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

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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

Forecast Changes in Water Demand
Changes in Subwatershed Land Cover

www.ncforestactionplan.com. Figure 4f-5, page 191
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:
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)

Map Produced by CAGIS @ UNC-C

High Rock Lake Watershed (12HUC)
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:

![Map of water supply intake locations](image.png)
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

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
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
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.

Stream Buffer Analysis: Reddies River subw/s

LULC Subw/s

Illustrations Produced by CAGIS @ UNC-C

50ft buffer

Forest Water Agriculture Pasture Urban

100ft buffer

6.93 11.51 3.27

11.57 71.57

300ft buffer

Forest Water Agriculture Pasture Urban

76.08 5.15 9.52 16.22

60.84 12.01
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

<table>
<thead>
<tr>
<th>LULC</th>
<th>50ft</th>
<th>100ft</th>
<th>300ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest</td>
<td>1</td>
<td>4</td>
<td>32</td>
</tr>
<tr>
<td>Ag/Pasture</td>
<td>1</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>Analysis (same owner)</td>
<td>10,000 LF buffer</td>
<td>5,000 LF buffer</td>
<td>2,000 LF buffer</td>
</tr>
<tr>
<td>Urban</td>
<td>0</td>
<td>3</td>
<td>n/a</td>
</tr>
<tr>
<td>Analysis (same owner)</td>
<td>1,000 LF buffer</td>
<td>500 LF buffer</td>
<td>n/a</td>
</tr>
</tbody>
</table>

Report Produced by CAGIS @ UNC-

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