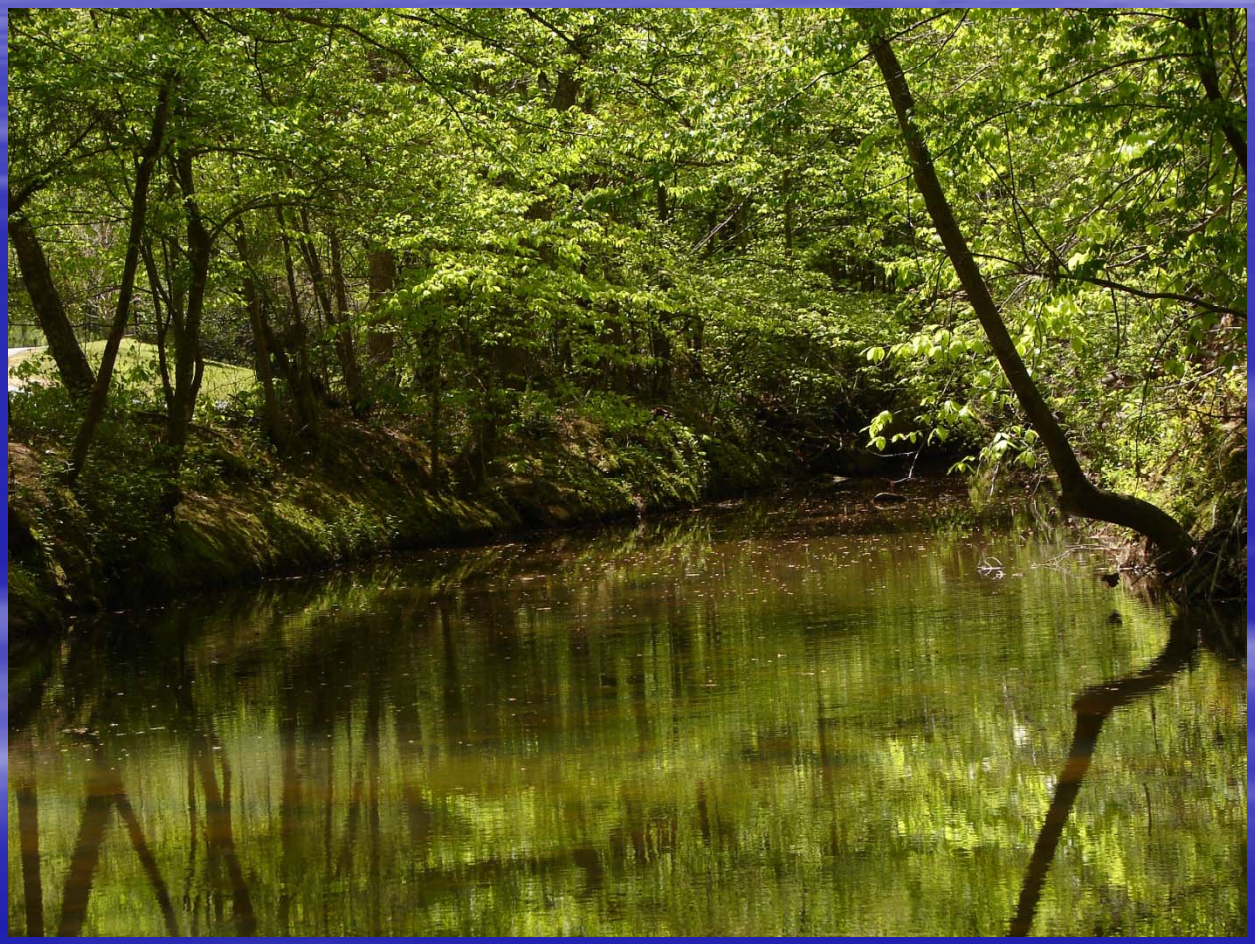
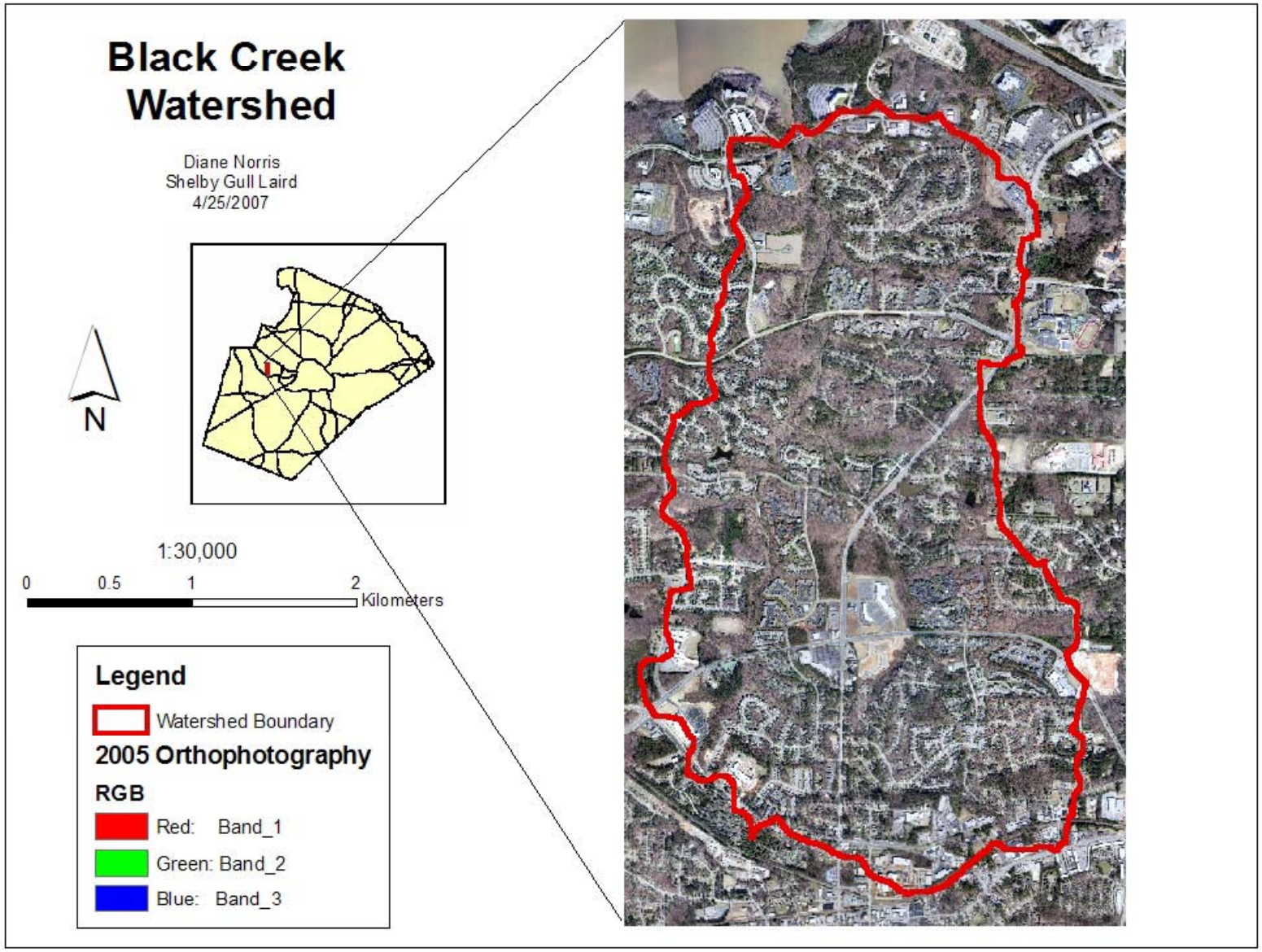
Black Creek Watershed

Shelby Gull Laird
Diane Norris
June 25, 2007

Black Creek Main Stem




Black Creek Watershed
Diane Norris
Shelby Gull Laird
4/25/2007
N
1:30,000
0
0.5
1
2
Kilometers
Legend
Watershed Boundary
2005 Orthophotography
RGB
Red: Band_1
Green: Band_2
Blue: Band_3

Why Black Creek?

- Listed on North Carolina 303(d) Impaired Waters List for Impaired Biological Integrity (based on macroinvertebrates)
- Watershed Monitoring as a 319 Project, with cooperation from the Town of Cary, WECO, and DFER
- Project includes geodatabase development, as well as collecting a broad range of Water Quality data

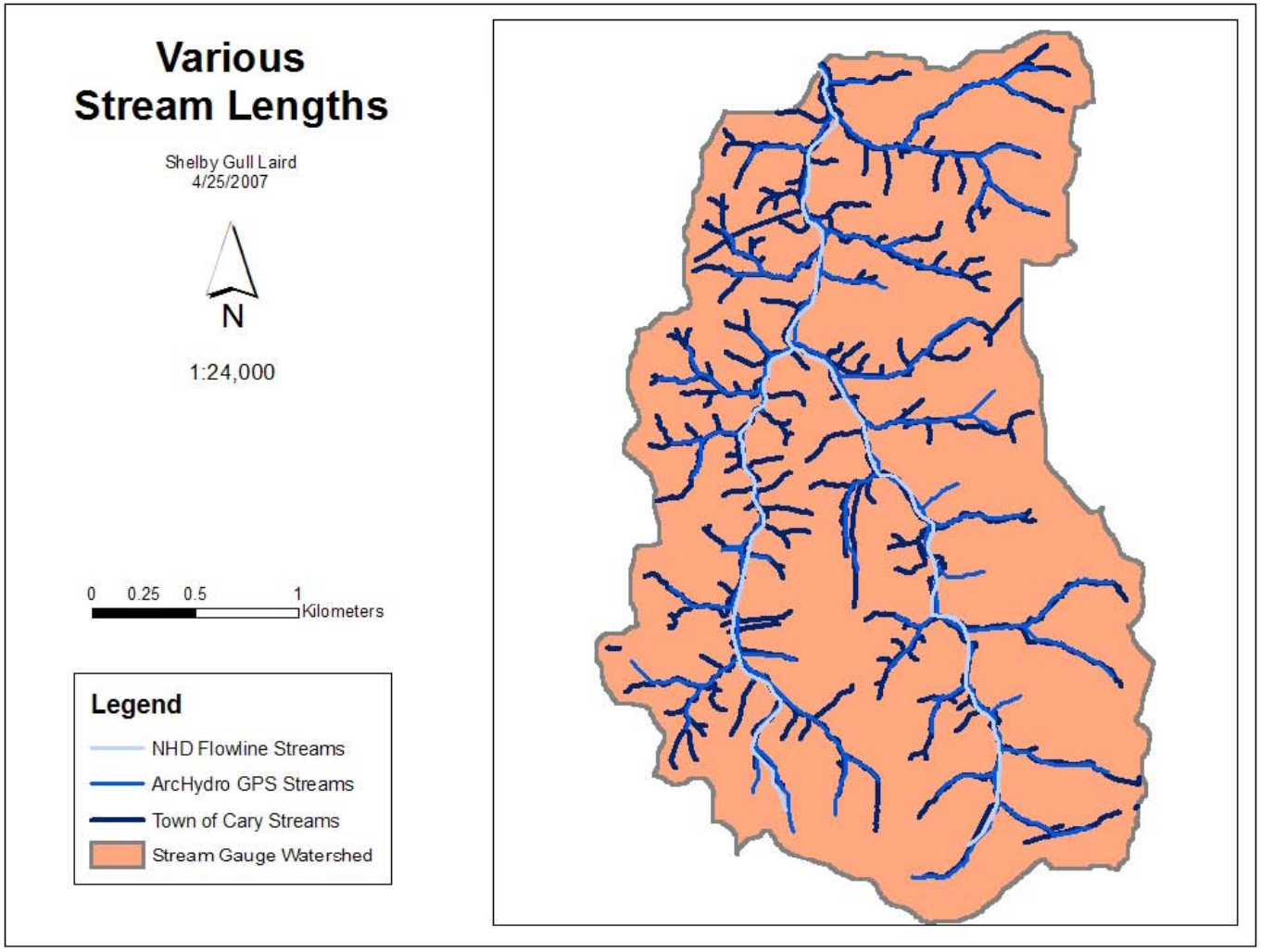
Objectives

- GIS Analysis so far…
  - Comparison of Town of Cary and NHDPlus stream lengths to those obtained in ArcHydro using GPS data as a guide.
  - Began Calculations for TR55 model.
- Physical, Chemical, and Biological Monitoring
  - Began collecting water quality and macroinvertebrate data
  - Possible preliminary interpretations of various data.

Stream Lengths

- Used Umstead Numbers for steam initiation, as they most closely matched available GPS stream origins. (1440, 0.0360)
- NHD: 7.22 km, DD = 0.882 km/km^2
- ArcHydro: 25.50 km, DD = 3.115 km/km^2
- ToC: 45.81 km, DD = 5.597 km/km^2

Stream Lengths



TR55 Calculations

- Used by mainly Engineers to determine peak flow
- Quite complicated
- Can be limited in scope and sometimes inaccurate, but widely accepted

Curve Number Layers

Shelby Gull Laird
5/7/2007

N

1:24,000

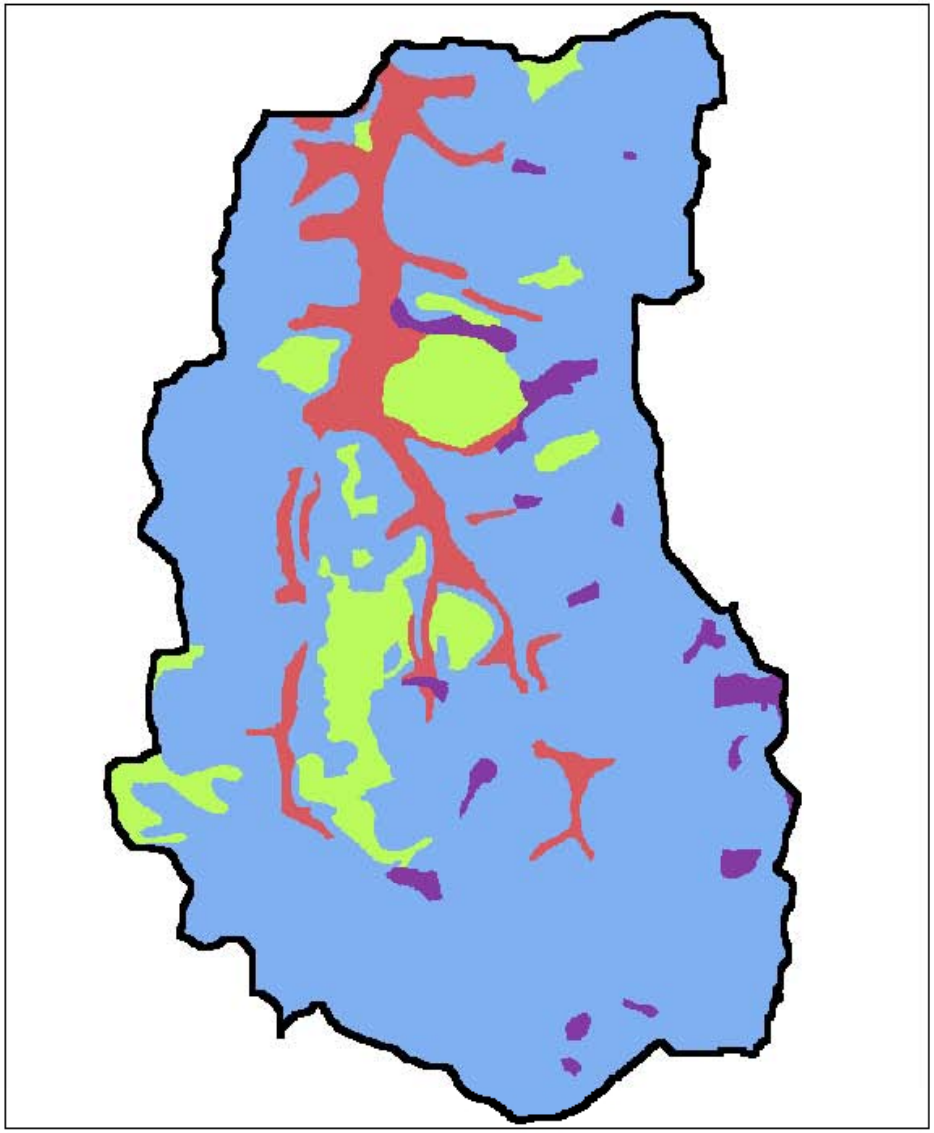
0 0.25 0.5 1 Kilometers

Legend

Stream Gauge Watershed

Hydrologic Soil Classifications

1 A
2 B
3 C
4 D



Impervious Surface

Shelby Gull Laird
6/25/2007

N

1:24,000

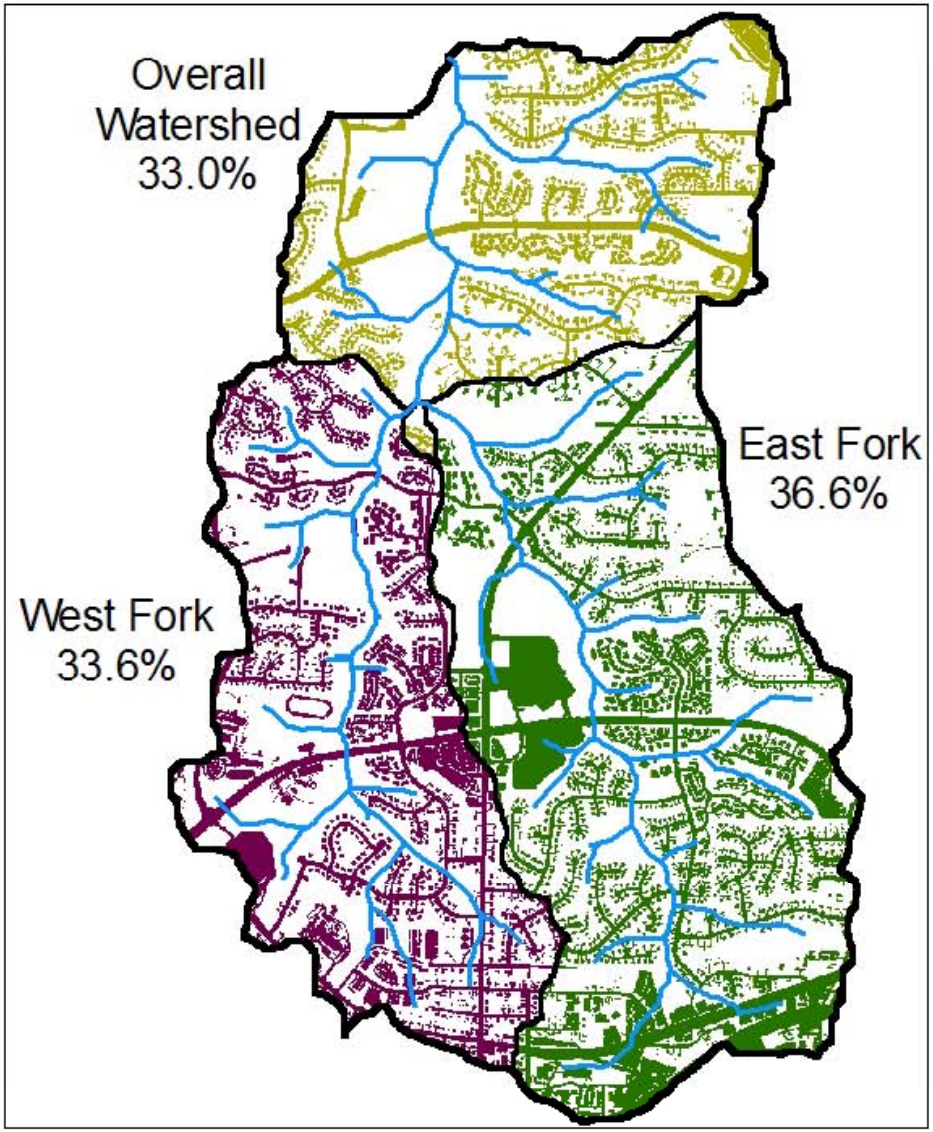
0 0.25 0.5 1 Kilometers

Legend

- Stream Gauge Watershed

Final Impervious Surface

- 0 / 90 — Main Stem at Stream Gauge
- 0 / 90 — West Fork
- 0 / 90 — East Fork
- Streams

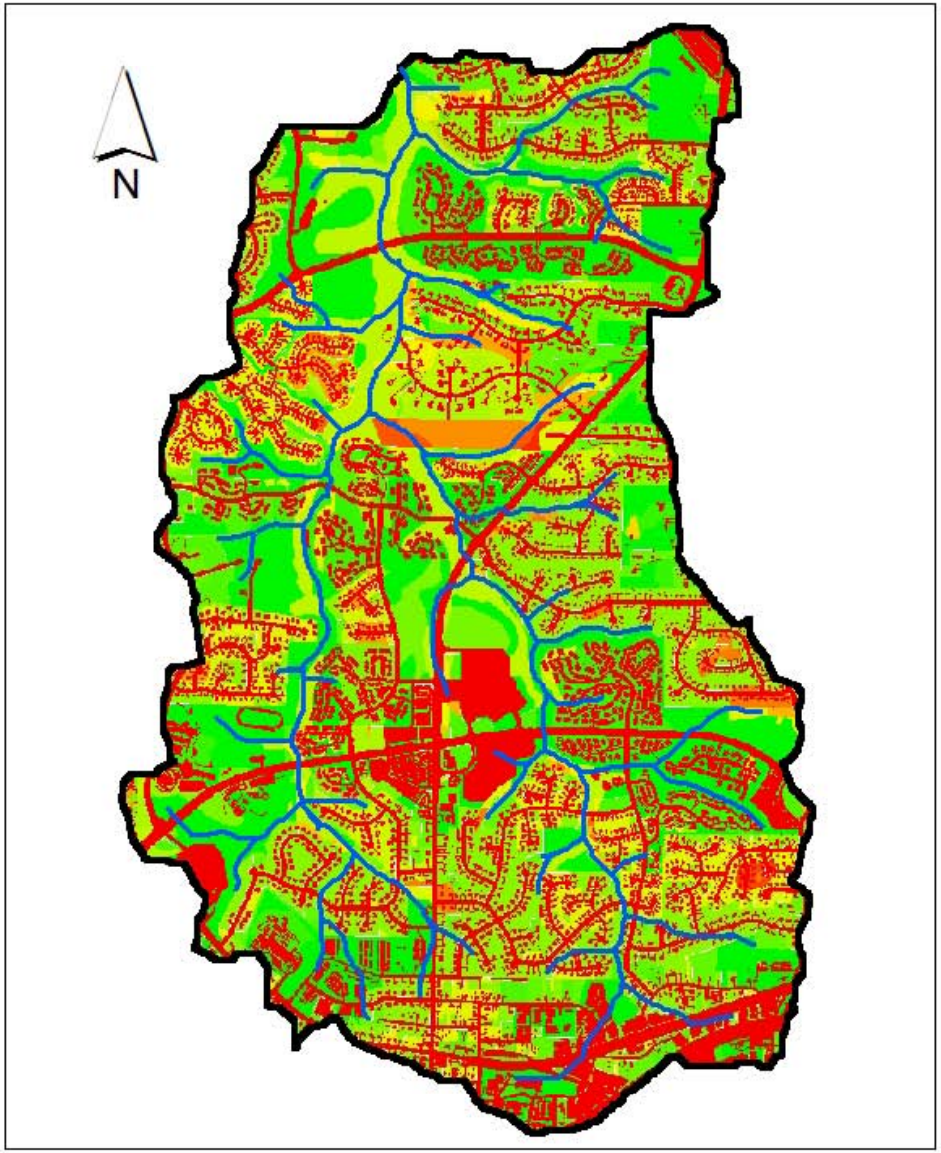


Black Creek Watershed TR-55 Curve Numbers

Shelby Gull Laird
6/22/2007

1:24,000

0 0.25 0.5 1 Kilometers



Legend

- Streams
- Stream Gauge Watershed
- 98
- 94
- 92
- 91
- 90
- 87
- 86
- 85
- 84
- 83
- 82
- 80
- 79
- 77
- 75
- 70
- 68
- 65
- 61
- 55
- 54
- 51
- 46
- 30

TR55 Calculations (con't)

- Did Weighted Average in Excel
- CN = 68.50 for Black Creek Watershed
- Use with stream and flow calculations to estimate peak flow during events.
- Will test with "Stream Gauge"

Water Quality Monitoring

- One site on Main Stem (aka “Stream Gauge” site)
- East Fork 2 & West Fork 2 are close to their confluence into the Main Stem (these are the downstream sites)
- East Fork 1 & West Fork 1 are on the forks just South of Maynard (these are the upstream sites)

Monitoring Sites

Shelby Gull Laird
6/25/2007

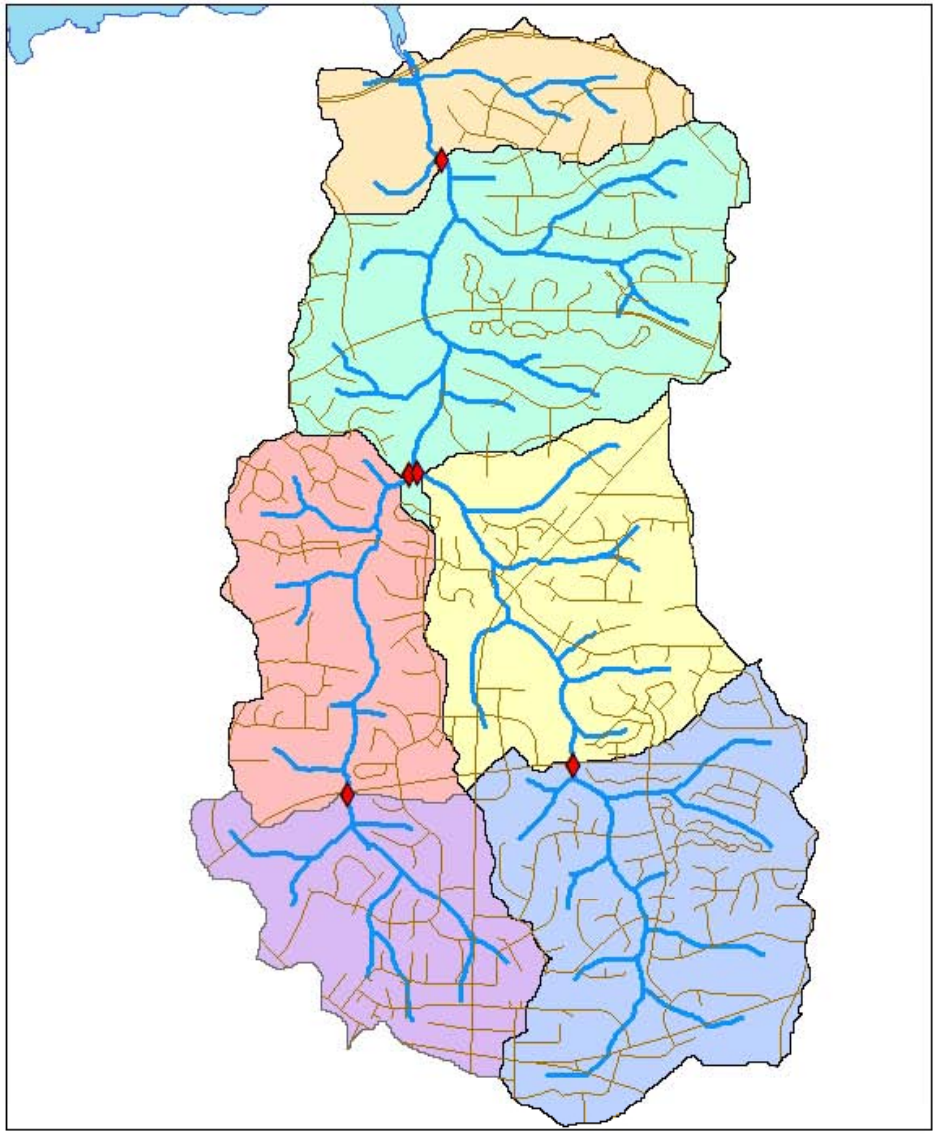
N

1:26,500

0 0.3 0.6 1.2
Kilometers

Legend

- Black Creek Watershed
- Monitoring Sites
- Stream Gauge Watershed
- East Fork 2
- West Fork 2
- East Fork 1
- West Fork 1
- Streets
- Crabtree Lake



Water Quality Parameters

- Physical: pH, dissolved oxygen, temperature, conductivity, turbidity
- Nutrients: Nitrogen, Phosphorous
- Bacteria: Fecal coliform
- Organic compounds: pesticides, hydrocarbons (fuels), industrial solvents
- Aquatic Macroinvertebrates

Water Quality Standards

The NC DENR- Division of Water Quality "Redbook" gives standards for some water quality parameters.

- Standards for Class C waters protect for secondary recreation (wading, fishing) wildlife, fish and aquatic life, agriculture
  - Human health standards
  - Freshwater aquatic life standards

Physical Parameters

- Turbidity
  - Measure of light transmission
  - Water Quality Standards for aquatic life are < 50/25 NTU
  - Erosion (natural & manmade), detritus, phytoplankton
- pH
  - Standards for aquatic life are 6 - 9
  - Black Creek mean is 6.9

All Sites	NTU
Standard	< 50/25
Overall Mean	22.25
Baseflow	7.53
Stormflow	90.03

Physical Parameters

- Dissolved Oxygen
  - Standards are not less than 5 mg/L for aquatic life
  - Black Creek average is 10.12 mg/L
  - DO at main stem on 6/19/2007 was 4.3 mg/L
  - DO decreases with increasing water temperature
  - Critters can withstand minimal DO (4 mg/L) for only short periods of time

Nutrients

- Nitrogen
  - Organic nitrogen found in animal waste, leaves, litter and soil organic matter
  - Ammonia and Nitrates are typically from commercial fertilizers- result in conversion of organic nitrogen to ammonia
  - Ammonia- levels above 100ug/L may indicate sewage or industrial contamination (BC: 43 ug/L)
  - Sum of organic nitrogen and ammonia is TKN.
- Contribute to aquatic plant growth and algal blooms
  - Excessive amounts result in eutrophication

Nutrients

Phosphorous

- Sources similar to Nitrogen
- Frequently bound to soil particles, P_{part} pollution associated with sediment loading
- Much lower levels than N can cause degradation, on the order of 100ug/L (BC: 24.6 ug/L)

Nutrients

- Nitrogen & Phosphorus
  - Buffers?

Baseflow Nitrogen & Phosphorus				
TP	SRP	TKN	NO_3 / NO_2	NH_4
µg/L	µg/L	µg/L	µg/L	µg/L
27	9	314	128	67
29	9	231	120	32
21	9	171	73	31
20	8	171	77	33
26	8	250	64	52
24.6	8.6	227.4	92.4	43

Mean

Nutrients

- Nitrogen & Phosphorus

Stormflow Nitrogen & Phosphorus				
TP	SRP	TKN	NO_3 / NO_2	NH_4
µg/L	µg/L	µg/L	µg/L	µg/L
172	27	678	263	132
194	35	1303	352	291
163	33	796.5	277	127
137	42	736	168	112
128	42	1025	296	347
159	36	908	271	202

Mean

Bacteria

- Currently measured by total fecal coliform
- *E. coli* comprises 85-95% of fecal coliform
- The vast majority of *E. coli* bacteria are not human pathogens and in most cases are beneficial to humans by aiding in digestion.
- Fecal coliform is used as an indicator for fecal-borne pathogens

Bacteria Standards

- Recreational Standards (not Drinking)
- Standards were developed to protect against human gastrointestinal distress (Stomach illness for 24-48 hours)
- Assumes incidental ingestion of water during recreation
- Does not assume full body contact/swimming

Bacteria

- The human health standard for fecal coliform is a geomean of 200 cfu/100 ml.

  (14 cfu/100ml salt water)

  CFU = Colony Forming Units
- A mean is used due to erratic spikes and drops in the data. 4 to 5 samples need to be collected per month
- We only have preliminary samples

Bacteria

Black Creek Fecal Coliform		
Site	**CFU/100ml**	**CFU/100ml**
	6/5/2007	**6/19/2007**
EF1		590
WF1		365
EF2	295	140
WF2	280	570
MS1	235	117

Ellerbe Creek Fecal Coliform 2006
304
255
152
140
330
1691*
2393*
501
4309*
1309*
304
255

*Ellerbe Creek “Parameters of Concern”

Aquatic Macroinvertebrates

Data DWQ & BC Tech Team	Date	Total Taxa (# species)	Total EPT (# species)	EPT N (abundance)	EPT Biotic Index	EPT score	Biotic Index	Biotic Index Score	Classification
Assumed Main Stem	1994		**11**	53	5.79	2			fair
Assumed Main Stem	2000		**8**	50	6.34	1.6			fair
EF2	4/20/2006	27	adj. 5	adj. 14	5.9	1	7.38	2	1 poor
WF2	4/20/2006	19	3	12	7	1	7.62	1	1 poor
MS1	4/20/2006	24	4	26	7	1	7.27	2	1 poor
EF2	10/19/2006	10	2	6	6.6	1	7.5	1.4	1 poor
WF2	10/19/2006	10	4	4	5.48	1	7	2	1 poor
MS1	10/19/2006	18	5	43	5.7	1	6.55	2	2 fair
EF2	`5/15/2007	17	3	21	in progress				(poor by old method)
WF2	`5/15/2007	16	3	14	in progress				(poor by old method)
MS1	`5/15/2007	27	5	43	in progress				(poor by old method)

Synoptic Sampling

- For initial storm flow “first flush”
- Current monitoring of stormwater is peak flow
- Requires multiple volunteers with equipment to synchronize sampling at the beginning of a storm before a known / “planned” storm
- Brief training may be required, open schedule, cell phone minutes…

Questions?