
| R4 | 0.0022 | 77.9 | 103 | 10.68 | 0 | 207 | 7.31 | 13.7 | 0.0174 | 72.1 | 2.1 | 8.28 | 72.5 | 742 | 15 |
| R5 | 0.0023 | 81.9 | 111 | 11.14 | 0 | 220 | 7.6 | 14.6 | 0.0086 | 81.6 | 2.04 | 8.37 | 79.5 | 760 | 11.3 |
| R6 | 0.0023 | 81.2 | 106 | 11.61 | 0 | 232 | 7.46 | 14.5 | 0.0088 | 75.6 | 1.98 | 8.61 | 75.9 | 796 | 13.2 |
| R7 | 0.0024 | 74.8 | 85.9 | 10.6 | 0 | 207 | 6.96 | 12.9 | 0.0088 | 68.5 | 1.26 | 8.74 | 70.9 | 679 | 11 |

# Data Collected: Aquifer Chem.

| Site | Aquifer | HCO3 | Cl | SO4 | NO3 | F | As | Ca | Fe | Mg | Mn | K | Na | Water Elevation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BVOP-0279 | BRAA | 683 | 39.9 | 52.9 | <.1 | <1 | 0.001 | 169 | 6.91 | 34.5 | 0.6544 | 3.38 | 37.8 | 211.52 |
| BVR-3867 | BRAA | | 178 | 141 | 6.82 | <1 | 0.0011 | 109 | 1.57 | 21.5 | 0.4209 | 1.95 | 113 | 251.3 |
| BVR-2441 | Queen City | 322 | 22.5 | 107 | 0.31 | <1 | <.0005 | 1.87 | <.05 | 0.4095 | 0.0023 | 1.42 | 177 | 230.62 |
| BVR-1451 | Queen City | 544 | <5 | 32.1 | <.1 | <1 | <.0005 | 4.52 | <.05 | 0.9421 | 0.0044 | 1.3 | 238 | 255.62 |
| BVR-4730 | Queen City | 861 | 143 | 91.5 | <.1 | <1 | <.0005 | 7.33 | 0.0545 | 1.86 | 0.0064 | 2.91 | 448 | 208.92 |
| BVDO-0019 | Queen City | 993 | | | | | | | | | | | | 218.34 |
| BVR-0202 | Queen City | 561 | | | | | | | | | | | | 236.74 |
| BVR-0985 | Simsboro | 464 | | | | | | | | | | | | 149.78 |
| BVR-0242 | Simsboro | 390 | | | | | | | | | | | | 175.31 |
| BVHU-1070 | Simsboro | | 188 | 120 | <.1 | <1 | <.0005 | 2.48 | 0.0641 | 0.5312 | 0.0067 | 0.0591 | 2.97 | 242.04 |
| BVR-0841 | Sparta | 627 | 35.6 | 411 | <.1 | <1 | <.0005 | 6.48 | 0.0637 | 1.64 | 0.0087 | 2.74 | 414 | 213.54 |

*Some data is still being processed by the lab.

# Timeline

| Task | Fall '23 | Spring '24 | Summer '24 | Fall '24 | Sprin '24 |
|---|---|---|---|---|---|
| Literature Review | | | | | |
| River Sampling | | | | | |
| Aquifer Sampling | | | | | |
| Data Analysis | | | | | |
| Report and Thesis Composition | | | | | |

# Acknowledgements


- Alan Day, Brazos Valley GCD
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- Dr. Joe Yelderman, Baylor University


# Questions

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