Occurrence of Pesticides in Soil and Sediment of the Indian Creek and Huntsville Spring Branch Watersheds of Northern Alabama

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Introduction

- The degradation of water resources is becoming a critical issue in Alabama.
- Currently, Alabama is ranked sixth on the EPA Toxics Release Inventory and has four of the ten most threatened river systems in the nation.

- The state's current inadequacies in water quality data call for a more focused effort to identify polluted waters in hopes of maintaining and protecting the integrity of its water resources (Tsegaye et al., 2006).

Introduction

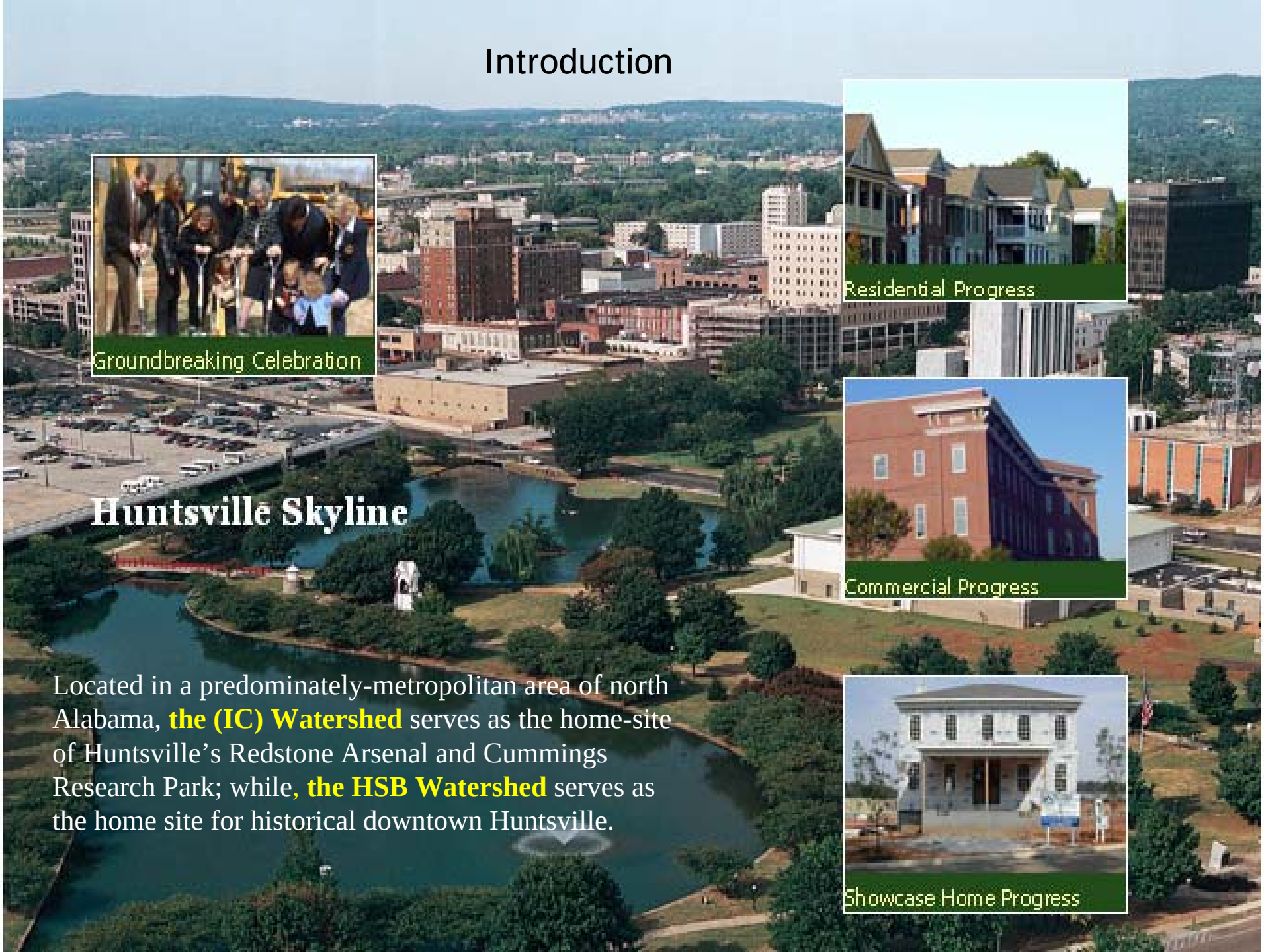
- Reducing pollutant loads in surface water implies identifying the pathways and sources responsible for the pollution.

- Many studies have linked the degradation of water quality by pollutants to changes in land use and land cover patterns.

According to Schueler (1995), a number of monitoring and modeling studies, show that pollutant loads increase significantly with changes to the natural environment, like urban development.

The most obvious manifestation of urban development is an increase in impervious zones.

Introduction



Located in a predominately-metropolitan area of north Alabama, **the (IC) Watershed** serves as the home-site of Huntsville's Redstone Arsenal and Cummings Research Park; while, **the HSB Watershed** serves as the home site for historical downtown Huntsville.

Indian Creek @ Providence Community (2005)

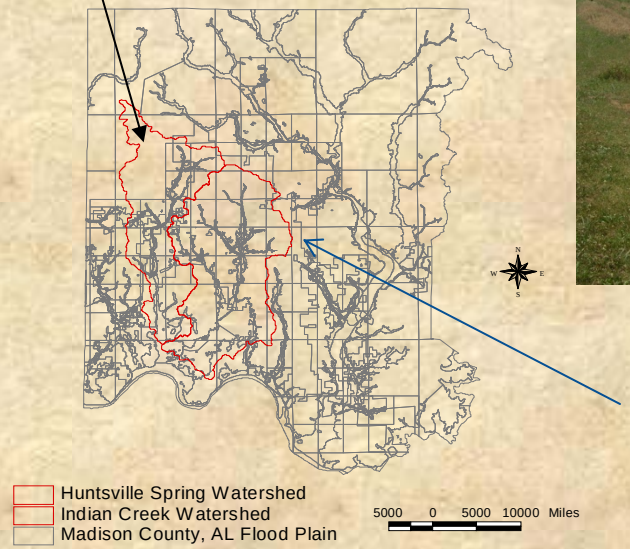
Indian Creek @ Patton Road

Indian Creek @ Providence Community (2006)

Introduction to the Study Area

Indian Creek

Fema Data

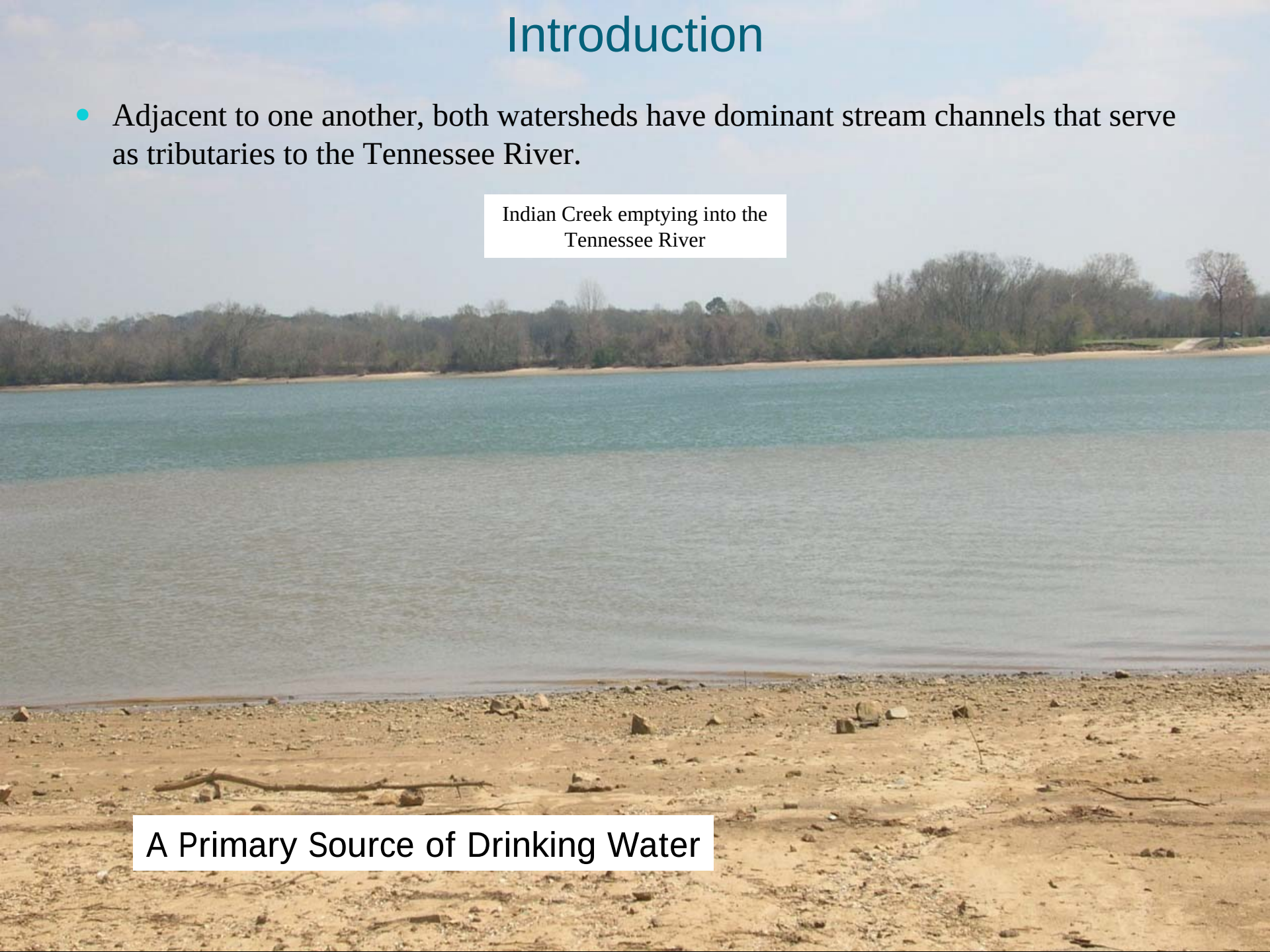


Huntsville Spring Branch

- Both watersheds are a part of the Wheeler Lake Basin and have historically been frequented with flooding and continue to be flood prone.
- This makes it difficult to pinpoint sources of point and non-point source pollution within these watersheds.

Introduction

- Adjacent to one another, both watersheds have dominant stream channels that serve as tributaries to the Tennessee River.

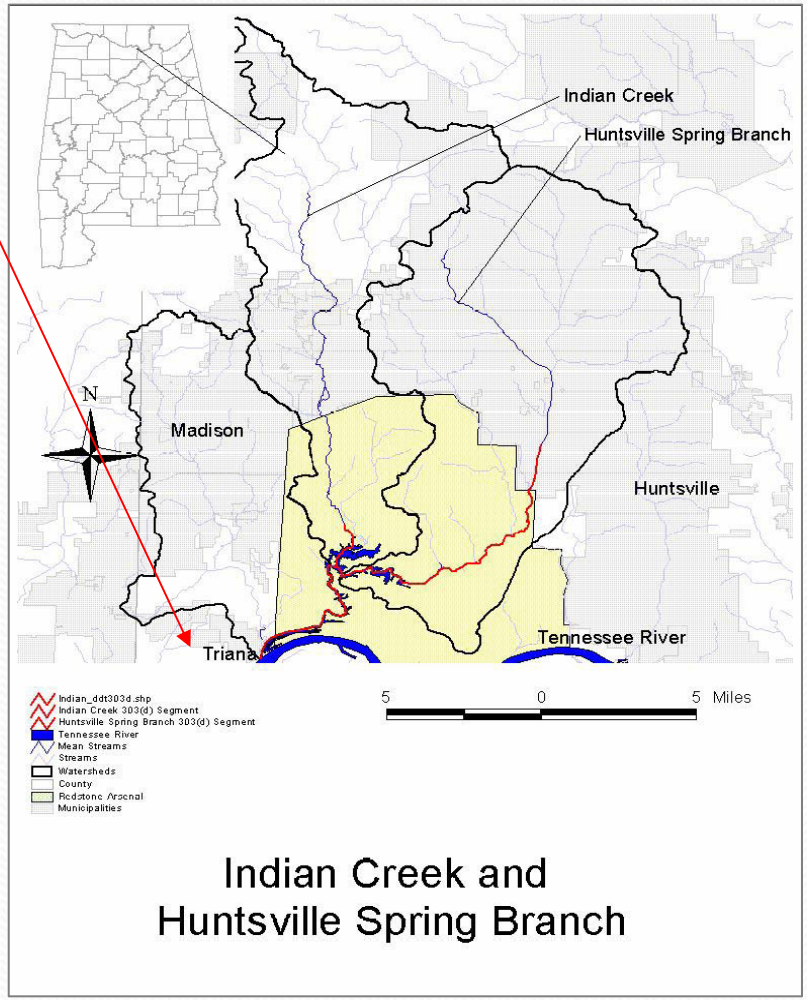


Indian Creek emptying into the Tennessee River

A Primary Source of Drinking Water

What else do they have in common?

Triana, Alabama



“Poor” BMP Implementation

Objectives

- To examine spatial and temporal variation of heavy metals
- To examine the distribution of pesticides (DDT and by-products) in soils and sediments along the stream banks
- To compare the pesticide concentration in two adjacent watersheds

Materials and Methods

“Taking a Look at the Study Areas”

Indian Creek

Site 1- (Indian Creek @ Kelly Springs Rd)

Site 2- (Indian Creek @Hwy 72)

Site 3- (Indian Creek @Hwy 20)

Site 4- (Indian Creek @ Martin Rd)

Site 5- (Indian Creek @ Tennessee River)

"Taking a Look at the Study Areas"

Huntsville Spring Branch

Site 1- (Big Spring @ Downtown Hsv)

Site 2- (Hsv Spring Branch @ St. Clair)

Site 3- (Hsv Spring Branch@ Drake Ave)

Site 4- (Hsv Spring Branch @ Johnson Rd)

Site 5- (Hsv Spring Branch @Patton Road)

Methodology of the Study

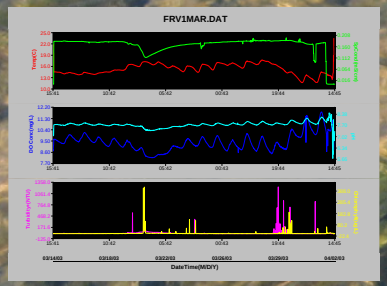
- Discrete grab samples are being drawn from midstream and within 15 to 20 inches of the stream's surface.
- A WaterMark Horizontal Polycarbonate Water Bottle with a messenger-activated release mechanism is being used to collect the water samples.
- The samples are be placed in 1-L LDPE (low density polyethylene) sample bottles, placed on ice, transported to the laboratory and stored at 4º C until analysis.
- The water samples are being examined employing methods taken from Standard Methods for the Examination of Water and Wastewater (Greenberg, et al., 2000).

YSI 6600 EDS - Extended Deployment System

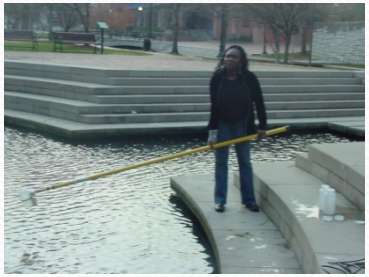
YSI 650 MDS Multi-parameter Display System

Physio-chemical Parameters

pH, temperature, chlorophyll, turbidity, and dissolved oxygen



Soil Sample Collection and Analysis

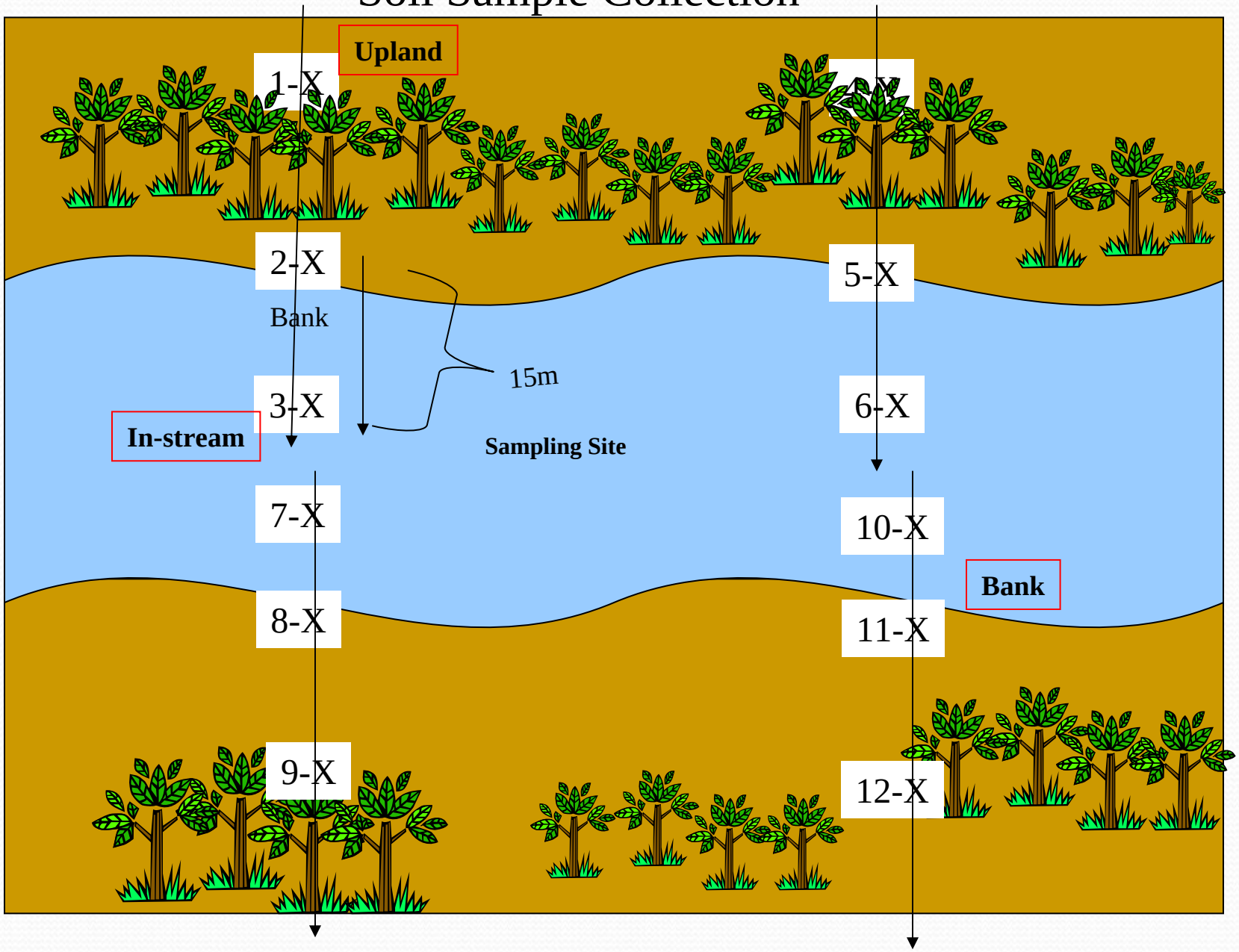


- Soil samples were collected from each of the sampling locations, with an exception of SB-DT, due to the unnatural setting.

- A total 108 soil samples were collected, stored in bags and refrigerated until analysis.

- All sampling locations were geo-referenced using a Garmin GPSmap 76CS guided system.

Soil Sample Collection



All locations were less than 10m apart

Composite soil samples were collected on transects, from upland (4), bank (4) and in-stream-depositional (4) areas.

Upland

Bank

In-stream Depositional Area

Methodology of the Study

- The upland and bank samples were collected using a soil auger and the in-stream depositional samples were collected using a hand scoop or swing pole sampler.

- In-situ measurements for soil surface and subsurface temperature were obtained using a Rayteck MiniTemp IR Thermometer and the Thermistor Thermometer Model 8402-10.

- Measurements for volumetric water content were obtained using a ML2x Theta Probe Type 1, with a HH2 data logger.

- Similar analysis will also be carried out for soils, to include anions, pesticides and heavy metals (Blake, 1986; Day, 1986; Greenberg et al., 2000)

Results and Discussion

Indian Creek

Table 1. Land use/ land cover characteristics.	
Forest	24.3%
Urban	27.7%
Agriculture	22.5%
Pasture	25.5%

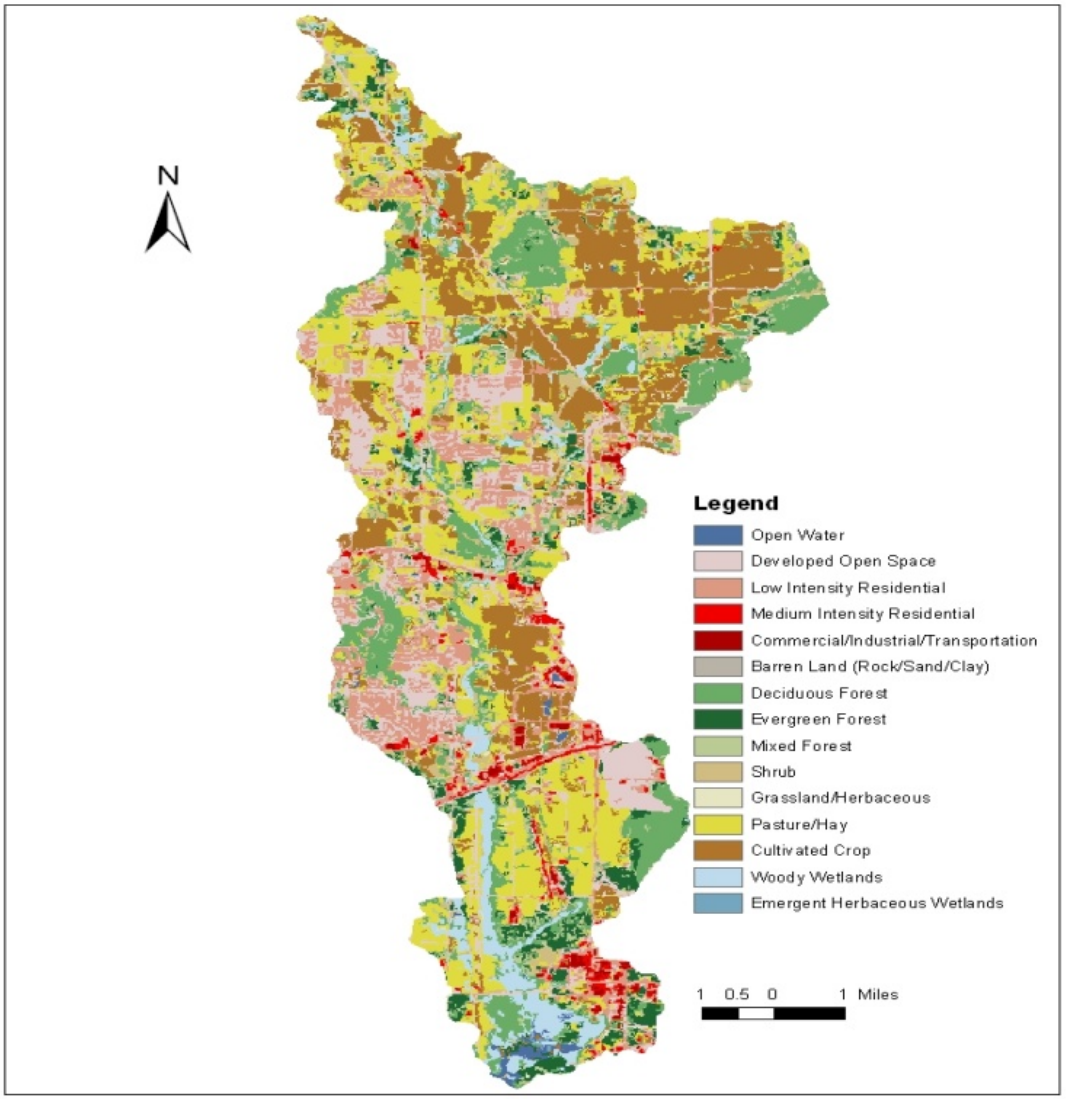
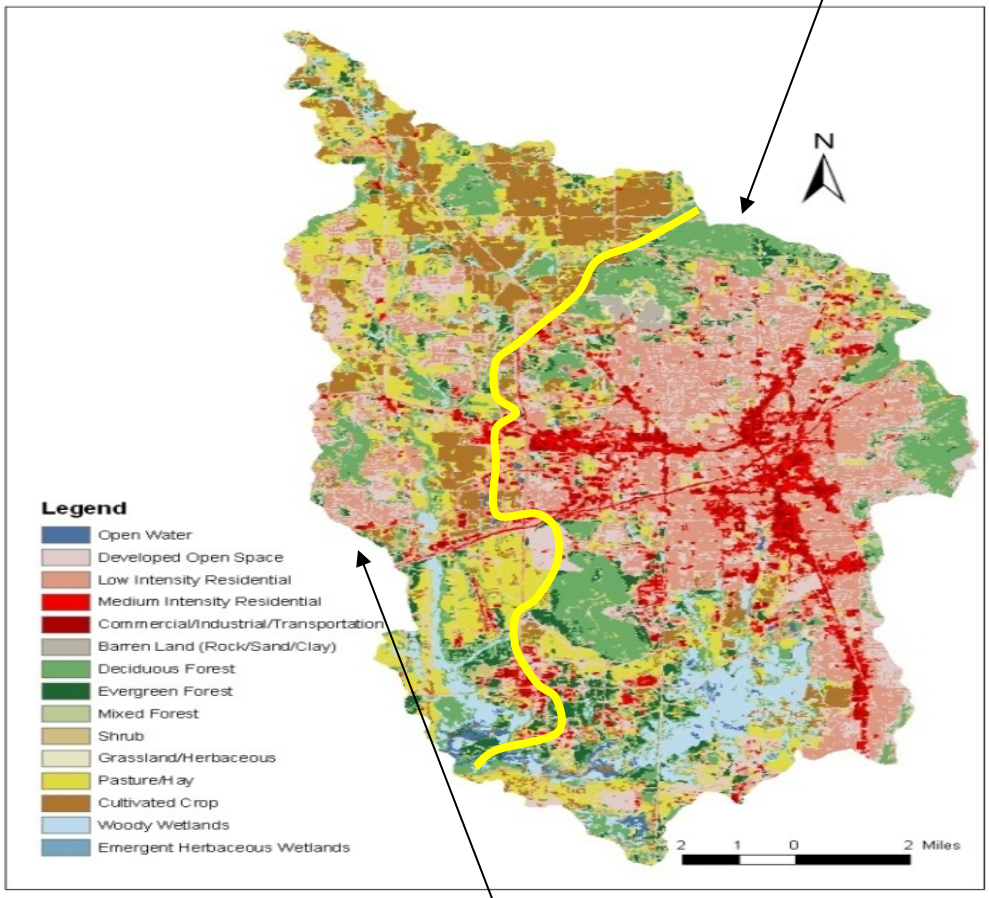


Table 2. Land use/ land cover characteristics.	
Forest	34.1%
Urban	46.9%
Agriculture	8.7%
Pasture	3.5%
Other	6.8%

Huntsville Spring Branch



Indian Creek

Indian Creek

Table 1. Summary statistics for heavy metal concentrations (µg/l) in surface water samples.

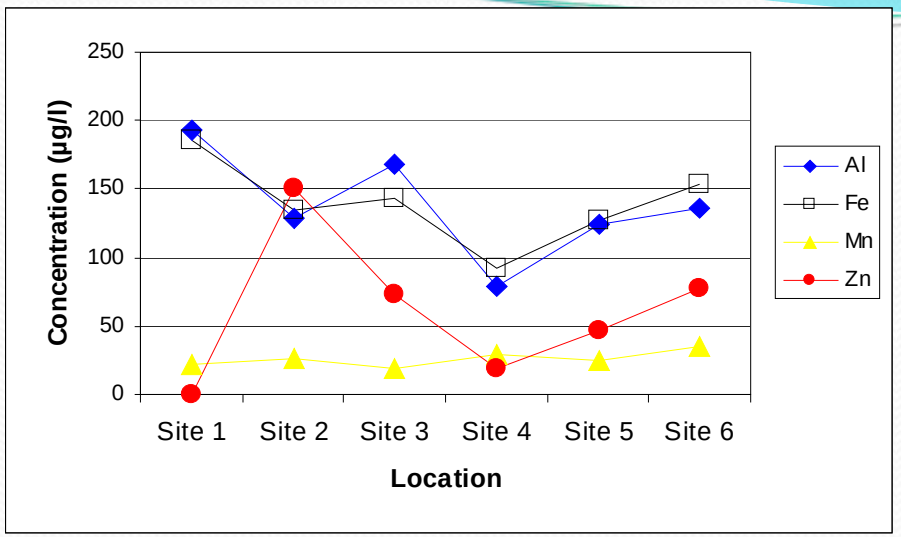
Variable	Mean	Std. Dev.	r^2	Pr > F	Min	Max	MCL/SS/MCLG (µg/l)
Al*	130.32	164.33	0.99	<.0001	ND	735.00	50-200µg/l --SS
Ni	1.22	1.74	0.90	<.0001	ND	10.00	100 µg/l------MCL
Cu	1.68	3.77	0.73	<.0001	ND	22.00	130 µg/l -----MCLG
Fe*	134.57	168.95	0.99	<.0001	ND	958.00	300 µg/l -----MCL
Mn*	27.72	48.29	0.30	NS	ND	590.00	50 µg/l -----SS
Cd	0.37	0.72	0.99	<.0001	ND	3.00	5 µg/l------MCL
As*	3.44	9.54	0.34	NS	ND	31 .00	10 µg/l------MCL
Pb*	1.84	4.17	0.48	<.0002	ND	27.00	15 µg/l------ MCL
Se*	2.32	5.42	0.99	<.0001	ND	31.00	50 µg/l-------MCL
Zn	74.46	197.40	0.78	<.0001	ND	986.00	5000 µg/l------SS

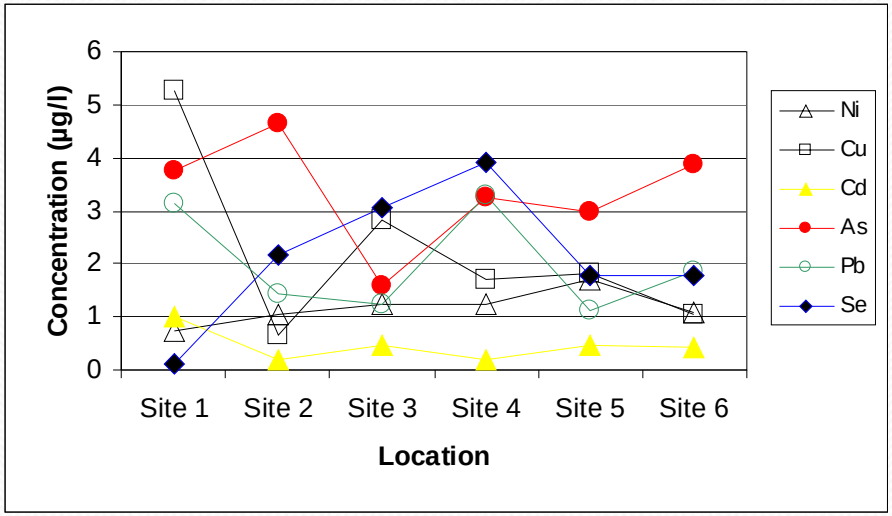
Key: **ND** = non-detectable concentration, **MCL** = Maximum Contaminant Level (the highest level of a contaminant that is allowed in drinking water). Observed heavy metal concentrations exceeding MCL values are represented by an *. SS = Secondary Standards (non-enforceable guidelines regulating contaminants that may cause cosmetic effects). MCLG = Maximum Contaminant Level Goal (non-enforceable levels of a contaminant in drinking water below, which there is no known or expected risk to health).

Huntsville Spring Branch

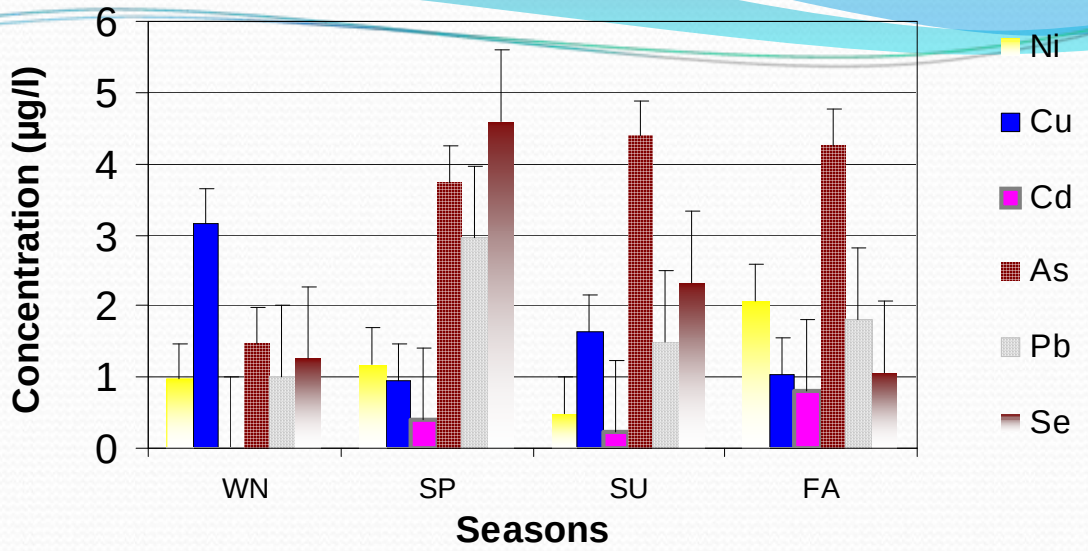
Table 3. Summary statistics for heavy metal concentrations (µg/l) in surface water samples of Huntsville Spring Branch, Madison County, AL.

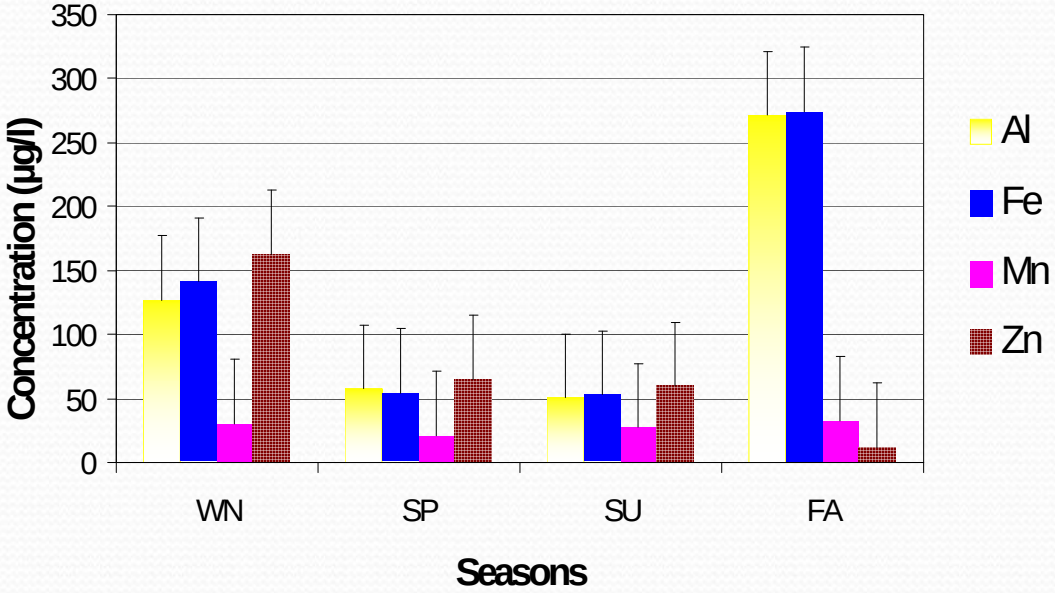
Metal	*Mean*	*Std. Dev.*	*Minimum*	*Maximum*	*MCL/SS (µg/l)*
Al*	85.38	160.39	ND	867.00	50-200µg/l ——SS
Ni	1.87	3.09	ND	22.00	100 µg/l——MCL
Cu	2.15	3.61	ND	20.00	130 µg/l ——TT
Fe*	86.69	149.39	ND	868.00	300 µg/l ——MCL
Mn*	24.89	44.34	ND	274.00	50 µg/l ——SS
Cd	0.23	0.56	ND	2.00	5 µg/l——MCL
As*	2.95	4.71	ND	23.00	10 µg/l——MCL
Pb*	1.18	2.52	ND	15.00	15 µg/l——MCL
Se	3.61	7.37	ND	37.00	50 µg/l——MCL
Zn	96.63	237.59	ND	1325.00	5000 µg/l——SS



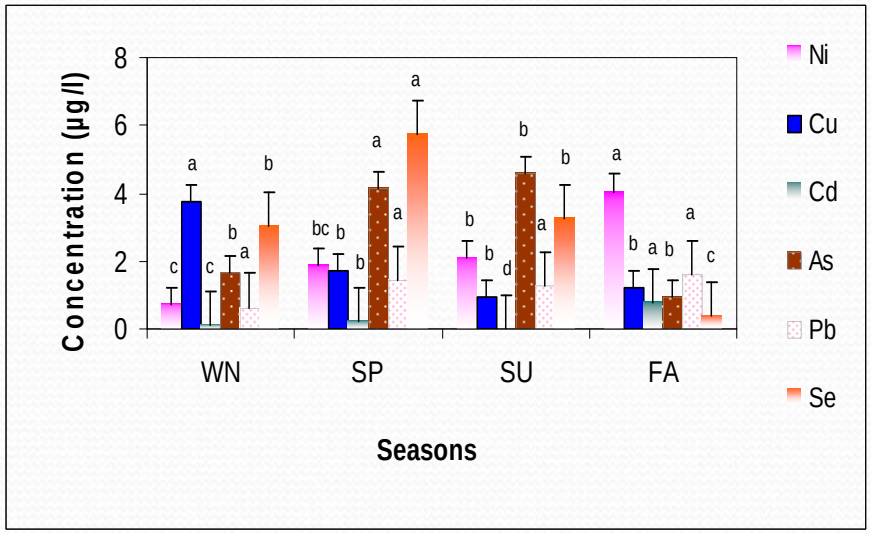


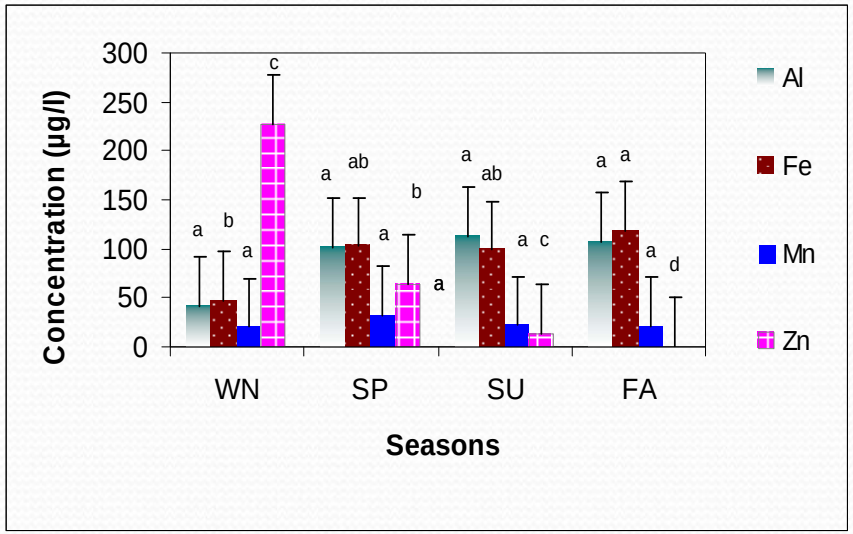
Figures 2 & 3. Site variation of heavy metal concentrations in Indian Creek, Madison County, AL, 2005-2006.



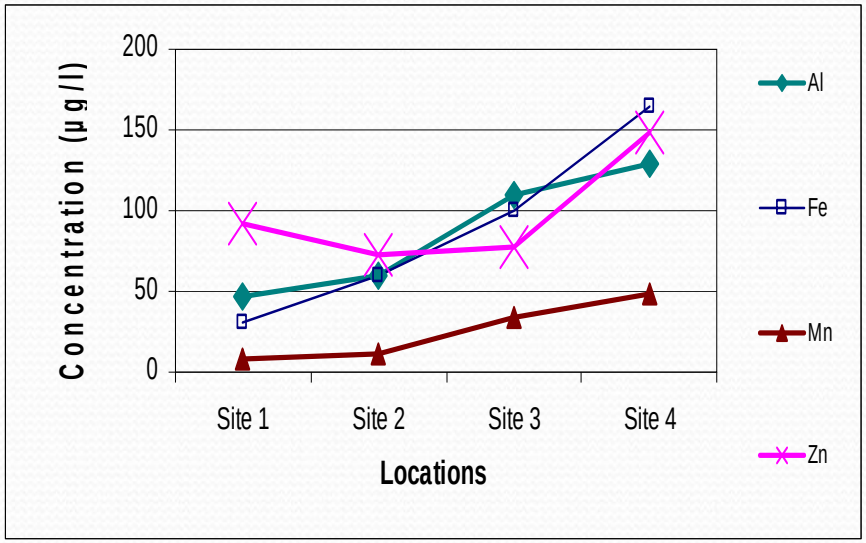


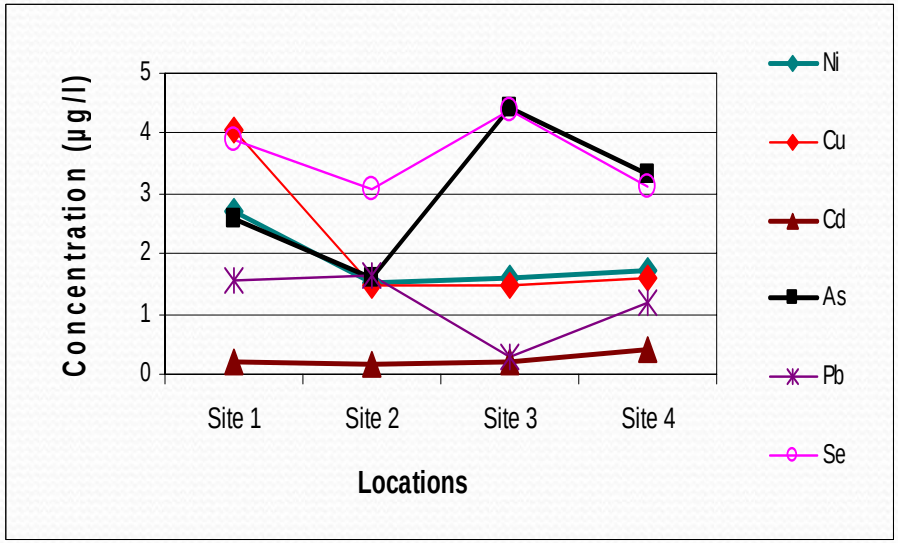
Figures 4 & 5. Seasonal variation of heavy metal concentrations (mg/L) in Indian Creek, Madison County, AL 2005-2006.





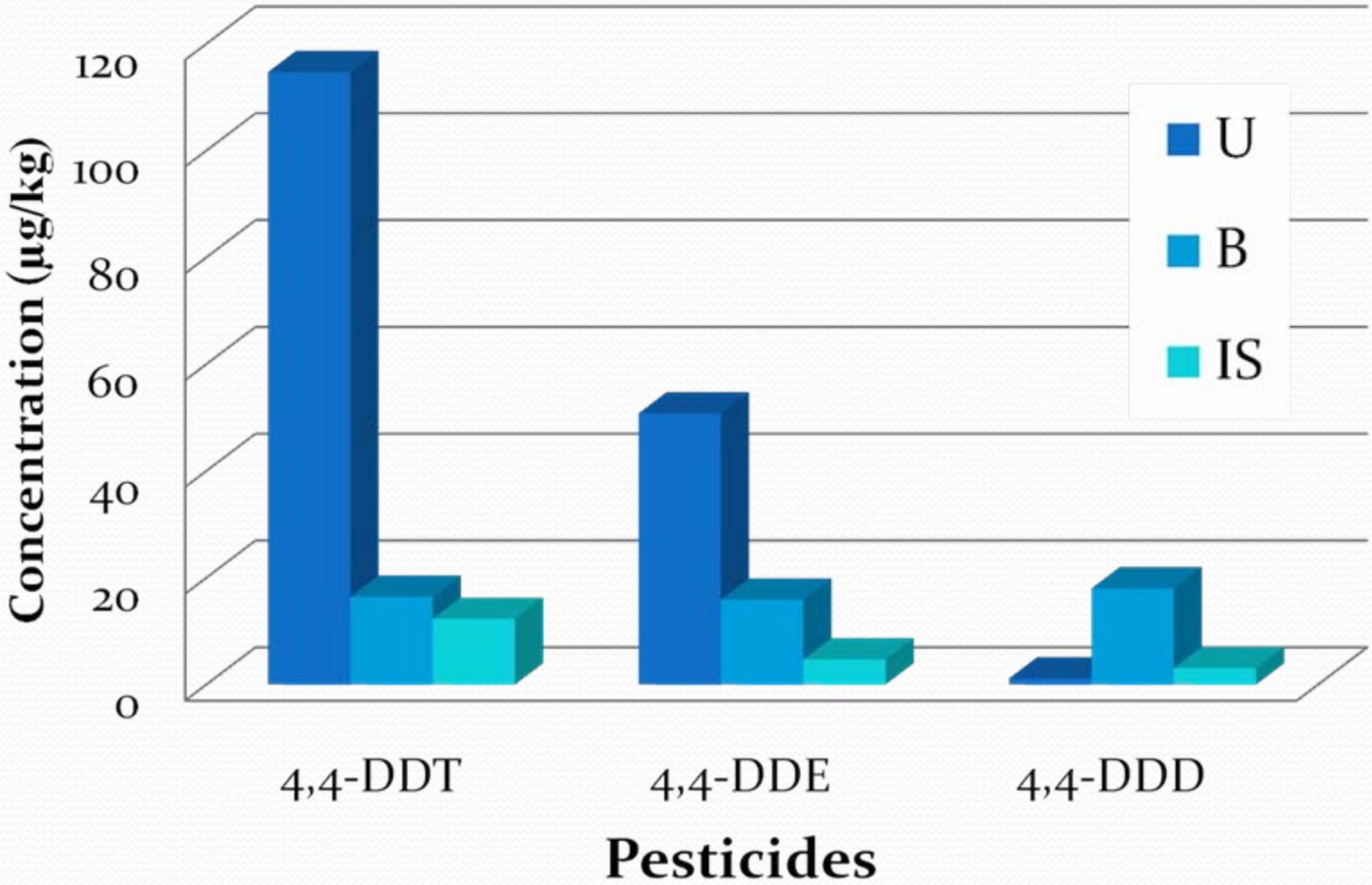
Figures.2a & b. Seasonal variation in metal concentrations for HSB, Madison County, AL



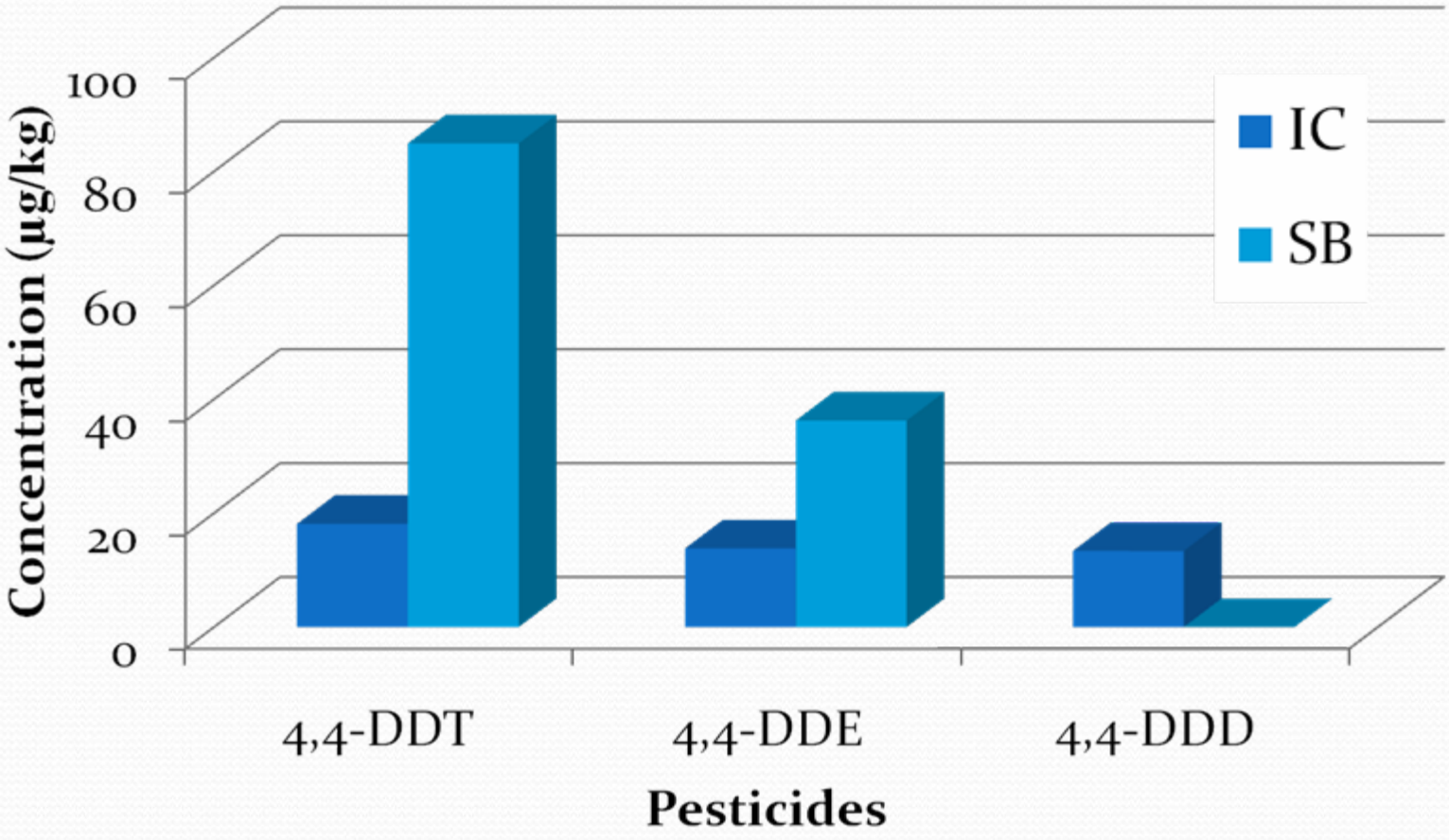


Figures. 3a & b. Spatial variation in metal concentrations for HSB, Madison County, AL

Average Distribution of DDT by Location



Average Distribution of Pesticides by Watershed



Summary

- There is a clear difference in spatial and temporal distribution of heavy metals within each watershed
- DDT concentration is higher in Upland and decreases in the Bank and In-stream sediments
- By-products of DDT (DDE and DDD) increases as DDT concentration decreases from Upland to Bank to In-stream
- The concentration of DDT and DDE are higher in SB compared to IC due to the land-use and cover