Comprehensive Water Quality Assessment and Database Development at Alabama A&M University

By

T. Tsegaye*, R. Ward, M. Wagaw,

L. Williams, W. Tadesse, K. Garner,

P. Okweye, A. Bohlman, and D. Spencer

Our Watersheds

Flint River | Indian Creek | Flint Creek

Streams and Rivers in our Watersheds

Water Quality Research at Alabama A&M University

- The water quality program at Alabama A&M University (AAMU) has progressively expanded our research, teaching, and service capacities in the last few years.

- In 2005, comprehensive water quality monitoring and modeling research was launched to evaluate surface water bodies of five watersheds in northern Alabama.

Cont'd

- Filed data collection was expanded throughout five watersheds:
  - Flint River
  - Flint Creek
  - Huntsville Spring Branch
  - Indian Creek
  - Sipsey Fork

Cont'd

- Five thrust areas in these water quality evaluation efforts are:
  - Bio-assessment of macroinvertebrates as bioindicators
  - Heavy metals
  - Pesticides and herbicides
  - Nutrients
  - Source tracking for pathogenic and non-pathogenic microorganisms

Cont'd

- Furthermore, this comprehensive database development also will evaluate the applicability of some of the most popular water quality modeling tools, namely AQUATOX, BASINs, AnnAGNPS, and SWAT.

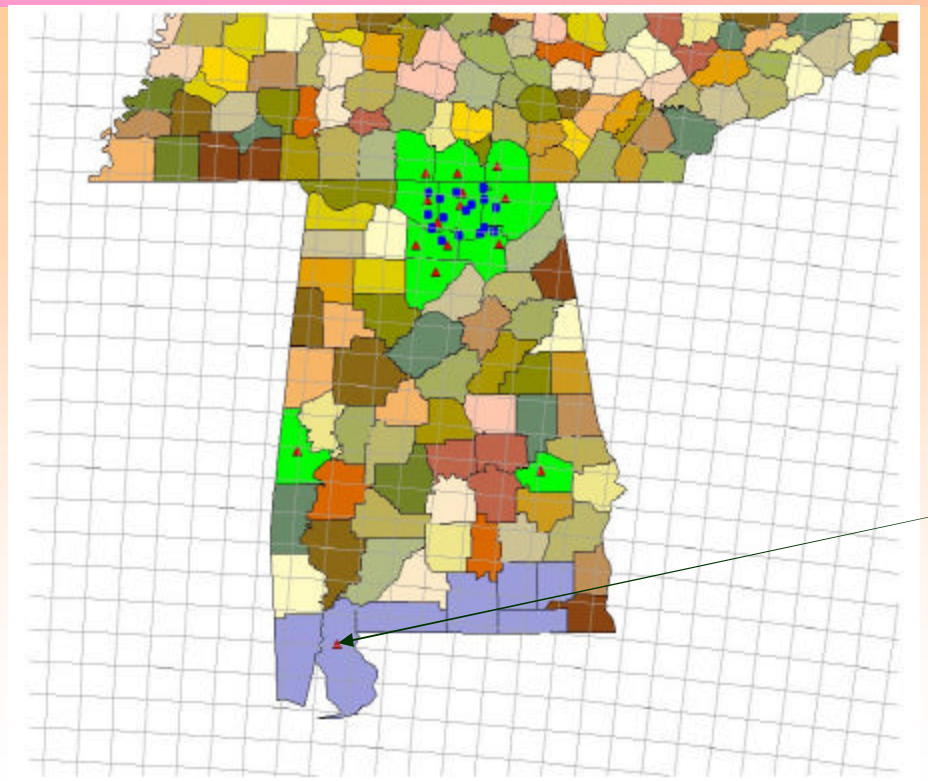
Cont'd

- Our database will eventually archive all necessary datasets such as remotely sensed, meteorological, hydrological, soil, nutrient, heavy metals, pesticides, micro- & macro-invertebrates, pathogenic and non pathogenic bacteria and viruses, to investigate the pollution trends and over all health of the aquatic ecosystem.

Database Development

ALMNet was established by Alabama A&M University in 2002

Alabama MesoNet



Weather station

Soil Profile station

Alabama
Madison
Limetone
Marshall
Morgan
Jackson
Cullman
Sumter
Macon

Tennessee
Franklin
Giles
Lincoln

ALMNet

- Equipped with state-of-the-art *in situ* sensors that continuously record
  - Precipitation
  - Relative humidity
  - Soil heat flux
  - Soil moisture
  - Solar radiation
  - Temperature (air & soil) and
  - Wind (speed and direction)
  - Depth of water table (selected sites)

Eddy Covariance Measurement of Energy Flux (CO_2 and Water Vapor) at AAMU in Hazel Green, AL

Cont'd

ALMNet - WATARS (East) - Microsoft Internet Explorer

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Weather

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Hydrology
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Wind

ALMNet

Sites:
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About
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SMEX '03

Other Stations

AWIS:
Choose...
NOAA:
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RAWS:
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Alabama A & M Univ.

AAMU
HSCaRS
USDA NRCS Soil Survey Office

Winfred A. Thomas Agricultural Research Station (East), Madison County, AL
Latitude: 34° 54' 6"
Longitude: 86° 32' 19"
Elevation: 625 feet

Alabama MesoNet

Mr. Nall, Manager

For more information about this weather station click here. This site is part of the USDA NRCS SCAN network, and is operated in cooperation with the Alabama A & M University HSCaRS Center ALMNet.

The USDA NRCS has performed a soil survey for this site.

Internet

start 50.0°:Normal 3 Microsof... ALMNet ALMNET_DC... NewALMNet... ALMNet - W... 50° 11:15 AM

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http://wx.aamu.edu/2053/csmoi.php

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ALMNEt Go Bookmarks 19 blocked Check AutoLink AutoFill Send to Settings

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Other Stations

AWIS:
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RAWS:
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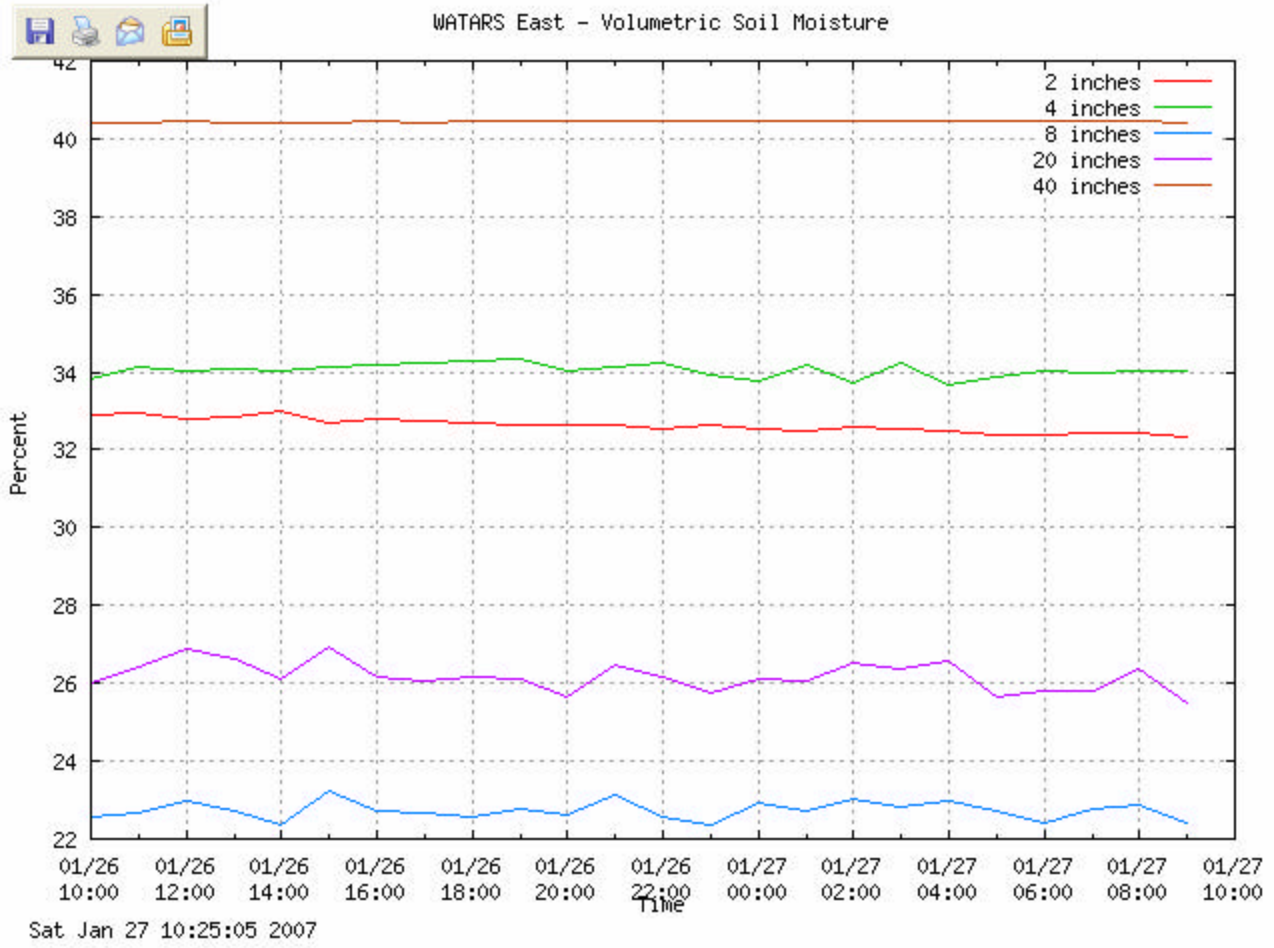
Alabama A & M Univ.

AAMU
HSCaRS
USDA NRCS Soil Survey Office

WATARS (East), Madison County, AL
24 Hour Soil Moisture:



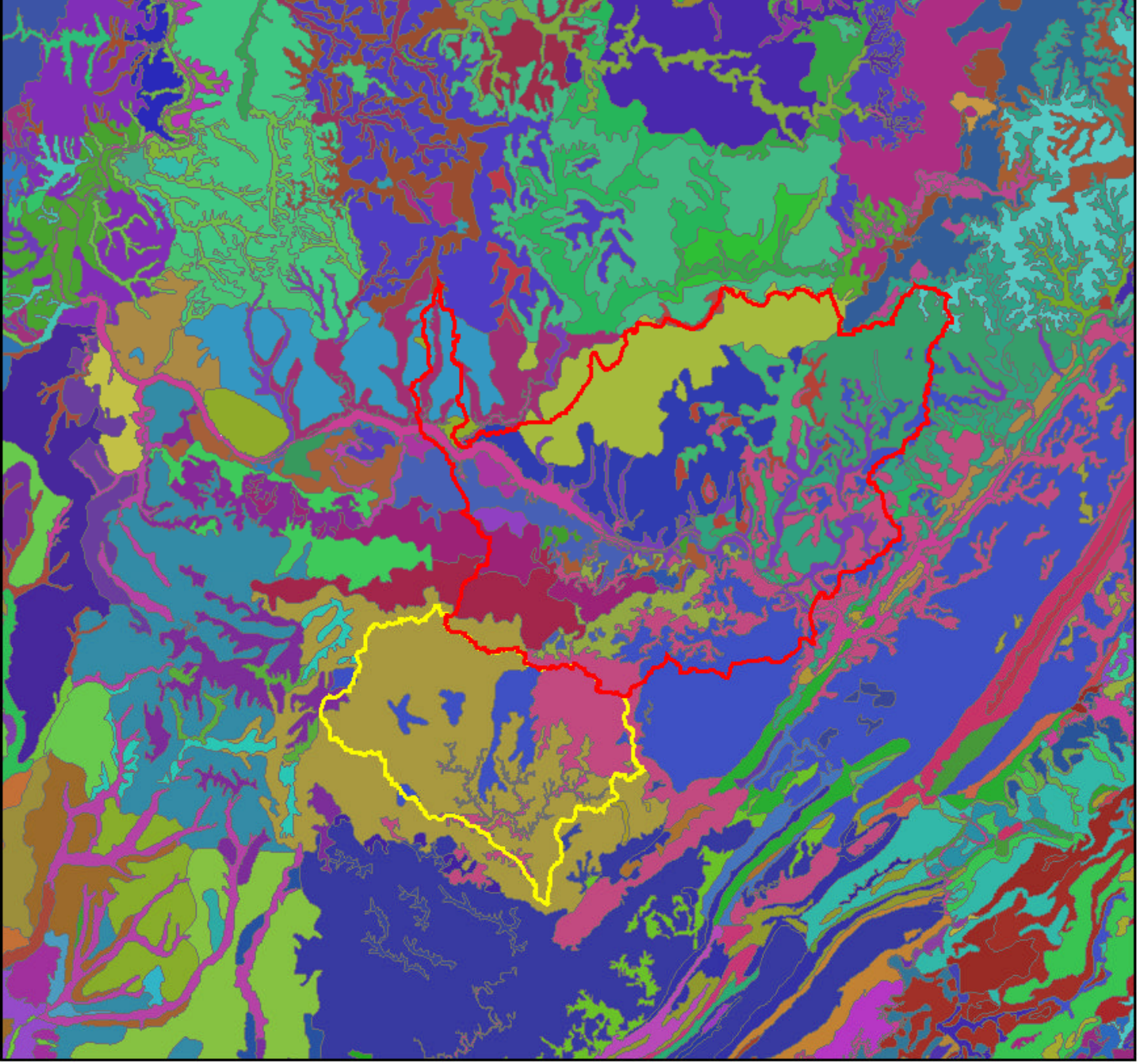
Sat Jan 27 10:25:05 2007

Internet

- **The database is accessible to anyone interested to use it free:**
  - **Data may be viewed on the Internet at:**
    - http://www.wcc.nrcs.usda.gov/scan/Alabama/alabama.html
  - **Graphical results are also available at:**
    - http://wx.aamu.edu/ALMNET.html

Soil Database

USDA-NRCS



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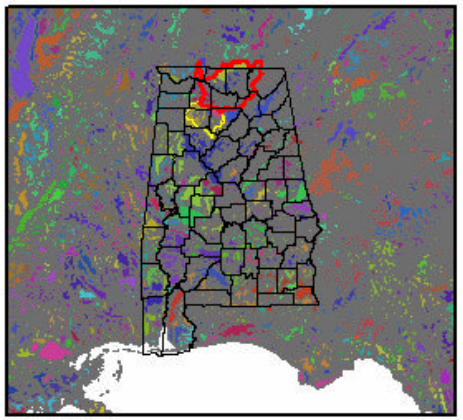
Legend

- Wheeler Lake Basin
- Sipsey Fork



350 175 0 350 Miles

Tennessee Valley

- Ap--0 to 7 inches; dark reddish brown silt loam
- Bt1--7 to 20 inches; dark reddish brown silty clay loam
- Bt2--20 to 72 inches; dusky red clay
- Bt3--72 to 120 inches; dusky red clay, few fragments of chert

Decatur Series

*** Primary Characterization Data ***

(Madison, Alabama)

on ID: S03AL-089-005

Print Date: Jan 27 2007 10:26AM

pled as : DECATOR
sed to :

- Project C2003USAL171 Climate Monitoring Station, SNOTEL/SCAN - BRAGG SITE
- Site ID S03AL-089-005 Lat: 34° 53' 37.40" north Long: 86° 36' 9.00" west
- Pedon No. 03N0926
- General Methods 1B1A, 2A1, 2B

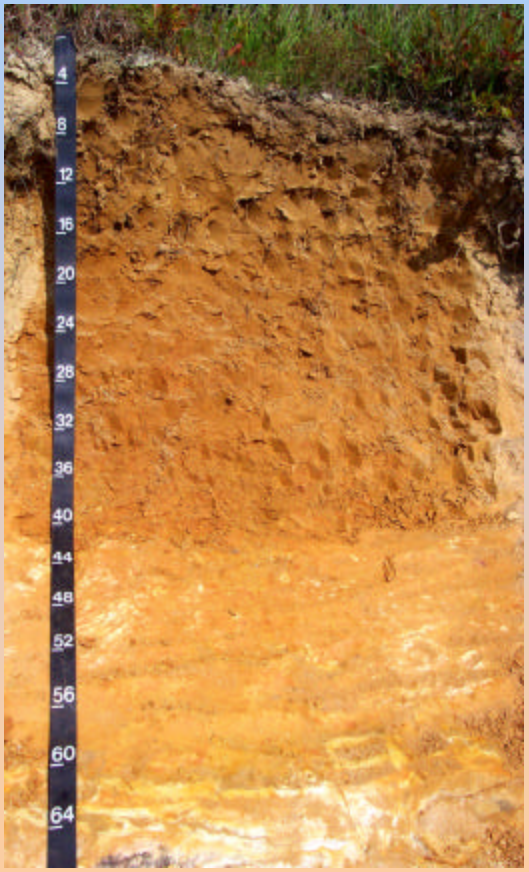
United States Department of Agriculture
Natural Resources Conservation Service
National Soil Survey Center
Soil Survey Laboratory
Lincoln, Nebraska 68508-3866

er	Horizon	Orig Hzn	Depth (cm)	Field Label 1	Field Label 2	Field Label 3	Field Texture	Lab Texture
04772	Ap		0-5	S03AL-089-005-1				SICL
04773	Bt1		5-20	S03AL-089-005-2				SICL
04774	Bt2		20-46	S03AL-089-005-3				SIC
04775	Bt3		46-104	S03AL-089-005-4				C
04776	Bt4		104-132	S03AL-089-005-5				C
04777	Bt5		132-152	S03AL-089-005-6				C

A & Rock Fragments

				-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-
				(- - - - - Total - - - - - -)			(- - Clay - - -)		(- - - - Silt - - - - -)		(- - - - - - - - - - - - Sand - - - - - - - - - - - -)					(Rock Fragments (mm))				
				Clay	Silt	Sand	Fine	CO_3	Fine	Coarse	VF	F	M	C	VC	(- - - - - - - - Weight - - - - - - - -)				>2 mm
				< .002	.002 -.05	.05 -2	< .0002	< .002	.002 -.02	.02 -.05	.05 -.10	.10 -.25	.25 -.50	.5 -1	1 -2	2 -5	5 -20	20 -75	.1- 75	wt % whole soil
er	Depth (cm)	Horz	Prep	(- % of <2mm Mineral Soil -)												(- - - - - - - % of <75mm - - - - - -)				
				3A1a1a			3A1a1a		3A1a1a		3A1a1a	3A1a1a	3A1a1a	3A1a1a	3A1a1a					
04772	0-5	Ap	S	31.1	56.2	12.7	19.2		37.1	19.1	5.3	5.0	1.3	0.9	0.2	2	1	--	10	3
04773	5-20	Bt1	S	36.7	50.2	13.1	25.4		33.0	17.2	5.6	4.6	1.5	1.1	0.3	2	1	1	11	4
04774	20-46	Bt2	S	48.9	43.1	8.0	35.8		29.6	13.5	3.2	3.3	0.8	0.4	0.3	1	1	--	7	2
04775	46-104	Bt3	S	54.1	38.4	7.5	40.9		27.5	10.9	3.5	3.0	0.6	0.3	0.1	1	1	1	7	3
04776	104-132	Bt4	S	56.5	34.6	8.9	43.4		24.3	10.3	4.1	3.4	0.7	0.6	0.1	1	1	--	7	2
04777	132-152	Bt5	S	56.2	33.8	10.0	45.9		22.6	11.2	4.0	4.0	1.1	0.7	0.2	1	3	2	12	6

Cumberland Plateau



- Ap--0 to 7 inches; brown fine sandy loam
- BE--7 to 11 inches; strong brown fine sandy loam;
- Bt--11 to 30 inches; strong brown sandy clay loam
- BC--30 to 42 inches; strong brown fine sandy loam;
- Cr--42 to 60 inches; yellowish brown and strong brown, level bedded, massive, weathered, sandstone bedrock.

Nauvoo Series

Highland Rim

Bodine Series

Ap--0 to 5 inches;
dark grayish brown gravelly silt loam

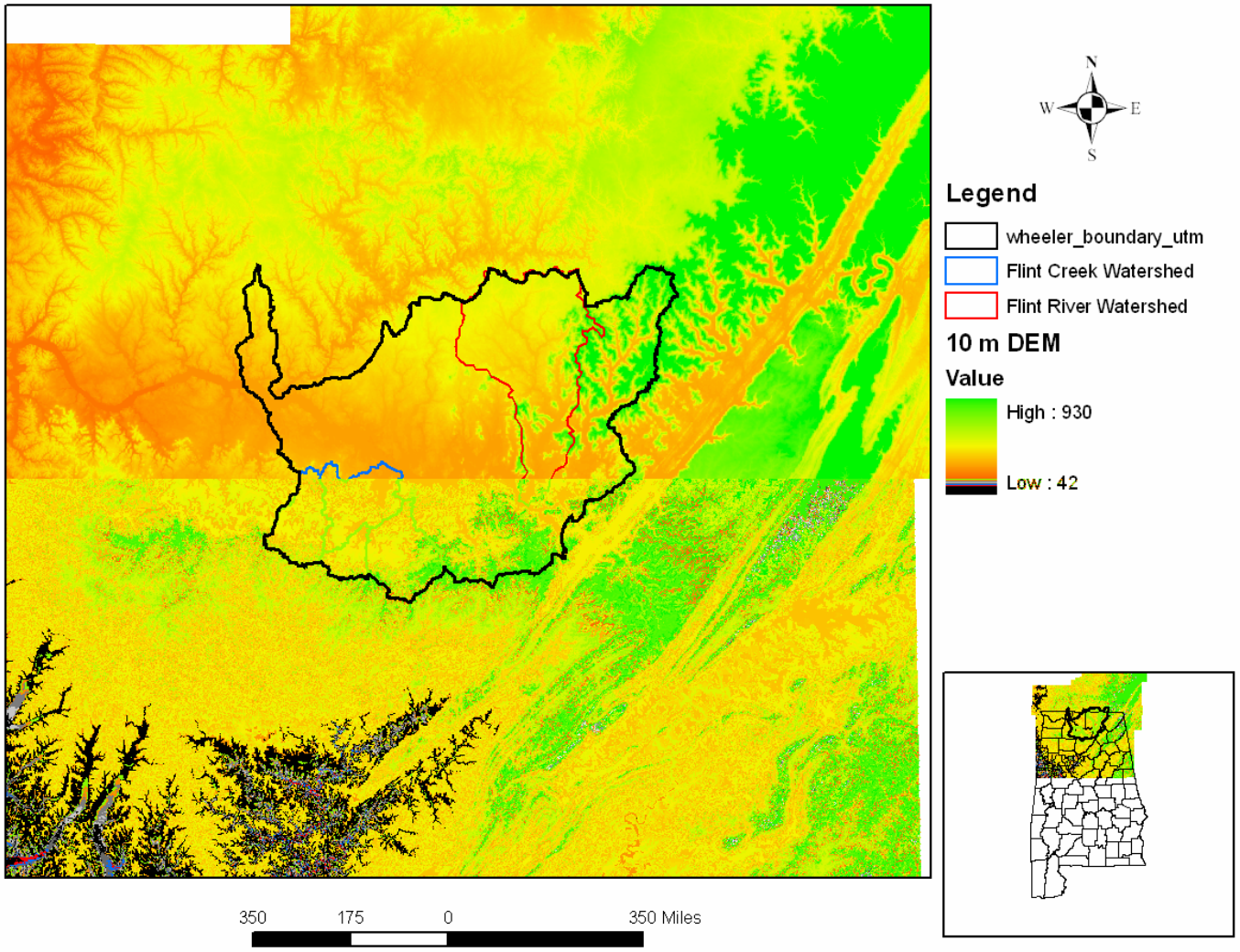
E--5 to 10 inches;
pale brown gravelly silt loam

Bt1--10 to 28 inches;
yellowish brown very gravelly silt loam, 50 percent fragments of chert

Bt2--28 to 60 inches;
yellowish brown very gravelly silt loam with red and pale brown mottles, 50 percent fragments of chert

Remote Sensing Database

DEM Data


N
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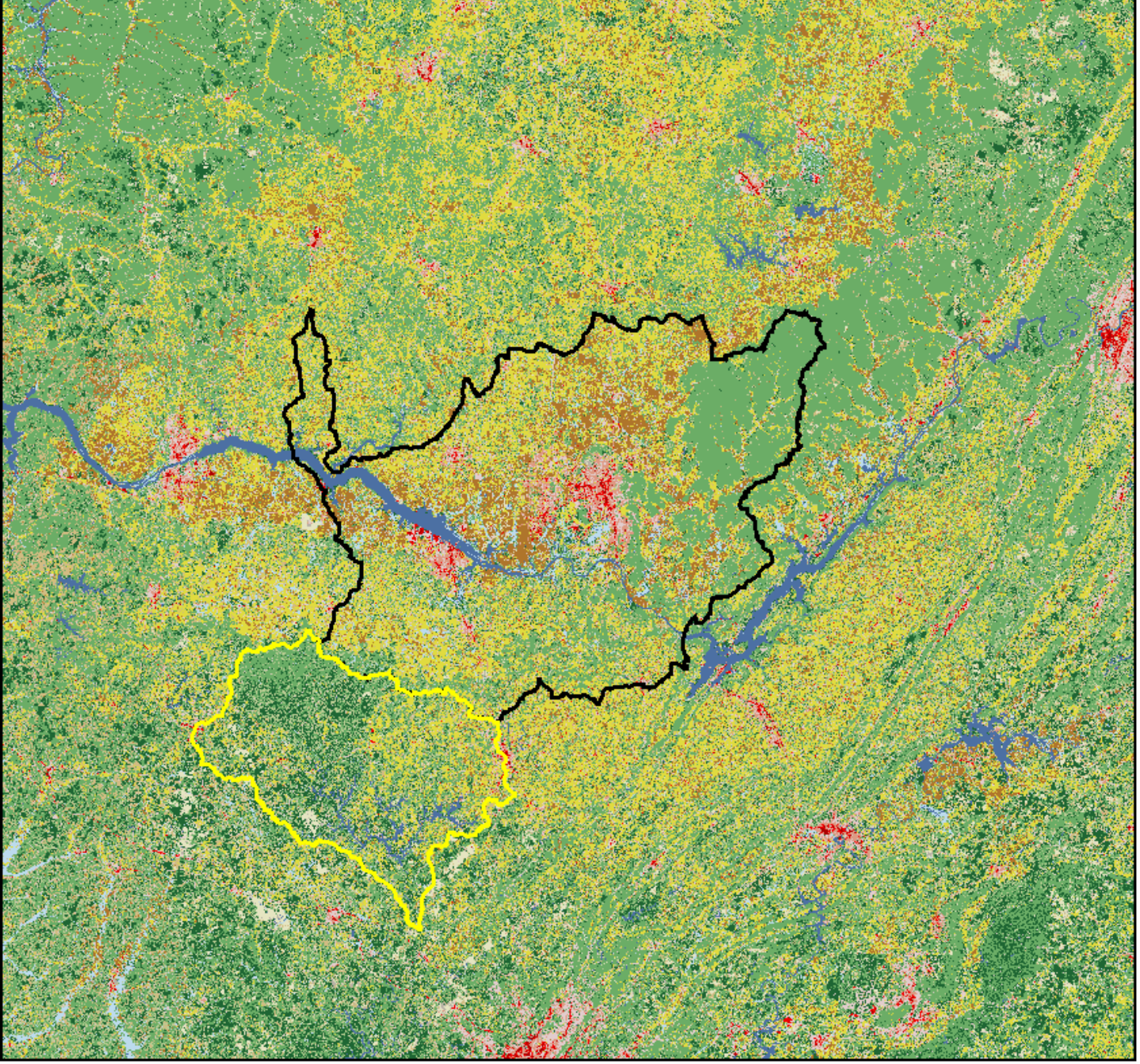
wheeler_boundary_utm
Flint Creek Watershed
Flint River Watershed
10 m DEM
Value
High : 930
Low : 42
350
175
0
350 Miles



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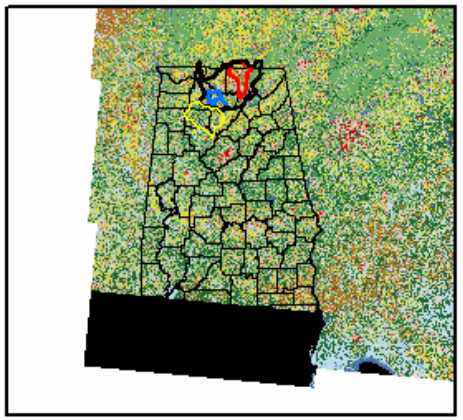
Legend

- Sipsey Fork
- Wheeler Lake Basin



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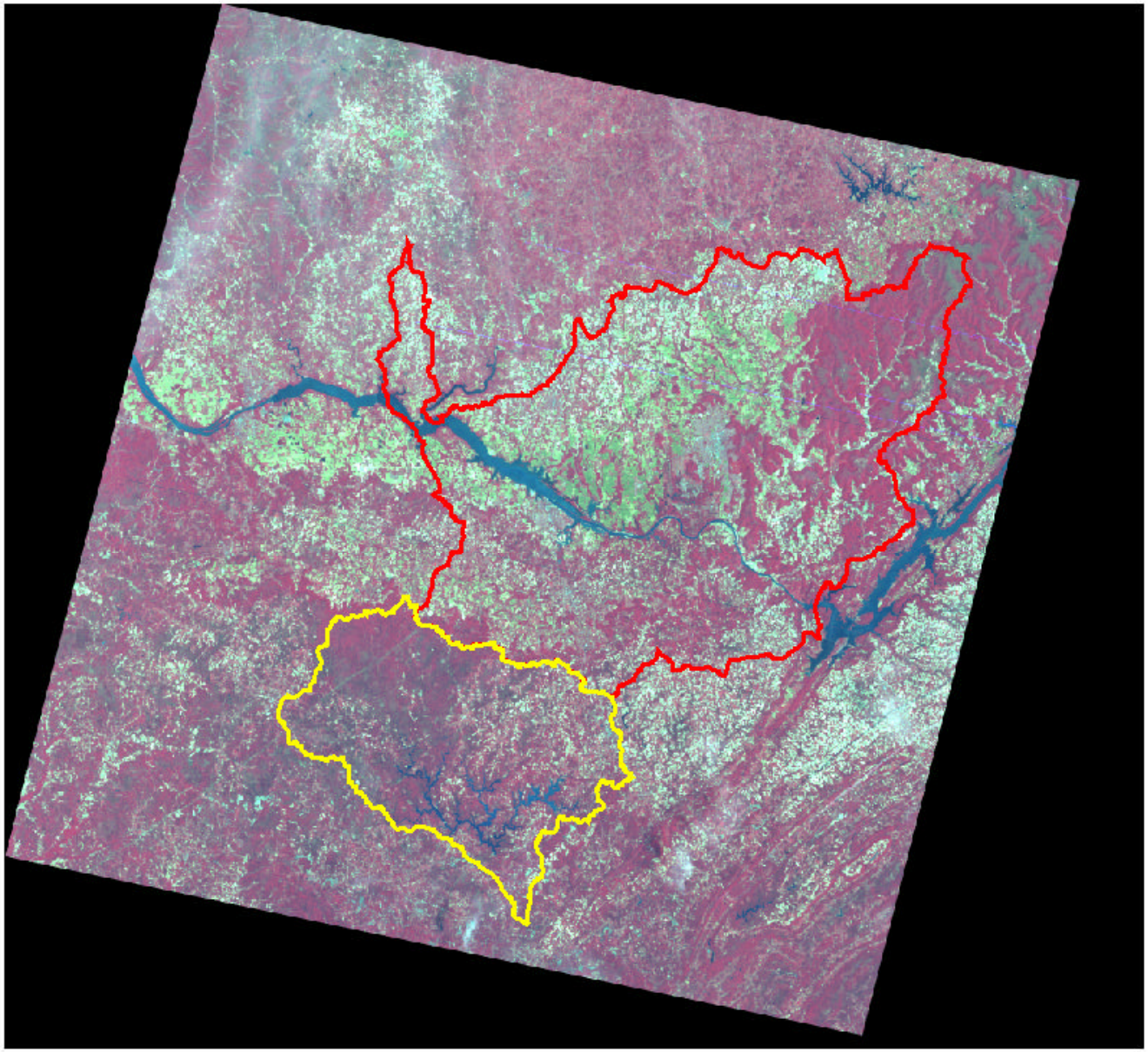

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Legend

Sipsey Fork

Wheeler Lake Basin

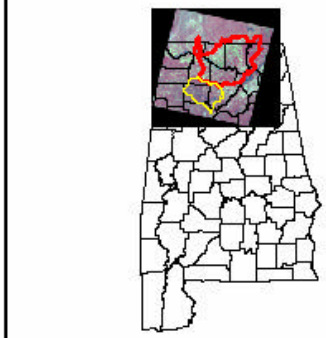
Landsat TM 1974

RGB

Red: Band_3

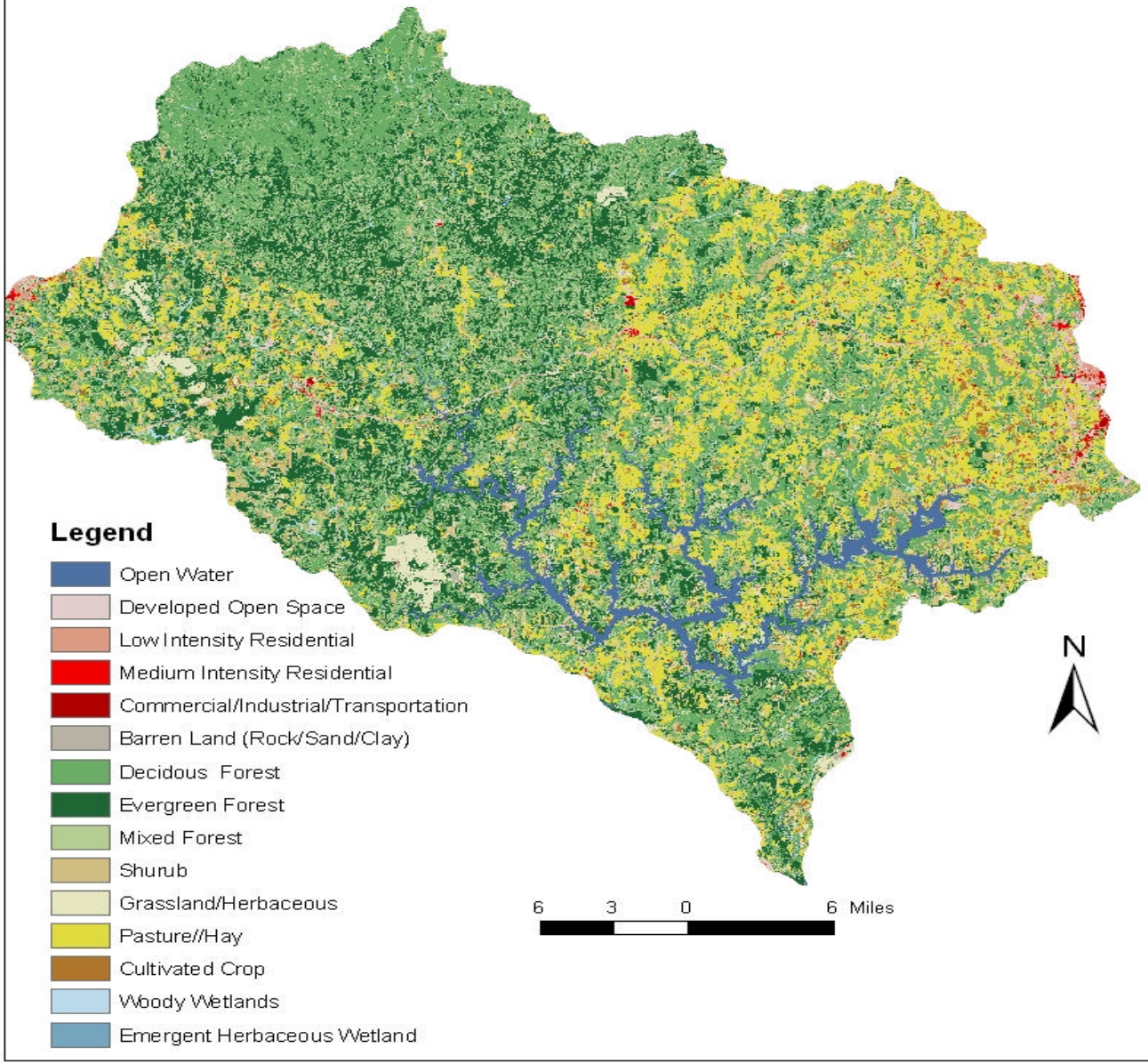
Green: Band_2

Blue: Band_1

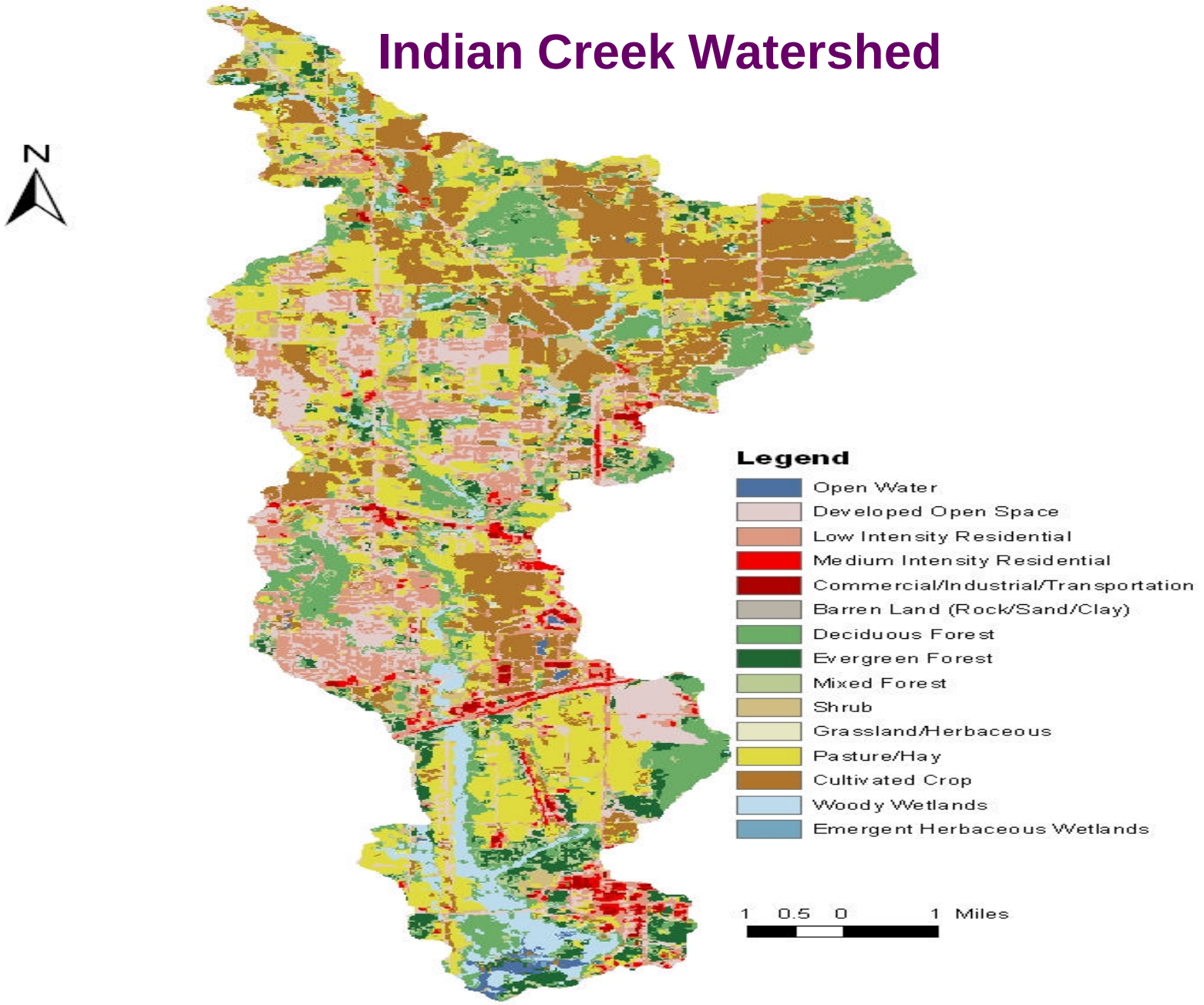


350 175 0 350 Miles

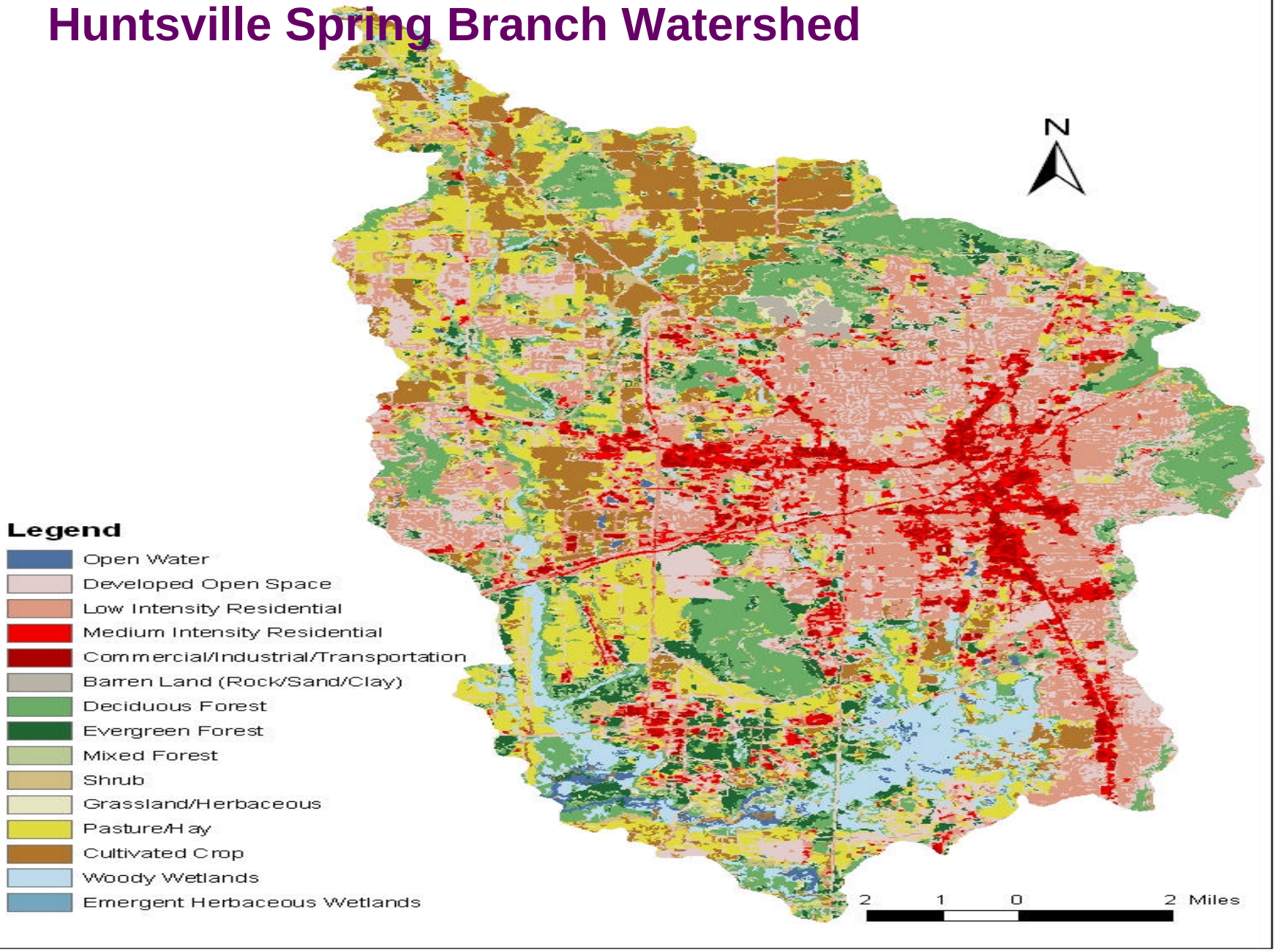
Sipsey Fork Watershed



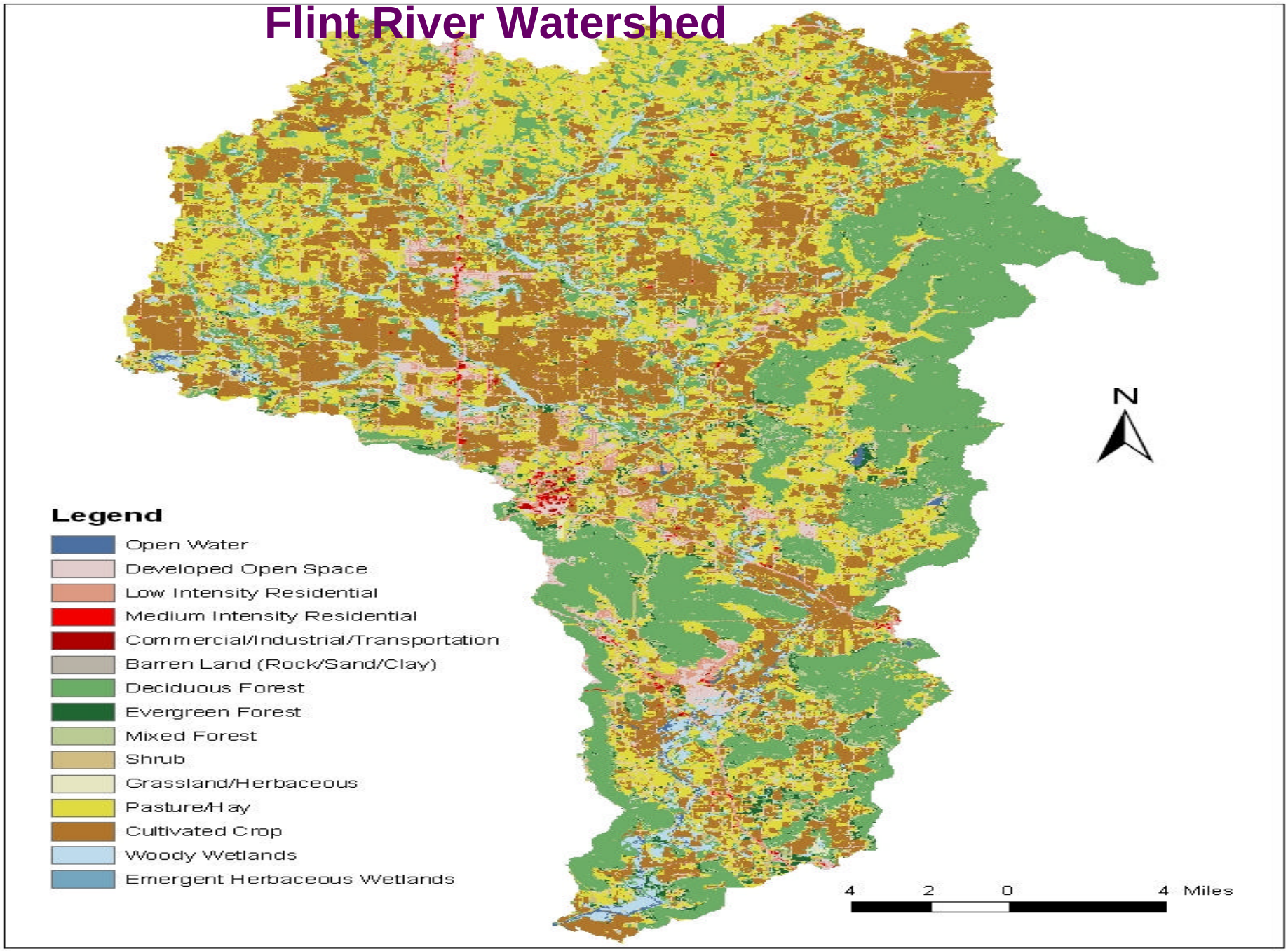
Indian Creek Watershed



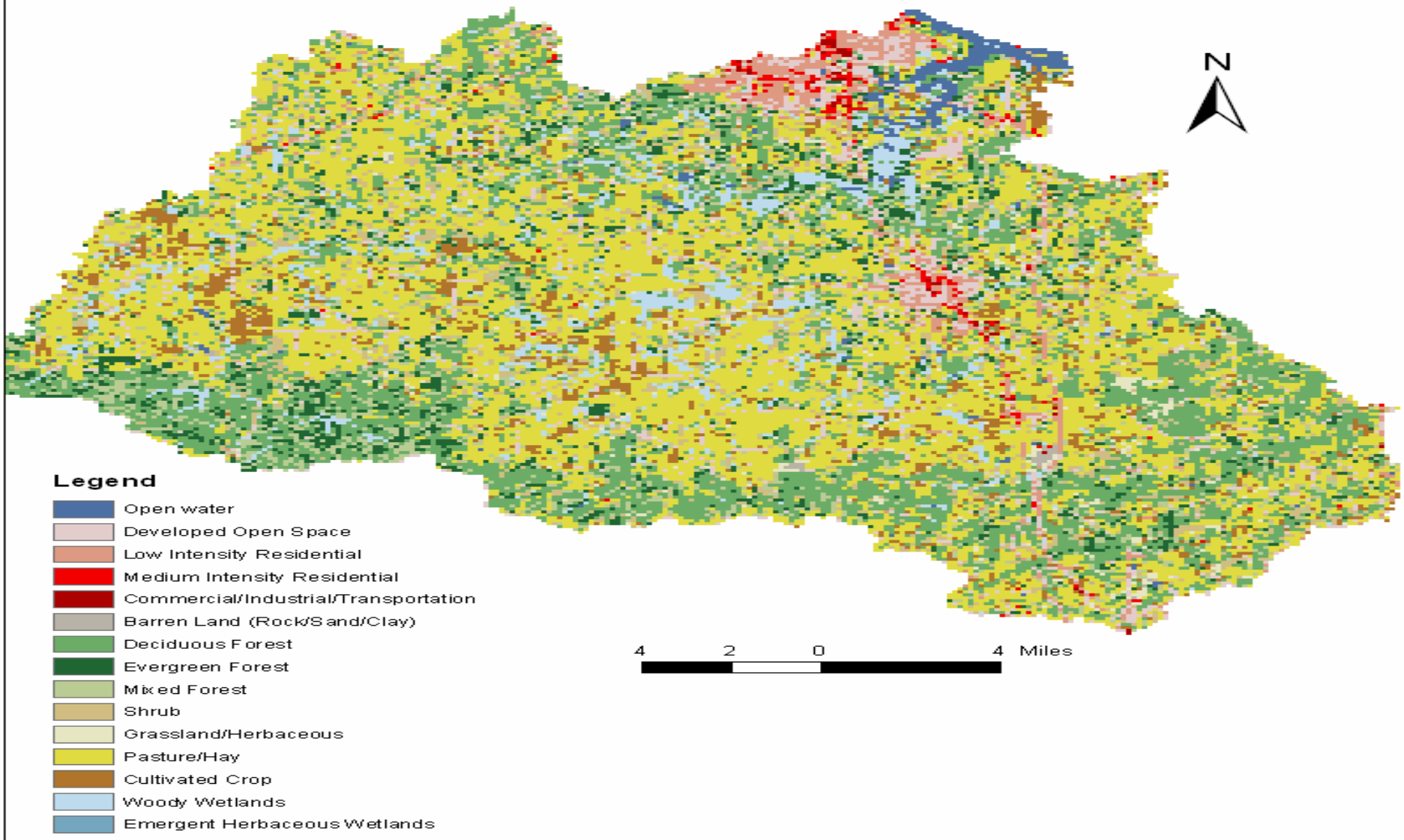
Huntsville Spring Branch Watershed



Flint River Watershed



Flint Creek Watershed



"Emphasis on Urban growth"
Indian Creek and Huntsville Spring Branch Watersheds

Ms. Karnita Golson-Garner
Doctoral Graduate Student
&
Research Associate

EPA STAR Fellowship Recipient (2006)

Cont'd

Pesticides	IC-KS (µg/L)	IC-MR (µg/L)	IC-TN (µg/L)	SB-DT (µg/L)	SB-DK (µg/L)	SB-MR (µg/L)
Aldrin	<0.0400	<0.0400	<0.0400	0.0133	<0.0400	<0.0400
Gamma-Chlordane	<0.250	<0.250	<0.250	0.0257	<0.250	<0.250
4,4' -DDT	<0.0400	<0.0400	<0.0400	<0.0400	<0.0400	<0.0400
4,4' -DDE	<0.0400	<0.0400	<0.0400	<0.0400	<0.0400	<0.0400
4,4' -DDD	<0.0400	<0.0400	<0.0400	<0.0400	<0.0400	<0.0400
Dieldrin	<0.0400	<0.0400	<0.0400	0.0712	<0.0400	0.0167
Endosulfan I	<0.0400	<0.0400	<0.0400	<0.0400	<0.0400	<0.0400
Endosulfan 2	<0.0400	<0.0400	<0.0400	<0.0400	<0.0400	<0.0400
Endrin	<0.0400	<0.0400	<0.0400	<0.0400	<0.0400	<0.0400
Heptachlor epoxide	<0.0400	<0.0400	<0.0400	0.0321	<0.0400	<0.0400
Methoxychlor	<0.0400	<0.0400	<0.0400	<0.0400	<0.0400	<0.0400

Please visit the Poster Presentation for more information

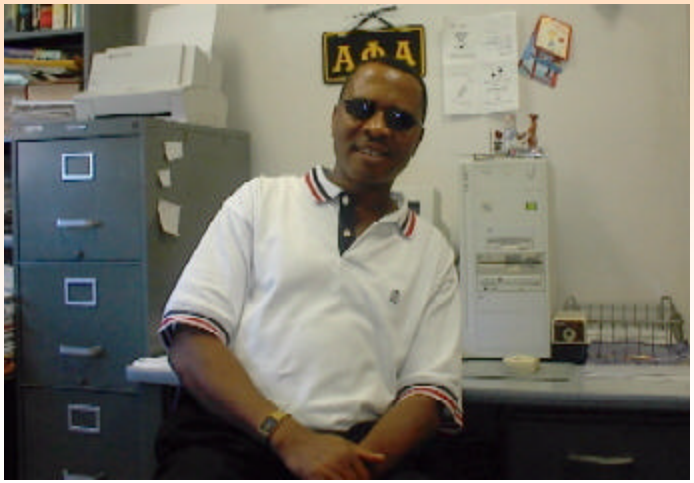
Cont'd

Location	Al (mg/L)	Fe (mg/L)	Mn (mg/L)	Cu (mg/L)	Ni (mg/L)	As (mg/L)	Pb (mg/L)	Zn (mg/L)	Se (mg/L)
IC@MR	0.065	0.110	0.044	ND	ND	0.013	ND	0.052	0.003
IC@TN	0.122	0.111	0.019	0.001	0.004	0.028	ND	0.020	0.016
IC@72	0.196	0.159	0.039	0.001	0.001	ND	ND	0.142	0.018
SB@PR	0.847	0.856	0.273	0.003	ND	0.014	0.001	0.176	ND
SB@JN	0.023	0.049	0.48	0.001	ND	0.008	ND	0.093	0.014
SB@DT	0.148	0.068	0.003	0.012	0.021	0.003	0.004	0.637	0.001

Please visit the Poster Presentation for more information

Flint River and Flint Creek Watersheds

Mr. Paul Okweye
(Doctoral Graduate Student)



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WINTER							
	EPA-MCL	WR-FR	BF-FR	HR-FR	RB-FC	MB-FC	VB-FC
Al	50	**90.1**	**169**	**196.5**	**185**	**165.3**	**160**
Co	0	0.5	39.8	24.6	0	0	0
Ni	100	1	0.3	3.1	0.3	0.6	1.6
Cu	1000	0	0	5.3	0.3	2.3	0.3
Fe	300	89	112.3	113.6	214.3	174.6	168.3
Mn	50	8.5	10	16.8	10.3	13.6	19.6
Ag	50	0	0.3	0.3	0	0	0
Cd	5	0	0	0	0	0	0
As	50	0.8	1.3	0	2.6	0.3	0.3
Se	10	4.3	4	3	2	4.3	7
Zn	5000	20.3	208	453.1	127.3	197	117
Pb	10	**20.8**	**32.6**	**116**	0.6	0	0.6
Sn	None	0.1	1	1	4.3	2.6	2.3
Mo	None	1	0.8	1	0.3	0.6	0.6
P	None	18.6	11.8	31.2	15	45.3	76.1

Please visit the Poster Presentation for more information

Biological assessment of **Benthic Macroinvertebrates** as indicators of water quality

Dr. Rufina Ward

Ms. Allison Bohlman (Research Associate)

Allison at work.

Cont'd

Table 3. Number and percent (%) EPT, chironomids and simuliids collected in north Alabama watersheds.

Insect Group	Flint River		Indian Creek		Flint Creek	
	Number	%	Number	%	Number	%
Ephemeroptera	2431	61	1419	36.97	178	11.32
Plecoptera	179	4.5	4	0.1	349	22.2
Trichoptera	462	11.6	1347	35.1	116	7.38
EPT	3072	77.1	3838	72.17	821	45.43
Chironomidae	423	8.94	208	5.4	311	17.21
Simuliidae	142	3.6	405	10.55	40	2.21

Cont'd

Table 2. Watershed Averaged Physical Parameters 2006								
Location/ Parameter	DO (mg/L)	Turbidity (fau)	TDS (ppm)	pH	Temperature (°C)	Water Depth (cm)	Canopy Cover %	Light (ft candles)
Flint River	8.43	15.81	78.44	8.04	23.13	17.28	65.00	505.97
3 Forks	7.70	5.00	82.00	7.82	25.13	8.33	50.00	754.17
B.W. Road	9.42	25.40	56.50	7.93	21.05	12.50	67.00	201.25
Hwy 72	7.97	8.20	93.00	7.78	23.30	31.00	80.00	562.50
Indian Creek	8.03	26.90	114.76	8.62	22.85	19.90	77.50	1465.02
Providence	7.74	10.33	106.00	8.18	22.12	15.67	62.50	89.11
Farrow Road	8.78	6.75	116.60	8.54	23.38	20.92	90.00	109.17
Madison Pike	7.58	6.00	119.20	8.10	23.05	23.11	80.00	329.44
Flint Creek	10.15	17.33	112.75	8.54	20.85	8.82	50.12	312.78
Lacon, AL	11.40	23.75	91.00	7.95	23.40	9.15	41.67	280.00
Bankhead N.F.	7.65	3.50	151.66	8.22	18.30	17.33	100.00	933.33
Neel, AL*	-	-	-	-	-	-	50.00	325.00

Beck's Biotic Index

- Three Classes of Pollution Tolerance or Sensitivity
  - Class 1: Macroinvertebrates Intolerant to Pollution

Ephemeroptera : Mayfly

Plecoptera : Stonefly

Trichoptera : Caddisfly

Coleoptera : Water Penny

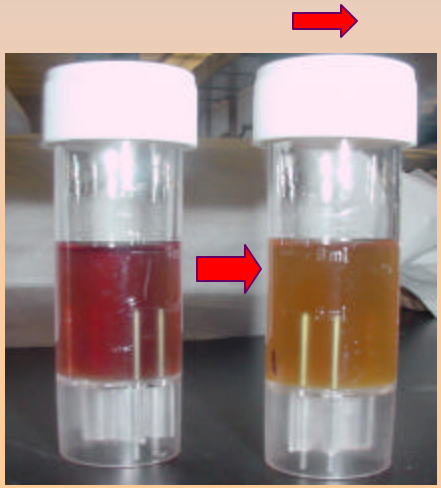
Coleoptera : Riffle Beetle

Megaloptera : Hellgrammite

Impedence & Water Sampling

- Preliminary Trends
  - High Growth Rates
    - Exponential Growth Curves
  - Coliform Presence Positive over 95% in all samples
  - Visual Confirmation:

    Purple Yellow



Random Amplified Polymorphic DNA Analysis and Genotypic Analysis of Verotoxin-Producing *Escherichia* coli

Dr. Leonard Williams

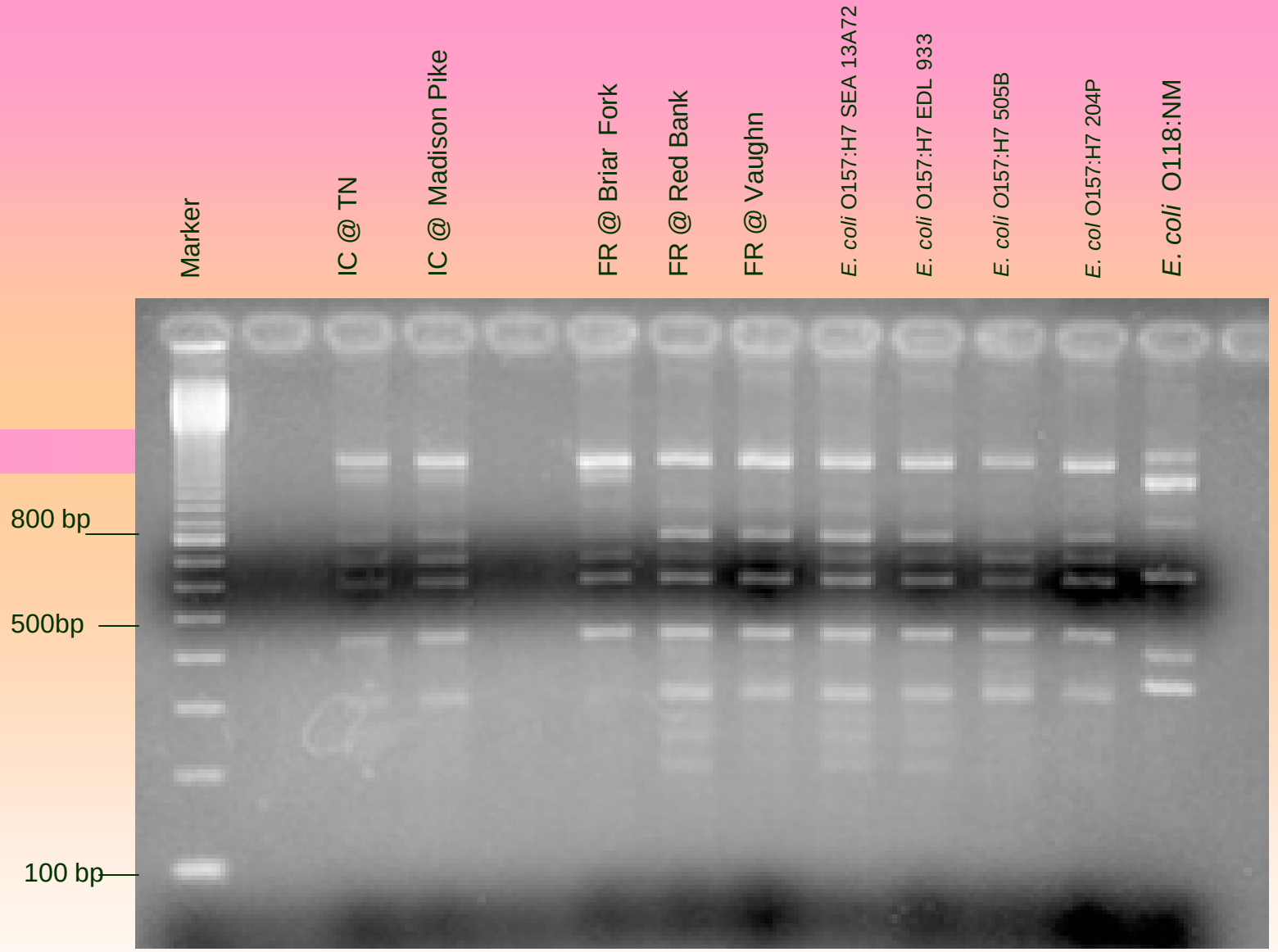


Figure 1. Random amplified polymorphic DNA analysis of isolates detected from selected water samples.

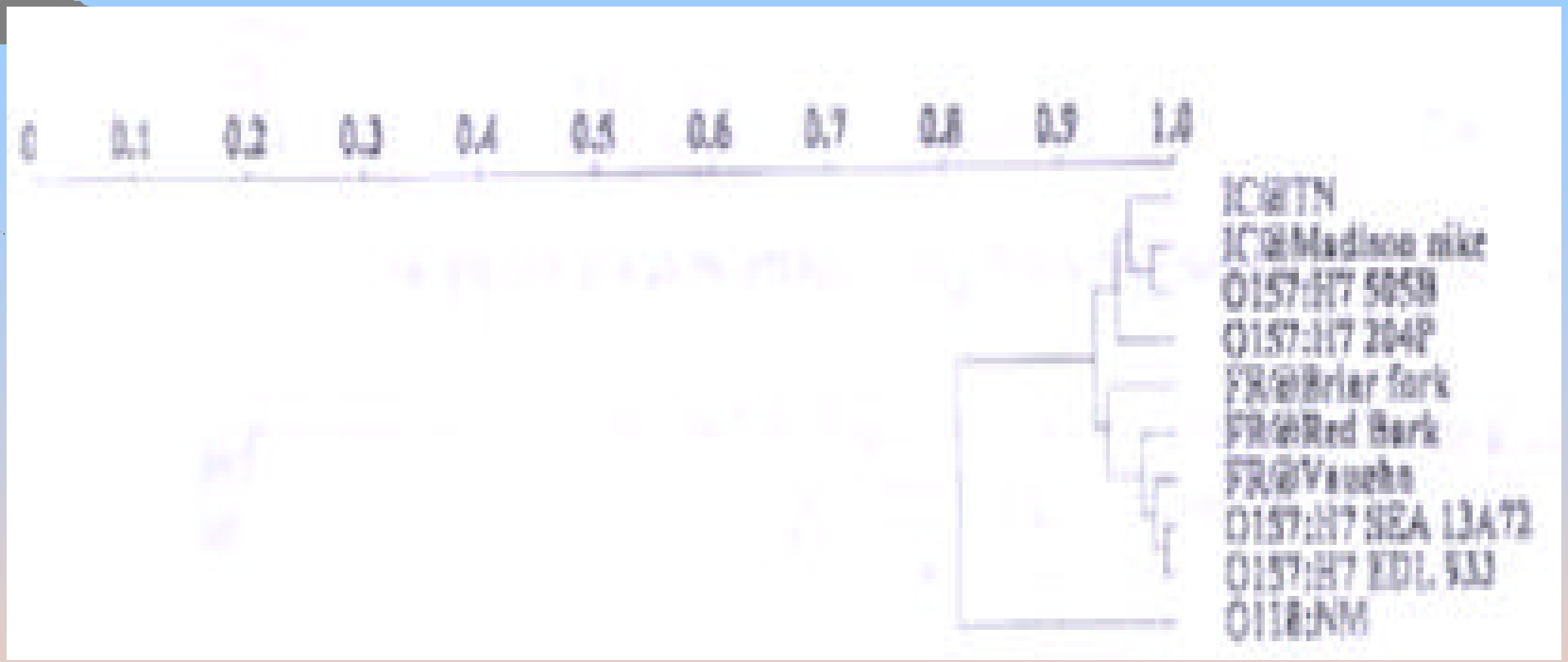
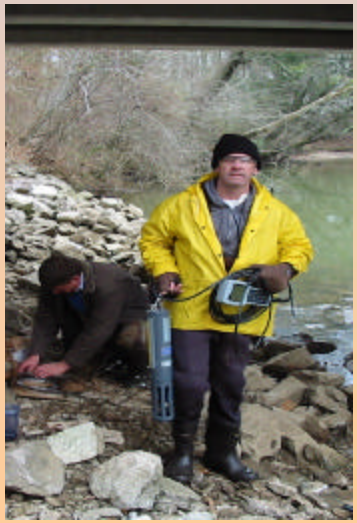


Figure 2. Dendrogram based on UPGMA cluster analysis of 10 different RAPD obtained in this study.

Field Monitoring and Maintenance and Calibration of Water Quality Instruments
Mr. Dirk Spencer (Research Associate)

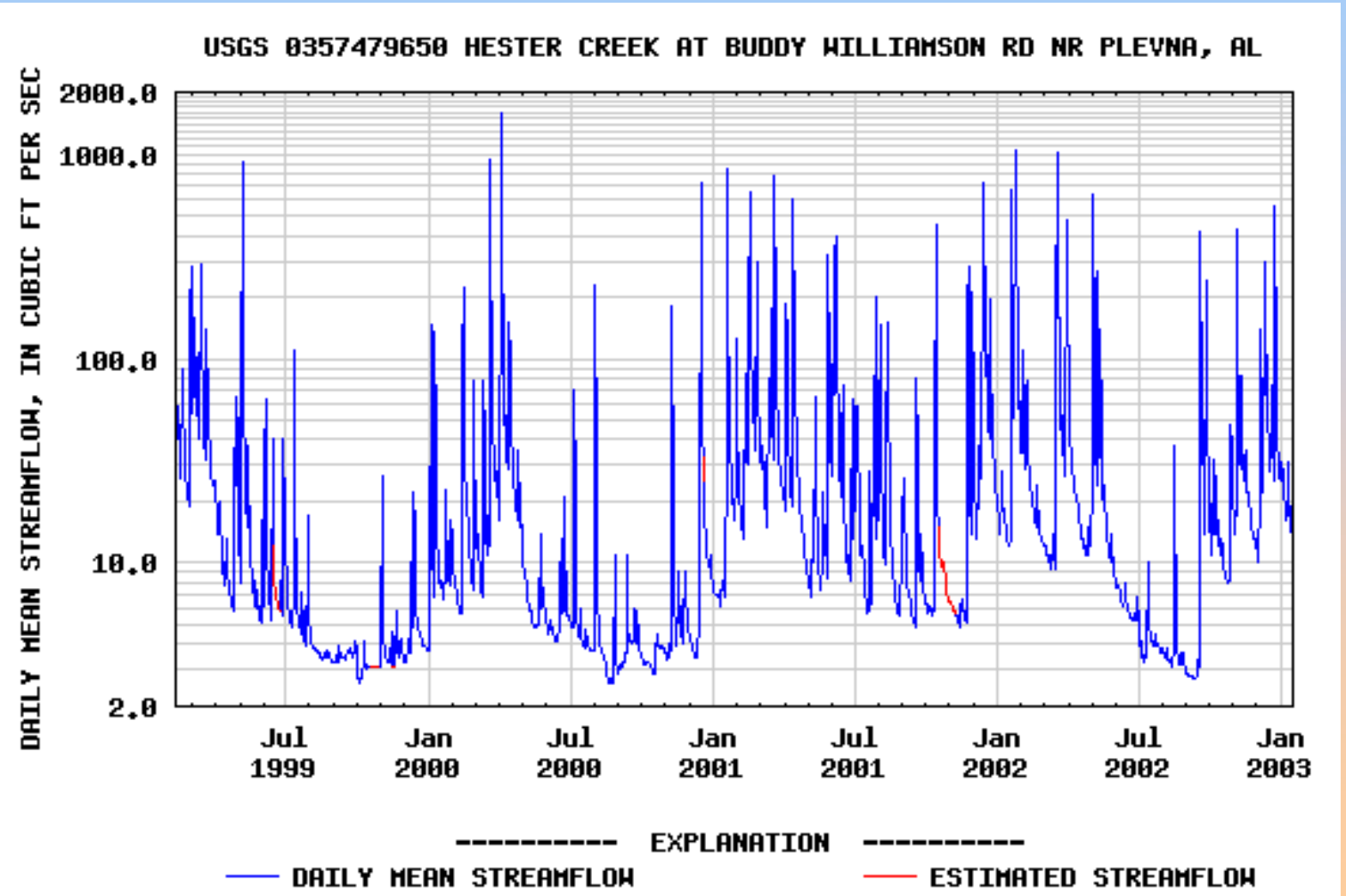


Water Quality Modeling

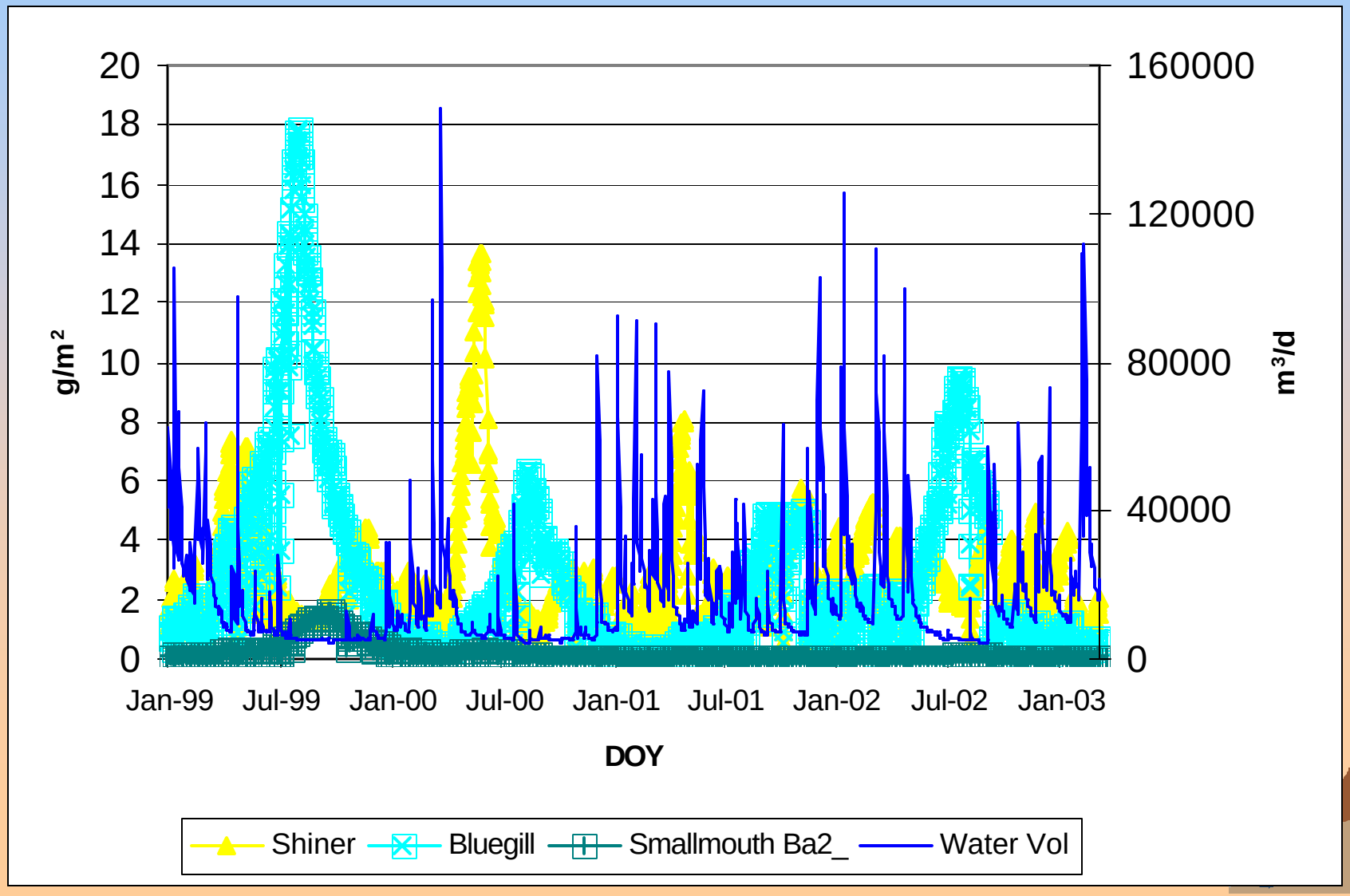
Teferi Tsegaye
&
Mezemir Wagaw

Daily Stream Flow

Hester Creek,1999-2003



Impact Analysis on Fish Types, Population, and Distribution



Current Water Resources Outreach Activities at AAMU

Summary

- Creating a long-term water quality database for streams in Northern Alabama.
- The data is in the process to be compiled into a single database to evaluate aquatic ecosystem health, examine trends within or among water bodies, and identify specific problems.
- The water quality data is not available to the general public at this moment.

Summary

- The entire database will be downloaded in the future by exploring the Water Quality website at AAMU.
- Further, publications, presentations and other reports that include data from this water quality program for the watersheds under investigations will be viewed also by accessing the website.
- Our ultimate goal is to provide extensive water quality data that can be used by watershed council members, water resource professionals, and other stakeholders to further our common goal of protecting our water resources in Alabama.

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-USDA-CSREES

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-Alabama Agricultural Experiment Station

-All Collaborating Research Investigators and Students