



Geochemical Analyses of Base Metals in Sediments and Stream Water Black Cypress Bayou, Marion County, Texas

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Abstract

Black Cypress Bayou is a primary tributary of Caddo Lake watershed in eastern Texas. The watershed is underlain by Eocene-aged strata from the Wilcox and Claiborne groups, which represent transgressive/regressive shoreline fluctuations that deposited interbedded friable sandstones and mudstones. The Wilcox Group is of special interest because it contains lignite coal, which has a direct link to heavy metals in sediment and natural waters. Caddo Lake has been listed on the Texas Commission on Environmental Quality 303(d) list for impairment due to mercury in edible tissue since 1995 and Black Cypress Bayou has been listed for impaired waters due to elevated copper since 2010.

In July 2019, water and sediment samples from six locations along Black Cypress Bayou were analyzed for metal concentrations including Ca, Fe, Pb, Mg, Mn, Na, Zn, and Hg. Physiochemical parameters of water samples (temperature, pH, and conductivity) were recorded in the field; and later analyzed in the laboratory for cation/metals and anion concentrations. Sediment samples were collected along the stream banks, processed, and digested using EPA method 6010 for trace metal analyses and EPA 7471 for mercury analyses. Zinc and lead concentrations can be seen in **Figure 5**. Other metal concentrations were not detectable or within normal limits for the environment.

Study Area and Methods

Black Cypress Bayou is located in northeastern Texas near the city of Jefferson. The bayou begins in the southern portion of Cass County and flows southeasterly through Marion County (**Figure 1**). Six sediment and water samples were collected at various locations along Black Cypress Bayou. The pH, conductivity, and temperature of the water samples were measured at each site using an Oakton PCD 650 multi-meter probe (**Figure 2**). Water samples were analyzed at the SFA Soil, Plant, and Water Analysis Laboratory and sediment samples were processed by Pace Analytical.

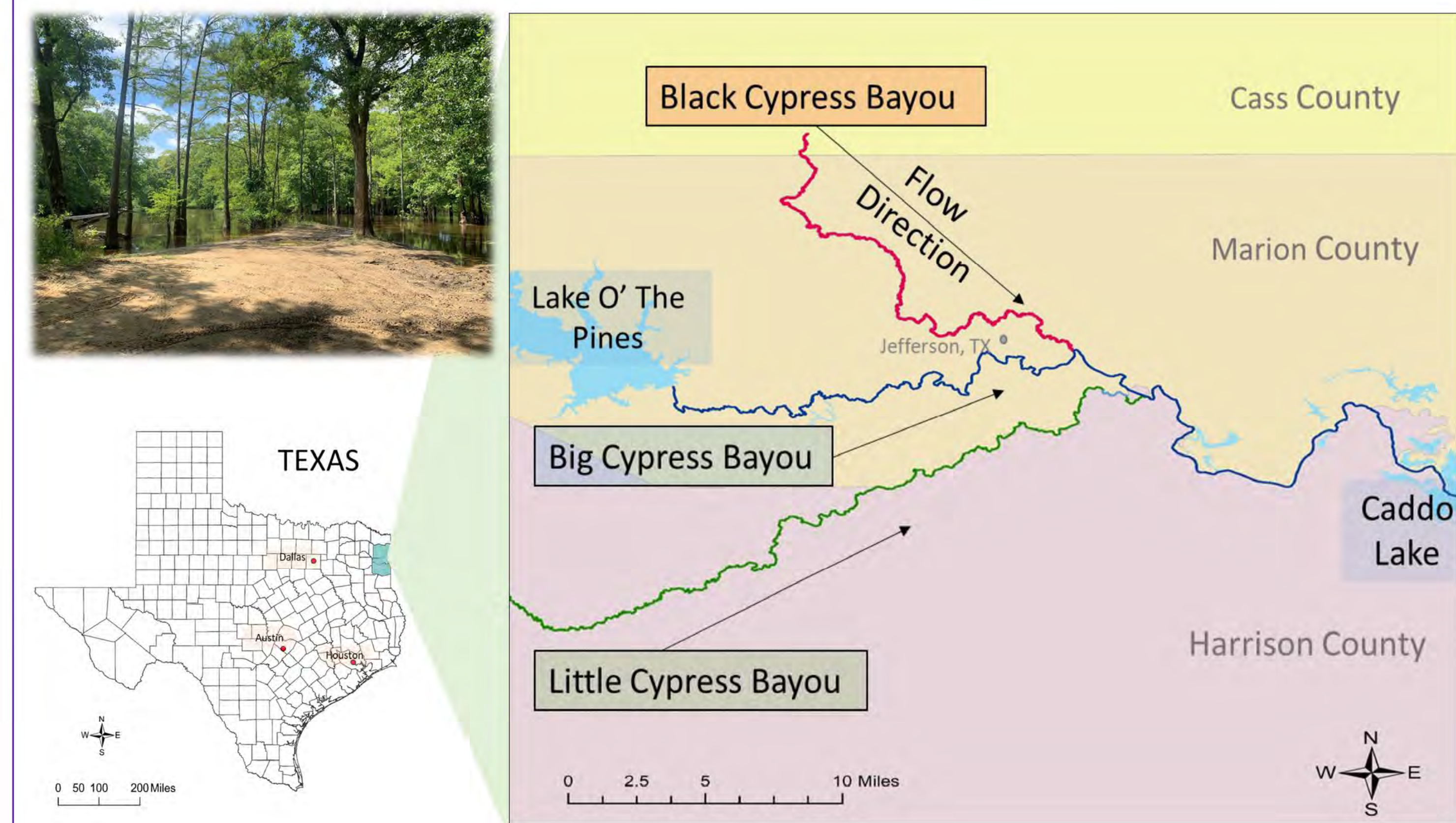


Figure 1. Map of Texas showing the location of the primary tributaries of Caddo Lake, including Black Cypress Bayou, Big Cypress Bayou, and Little Cypress Bayou. A photo taken at the confluence of Black Cypress Bayou with Big Cypress Bayou.

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Sample Area Map With Nearby Industrial Sites and Railroads

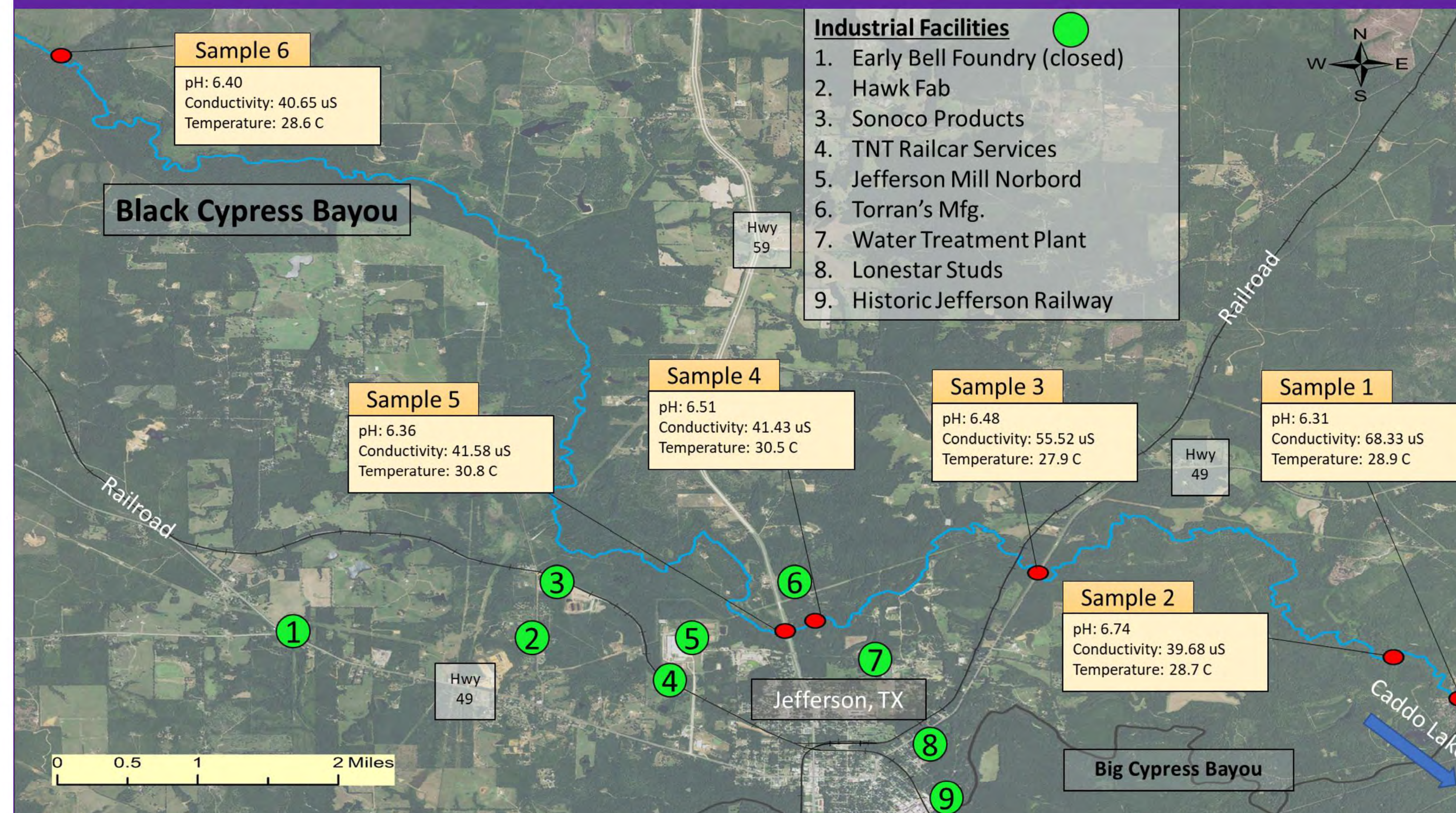
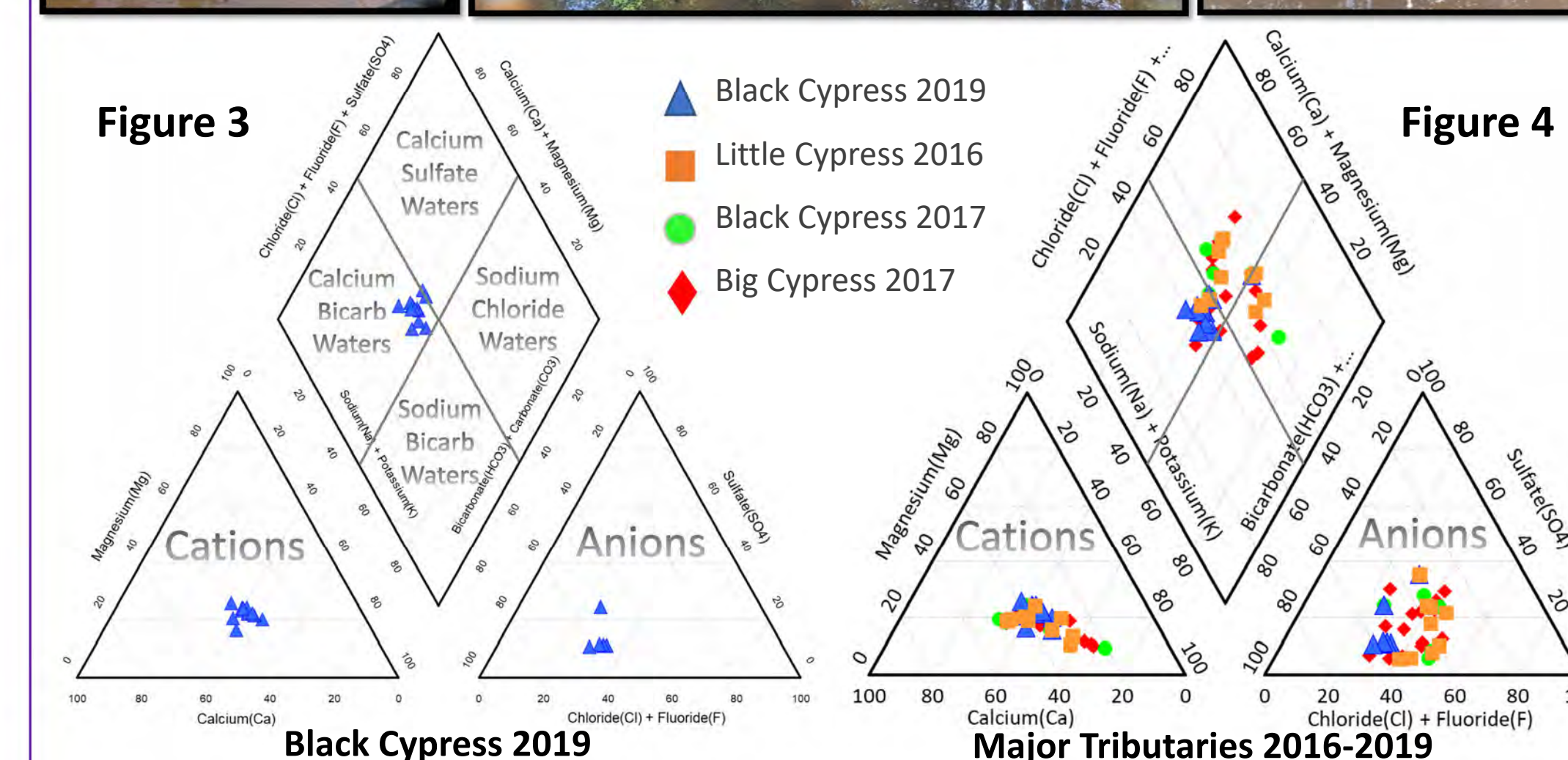
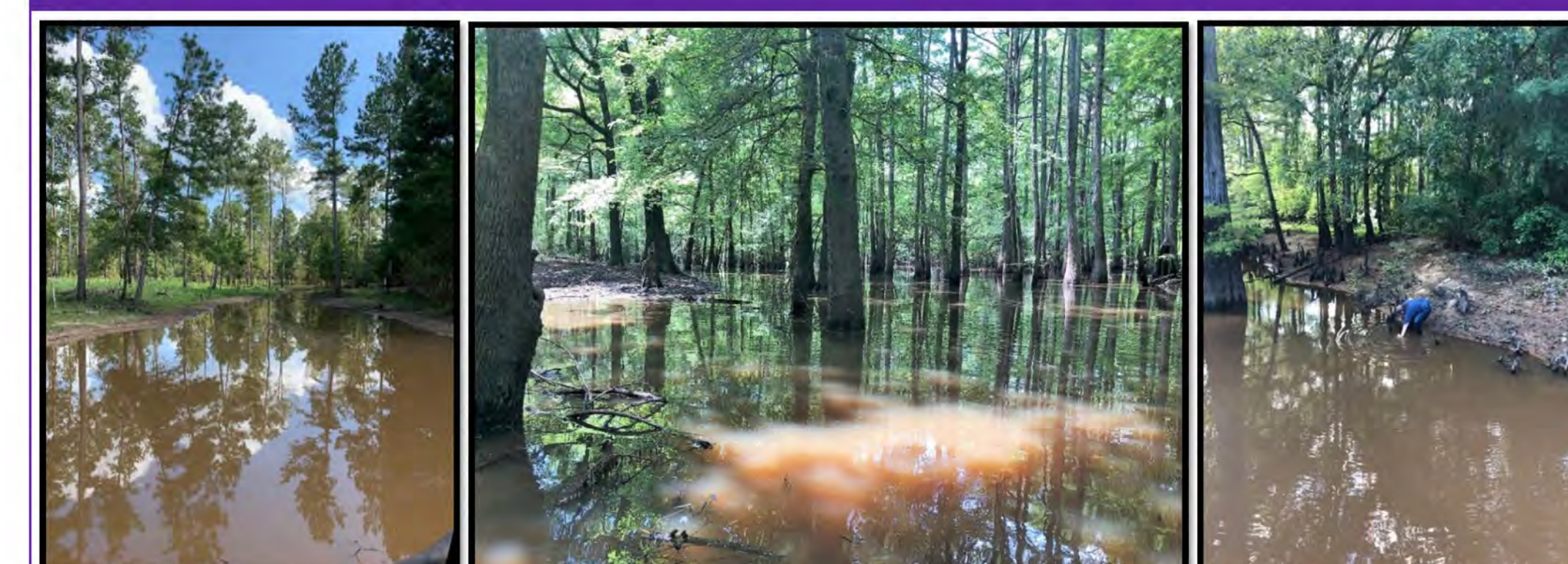


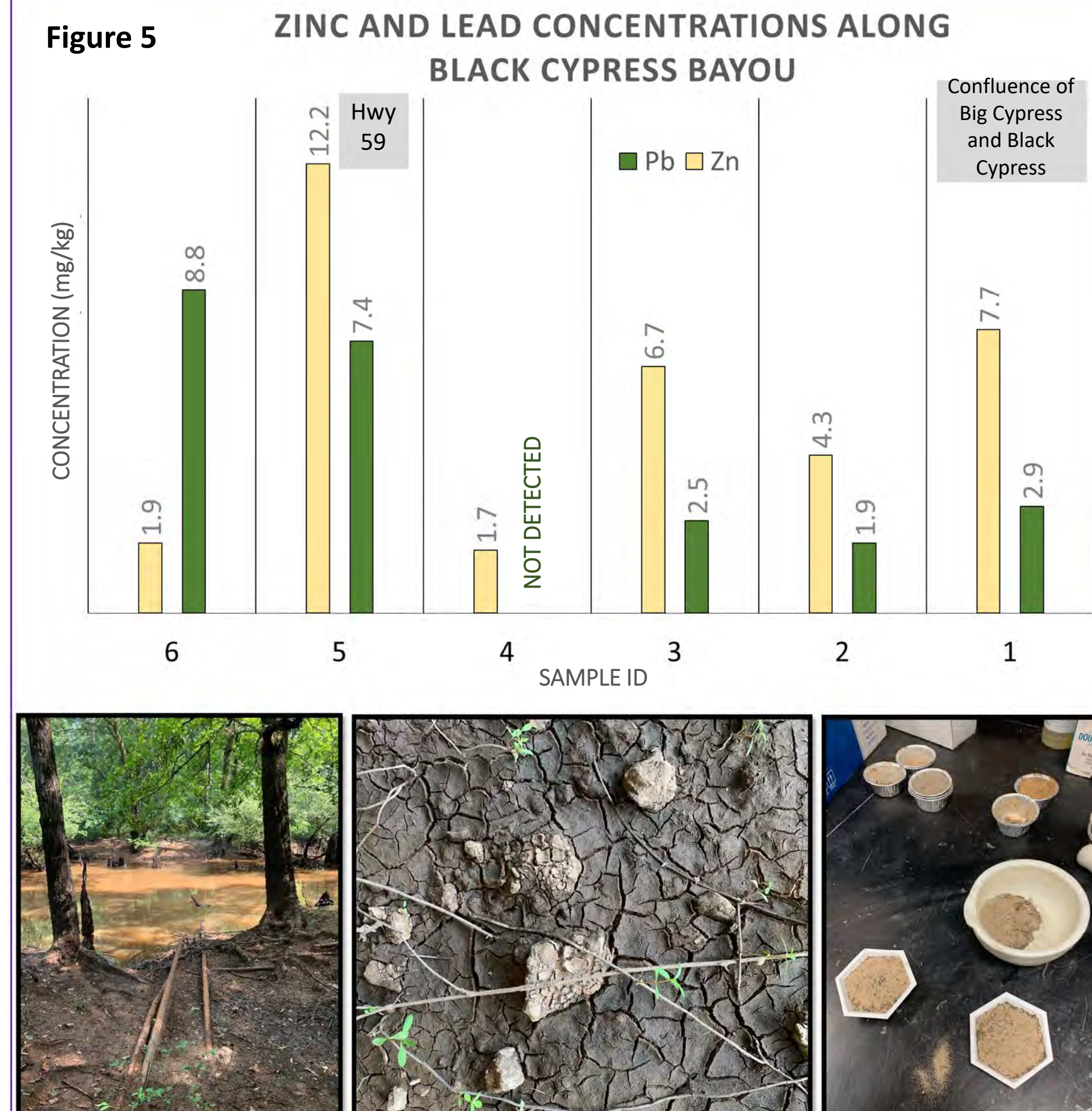
Figure 2: The red dots on the map reflect the six sites from which water samples and sediment samples were taken. The green dots represent the industrial buildings near the city of Jefferson, Texas with the corresponding names given in the legend at the top right of the map. At each location the pH, conductivity, and temperature are shown in the boxes below each sample.

Water Sample Data



Piper plot diagram for Black Cypress Bayou, **Figure 3**, shows $\text{Ca}(\text{HCO}_3)_2$ waters which is common for shallow, fresh waters. Our findings are consistent with previous data, see **Figure 4**.

Sediment Analysis



Particle Size Analysis



Figure 6: Sieve with sediment before and after. Each sample was put through a Gilson Model SS-15 Sieve Shaker to identify the different grain sizes seen at each location, see **Figure 6**.

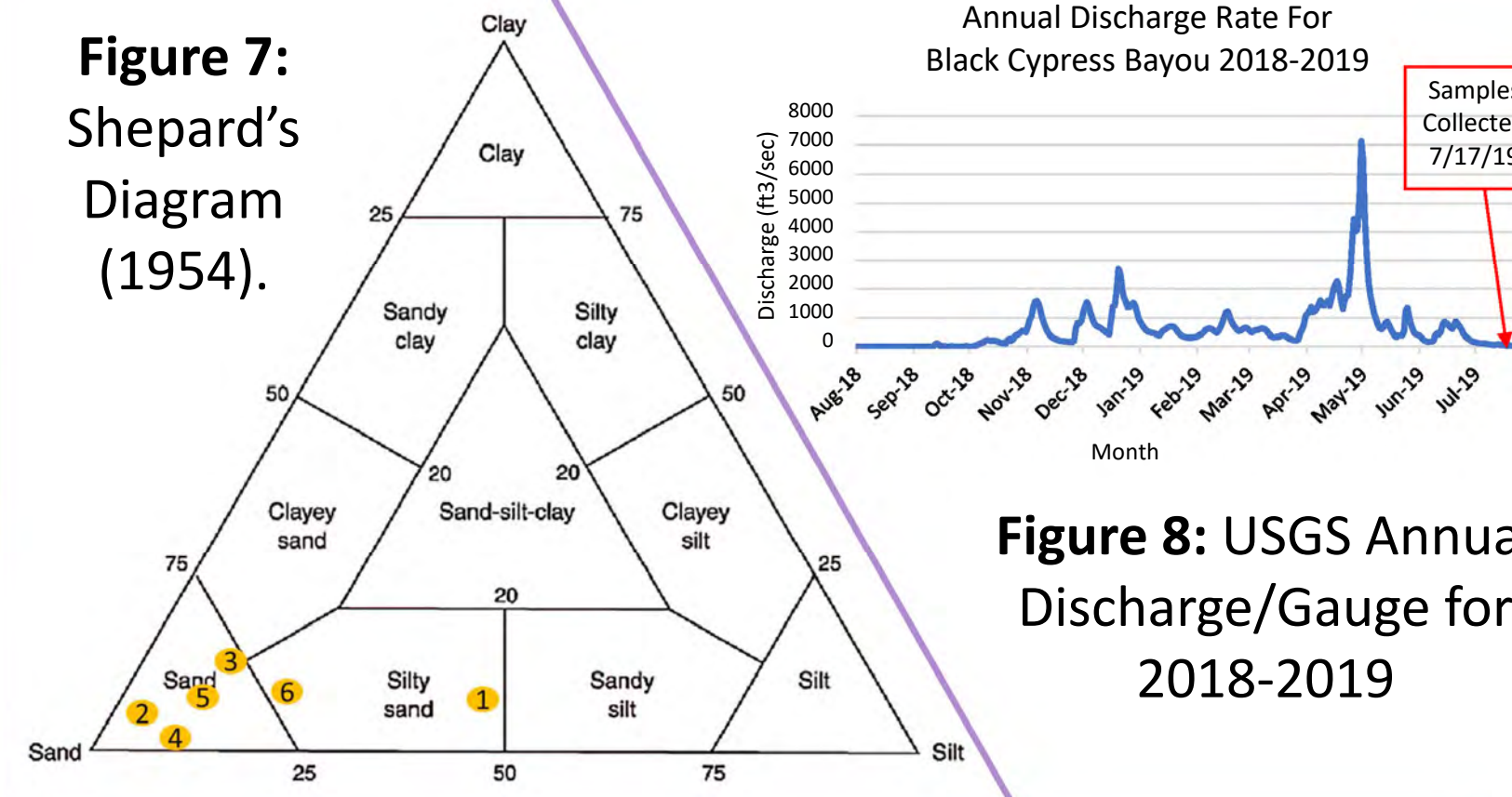


Figure 7 shows sand as the dominant particle size, indicating a slow moving body of water. Seasonal variation in annual discharge rate can be seen in **Figure 8**.

Results/Conclusions

Water sample data reported cations and anions associated with shallow, fresh water systems that correlate with previous studies. Chemical analyses of stream sediments reported Ca, Mg, Na, Mn and Fe concentrations within normal limits for sediments associated with the Wilcox and Claiborne strata. Although the Caddo Lake watershed is impaired for mercury in edible tissue, no Hg was detected in stream sediment samples. Previous studies indicated elevated Zn levels near the confluence of Black Cypress and Big Cypress Bayou. Laboratory analyses confirmed elevated Zn in Sample 5 near Highway 59; Zn remained elevated near the city of Jefferson and Big Cypress Bayou. Lead concentrations were elevated in Sample 6, and continued to drop as Black Cypress flowed towards the confluence with Big Cypress Bayou. Further research in the area may reveal the causes, anthropogenic or natural, for results seen in this study.

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