Neuse 01 Regional Watershed Plan

Characterizing Stream Buffer Condition in GIS

2014 ESRI SERUG Conference
May 5th - 7th
Charlotte, NC
Presentation Outline

- Background
- Methodology
- Results
- Questions
Background
Where is the Neuse River Basin?

North Carolina
Where is the Neuse River Basin?

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Where is the Neuse River Basin?

North Carolina
Where is the Neuse River Basin?

- ~ 275 miles in length
- ~ 6,200 sqmi drainage area

North Carolina
Neuse River Basin - Impacts

- High nutrient levels entering river – Pamlico Sound
  - Eutrophication
  - Occurrences of hypoxia
  - Outbreaks of Pfiesteria
  - Fish kills
Neuse River Basin - Impacts

- River/tributaries designated as nutrient sensitive waters
- Nutrient management strategy established to reduce loads
- Significant need for stream/wetland mitigation from rapid population growth and widespread development
Where is the Neuse River RWP study area?

North Carolina

- Neuse River Basin
- Neuse River
- Pamlico Sound
Where is the Neuse River RWP study area?

North Carolina
Neuse River RWP Study Area
Neuse River RWP – Purpose

- To identify and prioritize potential mitigation projects to offset ecological impacts
  - Stream/wetland restoration
  - Buffer restoration
  - Nutrient offset
  - BMPs
  - Habitat preservation

- Proposed I-540 Corridor is a major driver for mitigation related to development
Neuse River RWP Phases

- Phase I: Characterization of Current Watershed Conditions
- Phase II: Detailed Watershed Assessment
- Phase III: Development of Watershed Management Plan and Project Atlas
- Phase IV: Implementation of Watershed Management Plan and Project Atlas
Phase I - Characterization of Current Watershed Conditions

- Remote sensing using GIS
- Preliminary evaluation of watershed conditions
- Preliminary identification of functional stressors/assets
- Perform functional assessment of 18 subwatersheds
- Identify subwatersheds for more detailed study
Prioritization of Subwatersheds

- Four functional categories
  - Stream corridor condition
  - Wetland condition
  - Water quality
  - Presence of important habitats
Prioritization of Subwatersheds

- Four functional categories
  - Stream corridor condition
  - Wetland condition
  - Water quality
  - Presence of important habitats
Stream Corridor Condition - Stream Buffers

- Functions of Vegetated Buffers
  - Reduce pollutant loading by filtering stormwater runoff
  - Stabilize stream banks
  - Provide shade to reduce water temperatures
  - Provide habitat structure
Stream Buffer Condition – No Buffer
Stream Buffer Condition – No Buffer
Methodology

Stream Buffer Condition Analysis
Don’t fear the raster world:

“I’m just a caveman…your world frightens and confuses me”
Software

- ESRI ArcMap 10.1
- Spatial Analyst
GIS Datasets

- Vector
  - National Hydrography Dataset (NHD) 24K layer from USGS

- Raster
  - National Land Cover Database 2006 (NLCD)
Stream Buffer Classifications

- Characterize stream buffers using the following classifications based on a 50 foot buffer width:
  - **No buffer**: no buffer either side
  - **Minimal buffer**: < 50 feet both sides
  - **Adequate buffer**: > 50 feet on one side
  - **Good buffer**: > 50 feet both sides
  - **Exceptional buffer**: > 200 feet both sides
Stream Buffer Classifications

- Characterize stream buffers using the following classifications based on a 50 foot buffer width:
  - No buffer ‡: no buffer either side
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  - Good buffer ‡: > 50 feet both sides
  - Exceptional buffer ‡: > 200 feet both sides

GOAL ‡: ATTRIBUTED NHD VECTOR LAYER
Reclass 2006 NCLD (Buffer/No Buffer)

- Intact buffer classes (assigned value of 1)
  - Undeveloped, primarily forested land cover classes associated with well established buffers

- Denuded buffer classes (assigned value of 0)
  - Low to high density developed lands
  - Open space
  - Pastureland
  - Agricultural land
Reclass 2006 NCLD (Buffer/No Buffer)
Unioned Merged NHD to Buffer Raster

- Created shorter stream segments from which to calculate and report buffer width
  - Attributed with unique ID to which buffer classifications will be joined
- Buffer width values measured along these shorter stream segments were more consistently uniform
Union Merged NHD to Buffer Raster
Union Merged NHD to Buffer Raster
Measure Buffer Width – Euclidean Distance
Measure Buffer Width – Raster Calculator (X)
Copy Parallel - NHD Centerline

- Enables measurement of buffer width along both floodplains independently
- Left/Right copied parallel segments retain unique ID of centerline
Measure Buffer Width Range – Focal Statistics

- Ran Focal Statistics on Euclidean distance buffer width raster
- Measured buffer along left/right floodplains independently using a raster analysis mask per floodplain:
  - Range
  - Circle
Measure Buffer Width Range – Focal Statistics
Measure Buffer Width Range – Focal Statistics
Zonal Tabular Statistics

- For both left/right floodplain buffer width measurements
- Used unique IDs of left/right floodplain polylines as zone (originally from the NHD layer)
- Joined left/right floodplain zonal statistics tables to NHD centerline layer using these unique IDs
Zonal Tabular Statistics - Majority
Zonal Tabular Statistics

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RANGE: The range is calculated as MAX - MIN.

MAJORITY: The majority value is highlighted in red.
Buffer Width Classification Attribution

- Field calculator

- Code fields for left/right floodplain according to Majority statistic buffer width category per floodplain:
  - 0’ buffer width = 0
  - 1’ – 49’ buffer width = 1
  - > 50’ buffer width = 2

- No buffer ‡ no buffer either side
- Minimal buffer ‡ < 50 feet both sides
- Adequate buffer ‡ > 50 feet on one side
- Good buffer ‡ > 50 feet both sides
- Exceptional buffer ‡ > 200 feet both sides
Buffer Width Classification Attribution

- Sum left/right floodplain coded values:
  - 0 (0 + 0) =
    - no buffer on either side
  - 1 or 2 (0 +1 or 1+1) =
    - minimal buffer on both sides (<50 feet)
  - 2 or 3 (2 + 1 or 2 + 0) =
    - adequate buffer on one side (>50 feet on one side)
  - 4 (2 + 2) =
    - good buffer on both sides (>50 feet)
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**Buffer Condition**

- **No Buffer (on either side)**
- **Minimal Buffer (<50 feet both sides)**
- **Adequate Buffer (>50 feet both sides)**
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**Code**

1. No Buffer (on either side)
2. Minimal Buffer (<50 feet both sides)
3. Minimal Buffer (<50 feet both sides)
4. Adequate Buffer (>50 feet both sides)
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Results
Stream Buffer Condition - Results
Stream Buffer Condition - Results
Stream Buffer Condition – Results (No Buffer)
Stream Corridor Prioritization

Figure 16 - Prioritization of Subwatersheds for Stream Corridor Condition
Neuse 01 Regional Watershed Plan

Wake and Johnston Counties, NC
Stream Corridor Restoration

Before vs After

Before image shows a degraded stream with little vegetation and a lack of water flow. After image shows a restored stream with increased vegetation, a wider water flow, and a fish in hand, indicating increased fish population and habitat.
Questions?

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