Assessment of Forest Cover in the High Rock Lake Watershed of North Carolina

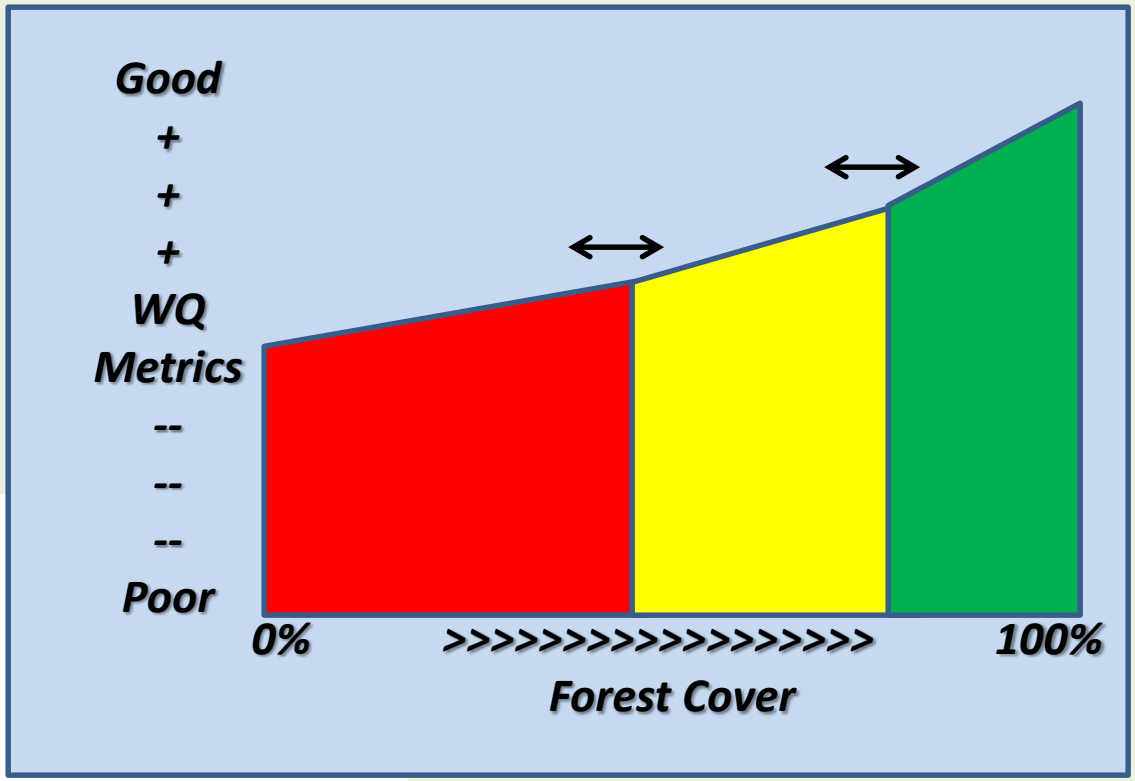
NCDA&CS North Carolina Forest Service

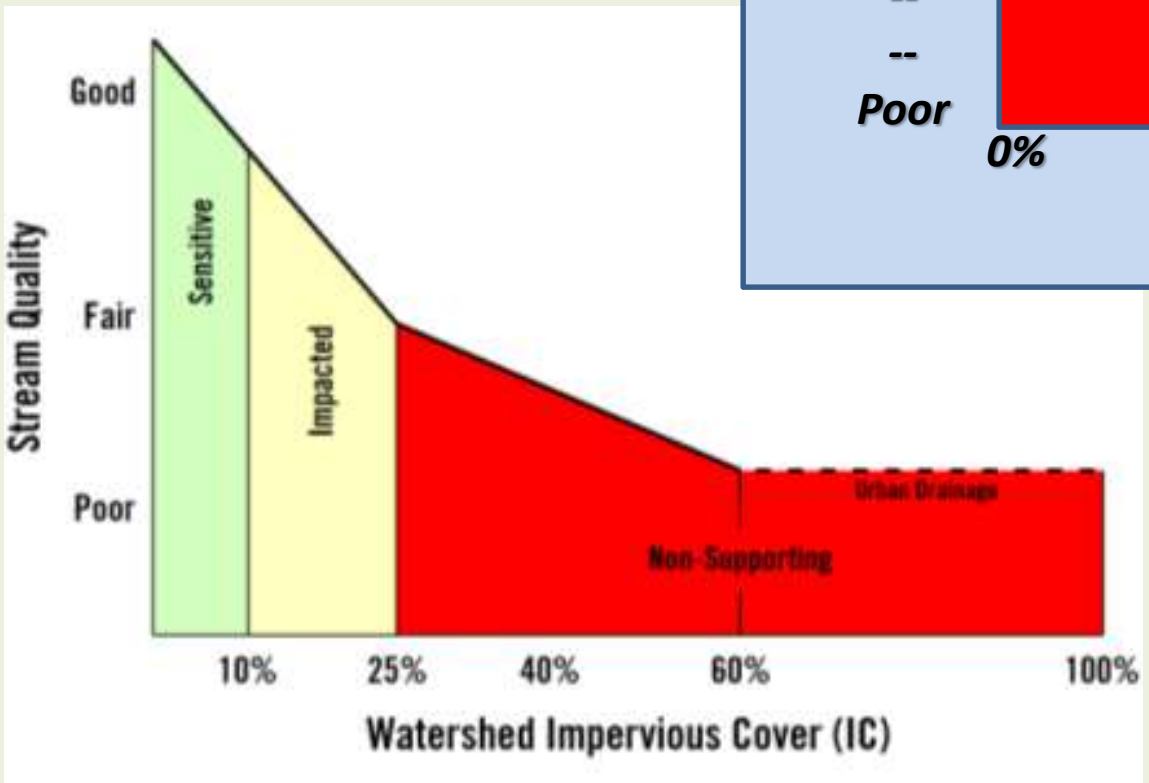
Primary Funding by a Cooperative Grant (11DG-11083137-001) from the USDA-Forest Service, State & Private Forestry Div., Urban & Community Forestry Program; supported by a USEPA Nonpoint Source Program Section 319 Grant.

Watershed Analysis Conducted by the Center for GIS Sciences in the University of North Carolina at Charlotte.

Purpose & Intent

Theoretical Forest Cover Model





Center for Watershed Protection, Impervious Cover Model

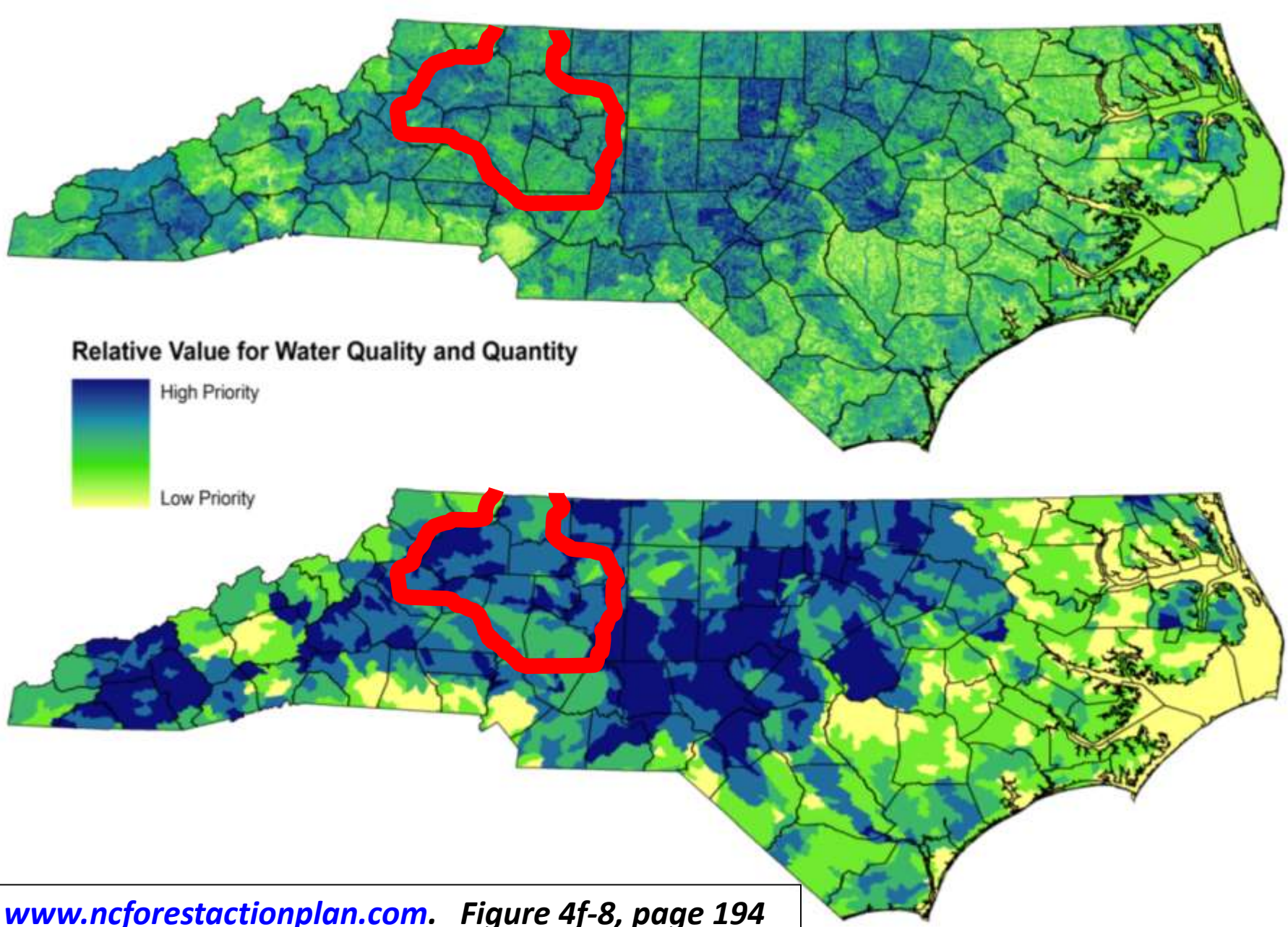
Desired Outcomes

- **Determine correlation between:**
  - **forest cover and watershed biology (ie: quality)**
  - **forest cover and raw/source water quality**
  - **forest cover and water treatment costs**
- **Tests method to assess forest cover**
- **Identify method to assess streams where conservation practices might be appropriate and get a high benefit : cost.**
- **Identify parcels for possible recon & contact**

Study Location

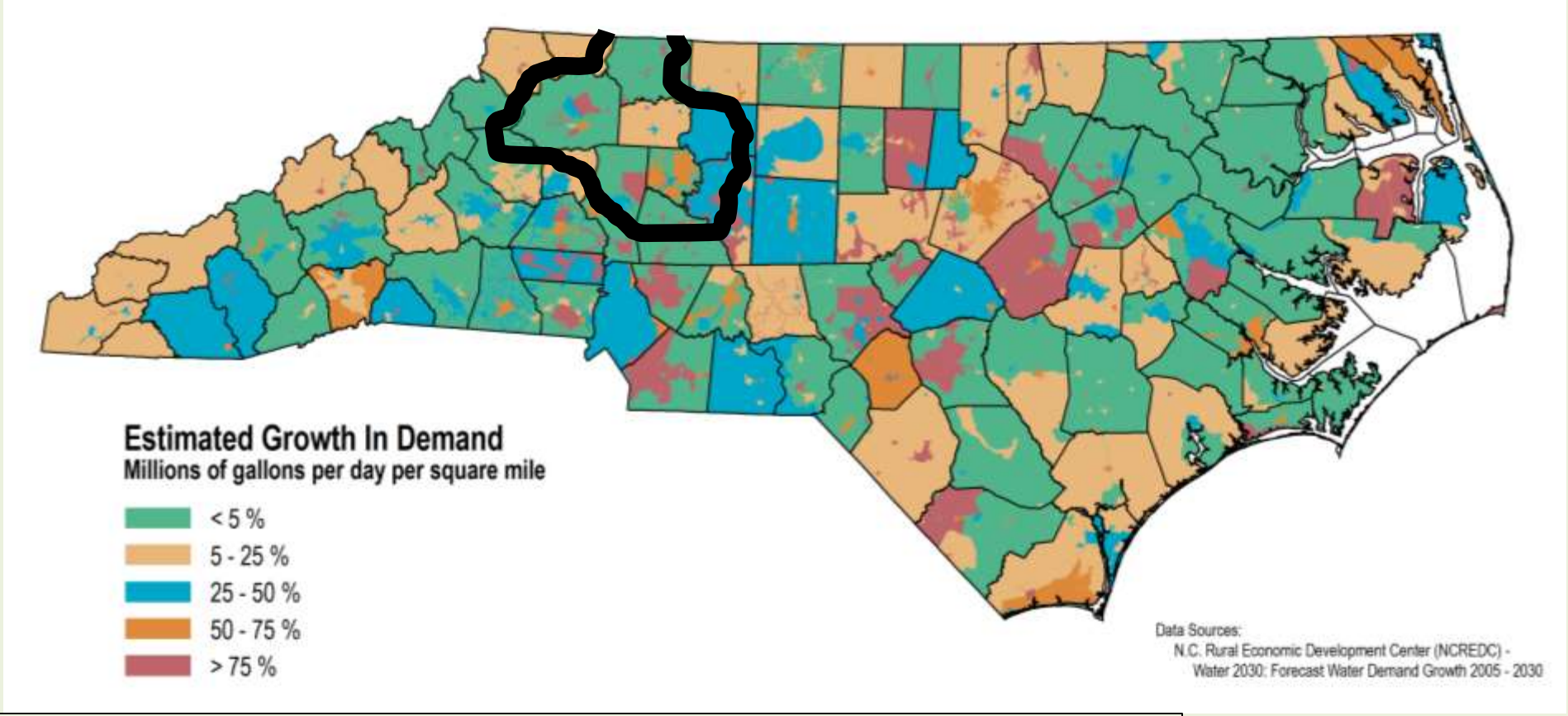
- **High Rock Lake watershed**
  - **upper Yadkin River: ~ 3,970 square miles**
- **TMDL for High Rock Lake in progress**
- **Add to the base of knowledge, data**
- **Diverse land use/cover**
  - **65% forest, 20% ag, 15% urban**
- **NC *Forest Action Plan* WQ&Q Assessment:**

Priority Forests for Water Quality & Quantity



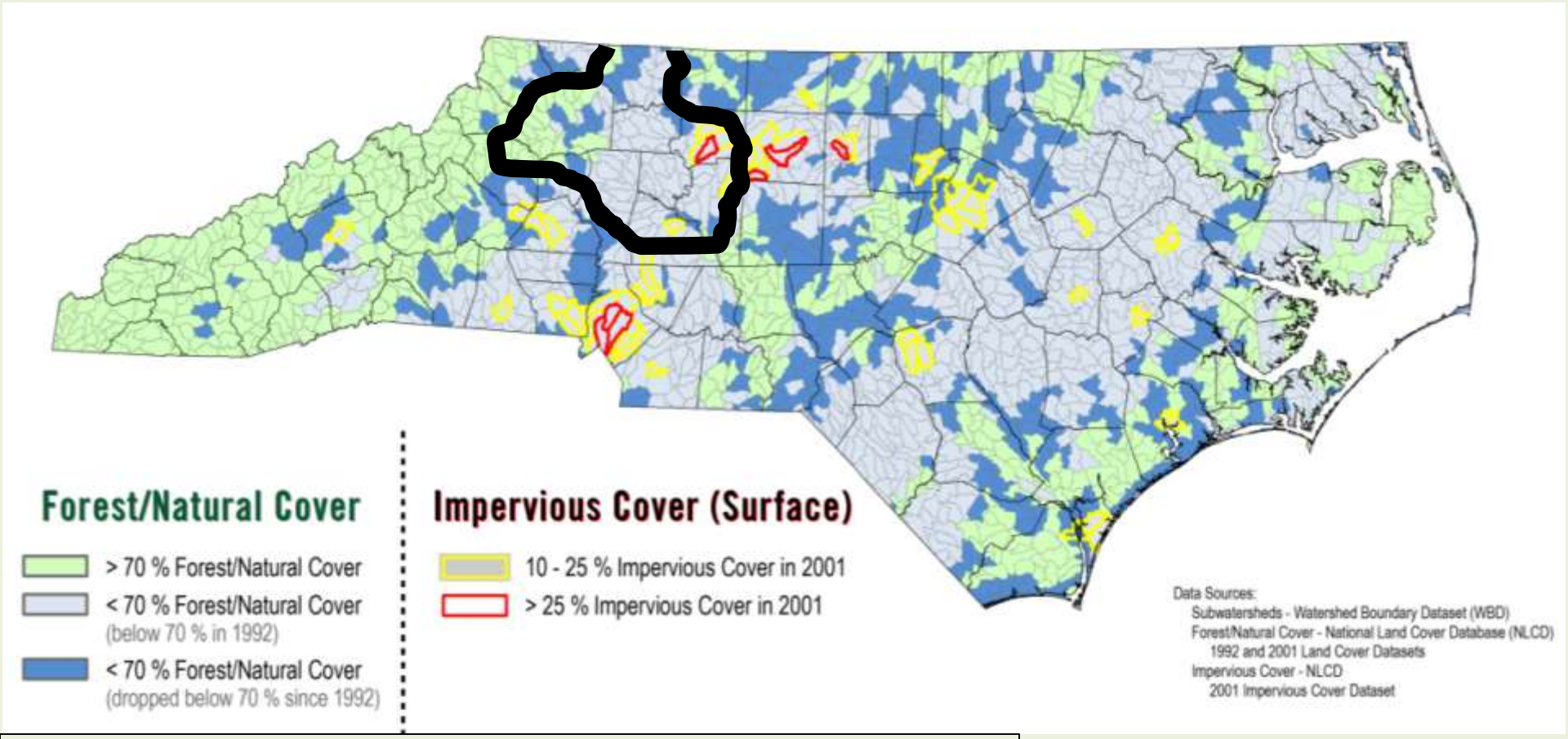
www.ncforestactionplan.com. *Figure 4f-8, page 194*

Forecast Changes in Water Demand



www.ncforestactionplan.com. Adapted From Figure 4f-7, page 193

Changes in Subwatershed Land Cover



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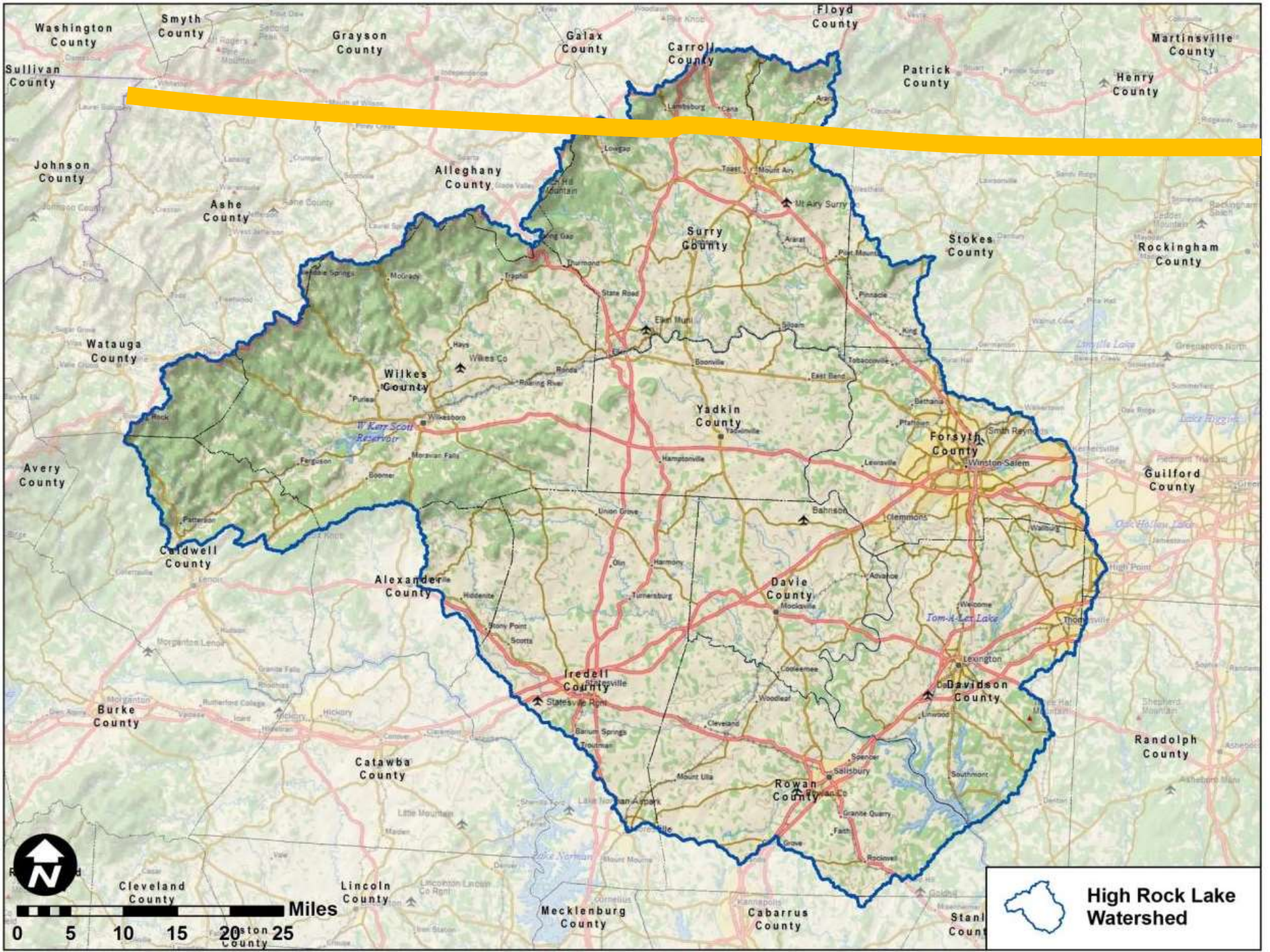
Washington County
Smyth County
Grayson County
Galax County
Carroll County
Floyd County
Martinsville County
Sullivan County
Patrick County
Henry County
Johnson County
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Ashe County
Surry County
Stokes County
Rockingham County
Watauga County
Wilkes County
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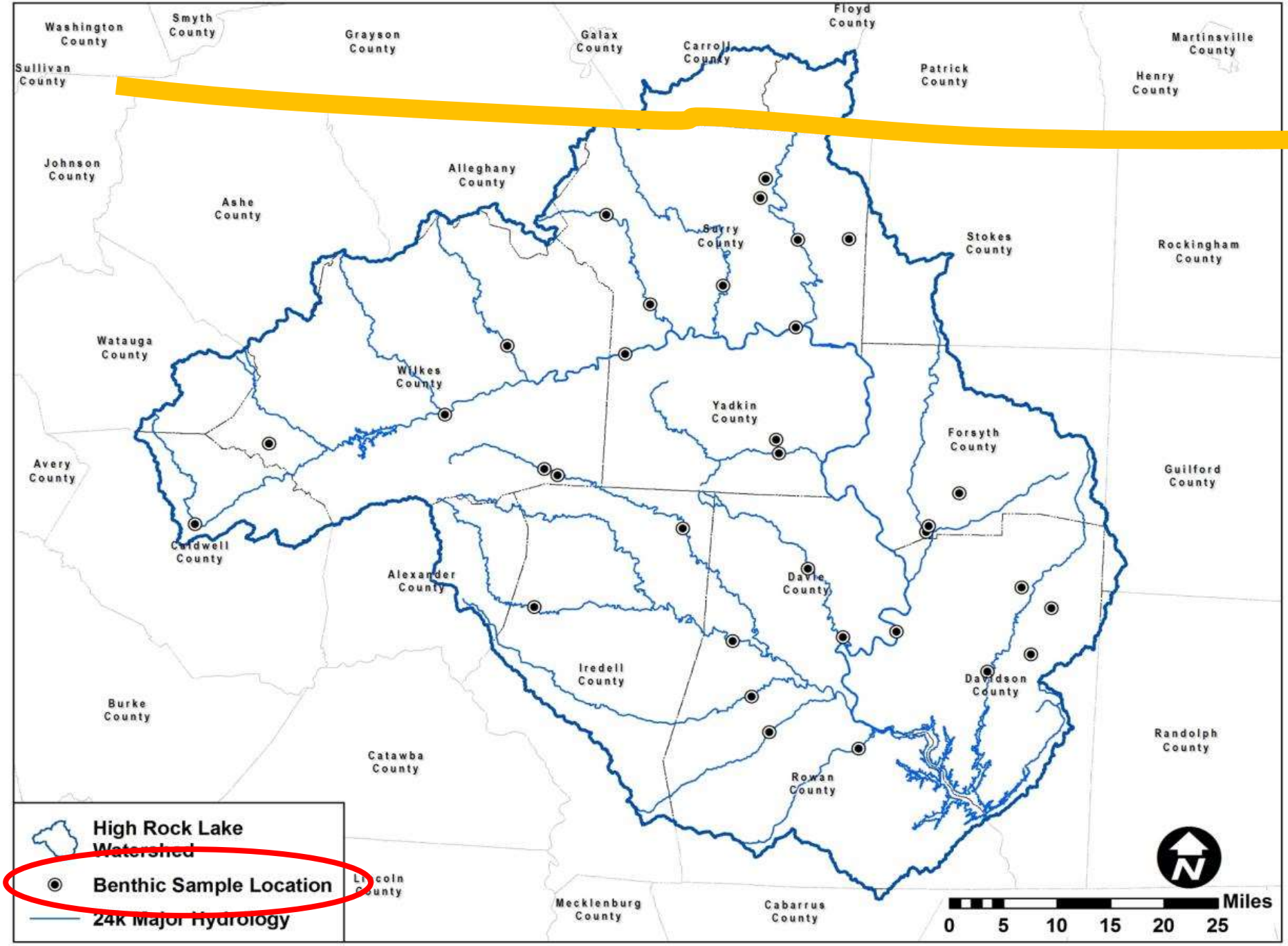
Forsyth County
Avery County
Guilford County
Caldwell County
Alexander County
Davie County
Iredell County
Davidson County
Burke County
Randolph County
Catawba County
Rowan County
Cleveland County
Lincoln County
Mecklenburg County
Cabarrus County
W Kerr Scott Reservoir
Tom-A-Lex Lake
Miles
0 5 10 15 20 25
High Rock Lake Watershed

1. Forest Cover & Water Quality

- **Benthic macroinvertebrates samples**
- **Serve as a proxy for water quality**
- **NC Div. of Water Resources data source**
- **71 individual datasets, from 33 locations, covering 5 specific years** (92, 01, 06, 08, 11)
- **Detailed statistical analyses by UNCC**
- **Sample Locations:**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Randolph County
Catawba County
Rowan County
Lincoln County
Mecklenburg County
Cabarrus County
High Rock Lake Watershed
Benthic Sample Location
24k Major Hydrology
N
Miles
0 5 10 15 20 25

1. Forest Cover & WQ - Findings

More Forests =>>>>>= Better WQ!

Thresholds Identified:

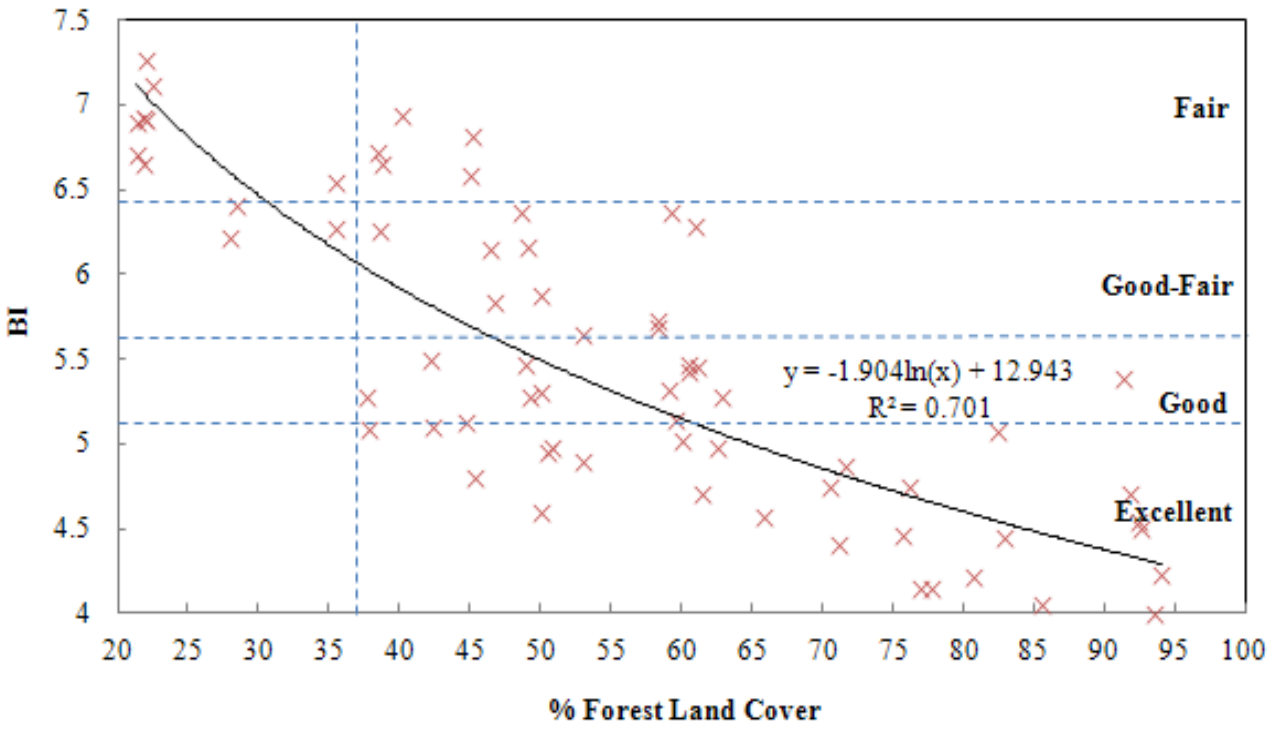
- **When Forest cover is ~40%$^{+}$ …..better WQ**
- **When Natural cover is ~50%$^{+}$ …..better WQ**
- **When Urban cover is ~20%$^{+}$ …..lower WQ**
- **No correlation found for Ag land cover** (scatterplot)

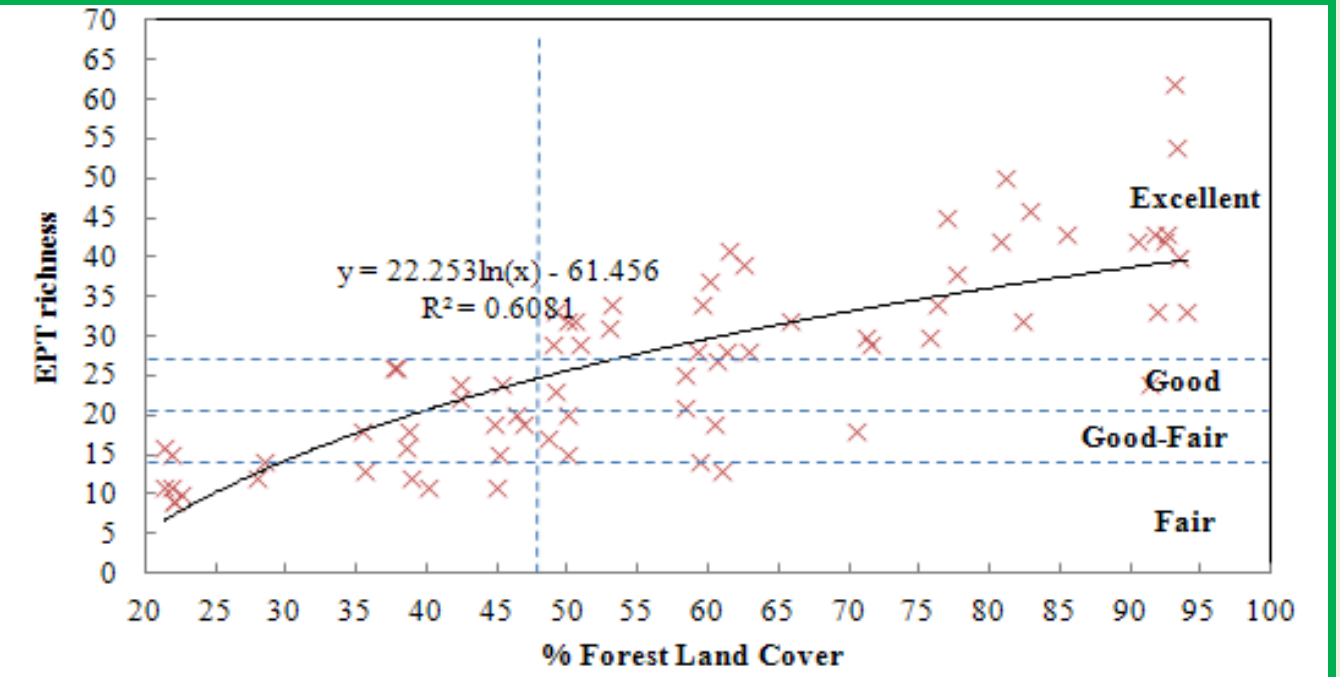
Biotic Index Correlation to Forest Cover

(lower B-I is better)

Breakpoint = 37%

Graph Produced by CAGIS @ UNC-C





EPT Richness Correlation to Forest Cover

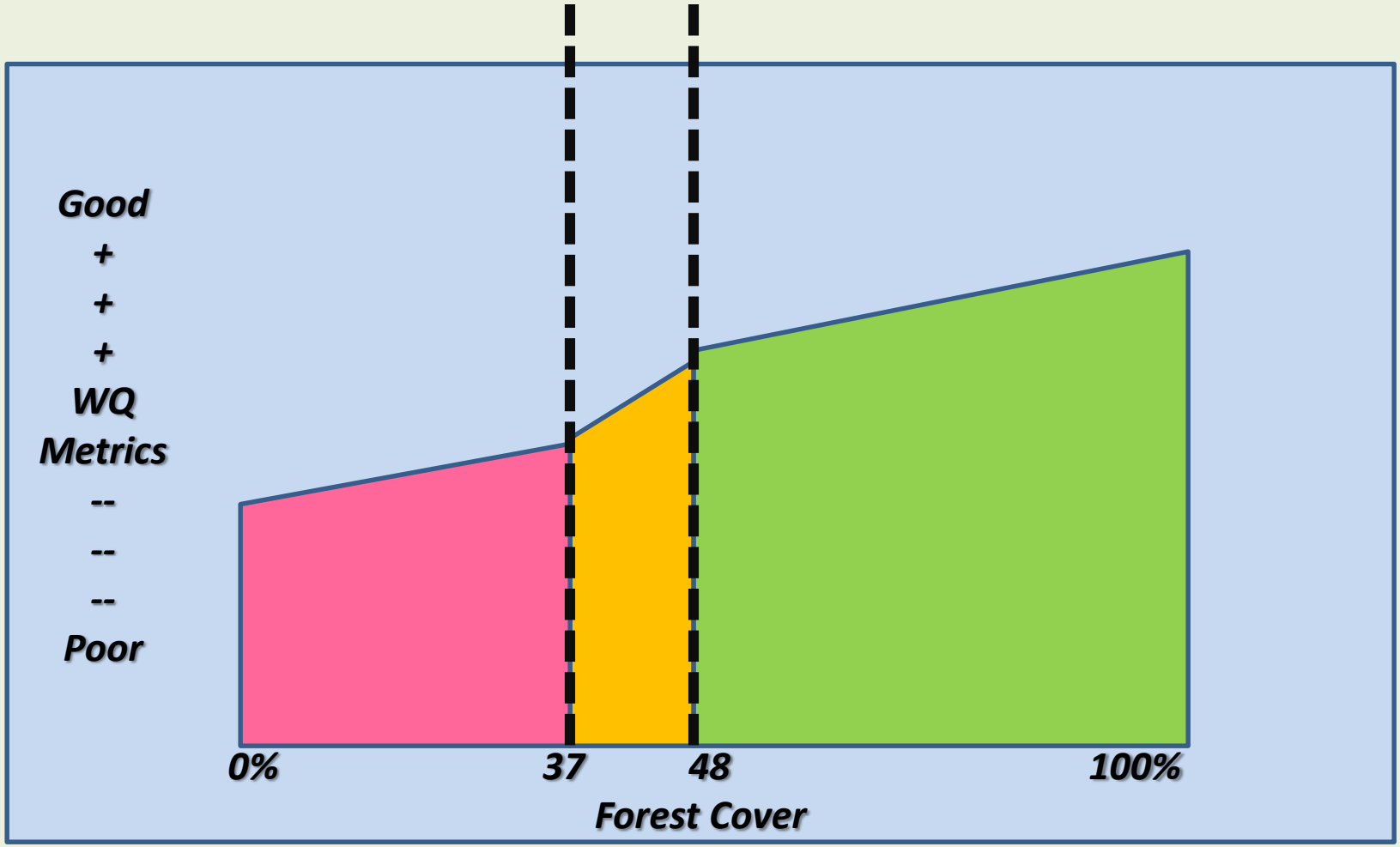
(higher EPT is better)

Breakpoint = 48%

Graph Produced by CAGIS @ UNC-C

1. Forest Cover & WQ - Findings

The Forest Cover Model for High Rock Lake Watershed…

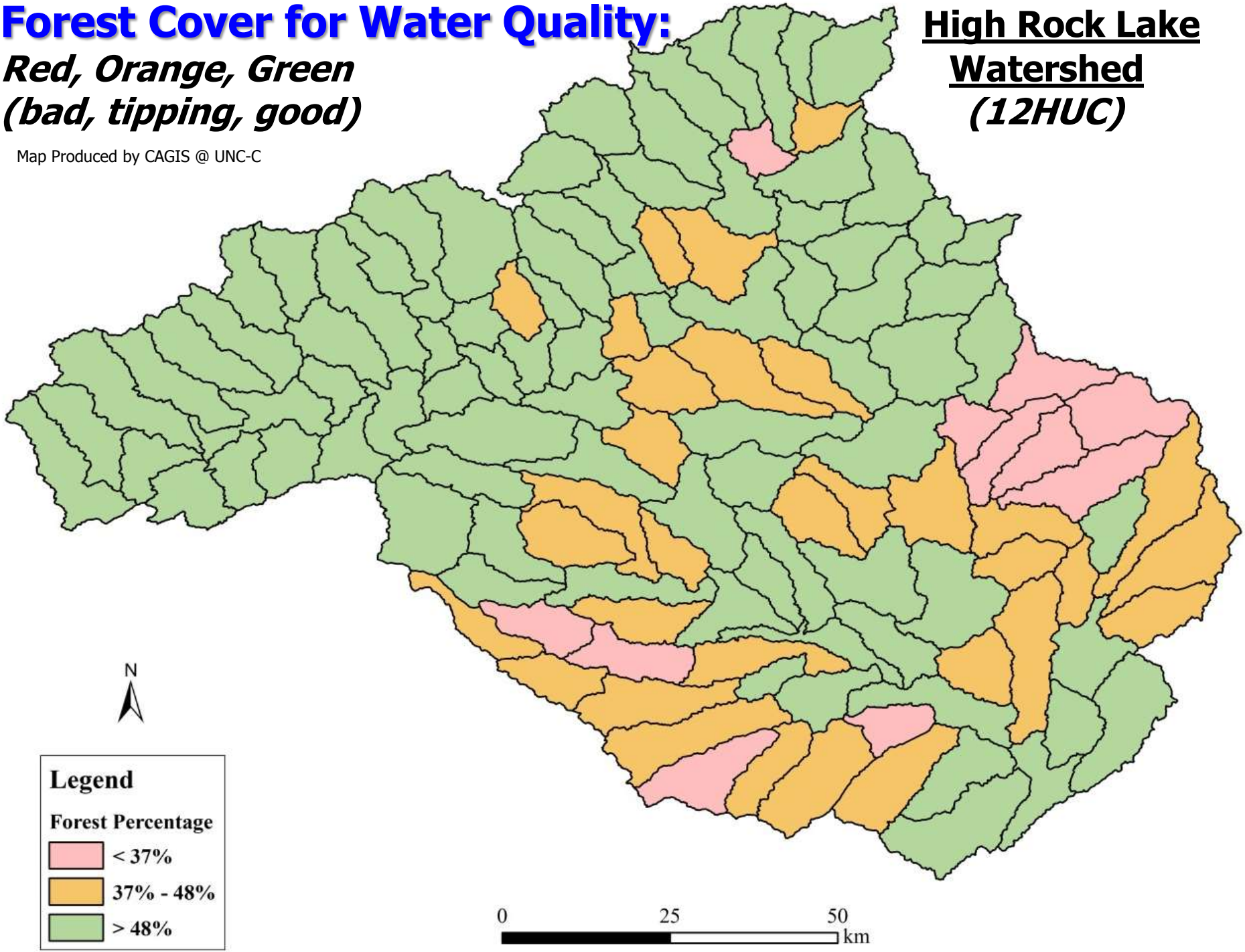


Forest Cover for Water Quality:

Red, Orange, Green
(bad, tipping, good)

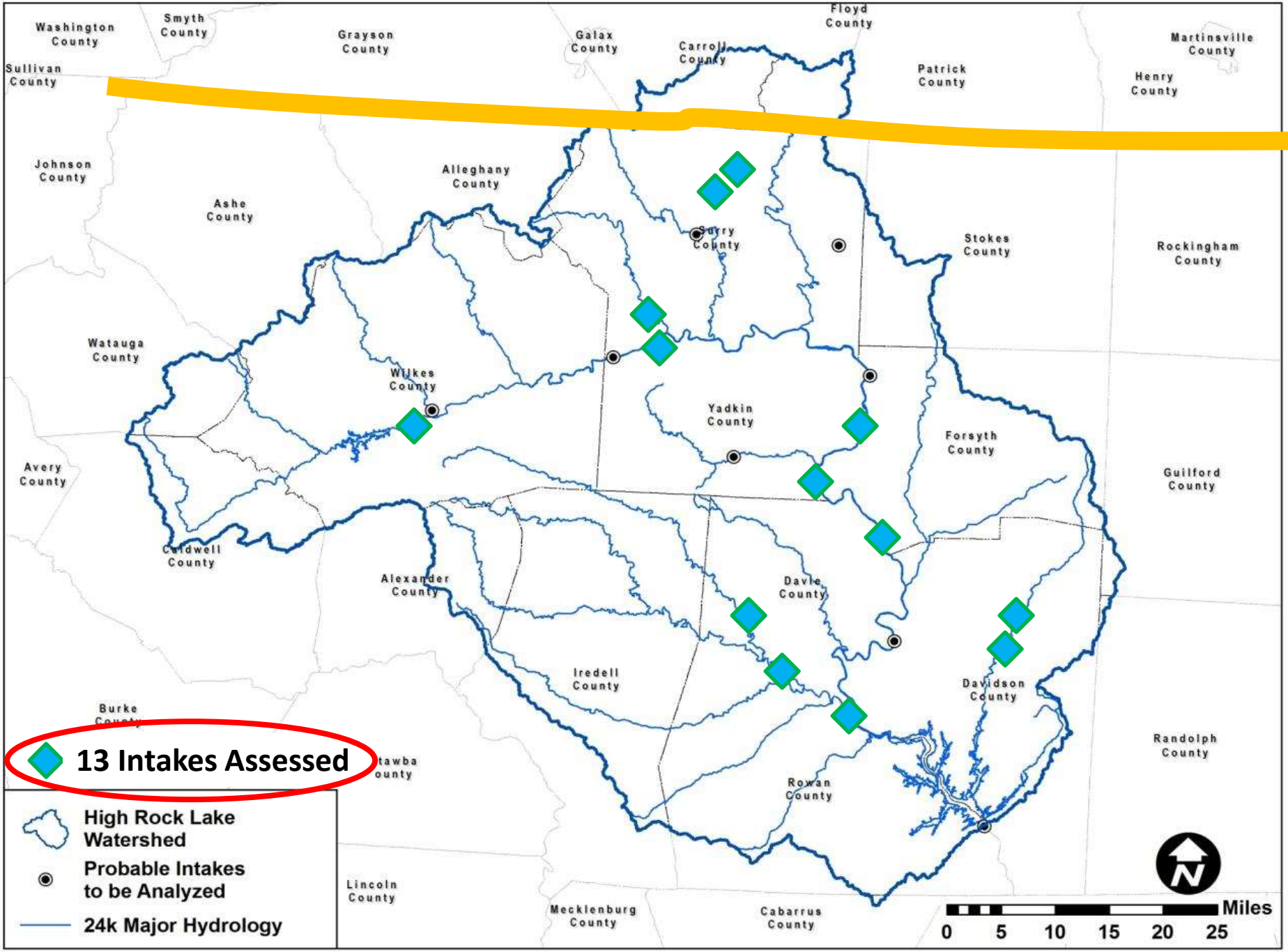
High Rock Lake Watershed
(12HUC)

Map Produced by CAGIS @ UNC-C



2. Land Cover & Water Supply

- **Data(?) from 13 water intakes**
- **Raw water grab samples, pre-treatment**
  - **Turbidity and Coliform @ the WTP**
- **Obtained estimates of treatment costs**
- **This proved to be most challenging aspect**
- **Consider this as more of a "case study"……**
- **Water Supply Intake Locations:**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Iredell County
Davidson County
Randolph County
Burke County
Rowan County
Lincoln County
Mecklenburg County
Cabarrus County
13 Intakes Assessed
High Rock Lake Watershed
Probable Intakes to be Analyzed
24k Major Hydrology
Miles
0 5 10 15 20 25

2. Land Cover & WS – Findings(?)

No Clear, Strong Relationships. Small dataset.

Weak Statistical Correlations (all $r^2 < 0.50$).

Study found higher turbidity when:

- **Forest cover falls below 60% to 70%**
- **Ag cover is more than 15% to 25%**

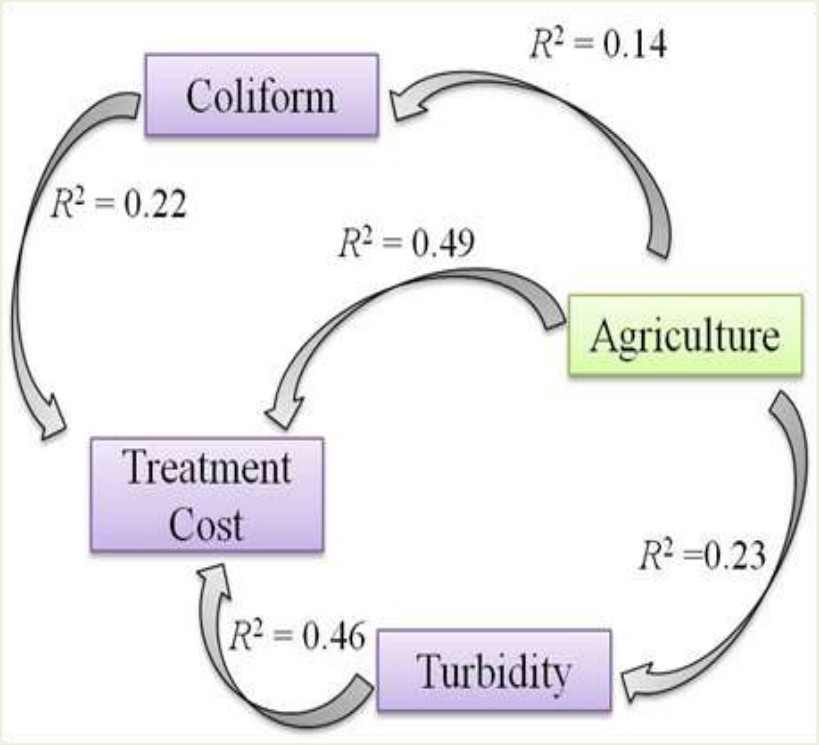
Cost of treating potable water higher when:

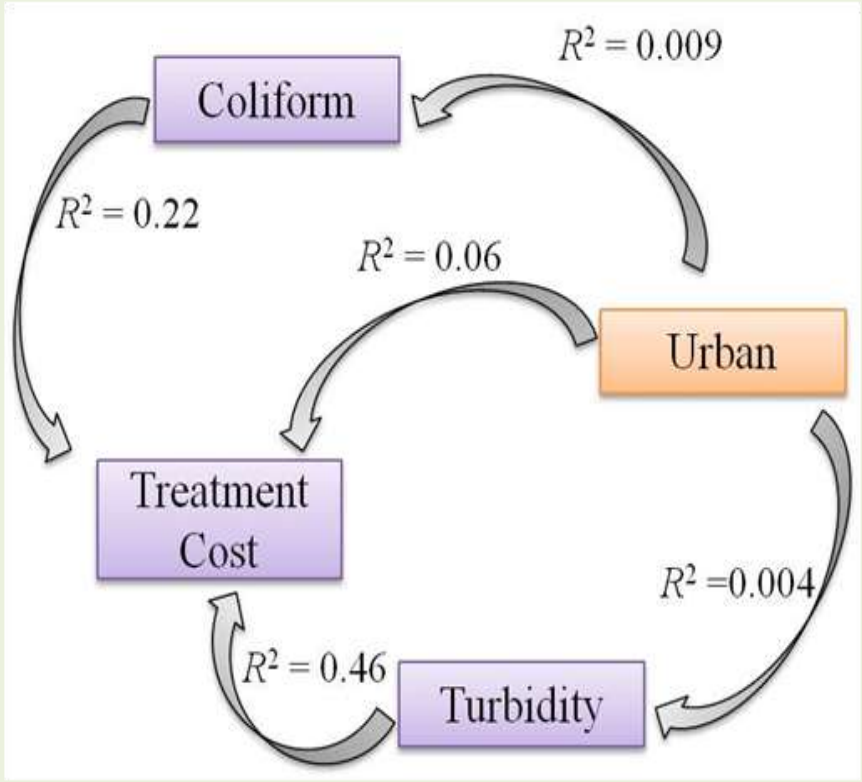
- **Higher turbidity or coliform**
- **More Ag land (trend is stronger @25% cover or more)**

Cost of treating potable water lower when:

- **Forest cover is ~70% or more**

2. Land Cover & WS – Findings?





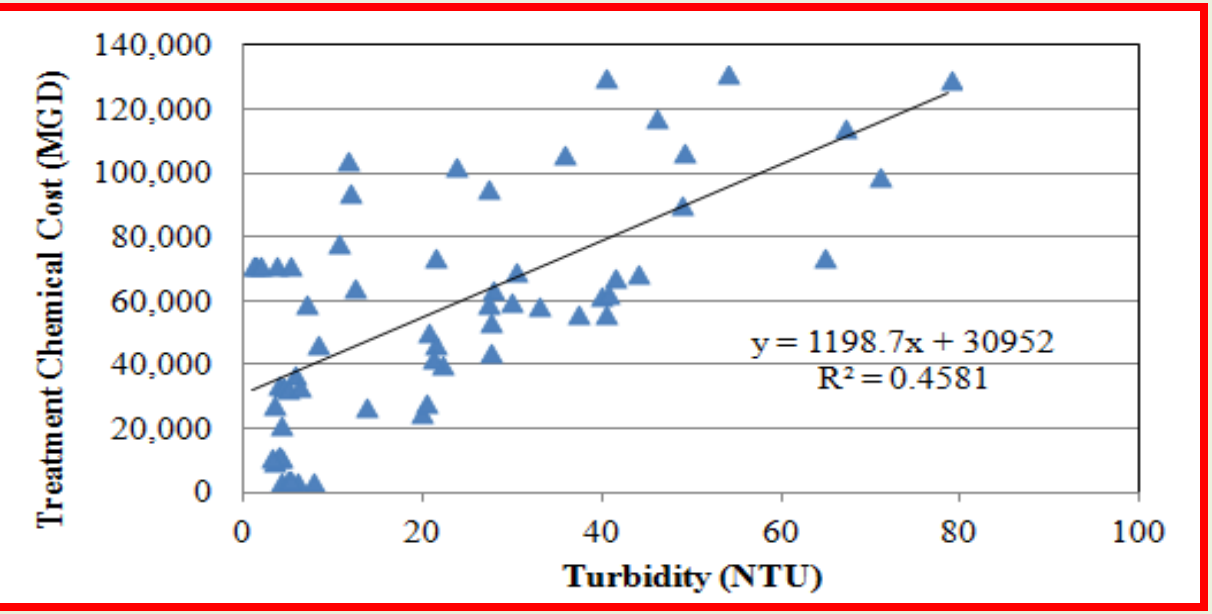
Illustrations Produced by CAGIS @ UNC-C

Many inter-relationships between multiple factors.
Similar to a pleasant summer breeze…… *"light & variable"*

Ag land cover seems to be the strongest variable on treatment cost.
Urban land cover seems to be…… a non variable????

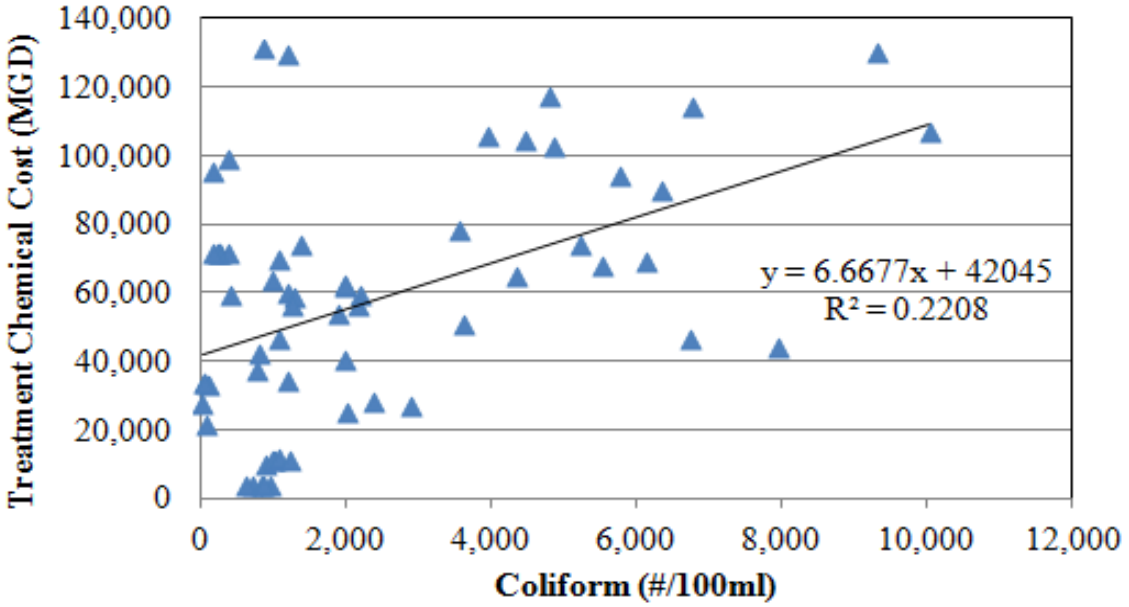
Land cover is stronger variable when stream buffers are smaller (urban)

Water Treatment Cost$, versus:



Turbidity

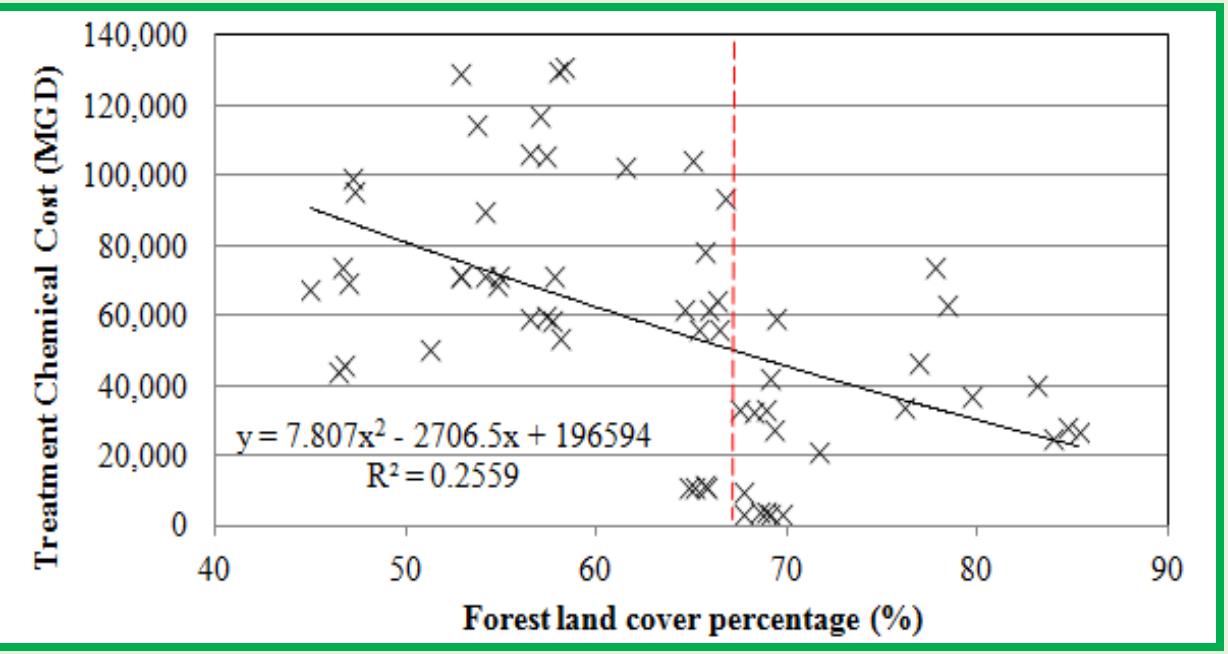
Graph Produced by CAGIS @ UNC-C



Coliform

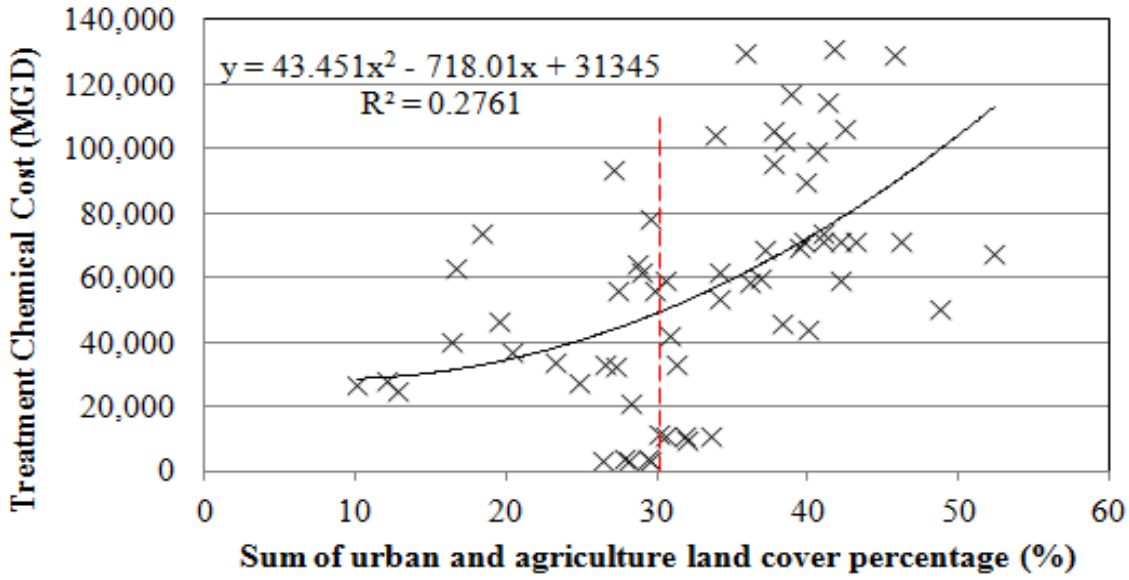
Graph Produced by CAGIS @ UNC-C

Water Treatment Cost$, versus:



Forest land cover

Graph Produced by CAGIS @ UNC-C



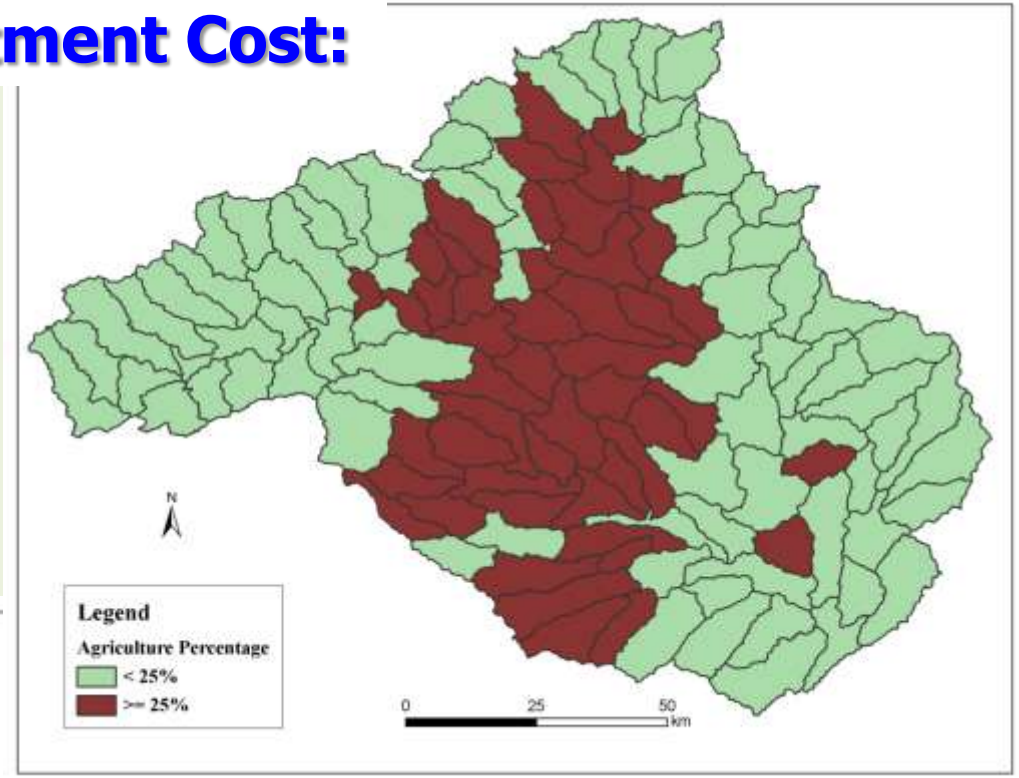
Urban + Ag land cover

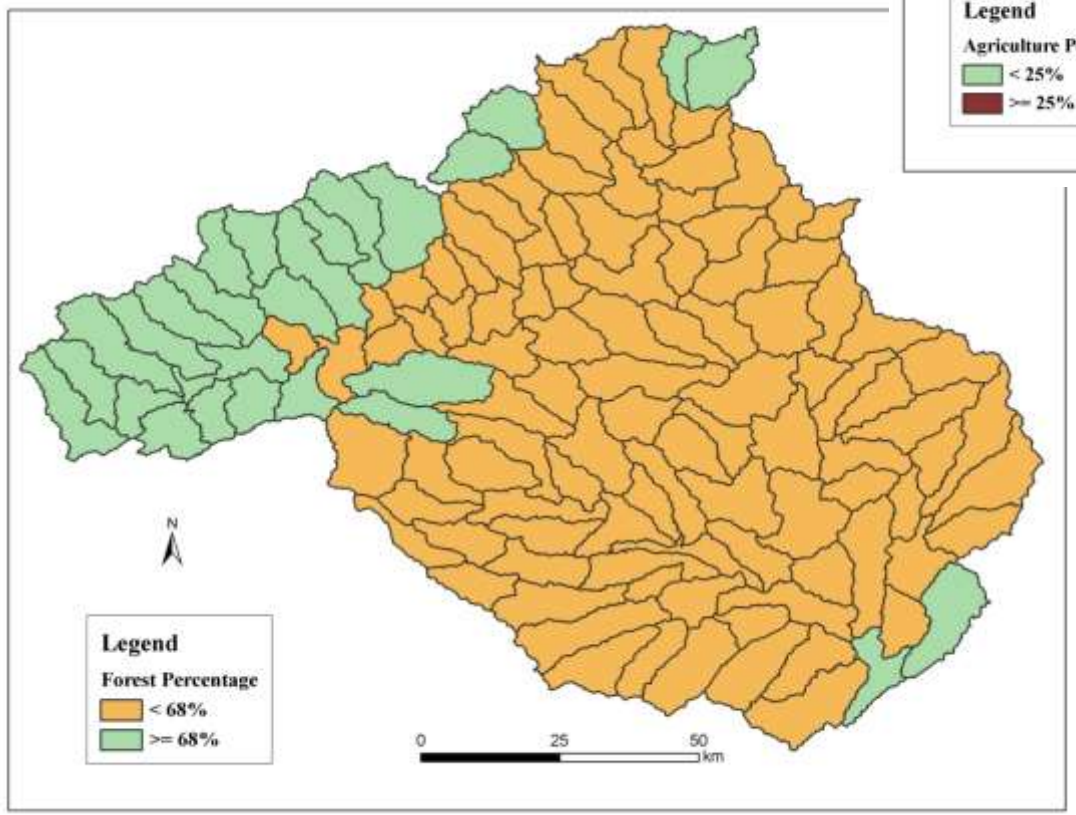
Graph Produced by CAGIS @ UNC-C

Land Cover for Water Treatment Cost:

Maps Produced by CAGIS @ UNC-C

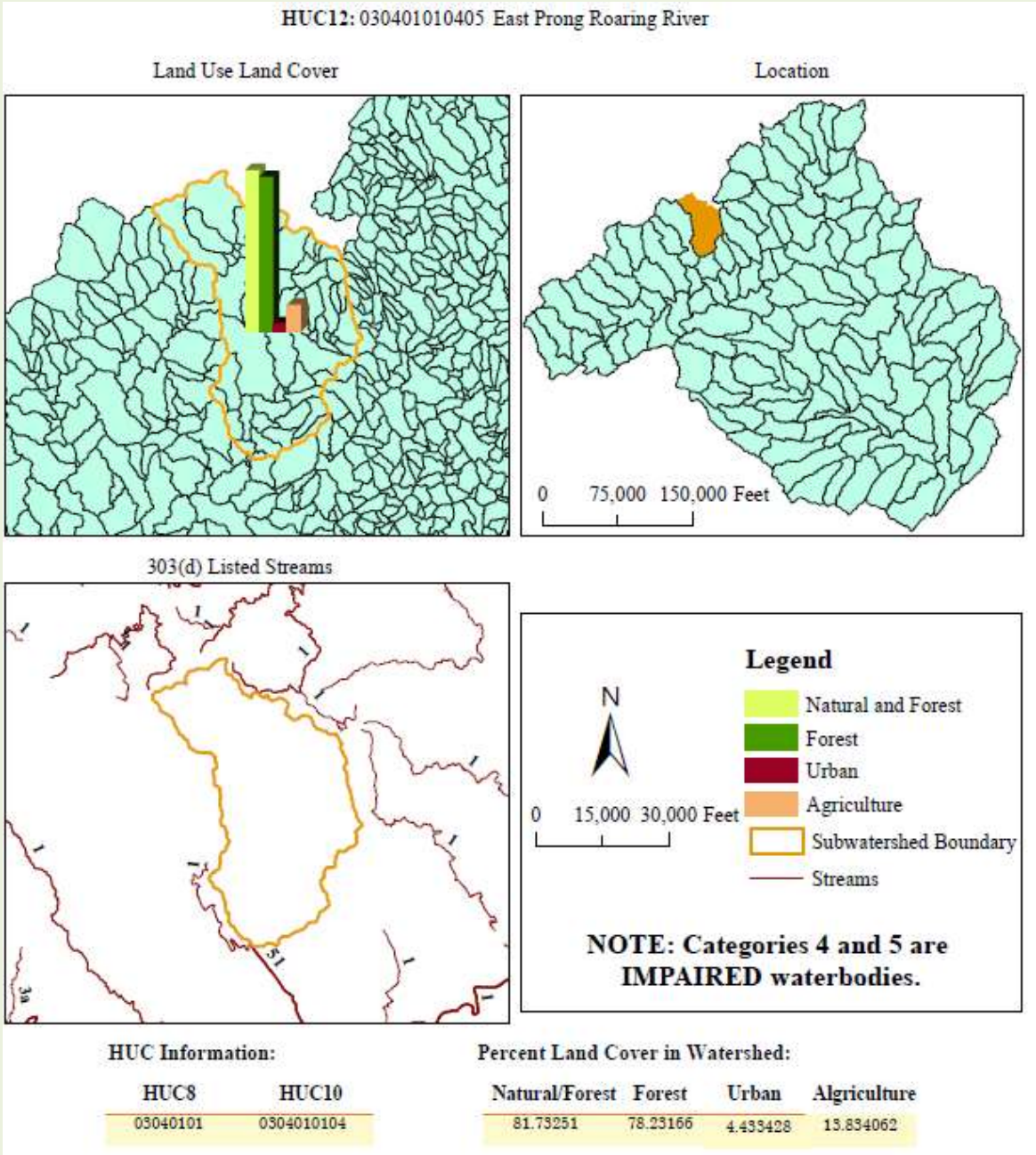
Agriculture Variable:
(25% break point)





Forest Variable:
(68% break point)

3. Forest Cover & Buffer Analyses



Example:
East Prong Roaring River

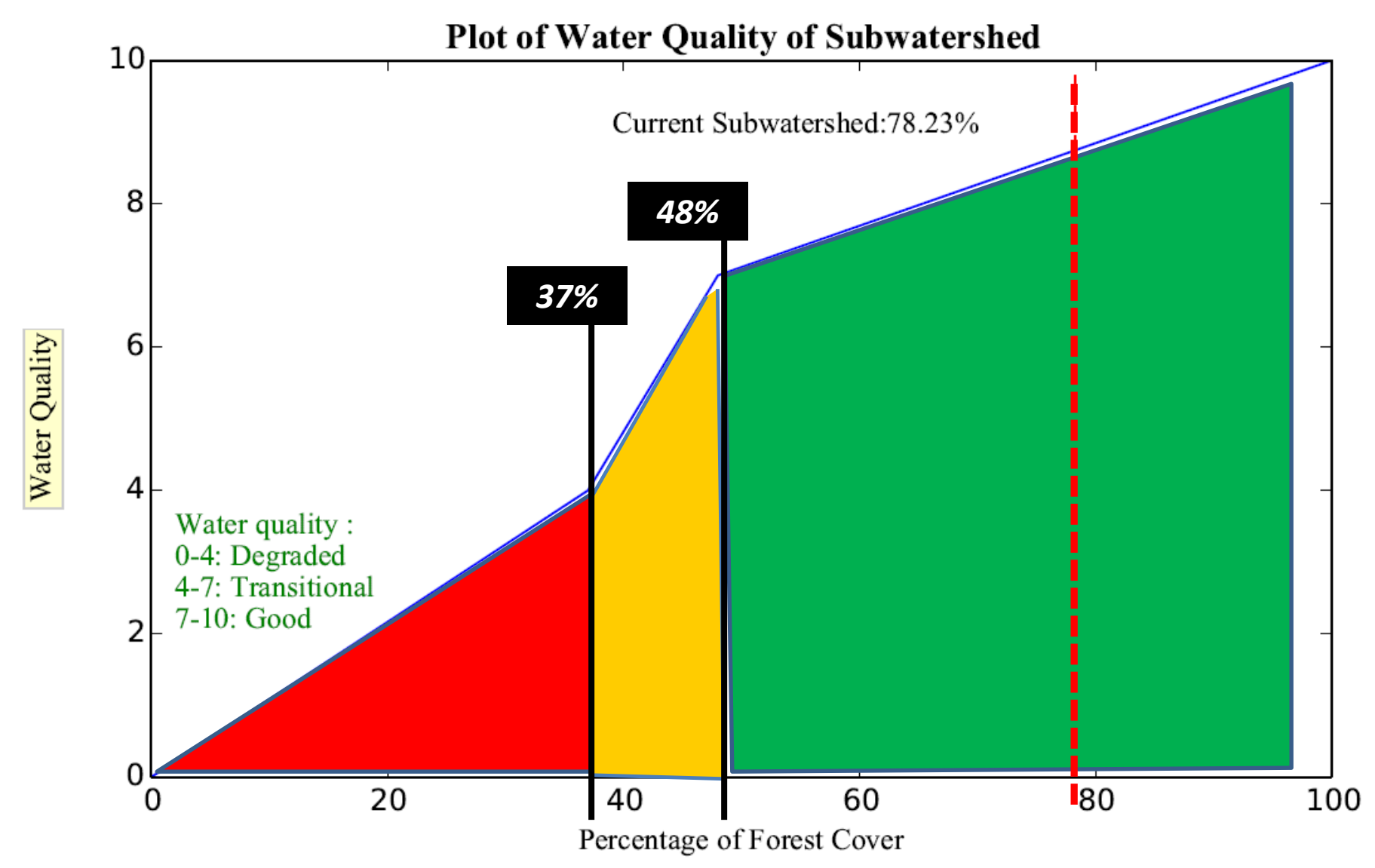
Report generated for each of the 12HUC subwatersheds (127)

- **LULC**
- **Location**
- **303d listed streams**
- **% land cover**

Report Produced by CAGIS @ UNC-C

Subwatershed "snapshot report" – Page 2

Example:
East Prong Roaring River



Blue line curve represents one possible version of a "forest cover model", based on results from WQ assessment of biotic parameters

Zoomed-in to 6 subwatersheds.

Forest cover was compared between 1m and 10m resolution.

A stream buffer analysis was also done in each.

Example:
High Rock Lake Subwatershed

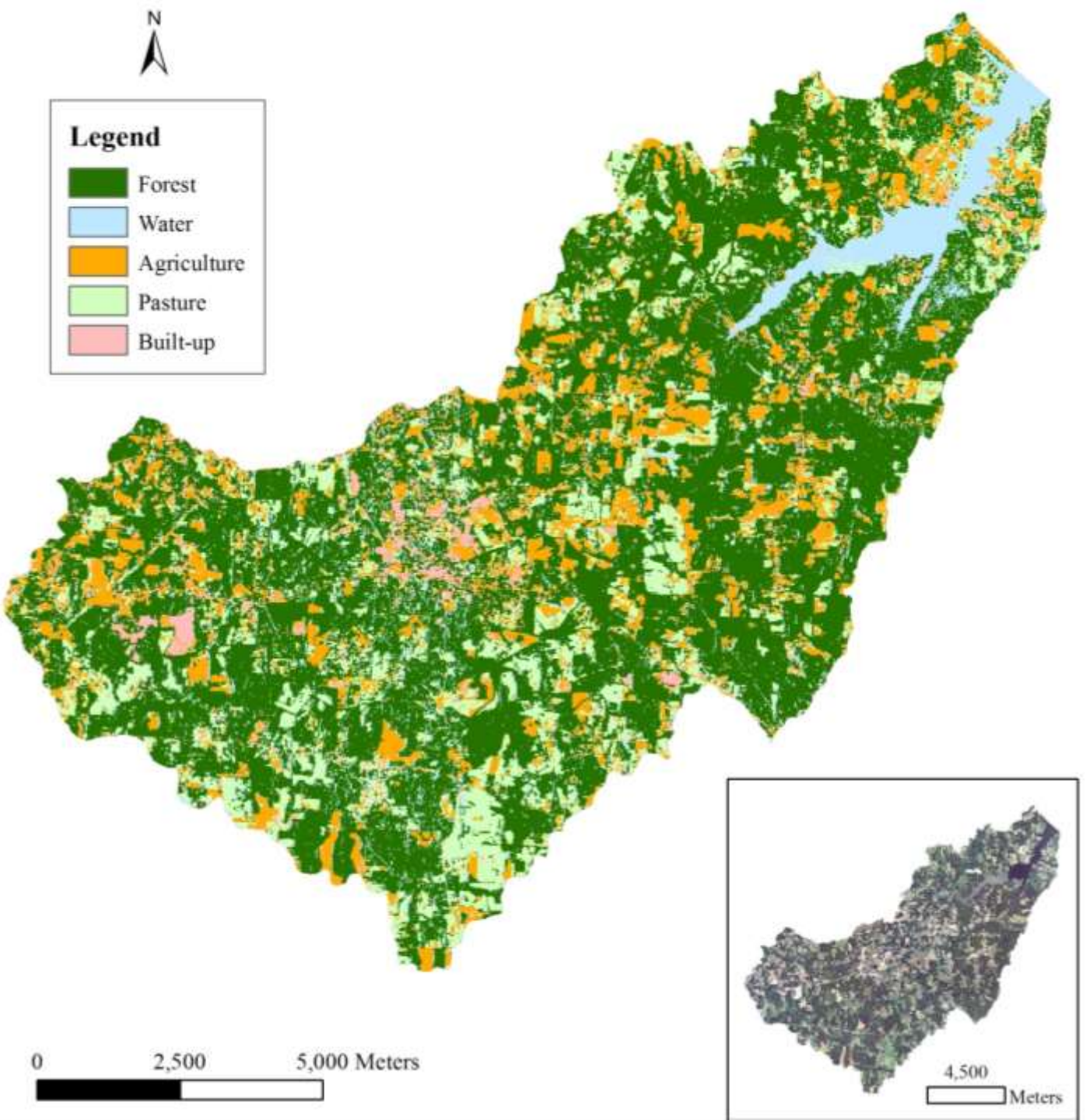
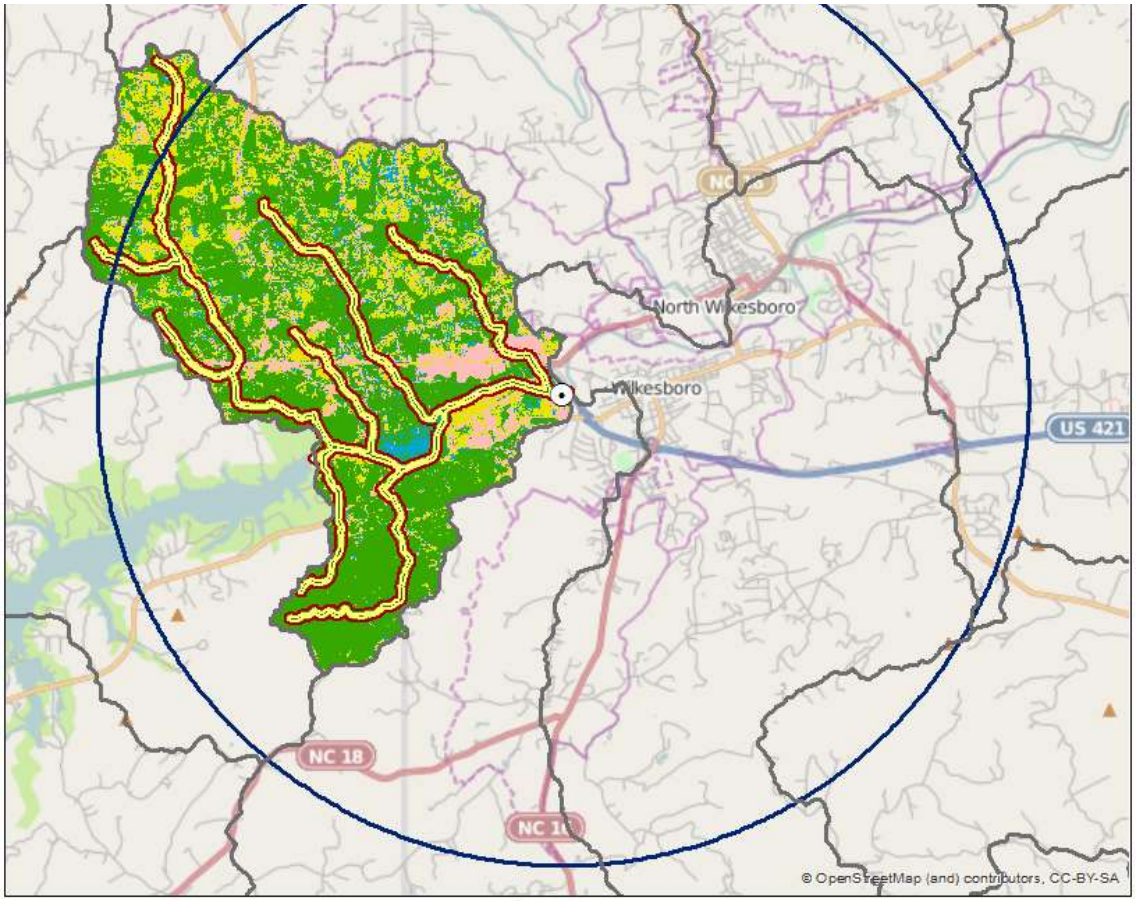
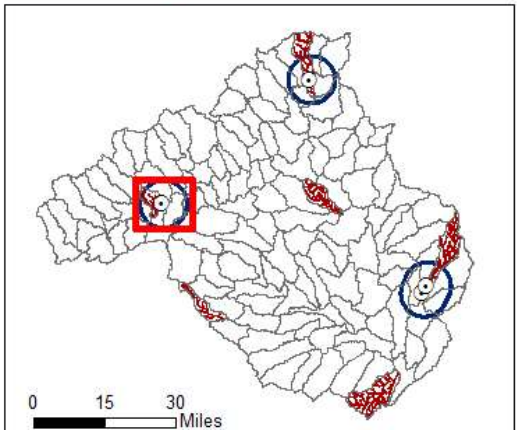
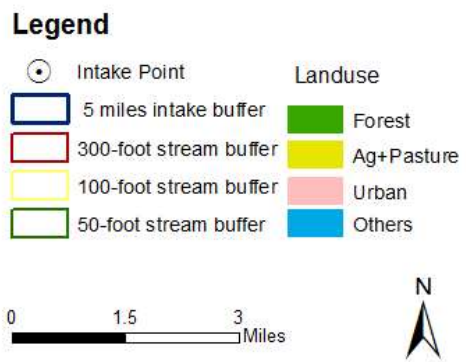


Illustration Produced by CAGIS @ UNC-C

Further Analysis of the 6 Subwatersheds







Example:
Reddies River/Yadkin River

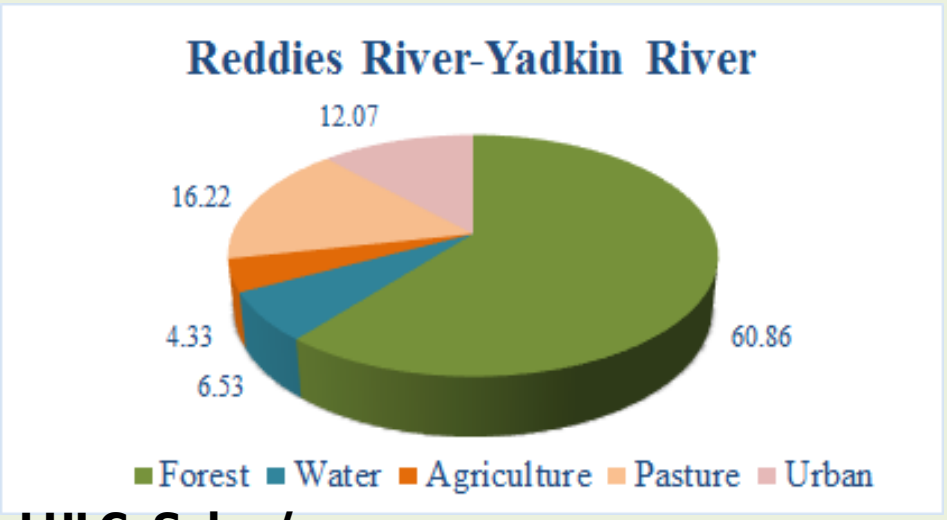
Stream Buffer Analysis:

- **LULC @ 1-m resolution**
- **Stream Buffers @ 50, 100, 300 feet on major streams**
- **A 5-mile radius of any water supply intakes**

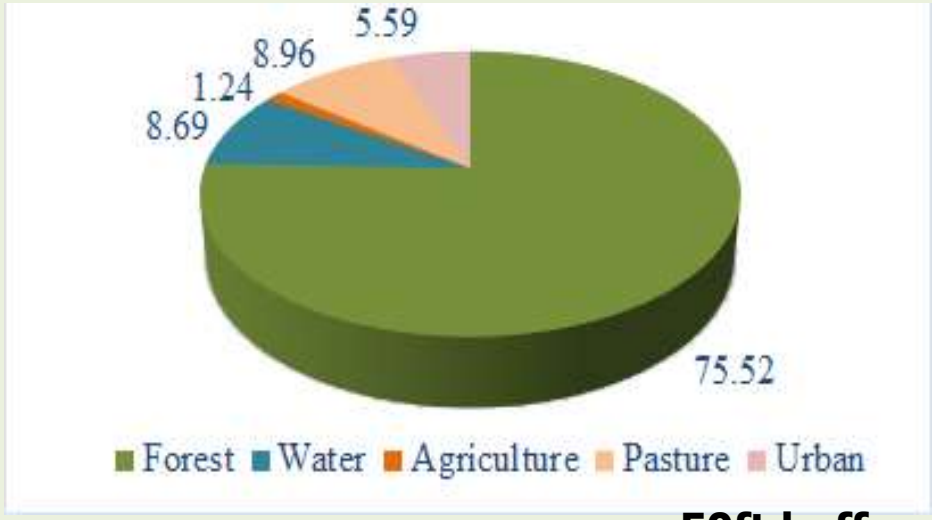
This analysis was also done for each of these same 6 subwatersheds.

Report Produced by CAGIS @ UNC-C

Stream Buffer Analysis: Reddies River subw/s



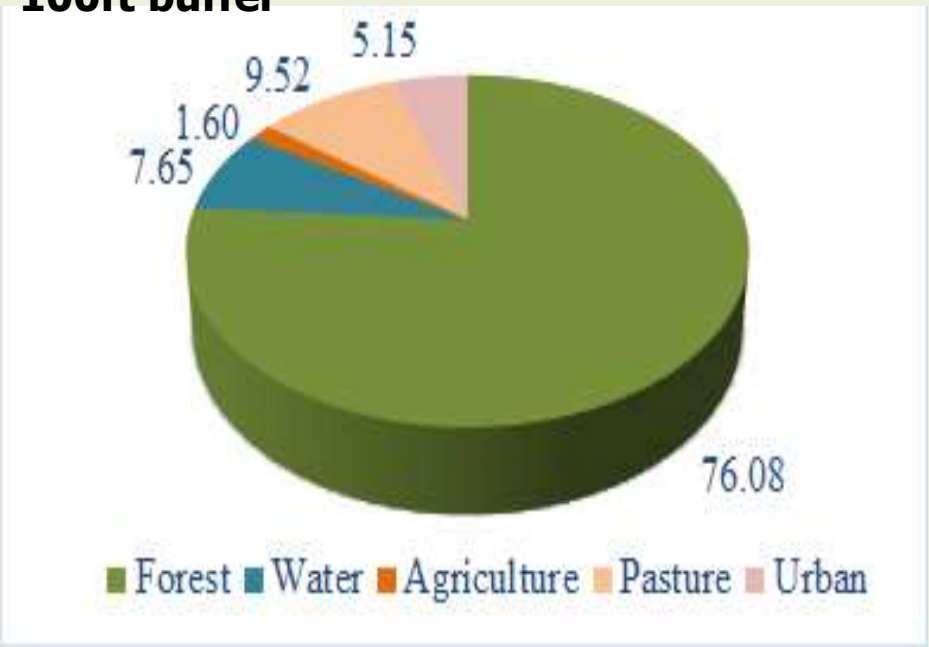
LULC Subw/s



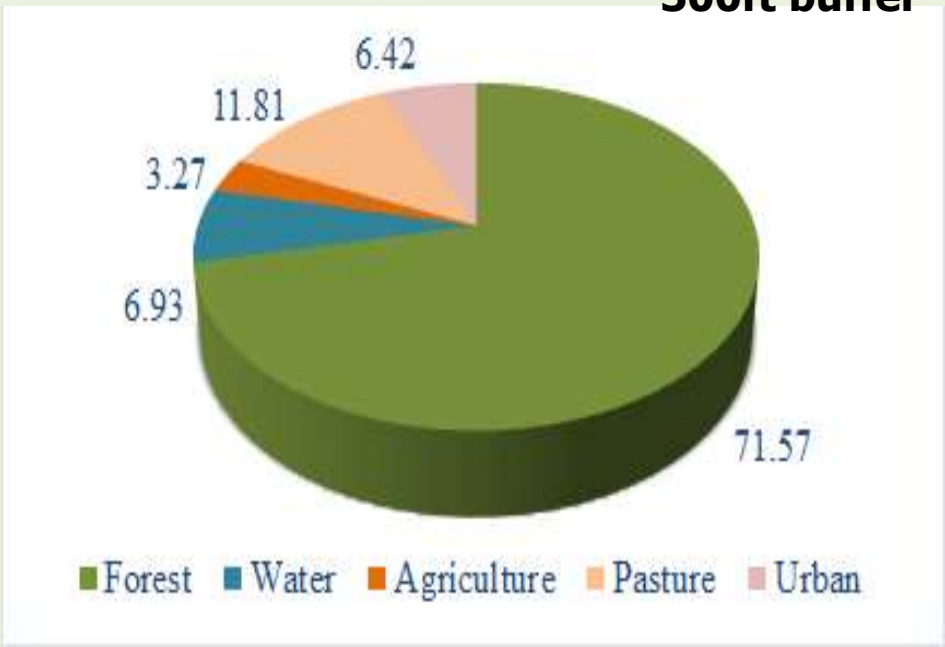
50ft buffer

Illustrations Produced by CAGIS @ UNC-C

100ft buffer



300ft buffer



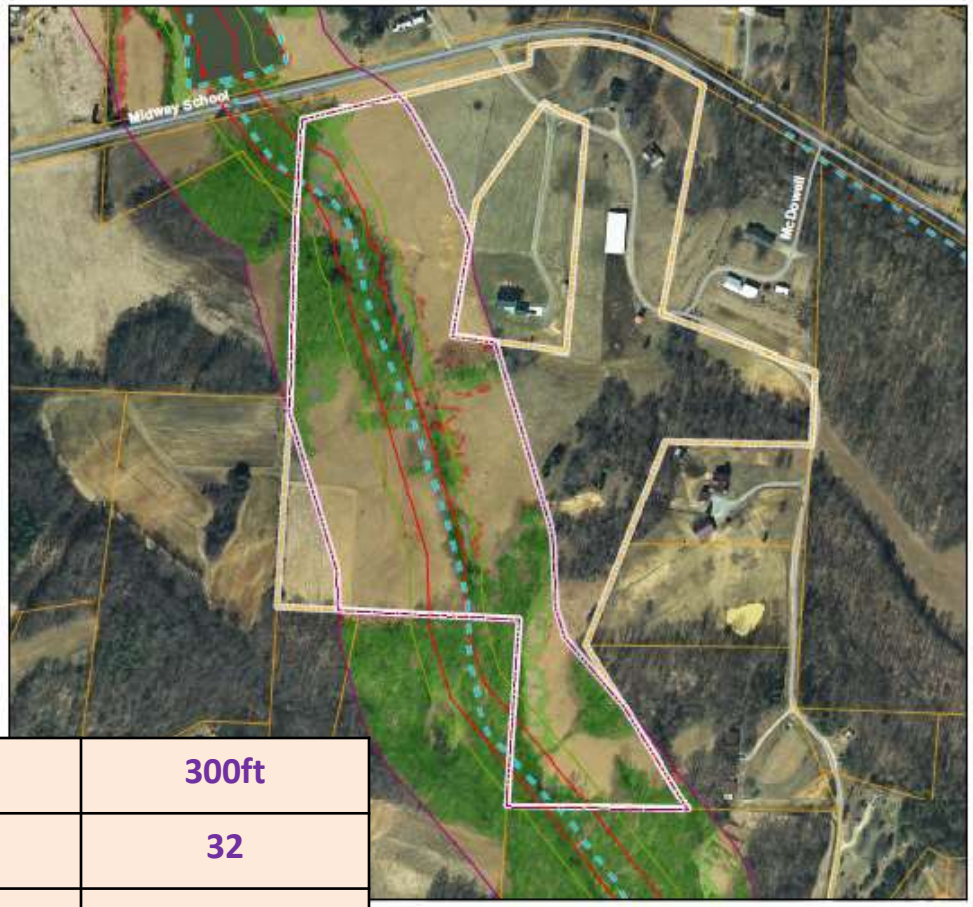
Stream Buffer Analysis: Parcel Owner Maps

Example:
Abbotts Creek subw/s

A method was created to identify parcels that exist within certain stream buffer and length parameters, within the same ownership.

This was done for each of the 6 subwatersheds.

Result: 54 parcel maps



LULC	50ft	100ft	300ft
Forest	1	4	32
Ag/Pasture	1	2	11
Analysis (same owner)	*10,000 LF buffer*	*5,000 LF buffer*	*2,000 LF buffer*
Urban	0	3	n/a
Analysis (same owner)	*1,000 LF buffer*	*500 LF buffer*	*n/a*

Summary

- **More Forest → better water quality**
  - **"Forest Cover Model" for WQ (using bug data):**
  - **<37% to 48%.... 37% to 48%..... >48%**
- **More Natural → better water quality**
  - **"Natural Cover Model" for WQ (using bug data):**
  - **<43% to 52%.... 43% to 52%..... >52%**
- **More Forest → lower cost of water treatment, but need more data**
  - **"Forest Cover Model" for water cost$:**
  - **68% breakpoint for forest… 25% for ag**
- **Subwatershed assessments**
  - **Land cover analysis comparison, 1m VS 10m**
  - **Subwatershed snapshot reports**
  - **Stream buffer analysis with parcel ownership maps**