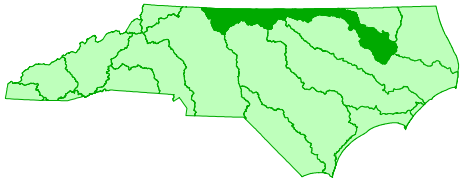
Executive Summary

Roanoke River Basin



River Basin Description

The Roanoke River basin extends from its source in the Blue Ridge Mountains of Virginia to the Albemarle Sound in North Carolina, encompassing mountainous, piedmont, and coastal topography as it flows generally east-southeastward. Its five subbasins (Figure ES-2) constitute approximately 3,500 square miles of drainage area and approximately 2,400 miles of streams and rivers in North Carolina, and contains diversity with classified trout streams in the western portion and swamp classified waters in the eastern portion. Seventeen counties and 42 municipalities are within the NC portion of the basin.

The ecoregions associated with this river basin are the:

- Sauratown Mountains of the Blue Ridge ecoregion;
- Triassic Basins;
- Southern Outer Piedmont;
- Northern Inner Piedmont;
- Carolina Slate Belt;
- Northern Outer Piedmont ecoregions of the Piedmont;
- Rolling Coastal Plain;
- Southeastern Floodplains;
- Low Terraces ecoregions of the Southeastern Plains;
- Mid-Atlantic Flatwoods;
- Mid-Atlantic Floodplains;
- Low Terraces ecoregions of the Middle Atlantic Coastal Plain.

Though some urban and suburban development has occurred in the Roanoke River basin, according to 2006 data, the greatest portion of land cover in the basin has remained forest and, to a lesser extent, agriculture-based. Also characteristic of activities throughout the state, nonpoint source runoff and numerous small point source dischargers associated with development and agricultural activities have potential to affect water quality in the basin.

Basin at a Glance

Counties:

Beaufort, Bertie, Caswell, Forsyth, Granville, Guilford, Halifax, Martin, Northampton, Orange, Person, Rockingham, Stokes, Surry, Vance, Warren, & Washington

Major Municipalities:

Eden, Henderson, Oak City, Reidsville, Roanoke Rapids, & Roxboro

Permitted Facilities:

NPDES Dischargers:	223
Major	17
Minor	48
General	158
NPDES Non-Discharge:	44
Stormwater:	131
General	122
Individual	9
Animal Operations:	84
Aquaculture:	45

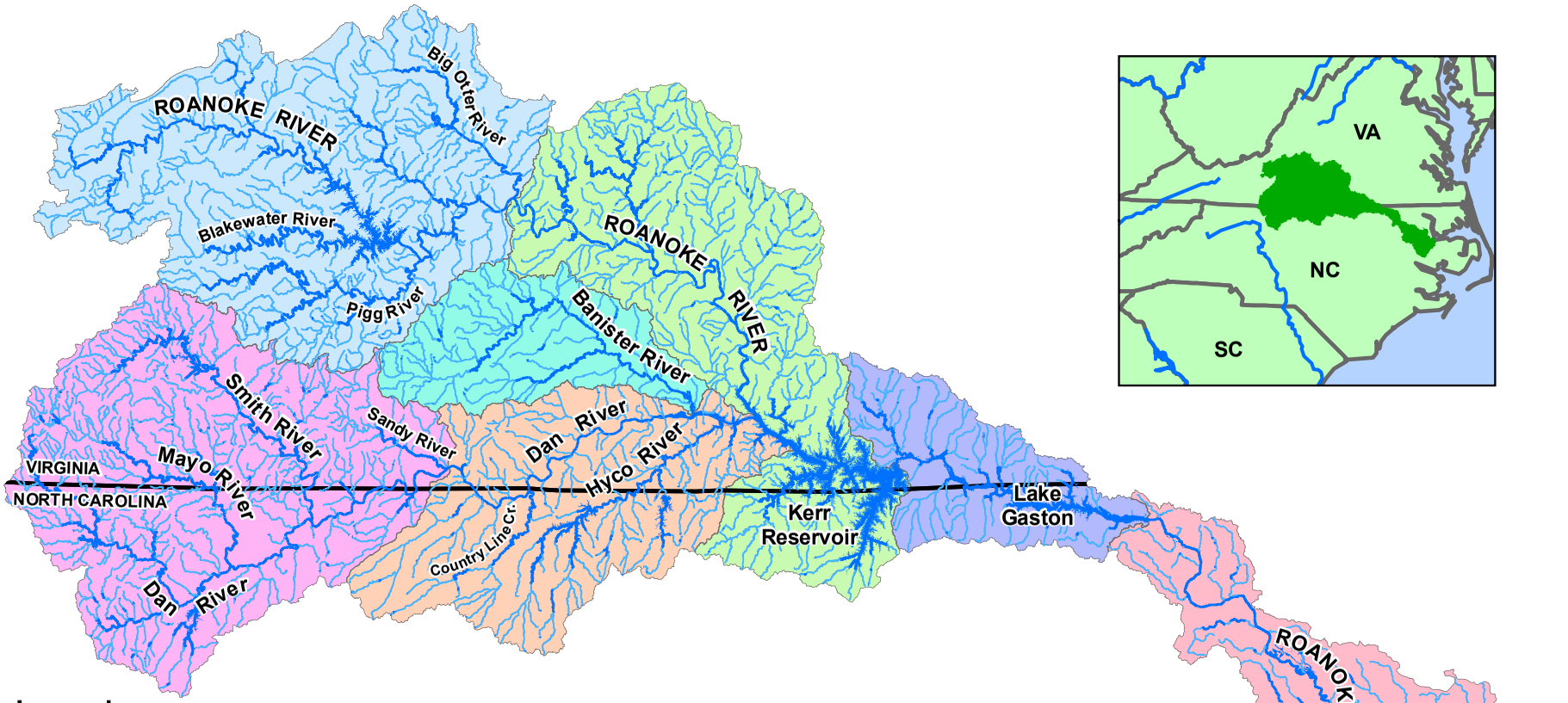
Population:

2000 Census	285,488
2010 Census	289,784

2006 Land Cover:

Open Water	2.6%
Developed	6.5%
Forest	48.2%
Agriculture	21.1%
Wetlands	11.9%
Barren Land	0.1%
Shrub/Grassland	9.6%

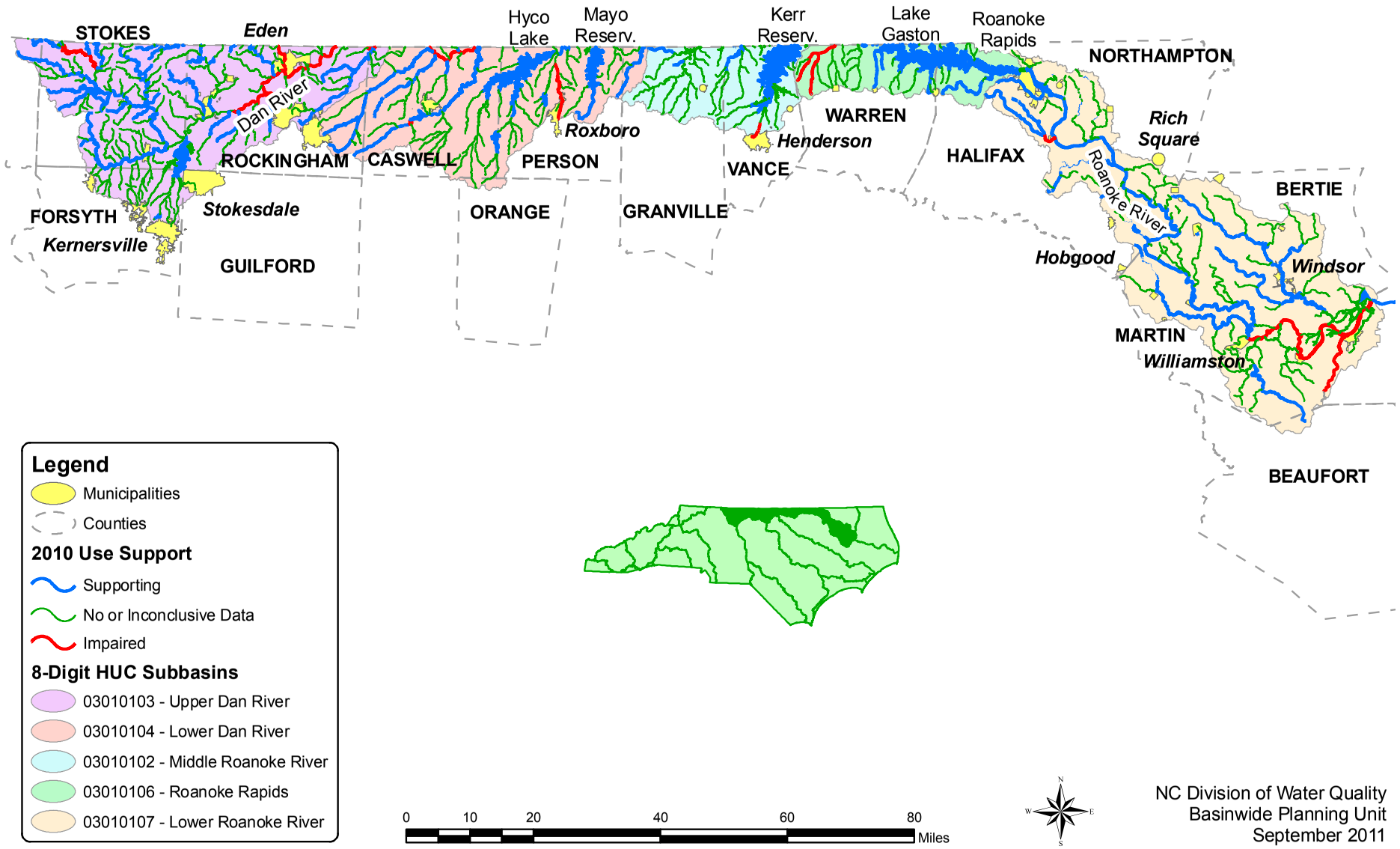
Entire Roanoke River Basin



NC Division of Water Quality
Basinwide Planning Unit
September 2011

FIGURE ES-1: THE ENTIRE ROANOKE RIVER BASIN (HYDROLOGIC UNIT CODE 030101)

NC Portion of the Roanoke River Basin



NC Division of Water Quality
Basinwide Planning Unit
September 2011

FIGURE ES-2: NORTH CAROLINA PORTION OF THE ROANOKE RIVER BASIN

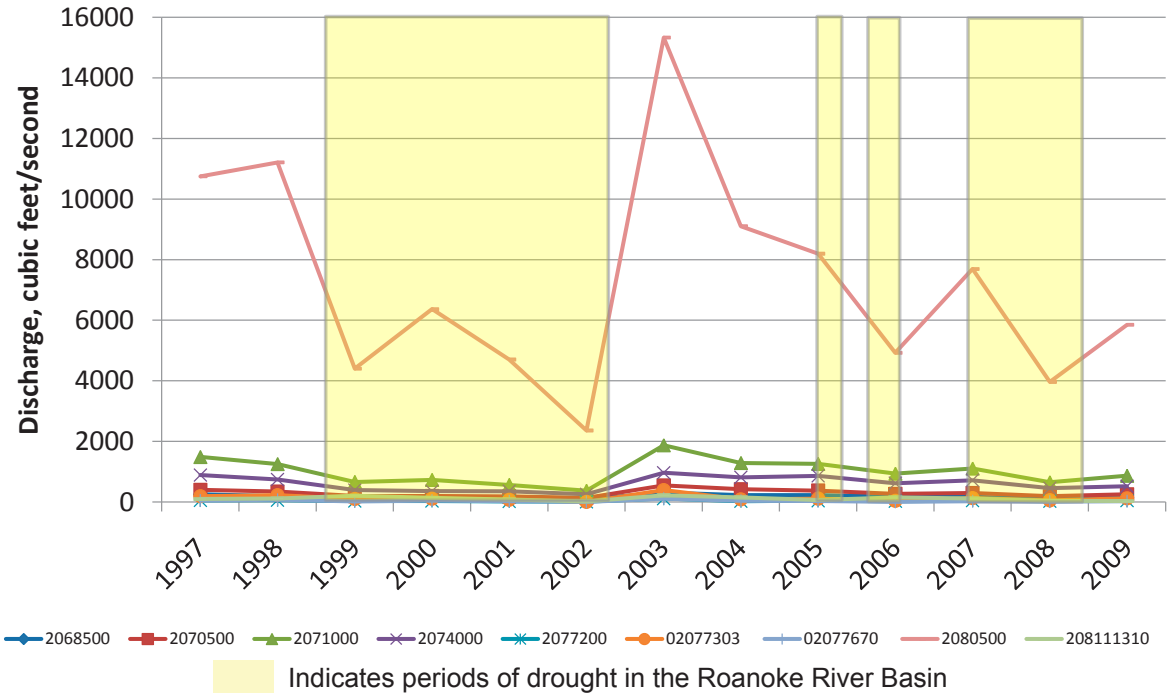
WATER QUALITY DATA OVERVIEW

Stream flow, aquatic biology, and chemical/physical parameters were analyzed as part of the basinwide planning process. Detailed information about the Division of Water Quality (DWQ) monitoring and the effects each parameter has on water quality is discussed in Chapters 2 and 3 of the Supplemental Guide to North Carolina's Basinwide Planning document.

STREAM FLOW

The basin experienced prolonged droughts between 1998-2002 and between 2007-2008, with moderate droughts in 2005 and 2006 (Figure ES-3). Details about flows in the Roanoke River Basin is in the 2010 Roanoke River Basinwide Assessment Report by DWQ-Environmental Sciences Section (ESS).

FIGURE ES-3: YEARLY FLOW RATES (CFS) OF THE USGS GAGE STATIONS IN THE ROANOKE RIVER BASIN BETWEEN 1997 & 2009



From Left to Right:

- 2068500: Dan River (Francisco)
- 2070500: Mayo River
- 2071000: Dan River (Wentworth)
- 2074000: Smith River
- 2077200: Hyco Creek (Leasburg)
- 2077303: Hyco Creek (McGehees)
- 2077670: Mayo Creek
- 2080500: Roanoke River
- 208111310:Cashie River

Biological Data

Biological samples of benthic macroinvertebrate and fish communities were collected mostly during the spring and summer months of 2009 by DWQ-ESS as part of the five-year cycle basinwide sampling efforts. Limited samples were also collected for special studies. Overall, 65 biological sampling sites were monitored and rated within the Roanoke River Basin. Each site's biological rating is used to determine the stream's aquatic life use support category (Figure ES-4) for use on the Integrated Report.

Benthic Macroinvertebrate Sampling

Each benthic station monitored during the current cycle is shown in Figure ES-5 and color coded based on its current rating. Each of the sites are discussed in more detail in the subbasin chapters. Figure ES-7 is a comparison of benthic site ratings sampled during the last two basinwide cycles to indicate if there are any overall shifts in ratings. Benthic ratings from this cycle are overall similar to those received during the previous cycle, indicating a relatively stable benthic macroinvertebrate community.

Figure ES-4: Use Support Categories for Biological Ratings

Biological Ratings	Aquatic Life Use Support
Excellent	Supporting (Categories 1-2)
Good	
Good-Fair	
Not Impaired	
Not Rated	Not Rated (Category 3)
Fair	Impaired (Categories 4-5)
Poor	

Benthic Sampling Summary

Total Stations Monitored	39
Total Samples Taken	42
Number of New Stations	17

Figure ES-5: Benthic Macroinvertebrate Stations Color Coded by Current Rating in the Roanoke River Basin

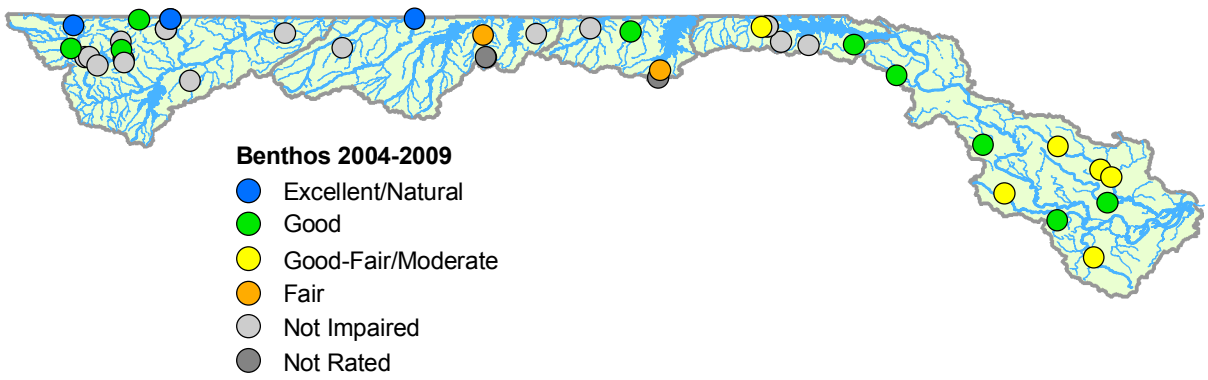


Figure ES-6: Current Benthic Macroinvertebrate Site Ratings

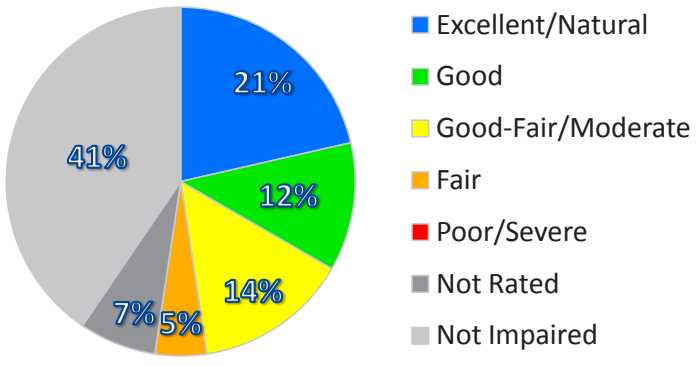
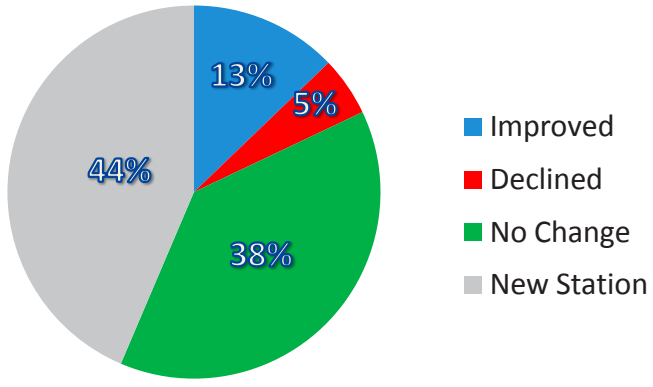


Figure ES-7: Change in Benthic Macroinvertebrate Site Ratings



Fish Community Sampling

Each fish community station monitored during the current cycle is shown in Figure ES-8 and color coded based on the current rating. Each of the sites are discussed in more detail in the watershed section, below. Figure ES-9 shows the percentages of each rating given during this sampling cycle within the basin. Figure ES-10 is a comparison of fish community site ratings sampled during the last two cycles to determine if there are any overall watershed shifts in ratings. The majority of stations had no change in rating; however, six stations declined in rating and six increased in rating.

FISH COM. SAMPLING SUMMARY

Total Stations Monitored	26
Total Samples Taken	29
Number of New Stations	3

FIGURE ES-8: FISH COMMUNITY STATIONS COLOR CODED BY CURRENT RATING IN THE ROANOKE RIVER BASIN

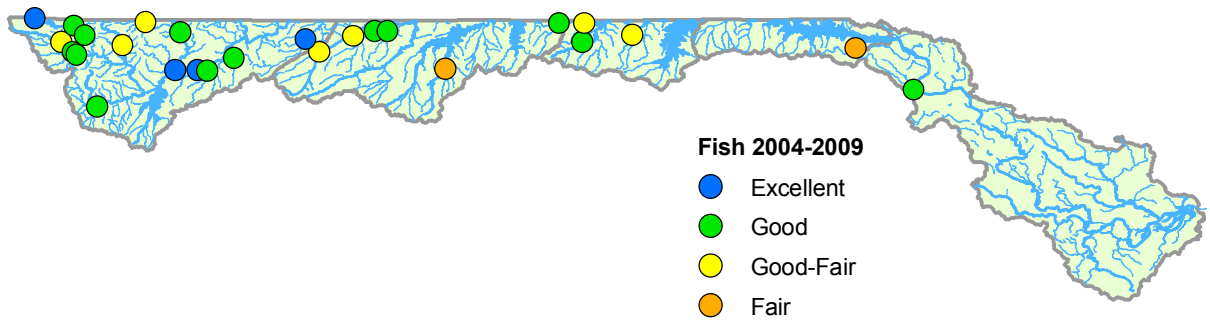


FIGURE ES-9: CURRENT FISH COMMUNITY SITE RATINGS

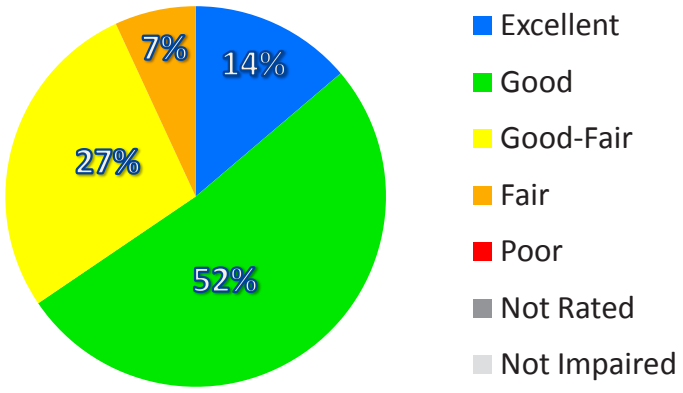
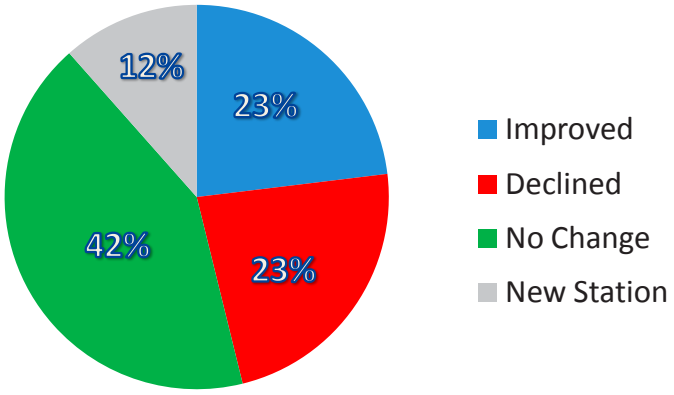


FIGURE ES-10: CHANGE IN FISH COMMUNITY SITE RATINGS



For more information about biological data in this basin, see the 2010 Roanoke River Basinwide Assessment Report. Detailed data sheets for each sampling site can be found in Appendix 1-B.

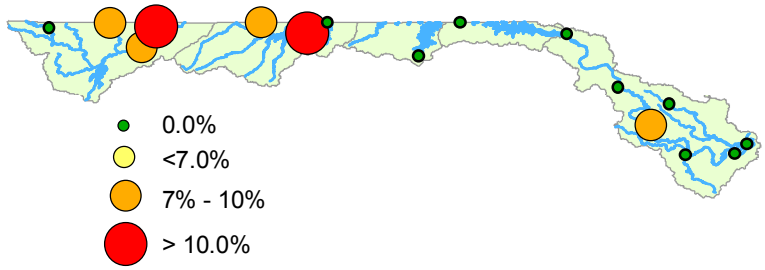
AMBIENT MONITORING DATA

During the 2004-2008 sampling cycle, DWQ collected samples at 18 Ambient Monitoring System (AMS) stations in the basin. Each station was sampled ten or more times and used for use support assessment. The assessment shows that the majority of exceedances were for copper and turbidity parameters. Fecal coliform bacteria is also a parameter of concern within the Roanoke River Basin. All three parameters are discussed below.

Specific information about ambient monitoring methodology, seasonal variation, and data sheets for ambient stations in this basin are in the **Roanoke River Basin Ambient Monitoring System Report**.

Copper

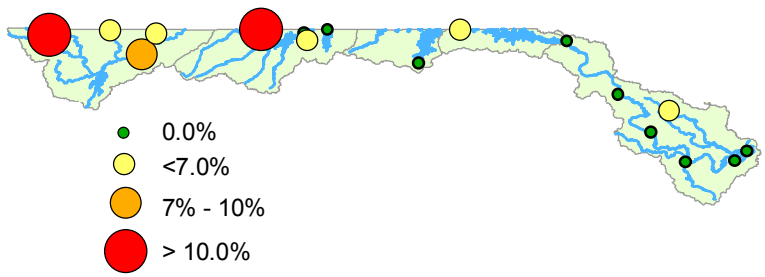
Figure ES-11: Percent of Samples Exceeding the Copper Standard (2005-2009)



Two ambient stations exceeded the State standard for copper levels more than 10% of the time (Smith River and Marlowe Creek). These stations are indicated by the large red dots in Figure ES-11. Four stations exceeded the standard in less than 10% of samples and 12 stations had no exceedances. The cause of the elevated levels is unknown; however, possible sources could be past instream mining operations, agricultural use such as pesticides, or urban influences such as dust from brake pads. The current copper standard is relatively low and maybe revised during this upcoming cycle. If samples continue to exceed the standard during the next sampling cycle, a source study is recommended.

Turbidity

Figure ES-12: Percent of Samples Exceeding the Turbidity Standard (2005-2009)

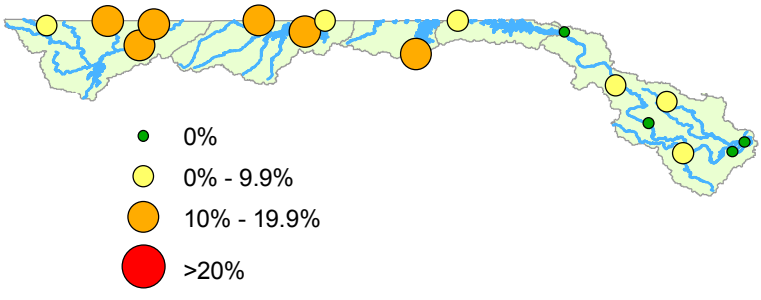


The two ambient stations exceeding the State standard, as indicated in Figure ES-12 by large red dots, are both on the Dan River. The Dan River has a long history of being turbid. Six other stations exceeded the standard in less than 10% of samples.

The cause of turbidity in the Dan River has previously been linked to instream mining operations and agricultural fields along the river. However, no permitted mining operations remain and many agricultural practices have adopted better management practices to reduce sediment reaching the streams.

Fecal Coliform Bacteria (FCB)

Figure ES-13: Percent of Samples Exceeding the FCB Screening Criteria (2005-2009)



The FCB standard for freshwater streams is not to exceed the geometric mean of 200 colonies/100 ml or 400 colonies/100 ml in 20% of the samples where five samples have been taken in a span of 30 days (5-in-30). Only results

from a 5-in-30 study are used to determine whether a stream is Impaired or Supporting. Waters with a use classification of B (primary recreational waters) receive priority over other waters for 5-in-30 studies.

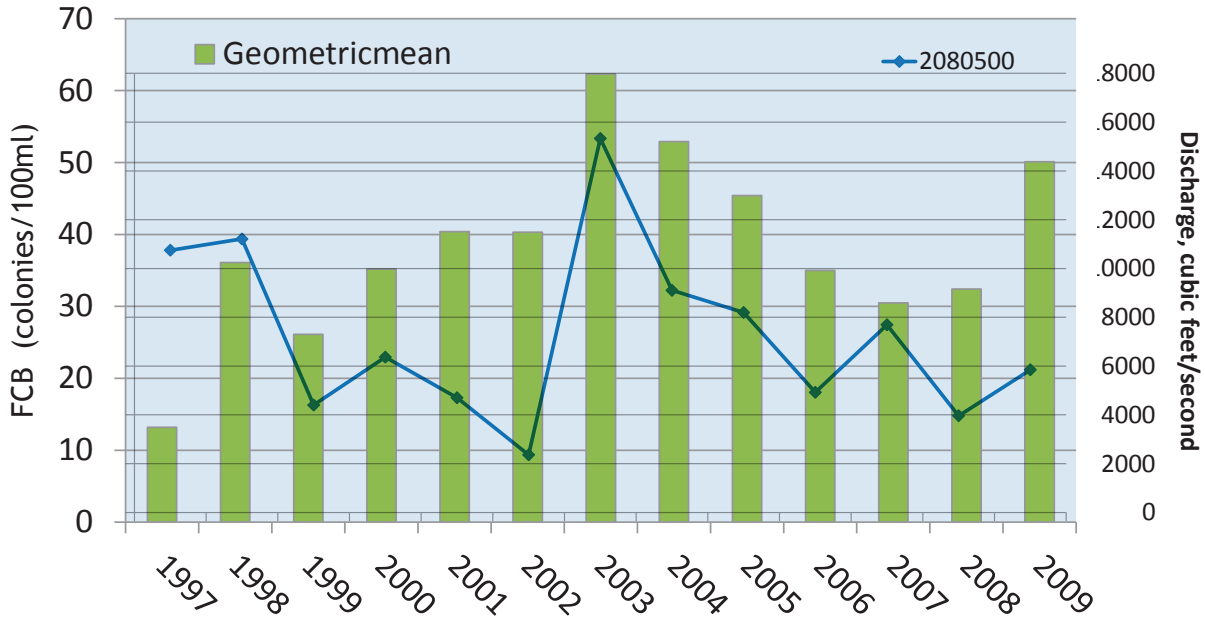
DWQ uses a screening criteria of 400 colonies/100 ml in 20% of samples to consider the need for a 5-in-30 study. Figure ES-13 shows the percentage of samples at each station that exceeded this screening criteria. Recreational waters that exceed this criteria would be prioritized for additional sampling. However, none of the recreational waters in the Roanoke River Basin exceeded the screening criteria.

FIGURE ES-14: LIVESTOCK IN STREAM

The geometric mean of FCB per year for the basin between 1997 and 2009 is shown in Figure ES-15. Overlaying the yearly flow averages for the Roanoke River with the yearly geometric mean of FCB indicates an influence of flow on FCB levels.

The overall decrease in levels from 2003-2008 could be attributed to a number of reasons including reduced flow levels and watershed groups that have actively been fencing livestock out of streams, as in Figure ES-14. Recommendations to further reduce FCB levels can be found in the subbasin chapters.

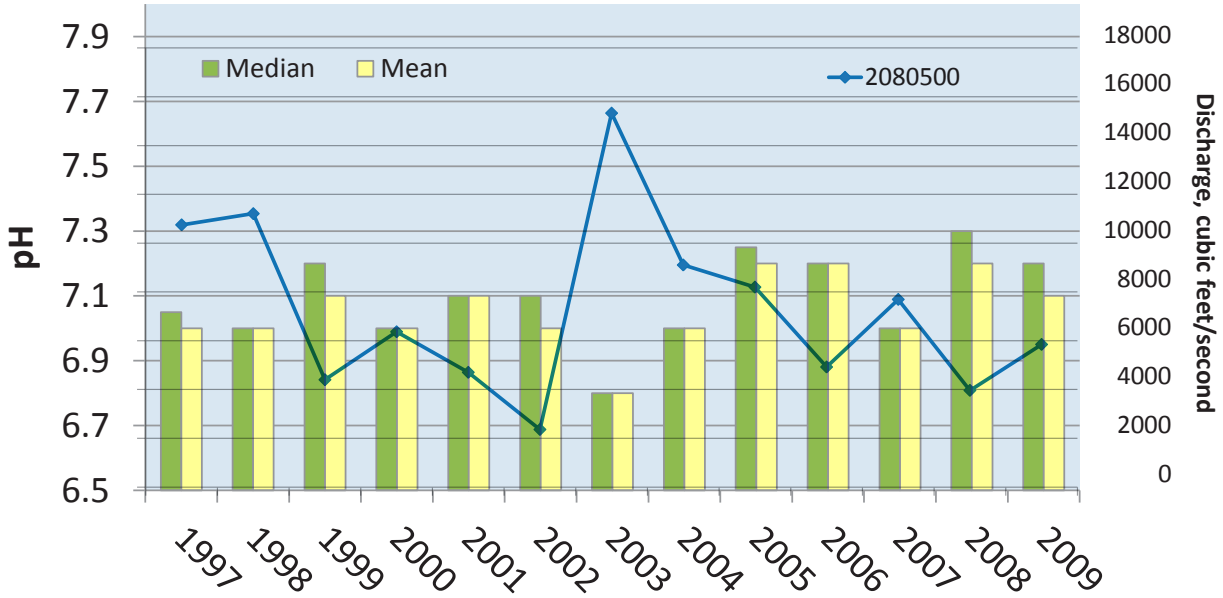
FIGURE ES-15: YEARLY GEOMETRIC MEAN FECAL COLIFORM BACTERIA DATA WITHIN THE ROANOKE RIVER BASIN WITH FLOW GAGE DATA FROM THE ROANOKE RIVER AT ROANOKE RAPIDS (BETWEEN 1997 & 2009)



pH

Figure ES-16 shows the mean and medians of all pH data collected in the basin per year over time along with the flow line for the Roanoke River. A few of the eastern AMS stations are exceeding the state standard for pH; however, in less than 10% of samples. The graph may indicate pH levels in the basin are at least somewhat linked to stream flow.

FIGURE ES-16: MEAN & MEDIAN YEARLY PH DATA WITHIN THE ROANOKE RIVER BASIN WITH FLOW GAGE DATA FROM THE ROANOKE RIVER AT ROANOKE RAPIDS (BETWEEN 1997 & 2009)



POPULATION & LAND COVER

Urbanization most often has a detrimental affect on to aquatic resources. Small towns and communities are usually not considered urban centers, but even small concentrations of urbanization can have significant impacts on local waterways. For example, a one-acre parking lot produces 16 times more runoff than a one-acre meadow (Schueler and Holland, 2000). A wide variety of studies over the past decade converge on a central point: when more than 10 percent of the acreage in a watershed is covered in roads, parking lots, rooftops, and other impervious surfaces, the rivers and streams within the watershed become seriously degraded. Studies show that if urbanized areas cover more than 25 percent of a watershed, the decline in the health of the ecosystem is irreversible (Beach, 2002; Galli, 1991).

POPULATION

Population growth and urban stormwater runoff are likely contributing factors to stream pollution in urban areas throughout the Roanoke River Basin. The 2010 census population of the North Carolina portion of the Roanoke River basin is 289,784. This is an increase of roughly 4,300 (1.5%) individuals from the 2000 census. The two figures below show distribution in population throughout the basin by 12-digit subwatersheds between 2000 and 2010. The subwatersheds with the highest populations are indicated by red and those with smaller populations are indicated by green. The two 12-Digit HUCs with largest growth contains the Town of Windsor and the 12-Digit HUC just down stream. These two HUCs had 33% and 121% growth, respectively. Subwatersheds around the Mayo and Kerr Reservoirs had growth of 25% and 31%, respectively (as indicated in Figure ES-18).

FIGURE ES-17: 2000 US CENSUS POPULATION IN THE ROANOKE RIVER BASIN BY 12-DIGIT SUBWATERSHED

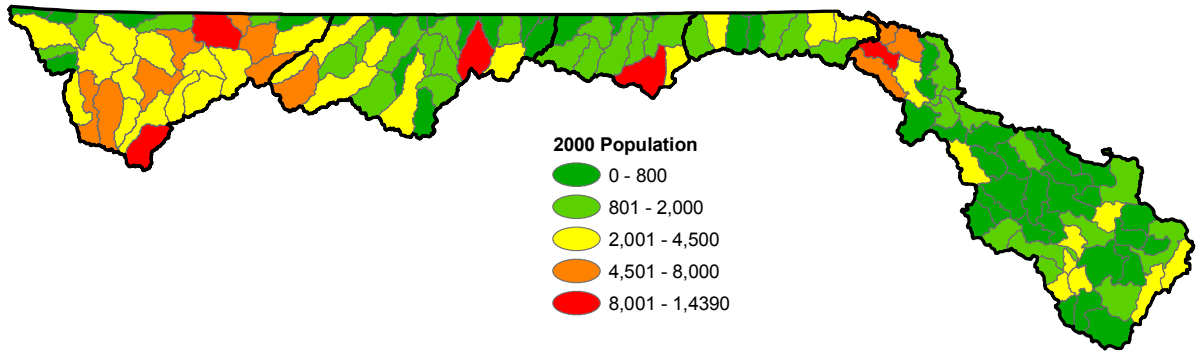
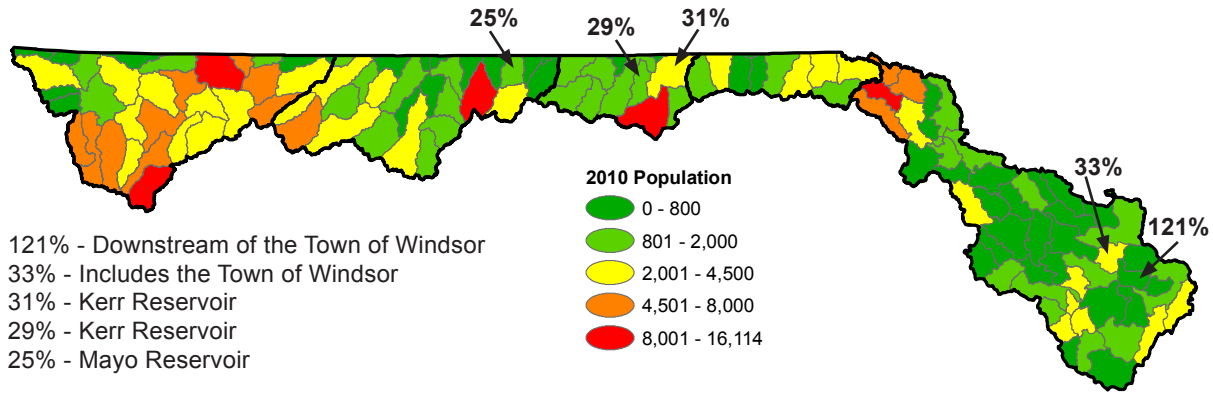


FIGURE ES-18: 2010 US CENSUS POPULATION IN THE ROANOKE RIVER BASIN BY 12-DIGIT SUBWATERSHED



Land Cover

The largest percent of land cover in the four western subbasins is forested land. In the Lower Roanoke River subbasin, it shifts to be split between wetlands and forested area. Developed area has remained about the same since 2001 and is between six and nine percent for each subbasin. Agricultural activities make up about 20% of the land cover across the basin. Table ES-1, Figure ES-19, and Figure ES-20 show the distribution of land cover across the basin during 2001 and 2006. There was very little change in overall land cover between the two years compared.

Table ES-1: Percent of Land Cover by Category for 2001 & 2006 in the Roanoke River Basin

Category	% in 2001	% in 2006
Open Water	2.4	2.6
Developed, Open Space	4.2	5.1
Developed, Low Intensity	1	1
Developed, Medium Intensity	0.2	0.3
Developed, High Intensity	0.1	0.1
Barren Land	0.6	0.1
Forest	52.3	48.2
Shrub/Grassland	6.7	9.6
Agriculture, Pasture Hay	13.2	11.8
Agriculture, Cultivated Crops	9.4	9.3
Wetlands	9.8	11.9

Figure ES-19: 2001 Land Cover in the Roanoke River Basin

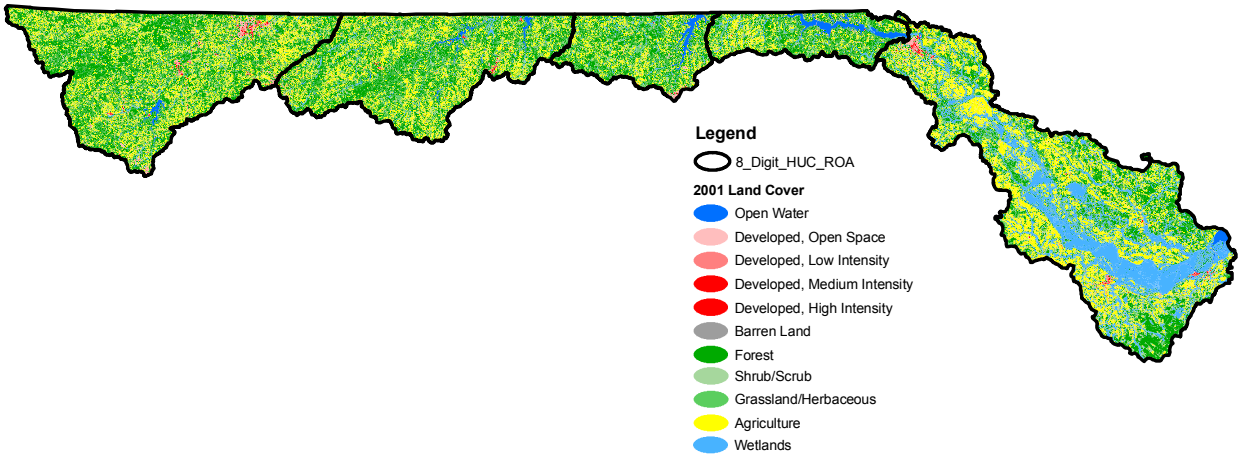
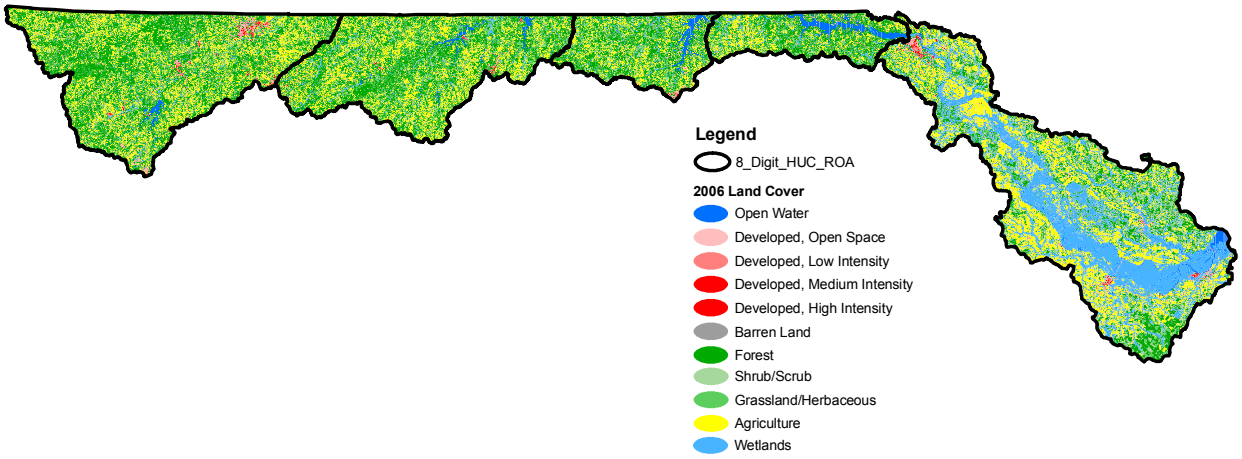


Figure ES-20: 2006 Land Cover in the Roanoke River Basin



SUBBASIN WATER QUALITY SUMMARIES

UPPER DAN RIVER SUBBASIN (03010103)

The Upper Dan River Subbasin is the western-most subbasin and runs along the North Carolina/ Virginia state line. The subbasin contains two Impaired streams: five segments of the Dan River are Impaired for either fecal coliform bacteria, turbidity or both; and the Smith River is Impaired for biological integrity, fecal coliform bacteria, and copper.

Monitoring results the biological community during this basinwide cycle showed only a small percent declined. There were no major ambient monitoring violations; however, a long term pattern of a slight increase in pH was seen.

There is a coordinated effort between Virginia and North Carolina to focus studies and restoration implementation on the greater Dan River drainage area. More details about this effort are in Chapter 1.

LOWER DAN RIVER (03010104)

The Lower Dan River Subbasin is the second western-most subbasin and runs along the North Carolina/Virginia state line. The subbasin contains two Impaired streams: Dan River is newly Impaired for fecal coliform bacteria and turbidity; Marlowe Creek remains Impaired for biological integrity and zinc in the downstream segment.

Monitoring results of the biological community during this time showed a small percent improved. There were no major ambient monitoring violations; however, there were a few elevated levels for turbidity and FCB.

MIDDLE ROANOKE RIVER SUBBASIN (03010102)

The Middle Roanoke River Subbasin located around the middle of the basin along the North Carolina/Virginia state line, contains one Impaired stream: Nutbush Creek remains Impaired for biological integrity. During this assessment cycle, the subbasin experienced prolonged drought between 2007 and 2008.

The John H. Kerr Dam and Reservoir Section 216 Feasibility Study project is partially located in this subbasin. The study has focused on examining the feasibility of addressing downstream environmental resource concerns in the Lower Roanoke River drainage area through changes in operations or structures at the John H. Kerr Dam and Reservoir.

ROANOKE RAPIDS SUBBASIN (03010106)

The Roanoke Rapids Subbasin is the second eastern most subbasin and runs along the North Carolina/Virginia state line. The subbasin contains two Impaired streams: Newmans Creek is newly Impaired for biological integrity; Smith Creek remains Impaired for low DO, and the upper and lower segments are Impaired for biological integrity.

Monitoring results of the biological community during this time did not indicate much change between cycles. There were no major ambient monitoring violations; however, there is a general downward long term pattern in pH levels and a few spikes in turbidity and fecal coliform bacteria levels were measured.

The John H. Kerr Dam and Reservoir Section 216 Feasibility Study project is also partially located in this subbasin.

Lower Roanoke River Subbasin (03010107)

The Lower Roanoke River Subbasin is the eastern most subbasin and empties into Albemarle Sound. The subbasin contains three Impaired streams. One segment of Quankey Creek remains Impaired for biological integrity. Welch Creek remains Impaired for dioxin and low pH; and one of the two most downstream segments of the Roanoke River is Impaired for low DO and the other is Impaired for dioxin.

Monitoring the biological community showed only a small percent declined and some improved. There were no major ambient monitoring violations.

The John H. Kerr Dam and Reservoir Section 216 Feasibility Study project is also partially located in this subbasin.

Other Basinwide Water Quality Information

John H. Kerr Dam & Reservoir Section 216 Feasibility Study

The John H. Kerr Dam and Reservoir Section 216 Feasibility Study project is located in three subbasins (HUCs 03010102, 03010106, and 03010107). The study has focused on examining the feasibility of addressing downstream environmental resource concerns in the Lower Roanoke River drainage area through changes in operations or structures at the John H. Kerr Dam and Reservoir. Along with USACE, the non-federal cost sharing partners for this study are Virginia and North Carolina. The process includes forming diverse workgroups, conducting a wide range of studies and developing a plan of recommendations. The project is currently completing phase 2 and beginning phase 3, the final phase. A more detailed description of the project is found in the Additional Study section of Chapter 2.

NC/VA Cooperative Efforts

North Carolina and Virginia have been communicating periodically over the last few years to coordinate watershed efforts. The entire Dan River drainage area which crosses the state lines several times, has been selected as a larger area in which to coordinate efforts between the states. More information about this effort is provided in Chapter 2.

Interbasin Transfers (IBTs)

The Kerr Lake Regional Water System (KLRWS) is a regional provider of drinking water. The system sells bulk water to Henderson, Oxford, and Warren County. These three customers, in turn, serve portions of Vance, Granville, Franklin, and Warren Counties.

KLRWS has an existing, grandfathered surface water transfer capacity of 10 MGD. The grandfathered capacity allows the system to move water from the Roanoke River Basin (Kerr Lake) to the Tar and Fishing Creek River Basins, both of which are sub-basins to the Tar-Pamlico Major River Basin. On February 18, 2009, KLRWS submitted a *Notice of Intent to Request an Interbasin Transfer (IBT) Certificate* to the Environmental Management Commission (EMC). In that notice, KLRWS requested to increase the authorized transfer from 10 MGD to 24 MGD, and to transfer 2.4 MGD from the Roanoke River Basin to the Neuse River Basin. These transfer amounts are based on water use projections to the year 2040.

Dates of interest for this request are as follows:

- February 18, 2009 - KLRWS submitted a Notice of Intent to Request an Interbasin Transfer Certificate to the EMC.

- February 26, 2009 - CH2MHill (consultant for KLRWS) provided written notice of scheduled public meetings as required by §143-215.22L(c).
- March 12, 2009 - A status update was presented to EMC's Water Allocation Committee.
- April 1-8, 2009 - The applicant held five public meetings to collect comments on the scope of the *draft Environmental Impact Statement* (EIS).
- May 31, 2009 - Public comment scoping period ended.
- November 2009 - The applicant provided a **status report** to the Division of Water Resources.

Status:

The applicant is currently working to develop a *draft Environmental Impact Statement* (EIS). The EIS must address the following requirements, which are also set forth in G.S. §113A-4 and §143-215.22L(d):

1. A comprehensive analysis of the environmental impacts that would occur in the source and receiving river basins if the petition for a certificate is granted;
2. Any significant adverse environmental effects which cannot be avoided;
3. A description of measures to mitigate any adverse impacts that may arise from the proposed interbasin transfer;
4. An evaluation of alternatives to the proposed interbasin transfer, including water supply options that do not require an interbasin transfer and use of water conservation measures;
5. The relationship between the short-term uses of the environment involved in the proposed action and the maintenance and enhancement of long-term productivity and;
6. Any irreversible and irretrievable environmental changes which would be involved in the proposed action should it be implemented.

The draft EIS is expected to be available for review in 2011. The EMC may not act on any petition until they have determined that the EIS is adequate.

Status of the IBT will be updated periodically on the Division of Water Resources' **Kerr Lake Regional Water System Interbasin Transfer Certification Request** webpage.

Roanoke River Basin Bi-State Commission

The Roanoke River Basin Bi-State Commission (RRBBC) was established as a bi-state commission composed of members from the Commonwealth of Virginia and the State of North Carolina. The purpose of the RRBBC is to:

- Provide guidance, conduct joint meetings, and make recommendations to local, state, and federal legislative and administrative bodies, and to others as it deems necessary and appropriate, regarding the use, stewardship, and enhancement of the Basin's water and other natural resources;
- Provide a forum for discussion of issues affecting the Basin's water quantity, water quality, and other natural resources;
- Promote communication, coordination, and education among stakeholders within the Basin;
- Identify Basin-related problems and recommend appropriate solutions; and

- Undertake studies and prepare, publish, and disseminate information through reports, and other communications related to water quantity, water quality, and other natural resources of the Basin.

Topics and issues the Bi-State Commission have been discussing over the past few years include: importance of natural resources to the economic vitality of the basin; interbasin transfer of water; as well as discussions on the controversial topic of uranium mining and its potential occurrence in Virginia. Annual reports, meeting minutes, and membership lists are found on the Commission's website.

Source Water Assessment of Public Water Supplies

Public Water Supply Susceptibility Determinations in the Roanoke River Basin

In April 2004, the Division of Environmental Health's Public Water Supply Section completed source water assessments for all drinking water sources and generated reports for the PWS systems using these sources. The assessments are updated regularly; the most recent updates were published in May 2010. The results of the assessments can be viewed in two different ways, either through the interactive ArcIMS mapping tool or compiled in a written report for each PWS system. To access the ArcIMS mapping tool, simply click on the "NC SWAP Info" icon on DEH's website. To view a report, select the PWS System of interest by clicking on the "Source Water Assessment Results-2010" link found on the SWAP web page.

In the Roanoke River Basin, 422 public water supply sources were identified. Twelve are surface water sources and 410 are groundwater sources. Of the 410 groundwater sources, nine have a Higher, 373 have a Moderate and 28 have a Lower susceptibility rating. Table ES-2 identifies the surface water sources and their overall susceptibility ratings. It is important to note that a susceptibility rating of Higher does not imply poor water quality as susceptibility is an indication of a water supply's potential to become contaminated.

Table ES-2: SWAP Results for Surface Water Sources in the Roanoke River Basin

PWS ID Number	Inherent Vulnerability Rating	Contaminant Rating	Overall Susceptibility Rating	Name of Surface Water Source	PWS System Name
0217010	M	L	M	Farmer Lake	Town of Yanceyville
0217010	M	L	M	Fuller's Creek	Town of Yanceyville
0273010	M	L	M	City Lake	City of Roxboro
0273010	M	L	M	Lake Roxboro	City of Roxboro
0273409	M	L	M	Hyco Lake	Roxboro Steam Plant
0279010	H	H	H	Dan River	Town of Eden
0279025	H	L	M	Mayo River	Town of Mayodan
0279030	H	M	H	Dan River	Town of Madison
0291010	M	L	M	Kerr Lake	Henderson-Kerr Lake Regional Water
0442010	H	L	M	Roanoke River	Roanoke Rapids Sanitary District
0442010	M	L	M	Roanoke Rapids Lake	Roanoke Rapids Sanitary District
0442020	H	L	M	Roanoke River	Weldon Water System

Additional information concerning SWAP on a statewide level can be found in Chapter 18 of the *2006 Roanoke River Basinwide Water Quality Plan*.

ECOLOGICAL FLOW IN THE ROANOKE RIVER BASIN

The North Carolina General Assembly enacted **legislation** in 2010 directing the Department of Environment and Natural Resources to develop hydrologic models for each river basin in N.C. An important part of this bill requires the department to determine the flows needed to maintain ecological integrity in surface waters. The bill further authorized the creation of a Science Advisory Board to assist the department in assessing these ecological flows. The **members and alternates** of the board all have a strong background in aquatic ecology and represent a diversity of water use interests. The board has a **charter** that will help guide them through this process.

Updates on the **progress of the Roanoke River model** are on the Division of Water Resources website.

BASINWIDE NEEDS

To achieve the goal of restoring Impaired waters throughout the basin, DWQ will need to continue to work closely with other state agencies in NC and across state lines as well as stakeholders to identify and control pollutants. The costs of restoration can be high, but several programs exist to provide funding for restoration efforts.

Balancing economic development and water quality protection will be a challenge. Some impacts on surface waters can be measured and addressed through the basinwide planning process. Others can be identified through the basinwide plan, but actions to address these impacts must be taken at the local level. Such actions should include: development and enforcement of local sediment and erosion control ordinances; stormwater best management practices for existing and new development; development and enforcement of riparian buffer ordinances; and land use planning that assesses impacts on natural resources. This basinwide plan presents many water quality initiatives and accomplishments that are underway throughout the Roanoke River Basin that provide a foundation on which future initiatives can be built.

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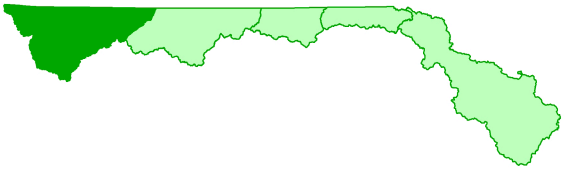
Schueler, T., and H.K. Holland. 2000. The Practice of Watershed Protection. Center for Watershed Protection, Ellicott City, Maryland.

CHAPTER 1



Upper Dan River Subbasin

HUC 03010103

Includes: Dan River, Snow Creek, Big Creek, Town Fork Creek, Mayo River, Rock House Creek, Smith Creek, & Wolf Island Creek

Subbasin Water Quality Overview

The Upper Dan River Subbasin is the western most subbasin and runs along the North Carolina/Virginia state line. The subbasin contains two Impaired streams: five segments of the Dan River are Impaired for either fecal coliform bacteria, turbidity or both; and the Smith River is Impaired for biological integrity, fecal coliform bacteria and copper.

During this assessment cycle (2004-2009), the subbasin experienced a moderate drought in 2005 and 2006 as well as a prolonged drought between 2007 and 2008. Monitoring the biological community during this cycle showed only a small percent declined. There were no major ambient monitoring violations; however, a long term pattern of a slight increase in pH was seen.

This subbasin is part of a bi-state coordinated effort between Virginia and North Carolina to focus studies and restoration implementation on the greater Dan River drainage area. More information about these efforts can be found in the Recommendations, Action Plans & Other Information at the Subbasin Scale section.

Subbasin at a Glance

Counties:

Surry, Stokes, Forsyth, Rockingham, & Caswell

Municipalities:

Eden, Stoneville, Wentworth, Mayodan, Reidsville, Stokesdale, Danbury, Walnut Cove, Rural Hall, & Walkertown

Ecoregions:

Sauratown Mountains, Northern Inner Piedmont, & Triassic Basin

Permitted Facilities:

NPDES Dischargers:	126
Major	5
Minor	28
General	93
NPDES Non-Dischargers:	3
Stormwater:	49
General	49
Individual	0
Animal Operations:	8

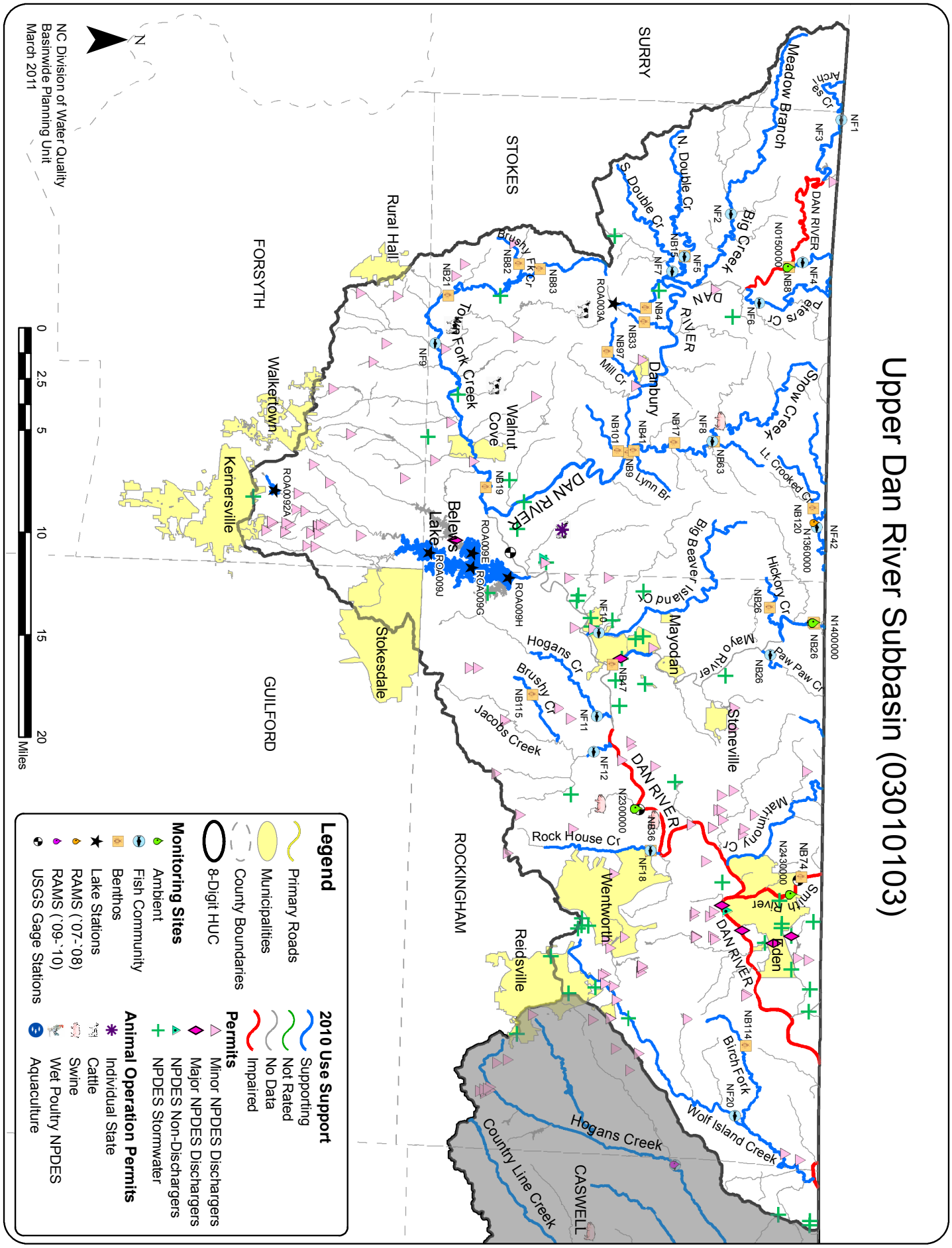
Population:

2010 Census	124,907

2006 Land Cover:

Open Water	1.2%
Developed	8.3%
Forest	62.8%
Agriculture	19.0%
Wetlands	0.6%
Barren Land	0.1%
Shrub/Grassland	8.0%

FIGURE 1-1: UPPER DAN RIVER SUBBASIN (03010103)



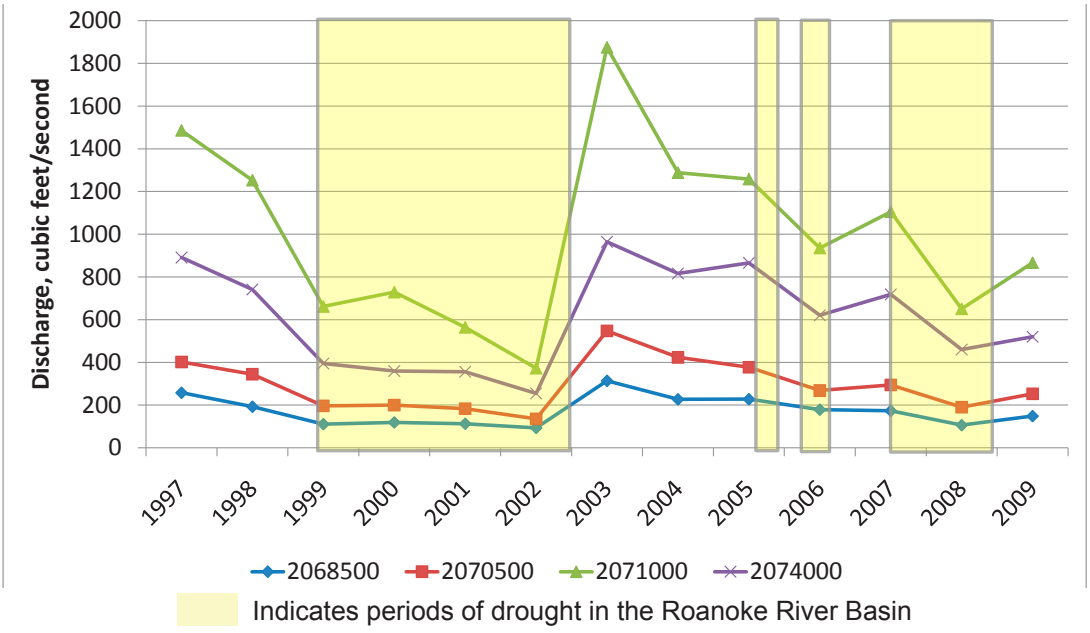
Water Quality Data Summary for this Subbasin

Monitoring stream flow, aquatic biology and chemical/physical parameters is a large part of the basinwide planning process. More detailed information about DWQ monitoring and the effects each parameter has on water quality is discussed in Chapters 2 and 3 of the Supplemental Guide to North Carolina's Basinwide Planning document.

Stream Flow

The basin experienced prolonged droughts from 1998-2002 and again from 2007-2008, with moderate droughts in 2005 and 2006 (Figure 1-2). More detail about flows in the Roanoke River Basin can be found in the 2010 Roanoke River Basinwide Assessment Report produced by DWQ-Environmental Science Section.

Figure 1-2: Yearly Flow Rates (cfs) of the USGS Gage Stations in the Upper Dan River Subbasin Between 1997 & 2009



From Left to Right:

- 2068500: Dan River (Francisco)
- 2070500: Mayo River
- 2071000: Dan River (Wentworth)
- 2074000: Smith River

Biological Data

Biological samples were collected during the spring and summer months of 2009 by the DWQ-Environmental Sciences Section as part of the five year basinwide sampling cycle, in addition to special studies. Overall, 30 biological sampling sites were monitored within the Upper Dan River Subbasin. The ratings for each station can be seen in Appendix 1-B.

Benthic Macroinvertebrate Sampling

Each benthic station monitored during the current cycle is shown in Figure 1-3 and color coded based on the current rating. Each of the sites are discussed in more detail in the watershed section below. Figure 1-5 is a comparison of benthic site ratings sampled during the last two basinwide cycles to indicate if there are any overall shifts in ratings. Benthic ratings from this cycle are similar to those received during the previous cycle indicating a relatively stable community.

Benthic Sampling Summary

Total Stations Monitored	15
Total Samples Taken	17
Number of New Stations	9

FIGURE 1-3: BENTHIC STATIONS COLOR CODED BY CURRENT RATING IN THE UPPER DAN RIVER SUBBASIN

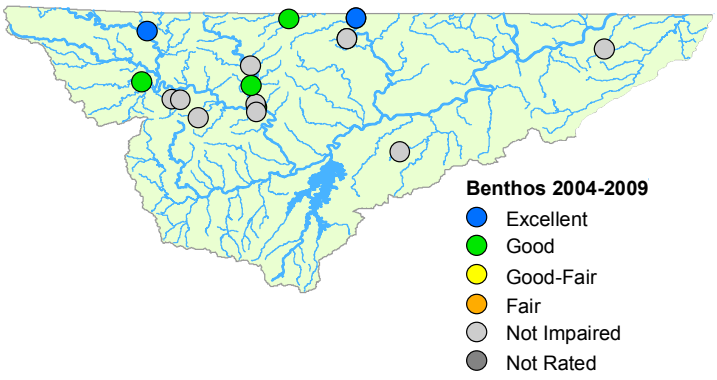


FIGURE 1-4: CURRENT BENTHIC SITE RATINGS

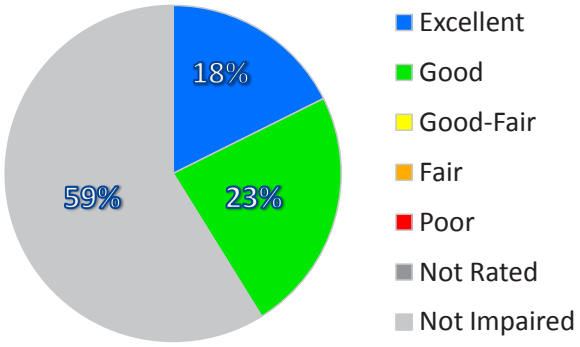
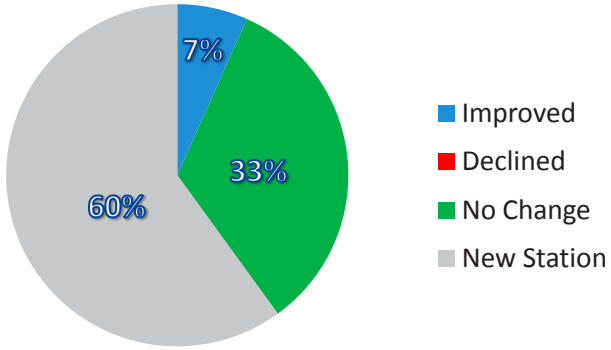


FIGURE 1-5: CHANGE IN BENTHIC SITE RATINGS



Fish Community Sampling

Each fish community station monitored during the current cycle is shown in Figure 1-6 and color coded based on the current rating. Each of the sites are discussed in more detail in the watershed section below. Figure 1-7 shows the percentages of each rating given during this sampling cycle within this subbasin. Figure 1-8 is a comparison of fish community site ratings sampled during the last two cycles to determine if there are any overall watershed shifts in ratings. Overall, the community is relatively stable.

FISH COM. SAMPLING SUMMARY

Total Stations Monitored	15
Total Samples Taken	15
Number of New Stations	1

FIGURE 1-6: FISH COMMUNITY STATIONS COLOR CODED BY CURRENT RATING IN THE UPPER DAN RIVER SUBBASIN

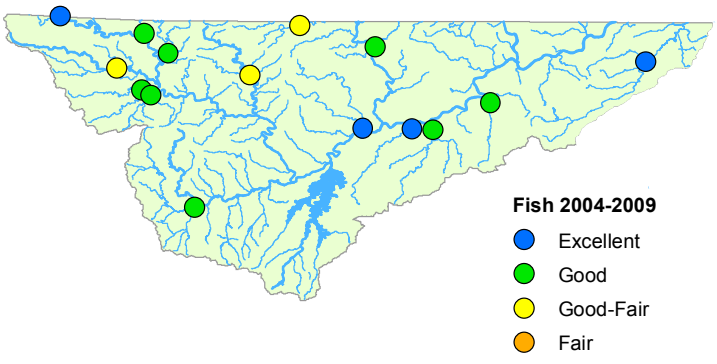


Figure 1-7: Current Fish Community Site Ratings

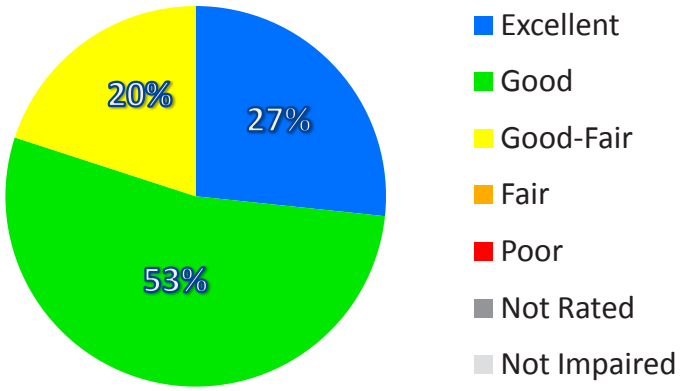
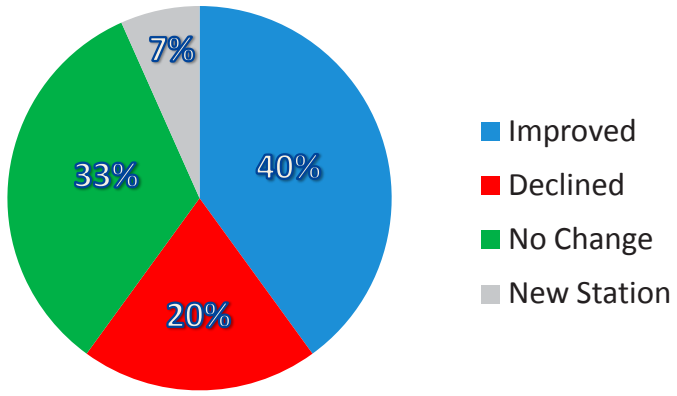


Figure 1-8: Change in Fish Community Site Ratings



For more information about biological data in this subbasin, see the 2010 Roanoke River Basinwide Assessment Report. Detailed data sheets for each sampling site can be found in Appendix 1-B.

Ambient Data

The ambient data are used to develop use support ratings every two years, which are then reported to the EPA via the Integrated Report (IR). The IR is a collection of all monitored waterbodies in North Carolina and their water quality ratings. The most current IR is the 2010 version and is based on data collected between 2004 and 2008. The ambient data reported in this basin plan were collected between 2005 and 2009 and will be used for the 2012 IR. If a waterbody receives an Impaired rating, it is then placed on the 303(d) Impaired Waters List. The Roanoke River Basin portion of the 2010 IR can be found in Appendix 1-A and the full 2010 IR can be found on the Modeling & TMDL Unit's website.

Four Ambient Monitoring System (AMS) stations are located in the Upper Dan River subbasin (see Figure 1-1 for the station locations). During the current sampling cycle (January 2005 and December 2009), samples were collected for all parameters on a monthly basis except metals which were sampled quarterly until May 2007 when metals sampling was suspended. For more information about the ambient monitoring, parameters, how data are used for use support assessment and other information, see Chapter 2 of the Supplemental Guide to North Carolina's Basinwide Planning.

Long Term Ambient Monitoring

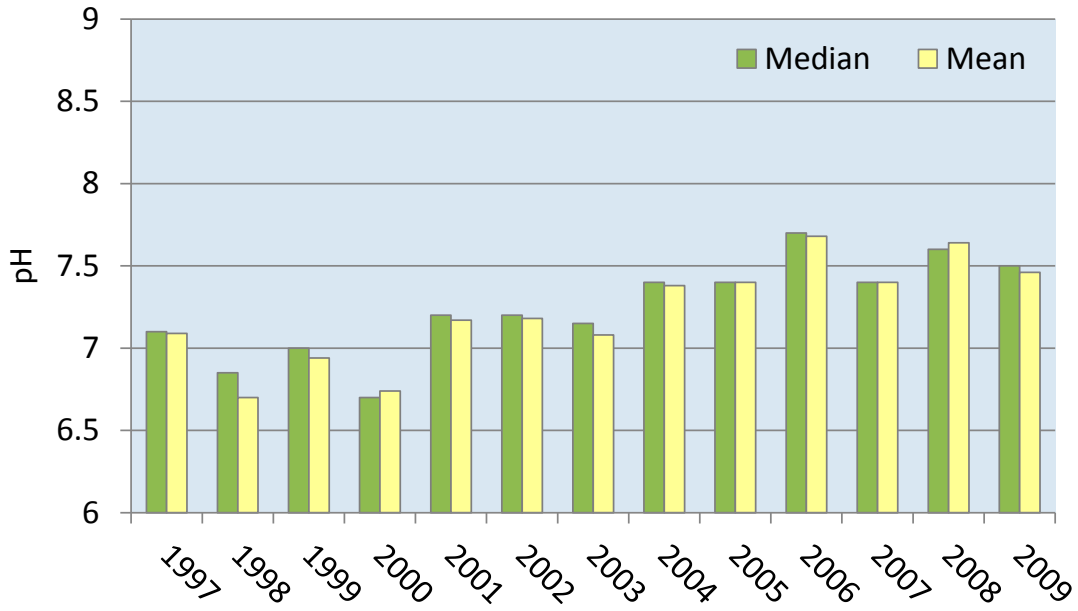
The following discussion of ambient monitoring parameters of concern include graphs showing the median and mean concentration values for each ambient station in this subbasin by specific parameter over a 13 year period (1997-2009). The geometric mean is a type of mean or average, which indicates the central tendency or typical value of a set of numbers. The graphs are not intended to provide statistically significant trend information, but rather an idea of how changes in land use or climate conditions can affect parameter readings over the long term. The difference between median and mean results indicate the presence of outliers in the data set. Box and whisker plots of individual ambient stations were completed by parameter for data between 2005 and 2009 by DWQ's Environmental Sciences Section (ESS) and can be found in the Roanoke River Basin Ambient Monitoring System Report.

pH

Figure 1-9 shows the mean and median pH levels for all samples taken over the course of 13 years in the Upper Dan River Subbasin. The pH pattern seen during this time period is a steady increase until 2006 when it dips back down. This pattern is seen in other parts of the northwestern corner of the state. Possible causes of the increasing levels in this subbasin could be atmospheric deposition, groundwater influences or precipitation influences. However, the exact reason is unknown at this time.

Proper riparian buffers throughout the subbasin could reduce the impact of stormwater runoff, which can include nutrients from farm or lawn fertilizers, as well as impacts from acid rain. Trees within riparian buffers are also beneficial for shading streams and reducing water temperatures. It is recommended to continue monitoring pH levels within the subbasin and investigate possible causes.

FIGURE 1-9: SUMMARIZED PH VALUES FOR ALL DATA COLLECTED AT AMBIENT SAMPLING STATIONS IN HUC 03010103



* NC pH Standard: Between 6.0 and 9.0 su

Turbidity

All four AMS stations within the Upper Dan River subbasin exceeded the state's turbidity standard in 6 to 23 percent of samples, as seen in Figure 1-10 indicated by yellow and red dots. Possible sources of the elevated turbidity levels are discussed in the 10-digit watershed section. Figure 1-11 shows the mean and median turbidity levels for all samples taken over the course of 13 years in the Upper Dan River subbasin. The yearly averages are well below the state standard of 50 NTUs with the exception of the 2009 mean. The western most station is located in a designated Trout Water which has a standard of 10 NTU.

While some erosion is a natural phenomenon, human land use practices may accelerate the process to unhealthy levels for aquatic life. Construction sites, mining operations, agricultural operations, logging operations and excessive stormwater flow off impervious surfaces are all potential sources. Turbidity exceedances demonstrate the importance of using best management practices to minimize the impacts of agriculture and development upon water quality, and **protecting and conserving stream buffers and natural areas**.

Figure 1-10: Percentage of Samples Exceeding the Turbidity Standard (2005-2009)

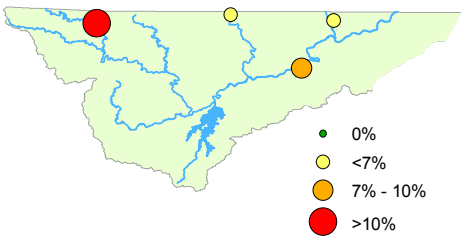
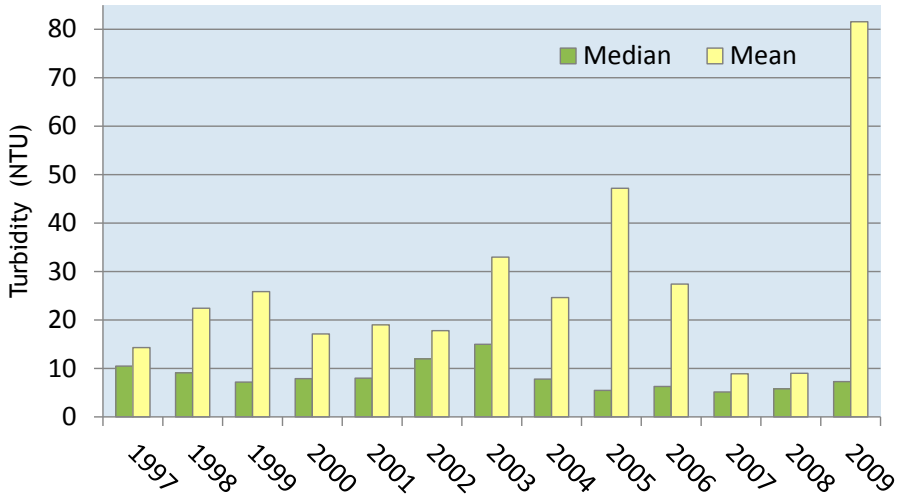


Figure 1-11: Summarized Turbidity Values for All Data Collected at Ambient Sampling Stations in HUC 03010103



* NC Turbidity Standard: Class C Waters = 50 NUT; Class Tr Waters = 10 NTU

Dissolved Oxygen (DO)

As seen in Figure 1-12, none of the four sites recorded DO standard exceedance during this monitoring cycle. Figure 1-13 shows the mean and median of DO levels for all samples taken over the course of 13 years in the Upper Dan River subbasin. These averages are well within the normal DO range.

Figure 1-12: Percentage of Samples Exceeding the DO Standard (2005-2009)

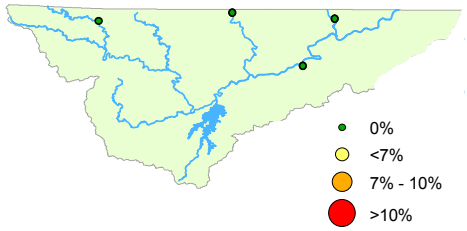
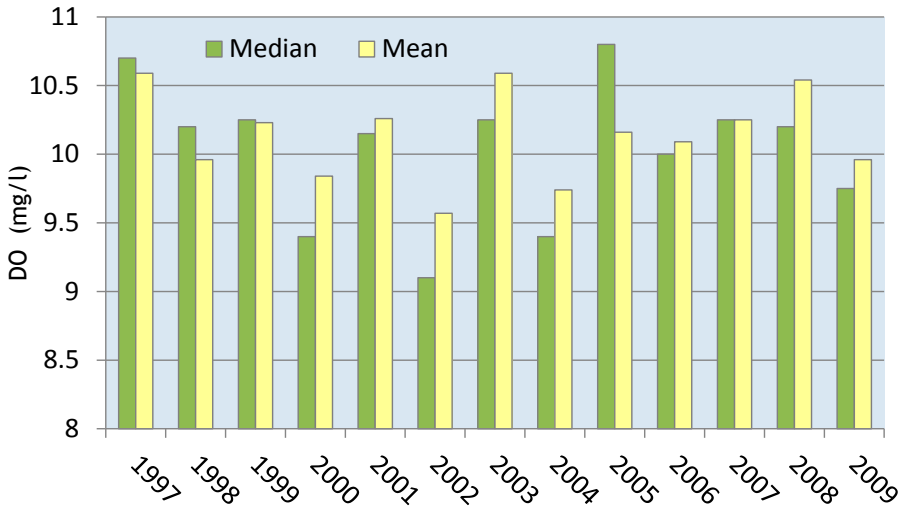


Figure 1-13: Summarized DO Values for All Data Collected at Ambient Sampling Stations in HUC 0301010

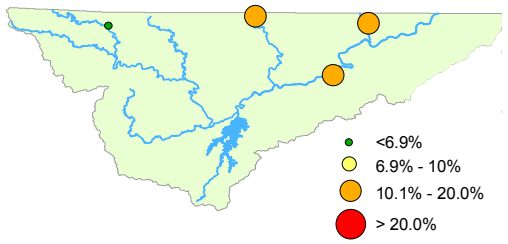


* NC DO Standard: Not < 5 mg/l daily avg. or not < 4 mg/l instantaneous

Fecal Coliform Bacteria

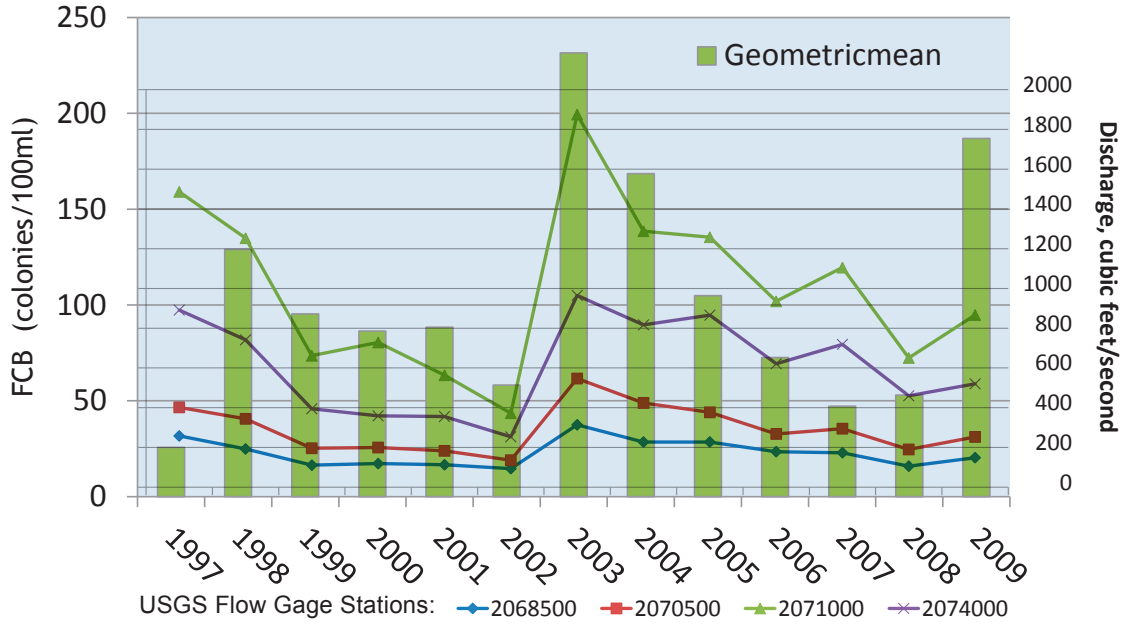
Fecal coliform bacteria (FCB) occurs in water as a result of nonpoint sources such as animal waste from wildlife, farm animals and/or pets, as well as from sanitary sewer overflows (SSOs). The FCB standard for freshwater streams is not to exceed the geometric mean of 200 colonies/100 ml, or 400 colonies/100 ml in 20% of the samples where five samples have been taken in a span of 30 days (5-in-30). Only results from a 5-in-30 study are used to indicate whether the stream is Impaired or Supporting. Waters with a use classification of B (primary recreational waters) receive priority for 5-in-30 studies. Other waters are studied as resources permit.

FIGURE 1-14: PERCENTAGE OF SAMPLES WITH ELEVATED FCB LEVELS (2005-2009)



As seen in Figure 1-14, three of the four sites had between 10% and 20% of samples over 400 colonies/100 ml. Possible sources of elevated levels of FCB are discussed in the subwatershed sections. Figure 1-15 shows the yearly geometric mean (calculated average) for all samples taken over the course of 13 years in the Upper Dan River subbasin. The highest yearly geometric mean was recorded in 2003 (232 colonies/100 ml). The figure also includes the yearly average stream flow, as seen in Figure 1-2, to show how flow can be closely linked to FCB levels.

FIGURE 1-15: SUMMARIZED FECAL COLIFORM BACTERIA VALUES FOR ALL DATA COLLECTED AT AMBIENT SAMPLING STATIONS IN HUC 03010103 WITH OVERLAYING FLOW



* NC FCB Standard (5-in-30 data only): Geomean not > 200/100 ml or 400/100 ml in 20% of samples

Additional information about possible causes of parameters discussed above for particular stations, see the stream write ups below. For more information regarding any of the parameters listed above, see Section 3.3 of the Supplemental Guide to North Carolina's Basinwide Planning. For additional information about ambient monitoring data collected in this river basin, see the Roanoke River Basin Ambient Monitoring System Report.

Understanding the Data

Biological & Ambient Ratings Converted to Use Support Categories

Biological (benthic and fish community) samples are given a bioclassification/rating based on the data collected at the site by DWQs Environmental Sciences Section (ESS). These bioclassifications include Excellent, Good, Good-Fair, Not Impaired, Not Rated, Fair and Poor. For specific methodology defining how these rating are given see Benthic Standard Operating Procedures (SOP) or the Fish Community SOP. Once a rating is given, it is then translated into a Use Support Category (see Figure 1-16).

Figure 1-16: Use Support Categories for Biological Ratings

Biological Ratings	Aquatic Life Use Support
Excellent	Supporting (Categories 1-2)
Good	
Good-Fair	
Not Impaired	
Not Rated	Not Rated (Category 3)
Fair	Impaired (Categories 4-5)
Poor	

Ambient monitoring data are analyzed based on the percent of samples exceeding the state standard for individual parameters for each site within a five year period. In general, if a standard is exceeded in greater than 10.0% of samples taken for a particular parameter, that stream segment is Impaired for that parameter. The fecal coliform bacteria parameter is exception to the rule. See the Fecal Coliform Bacteria section in the Ambient Data portion above.

Figure 1-17: Category Number to Use Support Rating

Category #	Use Support Rating
1	Supporting
2	
3	Not Rated
4	Impaired
5	

Each biological parameter (benthic and fish community) and each ambient parameter is assigned a Use Support Category based on its rating or percent exceedance. A detailed description of each category can be found on the first page of Appendix 1-A. Each monitored stream segment is given an overall category number which reflects the highest individual parameter category. Figure 1-17 shows how the category number is translated into the use support rating.

Example

Stream A had a benthic sample that rated Good-Fair and 12% of turbidity samples taken at the ambient station were exceeding the standard. The benthic sample would be given an individual category number of 1 (Figure 1-16) and the turbidity parameter would be given a category number of 5 since >10% of samples exceeded the standard. Therefore, stream A's overall category number would be a 5, indicating the stream has a use support rating of Impaired.

RECOMMENDATIONS, ACTION PLANS & OTHER INFORMATION AT THE SUBBASIN SCALE

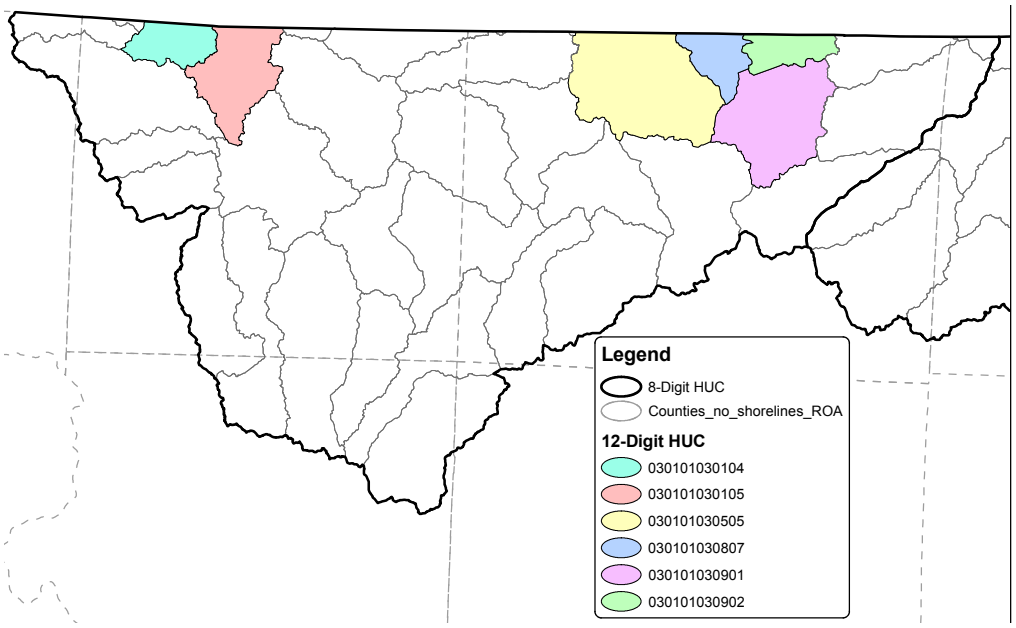
WATERSHED RESTORATION IMPROVEMENT TEAM (WRIT)

The Upper Dan River Subbasin has been prioritized as an area in which to focus resources by the NC Watershed Restoration Improvement Team (WRIT), which has only a selected few areas across the state. The WRIT is comprised of representatives from different DENR divisions and programs (although now due to 2011 legislative organizational mandates there are programs from the NC Department of Agriculture and Consumer Services as well) who are working to better coordinate watershed efforts across the state. WRIT has specifically selected the following 12-digit HUCs within this subbasin as part of those few watersheds across the state to focus efforts:

- Elk Creek (030101030104);
- Peters Creek (030101030105);
- Matrimoney Creek (030101030505);
- Smith River (030101030807);
- Town Creek (030101030901); and
- Cascade Creek (030101030902).

More specific details on these subwatersheds can be found in the 10-Digit Watershed section below.

FIGURE 1-18: UPPER DAN RIVER WRIT SUBWATERSHEDS



NORTH CAROLINA & VIRGINIA COORDINATED EFFORTS

The states of Virginia and North Carolina have been communicating periodically over the last few years in an effort to coordinate watershed efforts between the two states. The entire Dan River drainage area which crosses the state lines several times, has been selected as a larger area in which to coordinate efforts between the states.

Rodney Wright with the Stokes, Rockingham, and Caswell County Soil & Water Conservation Districts is serving as the watershed coordinator for the Upper Dan River Subbasin. He is working with locals and others to identify and implement management measures in the subbasin. This effort will mainly focus on those areas that drain to Impaired waters. Some specific projects implemented by this effort will be discussed in the 10-digit HUC's Local Initiatives sections. The coordinator and local districts will be making a concerted effort to work with their counterparts in VA in those subwatersheds that border VA to better coordinate activities.

Piedmont Triad Regional Council (PTRC) received a Clean Water Management Trust Fund Grant to develop an Eden Area Watershed Plan intended to address the impairments on both the Dan and Smith rivers in this area. For more information on this effort, please refer to the PTRC's website. PTRC also received a 205(j)/604(b)-funded GIS project to prioritize 12-digit HUC watersheds in both NC & VA for conservation and restoration as they had previously done for the Yadkin-Pee Dee River Basin.

DWQ Priority Summary

Table 1-1 is a list of waters in the Upper Dan River Subbasin that DWQ has prioritized for restoration/protection. The order of priority is not based solely on the severity of the steam's impairment or impacts but rather by the need for particular actions to be taken. A stream that is currently supporting its designated uses may be prioritized higher within this table than a stream that is currently impaired. This is based on a more holistic evaluation of the drainage area which includes monitoring results, current and needed restoration/protection efforts, land use and other activities that could potentially impact water quality in the area. Some supporting streams may have a more urgent need for protections than an impaired stream with restoration needs already being implemented.

The table also lists potential stressors and sources that may be impacting a stream including in-field observations, monitoring data, historical evidence and permit or other violations. Additional study may be needed to determine exact source(s) of the impact. The last column includes a list of recommended actions.

Table 1-1: Notable Waters in the Upper Dan River Subbasin (Not Ranked)

Stream Name	AU#	Class.	Potential Stressor(s)	Potential Source(s)	Qualitative Status	Actions Needed
Dan River	22-(1)a	C;Tr	--	--	Supporting	P: additional (biological diversity)
Dan River	22-(1)b	C;Tr	Turbidity	--	Impaired	P (endangered species)
Dan River	22-(8)	WS-V	--	--	Supporting	P (rare species)
North Double Cr	22-10	C	Nutrients (in the past)	--	Supporting	M
South Double Cr	22-11	B	--	--	Supporting	M
Archies Cr	22-2	C;Tr	--	--	Supporting	P (qualifies for HQW)
Snow Cr	22-20	C	Nutrient enrichment	--	Supporting	RBR
Town Fork Cr	22-25a & b	C	--	--	Supporting	M
Big Beaver Island Cr	22-29	C	--	--	Improving	P (Fed Endangered)
Jacobs Cr	22-32-(3)	WS-IV	Turbidity	--	Supporting	SEC BMPs
Rock House Cr	22-34-(2)	WS-IV	Turbidity	--	Supporting	P (rare species)
Smith River	22-40-(1), (2.5) & (3)	WS-IV; CA;C	Turbidity, FCB, Copper	--	Impaired	SS
Elk Cr	22-5	C;Tr	Habitat Degradation (Riparian Buffers)	--	Supporting	RBR
Peter Cr	22-6	C;Tr	--	--	Supporting	M, P (state threatened species)
Big Cr	22-9	C;Tr	Nutrients, DO Saturation	--	Supporting	SS

Class.: Classification (e.g., C, B, WS-I, WS-II, WS-III, WS-IV, WS-V, Tr, HQW, ORW, SW, UWL)

Stressor: Chemical parameters or physical conditions that at certain levels prevent waterbodies from meeting the standards for their designated use (e.g., low/high DO, nutrients, toxicity, habitat degradation, etc.). Fecal Coliform Bacteria (FCB),

Source: The cause of the stressor. (Volume & Velocity: when a stream receives stormwater runoff at a much higher volume and velocity than it would naturally receive due to ditching, impervious surfaces, etc.)

Status: Impaired, Impacted, Supporting, Improving (For current Use Support Assessment see the Integrated Report.)

Actions Needed: Agriculture BMPs (**Ag**), Best Management Practices (**BMPs**), Daylight Stream (**DS**), Education (**E**), Forestry BMPs (**F**), Local Ordinance (**LO**), Monitoring (**M**), Nutrient Mgnt Controls (**NMC**), Protection (**P**), Restoration (**R**), Riparian Buffer Restoration (**RBR**), Stormwater Controls (**SC**), Sediment and Erosion Control BMPs (**SEC BMPs**), Species Protection Plan (**SPP**), Stressor Study (**SS**), .

STATUS & RECOMMENDATIONS FOR MONITORED WATERS

UNDERSTANDING THIS SECTION

In this Section, more detailed information about stream health, special studies, aquatic life stressors and sources and other additional information is provided by each 10-digit Hydrological Unit Code (HUC). Waterbodies discussed in this Chapter include all monitored streams, whether monitored by DWQ or local agencies with approved methods. Use Support information on all monitored streams within this watershed can be seen on the map in Figure 1-1, and a Use Support list of all monitored waters in this basin can be found in the Use Support Chapter.

Use Support & Monitoring Box:

Each waterbody discussed in the Status & Recommendations for Monitored Waters within this Watershed section has a corresponding Use Support and Monitoring Box (Table 1-2). The top row indicates the 2010 Use Support and the length of that stream or stream segment. The next two rows indicate the overall Integrated Report category which further defines the Use Support for both the 2008 and the 2010 reports. These first three rows are consistent for all boxes in this Plan. The rows following are based on what type of monitoring stations are found on that stream or stream segment and may include benthic, fish community and/or ambient monitoring data. If one of these three types of monitoring sites is not shown, then that stream is not sampled for that type of data. The first column indicates the type of sampling in bold (e.g., **Benthos**) with the site ID below in parenthesis (e.g., CB79). The latest monitoring result/rating of that site is listed in the next column followed by the year that sample was taken. If there is more than one benthic site, for example, on that stream, the second site ID and site rating will be listed below the first. The last row in the sample box in Table 1-2 is the AMS data. The data window for all AMS sites listed in the boxes in this Plan is between 2004-2008. Only parameters exceeding the given standard are listed in the second column with the percent of exceedance listed beside each parameter.

TABLE 1-2: EXAMPLE OF A USE SUPPORT AND MONITORING BOX

USE SUPPORT: **IMPAIRED** (14 MI)	
2008 IR Cat.	4a
2010 IR Cat.	4
Benthos (CB79) (CB80)	 Fair (2002) Fair (2002)
Fish Com (CF33)	 Good-Fair (2002)
AMS (C1750000)	Turbidity - 12% FCB - 48%

Please note any fecal coliform bacteria (FCB) listing in the last row (as seen in Table 1-2) only indicates elevated levels and a study of five samples in 30 days (5-in-30) must be conducted before a stream becomes Impaired for FCB.

DAN RIVER CURRENT WATER QUALITY STATUS

The Dan River drainage area stretches across two subbasins (03010103 & 03010104); however, the full length of the NC portion of the river is discussed here including a summary of all Dan River Impairments and TMDLs. A bi-state restoration effort for the Dan River drainage area is discussed in the section above.

Dan River [AU#: 22-(1)a]

This portion of the Dan River is the first segment to across the state line into NC. The river crosses the state line four additional times before exiting NC west of the Town of Milton flowing northward to Kerr Lake. The segment is approximately five miles from the state line to it's confluence with the Little Dan River [AU#: 22-4] and is designated as Trout Waters. The majority of the drainage area is forestry, agriculture, residential and some industrial areas.

USE SUPPORT: **SUPPORTING** (5.1 MI)	
2008 IR Cat.	2
2010 IR Cat.	2
Fish Com (NF3)	 Good (2004)

All waters upstream of the Big Creek and Dan River confluence hold the secondary use classification of Trout Waters. Near the most upstream portion of this segment, just after the Dan River crosses into NC, there is a designated 363 acre Significant Natural Heritage Area. The river is known for its high level of fish species

diversity and the presence of several endemic species that are endangered, threatened, or significantly rare. This segment of the Dan River was placed under the Supporting use support category on the 2010 Integrated Report based on the 2004 fish sample.

Water Quality Status

This segment was last monitored in 2004. At that time, the fish population comprised of all pollution intolerant species. There was a concern for the absence of sunfish and piscivores as a result of the segment being Hatchery Supported Trout Waters; however, it is likely due to the habitat and fast running nature of the river. The NC Wildlife Resources manages efforts to stock 6,800 brook, rainbow and brown trout from May to July each year. Overall, the fish community in this segment was healthy as of 2004.

Dan River [AU#: 22-(1)b]

The second segment of the Dan River is approximately 11.6 miles from it's confluence with the Little Dan River [AU#: 22-4] to Peters Creek [AU#: 22-6] and is designated as Trout Waters. The majority of land cover in the drainage area is agriculture, forest and some residential. This segment of the Dan River has been on the Impaired Waters List since 2008 for exceeding the turbidity standard.

Use Support: Impaired (11.6 mi)	
2008 IR Cat.	5
2010 IR Cat.	5
Benthos (NB8)	Excellent (2009)
AMS (N0150000)	Turbidity - 22%

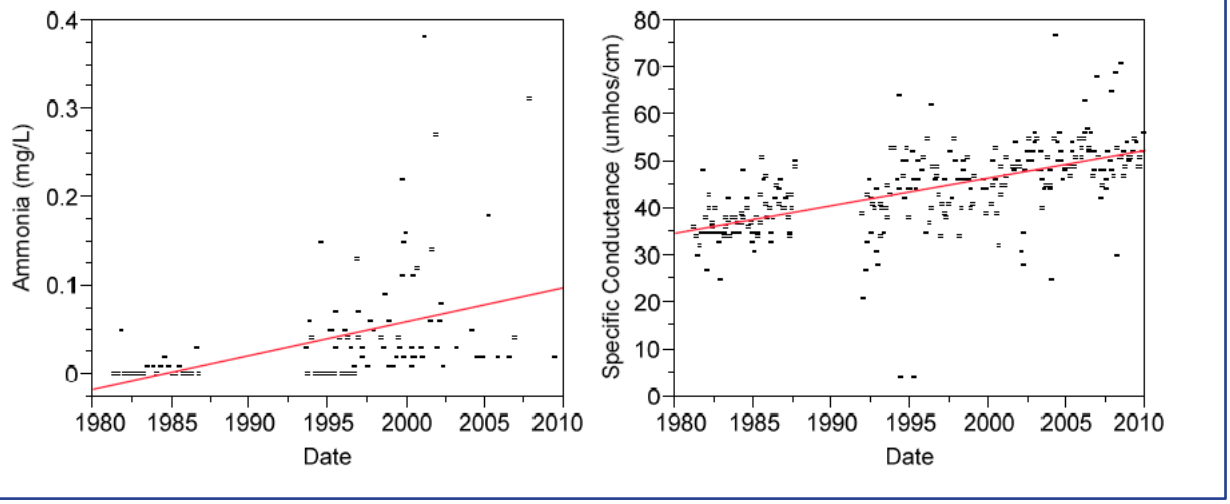
Water Quality Status

This segment of the Dan River has been monitored by DWQ since 1984 at the benthic station NB8. Ratings between 1984 and 2009 have either been Good or Excellent. In 2009, the site received an Excellent rating, reflecting the stable pollution intolerant macroinvertebrate community which has been observed in the past.

An ambient station is also located on this segment which has shown turbidity standard exceedances since the 2001 plan. The segment was first listed as Impaired for turbidity in 2008 and was not included on previous lists due to difference in use support methodology. Streams classified as Trout Waters, as this segment is, have a lower turbidity standard of 10 NTUs verses 50 NUTs for Class C waters. Even though the number of samples exceeding the standard didn't change much between the previous monitoring cycle and the present cycle, the value of the exceeding samples increased.

A nutrient and sediment trend analysis was completed during this cycle. The analysis showed nutrients peaking in February and August and decreasing to a minimum in October. Turbidity and total suspended solid levels peaked in late spring and early summer months. Long term trends were evaluated during this cycle for data collected between 1980 and 2009. Ammonia and specific conductance increased +0.004 mg/l per year and +0.60 umhos/cm per year, respectively (Figure 1-19). See the **Roanoke River Ambient Monitoring Report** for more details.

Figure 1-19: Long Term Trends at N0150000 (1980-2010)



Recommendations

Examine the possibility of additional monitoring stations, stream walking or other investigation to try to identify causes and sources of turbidity problems in Dan River. The upper part of this segment is located in Elk Creek subwatershed which is one of the subwatersheds targeted for greater focus and resources by WRIT; therefore, additional resources may be available for investigation. DWQ should coordinate with VA when working on this river segment.

Dan River [AU#: 22-(8)]

This segment of the Dan River is approximately 26 miles from Big Creek [AU#: 22-9] to Town Fork Creek [AU#: 22-25b]. However, only about 11.6 miles of the segment are within this watershed. The land cover for majority of the drainage area is forest and agriculture. There are two mining operations towards the downstream portion of the segment.

USE SUPPORT: **SUPPORTING** (25.9 MI)	
2008 IR Cat.	2
2010 IR Cat.	2
Benthos (NB9)	Good (2009)

Water Quality Status

The benthic station is just downstream from the Little Dan River watershed (0301010301) boundary and gives a representation of the water quality in that watershed. The land running parallel to the river in this upstream area is mostly forested. Samples have been taken at this benthic site since 1994 when it received a Good-Fair rating. That rating increased to a Good in 1999 and has remained at that rating ever since with a slightly increasing overall score. A few rare species (*Trycorythodes robacki* and *Ceraclea mentiea*)were collected in the 2009 sample.

Recommendations

This segment and the rare species found within it would benefit from additional protections on a state and local level.

Dan River [AU#: 22-(31.5)a & (31.5)b]

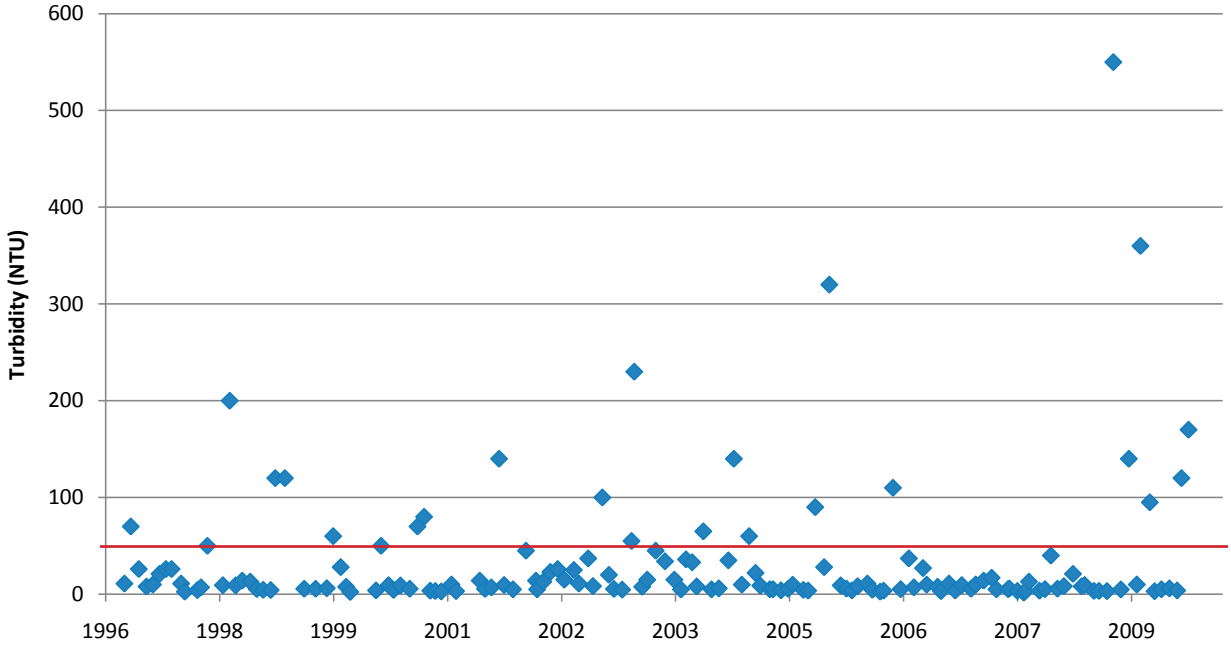
These two segments of the Dan River are approximately 14 miles combined from just over half a mile downstream of Jacobs Creek [AU#: 22-32-(3)] to Mill Branch [AU#: 22-39.5]. Land cover along these segments is mostly agriculture and residential with urban area around the Town of Eden. This segment has been on the Impaired Waters List since 2002 for turbidity standard violations.

USE SUPPORT: **IMPAIRED** (14.2 MI)	
2008 IR Cat.	5
2010 IR Cat.	4
AMS (N2300000)	Turbidity (14.8%)

Water Quality Status

There is one monitoring (AMS) station between these two segments. Almost 15% of turbidity samples exceeded the state standard at this station. Instream mining operations have been noted as a source in past plans. DWQ developed a **TMDL for turbidity** for this section of the Dan River in 2005. The TMDL recommended a 59% reduction in total suspended solids between both point and nonpoint sources. As seen in Figure 1-20, majority of sampling results have been reduced to below 35 NTUs since the TMDL was released in 2005 indicating progress.

Figure 1-20: Long Term Turbidity Sampling at N2300000 (1997-2009)



Dan River [AU#: 22-(39)a & b]

Use Support: Impaired (23.4 mi)	
2008 IR Cat.	5
2010 IR Cat.	5
AMS (N3000000) (N3500000)	Turbidity (19%) Turbidity (23%)

These two segments of the Dan River run from Mill Branch [AU#: 22-39.5] about 12 miles northeast to the state line. The river flows through Virginia for roughly six miles, crosses back into NC for a mile and a half before it returns to Virginia. After crossing state line again into NC, it flows for about 10 miles before its final exit just before reaching the Town of Milton. These segments are lined with agriculture and some forested areas, with tributaries draining additional farmland and residential areas. There are also two major dischargers within two and a half miles from the Smith River confluence (City of Eden WWTP and Duke Energy Dan River Steam Station). These segments have been on the Impaired Waters List for FCB and Turbidity since 2008.

Water Quality Status

There are two AMS monitoring stations along these two segments. Both station's samples exceeded the turbidity state standard. The average turbidity levels for both stations have decreased; however, the amount of samples exceeding the standard have increased at both stations. Both segments are on the Impaired Waters List for FCB standard violations as well. A **TMDL for FCB** for the Smith and Dan Rivers was developed in 2009 to address that impairment.

BMP Implementation

NC Division of Soil & Water Conservation was awarded an NC Section 319 NPS Program grant in 2008 to implement BMPs throughout the Dan River Watershed. BMPs that will be installed during the course of this project include: conservation cover, conservation crop rotation, cover crop, critical area planting, diversions, livestock exclusion fencing, field borders, grassed waterways, heavy use area protection, troughs, water wells, and watering facilities. This grant will conclude in March 2012. The DSWC received an additional 319 grant in 2011 to continue implementing these BMPs throughout the watershed. Quarterly reports providing updated on these projects are on the **NPS 319 Program** webpage.

Dan River Impairment Summary

There are a total of 49.8 miles of the Dan River Impaired for turbidity standard violations as well as 38.2 miles Impaired for fecal coliform bacteria standard violations.

Table 1-3: Dan River Impairments by Segment

AU#	Distance Impaired (mi)	Turbidity Impairment (% exceeded*)	New Turbidity Impairment	Fecal Impairment	New Fecal Impairment
22-(1)b	11.6	24%	No	No	--
22-(31.5)a	4.8	10%	No	Yes	Yes
22-(31.5)b	9.4	10%	No	Yes	No
22-(38.5)	0.6	12%	No	Yes	No
22-(39)a	13.8	12%	Yes	Yes	Yes
22-(39)b	9.6	16%	Yes	Yes	No

* Percents based off of 2010 Impaired Waters List (2004-2008)

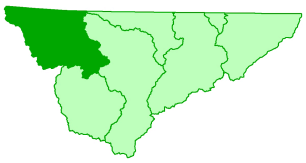
The 11.6 miles in the upper Dan River are in trout waters where the turbidity standard is 10 NTUs. This segment had elevated turbidity again during this assessment period. These same waters received an Excellent and a Good benthic bioclassification during the last three basin cycles.

The remaining 38.2 miles of the Dan River are impaired for both turbidity and fecal coliform bacteria. Of these, 14.2 miles were impaired for turbidity on the 2002 Impaired Waters List (22-(31.5)a & 22-(31.5)b). A TMDL for this 14.2 miles segment was approved by the USEPA in January 2005, which recommends a 59 percent reduction in Total Suspended Solids distributed over both point and nonpoint sources in order to achieve acceptable water quality levels in this area. A turbidity TMDL will have to be developed for the remaining 24 miles. An addendum to the approved Virginia bacteria TMDL was approved in July 2009 to include the segments of the Dan River in North Carolina which are Impaired for fecal coliform bacteria. The **FCB TMDL** for both NC point sources and NC and VA nonpoint sources is 2.88E+12 counts/day.

In the past, the Dan River was often called the “Muddy Dan” by locals. The river almost always ran brown due to sediment in the river. There were several instream sand mining operations as well as a lot of agricultural activity along the river. No permitted sand mining operations remain along this segment of the Dan River and many of the tobacco fields in this area have been converted to other agricultural practices such as cattle farming. Many of these fields have also been converted to permanent grasslands or to natural vegetation with help from the NC agriculture cost share program. While more environmentally friendly agricultural practices have started to occur in this area, more timber harvesting is occurring in both North Carolina and Virginia. Since the Dan River flows back and forth across the state line, timber harvesting practices in one state ultimately affects the water quality in the other. Development of single family homes have increased in this area as well. Sediment and erosion controls are often not required on these smaller size lots. The use of ATV’s was also noted as an activity in this area that is likely contributing to the sediment load in the small tributaries that flow into the Dan River. With a continued push to improve agricultural and forestry BMPs in the area as well as better sediment and erosion control ordinances along the Dan River, improvements should be achievable.

See the WRIT section above for more detail on focused state and bi-state study and restoration efforts for the Dan River drainage area.

Little Dan River-Dan River (0301010301)



Includes: Dan River [AU#: 22-(1)a, b, c, & (8)]**, Archies Creek** [AU#: 22-2], **Elk Creek** [AU#: 22-5], **Peter Creek** [AU#: 22-6]**, Big Creek** [AU#: 22-9]**, North Double Creek** [AU#: 22-10]**, South Double Creek** [AU#: 22-11]**, Cascade Creek** [AU#: 22-12-(2)a & b]**, Indian Creek** [AU#: 22-13-(2)]**, & Mill Creek** [AU#: 22-18]

This watershed contains a mix land use of agriculture, forested and some residential areas. There are five minor NPDES permitted facilities located within the watershed. Only one segment within this watershed (Dan River [AU#: 22-(1)b]) is on the 2010 Impaired Waters List.

Archies Creek [AU#: 22-2]

Approximately seven miles of Archies Creek is within NC and flows into the Dan River after crossing back into Virginia. The majority of the drainage area is agricultural and forested land. The stream holds a secondary classification of Trout Waters.

Use Support: Supporting (7.3 mi)	
2008 IR Cat.	2
2010 IR Cat.	2
Fish Com (NF1)	Excellent (2009)

Water Quality Status

A fish community site is located just before the stream flows back into Virginia where it meets the Dan River. This site was monitored for the first time in 2004 when it received an Excellent rating as it did again in 2009. The site had the highest number of pollution intolerant species and lowest percentage of pollution tolerant fish of any site in 2009. Even though this is not a NCWRC Hatchery Supported Trout stream, one large stocked Brook Trout was collected. This, along with other pollution sensitive fish collected and suitable habitat conditions, help toward qualifying this site as a regional reference site; however, the percentage of forested land does not meet the criteria.

Recommendations

There are a high number of pollution intolerant fish species. DWQ will coordinate with Virginia on any restoration or protection efforts in this river segment.

Elk Creek [AU#: 22-5]

Elk Creek is approximately three miles from the state line to the Dan River [AU#: 22-(1)b]. The majority of the land cover in this drainage area is forest and agriculture. This creek holds the secondary use classification of Trout Waters.

Use Support: Supporting (2.9 mi)	
2008 IR Cat.	2
2010 IR Cat.	2
Fish Com (NF4)	Good (2009)

Water Quality Status

A fish community site, located at Puckett Road, has been monitored since 2004 when it received a Good-Fair rating. At that time, riparian buffers along the stream were minimal, providing little to no shade for the stream and sometimes completely absent. The buffer zones had been periodically burned and noted as contributing to nonpoint source nutrients and sediment within the stream.

The 2009 sample improved to a Good rating. Biologists contributed the higher rating to an increased diversity in certain fish species and greater abundance of others. Streambanks have been re-vegetated since 2004; however, riparian zones were still narrow and offered little shading. This segment was noted to become easily silted and, at the time of sampling was slightly turbid.

Recommendations

Elk Creek would benefit from additional riparian buffer restoration. This should include widening buffer zones and planting of trees and large bushes to provide needed shade for better habitat for trout and other temperature sensitive species. Wider buffer zones will also increase filtration of nonpoint source runoff.

Monitoring turbidity levels in Elk Creek could help determine if the stream is contributing to turbidity exceedances measured just downstream of the Elk Creek/Dan River confluence. The Elk Creek subwatershed has been targeted for study and restoration/protection by WRIT; therefore, additional resources may be available for this investigation. DWQ will coordinate with Virginia on restoration or protection efforts in this river segment.

Peter Creek [AU#: 22-6]

Use Support: Supporting (9.1 mi)	
2008 IR Cat.	2
2010 IR Cat.	2
Fish Com (NF6)	Good (2009)

Peter Creek is approximately nine miles from the state line to the Dan River [AU#: 22-(1)b]. The majority of the land cover in this drainage area is forest and agriculture. This creek holds the secondary use classification of Trout Waters.

Water Quality Status

A fish community station, located on Hart Road, has been sampled since 2004 when it received an Excellent rating. That sample indicated exceptionally high water quality and qualified the site as a new fish community regional reference site. The 2004 sample also included the only collection of the State Threatened Bigeye Jumprock (*Scartomyzon ariommus*) within the basin.

The 2009 sample had similar results to the 2004 sample; however, it declined in rating to a Good. This sample did not include the Bigeye Jumprock or the Smallmouth Bass; both of which were in the 2004 sample. The fish community was still very diverse and included other pollution intolerant species. The pH level during the sample collection was lower than the state standard of 6.0 su and specific conductivity was slightly elevated. Habitat along the segment remained in good condition with good canopy cover, riffles and deep snag pools.

Recommendations

DWQ will continue to monitor this segment during the next sampling cycle. Due to the loss of the State Threatened species and the presence of the Roanoke Hogsucker, Blacktip Jumprock, and Riverweed Darter (Significantly Rare/Special Concern species), this stream would benefit from additional protections. DWQ will coordinate with Virginia on any restoration or protection efforts in this river segment.

Big Creek [AU#: 22-9]

Use Support: Supporting (19.9 mi)	
2008 IR Cat.	2
2010 IR Cat.	2
Fish Com (NF2)	Good-Fair (2009)

Big Creek is approximately 20 miles from source to the Dan River [AU#: 22-(8)b]. Next to the Dan River, Big Creek has the largest drainage area of this watershed. The majority of the land cover draining to the creek is a mixture of forest, residential and agriculture including row crops and fish farms.

Water Quality Status

The 2009 fish community sample taken at Frye Road, decreased in rating from the first sample taken at this site in 2004. The site had decent habitat with the exception of moderate to severe streambank erosion in some places. Biologists noted signs of nonpoint source nutrient enrichment within the sample as well as indications of early morning periphyton production. The decline in number of pollution intolerant species was the reason for the decline in rating.

The sampling site is roughly two miles downstream of three fish farms which could be contributing to the periphyton production.

North Double Creek [AU#: 22-10]

Use Support: Supporting (14.0 mi)	
2008 IR Cat.	2
2010 IR Cat.	2
Benthic (NB15)	Good (2009)
Fish Com (NF5)	Good (2009)

North Double Creek is approximately 14 miles from source to the Dan River [AU#: 22-(8)]. The majority of the land cover draining to the creek is a mixture of forest, residential and agriculture.

Water Quality Status

A benthic and a fish community monitoring stations are located about two and a half miles upstream of North Double Creek's confluence with the Dan River. The benthic site has been monitored since 1994 when it was rated Fair. Each

year the site has increased by one rating level with exception of 2009 when it remained at a Good rating. The 2009 sample included various pollution sensitive taxa and a few rarely collected taxa. Even though there were fewer pollution intolerant taxa as compared to the 2004 sample, it still suggests minimal upstream pollution inputs.

The fish community site has been sampled twice since 2004 when it was rated Good-Fair and is a regional reference site. The 2009 sample increased in rating to a Good. The presence of Bluehead Chub, which can be an indicator of excess nutrients in the stream, was reduced from 43% to 32% of fish collected. It is still the dominant species; however, the increase in other pollution sensitive species and a more balanced trophic structure is a possible indication of nutrient reductions.

Recommendations

DWQ will continue to monitor both biological sites to record possible future improvement.

South Double Creek [AU#: 22-11]

South Double Creek is approximately ten miles from source to the Dan River [AU#: 22-(8)]. The majority of the land cover draining to the creek is a mixture of forest, residential and agriculture.

Use Support: Supporting (9.9 mi)	
2008 IR Cat.	2
2010 IR Cat.	2
Fish Com (NF7)	Good (2009)

Water Quality Status

A fish community site, located a little less than a mile from its confluence with the Dan River, was sampled in 2004 (Good) and 2009. The habitat score for the 2009 sample was relatively low (65 out of 100) mostly due to poor bottom substrate and riffle habitat. There were signs of re-vegetation along one bank. The water column was slightly turbid and pH was just below the state standard of 6.0. Despite the non-ideal habitat, there was a slightly larger percentage of pollution intolerant species. There were no other changes from the sample collected in 2004, indicating a somewhat stable community.

Recommendations

DWQ will continue to monitor this station.

Cascade Creek (Hanging Rock Lake) [AU#: 22-12-(2)a & b]

Cascade Creek is approximately four miles from source to the Dan River [AU#: 22-(8)]. A little less than a mile downstream from the source of Cascade Creek is a 12 acre lake named Hanging Rock Lake. Land cover in this drainage area is dominated by forest with some agriculture. From source to the lake, the creek holds secondary use classifications of B or recreational waters and ORW. Cascade Creek is located in Hanging Rock State Park.

Use Support: Supporting (4.3 mi)	
2008 IR Cat.	2
2010 IR Cat.	2
Benthic (NB4)	Not Impaired (2005)
Lake Station (ROA003A)	No Exceedance (2009)

Water Quality Status

A benthic sample was taken in 2005 as part of a special study to develop biocriteria for small streams in North Carolina. The sample was given a Not Impaired rating since the studies proposed criteria has yet to be approved. Habitat was rated high (92 out of 100) and the benthic community showed no signs of being impacted.

Five lake samples were taken on Hanging Rock Lake between May and September in 2009. The lake was first monitored in 1985 by DWQ. DO, temperature, pH, turbidity, and percent DO saturation levels were all normal for the lake. Nutrient levels reflected low biological productivity and was found to be oligotrophic as it has been since first sampled.

Indian Creek [AU#: 22-13-(2)]

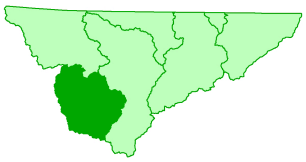
Indian Creek is approximately three miles from source to the Dan River [AU#: 22-(8)]. Almost the entire drainage area is forested. The first seven tenths of a mile of the stream holds a secondary use classification of ORW.

Use Support: Supporting (2.7 mi)	
2008 IR Cat.	2
2010 IR Cat.	2
Benthic (NB33)	Not Impaired (2005)

Water Quality Status

A benthic sample was taken in 2005 as part of a special study to develop biocriteria for small streams in North Carolina. The sample was given a Not Impaired rating since the studies proposed criteria has yet to be approved. Habitat was rated high (92 out of 100) and the benthic community showed no signs of being impacted.

Town Fork Creek (0301010302)



Includes: Town Fork Creek [AU#: 22-25a & b]**, Brushy Fork Creek** [AU#: 22-25-1]**, & Neatman Creek** [AU#: 22-25-6]

This watershed contains a mix land use of agriculture, forest and some residential and urban areas. There are 16 minor NPDES permitted facilities and three permitted cattle animal operations located within the watershed. There are no streams on the 2010 Impaired Waters List in this watershed.

Town Fork Creek [AU#: 22-25a & b]

Use Support: Supporting (26 mi)	
2008 IR Cat.	2
2010 IR Cat.	2
Benthos	
(NB83)	Good (2004)
(NB21)	Good-Fair (2004)
(NB19)	Good (2004)
Fish Com	
(NF9)	Good (2009)

Town Fork Creek is approximately 18 miles from source to the Dan River [AU#: 22-(25.5)]. All streams in this watershed drain to Town Fork Creek; therefore, land cover for this drainage area is the same as that of the watershed.

Water Quality Status

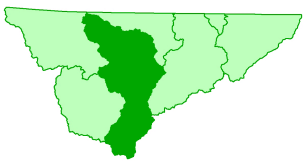
Town Fork Creek was listed on the Impaired Waters list between 2002 and 2006 due to a Poor benthic rating in 1995. Since that time, the water quality in this creek has gradually improved. A TMDL stressor study was conducted in 2004 and found that previous samples taken at NB83 and NB21 were too close to an impoundment to give a good representation of the upper Town Fork Creek watershed. There were also a significant number of agricultural BMPs implemented during the previous cycle, totaling in $46,504 in Agricultural Cost Share Program funding.

During the current cycle, one sample was taken at the fish community site. Despite the presences of periphyton and high dissolved oxygen saturation (128%), the NCIBI score slightly increased from the 2004 sample. The slight increase was due to the larger percentage of insectivores. The specific conductivity levels were somewhat elevated and the water column was slightly turbid. The overall habitat score was relatively good, at 79 out of 100.

Recommendations

Benthic station NB19 should be monitored during the upcoming sampling cycle if resources allow. This site provides the most holistic view of the watershed.

Belews Lake-Dan River (0301010303)



Includes: Dan River [AU#: 22-(8), (25.5), (27.5) & (28.5)]**, Snow Creek** [AU#: 22-20]**, Fulk Creek** [AU#: 22-24], **Belews Creek (Kernersville Lake)** [AU#: 22 27-(1.5)], **Belews Lake** [AU#: 22-27-10, 22-27-(6), (7), (7.5), 22-27-8-(2), 22-27-9-(3) & (4)], **Lynn Branch** [AU#: 22-20-9], **Raccoon Creek** [AU#: 22-20-4], **Wood Benton Branch** [AU#: 22-21], **& Big Beaver Island Creek** [AU#: 22-29]

This watershed contains a mix land use of agriculture, forest, residential and some urban areas. There are 28 minor and one major NPDES permitted facilities and three permitted animal operations located within the watershed. There are no streams on the 2010 Impaired Waters List in this watershed.

Snow Creek [AU#: 22-20]

Use Support: Supporting (18.9 mi)	
2008 IR Cat.	2
2010 IR Cat.	2
Benthos (NB17)	Good (2009)
Fish Com (NF8)	Good-Fair (2009)

Snow Creek is approximately 19 miles from source to the Dan River [AU#: 22-(8)]. The headwaters of Snow Creek and its tributaries has land cover which is dominated by agriculture. Further downstream, the land cover transitions to a blend of agriculture, forest and residential areas.

Water Quality Status

A benthic sample site is located just under four miles from Snow Creek's confluence with the Dan River. This site has been given a Good rating since 2000 and the benthic community has remained stable since that time. A few additional pollution sensitive species were collected in the 2009 sample that were not previously recorded indicating a possible increase in water quality.

The fish community site is about three and a half miles upstream from the benthic site. This site was first sampled in 2004 when it received a Good rating. The 2009 sample resulted in a decrease in rating to a Good-Fair. This was due to the increased number of omnivores which are an indication of nonpoint source nutrient enrichment. This site is closer to the headwaters which is mostly agricultural land, including one swine operation. Many of the tributaries in this drainage area have riparian buffers along either side of the streambanks. However, there are others that completely lack any buffer area.

Recommendations

Riparian buffer restoration would enhance water quality for this creek and its tributaries.

Raccoon Creek [AU#: 22-20-4]

Use Support: Supporting (3.4 mi)	
2008 IR Cat.	2
2010 IR Cat.	2
Benthos (NB63)	Not Impaired (2005)

Raccoon Creek is approximately three miles from source to Snow Creek [AU#: 22-20]. The land cover in this drainage area is a mixture of agriculture, forest and some residential.

Water Quality Status

A benthic sample was taken in 2005 as part of a special study to develop biocriteria for small streams in North Carolina. The sample was given a Not Impaired rating since the studies proposed criteria has yet to be approved. Habitat was rated somewhat high (84 out of 100) and the benthic community showed no signs of being impacted.

Lynn Branch [AU#: 22-20-9]

Use Support: Supporting (3.1 mi)	
2008 IR Cat.	2
2010 IR Cat.	2
Benthos (NB41)	Not Impaired (2005)

Lynn Branch is approximately three miles from source to Snow Creek [AU#: 22-20]. The majority of the drainage area is forested with some agriculture.

Water Quality Status

A benthic sample was taken in 2005 as part of a special study to develop biocriteria for small streams in North Carolina. The sample was given a Not Impaired rating since the studies proposed criteria has yet to be approved. Habitat was good (74 out of 100) and the benthic community showed no signs of being impacted.

Wood Benton Branch [AU#: 22-21]

Use Support: Supporting (3.7 mi)	
2008 IR Cat.	2
2010 IR Cat.	2
Benthos (NB101)	Not Impaired (2005)

Wood Benton Branch is approximately four miles from source to the Dan River [AU#: 22-(8)]. The majority of the drainage area is forested with areas of agriculture in the headwaters.

Water Quality Status

A benthic sample was taken in 2005 as part of a special study to develop biocriteria for small streams in North Carolina. The sample was given a Not Impaired rating since the studies proposed criteria has yet to be approved. Habitat was good (77 out of 100) and the benthic community showed no signs of being impacted.

Belews Creek (Kernersville Lake) [AU#: 22-27-(1.5)]

USE SUPPORT: SUPPORTING (46.1 ACRES)	
2008 IR Cat.	2
2010 IR Cat.	3n
Lake Station (ROA0092A)	Chlorophyll a (20%)*

* This data will be reflected on the 2012 Impaired Waters list.

Kernersville Lake is approximately 46 acres and drains to Belews Creek [AU#: 22-27-(2)]. The majority of the drainage area is residential and forest land. The lake also receives runoff from the Town of Kernersville. The lake is an emergency drinking reservoir for the town and holds the use classification of WS-IV; B.

Water Quality Status

The lake was sampled at one location five times in 2007 and five times in 2009. Results of both years were similar with the exception of DO levels that dropped down to 4.6 mg/l in September 2007. DO levels in 2009 returned to normal levels. Nutrient levels were elevated during both years and blue-green alga associated with nutrient-rich water was present in the lake during sampling. Twenty percent of chlorophyll *a* samples were above the state standard; therefore, the lake is expected to go on the 2012 Impaired Waters List.

An Algal Growth Potential Test was completed in 2009 and it was determined the lake is nitrogen limited. The test also showed that the lake has elevated biological productivity (eutrophic). The lake has been designated eutrophic since it was first sampled by DWQ in 1985.

Belews Lake [AU#: 22-27-(7), (7.5) & 22-27-9-(4)]

USE SUPPORT: SUPPORTING (2,982.4 MI)	
2008 IR Cat.	2
2010 IR Cat.	2
Lake Station (ROA009J) (ROA009E) (ROA009G) (ROA009H)	(2009) Temp (3 of 5) Temp (2 of 5)

Belews Lake's approximately 2,982 acres has four main arms which drain the southern portion of this watershed and flows into the Dan River [AU#: 22-(25.5)]. The majority of the drainage area is agriculture, residential, urban and some forested areas. The Duke Energy Belews Creek Steam Station is located along the west side of the lake.

Water Quality Status

The lake is split into seven different AU segments. There are four lake monitoring stations which are located in three of the seven segments. The segment AU#'s are listed above. Monitoring results from the five samples taken in 2009 indicated very little change from previous monitoring years. One exception was the elevated water temperatures that were found at ROA009J and ROA009E which is likely due to the thermal discharge from the coal-fired power plant.

Nutrients monitored resulted in normal to below detection levels. This lake has been designated as oligotrophic or very low biological productivity and has been since first sampled by DWQ in 1981. For more information see the **Roanoke River Basin Lake and Reservoir Assessment**.

Big Beaver Island Creek [AU#: 22-29]

USE SUPPORT: SUPPORTING (15.2 MI)	
2008 IR Cat.	2
2010 IR Cat.	2
Fish Com (NF10)	Excellent (2009)

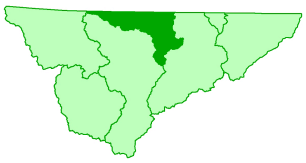
Big Beaver Island Creek is approximately 15 miles from source to the Dan River [AU#: 22-(28.5)]. The land cover in this area transitions from agriculture in the headwaters to forested land to more urban (residential and industrial) towards the creeks confluence with the Dan River.

Water Quality Status

A fish community sample was collected about a half mile upstream from its confluence with the Dan River. The habitat at this site was less than optimal with severe bank erosion in some places and a large debris dam at the end of the sampling reach. However, most of the bank vegetation and canopy were high quality.

The site was also sampled in 2004. At that time it received a rating of Good. The 2009 sample increased to an Excellent. This is due to the number of fish collected tripled from the previous sample. This can sometimes be a sign of nutrient enrichment if the species are mostly omnivores. That was not the case here. The sample showed a very diverse community which included the Federally Endangered Roanoke Logperch.

Mayo River (0301010304)



Includes: Mayo River [AU#: 22-30-(1), (5.5), (9.5) & (10)], **Crooked Creek** [AU#: 22-30-2-2], **Little Crooked Creek** [AU#: 22-30-2-2-2], **Hickory Creek** [AU#: 22-30-5] **& Pawpaw Creek** [AU#: 22-30-6-(2)]

This watershed contains a mix land use of agriculture, forest, residential and some urban areas. There are two minor and one major NPDES permitted facilities located within the watershed. There are no stream on the 2010 Impaired Waters List in this watershed.

Mayo River [AU#: 22-30-(1)]

There are three segments of the Mayo River within this watershed; however, only the first segment has been monitored during the past few cycles. This segment of the Mayo River is approximately four miles from the state line to half a mile down stream of the Hickory Creek [AU#: 22-30-5] confluence. Land cover along this segment is mostly forest and agriculture.

Use Support: Supporting (3.5 mi)	
2008 IR Cat.	5
2010 IR Cat.	2
Benthos (NB28)	Excellent (2009)
AMS (N140000)	Turbidity (10.2%)*

* This data will be reflected on the 2012 Impaired Waters list.

Water Quality Status

A benthic sampling station is located about a half mile downstream of the Virginia/North Carolina state line. The site has been sampled five times since 1989 and received a Good rating during every event except in 2009 when it received an Excellent rating. The increase in rating is due to the increase in EPT taxa richness or the diversity of pollution intolerant macroinvertebrates. This may be contributed to a reduction in nonpoint source runoff as a result of the prolonged drought.

An ambient monitoring station is located at the same place as the benthic station. Turbidity exceedances increased from 8.6% of samples exceeding the standard during the previous cycle to 10.2% exceeding during this cycle. This exceedance will cause this segment of the Mayo River to be listed on the Impaired Waters List for 2012. Copper and manganese levels were also elevated; however, only nine samples were collected. Fecal coliform bacteria exceedances were down by 10% from the previous cycle.

Recommendations

These sites will continue to be monitored by DWQ.

Crooked Creek [AU#: 22-30-2-2]

Crooked Creek begins in NC and flows in and out of the state twice before crossing back into Virginia to drain into the South Mayo River. The NC portion of the creek is approximately nine miles. Land cover in this drainage area starts with mostly agriculture in the headwaters and transitions to mostly forested area downstream.

Use Support: Supporting (8.5 mi)	
2008 IR Cat.	--
2010 IR Cat.	2
Fish Com (NF42)	Good-Fair (2007)
RAMS `07-`08 (N1360000)	No Exceedances

Hickory Creek [AU#: 22-30-5]

Hickory Creek is approximately four miles from source to the Mayo River [AU#: 22-30-(1)]. The majority of the drainage area is forest.

Use Support: Supporting (4.0 mi)	
2008 IR Cat.	2
2010 IR Cat.	2
Benthos (NB26)	Not Impaired (2006)

Water Quality Status

A benthic sample was taken in 2006 as part of a special study to develop biocriteria for small streams in North Carolina. The sample was given a Not Impaired rating since the studies proposed criteria has yet to be approved. Habitat was rated somewhat high (84 out of 100) and the benthic community showed no signs of being impacted.

Pawpaw Creek [AU#: 22-30-6-(2)]

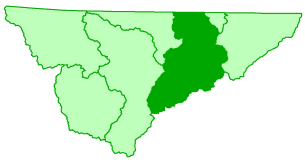
USE SUPPORT: SUPPORTING (1.8 MI)	
2008 IR Cat.	2
2010 IR Cat.	2
Fish Com (NF14)	Good (2009)

Pawpaw Creek is approximately 4.8 miles in total from the state line to the Mayo River [AU#: 22-30-(5.5)] and is split into two segments. Land cover in this drainage area is a mixture of agriculture and forest.

Water Quality Status

A fish community site has been monitored about a half mile upstream of Pawpaw Creek's confluence with the Mayo River since 1990. The last sample was taken in 2004 and resulted in a Good-Fair rating. The 2009 sample reflected some improvement in water quality with an increased rating of Good. There was a greater number of fish collected which were more diverse.

MATRIMONY CREEK-DAN RIVER (0301010305)



Includes: Dan River [AU#: 22-(28.5), (31.5)a, (31.5)b & (39)a], **Hogans Creek** [AU#: 22-31 & 22-31-1], **Brushy Creek** [AU#: 22-32-1], **Jacobs Creek** [AU#: 22-32-(0.5) & (3)], **Rock House Creek** [AU#: 22-34-(1) & (2)] **& Matrimony Creek** [AU#: 22-38]

This watershed contains a mix land use of agriculture, forest, residential and some urban areas. There are 35 minor NPDES permitted facilities and two permitted swine animal operations located within the watershed. There is one stream (Dan River) within this watershed that is on the 2010 Impaired Waters List.

Hogans Creek [AU#: 22-31]

USE SUPPORT: SUPPORTING (12.7 MI)	
2008 IR Cat.	2
2010 IR Cat.	2
Fish Com (NF11)	Excellent (2009)

Hogans Creek is approximately 13 miles total from source to the Dan River [AU#: 22-(28.5)]. Land cover in this drainage area is a mixture of agriculture, forest and residential areas. The majority of forested area is found along the streams edge and agricultural land is in the tributary headwaters.

Water Quality Status

About a mile upstream from the confluence with the Dan River, Hogans Creek has been monitored for the pass two sampling cycles. In 2004, the site rated Good and was designated as a regional reference site. The rating increased to an Excellent in 2009 due to a greater and more diverse community collected in the sample. During both sampling years, this site had the highest habitat score of any other fish site within the basin.

Local Initiatives

In 1997, the Caswell County Soil and Water Conservation District and the Wetlands Restoration Program conducted a stream restoration project on an unnamed tributary of Hogans Creek. Approximately 900 feet of stream was restored and expanded to 1,800 feet. DWQ conducted pre and post stream project data collections in 1996 and 1998. Since then, beavers have populated the restored area.

Jacobs Creek [AU#: 22-32-(3)]

USE SUPPORT: SUPPORTING (1.8 MI)	
2008 IR Cat.	2
2010 IR Cat.	2
Fish Com (NF12)	Good (2009)

Jacobs Creek is approximately 13 miles total from source to the Dan River [AU#: 22-(31.5)a] and is split into two segments. The drainage area of this segment consists of a mixed land cover of forest and agriculture.

Water Quality Status

A fish community monitoring station is located about a mile and a half upstream from the confluence with the Dan River. This site was sampled during the last two sampling cycles. The site scored a Good rating during both sampling events. However, the habitat score was the lowest (55 out of 100) in 2009 than any other site of the 2004 and 2009 fish community samples in this basin. One bank had been re-vegetated since 2004, but the stream still suffers from substantial nonpoint source erosion and sedimentation.

Rock House Creek [AU#: 22-34-(2)]

Use Support: Supporting (6.5 mi)	
2008 IR Cat.	2
2010 IR Cat.	2
Benthos (NB36)	Good-Fair (2001)
Fish Com (NF18)	Good (2009)

Rock House Creek is approximately eight miles total from source to the Dan River [AU#: 22-(31.5)b] and is split into two segments. Land cover in this drainage area is a mixture of forest, agriculture and urban area in the Town of Wentworth.

Water Quality Status

A little over a half mile upstream of the confluence with the Dan River is a fish community station that has been monitored during the last two sampling cycles. This location is also downstream of where the tributaries draining the Town of Wentworth enter Rock House Creek. The site scored a Good rating during both sampling events. In 2009, the site had high quality banks and riparian zones; however, the stream still exhibits substantial nonpoint source erosion impacts. The number and diversity of the fish collected had slightly increased from the 2004 sample. The significantly rare Roanoke Hogsucker was also collected during this cycle.

Recommendations

DWQ will monitor the benthic site (NB36) during the upcoming sampling cycle to determine any changes in water quality, if resources allow.

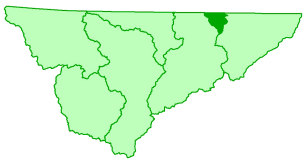
Matrimony Creek [AU#: 22-38]

Use Support: Supporting (11.2 mi)	
2008 IR Cat.	2
2010 IR Cat.	2
Fish Com (NF17)	Good (2004)

Matrimony Creek begins in NC, crosses into Virginia for roughly three to four miles before returning to NC. The NC portion of the creek is approximately 11 miles and drains into the Dan River [AU#: 22-(31.5)b]. Land cover in this drainage area is a mixture of agriculture, some forest and residential/urban area near the Town of Eden.

The 12-Digit subwatershed of Matrimony Creek (030101030505) is part of the WRIT study area within the Dan River drainage area. For more information see the Recommendations, Action Plans & Other Information at the Subbasin Scale section above.

Lower Smith River (0301010308)



Includes: Smith River [AU#: 22-40-(1), (2.5) & (3)]

This watershed contains a mix land use of urban, residential areas with some forested areas. There are no permitted facilities within the watershed. There is one stream (Smith River) within this watershed that is on the 2010 Impaired Waters List.

Smith River [AU#: 22-40-(1), (2.5) & (3)]

Use Support: Impaired (5.1 mi)	
2008 IR Cat.	5
2010 IR Cat.	5
Benthos (NB74)	Fair (1999)
AMS (N2430000)	Turbidity (10.0%) Copper (15.4%)

Smith River is approximately five miles from the state line to Dan River [AU#: 22-(39)a]. Land cover for the Smith River drainage area is mostly urban with some forested area near the state line. Smith Creek has been on the Impaired Waters List since 2002.

The 12-Digit subwatershed of Fall Creek-Smith Creek (030101030807) is part of the WRIT study area within the Dan River drainage area. For more information see the Recommendations, Action Plans & Other Information at the Subbasin Scale section above.

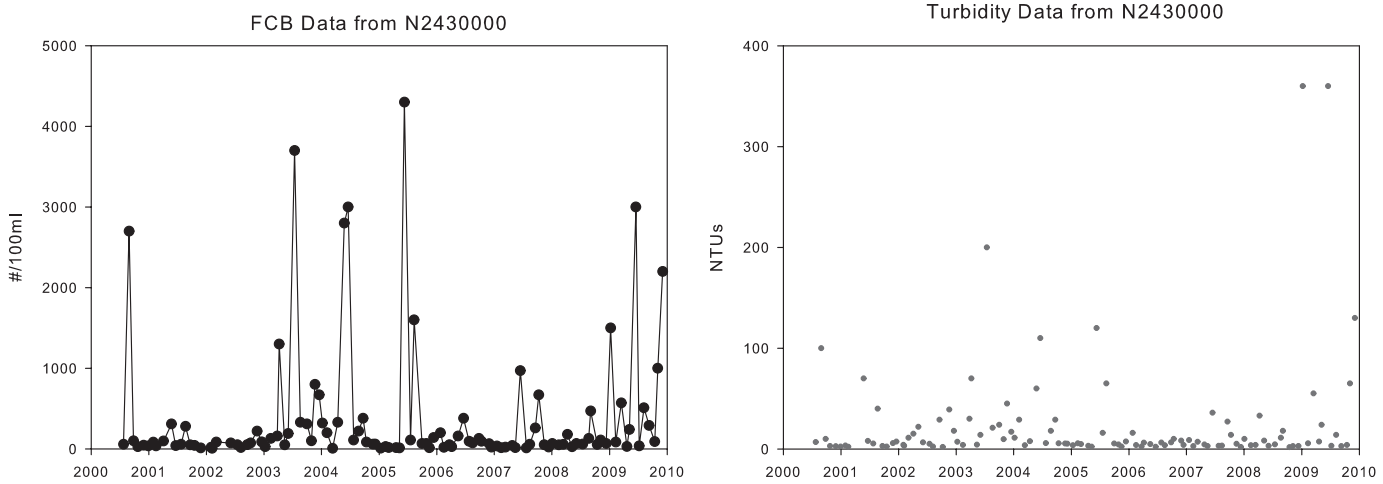
Water Quality Status

Smith River was first placed on the Impaired Waters List in 2002 due to a Fair benthic sample collected in 1999. Roughly two miles downstream of the state line is an ambient monitoring site. Samples collected between 2005 and 2009 showed elevated turbidity, fecal coliform bacteria and copper levels. The geometric mean of FCB between 2005 and 2009 decreased from data collected between 2000 and 2004; however, the

percent of samples over 400 colonies/100 ml increased (see Figure 1-21). Average turbidity levels as well as percent of samples exceeding the standard decreased. FCB and copper were added to the list of parameters exceeding state standards on the 2010 Impaired Waters List.

In 2009 a **Fecal Coliform Bacteria TMDL** was approved by EPA for the Smith and Dan Rivers. This is discussed in more detail in the **Dan River discussion**.

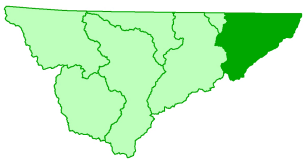
FIGURE 1-21: LONG TERM FCB & TURBIDITY SAMPLING AT N2430000 (2000-2010)



Recommendations

DWQ will monitor the benthic station on the Smith River to evaluate if there has been any biological improvements since 1999.

CASCADE CREEK-DAN RIVER (0301010309)



Includes: Dan River [AU#: 22-(39)a], **Wolf Island Creek** [AU#: 22-48] **& Birch Fork** [AU#: 22-48-4]

This watershed contains a mix land use of agriculture, forest, residential and some urban areas. There are 37 minor and four major NPDES permitted facilities located within the watershed. There is one stream (Dan River) within this watershed that is on the 2010 Impaired Waters List.

The 12-Digit subwatersheds Town Creek (030101030901) and Cascade Creek (030101030902) are part of the WRIT study area within the Dan River drainage area. For more information see the **Recommendations, Action Plans & Other Information at the Subbasin Scale** section above.

Wolf Island Creek [AU#: 22-48]

Wolf Island Creek is approximately 22 miles from source to the Dan River [AU#: 22-(39)a]. Land cover in this drainage area is mostly agriculture with some forest and residential area. The upper headwaters also drains a portion of the Town of Reidsville.

USE SUPPORT: SUPPORTING (21.8 MI)	
2008 IR Cat.	2
2010 IR Cat.	2
Fish Com (NF20)	Excellent (2009)

Water Quality Status

About a mile upstream from the streams confluence with Birch Fork Creek is a fish community site. This site had the most diverse community of any other fish community site in the basin. There is substantial nonpoint source erosion with channel and riparian bank instability which is responsible for the low habitat score. The diversity and large increase in the number of fish collected increased the site rating from a Good (2004) to an Excellent.

References

References marked with (*) indicates a DWQ special study report. These reports are not currently available online. Contact the DWQ Environmental Science Section at (919) 743-8400 to receive a hardcopy.

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Appendix 1-A

Use Support Ratings for All Monitored Waters in the Upper Dan River Subbasin

Draft 2010 IR Category	Integrated Reporting Categories for individual Assessment Unit/Use Support Category/ Parameter Assessments. A single AU can have multiple assessments depending on data available and classified uses.
1	All designated uses are monitored and supporting
1b	Designated use was impaired, other management strategy in place and no standards violations for the parameter of interest (POI)
1nc	DWQ have made field determination that parameter in exceedance is due to natural conditions
1r	Assessed as supporting watershed is in restoration effort status
1t	No criteria exceeded but approved TMDL for parameter of interest
2	Some designated uses are monitored and supporting none are impaired Overall only
2b	Designated use was impaired other management strategy in place and no standards violations Overall only
2r	Assessed as supporting watershed is in restoration effort status overall only
2t	No criteria exceeded but approved TMDL for POI Overall only
3a	Instream/monitoring data are inconclusive (DI)
3b	No Data available for assessment
3c	No data or information to make assessment
3n1	Chlorophyll a exceeds TL value and SAC is met-draft
3n2	Chlorophyll a exceeds EL value and SAC is not met first priority for further monitoring-draft
3n3	Chlorophyll a exceeds threshold value and SAC is not met first second priority for further monitoring-draft
3n4	Chlorophyll a not available determine need to collect-draft
3t	No Data available for assessment –AU is in a watershed with an approved TMDL
4b	Designated use impaired other management strategy expected to address impairment
4c	Designated use impaired by something other than pollutant
4cr	Recreation use impaired no instream monitoring data or screening criteria exceeded
4cs	Shellfish harvesting impaired no instream monitoring data- no longer used
4ct	Designated use impaired but water is subject to approved TMDL or under TMDL development
4s	Impaired Aquatic Life with approved TMDL for Aquatic Life POI or category 5 listing
4t	Designated use impaired approved TMDL
5	Designated use impaired because of biological or ambient water quality standards violations and needing a TMDL
5r	Assessed as impaired watershed is in restoration effort status

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All 13,123 Waters in NC are in Category 5-303(d) List for Mercury due to statewide fish consumption advice for several fish species

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Roanoke River Basin — **Little Dan River-Dan River Watershed** — **0301010301**

Roanoke River Basin — Dan River Headwaters Subbasin — 03010103

Roanoke River Basin — **Little Dan River-Dan River Watershed** — **0301010301**

22-2	**Archies Creek**	North Carolina portion	**7.3**	**FW Miles**	C;Tr
1	**Ecological/biological Integrity FishCom**	Excellent Bioclassification	Aquatic Life	2004	
22-9	**Big Creek**	From source to Dan River	**19.9**	**FW Miles**	C;Tr
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	
22-12-(2)b	**Cascade Creek**	From dam at swimming lake to Dan River	**4.3**	**FW Miles**	B
1	**Ecological/biological Integrity Benthos**	Not Impaired Bioclassification	Aquatic Life	2005	
22-12-(2)a	**Cascade Creek (Hanging Rock Lake)**	From backwaters to dam at swimming lake	**12.2**	**FW Acres**	B
1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	
22-(1)a	**DAN RIVER (North Carolina portion)**	From North Carolina-Virginia State Line to Little Dan River	**5.1**	**FW Miles**	C;Tr
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	
22-(1)b	**DAN RIVER (North Carolina portion)**	From Little Dan River to Peters Creek	**11.6**	**FW Miles**	C;Tr
1	**Ecological/biological Integrity Benthos**	Excellent Bioclassification	Aquatic Life	2004	
1	**Fecal Coliform (recreation)**	No Criteria Exceeded	Recreation	2008	
3a	**High Water Temperature**	Potential Standards Violation	Aquatic Life	2008	
5	**Turbidity**	Standard Violation	Aquatic Life	2008	2008
22-5	**Elk Creek**	From North Carolina-Virginia State Line to Dan River	**2.9**	**FW Miles**	C;Tr
1	**Ecological/biological Integrity FishCom**	Good-Fair Bioclassification	Aquatic Life	2004	
22-13-(2)	**Indian Creek**	From Window Falls to Dan River	**2.7**	**FW Miles**	C
1	**Ecological/biological Integrity Benthos**	Not Impaired Bioclassification	Aquatic Life	2005	
22-18	**Mill Creek**	From source to Dan River	**4.7**	**FW Miles**	C
1	**Ecological/biological Integrity Benthos**	Not Impaired Bioclassification	Aquatic Life	2005	
22-10	**North Double Creek**	From source to Dan River	**14.0**	**FW Miles**	C
1	**Ecological/biological Integrity Benthos**	Good Bioclassification	Aquatic Life	2004	
1	**Ecological/biological Integrity FishCom**	Good-Fair Bioclassification	Aquatic Life	2004	
22-6	**Peters Creek**	From North Carolina-Virginia State Line to Dan River	**9.1**	**FW Miles**	C;Tr
1	**Ecological/biological Integrity FishCom**	Excellent Bioclassification	Aquatic Life	2004	

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All 13,123 Waters in NC are in Category 5-303(d) List for Mercury due to statewide fish consumption advice for several fish species

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Roanoke River Basin — **Little Dan River-Dan River Watershed** — **0301010301**

22-11	**South Double Creek**	From source to Dan River	**9.9**	**FW Miles**	B
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	

Roanoke River Basin — **Town Fork Creek Watershed** — **0301010302**

22-25-1	**Brushy Fork Creek**	From source to Town Fork Creek	**3.0**	**FW Miles**	C
1	**Ecological/biological Integrity Benthos**	Good Bioclassification	Aquatic Life	2004	
22-25a	**Town Fork Creek**	From source to Timmons Cr.	**8.0**	**FW Miles**	C
1	**Ecological/biological Integrity Benthos**	Good Bioclassification	Aquatic Life	2004	
22-25b	**Town Fork Creek**	From Timmons Cr. to Dan River	**18.0**	**FW Miles**	C
1	**Ecological/biological Integrity Benthos**	Good Bioclassification	Aquatic Life	2004	
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	

Roanoke River Basin — **Belews Lake-Dan River Watershed** — **0301010303**

22-27-(7)	**Belews Creek (including Belews Lake below elevation 725) (1)**	From Southern Railroad Bridge to to a point 1.8 mile downstream of Forsyth-Stokes County Line	**789.7**	**FW Acres**	C
1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	
22-27-(7.5)	**Belews Creek (including Belews Lake below elevation 725) (1)**	From a point 1.8 mile downstream of the Forsyth-Stokes County Line to Dan River, excluding the Arm of Belews Lake described below which are classified "WS-IV&B"	**1,283.8**	**FW Acres**	WS-IV
1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	
1	**Water Quality Standards Water Supply**	No Criteria Exceeded	Water Supply	2008	
22-27-(1.5)	**Belews Creek (Kernersville Lake)**	From a point 0.5 mile upstream of backwaters of Kernersville Lake to Town of Kernersville Water Supply Dam	**46.1**	**FW Acres**	WS-IV;CA
3n	**Chlorophyll a**	Potential Standards Violation	Aquatic Life	2008	
1	**Water Quality Standards Water Supply**	No Criteria Exceeded	Water Supply	2008	
22-29	**Big Beaver Island Creek**	From source to Dan River	**15.2**	**FW Miles**	C
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	
22-(8)	**DAN RIVER**	From Big Creek to to a point 0.2 mile downstream of Town Fork Creek	**25.9**	**FW Miles**	WS-V
1	**Ecological/biological Integrity Benthos**	Good Bioclassification	Aquatic Life	2004	

NC 2010 Integrated Report

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AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Roanoke River Basin — Belews Lake-Dan River Watershed — 0301010303

22-20-9	Lynn Branch (Lynn Creek)	From source to Snow Creek	3.1 FW Miles	C	
1	Ecological/biological Integrity Benthos	Not Impaired Bioclassification	Aquatic Life	2005	
22-20-4	Raccoon Creek	From source to Snow Creek	3.4 FW Miles	C	
1	Ecological/biological Integrity Benthos	Not Impaired Bioclassification	Aquatic Life	2005	
22-20	Snow Creek	From source to Dan River	18.9 FW Miles	C	
1	Ecological/biological Integrity Benthos	Good Bioclassification	Aquatic Life	2004	
1	Ecological/biological Integrity FishCom	Good Bioclassification	Aquatic Life	2004	
22-27-9-(4)	West Belews Creek (West Belews Creek Arm of of Belews Lake below elevation 725)	From a point 0.4 mile downstream of Powerplant to Belews Creek	582.4 FW Acres	WS-IV	
1	Water Quality Standards Aquatic Life	No Criteria Exceeded	Aquatic Life	2008	
1	Water Quality Standards Water Supply	No Criteria Exceeded	Water Supply	2008	
22-21	Wood Benton Branch	From source to Dan River	3.7 FW Miles	C	
1	Ecological/biological Integrity Benthos	Not Impaired Bioclassification	Aquatic Life	2005	

Roanoke River Basin — Mayo River Watershed — 0301010304

22-30-2-2	Crooked Creek (North Carolina portion)	From source to last crossing of North Carolina-Virginia State Line	8.5 FW Miles	C	
1	Ecological/biological Integrity FishCom	Good-Fair Bioclassification	Aquatic Life	2007	
1	Water Quality Standards Aquatic Life	No Criteria Exceeded	Aquatic Life	2008	
22-30-5	Hickory Creek	From source to Mayo River	4.0 FW Miles	C	
1	Ecological/biological Integrity Benthos	Not Impaired Bioclassification	Aquatic Life	2006	
22-30-2-2-2	Little Crooked Creek	From source to Crooked Creek	4.7 FW Miles	C	
1	Ecological/biological Integrity Benthos	Good Bioclassification	Aquatic Life	2008	
22-30-(1)	Mayo River	From North Carolina-Virginia State Line to a point 0.6 mile downstream of Hickory Creek	3.5 FW Miles	WS-V	
1	Ecological/biological Integrity Benthos	Good Bioclassification	Aquatic Life	2004	
1	Fecal Coliform (recreation)	No Criteria Exceeded	Recreation	2008	
1	Water Quality Standards Aquatic Life	No Criteria Exceeded	Aquatic Life	2008	
1	Water Quality Standards Water Supply	No Criteria Exceeded	Water Supply	2008	

NC 2010 Integrated Report

All 13,123 Waters in NC are in Category 5-303(d) List for Mercury due to statewide fish consumption advice for several fish species

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Roanoke River Basin — **Mayo River Watershed** — **0301010304**

22-30-6-(2)	**Pawpaw Creek**	From a point 1.3 mile upstream of Rockingham County SR 1360 to Mayo R.	**1.8 FW Miles**		WS-IV
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	

Roanoke River Basin — **Matrimony Creek-Dan River Watershed** — **0301010305**

22-32-1	**Brushy Creek (West Prong Jacobs Creek)**	From source to Jacobs Creek	**4.3 FW Miles**		C
1	**Ecological/biological Integrity Benthos**	Not Impaired Bioclassification	Aquatic Life	2007	
22-(31.5)a	**DAN RIVER**	From a point 0.7 mile upstream of Jacobs Creek to subbasin 03-02-02/03 boundary	**4.8 FW Miles**		WS-IV
4t	**Fecal Coliform (recreation)**	No Criteria Exceeded	Recreation	2008	2008
4t	**Turbidity**	Data Inconclusive	Aquatic Life	2008	2002
1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	
1	**Water Quality Standards Water Supply**	No Criteria Exceeded	Water Supply	2008	
22-(31.5)b	**DAN RIVER**	From 03-02-02 boundary to a point 0.8 mile downstream of Matrimony Creek	**9.4 FW Miles**		WS-IV
4t	**Fecal Coliform (recreation)**	Standard Violation	Recreation	2008	2008
4t	**Turbidity**	Data Inconclusive	Aquatic Life	2008	2002
1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	
1	**Water Quality Standards Water Supply**	No Criteria Exceeded	Water Supply	2008	
22-(38.5)	**DAN RIVER**	From a point 0.8 mile downstream of Matrimony Creek to Mill Branch (Town of Eden water supply intake)	**0.6 FW Miles**		WS-IV;CA
4t	**Fecal Coliform (recreation)**	Standard Violation	Recreation	2008	2008
5	**Turbidity**	Standard Violation	Aquatic Life	2008	2008
22-31	**Hogans Creek**	From source to Dan River	**12.7 FW Miles**		C
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	
22-32-(3)	**Jacobs Creek**	From N.C. Hwy. 704 to Dan River	**1.8 FW Miles**		WS-IV
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	
22-38	**Matrimony Creek (North Carolina portion)**	From source to Dan River	**11.2 FW Miles**		WS-IV
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	

NC 2010 Integrated Report

All 13,123 Waters in NC are in Category 5-303(d) List for Mercury due to statewide fish consumption advice for several fish species

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Roanoke River Basin — Matrimony Creek-Dan River Watershed — 0301010305

◉ 22-30-(10)	Mayo River	From dam at Mayodan Water Supply Intake to Dan River	2.4	FW Miles	C

1	Ecological/biological Integrity Benthos	Good-Fair Bioclassification	Aquatic Life	1999	

◉ 22-34-(2)	Rock House Creek	From Rockingham Countly SR 2381 to Dan River	6.5	FW Miles	WS-IV

1	Ecological/biological Integrity Benthos	Good-Fair Bioclassification	Aquatic Life	2001	
1	Ecological/biological Integrity FishCom	Good Bioclassification	Aquatic Life	2004	

Roanoke River Basin — Lower Smith River Watershed — 0301010308

◉ 22-40-(1)	Smith River	From North Carolina-Virginia State Line to a point 0.8 mile downstream of Rockingham County SR 1714 (Aiken Road)	2.8	FW Miles	WS-IV

5	Copper	Standard Violation	Aquatic Life	2008	2008
4s	Ecological/biological Integrity Benthos	Fair Bioclassification	Aquatic Life	1999	2008
4t	Fecal Coliform (recreation)	Standard Violation	Recreation	2008	2008
1	Water Quality Standards Water Supply	No Criteria Exceeded	Water Supply	2008	

◉ 22-40-(2.5)	Smith River	From a point 0.8 mile downstream of Rockingham County SR 1714 (Aiken Road) to Fieldcrest Mills Water Supply Intake	0.5	FW Miles	WS-IV;CA

5	Copper	Standard Violation	Aquatic Life	2008	2008
4s	Ecological/biological Integrity Benthos	Fair Bioclassification	Aquatic Life	1999	2008
4t	Fecal Coliform (recreation)	Standard Violation	Recreation	2008	2008
1	Water Quality Standards Water Supply	No Criteria Exceeded	Water Supply	2008	

Roanoke River Basin — Cascade Creek-Dan River Watershed — 0301010309

◉ 22-48-4	Birch Fork	From source to Wolf Island Creek	8.4	FW Miles	C

1	Ecological/biological Integrity Benthos	Not Impaired Bioclassification	Aquatic Life	2007	

◉ 22-(39)a	DAN RIVER (North Carolina portion)	From Mill Branch to NC/VA crossing downstream of Wolf Island Creek	13.8	FW Miles	C

4t	Fecal Coliform (recreation)	Standard Violation	Recreation	2008	2008
5	Turbidity	Standard Violation	Aquatic Life	2008	2008

◉ 22-40-(3)	Smith River	From Fieldcrest Mills Water Supply Intake to Dan River	1.8	FW Miles	C

5	Copper	Standard Violation	Aquatic Life	2008	2008
4s	Ecological/biological Integrity Benthos	Fair Bioclassification	Aquatic Life	1999	2008
4t	Fecal Coliform (recreation)	Standard Violation	Recreation	2008	2008

NC 2010 Integrated Report

All 13,123 Waters in NC are in Category 5-303(d) List for Mercury due to statewide fish consumption advice for several fish species

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Roanoke River Basin — **Cascade Creek-Dan River Watershed** — **0301010309**

⊙	**22-48**	**Wolf Island Creek**	From source to Dan River	**21.8 FW Miles**	C

1	**Ecological/biological Integrity FishCom**	Excellent Bioclassification	Aquatic Life	2004

Appendix 1-B

Biological Sampling Site Data Sheets (Benthic Macroinvertebrate & Fish Community) for the Upper Dan River Subbasin

Biological Samples Taken During this Assessment Cycle

Station ID	Waterbody	County	Site Location	Sample Results
Benthic Sample Sites				
NB101	WOOD BENTON BR	STOKES	SR 1707	05 - Not Impaired
NB114	BIRCH FK	ROCKINGHAM	SR 1912	07 - Not Impaired
NB115	BRUSHY CR	ROCKINGHAM	SR 2321	07 - Not Impaired
NB120	L CROOKED CR	Stokes	SR 1622	08 - Good
NB15	N DOUBLE CR	STOKES	SR 1504	09 - Good
NB17	SNOW CR	STOKES	SR 1673	09 - Good
NB26	HICKORY CR	ROCKINGHAM	SR 1354	06 - Not Impaired 05 - Not Impaired
NB28	MAYO R	ROCKINGHAM	SR 1358	09 - Excellent 09 - Excellent
NB33	INDIAN CR	STOKES	SR 1001	05 - Not Impaired
NB4	CASCADE CR	STOKES	SR 2012	05 - Not Impaired
NB41	LYNN BR	STOKES	SR 1696	05 - Not Impaired
NB63	RACOON CR	STOKES	STEELE RD	05 - Not Impaired
NB8	DAN R	STOKES	NC 704	09 - Excellent
NB9	DAN R	STOKES	SR 1695	09 - Good
NB97	UT MILL CR	STOKES	SR 2018	05 - Not Impaired
Fish Community Sample Sites				
NF1	Archies Cr	Stokes	SR 1415	09 - Excellent
NF10	Big Beaver Island Cr	Rockingham	US 311	09 - Excellent
NF11	Hogans Cr	Rockingham	NC 704	09 - Excellent
NF12	Jacobs Cr	Rockingham	NC 704	09 - Good
NF14	Pawpaw Cr	Rockingham	SR 1360	09 - Good
NF18	Rock House Cr	Rockingham	SR 2127	09 - Good
NF2	Big Cr	Stokes	SR 1471	09 - Good-Fair
NF20	Wolf Island Cr	Rockingham	SR 1767	09 - Excellent
NF4	Elk Cr	Stokes	SR 1433	09 - Good
NF42	Crooked Cr	Stokes	off SR 1626	07 - Good-Fair
NF5	N Double Cr	Stokes	SR 1504	09 - Good
NF6	Peters Cr	Stokes	SR 1497	09 - Good
NF7	S Double Cr	Stokes	SR 1483	09 - Good
NF8	Snow Cr	Stokes	SR 1652	09 - Good-Fair
NF9	Town Fork Cr	Stokes	SR 1955	09 - Good

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
DAN R	**NC 704**	**NB8**	**08/10/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
STOKES	1	03010103	36.514722	-80.303056	22-(1)b	Northern Inner Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;Tr	169.0	886	19	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	90	0	0	10 (road/boat access)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	26.0
Dissolved Oxygen (mg/L)	10.8
Specific Conductance (µS/cm)	49
pH (s.u.)	8.2
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	19
Bottom Substrate (15)	8
Pool Variety (10)	10
Riffle Habitat (16)	16
Bank Erosion (7)	7
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	92

Site Photograph

Substrate Mix of boulder, cobble, gravel, sand, and silt.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/10/09	10747	106	52	4.16	3.38	Excellent
07/07/04	9403	91	45	3.89	3.42	Excellent
08/23/99	7981	85	41	4.17	3.26	Good
08/23/94	6686	57	28	3.85	3.51	Good
07/12/90	5379	94	48	4.46	3.65	Excellent

Taxonomic Analysis

Several intolerant macroinvertebrate taxa were collected at this sampling location such as the mayflies *Epeorus vitreus* , *Seratella serratoides* , and *Ephoron leukon* ; the long-lived stoneflies *Acroneuria abnormis* , *Paragnetina ichusa/media* , and P*teranarcys spp* .; and the caddisflies *Brachycentrus appalachia* , *B. lateralis* , *B. numerosus, and Goera spp* . Rarely collected taxa found at this site included *Brachycercus spp.* and *Brachycentrus lateralis.* Aquatic beetle fauna were extremely rich (13) at this sampling location.

Data Analysis

This portion of the Dan River continues to reflect Excellent water quality based on macroinvertebrate communities. The NCBI and EPTBI has remained low at the site since sampling began in 1984 and the highest total taxa richness (106) and EPT taxa richness (52) on record at this sample site was collected during the 2009 season. EPT abundance was also high at 216. This portion of the Dan River in North Carolina is relatively undisturbed by metropolitan areas found furthur downstream. A pollution intolerant macroinvertebrate community continues to reside at this sampling location. If requested, this site qualifies for reclassification as an Outstanding Resource Water or High Quality Water due to continued Excellent bioclassifications.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
DAN R	SR 1695	NB9	08/11/09	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
STOKES	1	03010103	36.401944	-80.138333	22-(8)	Northern Inner Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-V	335.0	700	40	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	90	0	10	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (℃)	27.8
Dissolved Oxygen (mg/L)	10.5
Specific Conductance (µS/cm)	53
pH (s.u.)	7.2

Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	20
Bottom Substrate (15)	13
Pool Variety (10)	9
Riffle Habitat (16)	7
Bank Erosion (7)	6
Bank Vegetation (7)	6
Light Penetration (10)	2
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	78

Site Photograph

Substrate Mostly bedrock, boulder, and cobble with less gravel and sand.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/11/09	10749	100	42	4.62	3.82	Good
07/07/04	9404	87	43	4.89	4.07	Good
08/23/99	7984	72	37	4.56	3.93	Good
08/23/94	6688	45	20	4.74	3.83	Good-Fair

Taxonomic Analysis

Several intolerant EPT taxa were collected including the mayflies *Epeorus vitreus*, *Ephoron leukon*, and *Serratella serratoides*; the stoneflies *Acroneuria abnormis* and *Paragnetina fumosa*; and the caddisflies *Brachycentrus lateralis* and *Polycentropus spp.* The intolerant beetles *Optioservus trivittatus*, *Promoresia elegans*, and *Psephenus herricki* were also common. Rare EPT taxa collected at this sampling station inluded *Trycorythodes robacki* and *Ceraclea mentiea* listed as "vulnerable to extirpation" by Morse *et al.* (1997) and Significantly Rare by the North Carolina Natural Heritage Program (2006) respectively.

Data Analysis

This site continues to exhibit Good water quality based on macroinvertebrate fauna. The NCBI and EPTBI has remained relatively similar since sampling began in 1994. Total taxa richness and EPT taxa richness steadily increased beginning in 1999 elevating the bioclassification from Good-Fair to Good; where it has remained. Consistent good water quality at the site is likely attributed to the mostly forested upstream land use with minimal anthropogenic activities.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
N DOUBLE CR	SR 1504	NB15	08/10/09	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
STOKES	1	03010103	36.440000	-80.311020	22-10	Northern Inner Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	12.0	785	8	0.1

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	70	10	20	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (℃)	22.3
Dissolved Oxygen (mg/L)	10.3
Specific Conductance (µS/cm)	58
pH (s.u.)	6.4

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	14
Pool Variety (10)	10
Riffle Habitat (16)	7
Bank Erosion (7)	5
Bank Vegetation (7)	5
Light Penetration (10)	10
Left Riparian Score (5)	4
Right Riparian Score (5)	5
Total Habitat Score (100)	83

Site Photograph

Substrate Mostly gravel and sand with some cobble substrate.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/10/09	10746	---	31	---	4.27	Good
06/28/04	9396	---	31	---	3.42	Good
08/23/99	7982	---	25	---	3.95	Good-Fair
08/23/94	6687	---	17	---	5.05	Fair

Taxonomic Analysis

Various pollution sensitive EPT taxa were collected at this monitoring station in 2009 including the stoneflies *Acroneuria abnormis*, *Leuctra spp*, and *Tallaperla spp*. *Tallaperla* has never been collected at this station. The intolerant mayflies *Leucrocuta spp*, *Heptagenia marginalis*, and *Stenacron pallidum* were common. Pollution-sensitive caddisflies such as *Chimarra spp*. and *Polycentropus spp*. were abundant and common respectively. The rarely collected mayfly *Seratella serrata* was also collected in 2009.

Data Analysis

This stream retained its bioclassification of Good in 2009 suggesting minimal upstream pollution input. EPT richness remained the same as in 2004, however, EPTBI was elevated. This higher EPTBI may be due to the emergence of some intolerant taxa found in 2004 such as *Pycnopsyche spp*. Empty *Pycnopsyche spp.* cases were found at the site suggesting the insects had already emerged preventing collection. Despite the presence of small infrequent riffles, this station continues to exhibit good water quality most likely due to minimal anthropogenic input and a mostly forested catchment.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
SNOW CR	**SR 1673**	**NB17**	**08/10/09**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
STOKES	1	03010103	36.434444	-80.147778	22-20	Northern Inner Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	34.0	650	11	0.1

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	60	10	0	30

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (℃)	27.2
Dissolved Oxygen (mg/L)	9.5
Specific Conductance (µS/cm)	80
pH (s.u.)	6.8

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	8
Pool Variety (10)	8
Riffle Habitat (16)	5
Bank Erosion (7)	3
Bank Vegetation (7)	5
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	4
Total Habitat Score (100)	68

Site Photograph

Substrate Mostly sand with minimal cobble and gravel.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/10/09	10748	---	29	---	4.48	Good
07/07/04	9405	---	31	---	4.33	Good
09/13/00	8308	---	29	---	4.08	Good
08/23/99	7983	---	18	---	4.29	Fair
08/23/94	6689	---	22	---	4.04	Good-Fair

Taxonomic Analysis

Both mayfly and caddisfly taxa new to this location were collected in 2009 including the caddislfies *Brachycercus spp* and *Glossosoma spp.* These macroinvertebrates are considered sensitive to pollution and usually are not present in degraded water quality conditions. Additionally, the moderately caddisfly intolerant *Polycentropus spp* was common at this site consistent with samples collected since 2000. *Leuctra spp* was the only stonefly collected at this location.

Data Analysis

The bioclassification at this site has remained Good since 2000. It was reassessed following the Fair rating it received in 1999 pending its addition to the 303(d) list. The EPTBI in 2009 is slightly elevated compared to past samples, however, EPT taxa richness has remained consistent between 29 and 31 beginning in 2000. Overall, water quality has improved at the site since 1999 when presumably this location suffered from low flows and/or temporary bridge construction impacts. No NPDES dischargers are currently active upstream from this macroinvertebrate monitoring station.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
MAYO R	SR 1358	NB28	08/11/09	Excellent

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Rockingham	2	03010103	36.535520	-79.990620	22-30-(1)	Northern Inner Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-V	261.0	720	40	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	100	0	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (℃)	26.6
Dissolved Oxygen (mg/L)	10.2
Specific Conductance (µS/cm)	53
pH (s.u.)	7.3

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	12
Pool Variety (10)	10
Riffle Habitat (16)	16
Bank Erosion (7)	7
Bank Vegetation (7)	6
Light Penetration (10)	5
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	89

Site Photograph

Substrate Mostly bedrock and rubble with some boulders, gravel, and sand.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/11/09	10807	91	48	4.03	3.37	Excellent
07/08/04	9406	78	33	4.74	4.13	Good
08/23/99	7985	70	32	4.27	3.45	Good
08/22/94	6685	64	38	3.58	3.20	Good
08/08/89	5035	79	42	4.79	4.00	Good

Taxonomic Analysis

In 2009, a diverse macroinvertebrate community was observed at this sampling location. EPT richness (48) was the highest yet recorded during Basinwide sampling at this site. Many intolerant EPT taxa were collected including but not limited to the mayflies *Drunella allegheniensis*, *Epeorus vitreus*, and *Serratella serratoides*; the stoneflies *Leuctra spp*, *Paragnetina fumosa*, and *Pteranarcys spp, and* the caddisflies *Brachycentrus lateralis*, *B. nigrosoma*, *B. numerosus*, *Ceraclea mentiea*, *Micrasema wataga*, and *M. bennetti*. Rarely collected EPT taxa included *Heterocloeon petersi*, *Rhithrogena spp*., *Brachycentrus lateralis* and *Ceraclea mentiea*. Intolerant beetles present included *Promeresia elegans*, *Psephenus herricki*, *Optioservus ovalis*, and *O. trivittatus*.

Data Analysis

The Mayo River Basinwide sampling location received a bioclassification of Excellent in 2009 suggesting an improvement in water quality from past benthic samples. This may reflect a reduction in non point pollution inputs as a result of the prolonged drought. The NCBI and EPTBI has remained stable throughout basinwide sampling at this location, however, total taxa richness and EPT taxa richness increased significantly in 2009 compared to past samples. A history of Good ratings (1989-2004) and recent Excellent rating (2009) suggests improved water quality and very little anthropogenic activity upstream. Further sampling should occur in the near future to determine if macroinvertebrate fauna continue to reflect improved water quality at this location. The presence of so many intolerant and rare taxa in this stretch of river suggests further investigation(s) are needed to assess its potential for reclassification.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
ARCHIES CR	SR 1415	05/11/09	NF1	Excellent

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
STOKES	1	03010103	36.55	-80.43277778	22-2	Northern Inner Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;Tr	9.3	1180	7	0.4	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	70	5	25	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	15.3
Dissolved Oxygen (mg/L)	9.2
Specific Conductance (µS/cm)	49
pH (s.u.)	6.0

Water Clarity	Slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	19
Bottom Substrate (15)	12
Pool Variety (10)	10
Riffle Habitat (16)	16
Erosion (7)	7
Bank Vegetation (7)	7
Light Penetration (10)	9
Left Riparian Score (5)	5
Right Riparian Score (5)	3
Total Habitat Score (100)	**93**

Site Photograph

Substrate Bedrock, cobble, boulder, sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/11/09	2009-28	22	54	Excellent
04/19/04	2004-09	21	54	Excellent

Most Abundant Species 2009 Redlip Shiner (23%), Bluehead Chub (21%)

Exotic Species 2009 Brown Trout, Smallmouth Bass

Species Change Since Last Cycle **Gains** -- Brown Trout (n=1). **Losses** -- none.

Data Analysis

Watershed -- drains southern Patrick County, VA and a very small portion of the extreme northwest corner of Stokes and northeastern Surry counties; no municipalities in the watershed; tributary to the Dan River; site is ~ 0.7 miles upstream of the creek's confluence with the river. **Habitats** -- very high quality instream and riparian habitats, site would have qualified as a regional reference site except the watershed landuse did not appear to be as greatly forested (~ 50 %) as required to meet the criteria (≥ 70 %). **Water Quality** -- specific conductance has always been low (37 and 49 µS/cm). **2009** -- greatest number of intolerant species (n=4) and lowest percentage of tolerant fish (3%) of any site in 2009; not a NCWRC Hatchery Supported Trout waters, but one stocked Brook Trout, 200 mm TL was collected. **2004 & 2009** -- 22 species known from the site, including 5 species of darters and the endemic Cutlip Minnow [Special Concern], Roanoke Hogsucker [Significantly Rare], Blacktip Jumprock, and Riverweed Darter [Special Concern]; dominant species are the Bluehead Chub and Redlip Shiner. Based on this site's most recent Excellent rating, the site qualifies at minimum for High Quality Waters (HQW) designation.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
ELK CR	**SR 1433**	**05/11/09**	**NF4**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
STOKES	1	03010103	36.52388889	-80.3075	22-5	Northern Inner Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;Tr	8.5	890	7	0.4	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	75	25	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	15.3
Dissolved Oxygen (mg/L)	9.2
Specific Conductance (µS/cm)	48
pH (s.u.)	6.3
Water Clarity	Slightly turbid, easily silted

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	17
Bottom Substrate (15)	12
Pool Variety (10)	9
Riffle Habitat (16)	16
Erosion (7)	6
Bank Vegetation (7)	3
Light Penetration (10)	4
Left Riparian Score (5)	1
Right Riparian Score (5)	2
Total Habitat Score (100)	**75**

Site Photograph

Substrate Bedrock, boulder, cobble, gravel, silt, sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/11/09	2009-29	18	52	Good
04/20/04	2004-13	21	44	Good-Fair

Most Abundant Species 2009 Bluehead Chub (34%)

Exotic Species 2009 Smallmouth Bass

Species Change Since Last Cycle

Gains -- White Sucker, Northern Hogsucker. **Losses** -- Mountain Redbelly Dace, Cutlip Minnow, Creek Chub, Golden Redhorse, Brown Trout. All species gained or lost were represented by 1 fish/species, except for Golden Redhorse and White Sucker (n=5 and 8, respectively).

Data Analysis

Watershed -- drains primarily southern Patrick County, VA and a very small portion of northwestern Stokes County; no municipalities in the watershed; tributary to the Dan River, site is ~ 0.8 miles above the creek's confluence with the river. **Habitats** -- high gradient stream with plunge pools and riffles; narrow riparian zones offering minimal shading to the stream, banks have re-vegetated since 2004. **Water Quality** -- specific conductance has always been low (41 and 48 µS/cm). **2009** -- a slight increase in the diversity of suckers and a greater abundance of piscivores (i.e., Smallmouth Bass) were largely responsible for the improved NCIBI score and rating; other metrics were unchanged. **2004 & 2009** -- 23 species known from the site, including 5 species of darters, 4 species of suckers, the endemic Cutlip Minnow [Special Concern], Roanoke Hogsucker [Significantly Rare], and Riverweed Darter [Special Concern], but only one species of sunfish; dominant species is the Bluehead Chub.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
PETERS CR	**SR 1497**	**05/12/09**	**NF6**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
STOKES	1	03010103	36.49388889	-80.27138889	22-6	Northern Inner Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;Tr	28.6	830	11	0.4	Yes

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	75	0	25	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	12.5
Dissolved Oxygen (mg/L)	11.2
Specific Conductance (µS/cm)	57
pH (s.u.)	5.4

Water Clarity: Slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	12
Pool Variety (10)	10
Riffle Habitat (16)	11
Erosion (7)	4
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	3
Right Riparian Score (5)	5
Total Habitat Score (100)	**83**

Site Photograph

Substrate: Cobble, boulder, gravel, sand, silt.

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/12/09	2009-30	27	50	Good
04/21/04	2004-14	24	54	Excellent

Most Abundant Species 2009: Bluehead Chub (24%)

Exotic Species 2009: Bluegill

Species Change Since Last Cycle

Gains -- Central Stoneroller, Bull Chub, Golden Shiner, Northern Hogsucker, Golden Redhorse, V-lip Redhorse. **Losses** -- Bigeye Jumprock, Smallmouth Bass, Chainback Darter. All species gained or lost were represented by 1or 2 fish/species, except for V-Lip Redhorse, Golden Redhorse, and Central Stoneroller (n=6, 7, and 19, respectively).

Data Analysis

Watershed -- drains a portion of the southern part of Patrick County, VA and north-central Stokes County; no municipalities in the watershed; tributary to the Dan River, site is ~ 1.9 miles above the creek's confluence with the river. **Habitats** -- a regional reference site; riffles, deep snag pools; good canopy over the stream. **Water Quality** -- pH less than the water quality standard of 6.0 s.u. **2009** -- 6 species of suckers collected, the most of any site in 2009 (Wolf Island Creek also had 6 species); the loss of the intolerant Bigeye Jumprock [State Threatened], and the intolerant Smallmouth Bass were responsible for the decline in the NCIBI score and rating; other metrics were unchanged. **2004 & 2009** -- very diverse community, 30 species known from the site, including 7 species of suckers, 6 species of darters and the endemic Roanoke Hogsucker [Significantly Rare], Bigeye Jumprock, Blacktip Jumprock, and Riverweed Darter [Special Concern]; the loss of the Bigeye Jumprock and Smallmouth Bass and the decline from Excellent to Good warrants additional monitoring in 2014.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
BIG CR	SR 1471	05/13/09	NF2	Good-Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
STOKES	1	03010103	36.4725	-80.34888889	22-9	Northern Inner Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;Tr	32.7	890	8	0.4	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	75	5	20	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	13.7
Dissolved Oxygen (mg/L)	13.0
Specific Conductance (µS/cm)	52
pH (s.u.)	6.0

Water Clarity	Slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	5
Pool Variety (10)	10
Riffle Habitat (16)	7
Erosion (7)	4
Bank Vegetation (7)	7
Light Penetration (10)	9
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**73**

Site Photograph

Substrate Sand, gravel, boulder, bedrock

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/13/09	2009-33	19	42	Good-Fair
04/20/04	2004-10	17	48	Good

Most Abundant Species 2009 Bluehead Chub (47%)

Exotic Species 2009 Bluegill

Species Change Since Last Cycle

Gains -- Central Stoneroller, White Shiner, Mountain Redbelly Dace, Blacktip Jumprock, Flat Bullhead. **Losses** -- Green Sunfish, Riverweed Darter, Roanoke Darter. All species gained or lost were represented by 1-9 fish/species.

Data Analysis

Watershed -- drains eastern Surry and northwestern Stokes counties; no municipalities in the watershed; tributary to the Dan River. **Habitats** -- gravel riffles, runs, pools, woody debris, bank erosion is moderate to severe in places. **Water Quality** -- dissolved oxygen saturation at 125% indicating high early morning periphyton production. **2009** -- more than twice as many fish collected in 2009 than in 2004 (888 *vs*. 413), primarily Bluehead Chub and Crescent Shiner; highest percentage of omnivores+ herbivores of any site (49%, indicative of non-point source nutrient enrichment; the loss of two intolerant darters, Roanoke Darter and Riverweed Darter, and one species of sunfish were responsible for the decline in the NCIBI score and rating. **2004 & 2009** -- 22 species known from the site, including 4 species of darters and the endemic Roanoke Hogsucker [Significantly Rare], Blacktip Jumprock, and Riverweed Darter [Special Concern]; dominant species is the Bluehead Chub.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
N DOUBLE CR	SR 1504	05/12/09	NF5	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
STOKES	1	03010103	36.43972222	-80.31111111	22-10	Northern Inner Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	12.4	790	8	0.4	Yes

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	75	15	10	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	15.0
Dissolved Oxygen (mg/L)	10.2
Specific Conductance (µS/cm)	52
pH (s.u.)	6.1

Water Clarity: Very slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	14
Bottom Substrate (15)	4
Pool Variety (10)	8
Riffle Habitat (16)	12
Erosion (7)	6
Bank Vegetation (7)	7
Light Penetration (10)	9
Left Riparian Score (5)	3
Right Riparian Score (5)	5
Total Habitat Score (100)	**73**

Site Photograph

Substrate: Sand, gravel, some cobble

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/12/09	2009-32	20	50	Good
04/20/04	2004-11	18	42	Good-Fair

Most Abundant Species 2009: Bluehead Chub (32%), Crescent Shiner (25%)

Exotic Species 2009: Bluegill

Species Change Since Last Cycle: **Gains** -- Satinfin Shiner, Golden Redhorse, Bluegill, Roanoke Darter. **Losses** -- Flat Bullhead, Largemouth Bass. All species gained or lost were represented by 1-5 fish/species.

Data Analysis

Watershed -- drains west-central Stokes County; no municipalities in the watershed; tributary to the Dan River, site is ~ 2.7 miles upstream of the creek's confluence with the river. **Habitats** -- a regional reference site; primarily gravel/sand runs; one riffle at the upper end, some snags, undercuts; high quality riparian zone on the right. **2009** -- the number of fish collected in 2009 was ~ 1.5 times more than in 2004 (811 vs. 539), primarily Crescent Shiner which increased almost 10-fold; the slight increase in the diversity of suckers and darters and a more balanced trophic structure (i.e., less dominance by the omnivorous Bluehead Chub) were responsible for the increased NCIBI score and rating; no lingering drought impacts. **2004 & 2009** -- 22 species known from the site, including 4 species of darters and the endemic Roanoke Hogsucker [Significantly Rare]; dominant species is the Bluehead Chub.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
S DOUBLE CR	SR 1483	05/12/09	NF7	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
STOKES	1	03010103	36.43138889	-80.29805556	22-11	Northern Inner Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
B	16.4	750	7	0.5	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	70	10	20	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	12.9
Dissolved Oxygen (mg/L)	10.5
Specific Conductance (µS/cm)	47
pH (s.u.)	5.9
Water Clarity	Slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	14
Bottom Substrate (15)	3
Pool Variety (10)	10
Riffle Habitat (16)	5
Erosion (7)	6
Bank Vegetation (7)	6
Light Penetration (10)	9
Left Riparian Score (5)	3
Right Riparian Score (5)	4
Total Habitat Score (100)	**65**

Site Photograph

Substrate Sand, gravel, bedrock outcrops

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/12/09	2009-31	21	48	Good
04/20/04	2004-12	22	46	Good

Most Abundant Species 2009 Bluehead Chub (27%), Redbreast Sunfish (20%)

Exotic Species 2009 Bluegill

Species Change Since Last Cycle

Gains -- Central Stoneroller, Blacktip Jumprock, Bluegill. **Losses** -- Mountain Redbelly Dace, Flat Bullhead, Green Sunfish, Chainback Darter. All species gained or lost were represented by 1-5 fish/species.

Data Analysis

Watershed -- drains west-central Stokes County; no municipalities in the watershed; tributary to the Dan River, site is ~ 0.8 miles upstream of the creek's confluence with the river. **Habitats** -- borders the Sauratown Mountains Level IV ecoregion; gravel riffles and runs, silty pools with bedrock outcrops; re-vegetated left bank. **Water Quality** -- lowest specific conductance of any site in 2009, has always been low (46 µS/cm in 2004). **2009** -- slightly more total fish and a lower percentage of tolerant fish were largely responsible for the very slight increase in NCIBI score and rating, no other changes in the other metric scores; no lingering impacts from droughts. **2004 & 2009** -- 25 species known from the site, including 5 species of darters and the endemic Roanoke Hogsucker [Significantly Rare] and Blacktip Jumprock; dominant species is the Bluehead Chub.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
SNOW CR	SR 1652	05/13/09	NF8	Good-Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
STOKES	1	03010103	36.46166667	-80.14972222	22-20	Northern Inner Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	22.7	750	9	0.4	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	90	10	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	13.9
Dissolved Oxygen (mg/L)	12.2
Specific Conductance (µS/cm)	66
pH (s.u.)	6.2

Water Clarity: Very slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	4
Pool Variety (10)	6
Riffle Habitat (16)	10
Erosion (7)	4
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**72**

Site Photograph

Substrate: Sand, gravel, cobble, silt

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/13/09	2009-34	19	44	Good-Fair
04/21/04	2004-15	16	46	Good

Most Abundant Species 2009: Bluehead Chub (38%)

Exotic Species 2009: Bluegill

Species Change Since Last Cycle

Gains -- Central Stoneroller (n=9), Northern Hogsucker (n=4), Blacktip Jumprock (n=1), Bluegill (n=14).
Losses -- Flat Bullhead (n=6).

Data Analysis

Watershed -- drains northeastern and north-central Stokes County; no municipalities in the watershed; tributary to the Dan River. **Habitats** -- shallow riffles, runs, side snags, bedrock outcrop pool at the end of the reach. **2009** -- 3 times more fish collected in 2009 than in 2004 (746 *vs* . 249), primarily Bluehead Chub, Redlip Shiner, and Crescent Shiner (69% of all the fish collected); a slight increase in sucker diversity was offset by the abundance of omnivores, primarily Bluehead Chub, indicative of nonpoint source nutrient enrichment, which slightly decreased the NCIBI score and rating; no lingering effects from the drought. **2004 & 2009** -- only 20 species known from the site, including the endemic Roanoke Hogsucker [Significantly Rare] and Blacktip Jumprock; interestingly Snow Creek was the only site in the basin from which the Johnny Darter or the Tessellated Darter was not collected in 2004 or 2009, its absence is unexplained; dominant species is the Bluehead Chub.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
TOWN FORK CR	SR 1955	05/13/09	NF9	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
STOKES	1	03010103	36.26416667	-80.2325	22-25b	Northern Inner Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	28	680	10	0.4	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	25	15	60	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	16.7
Dissolved Oxygen (mg/L)	12.4
Specific Conductance (µS/cm)	95
pH (s.u.)	6.9
Water Clarity	Very slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	8
Pool Variety (10)	7
Riffle Habitat (16)	15
Erosion (7)	6
Bank Vegetation (7)	7
Light Penetration (10)	7
Left Riparian Score (5)	3
Right Riparian Score (5)	3
Total Habitat Score (100)	**79**

Site Photograph

Substrate Bedrock shelves, gravel, cobble

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/13/09	2009-35	21	52	Good
04/21/04	2004-16	21	48	Good

Most Abundant Species 2009 Fantail Darter (34%)

Exotic Species 2009 Bluegill, Green Sunfish

Species Change Since Last Cycle **Gains** -- Mountain Redbelly Dace (n=5). **Losses** -- V-lip Redhorse (n=5).

Data Analysis

Watershed -- drains south-central Stokes and northern Forsyth counties, north and east of the City of Winston-Salem metropolitan area; three NPDES aci ities ithi the cree s atershed (00 5 00577 0 a d 00 7 com i ed $_{w}$ = 0.107 MGD); tributary to the Dan River. **Habitats** -- shallow gravel riffles, runs, bedrock riffles with *Podostemum,* side snag pools. **Water Quality** -- dissolved oxygen saturation at 128% due to afternoon photosynthetic activity by the periphyton. **2009** -- 2.2 times more fish collected in 2009 than in 2004, primarily an increase in the number of Fantail Darter (from 16% to 34%) and a decrease in the dominance of the Bluehead Chub (from 38% to 21%); these changes (decreasing the percentage of omnivores+herbivores and increasing the percentage of insectivores) slightly increased the NCIBI score but not the rating. **2004 & 2009** -- 22 species known from the site, including 5 species of sucker, 3 species of darters, and the endemic Roanoke Hogsucker [Significantly Rare]; dominant species is the Fantail Darter and Bluehead Chub.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
BIG BEAVER ISLAND CR	US 311	05/14/09	NF10	Excellent

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
ROCKINGHAM	2	03010103	36.3825	-79.98083333	22-29	Triassic Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	23.8	570	6	0.4	No

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	25	50	25	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	17.5
Dissolved Oxygen (mg/L)	8.8
Specific Conductance (µS/cm)	64
pH (s.u.)	6.3

Water Clarity: Clear, easily silted

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	14
Bottom Substrate (15)	6
Pool Variety (10)	8
Riffle Habitat (16)	10
Erosion (7)	1
Bank Vegetation (7)	7
Light Penetration (10)	9
Left Riparian Score (5)	3
Right Riparian Score (5)	4
Total Habitat Score (100)	**67**

Site Photograph

Substrate: Gravel, cobble, sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/14/09	2009-38	26	56	Excellent
04/22/04	2004-18	22	52	Good

Most Abundant Species 2009: Bluehead Chub (27%)

Exotic Species 2009: Bluegill

Species Change Since Last Cycle

Gains -- Creek Chub, Golden Redhorse, V-lip Redhorse, Blacktip Jumprock, Redfin Pickerel, Largemouth Bass, Roanoke Logperch. **Losses** -- Golden Shiner, Northern Hogsucker, Glassy Darter, Chainback Darter. All species gained or lost were represented by 1 or 2 fish/species, except for Glassy Darter, Northern Hogsucker, Golden Redhorse, and Redfin Pickerel (n=4, 7, 9, and 28, respectively).

Data Analysis

Watershed -- drains north-central Stokes and northwest Rockingham counties, including the western area of the towns of Madison and Mayodan; tributary to the a i er site is ~ 0. mi es a o e the cree s co ue ce ith the ri er. **Habitats** -- severe bank erosion in places, but bank vegetation and canopy are of high quality; riffles, runs, side undercuts and snags, large coarse woody debris, large debris dam at end of reach. **2009** -- ~ 3.5 times more fish collected in 2009 than in 2004 (866 vs. 247), primarily Bluehead Chub, Redlip Shiner, Fantail Darter, and Crescent Shiner (71% of all the fish collected); the collection of 28 piscivorous Redfin Pickerel resulted in a more balanced trophic structure, increasing the NCIBI score and rating; one specimen of the Federally Endangered Roanoke Logperch was collected. **2004 & 2009** -- very diverse community with 30 species known from the site, including 6 species of darters, 6 species of suckers, and the endemic Roanoke Hogsucker [Significantly Rare], Blacktip Jumprock, and Roanoke Logperch; dominant species is the Bluehead Chub.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
PAWPAW CR	**SR 1360**	**05/14/09**	**NF14**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
ROCKINGHAM	2	03010103	36.50444444	-79.96277778	22-30-6-(2)	Northern Inner Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	8.1	750	7	0.3	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	65	2	33	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	14.4
Dissolved Oxygen (mg/L)	9.2
Specific Conductance (µS/cm)	57
pH (s.u.)	6.1

Water Clarity: Clear, easily silted

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	17
Bottom Substrate (15)	10
Pool Variety (10)	4
Riffle Habitat (16)	15
Erosion (7)	5
Bank Vegetation (7)	6
Light Penetration (10)	7
Left Riparian Score (5)	3
Right Riparian Score (5)	3
Total Habitat Score (100)	**75**

Site Photograph

Substrate: Cobble, gravel

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/14/09	2009-36	21	52	Good
04/22/04	2004-17	18	44	Good-Fair
08/03/90	90-08	23	48	Good

Most Abundant Species 2009: Bluehead Chub (22%)

Exotic Species 2009: Green Sunfish, Bluegill

Species Change Since Last Cycle: **Gains** -- White Sucker (n=4), Golden Redhorse (n=18), Pumpkinseed (n=10), Warmouth (n=2). **Losses** -- White Shiner (n=8).

Data Analysis

Watershed drai s orth ester oc i ham ou t o mu ici a ities i the atershed tri utar to the a o i er site is ~ 0. mi es a o e the cree s confluence with the river. **Habitats** -- good gradient with riffles and runs, shallow pools, narrow riparian zones. **2009** -- almost twice as many fish collected in 2009 than in 2004 (979 *vs*. 527), primarily Redlip Shiner, Crescent Shiner, Central Stoneroller, and Fantail Darter (45% of all the fish collected); greater diversities of sunfish and suckers and a very slight improvement in the trophic structure were responsible for the increased NCIBI score and rating. **1990 - 2009** -- 27 species known from the site, including 4 species of darters and the endemic Roanoke Hogsucker [Significantly Rare] and Bigeye Jumprock [State Threatened]; the dominant species is the Bluehead Chub; the intolerant Bigeye Jumprock and Roanoke Darter have not been collected since 1990; the loss of two intolerant species, one of which is an endemic species of sucker, and the absence another species of sucker since 1990 from this site warrants repeat assessment in 2014.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
HOGANS CR	NC 704	05/14/09	NF11	Excellent

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
ROCKINGHAM	2	03010103	36.3816593	-79.9076818	22-31	Triassic Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	23	600	8	0.4	Yes

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	95	0	0	5 (road)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

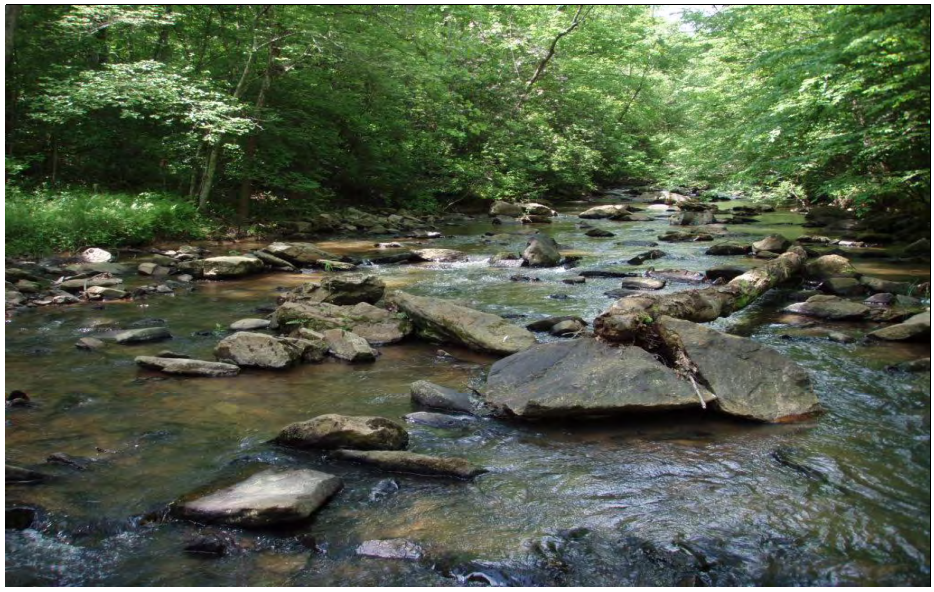
Temperature (°C)	16.0
Dissolved Oxygen (mg/L)	9.1
Specific Conductance (µS/cm)	62
pH (s.u.)	6.3

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	19
Bottom Substrate (15)	12
Pool Variety (10)	10
Riffle Habitat (16)	16
Erosion (7)	6
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**95**

Site Photograph



Substrate Cobble, boulder, gravel, silt

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/14/09	2009-37	24	54	Excellent
04/22/04	2004-19	17	48	Good

Most Abundant Species 2009 Redlip Shiner (31%)

Exotic Species 2009 Green Sunfish, Bluegill

Species Change Since Last Cycle

Gains -- White Shiner, Satinfin Shiner, Golden Redhorse, V-lip Redhorse, Green Sunfish, Pumpkinseed, Bluegill, Largemouth Bass, Riverweed Darter, Glassy Darter. **Losses** -- Rosyside Dace, Golden Shiner, Blacktip Jumprock. Species gained or lost were represented by 1-10 fish/species.

Data Analysis

Watershed drai s south est oc i ham ou t o mu ici a ities i the atershed tri utar to the a i er site is ~ . mi es a o e the cree s co ue ce ith the ri er our sma aci ities or mo i e home ar s ithi the cree s atershed (tota $_w$=0.251 MGD). **Habitat --** a regional reference site; borders the Northern Outer Piedmont Level IV ecoregion, atypical Triassic Basin habitats; highest score of any site in the basin in 2004 and 2009; high gradient boulder and cobble riffles, runs, deep, long pools. **2009** -- 2.3 times more fish collected in 2009 than in 2004, primarily Redlip Shiner; with a greater diversity of sunfish and more species with multiple age classes in 2009 than in 2004 the NCIBI score and rating increased; other metric scores were unchanged; no lingering drought impacts. **2004 & 2009** -- 27 species known from the site, including 6 species of suckers, 5 species of darters, and the endemic Roanoke Hogsucker [Significantly Rare], Blacktip Jumprock, and Riverweed Darter [Special Concern]; dominant species is the Redlip Shiner; extremely low flows during the 2002 drought may have impacted the community in 2004; as a regional reference site and with an Excellent rating, if requested the site qualifies as High Quality Waters. Based on this site's most recent Excellent rating, the site qualifies at minimum for High Quality Waters (HQW) designation.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
JACOBS CR	NC 704	05/20/09	NF12	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
ROCKINGHAM	2	03010103	36.37944444	-79.87638889	22-32-(3)	Northern Inner Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	36.2	565	8	0.4	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	75	0	25	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	11.6
Dissolved Oxygen (mg/L)	9.5
Specific Conductance (µS/cm)	76
pH (s.u.)	6.1

Water Clarity: Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	17
Bottom Substrate (15)	4
Pool Variety (10)	4
Riffle Habitat (16)	3
Erosion (7)	2
Bank Vegetation (7)	4
Light Penetration (10)	8
Left Riparian Score (5)	3
Right Riparian Score (5)	5
Total Habitat Score (100)	**55**

Site Photograph

Substrate: Sand, gravel

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/20/09	2009-39	22	50	Good
04/22/04	2004-20	19	50	Good

Most Abundant Species 2009: Redlip Shiner (26%)

Exotic Species 2009: Bluegill

Species Change Since Last Cycle

Gains -- Rosyside Dace, Mountain Redbelly Dace, Creek Chub, Golden Redhorse, Flat Bullhead, Bluegill, Chainback Darter. **Losses** -- Margined Madtom, Snail Bullhead, Green Sunfish, Largemouth Bass. All species gained or lost were represented by 1-4 fish/species, except for Bluegill, Creek Chub, and Golden Redhorse, (n=6, 8, 12, respectively).

Data Analysis

Watershed -- drains southwestern Rockingham County; no municipalities in the watershed; tributary to the Dan River, site is ~ 1.6 miles above the creek's co ue ce ith the ri er t o sma aci ities ithi the cree s atershed 00 5 a d 00 700 tota $_w$ = 0.01 MGD). **Habitats** -- gravely and sandy runs, side snags and deadfall pools, scour pools, boulders and bluff along the right bank; left bank has re-vegetated since 2004; site still suffers from very substantial nonpoint source erosion and sedimentation; habitat score was the lowest of any site in 2004 and 2009. **2009** -- 2.6 times more fish collected in 2009 than in 2004 (459 vs. 176), primarily Redlip Shiner; piscivores absent; no other changes in the metric scores. **2004 & 2009** -- 26 species known from the site, including 5 species of suckers, 5 species of darters, and the endemic Roanoke Hogsucker [Significantly Rare]; dominant species are the Redlip Shiner and Bluehead Chub.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
ROCK HOUSE CR	SR 2127	05/20/09	NF18	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
ROCKINGHAM	3	03010103	36.42055556	-79.79055556	22-34-(2)	Triassic Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-IV	23	510	9	0.3	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	75	5	20	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	13.1
Dissolved Oxygen (mg/L)	9.6
Specific Conductance (µS/cm)	84
pH (s.u.)	6.7

Water Clarity	Clear, easily silted

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	14
Bottom Substrate (15)	4
Pool Variety (10)	6
Riffle Habitat (16)	7
Erosion (7)	6
Bank Vegetation (7)	7
Light Penetration (10)	9
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**68**

Site Photograph

Substrate Sand, gravel, some cobble

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/20/09	2009-40	24	52	Good
04/23/04	2004-22	17	48	Good

Most Abundant Species 2009 Bluehead Chub (23%), Fantail Darter 18%)

Exotic Species 2009 Bluegill, Redear Sunfish

Species Change Since Last Cycle

Gains -- Central Stoneroller (n=21), Rosyside Dace (n=4), Swallowtail Shiner (n=10), Creek Chub (n=10), V-lip Redhorse (n=15), Redear Sunfish (n=1), Largemouth Bass (n=2), Chainback Darter (n=1). **Losses** -- Green Sunfish (n=34).

Data Analysis

Watershed -- drains central Rockingham County; no municipalities in the watershed; tributary to the Dan River, site is ~ 0.6 miles above the creek's confluence with the river. **Habitats** -- sand and gravel bars, very shallow sandy runs, side pools, high quality banks and riparian zones, but stream still exhibits some substantial nonpoint source erosion impacts. **2009** -- 2.7 times more fish collected in 2009 than in 2004 (1149 vs. 417), primarily Fantail Darter and Bluehead Chub; most fish collected from any site in 2009; less dominance by the omnivorous Bluehead Chub resulted in a more balanced trophic structure and a slight increase in the NCIBI score; no lingering drought effects. **2004 & 2009** -- 25 species known from the site, including 5 species of darters and the endemic Roanoke Hogsucker [Significantly Rare]; dominant species is the Bluehead Chub.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
WOLF ISLAND CR	**SR 1767**	**05/20/09**	**NF20**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
ROCKINGHAM	3	03010103	36.48138889	-79.55861111	22-48	Northern Inner Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	43.2	510	10	0.4	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	75	25	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	16.5
Dissolved Oxygen (mg/L)	8.8
Specific Conductance (µS/cm)	103
pH (s.u.)	6.5
Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	3
Pool Variety (10)	10
Riffle Habitat (16)	7
Erosion (7)	1
Bank Vegetation (7)	6
Light Penetration (10)	5
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**63**

Site Photograph

Substrate Sand, gravel, silt

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/20/09	2009-41	28	56	Excellent
04/23/04	2004-23	21	50	Good

Most Abundant Species 2009 Bluehead Chub (25%), Crescent Shiner (18%)

Exotic Species 2009 Bluegill, Redear Sunfish

Species Change Since Last Cycle

Gains -- Rosyside Dace, Mountain Redbelly Dace, Blacktip Jumprock, Pumpkinseed, Redear Sunfish, Largemouth Bass, Black Crappie, Glassy Darter, Chainback Darter, Roanoke Darter. **Losses** -- Notchlip Redhorse, Green Sunfish, Smallmouth Bass. All species gained or lost were represented by 1-4 fish/species.

Data Analysis

Watershed -- drains the northeast corner of Rockingham County; headwaters begin northwest of the Town of Reidsville; tributary to the Dan River; one small NPDES facility in the headwaters (NC0078271, Q_w = 0.0084). **Habitats** -- large deadfalls and coarse woody debris, stick riffles, snag pools, wide riparian zones with mature trees; stream still exhibits substantial nonpoint source erosion with channel and riparian bank instabilities. **2009** -- ~4 times more fish collected in 2009 than in 2004 (719 *vs*. 177), primarily Bluehead Chub, Redlip Shiner, Crescent Shiner, and Bluegill; most diverse community of any site, including 6 species of suckers; increased abundance and species richness of darters and sunfish were largely responsible for the increase in NCIBI score and rating, no lingering drought effects. **2004 & 2009** -- very diverse community with 31 species known from the site, including 6 species of sucker, 5 species of darters, and the endemic Roanoke Hogsucker [Significantly Rare] and Blacktip Jumprock; dominant species is the Bluehead Chub.

Appendix 1-C

Ambient Monitoring Systems
Station Data Sheets
for the Upper Dan River Subbasin

Station ID	Waterbody	AU#	Location
N0150000	Dan River	22-(1)	AT NC 704 NEAR FRANCISCO
N1400000	Mayo River	22-30-(1)	AT SR 1358 NEAR PRICE
N2300000	Dan RIver	22-(31.5)	AT SR 2150 NEAR WENTWORTH
N2430000	Smith River	22-40-(1)	AT SR 1714 NEAR EDEN
N3000000	Dan River	22-(39)	AT SR 1761 NEAR MAYFIELD

Ambient Monitoring System Station Summaries
NCDENR, Division of Water Quality
Basinwide Assessment Report

Location: DAN RIV AT NC 704 NR FRANCISCO
Station #: N0150000 **Hydrologic Unit Code:** 03010103
Latitude: 36.51459 **Longitude:** -80.30282 **Stream class:** C Tr
Agency: NCAMBNT **NC stream index:** 22-(1)

Time period: 01/10/2005 to 01/04/2010

	# results	# ND	EL	Results not meeting EL #	%	%Conf	Percentiles Min	10th	25th	50th	75th	90th	Max
Field													
D.O. (mg/L)	57	0	<6	0	0		6.1	8.3	8.8	10.4	12.1	13.2	17.5
pH (SU)	58	0	<6	0	0		6.2	7	7.3	7.6	7.8	8.2	8.6
	58	0	>9	0	0		6.2	7	7.3	7.6	7.8	8.2	8.6
Spec. conductance (umhos/cm at 25°C)	56	0	N/A				30	47	49	51	55	59	71
Water Temperature (°C)	58	0	>32	0	0		1.2	4.5	8.8	14.5	21.9	24.1	27.5
Other													
TSS (mg/L)	20	9	N/A				2.5	2.5	3.2	6.2	7	12.9	15
Turbidity (NTU)	58	1	>10	13	22.4	99.9	1	1.5	2	3.8	8	25.5	450
Nutrients (mg/L)													
NH3 as N	58	52	N/A				0.02	0.02	0.02	0.02	0.02	0.02	0.31
NO2 + NO3 as N	58	1	N/A				0.02	0.16	0.27	0.36	0.41	0.5	0.55
TKN as N	58	33	N/A				0.2	0.2	0.2	0.2	0.23	0.45	3.4
Total Phosphorus	58	17	N/A				0.02	0.02	0.02	0.02	0.03	0.08	1
Metals (ug/L)													
Aluminum, total (Al)	10	0	N/A				62	63	80	115	315	702	730
Arsenic, total (As)	10	10	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	10	10	>0.4	0	0		1	1	1.8	2	2	2	2
Chromium, total (Cr)	10	10	>50	0	0		10	10	21	25	25	25	25
Copper, total (Cu)	10	9	>7	0	0		2	2	2	2	2	4	5
Iron, total (Fe)	10	0	>1000	0	0		150	151	168	245	500	959	990
Lead, total (Pb)	10	10	>25	0	0		10	10	10	10	10	10	10
Mercury, total (Hg)	8	8	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	10	10	>88	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	10	10	>50	0	0		10	10	10	10	10	10	10

Fecal Coliform Screening(#/100mL)

# results:	Geomean:	# > 400:	% > 400:	%Conf:
58	41.5	4	6.9	

Key:
result: number of observations
ND: number of observations reported to be below detection level (non-detect)
EL: Evaluation Level; applicable numeric or narrative water quality standard or action level
Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : States the percent statistical confidence that the actual percentage of exceedances is at least 10% (20% for Fecal Coliform)
Stations with less than 10 results for a given parameter were not evaluated for statistical confidence

Location: MAYO RIV AT SR 1358 NR PRICE

Station #: N1400000 **Hydrologic Unit Code:** 03010103

Latitude: 36.53514 **Longitude:** -79.99117 **Stream class:** WS-V

Agency: NCAMBNT **NC stream index:** 22-30-(1)

Time period: 01/10/2005 to 12/03/2009

	# results	# ND	EL	Results not meeting EL #	%	%Conf	Percentiles Min	10th	25th	50th	75th	90th	Max
Field													
D.O. (mg/L)	59	0	<4	0	0		6.5	7.8	8.8	10.5	12	13.1	17.2
	59	0	<5	0	0		6.5	7.8	8.8	10.5	12	13.1	17.2
pH (SU)	59	0	<6	0	0		6.7	7.2	7.4	7.6	7.9	8.1	8.3
	59	0	>9	0	0		6.7	7.2	7.4	7.6	7.9	8.1	8.3
Spec. conductance (umhos/cm at 25°C)	57	0	N/A				35	49	56	58	64	68	91
Water Temperature (°C)	59	0	>32	0	0		1.3	5.9	9.2	14.3	22.9	25.4	28.7
Other													
TSS (mg/L)	20	9	N/A				2.5	2.6	4.4	6.2	15.8	41.6	182
Turbidity (NTU)	59	0	>50	6	10.2	62.3	2	2.7	3.5	6.2	13	55	800
Metals (ug/L)													
Aluminum, total (Al)	9	0	N/A				120	120	140	180	1215	5400	5400
Arsenic, total (As)	9	9	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	9	9	>2	0	0		1	1	2	2	2	2	2
Chromium, total (Cr)	9	9	>50	0	0		10	10	25	25	25	25	25
Copper, total (Cu)	9	7	>7	1	11.1		2	2	2	2	2	17	17
Iron, total (Fe)	9	0	>1000	3	33.3		310	310	425	440	1750	12000	12000
Lead, total (Pb)	9	8	>25	0	0		10	10	10	10	10	15	15
Manganese, total (Mn)	9	0	>200	1	11.1		12	12	20	24	46	950	950
Mercury, total (Hg)	8	8	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	9	9	>25	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	9	7	>50	0	0		10	10	10	10	11	29	29

Fecal Coliform Screening(#/100mL)

# results:	Geomean:	# > 400:	% > 400:	%Conf:
58	100.3	9	15.5	

Key:
result: number of observations
ND: number of observations reported to be below detection level (non-detect)
EL: Evaluation Level; applicable numeric or narrative water quality standard or action level
Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : States the percent statistical confidence that the actual percentage of exceedances is at least 10% (20% for Fecal Coliform)
Stations with less than 10 results for a given parameter were not evaluated for statistical confidence

Ambient Monitoring System Station Summaries
NCDENR, Division of Water Quality
Basinwide Assessment Report

Location: DAN RIV AT SR 2150 NR WENTWORTH
Station #: N2300000 **Hydrologic Unit Code:** 03010103
Latitude: 36.41055 **Longitude:** -79.82693 **Stream class:** WS-IV
Agency: NCAMBNT **NC stream index:** 22-(31.5)

Time period: 01/10/2005 to 12/03/2009

	# results	# ND	EL	Results not meeting EL #	%	%Conf	Percentiles Min	10th	25th	50th	75th	90th	Max
Field													
D.O. (mg/L)	60	0	<4	0	0		6.3	7.2	7.8	9.6	11.4	13.3	14.7
	60	0	<5	0	0		6.3	7.2	7.8	9.6	11.4	13.3	14.7
pH (SU)	60	0	<6	0	0		6.6	7	7.2	7.4	7.5	7.7	8.2
	60	0	>9	0	0		6.6	7	7.2	7.4	7.5	7.7	8.2
Spec. conductance (umhos/cm at 25°C)	58	0	N/A				37	58	64	71	84	140	158
Water Temperature (°C)	60	0	>32	0	0		1.4	5.4	8.8	17	23.8	25.8	28.8
Other													
TSS (mg/L)	19	6	N/A				2.5	3	6.2	10	23	150	201
Turbidity (NTU)	61	0	>50	9	14.8	92	1.6	3.3	4	7.1	15.5	118	550
Nutrients (mg/L)													
NH3 as N	61	47	N/A				0.02	0.02	0.02	0.02	0.02	0.03	0.04
NO2 + NO3 as N	61	0	>10	0	0		0.02	0.05	0.12	0.18	0.24	0.3	0.34
TKN as N	61	26	N/A				0.2	0.2	0.2	0.23	0.31	0.89	2.2
Total Phosphorus	61	1	N/A				0.02	0.02	0.03	0.03	0.05	0.22	0.83
Metals (ug/L)													
Aluminum, total (Al)	9	0	N/A				110	110	175	320	700	6600	6600
Arsenic, total (As)	9	9	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	9	9	>2	0	0		1	1	2	2	2	2	2
Chromium, total (Cr)	9	9	>50	0	0		10	10	25	25	25	25	25
Copper, total (Cu)	9	8	>7	0	0		2	2	2	2	2	3	3
Iron, total (Fe)	9	0	>1000	2	22.2		390	390	535	700	1125	5000	5000
Lead, total (Pb)	9	9	>25	0	0		10	10	10	10	10	10	10
Manganese, total (Mn)	9	0	>200	0	0		21	21	27	32	54	90	90
Mercury, total (Hg)	8	8	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	9	9	>25	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	9	7	>50	0	0		10	10	10	10	12	25	25

Fecal Coliform Screening(#/100mL)

# results:	Geomean:	# > 400:	% > 400:	%Conf:
61	101.6	10	16.4	

Key:
result: number of observations
ND: number of observations reported to be below detection level (non-detect)
EL: Evaluation Level; applicable numeric or narrative water quality standard or action level
Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : States the percent statistical confidence that the actual percentage of exceedances is at least 10% (20% for Fecal Coliform)
Stations with less than 10 results for a given parameter were not evaluated for statistical confidence

Ambient Monitoring System Station Summaries
NCDENR, Division of Water Quality
Basinwide Assessment Report

Location: SMITH RIV AT SR 1714 NR EDEN
Station #: N2430000 **Hydrologic Unit Code:** 03010103
Latitude: 36.52087 **Longitude:** -79.75281 **Stream class:** WS-IV
Agency: NCAMBNT **NC stream index:** 22-40-(1)

Time period: 01/10/2005 to 12/03/2009

	# results	# ND	EL	Results not meeting EL #	%	%Conf	Percentiles Min	10th	25th	50th	75th	90th	Max
Field													
D.O. (mg/L)	60	0	<4	0	0		7.1	8	8.6	10.3	11.4	13.2	14.8
	60	0	<5	0	0		7.1	8	8.6	10.3	11.4	13.2	14.8
pH (SU)	60	0	<6	0	0		6.4	7.1	7.3	7.5	7.7	8	8.6
	60	0	>9	0	0		6.4	7.1	7.3	7.5	7.7	8	8.6
Spec. conductance (umhos/cm at 25°C)	58	0	N/A				35	59	74	82	90	96	107
Water Temperature (°C)	60	0	>32	0	0		1.6	6.1	8.8	16	20.7	23.6	26
Other													
TSS (mg/L)	19	4	N/A				2.8	3.2	6.2	8.2	33	152	470
Turbidity (NTU)	60	0	>50	7	11.7	75.2	1.8	2.4	3.2	5.5	14	64	360
Metals (ug/L)													
Aluminum, total (Al)	9	0	N/A				84	84	125	210	720	8200	8200
Arsenic, total (As)	9	9	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	9	9	>2	0	0		1	1	2	2	2	2	2
Chromium, total (Cr)	9	9	>50	0	0		10	10	25	25	25	25	25
Copper, total (Cu)	9	6	>7	1	11.1		2	2	2	2	5	14	14
Iron, total (Fe)	9	0	>1000	2	22.2		360	360	410	490	1010	7600	7600
Lead, total (Pb)	9	9	>25	0	0		10	10	10	10	10	10	10
Manganese, total (Mn)	9	0	>200	1	11.1		26	26	30	36	56	240	240
Mercury, total (Hg)	8	8	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	9	9	>25	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	9	5	>50	0	0		10	10	10	10	16	28	28

Fecal Coliform Screening(#/100mL)

# results:	Geomean:	# > 400:	% > 400:	%Conf:
60	92.9	11	18.3	

Key:
result: number of observations
ND: number of observations reported to be below detection level (non-detect)
EL: Evaluation Level; applicable numeric or narrative water quality standard or action level
Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : States the percent statistical confidence that the actual percentage of exceedances is at least 10% (20% for Fecal Coliform)
Stations with less than 10 results for a given parameter were not evaluated for statistical confidence

Ambient Monitoring System Station Summaries
NCDENR, Division of Water Quality
Basinwide Assessment Report

Location: DAN RIV AT SR 1761 NR MAYFIELD
Station #: N3000000 **Hydrologic Unit Code:** 03010103
Latitude: 36.54142 **Longitude:** -79.60525 **Stream class:** C
Agency: NCAMBNT **NC stream index:** 22-(39)

Time period: 01/10/2005 to 12/03/2009

	# results	# ND	EL	Results not meeting EL #	%	%Conf	Percentiles Min	10th	25th	50th	75th	90th	Max
Field													
D.O. (mg/L)	59	0	<4	0	0		6	7.1	7.7	9.6	11.4	12.9	14
	59	0	<5	0	0		6	7.1	7.7	9.6	11.4	12.9	14
pH (SU)	59	0	<6	0	0		6.2	7.1	7.3	7.5	7.7	7.9	8.1
	59	0	>9	0	0		6.2	7.1	7.3	7.5	7.7	7.9	8.1
Spec. conductance (umhos/cm at 25°C)	58	0	N/A				45	71	91	114	141	187	225
Water Temperature (°C)	59	0	>32	0	0		5.4	7.4	10.2	17.6	23.8	27.9	30
Other													
TSS (mg/L)	20	2	N/A				4	4.1	8	10.2	27.2	62.4	322
Turbidity (NTU)	59	0	>50	11	18.6	98.7	2	3.1	4.7	7.4	25	160	260
Metals (ug/L)													
Aluminum, total (Al)	10	0	N/A				140	142	220	430	1035	2040	2100
Arsenic, total (As)	10	10	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	10	10	>2	0	0		1	1	1.8	2	2	2	2
Chromium, total (Cr)	10	10	>50	0	0		10	10	21	25	25	25	25
Copper, total (Cu)	10	5	>7	0	0		2	2	2	2	4	5	6
Iron, total (Fe)	10	0	>1000	4	40	99.8	470	472	565	880	1875	3000	3100
Lead, total (Pb)	10	10	>25	0	0		10	10	10	10	10	10	10
Mercury, total (Hg)	8	8	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	10	10	>88	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	10	7	>50	0	0		10	10	10	10	12	13	13

Fecal Coliform Screening(#/100mL)

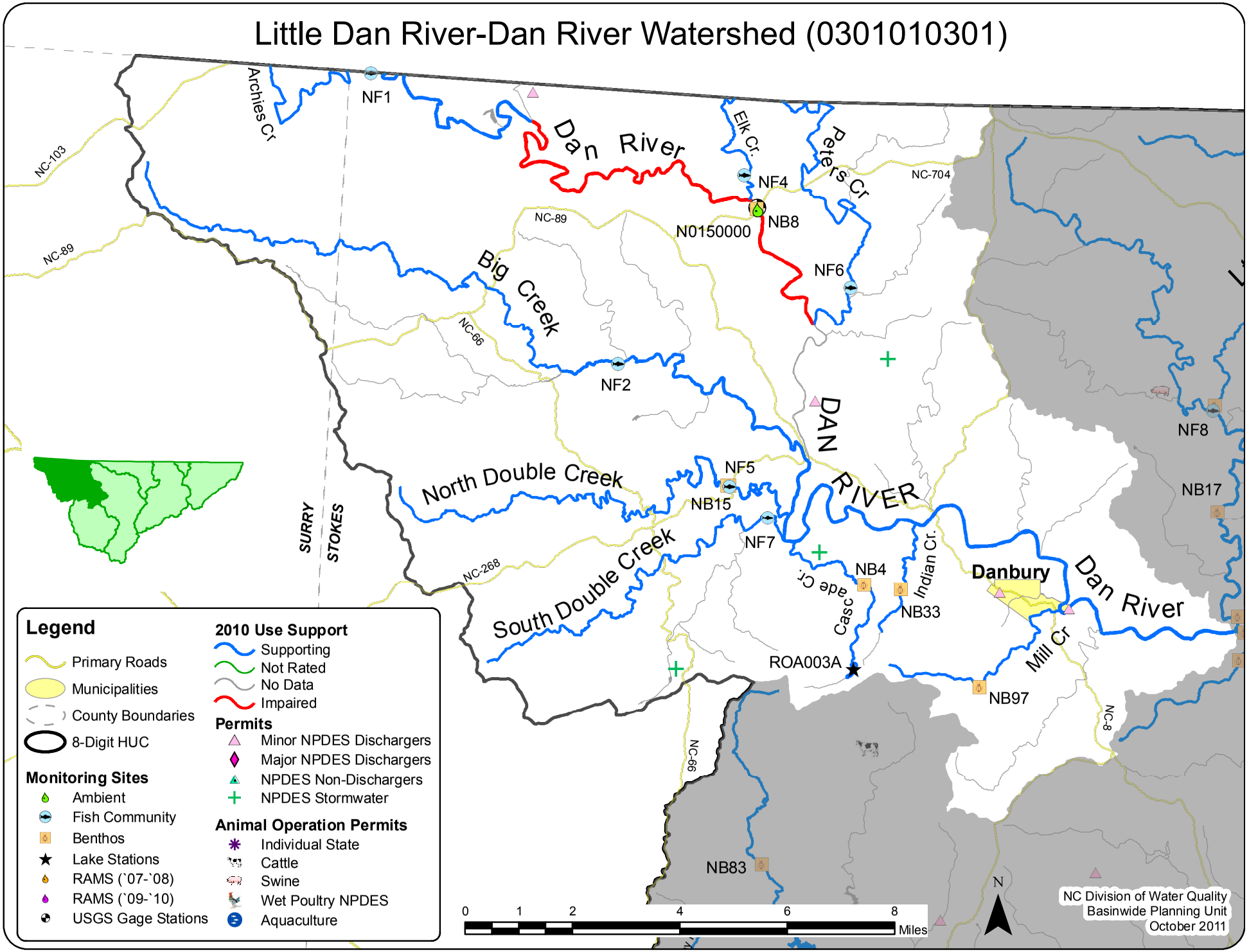
# results:	Geomean:	# > 400:	% > 400:	%Conf:
59	86.6	11	18.6	

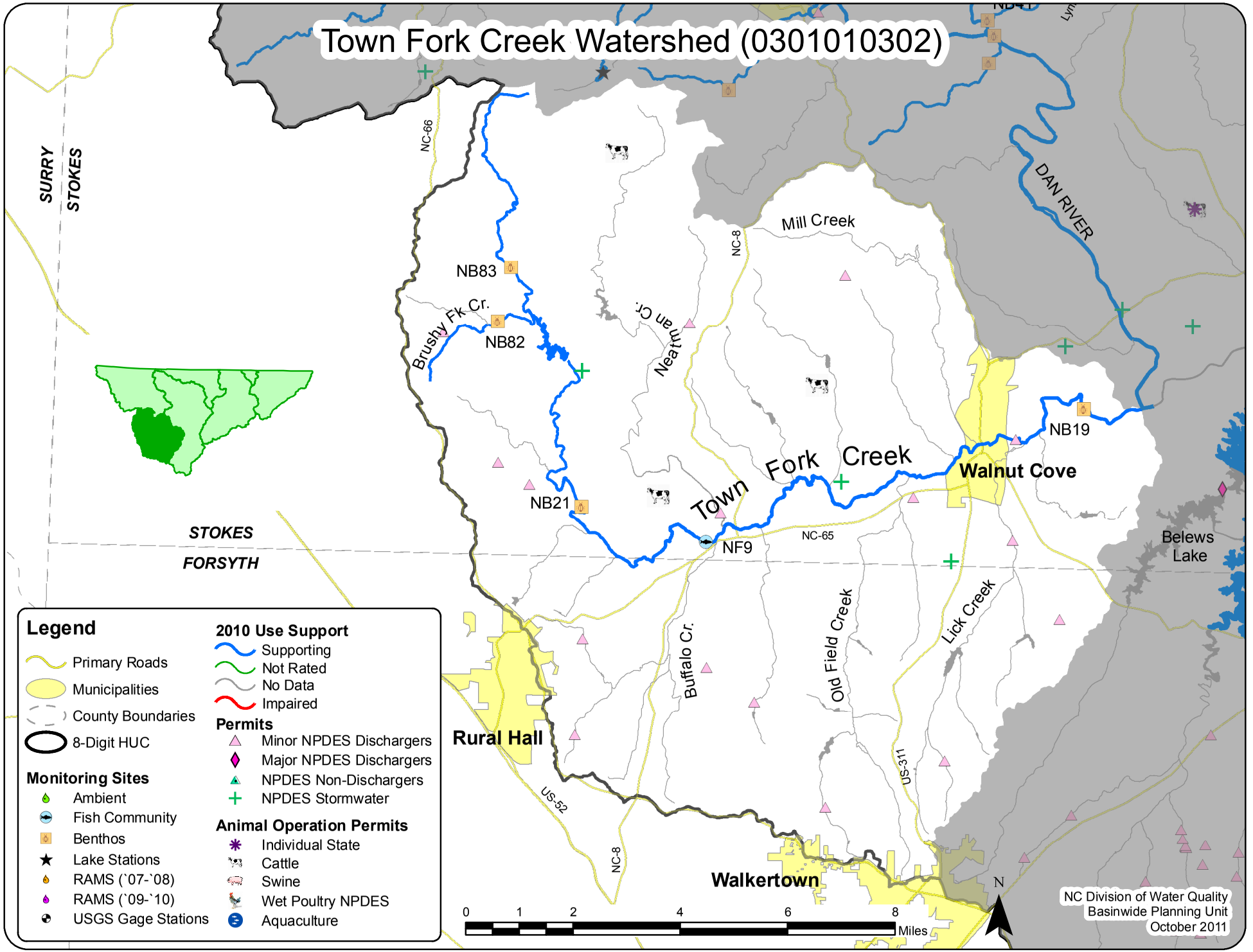
Key:
result: number of observations
ND: number of observations reported to be below detection level (non-detect)
EL: Evaluation Level; applicable numeric or narrative water quality standard or action level
Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : States the percent statistical confidence that the actual percentage of exceedances is at least 10% (20% for Fecal Coliform)
Stations with less than 10 results for a given parameter were not evaluated for statistical confidence

Appendix 1-D

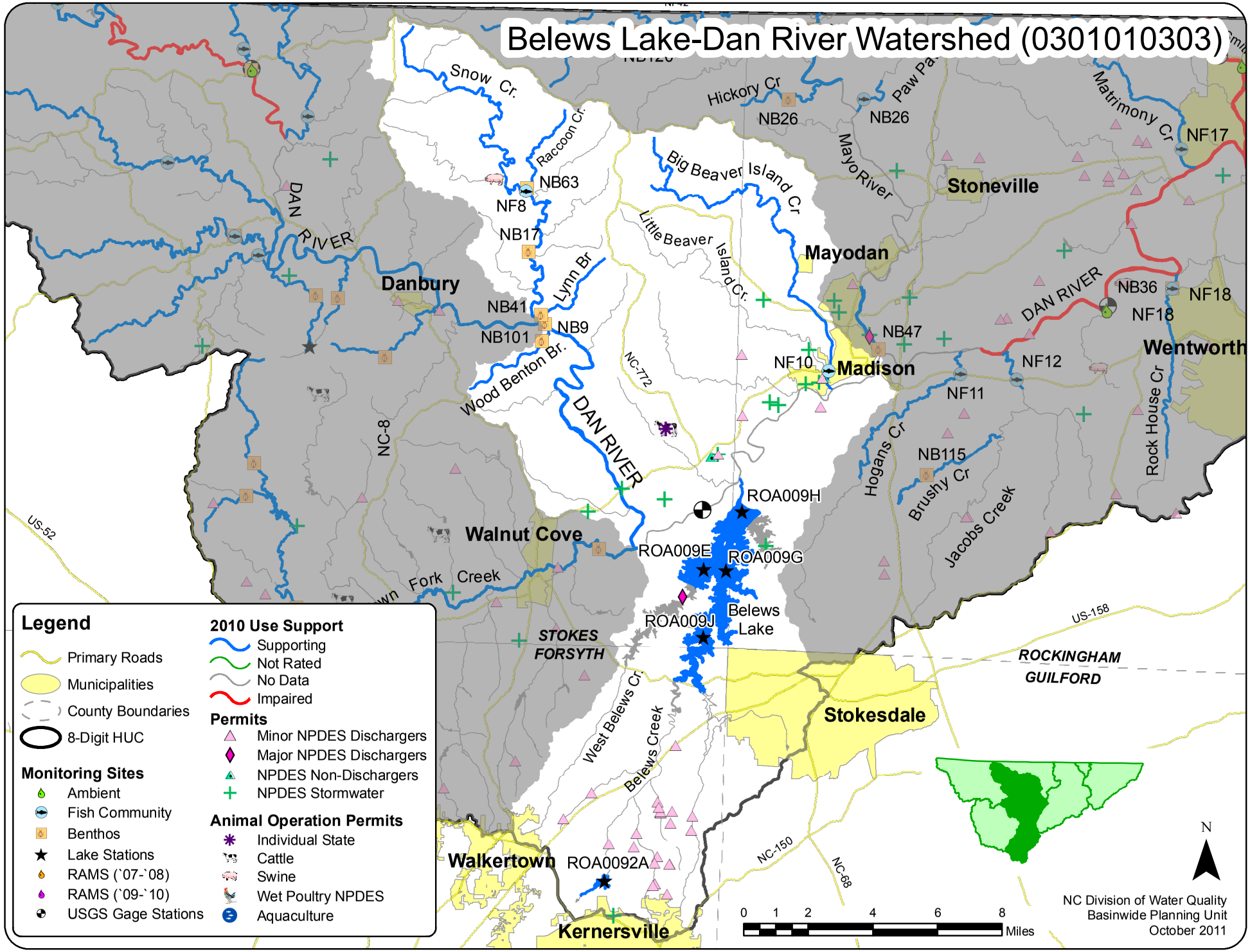
10-Digit Watershed Maps for the Upper Dan River Subbasin

Little Dan River-Dan River Watershed (0301010301)

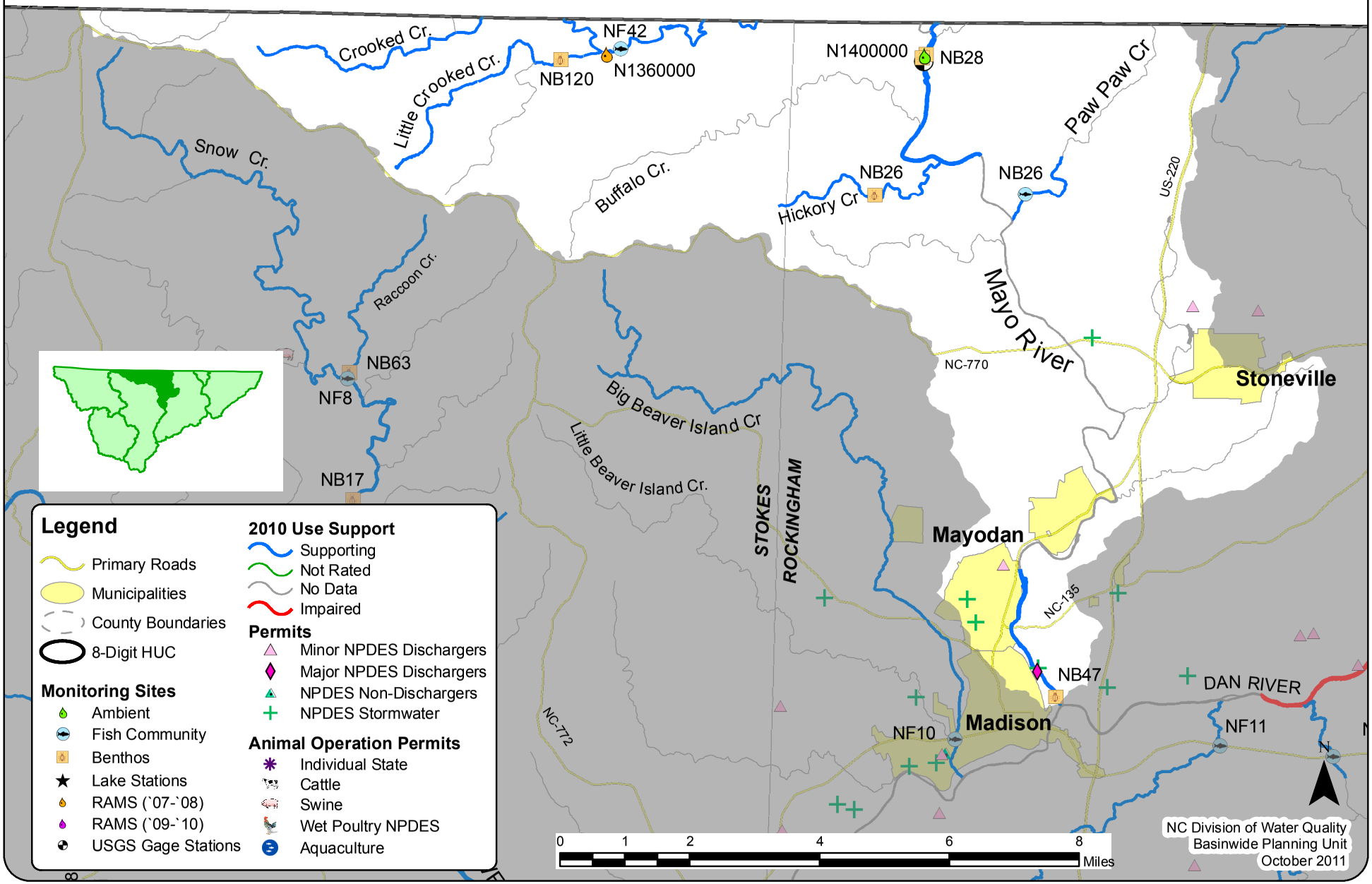



Town Fork Creek Watershed (0301010302)
SURRY
STOKES
STOKES
FORSYTH
NC-66
NB83
Brushy Fk Cr.
NB82
Neatman Cr.
NC-8
Mill Creek
DAN RIVER
NB19
Walnut Cove
Town Fork Creek
NB21
NF9
NC-65
Belews Lake
Buffalo Cr.
Old Field Creek
Lick Creek
US-311
Rural Hall
US-52
NC-8
Walkertown
N
0 1 2 4 6 8
Miles
NC Division of Water Quality
Basinwide Planning Unit
October 2011
Legend
Primary Roads
Municipalities
County Boundaries
8-Digit HUC
Monitoring Sites
Ambient
Fish Community
Benthos
Lake Stations
RAMS (`07-`08)
RAMS (`09-`10)
USGS Gage Stations
2010 Use Support
Supporting
Not Rated
No Data
Impaired
Permits
Minor NPDES Dischargers
Major NPDES Dischargers
NPDES Non-Dischargers
NPDES Stormwater
Animal Operation Permits
Individual State
Cattle
Swine
Wet Poultry NPDES
Aquaculture

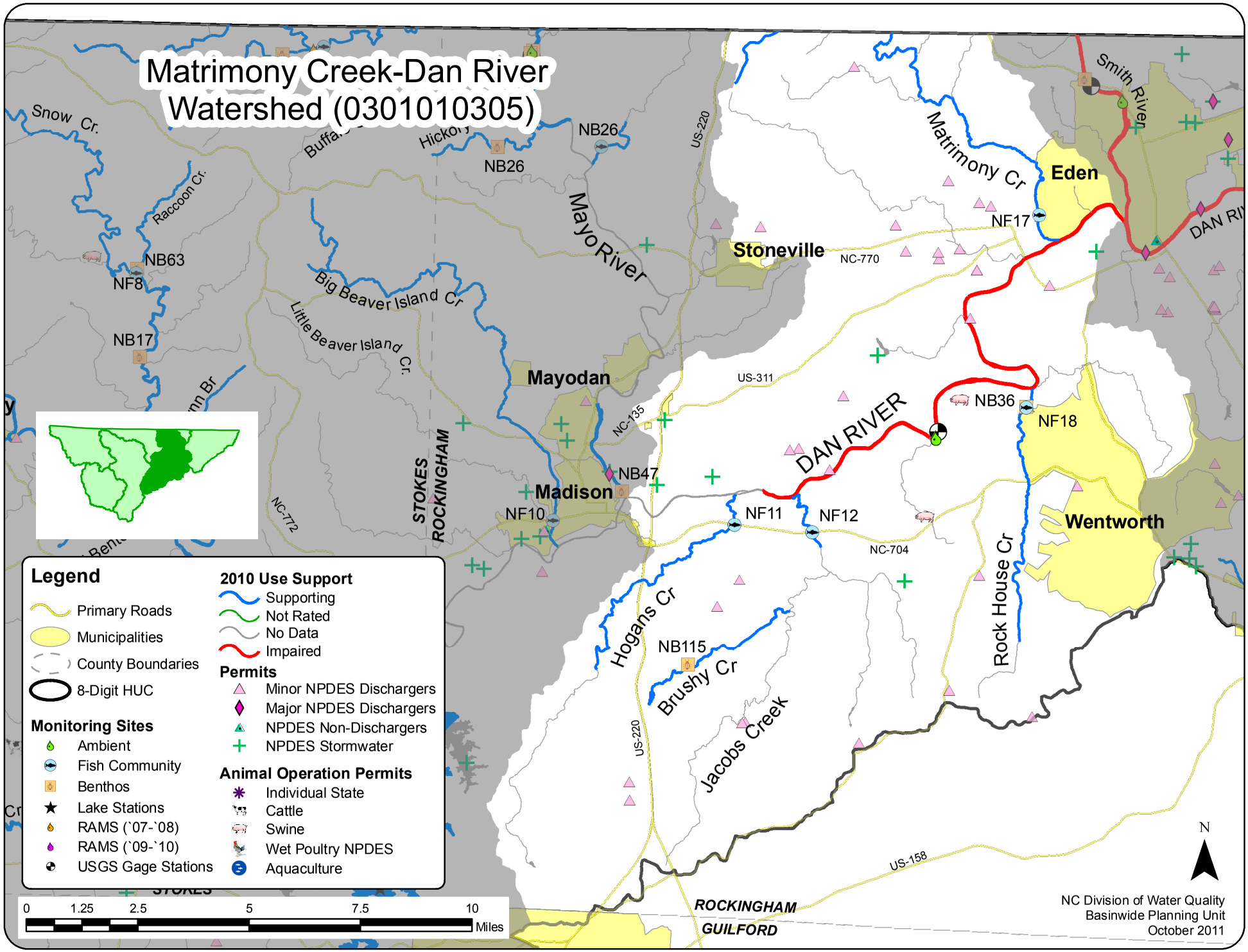
1-D.4


Belews Lake-Dan River Watershed (0301010303)
Snow Cr.
Raccoon Cr.
Hickory Cr
NB26
NB26
Paw Pa
Matrimony Cr
NF17
Big Beaver Island Cr
Mayo River
Stoneville
NB63
NF8
NB17
Little Beaver Island Cr.
Mayodan
DAN RIVER
Lynn Br
Danbury
NB41
NB9
NB101
Wood Benton Br.
NC-772
NF10
Madison
NB47
DAN RIVER
NB36
NF18
NF18
Wentworth
NF12
NF11
Rock House Cr
Hogans Cr
NB115
Brushy Cr
Jacobs Creek
NC-8
DAN RIVER
ROA009H
US-52
Walnut Cove
ROA009E
ROA009G
Fork Creek
ROA009J
Belews Lake
US-158
STOKES
FORSYTH
ROCKINGHAM
GUILFORD
Stokesdale
West Belews Cr
Belews Creek
Walkertown
ROA0092A
NC-150
NC-68
Kernersville
Legend
Primary Roads
Municipalities
County Boundaries
8-Digit HUC
Monitoring Sites
Ambient
Fish Community
Benthos
Lake Stations
RAMS (`07-`08)
RAMS (`09-`10)
USGS Gage Stations
2010 Use Support
Supporting
Not Rated
No Data
Impaired
Permits
Minor NPDES Dischargers
Major NPDES Dischargers
NPDES Non-Dischargers
NPDES Stormwater
Animal Operation Permits
Individual State
Cattle
Swine
Wet Poultry NPDES
Aquaculture
N
0 1 2 4 6 8
Miles
NC Division of Water Quality
Basinwide Planning Unit
October 2011

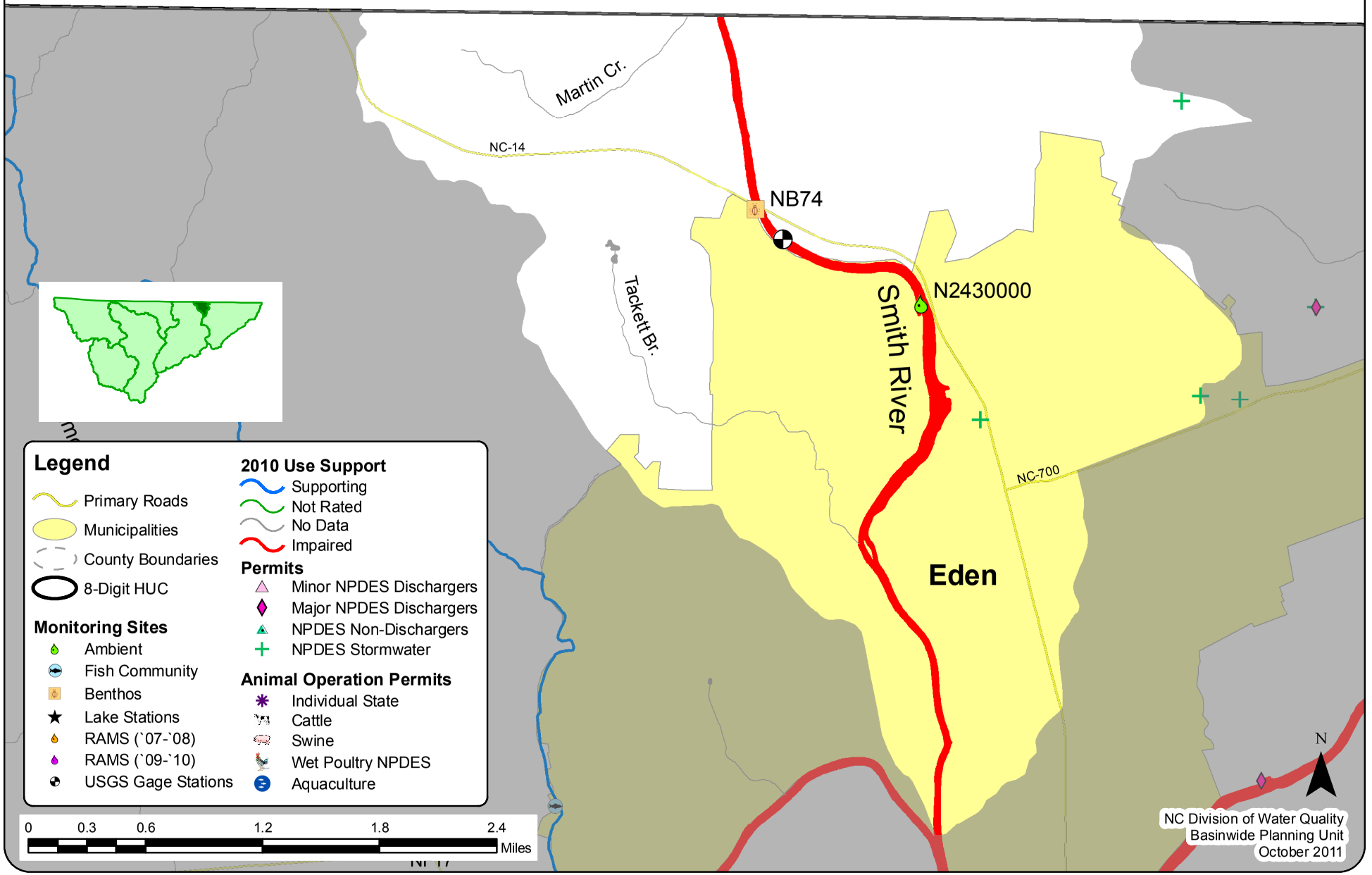
Mayo River Watershed (0301010304)



1-D.6

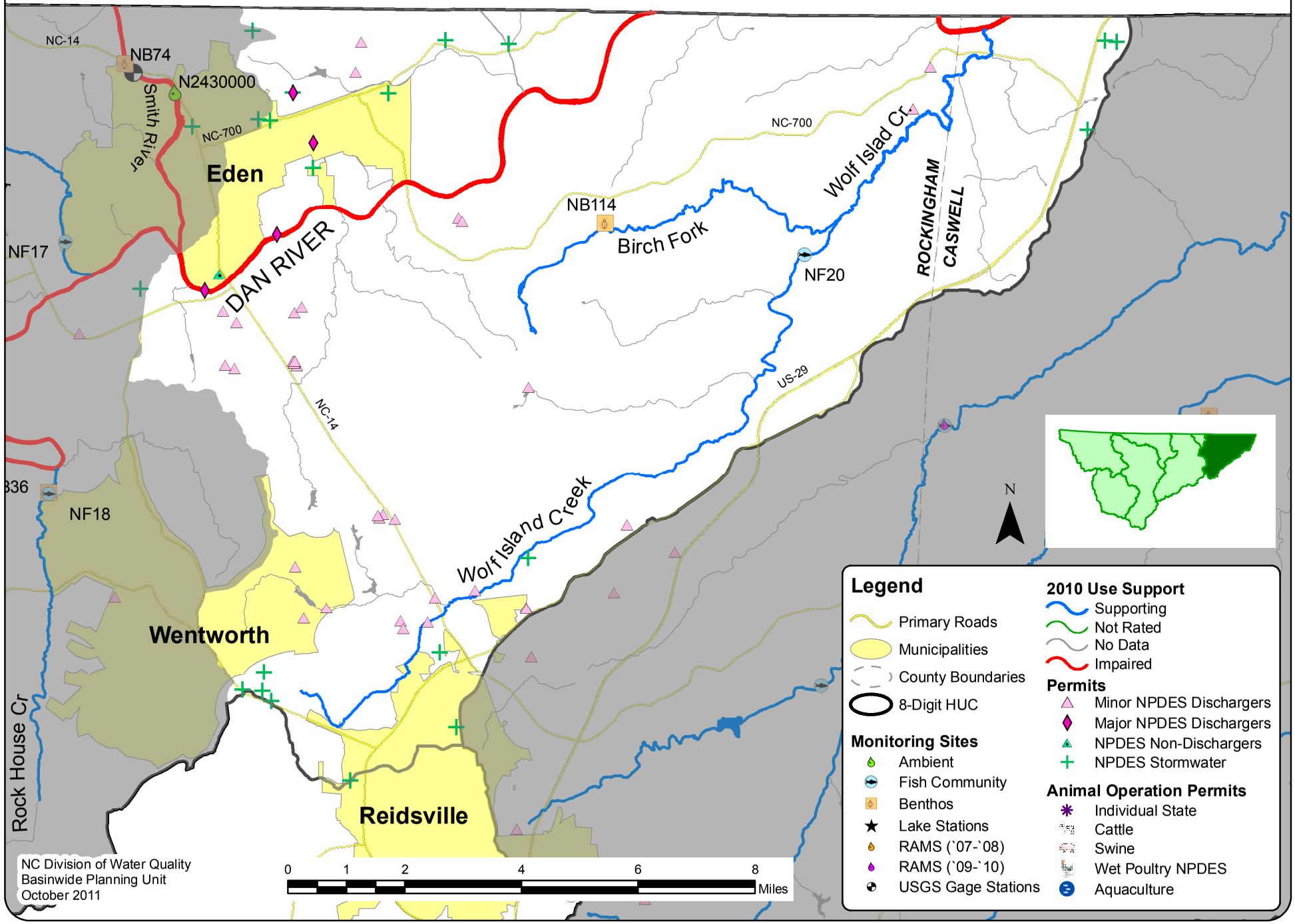

Matrimony Creek-Dan River Watershed (0301010305)
Snow Cr.
Raccoon Cr.
NB63
NF8
NB17
Big Beaver Island Cr
Little Beaver Island Cr.
NB26
NB26
Mayo River
US-220
Matrimony Cr
Smith River
Eden
NF17
Stoneville
NC-770
DAN RIVER
NB36
NF18
US-311
Mayodan
NC-135
NB47
Madison
NF10
STOKES
ROCKINGHAM
NC-772
NF11
NF12
NC-704
Wentworth
Rock House Cr
Hogans Cr
NB115
Brushy Cr
Jacobs Creek
US-220
US-158
ROCKINGHAM
GUILFORD
Legend
Primary Roads
Municipalities
County Boundaries
8-Digit HUC
Monitoring Sites
Ambient
Fish Community
Benthos
Lake Stations
RAMS (`07-`08)
RAMS (`09-`10)
USGS Gage Stations
2010 Use Support
Supporting
Not Rated
No Data
Impaired
Permits
Minor NPDES Dischargers
Major NPDES Dischargers
NPDES Non-Dischargers
NPDES Stormwater
Animal Operation Permits
Individual State
Cattle
Swine
Wet Poultry NPDES
Aquaculture
0 1.25 2.5 5 7.5 10
Miles
N
NC Division of Water Quality
Basinwide Planning Unit
October 2011

Lower Smith River Watershed (0301010308)



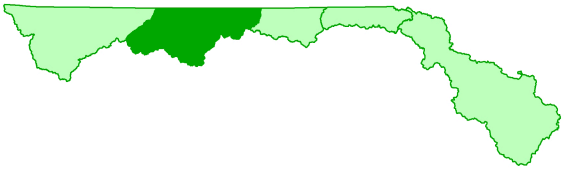
1-D.8

Cascade Creek-Dan River Watershed (0301010309)



CHAPTER 2

Lower Dan River Subbasin



HUC 03010104

Includes: Dan River, Country Line Creek, Lake Roxboro, Hyco River, Hyco Lake, Marlowe Creek, Mayo Reservoir & Aarons Creek

Subbasin Water Quality Overview

The Lower Dan River Subbasin is the second western most subbasin and runs along the North Carolina/Virginia state line. The subbasin contains two Impaired streams: Dan River is Impaired for fecal coliform bacteria and turbidity; and Marlowe Creek is Impaired for biological integrity as well as zinc in the downstream segment.

During this assessment cycle (2004-2009), the subbasin experienced a moderate drought in 2005 and 2006 as well as a prolonged drought between 2007 and 2008. Monitoring the biological community during this time showed a small percent improved. There were no major ambient monitoring violations; however, there were a few elevated levels for turbidity and fecal coliform bacteria.

Subbasin at a Glance

Counties:

Rockingham, Caswell, Person, & Granville

Municipalities:

Reidsville, Yanceyville, Milton, & Roxboro

Ecoregions:

Northern Inner Piedmont, Southern Outer Piedmont, & Northern Outer Piedmont

Permitted Facilities:

NPDES Dischargers: 67
- Major 3
- Minor 8
- General 56

NPDES Non-Dischargers:.....26
Stormwater: 12
- General 11
- Individual 1

Animal Operations: 11

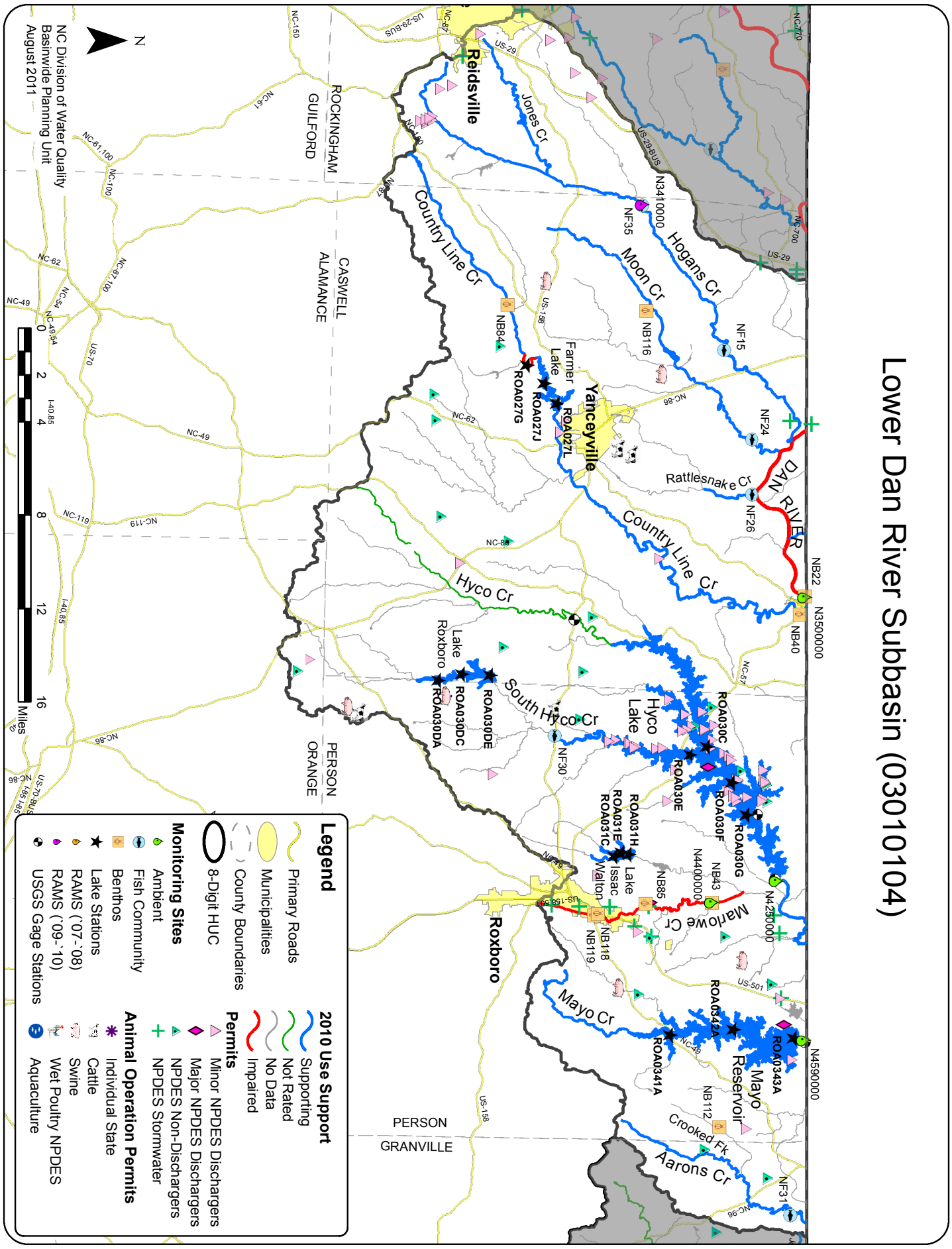
Population:

2010 Census.....50,017

2006 Land Cover:

Open Water.....2.2%
Developed.....4.7%
Forest 61.8%
Agriculture.....19.5%
Wetlands.....1.3%
Barren Land.....0.2%
Shrub/Grassland.....10.3%

FIGURE 2-1: LOWER DAN RIVER SUBBASIN (03010104)



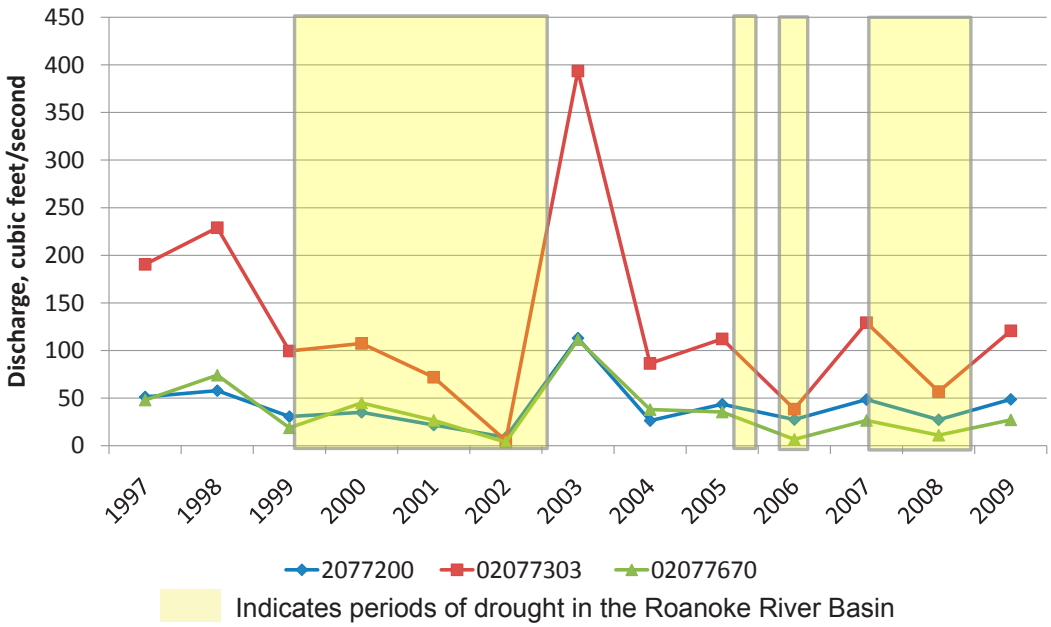
Water Quality Data Summary for this Subbasin

Monitoring stream flow, aquatic biology and chemical/physical parameters is a large part of the basinwide planning process. More detailed information about DWQ monitoring and the effects each parameter has on water quality is discussed in Chapters 2 and 3 of the Supplemental Guide to North Carolina's Basinwide Planning document.

Stream Flow

The basin experienced prolonged droughts from 1998-2002 and again from 2007-2008, with moderate droughts in 2005 and 2006 (Figure 2-2). More detail about flows in the Roanoke River Basin can be found in the 2010 Roanoke River Basinwide Assessment Report produced by DWQ-Environmental Science Section.

Figure 2-2: Yearly Flow Rates (cfs) of the USGS Gage Stations in the Lower Dan River Subbasin Between 1997 & 2009



From Left to Right:

- 2077200: Hyco Creek (Leasburg)
- 2077303: Hyco River (McGehees)
- 2077670: Mayo Creek (Bethel Hill)

Biological Data

Biological samples were collected during the spring and summer months of 2009 by the DWQ-Environmental Sciences Section as part of the five year basinwide sampling cycle, in addition to special studies. Overall, 12 biological sampling sites were monitored within the Lower Dan River Subbasin. The ratings for each of the sampling stations can be seen in Appendix 2-B.

Benthic Macroinvertebrate Sampling

Each benthic station monitored during the current cycle is shown in Figure 2-3 and color coded based on the current rating. Each of the sites are discussed in more detail in the watershed section below. Figure 2-5 is a comparison of benthic site ratings sampled during the last two basinwide cycles to indicate if there are any overall shifts in ratings. Of the two existing sites, one declined and one improved.

Benthic Sampling Summary

Total Stations Monitored	6
Total Samples Taken	6
Number of New Stations	4

Figure 2-3: Benthic Stations Color Coded by Current Rating in the Lower Dan River Subbasin

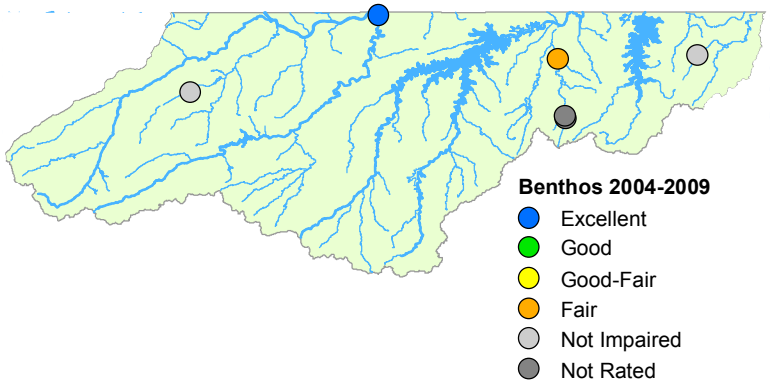


Figure 2-4: Current Benthic Site Ratings

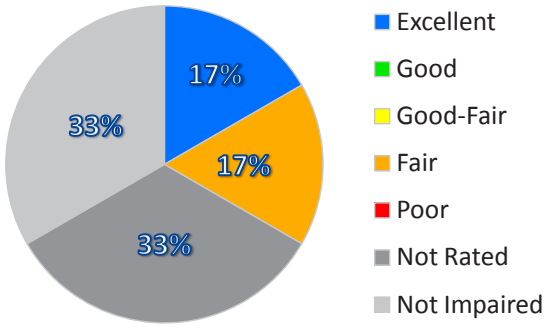
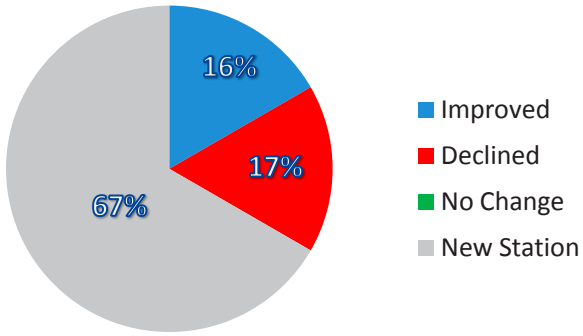


Figure 2-5: Change in Benthic Site Ratings



Fish Community Sampling

Each fish community station monitored during the current cycle is shown in Figure 2-6 and color coded based on the current rating. Each of the sites are discussed in more detail in the watershed section below. Figure 2-7 shows the percentages of each rating given during this sampling cycle within this subbasin. Figure 2-8 is a comparison of fish community site ratings sampled during the last two cycles to determine if there are any overall watershed shifts in ratings. Overall, the community is relatively stable.

Fish Com. Sampling Summary

Total Stations Monitored	6
Total Samples Taken	7
Number of New Stations	1

Figure 2-6: Fish Community Stations Color Coded by Current Rating in the Lower Dan River Subbasin

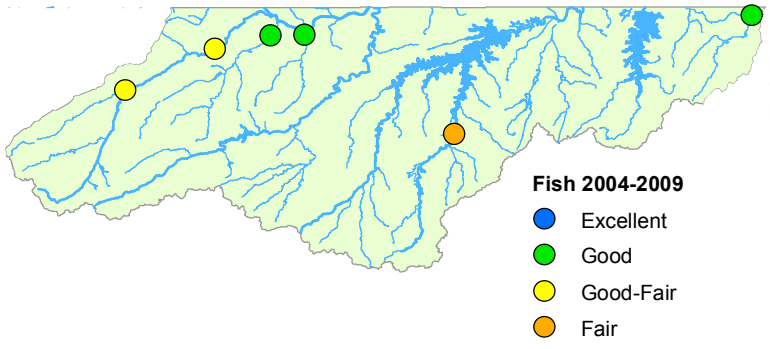


Figure 2-7: Current Fish Comm Site Ratings

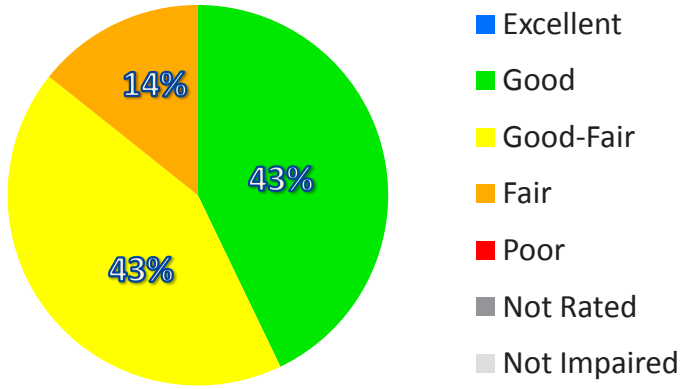
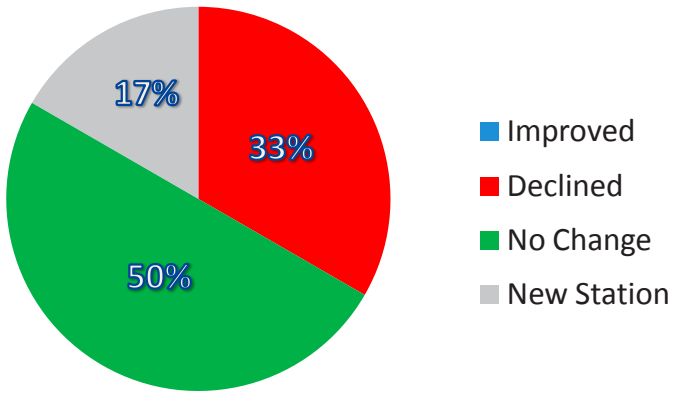


Figure 2-8: Change in Fish Comm Site Ratings



For more information about biological data in this subbasin, see the **2010 Roanoke River Basinwide Assessment Report**. Detailed data sheets for each sampling site can be found in **Appendix 2-B**.

Fish Kills/Spill Events

Mayo Creek:

A site visit, conducted on 30 March 2004 by DWQ staff, resulted in the observation of approximately 60 dead common carp in various stages of decay within 500 meters of the reservoir spillway. There were also approximately 200 live carp congregating in the shallow areas and around spillway. Approximately 50% of the live carp had sores on top of their head and body. Many carp were very lethargic and unresponsive, as was a bluehead chub. Live carp were in spawning condition, but no spawning activity was observed. Four specimens were sent to Warm Springs Fish Health Center, Georgia, for analysis. There are no known causes.

Bowes Branch:

The La. Pacific Corporation plant near Roxboro experienced a serious fire within the production facility. A subsequent fish kill occurred in the company's fire pond. During the fire, large quantities of water were pulled from the pond to spray on the fire. Runoff was at times about 3 to 4 inches deep running from the building to the stormwater system, thereby returning to the pond. The fire began at 2:41 AM on June 13, 2006, and the use of water ended about 4:30 PM. Production units that burned included mixers in which the chemicals methyl diisocyanate, paraformaldehyde, and paraffin wax were being applied to wood. Some undetermined quantity of these materials returned to the pond with the recycling firewater. There was heavy rain from the remnants of tropical depression Alberto most of the day of June 14, as well. Dead fish were observed and reported at about 7:35 AM on June 15. The pond was also observed at that time to have a reddish material floating along one edge where the wind had moved it. A total of 290 fish were observed killed the first day: 113 bass, 50 carp, and 127 sunfish. None was observed to be diseased, malformed, or otherwise abnormal. The next day, another 50 were gathered, 20 bass and 30 sunfish. About half were "fresh" enough to have expired overnight.

Ambient Data

The ambient data are used to develop use support ratings every two years, which are then reported to the EPA via the Integrated Report (IR). The IR is a collection of all monitored waterbodies in North Carolina and their water quality ratings. The most current IR is the 2010 version and is based on data collected between 2004 and 2008. The ambient data reported in this basin plan were collected between 2005 and 2009 and will be used for the 2012 IR. If a waterbody receives an Impaired rating, it is then placed on the 303(d) Impaired Waters List. The Roanoke River Basin portion of the 2010 IR can be found in **Appendix 2-A** and the full 2010 IR can be found on the **Modeling & TMDL Unit's** website.

Four Ambient Monitoring System (AMS) stations are located in the Lower Dan River subbasin (see Figure 2-1 for the station locations). During the current sampling cycle (January 2005 and December 2009), samples were collected for all parameters on a monthly basis except metals which were sampled quarterly until May

2007 when metals sampling was suspended. For more information about the ambient monitoring, parameters, how data are used for use support assessment and other information, see Chapter 2 of the Supplemental Guide to North Carolina's Basinwide Planning.

Long Term Ambient Monitoring

The following discussion of ambient monitoring parameters of concern include graphs showing the median and mean concentration values for each ambient station in this subbasin by specific parameter over a 13 year period (1997-2009). The geometric mean is a type of mean or average, which indicates the central tendency or typical value of a set of numbers. The graphs are not intended to provide statistically significant trend information, but rather an idea of how changes in land use or climate conditions can affect parameter readings over the long term. The difference between median and mean results indicate the presence of outliers in the data set. Box and whisker plots of individual ambient stations were completed by parameter for data between 2005 and 2009 by DWQ's Environmental Sciences Section (ESS) and can be found in the Roanoke River Basin Ambient Monitoring System Report.

pH

Figure 2-10 shows the mean and median pH levels for all samples taken over the course of 13 years in the Lower Dan River Subbasin. Station N4250000 had two percent of samples exceeding the low pH standard of 6.0 as shown by the yellow dot in Figure 2-9. The pH levels in this subbasin remain mostly stable throughout this time frame.

Figure 2-9: Percentage of Samples Exceeding the pH Standards (2005-2009)

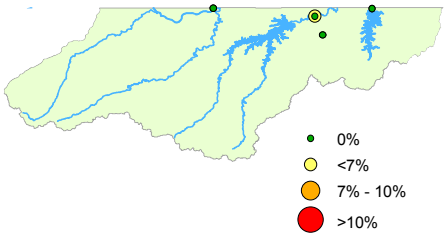
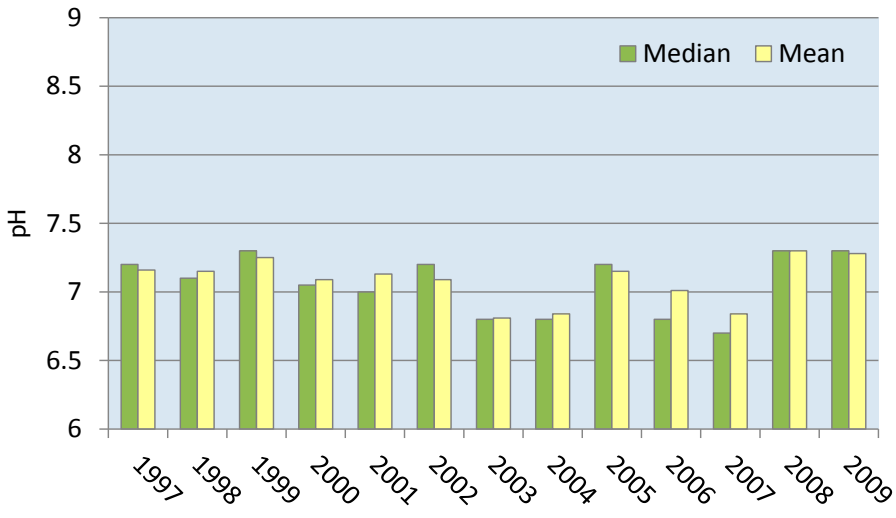


Figure 2-10: Summarized pH Values for All Data Collected at Ambient Sampling Stations in HUC 03010104



* NC pH Standard: Between 6.0 and 9.0 su

Turbidity

Two of the four AMS stations in the Lower Dan River subbasin exceeded the state's turbidity standard in 5 to 16 percent of samples, as seen in Figure 2-11 indicated by yellow and red dots. Possible sources of the elevated turbidity levels are discussed in the 10-digit watershed section. Figure 2-12 shows the mean and median turbidity levels for all samples taken over the course of 13 years in the Lower Dan River subbasin. The yearly averages are well below the state standard of 50 NTUs.

While some erosion is a natural phenomenon, human land use practices may accelerate the process to unhealthy levels for aquatic life. Construction sites, mining operations, agricultural operations, logging operations and excessive stormwater flow off impervious surfaces are all potential sources. Turbidity exceedances demonstrate the importance of protecting and conserving stream buffers and natural areas.

Figure 2-11: Percentage of Samples Exceeding the Turbidity Standard (2005-2009)

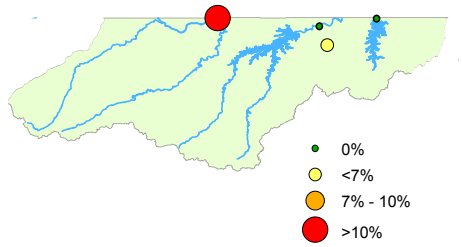
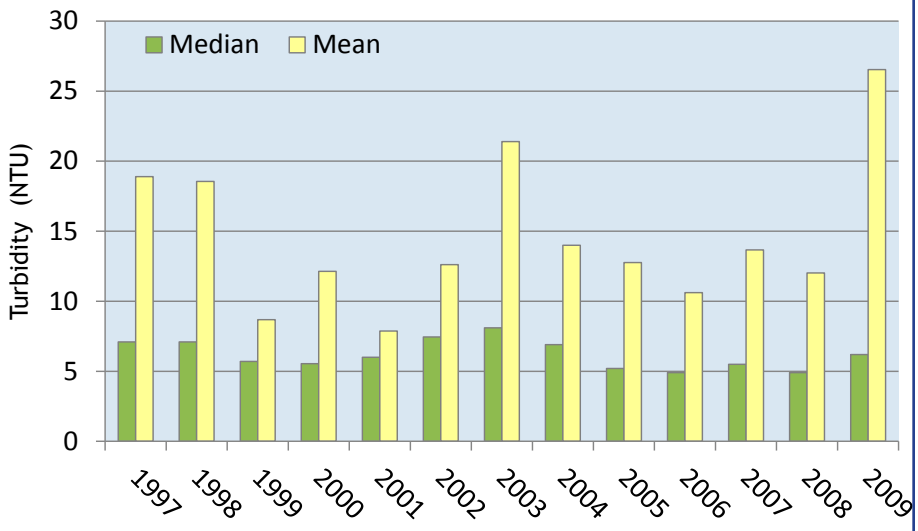


Figure 2-12: Summarized Turbidity Values for All Data Collected at Ambient Sampling Stations in HUC 03010104



* NC Turbidity Standard: 50 NUT

Dissolved Oxygen (DO)

As seen in Figure 2-13, none of the four sites recorded DO standard exceedance during this monitoring cycle. Figure 2-14 shows the mean and median of DO levels for all samples taken over the course of 13 years in the Lower Dan River subbasin. These averages are well within the normal DO range.

Figure 2-13: Percentage of Samples Exceeding the DO Standard (2005-2009)

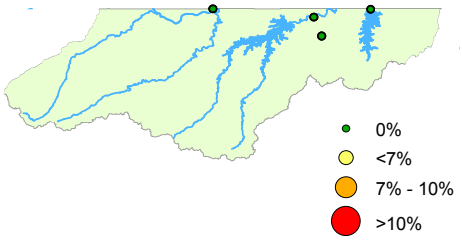
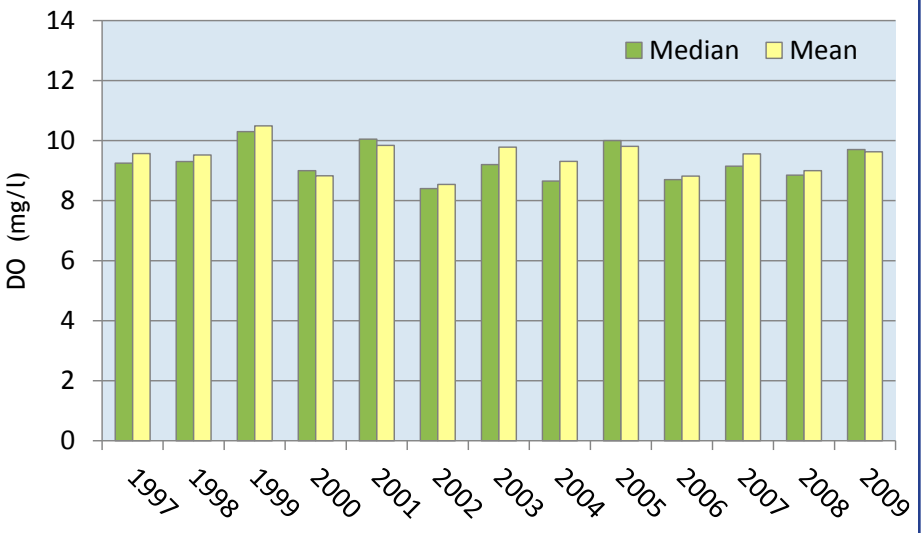


Figure 2-14: Summarized DO Values for All Data Collected at Ambient Sampling Stations in HUC 03010104

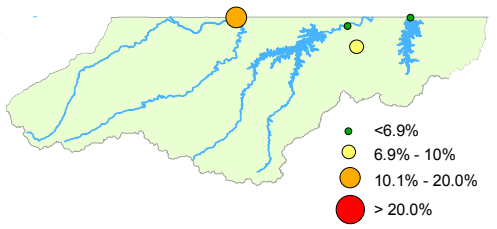


* NC DO Standard: Not < 5 mg/l daily avg. or not < 4 mg/l instantaneous

Fecal Coliform Bacteria

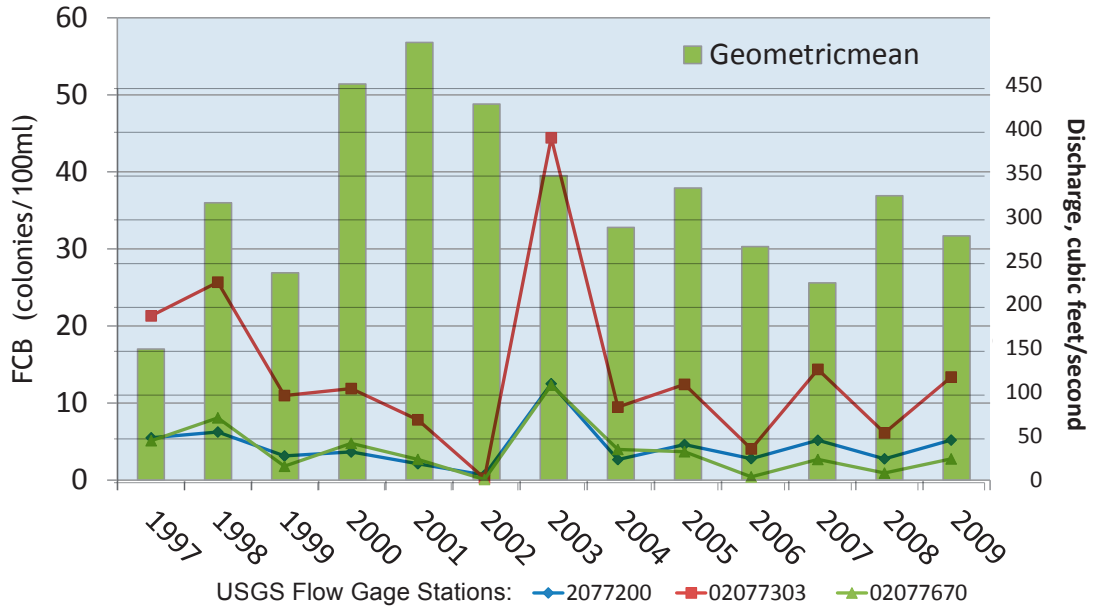
Fecal coliform bacteria (FCB) occurs in water as a result of nonpoint sources such as animal waste from wildlife, farm animals and/or pets, as well as from sanitary sewer overflows (SSOs). The FCB standard for freshwater streams is not to exceed the geometric mean of 200 colonies/100 ml, or 400 colonies/100 ml in 20% of the samples where five samples have been taken in a span of 30 days (5-in-30). Only results from a 5-in-30 study are used to indicate whether the stream is Impaired or Supporting. Waters with a use classification of B (primary recreational waters) receive priority for 5-in-30 studies. Other waters are studied as resources permit.

Figure 2-15: Percentage of Samples with Elevated FCB Levels (2005-2009)



As seen in Figure 2-15, two of the four sites had between 6.9% and 20% of samples over 400 colonies/100 ml. Possible sources of elevated levels of FCB are discussed in the subwatershed sections. Figure 2-16 shows the yearly geometric mean (calculated average) for all samples taken over the course of 13 years in the Lower Dan River subbasin. The highest yearly geometric mean was recorded in 2001 (56 colonies/100 ml). The figure also includes the yearly average stream flow, as seen in Figure 2-2, to show how flow can be closely linked to FCB levels.

Figure 2-16: Summarized Fecal Coliform Bacteria Values for All Data Collected at Ambient Sampling Stations in HUC 03010104 with Overlaying Flow



* NC FCB Standard (5-in-30 data only): Geomean not > 200/100 ml or 400/100 ml in 20% of samples

Additional information about possible causes of parameters discussed above for particular stations, see the stream write ups below. For more information regarding any of the parameters listed above, see Section 3.3 of the Supplemental Guide to North Carolina's Basinwide Planning. For additional information about ambient monitoring data collected in this river basin, see the Roanoke River Basin Ambient Monitoring System Report.

Understanding the Data

Biological & Ambient Ratings Converted to Use Support Categories

Biological (benthic and fish community) samples are given a bioclassification/rating based on the data collected at the site by DWQs Environmental Sciences Section (ESS). These bioclassifications include Excellent, Good, Good-Fair, Not Impaired, Not Rated, Fair and Poor. For specific methodology defining how these rating are given see Benthic Standard Operating Procedures (SOP) or the Fish Community SOP. Once a rating is given, it is then translated into a Use Support Category (see Figure 2-17).

Figure 2-17: Use Support Categories for Biological Ratings

Biological Ratings	Aquatic Life Use Support
Excellent	Supporting (Categories 1-2)
Good	
Good-Fair	
Not Impaired	
Not Rated	Not Rated (Category 3)
Fair	Impaired (Categories 4-5)
Poor	

Ambient monitoring data are analyzed based on the percent of samples exceeding the state standard for individual parameters for each site within a five year period. In general, if a standard is exceeded in greater than 10.0% of samples taken for a particular parameter, that stream segment is Impaired for that parameter. The fecal coliform bacteria parameter is exception to the rule. See the Fecal Coliform Bacteria section in the Ambient Data portion below.

Figure 2-18: Category Number to Use Support Rating

Category #	Use Support Rating
1	Supporting
2	
3	Not Rated
4	Impaired
5	

Each biological parameter (benthic and fish community) and each ambient parameter is assigned a Use Support Category based on its rating or percent exceedance. A detailed description of each category can be found on the first page of Appendix 2-A. Each monitored stream segment is given an overall category number which reflects the highest individual parameter category. Figure 2-18 shows how the category number is translated into the use support rating.

Example

Stream A had a benthic sample that rated Good-Fair and 12% of turbidity samples taken at the ambient station were exceeding the standard. The benthic sample would be given an individual category number of 1 (Figure 2-17) and the turbidity parameter would be given a category number of 5 since >10% of samples exceeded the standard. Therefore, stream A's overall category number would be a 5, indicating the stream has a use support rating of Impaired.

Recommendations & Action Plans at the Subbasin Scale

DWQ Priority Summary

Table 2-1 is a list of waters in the Middle Roanoke River Subbasin that DWQ has prioritized for restoration/ protection. The order of priority is not based solely on the severity of the steam's impairment or impacts but rather by the need for particular actions to be taken. A stream that is currently supporting its designated uses may be prioritized higher within this table than a stream that is currently impaired. This is based on a more holistic evaluation of the drainage area which includes monitoring results, current and needed restoration/ protection efforts, land use and other activities that could potentially impact water quality in the area. Some supporting streams may have a more urgent need for protections than an impaired stream with restoration needs already being implemented.

The table also lists potential stressors and sources that may be impacting a stream including in-field observations, monitoring data, historical evidence and permit or other violations. Additional study may be needed to determine exact source(s) of the impact. The last column includes a list of recommended actions.

Table 2-1: Notable Waters in the Lower Dan River Subbasin (Not Ranked)

Stream Name	AU#	Class.	Potential Stressor(s)	Potential Source(s)	Qualitative Status	Actions Needed
Country Line Cr (Farmer Lake)	22-56-(3.5)a, (3.5b) &(3.7)	WS-II; HQW,CA	Low DO, Nutrients, Turbidity	--	Impaired	SS
Hyco Lake	22-58-(0.5)	WS-V;B	Chlorophyll a, Low pH, Low DO	--	Supporting	SS
Marlowe Cr	22-58-12-6a & b	C	Habitat Degradation, Copper ,Zinc	Urban Runoff	Impaired	SC, E, RBR
Mayo Cr (Mayo Reservoir)	22-58-15-(0.5)	WS-V	TSS	--	Supporting	SS

Class.: Classification (e.g., C, B, WS-I, WS-II, WS-III, WS-IV, WS-V, Tr, HQW, ORW, SW, UWL)

Stressor: Chemical parameters or physical conditions that at certain levels prevent waterbodies from meeting the standards for their designated use (e.g., low/high DO, nutrients, toxicity, habitat degradation, etc.). Fecal Coliform Bacteria (FCB),

Source: The cause of the stressor. (Volume & Velocity: when a stream receives stormwater runoff at a much higher volume and velocity than it would naturally receive due to ditching, impervious surfaces, etc.)

Status: Impaired, Impacted, Supporting, Improving (For current Use Support Assessment see the Integrated Report.)

Actions Needed: Agriculture BMPs (**Ag**), Best Management Practices (**BMPs**), Daylight Stream (**DS**), Education (**E**), Forestry BMPs (**F**), Local Ordinance (**LO**), Monitoring (**M**), Nutrient Mgnt Controls (**NMC**), Protection (**P**), Restoration (**R**), Riparian Buffer Restoration (**RBR**), Stormwater Controls (**SC**), Sediment and Erosion Control BMPs (**SEC BMPs**), Species Protection Plan (**SPP**), Stressor Study (**SS**), .

Status & Recommendations for Monitored Waters

Understanding this Section

In this Section, more detailed information about stream health, special studies, aquatic life stressors and sources and other additional information is provided by each 10-digit Hydrological Unit Code (HUC). Waterbodies discussed in this Chapter include all monitored streams, whether monitored by DWQ or local agencies with approved methods. Use Support information on all monitored streams within this watershed can be seen on the map in Figure 2-1, and a Use Support list of all monitored waters in this basin can be found in the Use Support Chapter.

Use Support & Monitoring Box:

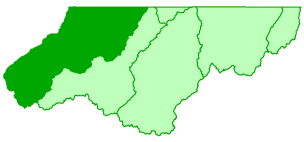
Each waterbody discussed in the Status & Recommendations for Monitored Waters within this Watershed section has a corresponding Use Support and Monitoring Box (Table 2-2). The top row indicates the 2010 Use Support and the length of that stream or stream segment. The next two rows indicate the overall Integrated Report category which further defines the Use Support for both the 2008 and the 2010 reports. These first three rows are consistent for all boxes in this Plan. The rows following are based on what type of monitoring stations are found on that stream or stream segment and may include benthic, fish community and/or ambient monitoring data. If one of these three types of monitoring sites is not shown, then that stream is not sampled for that type of data. The first column indicates the type of sampling in bold (e.g., **Benthos**) with the site ID below in parenthesis (e.g., CB79). The latest monitoring result/rating of that site is listed in the next column followed by the year that sample was taken. If there is more than one benthic site, for example, on that stream, the second site ID and site rating will be listed below the first. The last row in the sample box in Table 2-2 is the AMS data. The data window for all AMS sites listed in the boxes in this Plan is between 2004-2008. Only parameters exceeding the given standard are listed in the second column with the percent of exceedance listed beside each parameter.

Table 2-2: Example of a Use Support and Monitoring Box

Use Support: **Impaired** (14 mi)	
2008 IR Cat.	4a
2010 IR Cat.	4
Benthos (CB79) (CB80)	 Fair (2002) Fair (2002)
Fish Com (CF33)	 Good-Fair (2002)
AMS (C1750000)	Turbidity - 12% FCB - 48%

Please note any fecal coliform bacteria (FCB) listing in the last row (as seen in Table 2-2) only indicates elevated levels and a study of five samples in 30 days (5-in-30) must be conducted before a stream becomes Impaired for FCB.

Hogans Creek-Dan River (0301010401)



Includes: Dan River [AU#: 22-(39)b], **Jones Creek** [AU#: 22-50-3], **Hogans Creek** [AU#: 22-50], **Moon Creek** [AU#: 22-51], **Rattlesnake Creek** [AU#: 22-52] **& Cane Creek** [AU#: 22-54]

This watershed contains a mixed land use of agriculture, forest and residential areas. There are 12 minor NPDES permitted facilities and three permitted animal operations located within the watershed. There is one stream (Dan River) on the 2010 Impaired Waters List in this watershed.

Dan River [AU#: 22-(39)b]

This is the last segment of the Dan River within NC and is approximately ten miles from state line to state line. Land cover for this drainage area is mostly agriculture with some forested and residential areas.

Use Support: **Impaired** (9.6 mi)	
2008 IR Cat.	5
2010 IR Cat.	5
Benthos (NB22)	 Good (1999)
AMS (N3500000)	**Turbidity** (22.8%) FCB (22.8%)

Water quality status of this segment of the Dan River and other information about the full length of the river is discussed in the Dan River Impairment Summary section in Chapter 1.

Country Line Creek (0301010402)

Includes: Country Line Creek [AU#: 22-56-(1), (3.5)a, (3.5)b & (3.7)]

This watershed contains a mixed land use of agriculture, forest and residential areas. There are three minor NPDES permitted facilities and one permitted swine animal operation located within the watershed. There is one stream (Country Line Creek) on the 2010 Impaired Waters List in this watershed.

Country Line Creek (Farmer Lake) [AU#: 22-56-(3.5)a, (3.5)b & (3.7)]

Use Support: Impaired (90.7 ac)	
2008 IR Cat.	2
2010 IR Cat.	5
Lake Station (ROA027G) (ROA027J) (ROA027L)	Chlorophyll *a*, Turbidity

Farmer Lake is approximately 91 acres in size. The majority of the drainage area is forest, agriculture and some residential. The lake is a water supply reservoir for the City of Yanceyville and is classified as a WS-II, HQW, CA. Only the upstream segment of this lake is on the 2010 Impaired Waters List.

Water Quality Status

Lake station samples were taken in 2007 and 2009 during the summer months on Farmer Lake. Samples showed poor water clarity, thermally stratified waters, low DO levels and high biological productivity. Ammonia and nitrite plus nitrate concentration were low; however, total phosphorus and TKN levels were elevated. Four out of the 34 samples taken between the two years were exceeding the chlorophyll *a* state standard. All exceeding samples were found in the Impaired segment of the lake (ROA027G). Turbidity levels at this station were also exceeding the state standard by 33%. See Figure 2-1 for station locations.

Recommendations

A source study in this drainage area could determine the source of nutrients.

Hyco Lake (0301010405)

Includes: Hyco Creek [AU#: 22-58-1], South Hyco Creek (Lake Roxboro) [AU#: 22-58-4-(0.5), (1.7) & (3)], & Hyco Lake [AU#: 22-58-(0.5)]

This watershed contains a mixed land use of agriculture, forest and residential areas. There are 39 minor and one major NPDES permitted facilities and four permitted animal operation located within the watershed. There is one stream (Country Line Creek) on the 2010 Impaired Waters List in this watershed.

Hyco Lake [AU#: 22-58-(0.5)]

Use Support: Supporting (4,298 ac)	
2008 IR Cat.	5
2010 IR Cat.	2
Lake Stations (ROA030E) (ROA030C) (ROA030F) (ROA030G)	No Exceedances

Hyco Lake is located on the Hyco River approximately three miles south of the North Carolina-Virginia State line in Person and Caswell Counties. Land cover around the lake is a mixture of forest residential and agriculture. The lake was previously on the Impaired Waters List due to a NC DHHS fish consumption advisory-selenium. The advisory was lifted, removing the lake from the Impaired Waters List. This lake is currently supporting all designated uses.

Water Quality Status

There are four lake monitoring stations scattered throughout Hyco Lake. These stations were monitored between May and September 2009. Nutrient levels within the lake have historically measured at low to moderate levels. Results from this cycle indicate the lake remains at low to moderate nutrient and biological productivity levels. However, there is a moderate increase in chlorophyll *a* levels when

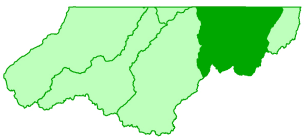
evaluating samples between 1994 - 2009. Long term monitoring results also show a decrease in pH and a steady decrease in DO levels. Specific conductivity averages almost doubled between the current and past sampling cycle.

In 2008, Progress Energy notified the Raleigh Regional Office (RRO) of DWQ that the FGD wastewater settling basin was seeping and at risk of failure. To reduce this risk, Progress Energy dewatered the settling basin into the adjacent ash pond to reduce the hydraulic head in the settling basin. On February 27, 2008, Progress Energy notified RRO staff that an 8 to 12 foot wide berm failure had occurred on the flush pond berm, allowing water from the pond to discharge into the adjacent Ash Pond. According to Progress Energy, at the time of the berm failure, the flush pond only contained start up water and not backwash water from the FGD Bioreactor. The RRO requested Progress Energy to conduct additional sampling of both lake surface water and adjacent ground water in an effort to determine changes or effects of the waste streams as a result of the treatment unit failure, bypass and changes in the treatment capacities of the settling basin. This sampling effort was conducted eight times in March and April. Data from this monitoring effort revealed elevated levels of thallium, selenium, copper, beryllium, silver, mercury and antimony in the effluent stream from outfall 003 in Hyco Lake and from a non-potable well located within 500 feet of the FGD Settling Pond and the FGD Flush Pond.

At the request of the Raleigh Regional Office, staff from DWQ's Intensive Survey Unit collected water and sediment samples on July 21, 2008 from various lake sites near the FGD wastewater treatment system along with two additional sites located upstream and downstream of the facility. Results of this sampling indicated that elevated metals detected by Progress Energy in the spring were now at very low levels or below DWQ laboratory detection levels. Thallium was present in the sediment samples along with vanadium and selenium, however, water samples collected near the bottom of the reservoir at the three sediment sampling sites exhibited concentrations of these metals below the DWQ laboratory's detection levels. Physical measurements taken at each sampling site were similar to those observed in the past with the exception of conductivity values, which were the greatest recorded by DWQ staff since 1983 when this reservoir was first monitored.

For more information about this and additional monitoring see the **Roanoke River Basin Lake and Reservoir Assessment Report**.

Hyco River (0301010406)



Includes: Hyco River [AU#: 22-58-(9.5)]**, Marlowe Creek** [AU#: 22-58-12-6a & b]**, & Mayo Creek (Mayo Reservoir)** [AU#: 22-58-15-(0.5)]

This watershed contains a mixed land use of agriculture, forest, urban and residential areas. There are five minor and two major NPDES permitted facilities and two permitted swine animal operation located within the watershed. There is one stream (Marlowe Creek) on the 2010 Impaired Waters List in this watershed.

Marlowe Creek [AU#: 22-58-12-6a & b]

Marlowe Creek is split into two segments and is approximately 11 miles from source to Storys Creek which flows into Hyco River [AU#: 22-58-(9.5)]. The Town of Roxboro is located in the headwaters of Marlowe Creek. Further downstream, the land use is mostly forest and agriculture. Marlowe Creek has been on the Impaired Waters List since 1998.

Use Support: Impaired (11.1 mi)	
2008 IR Cat.	5
2010 IR Cat.	5
Benthos (NB43) (NB85) (NB119)	 Fair (2009) Fair (2004) Not Rated (2006)
Fish Com (NF27)	 Good-Fair (2004)
AMS (N4400000)	Copper (22.2%) Zinc (44.4%)

Water Quality Status

Marlowe Creek was sampled twice for biological health during this cycle. The first sample was taken in 2006 as part of a **Small Stream Biocriteria Development** study near the intersection of N. Main Street and NC-49 in Roxboro. The sample showed the creeks aquatic life was severely impacted by the highly urbanized area and had poor habitat (scored a 39 out of 100).

The second sample (NB43) was taken further downstream near the confluence of Fishing Creek. This site has been sampled since 1994 when it received a Poor rating. Each sample increased in rating following the 1994 sample up to a Good-Fair in 2004. This water quality improvement was contributed to significant facility upgrades at the Roxboro WWTP. The 2009 sample dropped back to a Fair rating and reflected water quality similar to what was seen in 1999. The WWTP however, had only a few minor permit violations and only failed one toxicity test.

An Ambient Monitoring Station is also located near the confluence of Fishing Creek. DO and turbidity levels have improved as compared to the last cycle (1999-2003). Fecal coliform bacteria levels have also improved. The geometric mean was three time lower than the previous cycle. However, copper and zinc levels remain elevated above the state standards.

Marlowe Creek will remain on the Impaired waters list for both biological impairments as well as for copper and zinc exceedances.

Local Initiatives

The City of Roxboro was designated as a Phase II community as of January 2010 which require additional stormwater BMPs. This will assist in reducing the urban runoff impacting the stream.

Mayo Creek (Mayo Reservoir) [AU#: 22-58-15-(0.5)]

Use Support: Supporting (2,613 ac)	
2008 IR Cat.	2
2010 IR Cat.	2
Lake Stations (ROA0343A) (ROA0342A) (ROA0341A)	No Exceedances

The Mayo Reservoir is roughly 2,613 acres and is owned by Progress Energy. The majority of the drainage area is agriculture, forest and residential.

Water Quality Status

Surface physical parameters (DO, pH and water temperature) in 2009 were similar to those values observed in this reservoir since it was first monitored by DWQ in 1983. Conductivity values, however, were greater in 2009 (range = 111 to 166 µmhos/cm). Total solids were also greater in 2009 than in previous years (range = 80 to 130 mg/L) while values for turbidity and total solids remained the same. Nutrient levels and chlorophyll *a* levels were all low. The lake was determined to be mesotrophic, or having moderate biological productivity, in 2009.

Progress Energy Mayo Steam Electric Power Plan (NC0038377)

CP&L DBA Progress Energy Carolinas, Inc. operates a steam electric power plant facility and holds an NPDES permit NC0038377 to discharge process control and industrial waste streams to Mayo Lake a Class WS-V water, in the Roanoke River Basin, in Person County.

Progress Energy Carolinas, Inc. installed wet limestone forced oxidation wet scrubbers on all operating units at the Mayo Steam Electric Plant in response to requirements from the State of North Carolina under the Clean Smokestacks legislation. Accordingly, Progress Energy installed a Flue Gas Desulfurization (FGD) wastewater settling pond, a General Electric ABMet bioreactor (a new technology biological treatment system), and a flush pond to treat wastewater generated by the recently added wet scrubbers.

Since installation of FGD settling basin, FGD flush pond and GE ABMet bioreactor Progress Energy Carolinas, Inc. has:

- upgraded ash handling system to handle all fly ash at the plant as dry ash to reduce pollutant loading to the outfall.
- installed and uses the addition of a MetClear injection system to aid in the settling of mercury and other constituents in the settling pond.
- added a pH adjustment system to the inlet of the bioreactor to aid in keeping the pH of the wastewater at an optimum level for maximum treatment efficiency.
- placed into service secondary hydrocyclones to reduce the amount of suspended solids in the blowdown to the settling pond.

However, effluent sampling results reported by Progress Energy from the NPDES Outfall 002 has revealed effluent limit exceedances. On December 9, 2010, Progress Energy provided DWQ an Application for a Special Order by Consent, whereby a schedule may be developed for additional treatment unit(s) and/or alternative treatment technology construction.

Aarons Creek-Dan River (0301010407)

Includes: Crooked Fork [AU#: 22-59-1]**, & Aarons Creek** [AU#: 22-59]

This watershed contains a mixed land use of agriculture, forest and residential areas. There are no permitted facilities located within the watershed. There are no streams on the 2010 Impaired Waters List in this watershed.

References

References marked with (*) indicates a DWQ special study report. These reports are not currently available online. Contact the DWQ Environmental Science Section at (919) 743-8400 to receive a hardcopy.

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Appendix 2-A

Use Support Ratings for All Monitored Waters in the Lower Dan River Subbasin

Draft 2010 IR Category	Integrated Reporting Categories for individual Assessment Unit/Use Support Category/ Parameter Assessments. A single AU can have multiple assessments depending on data available and classified uses.
1	All designated uses are monitored and supporting
1b	Designated use was impaired, other management strategy in place and no standards violations for the parameter of interest (POI)
1nc	DWQ have made field determination that parameter in exceedance is due to natural conditions
1r	Assessed as supporting watershed is in restoration effort status
1t	No criteria exceeded but approved TMDL for parameter of interest
2	Some designated uses are monitored and supporting none are impaired Overall only
2b	Designated use was impaired other management strategy in place and no standards violations Overall only
2r	Assessed as supporting watershed is in restoration effort status overall only
2t	No criteria exceeded but approved TMDL for POI Overall only
3a	Instream/monitoring data are inconclusive (DI)
3b	No Data available for assessment
3c	No data or information to make assessment
3n1	Chlorophyll a exceeds TL value and SAC is met-draft
3n2	Chlorophyll a exceeds EL value and SAC is not met first priority for further monitoring-draft
3n3	Chlorophyll a exceeds threshold value and SAC is not met first second priority for further monitoring-draft
3n4	Chlorophyll a not available determine need to collect-draft
3t	No Data available for assessment –AU is in a watershed with an approved TMDL
4b	Designated use impaired other management strategy expected to address impairment
4c	Designated use impaired by something other than pollutant
4cr	Recreation use impaired no instream monitoring data or screening criteria exceeded
4cs	Shellfish harvesting impaired no instream monitoring data- no longer used
4ct	Designated use impaired but water is subject to approved TMDL or under TMDL development
4s	Impaired Aquatic Life with approved TMDL for Aquatic Life POI or category 5 listing
4t	Designated use impaired approved TMDL
5	Designated use impaired because of biological or ambient water quality standards violations and needing a TMDL
5r	Assessed as impaired watershed is in restoration effort status

NC 2010 Integrated Report

All 13,123 Waters in NC are in Category 5-303(d) List for Mercury due to statewide fish consumption advice for several fish species

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Roanoke River Basin — **Hogans Creek-Dan River Watershed** — **0301010401**

Roanoke River Basin — Dan River Subbasin — 03010104

Roanoke River Basin — **Hogans Creek-Dan River Watershed** — **0301010401**

⊙ **22-54**	**Cane Creek**	From North Carolina-Virginia State Line to Dan River		**0.8 FW Miles**	C	
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004		
⊙ **22-(39)b**	**DAN RIVER (North Carolina portion)**	From NC/VA crossing downstream of Wolf Island Creek to last crossing of North Carolina-Virginia State Line		**9.6 FW Miles**	C	
4t	**Fecal Coliform (recreation)**	Standard Violation	Recreation	2008	2008	
5	**Turbidity**	Standard Violation	Aquatic Life	2008	2008	
⊙ **22-50**	**Hogans Creek**	From source to Dan River		**29.1 FW Miles**	C	
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004		
⊙ **22-50-3**	**Jones Creek (Lake Wade)**	From source to Hogans Creek		**7.6 FW Miles**	C	
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004		
⊙ **22-51**	**Moon Creek (Wildwood Lake)**	From source to Dan River		**17.0 FW Miles**	C	
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004		
⊙ **22-52**	**Rattlesnake Creek**	From source to Dan River		**2.7 FW Miles**	C	
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004		

Roanoke River Basin — **Country Line Creek Watershed** — **0301010402**

⊙ **22-56-(1)**	**Country Line Creek**	From source to a point 0.5 mile upstream of mouth of Nats Fork		**10.5 FW Miles**	WS-II;HQW	
1	**Ecological/biological Integrity Benthos**	Good Bioclassification	Aquatic Life	2004		
⊙ **22-56-(3.7)**	**Country Line Creek**	From dam at Farmer Lake to Dan River		**24.5 FW Miles**	C	
1	**Ecological/biological Integrity Benthos**	Good Bioclassification	Aquatic Life	2004		
⊙ **22-56-(3.5)a**	**Country Line Creek (Farmers Lake)**	Upper reservoir- From a point 0.5 mile upstream of mouth Nats Fork to dam at Farmer Lake (Town of Yanceyville water supply intake located 1.8 mile upstream of N.C. Hwy. 62)		**90.7 FW Acres**	WS-II;HQW,CA	
5	**Chlorophyll a**	Standard Violation	Aquatic Life	2008	2010	
5	**Turbidity**	Standard Violation	Aquatic Life	2008	2010	
1	**Water Quality Standards Water Supply**	No Criteria Exceeded	Water Supply	2008		

NC 2010 Integrated Report

All 13,123 Waters in NC are in Category 5-303(d) List for Mercury due to statewide fish consumption advice for several fish species

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Roanoke River Basin — Country Line Creek Watershed — 0301010402

⊙ 22-56-(3.5)b	Country Line Creek (Farmers Lake)	Lower reservoir-From a point 0.5 mile upstream of mouth Nats Fork to dam at Farmer Lake (Town of Yanceyville water supply intake located 1.8 mile upstream of N.C. Hwy. 62)	271.1 FW Acres		WS-II;HQW,CA

1	Water Quality Standards Aquatic Life	No Criteria Exceeded	Water Supply	2008
1	Water Quality Standards Water Supply	No Criteria Exceeded	Water Supply	2008

Roanoke River Basin — Hyco Lake Watershed — 0301010405

⊙ 22-58-1	Hyco Creek (North Hyco Creek)	From source to Hyco Lake, Hyco River	16.8 FW Miles		C

3a	Ecological/biological Integrity FishCom	Not Rated Bioclassification	Aquatic Life	2004

⊙ 22-58-(0.5)	Hyco River, including Hyco Lake below elevation 410	From source in Hyco Lake to dam of Hyco Lake, including tributary arms below elevation 410	4,297.9 FW Acres		WS-V,B

1	Water Quality Standards Aquatic Life	No Criteria Exceeded	Aquatic Life	2008
1	Water Quality Standards Water Supply	No Criteria Exceeded	Water Supply	2008

⊙ 22-58-4-(3)	South Hyco Creek	From a point 0.6 mile downstream of Double Creek to Hyco Lake, Hyco River (City of Roxboro water supply intake)	0.7 FW Miles		WS-II;HQW,CA

1	Ecological/biological Integrity FishCom	Good Bioclassification	Aquatic Life	2004

⊙ 22-58-4-(1.4)	South Hyco Creek (Lake Roxboro)	From backwaters of Lake Roxboro to dam at Lake Roxboro	493.6 FW Acres		WS-II,B;HQW

3n	Chlorophyll a	Potential Standards Violation	Aquatic Life	2008
1	Water Quality Standards Water Supply	No Criteria Exceeded	Water Supply	2008

Roanoke River Basin — Hyco River Watershed — 0301010406

⊙ 22-58-(9.5)	Hyco River	From dam of Hyco Lake to North Carolina-Virginia State Line, including all portions in North Carolina	6.8 FW Miles		C

1	Fecal Coliform (recreation)	No Criteria Exceeded	Recreation	2008	
1	Water Quality Standards Aquatic Life	No Criteria Exceeded	Aquatic Life	2008	

⊙ 22-58-12-6a	Marlowe Creek	From source to Mitchell Creek	6.6 FW Miles		C

5	Ecological/biological Integrity Benthos	Fair Bioclassification	Aquatic Life	2004	1998

All 13,123 Waters in NC are in Category 5-303(d) List for Mercury due to statewide fish consumption advice for several fish species

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Roanoke River Basin — **Hyco River Watershed 0301010406**

⊙	**22-58-12-6b**	**Marlowe Creek**	From Mithcell Creek to Storys Creek	**4.5 FW Miles**	C
5	**Copper**	Standard Violation	Aquatic Life	2008	2008
1	**Ecological/biological Integrity Benthos**	Good-Fair Bioclassification	Aquatic Life	2004	
1	**Ecological/biological Integrity FishCom**	Good-Fair Bioclassification	Aquatic Life	2004	
1	**Fecal Coliform (recreation)**	No Criteria Exceeded	Recreation	2008	
5	**Zinc**	Standard Violation	Aquatic Life	2008	2008
⊙	**22-58-15-(3.5)**	**Mayo Creek (Maho Creek)**	From dam of Mayo Reservoir to North Carolina-Virginia State Line	**0.5 FW Miles**	C
1	**Fecal Coliform (recreation)**	No Criteria Exceeded	Recreation	2008	
1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	
⊙	**22-58-15-(0.5)**	**Mayo Creek (Maho Creek) (Mayo Reservoir)**	From source to dam of Mayo Reservoir	**2,613.8 FW Acres**	WS-V
1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	
1	**Water Quality Standards Water Supply**	No Criteria Exceeded	Water Supply	2008	
⊙	**22-58-12-(1.5)**	**Storys Creek [Roxboro City Lake (Lake Issac Walton)]**	From a point 0.9 mile downstream of N.C. Hwy. 57 to Roxboro City Lake Dam	**189.5 FW Acres**	WS-II;HQW,CA
1	**Water Quality Standards Water Supply**	No Criteria Exceeded	Water Supply	2008	

Roanoke River Basin — **Aarons Creek-Dan River Watershed 0301010407**

⊙	**22-59**	**Aarons Creek**	From source to North Carolina-Virginia State Line	**8.6 FW Miles**	C
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	

Appendix 2-B

Biological Sampling Site Data Sheets (Benthic Macroinvertebrate & Fish Community) for the Lower Dan River Subbasin

Biological Samples Taken During this Assessment Cycle

Station ID	Waterbody	County	Site Location	Sample Results
Benthic Sample Sites				
NB112	CROOKED FK	PERSON	SR 1558	06 - Not Impaired
NB116	NEGRO CR	CASWELL	SR 1769	06 - Not Impaired
NB118	TANYARD BR	PERSON	US 501	06 - Not Rated
NB119	MARLOWE CR	PERSON	NC 49	06 - Not Rated
NB40	COUNTRY LINE CR	CASWELL	NC 57	09 - Excellent
NB43	MARLOWE CR	PERSON	SR 1322	09 - Fair
Fish Community Sample Sites				
NF15	Hogans Cr	Caswell	SR 1330	09 - Good-Fair
NF24	Moon Cr	Caswell	SR 1511	09 - Good
NF26	Rattlesnake Cr	Caswell	SR 1523	09 - Good
NF30	S Hyco Cr	Person	US 158	09 - Fair
NF31	Aarons Cr	Granville	SR 1400	09 - Good
NF35	Hogans Cr	Caswell	SR 1301	09 - Good-Fair

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
HOGANS CR	SR 1301	07/06/09	NF35	Good-Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
CASWELL	3	03010104	36.439045	-79.515205	22-50	Northern Inner Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	65.4	550	8	0.3	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	100	0	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	20.0
Dissolved Oxygen (mg/L)	7.1
Specific Conductance (µS/cm)	122
pH (s.u.)	6.7
Water Clarity	Slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	13
Bottom Substrate (15)	3
Pool Variety (10)	9
Riffle Habitat (16)	3
Erosion (7)	6
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**66**

Site Photograph

Substrate Sand, gravel, block bedrock boulders jutting out from the left bank

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
07/06/09	2009-80	15	42	Good-Fair

Most Abundant Species 2009 Satinfin Shiner (25%)

Exotic Species 2009 Bluegill

Species Change Since Last Cycle **N/A**

Data Analysis

This is the first fish community sample collected from this 2009-2010 Random Ambient Monitoring site. **Watershed** -- drains primarily eastern Rockingham County, including a portion of the Town of Reidsville; two small NPDES facilities located in the headwaters (NC0002828 and NC0077135, total Q_w = 0.027 MGD); tributary to the Dan River. **Habitats** -- snags, stick riffles, gravel bars, deadfalls, and shallow runs; high quality bank and riparian characteristics, but stream still exhibits impacts such as poor quality riffles and sandy substrate from nonpoint source erosion. **2009** -- all diversity metrics (total species diversity and diversities of darters, sunfish, and suckers) were lower than expected; intolerant species were also absent; three species (White Sucker, Notchlip Redhorse, and Largemouth Bass) were represented only by young-of-year and were excluded from the sample. Long-term nonpoint source erosion seems to be the primary stressor to this stream.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
HOGANS CR	SR 1330	07/06/09	NF15	Good-Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
CASWELL	3	03010104	36.49027778	-79.40416667	22-50	Northern Inner Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	92.6	410	11	0.4	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	60	10	30	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	20.8
Dissolved Oxygen (mg/L)	7.3
Specific Conductance (µS/cm)	118
pH (s.u.)	6.7

Water Clarity: Slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	3
Pool Variety (10)	9
Riffle Habitat (16)	4
Erosion (7)	5
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**69**

Site Photograph

Substrate: Sand, gravel

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
07/06/09	2009-81	18	40	Good-Fair
05/25/04	2004-56	20	52	Good

Most Abundant Species 2009: Swallowtail Shiner (28%)

Exotic Species 2009: Bluegill

Species Change Since Last Cycle

Gains --Rosyside Dace, Crescent Shiner, Glassy Darter, Riverweed Darter. **Losses** -- White Sucker, Northern Hogsucker, Notchlip Redhorse, Margined Madtom, Channel Catfish, Green Sunfish, Chainback Darter, Roanoke Darter. All species gained or lost were represented by 1-3 fish/species, except for Crescent Shiner (n=37).

Data Analysis

Watershed -- drains eastern Rockingham and northwestern Caswell counties, including a portion of the Town of Reidsville; two small NPDES facilities located in the headwaters (NC0002828 and NC0077135, total Q_w = 0.027 MGD); tributary to the Dan River. **Habitats** -- gravelly and sandy runs; good snag pools, undercuts, *Podostemum* in the riffles, but stream still exhibits substantial nonpoint source erosion. **2009** -- ~ 2 times as many fish were collected in 2009 than in 2004 (336 vs. 178), primarily Swallowtail Shiner, Crescent Shiner, and Satinfin Shiner (53% of all the fish collected); the diversities of sunfish and suckers were much lower than expected; 1 of only 2 sites where suckers were absent, although Notchlip Redhorse were collected they were represented only by young-of-year and were excluded from the sample; combined with a skewed trophic structure the NCIBI score and rating declined; despite having a large drainage area the community may still be suffering from drought impacts and from chronic nonpoint source ersoion. **2004 & 2009** -- 26 species known from the site, including 6 species of darters; dominant species is the Swallowtail Shiner.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
MOON CR	SR 1511	05/21/09	NF24	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
CASWELL	4	03010104	36.5075	-79.33555556	22-51	Northern Inner Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	47.2	370	8	0.4	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	45	0	55	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	15.0
Dissolved Oxygen (mg/L)	8.4
Specific Conductance (µS/cm)	97
pH (s.u.)	6.5

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	14
Bottom Substrate (15)	3
Pool Variety (10)	6
Riffle Habitat (16)	5
Erosion (7)	5
Bank Vegetation (7)	6
Light Penetration (10)	9
Left Riparian Score (5)	3
Right Riparian Score (5)	3
Total Habitat Score (100)	**59**

Site Photograph

Substrate Sand, gravel

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/21/09	2009-42	20	52	Good
04/30/04	2004-32	16	46	Good
09/07/94	94-34	22	44	Good-Fair

Most Abundant Species 2009 Crescent Shiner (21%), Bluehead Chub (18%)

Exotic Species 2009 Green Sunfish, Bluegill, Redear Sunfish

Species Change Since Last Cycle

Gains -- Eastern Silvery Minnow, Crescent Shiner, Redlip Shiner, Mountain Redbelly Dace, Creek Chub, White Sucker, Redear Sunfish, Glassy Darter. **Losses** -- Golden Shiner, Redfin Pickerel, Pumpkinseed, Largemouth Bass. All species gained or lost were represented by 1- 4 fish/species, except for Redlip Shiner, Eastern Silvery Minnow, and Crescent Shiner (n=17, 41, and 130, respectively).

Data Analysis

Watershed -- drains northwestern Caswell County; no municipalities with the watershed; tributary to the Dan River, site is ~ 2.2 miles above the creek's confluence with the river. **Habitats** -- sandy runs, woody debris, snags, narrow riparian zones intact along both banks, but stream still exhibits substantial nonpoint source erosion as evident from the low scoring habitat characteristics. **2009** -- 6 times more fish collected in 2009 than in 2004 (627 *vs*. 104), especially Crescent Shiner (130 vs. 0), Bluehead Chub (112 *vs*. 11), and Eastern Silvery Minnow (41 *vs*. 0); no lingering effects from the drought. **1994 - 2009** -- very diverse fish community, 30 species are known from the site, including 12 species of cyprinids, 5 species of sunfish, and 4 species of darters; dominant species are variable and include Eastern Silvery Minnow (1994), Satinfin Shiner and Redbreast Sunfish (2004), and Crescent Shiner and Bluehead Chub (2009); NCIBI score and rating have gradually been improving over the past 15 years.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
RATTLESNAKE CR	**SR 1523**	**05/21/09**	**NF26**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
CASWELL	4	03010104	36.50777778	-79.29333333	22-52	Northern Inner Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	23.7	350	6	0.2	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	100	0	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	15.1
Dissolved Oxygen (mg/L)	8.8
Specific Conductance (µS/cm)	120
pH (s.u.)	6.6

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	14
Bottom Substrate (15)	4
Pool Variety (10)	6
Riffle Habitat (16)	7
Erosion (7)	3
Bank Vegetation (7)	6
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**65**

Site Photograph

Substrate Sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/21/09	2009-43	21	46	Good
05/25/04	2004-57	19	48	Good

Most Abundant Species 2009 Satinfin Shiner (46%)

Exotic Species 2009 Red Shiner, Green Sunfish, Bluegill

Species Change Since Last Cycle

Gains -- Crescent Shiner, Mountain Redbelly Dace, Creek Chub, V-lip Redhorse, Eastern Mosquitofish, Fantail Darter. **Losses** -- Golden Shiner, Channel Catfish, Redfin Pickerel, Warmouth. All species gained or lost were represented by 1-9 fish/species, except for Eastern Mosquitofish and Fantail Darter (n=14 and 17, respectively).

Data Analysis

Watershed -- drains northwestern Caswell County with its headwaters arising in the Town of Yanceyville; tributary to the Dan River, site is ~0.2 miles above the creek's confluence with the river. **Habitats** -- very shallow and sandy runs, a couple of large boulder outcrops in the channel, riparian zones intact providing good shading to the stream; but stream is impacted by very substantial nonpoint source erosion. **2009** -- 5 times more fish collected in 2009 than in 2004 (929 vs. 184), especially Satinfin Shiner, Eastern Silvery Minnow, Swallowtail Shiner, Bluehead Chub, Speckled Killifish, and Rosefin Shiner (86% of all the fish collected); very high percentage of tolerant fish (53%). **2004 & 2009** -- 25 species known from the site, including 12 species of cyprinids and 3 species of darters; dominant species is the Satinfin Shiner; very dynamic community, the close proximity to the river may influence the community (i.e., schooling species such as Eastern Silvery Minnow and Satinfin Shiner migrating back and forth from the creek to the river).

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
COUNTRY LINE CR	NC 57	NB40	08/12/09	Excellent

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
CASWELL	4	03010104	36.537778	-79.201111	22-56-(3.7)	Northern Inner Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	138.0	395	10	0.1

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	70	30	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	23.6
Dissolved Oxygen (mg/L)	7.7
Specific Conductance (µS/cm)	126
pH (s.u.)	6.4
Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	11
Pool Variety (10)	8
Riffle Habitat (16)	7
Bank Erosion (7)	0
Bank Vegetation (7)	5
Light Penetration (10)	10
Left Riparian Score (5)	4
Right Riparian Score (5)	1
Total Habitat Score (100)	69

Site Photograph

Substrate The channel substrata consisted of mostly sand and gravel.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/12/09	10808	---	28	---	4.31	Excellent
07/01/04	9400	---	24	---	4.82	Good
08/24/94	6691	---	14	---	4.55	Good-Fair
07/10/90	5337	---	26	---	4.53	Good
07/23/87	4158	---	26	---	5.15	Good

Taxonomic Analysis

Several pollution sensitive EPT taxa were collected at this site in 2009 such as the stoneflies *Paragnetina fumosa*, *Pteronarcys spp*., and long-lived *Acroneuria abnormis*. Intolerant caddisflies collected included *Brachycentrus numerosus*, *Nyctiophylax moestus*, and *Pycnopsyche spp*. The mayfly *Plauditus cestus* and caddisfly *Ceraclea mentiea* are listed by the North Carolina Natural Heritage Program as Significantly Rare (2006) and were collected from this location in 2009.

Data Analysis

This site received a bioclassification of Excellent in 2009 for the first time since sampling began in 1983. Decreases in EPTBI from 4.82 in 2004 to 4.31 in 2009 in addition to the highest EPT taxa richness (28) on record from this location continue to suggest better water quality. Pollution sensitive macroinvertebrate communities were collected at this site despite evidence of habitat degradation due to increased erosion leading to in-channel sedimentation, scouring, and increased bar development from nonpoint sources.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
S HYCO CR	US 158	05/21/09	NF30	Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
PERSON	5	03010104	36.38527778	-79.10777778	22-58-4-(3)	Southern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-II,HQW,CA	56.5	430	8	0.4	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	75	0	25	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	18.7
Dissolved Oxygen (mg/L)	7.3
Specific Conductance (µS/cm)	110
pH (s.u.)	6.7
Water Clarity	Clear, slightly tannin stained

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	13
Bottom Substrate (15)	3
Pool Variety (10)	6
Riffle Habitat (16)	5
Erosion (7)	2
Bank Vegetation (7)	7
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**58**

Site Photograph

Substrate Gravel, sand, woody debris

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/16/10	2010-48	21	44	Good-Fair
05/21/09	2009-44	15	38	Fair
04/30/04	2004-30	21	52	Good

Most Abundant Species 2009 Swallowtail Shiner (32%)

Exotic Species 2009 Green Sunfish, Bluegill

Species Change Since Last Cycle (2009 vs. 2004)

Gains -- Crescent Shiner, Eastern Mosquitofish, Black Crappie. **Losses** -- Mountain Redbelly Dace, White Sucker, Notchlip Redhorse, V-lip Redhorse, Margined Madtom, Yellow Bullhead, Redfin Pickerel, Speckled Killifish, Yellow Perch. All species gained or lost were represented by 1-6 fish/species, except for Crescent Shiner, V-lip Redhorse, and Eastern Mosquitofish (n=11, 13, and 36, respectively).

Data Analysis

Watershed -- drains northwest Orange, southeastern Caswell, and southwestern Person counties; no municipalities within the watershed; site is ~ 4.5 miles downstream from Roxboro Lake dam and ~ 1.5 miles above the backwaters of Hyco Reservoir, an impoundment of the Hyco River; stream is classified as High Quality Waters based upon its WS-II supplemental classification. **Habitats** -- very low flow; coarse woody debris in the channel, riparian bottomlands, snag debris dams, stream exhibits substantial nonpoint source erosion. **2009** -- 2.3 times more fish collected in 2009 than in 2004 (556 vs. 237), especially Swallowtail Shiner, Satinfin Shiner, Eastern Mosquitofish, and Bluegill (75% of all the fish collected), 1 of 2 sites where suckers were absent; very skewed trophic structure with only 3% omnivores+herbivores; lingering drought impacts. **2004 & 2009** -- despite a large drainage area, only 24 species are known from the site; including just 2 species of darters; dominant species is the Swallowtail Shiner; old weir below the bridge at the old gage may be an impediment to fish movement at low flow; recolonization avenues are limited by the upstream and downstream reservoirs. **Note:** the site was re-sampled in 2010 following a wetter winter and spring flow period and the community was rated Good-Fair.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
MARLOWE CR	SR 1322	NB43	08/12/09	Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
PERSON	5	03010104	36.483333	-78.979444	22-58-12-6b	Northern Inner Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	17.8	390	9	0.1

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	60	0	40	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Roxboro WWTP	NC0021024	5.0

Water Quality Parameters

Temperature (°C)	24.1
Dissolved Oxygen (mg/L)	9.8
Specific Conductance (µS/cm)	139
pH (s.u.)	6.5
Water Clarity	turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	8
Pool Variety (10)	8
Riffle Habitat (16)	10
Bank Erosion (7)	1
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	2
Total Habitat Score (100)	72

Site Photograph

Substrate This channel was dominated by mostly sand and gravel.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/12/09	10809	59	10	6.25	6.01	Fair
06/30/04	9397	56	13	6.43	5.93	Good-Fair
08/25/99	7988	53	9	6.35	5.74	Fair
08/24/94	6692	33	5	6.91	6.49	Poor

Taxonomic Analysis

This sampling location was dominated by pollution tolerant macroinvertebrates such as the mayflies *Baetis flavistriga* and *Maccaffertium modestum*; and the caddisflies *Cheumatopsyche spp*. and *Hydropsyche betteni.* The root mat-dwelling caddisflies *Oecetis persimilis* and *Trianodes ignitus* were rare at the site. The somewhat tolerant riffle beetle taxa *Macronychus glabratus* was abundant and the intolerant *Psephenus herricki* was rare at this sampling location. Eight odonate taxa were collected in addition to 26 chironomid taxa. *Polypedilum flavum* was the only abundant chironomid taxa collected. No stoneflies were collected at this site in 2009.

Data Analysis

This benthic montitoring station received a bioclassification of Fair in 2009 suggesting a transition back to degraded water quality found in 1999. EPTBI increased slightly and EPT richness decreased from the 2004 sample. In 2009, EPT taxa richness returned to the levels observed in 1999. Chironomid taxa richness (26) was the highest of all other sampling years at this site. Only one chironomid taxa was abundant at the site in 2009. The high chironomid taxa richness could be due to increased drift from the rain event that occurred the night before sampling. Conductivity was lower suggesting improvements from 2004 when levels were between 220 and 340 µS/cm. This stream drains northern portions of urban Roxboro and active row crop agriculture was noted upstream. This site may suffer from several variables including both point and nonpoint source pollution in addition to lack of substrate favorable to many rheophilic EPT taxa.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
AARONS CR	SR 1400	05/26/09	NF31	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRANVILLE	6	03010104	36.53166667	-78.73916667	22-59	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	27.6	370	8	0.4	Yes

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	100	0	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	21.1
Dissolved Oxygen (mg/L)	7.2
Specific Conductance (µS/cm)	76
pH (s.u.)	6.0

Water Clarity: Clear, easily silted

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	12
Pool Variety (10)	8
Riffle Habitat (16)	12
Erosion (7)	6
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**88**

Site Photograph

Substrate: Cobble, boulder, gravel

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/26/09	2009-45	16	50	Good
04/28/04	2004-25	15	46	Good

Most Abundant Species 2009: Fantail Darter (30%), Crescent Shiner (28%)

Exotic Species 2009: Green Sunfish, Bluegill, Redear Sunfish

Species Change Since Last Cycle: **Gains** -- Whitemouth Shiner, Pirate Perch, Redear Sunfish, Carolina Darter, **Losses** -- Rosyside Dace, Eastern Mosquitofish. All species gained or lost were represented by 1-5 fish/species.

Data Analysis

Watershed -- drains the extreme northeast corner of Person and the extreme northwest corner of Granville counties; no municipalities in the watershed; **Habitats** -- regional reference site, a typical Carolina Slate Belt-type stream with high quality instream and riparian habitat characteristics; shallow pools and riffles, undercuts, clay banks, blow-out on upper left bank at end of reach. **2009** -- one-half the number of fish collected in 2009 than in 2004 (397 *vs*. 791), especially Crescent Shiner (111 *vs*. 321); Carolina Darter [Special Concern] collected for the first time; a slight increase in the overall diversity and diversity of darters increased the NCIBI score, but not the rating; no change in the other metrics, trophic metrics very stable. **2004 & 2009** -- only 19 species known from this site, including 5 species of sunfish and 3 species of darters, but no intolerant species; dominant species is the Crescent Shiner; very possible that the flow in this stream becomes very reduced during dry periods and this may have caused the lower than expected NCIBI score and rating for a reference site.

APPENDIX 2-C

AMBIENT MONITORING SYSTEMS
STATION DATA SHEETS
FOR THE LOWER DAN RIVER SUBBASIN

Ambient Monitoring System Station Summaries
NCDENR, Division of Water Quality
Basinwide Assessment Report

Location: DAN RIV AT NC 57 AT VA LINE AT MILTON
Station #: N3500000 **Hydrologic Unit Code:** 03010104
Latitude: 36.54079 **Longitude:** -79.21422 **Stream class:** C
Agency: NCAMBNT **NC stream index:** 22-(39)

Time period: 01/12/2005 to 12/03/2009

	# results	# ND	EL	Results not meeting EL #	%	%Conf	Percentiles Min	10th	25th	50th	75th	90th	Max
Field													
D.O. (mg/L)	57	0	<4	0	0		6	6.6	7.3	9.5	11.4	13	13.9
	57	0	<5	0	0		6	6.6	7.3	9.5	11.4	13	13.9
pH (SU)	57	0	<6	0	0		6.4	7	7.2	7.5	7.7	7.8	8.2
	57	0	>9	0	0		6.4	7	7.2	7.5	7.7	7.8	8.2
Spec. conductance (umhos/cm at 25°C)	56	0	N/A				68	84	102	127	165	258	293
Water Temperature (°C)	57	0	>32	0	0		4.4	7.2	10.6	17.3	25.1	27.2	29.8
Other													
TSS (mg/L)	20	4	N/A				3	5.8	8.9	12	18.2	172	185
Turbidity (NTU)	57	0	>50	13	22.8	99.9	2.5	3.7	5.9	11	35.5	164	240
Metals (ug/L)													
Aluminum, total (Al)	8	0	N/A				120	120	335	515	2480	5100	5100
Arsenic, total (As)	9	9	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	9	9	>2	0	0		1	1	2	2	2	2	2
Chromium, total (Cr)	9	9	>50	0	0		10	10	25	25	25	25	25
Copper, total (Cu)	9	5	>7	0	0		2	2	2	2	4	6	6
Iron, total (Fe)	8	0	>1000	3	37.5		410	410	755	1000	3575	7100	7100
Lead, total (Pb)	9	9	>25	0	0		10	10	10	10	10	10	10
Mercury, total (Hg)	8	8	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	9	9	>88	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	9	6	>50	0	0		10	10	10	10	15	46	46

Fecal Coliform Screening(#/100mL)

# results:	Geomean:	# > 400:	% > 400:	%Conf:
57	95	13	22.8	76.2

Key:
result: number of observations
ND: number of observations reported to be below detection level (non-detect)
EL: Evaluation Level; applicable numeric or narrative water quality standard or action level
Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : States the percent statistical confidence that the actual percentage of exceedances is at least 10% (20% for Fecal Coliform)
Stations with less than 10 results for a given parameter were not evaluated for statistical confidence

Location: HYCO RIV BELOW AFTERBAY DAM NR MCGHEES MILL

Station #: N4250000 **Hydrologic Unit Code:** 03010104

Latitude: 36.52353 **Longitude:** -78.99600 **Stream class:** C

Agency: NCAMBNT **NC stream index:** 22-58-(9.5)

Time period: 01/10/2005 to 11/16/2009

	# results	# ND	EL	Results not meeting EL #	%	%Conf	Percentiles Min	10th	25th	50th	75th	90th	Max
Field													
D.O. (mg/L)	46	0	<4	0	0		6.3	6.7	7.1	9	10.9	11.8	12.6
	46	0	<5	0	0		6.3	6.7	7.1	9	10.9	11.8	12.6
pH (SU)	48	0	<6	1	2.1		5.9	6.4	6.6	7.1	7.3	7.4	7.8
	48	0	>9	0	0		5.9	6.4	6.6	7.1	7.3	7.4	7.8
Salinity (ppt)	8	0	N/A				0	0	0.1	0.1	0.1	0.1	0.1
Spec. conductance (umhos/cm at 25°C)	47	0	N/A				104	107	110	124	178	255	285
Water Temperature (°C)	48	0	>32	0	0		5.2	7.9	9.5	17.3	23.3	26.1	28.9
Other													
TSS (mg/L)	18	7	N/A				3	3.7	4.7	6.2	6.6	10.2	12
Turbidity (NTU)	47	0	>50	0	0		2.3	3.2	4	4.9	5.9	8.5	9.7
Metals (ug/L)													
Aluminum, total (Al)	8	0	N/A				160	160	160	215	368	410	410
Arsenic, total (As)	9	9	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	9	9	>2	0	0		1	1	2	2	2	2	2
Chromium, total (Cr)	9	9	>50	0	0		10	10	25	25	25	25	25
Copper, total (Cu)	9	6	>7	0	0		2	2	2	2	2	2	2
Iron, total (Fe)	8	0	>1000	0	0		250	250	275	405	520	860	860
Lead, total (Pb)	9	9	>25	0	0		10	10	10	10	10	10	10
Mercury, total (Hg)	8	8	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	9	9	>88	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	9	7	>50	0	0		10	10	10	10	12	17	17

Fecal Coliform Screening(#/100mL)

# results:	Geomean:	# > 400:	% > 400:	%Conf:
44	9.1	0	0	

Key:
result: number of observations
ND: number of observations reported to be below detection level (non-detect)
EL: Evaluation Level; applicable numeric or narrative water quality standard or action level
Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : States the percent statistical confidence that the actual percentage of exceedances is at least 10% (20% for Fecal Coliform)
Stations with less than 10 results for a given parameter were not evaluated for statistical confidence

Ambient Monitoring System Station Summaries
NCDENR, Division of Water Quality
Basinwide Assessment Report

Location: MARLOWE CRK AT SR 1322 NR WOODSDALE

Station #: N4400000 **Hydrologic Unit Code:** 03010104

Latitude: 36.48325 **Longitude:** -78.97941 **Stream class:** C

Agency: NCAMBNT **NC stream index:** 22-58-12-6

Time period: 01/10/2005 to 11/16/2009

	# results	# ND	EL	Results not meeting EL #	%	%Conf	Percentiles Min	10th	25th	50th	75th	90th	Max
Field													
D.O. (mg/L)	46	0	<4	0	0		6.5	6.9	7.6	9.3	12.1	13.5	14.2
	46	0	<5	0	0		6.5	6.9	7.6	9.3	12.1	13.5	14.2
pH (SU)	48	0	<6	0	0		6.2	6.5	6.8	7.1	7.4	7.7	8.8
	48	0	>9	0	0		6.2	6.5	6.8	7.1	7.4	7.7	8.8
Salinity (ppt)	8	0	N/A				0.1	0.1	0.1	0.1	0.2	0.3	0.3
Spec. conductance (umhos/cm at 25°C)	47	0	N/A				114	156	184	263	405	582	729
Water Temperature (°C)	48	0	>32	0	0		2.2	6.2	9.9	15.1	21.9	23.6	26.3
Other													
TSS (mg/L)	18	8	N/A				2.5	3.7	6.2	7	12.5	22.8	66
Turbidity (NTU)	47	0	>50	2	4.3		1.2	2.4	3.6	4.9	8.8	21	65
Nutrients (mg/L)													
NH3 as N	1	1	N/A				0.02	0.02	0.02	0.02	0.02	0.02	0.02
NO2 + NO3 as N	1	0	N/A				0.87	0.87	0.87	0.87	0.87	0.87	0.87
TKN as N	1	0	N/A				0.53	0.53	0.53	0.53	0.53	0.53	0.53
Total Phosphorus	1	0	N/A				0.3	0.3	0.3	0.3	0.3	0.3	0.3
Metals (ug/L)													
Aluminum, total (Al)	9	0	N/A				100	100	170	360	755	1000	1000
Arsenic, total (As)	9	9	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	9	9	>2	0	0		1	1	2	2	2	2	2
Chromium, total (Cr)	9	9	>50	0	0		10	10	25	25	25	25	25
Copper, total (Cu)	9	1	>7	2	22.2		2	2	4	4	7	16	16
Iron, total (Fe)	9	0	>1000	1	11.1		190	190	415	570	845	2200	2200
Lead, total (Pb)	9	9	>25	0	0		10	10	10	10	10	10	10
Mercury, total (Hg)	8	8	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	9	9	>88	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	9	0	>50	4	44.4		12	12	26	46	57	630	630

Fecal Coliform Screening(#/100mL)

# results:	Geomean:	# > 400:	% > 400:	%Conf:
47	81.7	5	10.6	

Key:
result: number of observations
ND: number of observations reported to be below detection level (non-detect)
EL: Evaluation Level; applicable numeric or narrative water quality standard or action level
Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : States the percent statistical confidence that the actual percentage of exceedances is at least 10% (20% for Fecal Coliform)
Stations with less than 10 results for a given parameter were not evaluated for statistical confidence

Location: HYCO RIV AT US 501 NR DENNISTON VA

Station #: N4510000 **Hydrologic Unit Code:** 03010104

Latitude: 36.58805 **Longitude:** -78.89814 **Stream class:** III NT

Agency: NCAMBNT **NC stream index:**

Time period: 01/10/2005 to 11/16/2009

	# results	# ND	EL	Results not meeting EL #	%	%Conf	Min	10th	25th	50th	75th	90th	Max
Field													
D.O. (mg/L)	46	0	N/A				5.9	6.4	6.9	8.7	10.8	11.7	12.6
pH (SU)	48	0	N/A				6.2	6.2	6.7	7	7.2	7.5	7.9
Salinity (ppt)	8	0	N/A				0.1	0.1	0.1	0.1	0.1	0.1	0.1
Spec. conductance (umhos/cm at 25°C)	47	0	N/A				102	130	144	168	193	234	265
Water Temperature (°C)	48	0	N/A				3.9	5.7	9	15.3	23.6	26	27.2
Other													
TSS (mg/L)	18	10	N/A				2.5	2.5	3.9	6.2	6.9	21.5	35
Turbidity (NTU)	47	0	N/A				1.7	2.8	4.1	6.3	10	27	95
Metals (ug/L)													
Aluminum, total (Al)	9	0	N/A				87	87	109	200	660	1600	1600
Arsenic, total (As)	9	9	N/A				5	5	5	5	5	5	5
Cadmium, total (Cd)	9	9	N/A				1	1	2	2	2	2	2
Chromium, total (Cr)	9	9	N/A				10	10	25	25	25	25	25
Copper, total (Cu)	9	3	N/A				2	2	2	2	3	4	4
Iron, total (Fe)	9	0	N/A				99	99	470	580	1095	2300	2300
Lead, total (Pb)	9	9	N/A				10	10	10	10	10	10	10
Manganese, total (Mn)	4	0	N/A				120	120	128	155	160	160	160
Mercury, total (Hg)	8	8	N/A				0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	9	9	N/A				10	10	10	10	10	10	10
Zinc, total (Zn)	9	6	N/A				10	10	10	10	16	41	41

Fecal Coliform Screening(#/100mL)

# results:	Geomean:	# > 400:	% > 400:	%Conf:
47	61	1	2.1	

Key:
result: number of observations
ND: number of observations reported to be below detection level (non-detect)
EL: Evaluation Level; applicable numeric or narrative water quality standard or action level
Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : States the percent statistical confidence that the actual percentage of exceedances is at least 10% (20% for Fecal Coliform)
Stations with less than 10 results for a given parameter were not evaluated for statistical confidence

Ambient Monitoring System Station Summaries
NCDENR, Division of Water Quality
Basinwide Assessment Report

Location: MAYO CRK AT SR 1501 NR BETHEL HILL
Station #: N4590000 **Hydrologic Unit Code:** 03010104
Latitude: 36.54021 **Longitude:** -78.87362 **Stream class:** C
Agency: NCAMBNT **NC stream index:** 22-58-15-(3.5)

Time period: 01/10/2005 to 11/16/2009

	# results	# ND	EL	Results not meeting EL #	%	%Conf	Percentiles Min	10th	25th	50th	75th	90th	Max
Field													
D.O. (mg/L)	46	0	<4	0	0		6.4	7	8.1	9.5	11.1	11.6	12.6
	46	0	<5	0	0		6.4	7	8.1	9.5	11.1	11.6	12.6
pH (SU)	48	0	<6	0	0		6.1	6.4	6.5	7	7.3	7.7	8.4
	48	0	>9	0	0		6.1	6.4	6.5	7	7.3	7.7	8.4
Salinity (ppt)	8	0	N/A				0	0	0	0.05	0.1	0.1	0.1
Spec. conductance (umhos/cm at 25°C)	47	0	N/A				92	97	113	119	128	140	160
Water Temperature (°C)	48	0	>32	0	0		4.7	7.2	9.8	16.3	22.1	24.9	31.6
Other													
TSS (mg/L)	18	14	N/A				2.5	2.5	2.5	6.2	6.2	6.3	7
Turbidity (NTU)	47	10	>50	0	0		1	1	1	1.3	2	2.9	3.9
Metals (ug/L)													
Aluminum, total (Al)	9	3	N/A				50	50	50	58	76	210	210
Arsenic, total (As)	9	9	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	9	9	>2	0	0		1	1	2	2	2	2	2
Chromium, total (Cr)	9	9	>50	0	0		10	10	25	25	25	25	25
Copper, total (Cu)	9	7	>7	0	0		2	2	2	2	2	3	3
Iron, total (Fe)	9	3	>1000	0	0		50	50	50	72	102	670	670
Lead, total (Pb)	9	9	>25	0	0		10	10	10	10	10	10	10
Mercury, total (Hg)	8	8	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	9	9	>88	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	9	7	>50	0	0		10	10	10	10	11	14	14

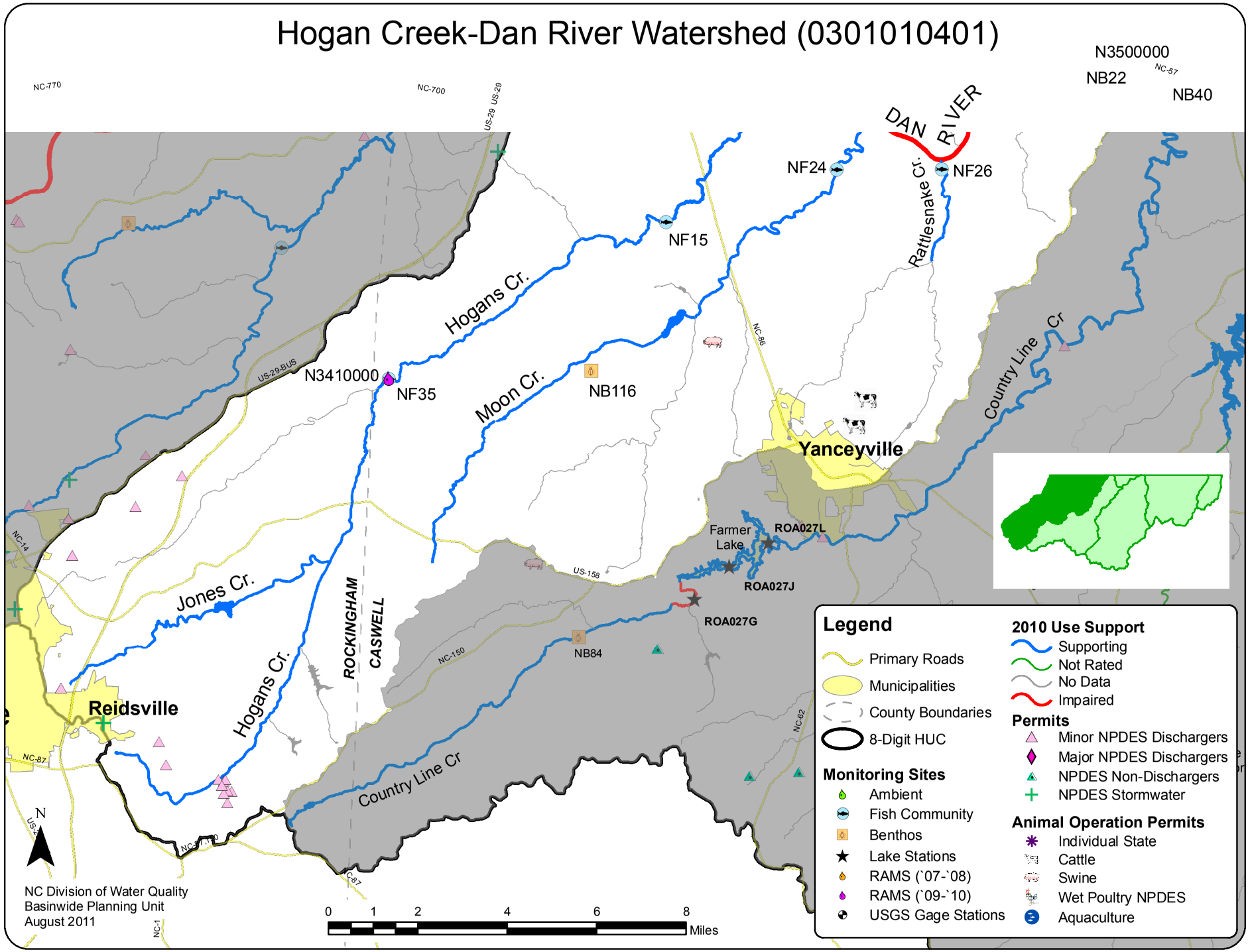
Fecal Coliform Screening(#/100mL)

# results:	Geomean:	# > 400:	% > 400:	%Conf:
46	7.6	1	2.2	

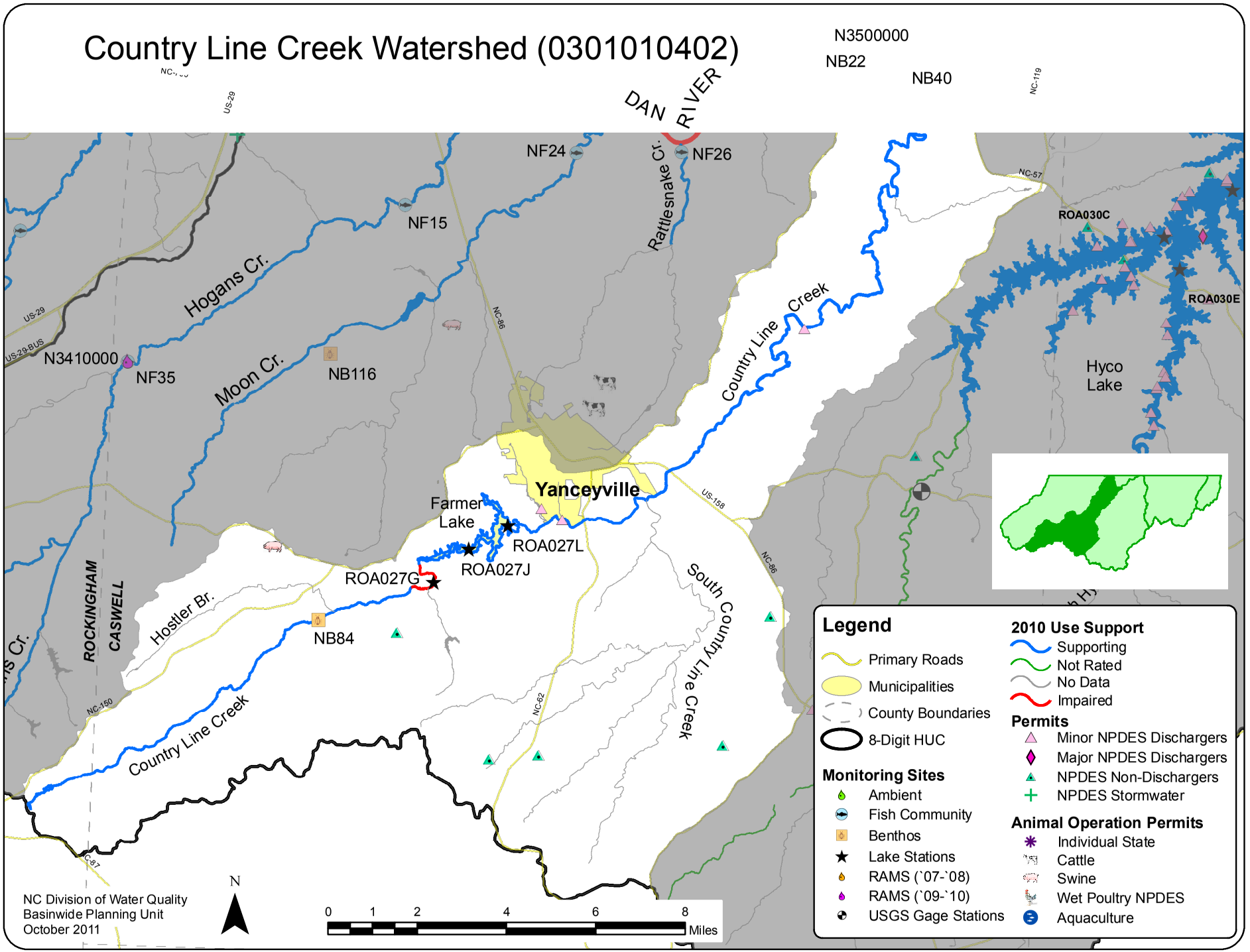
Key:
result: number of observations
ND: number of observations reported to be below detection level (non-detect)
EL: Evaluation Level; applicable numeric or narrative water quality standard or action level
Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : States the percent statistical confidence that the actual percentage of exceedances is at least 10% (20% for Fecal Coliform)
Stations with less than 10 results for a given parameter were not evaluated for statistical confidence

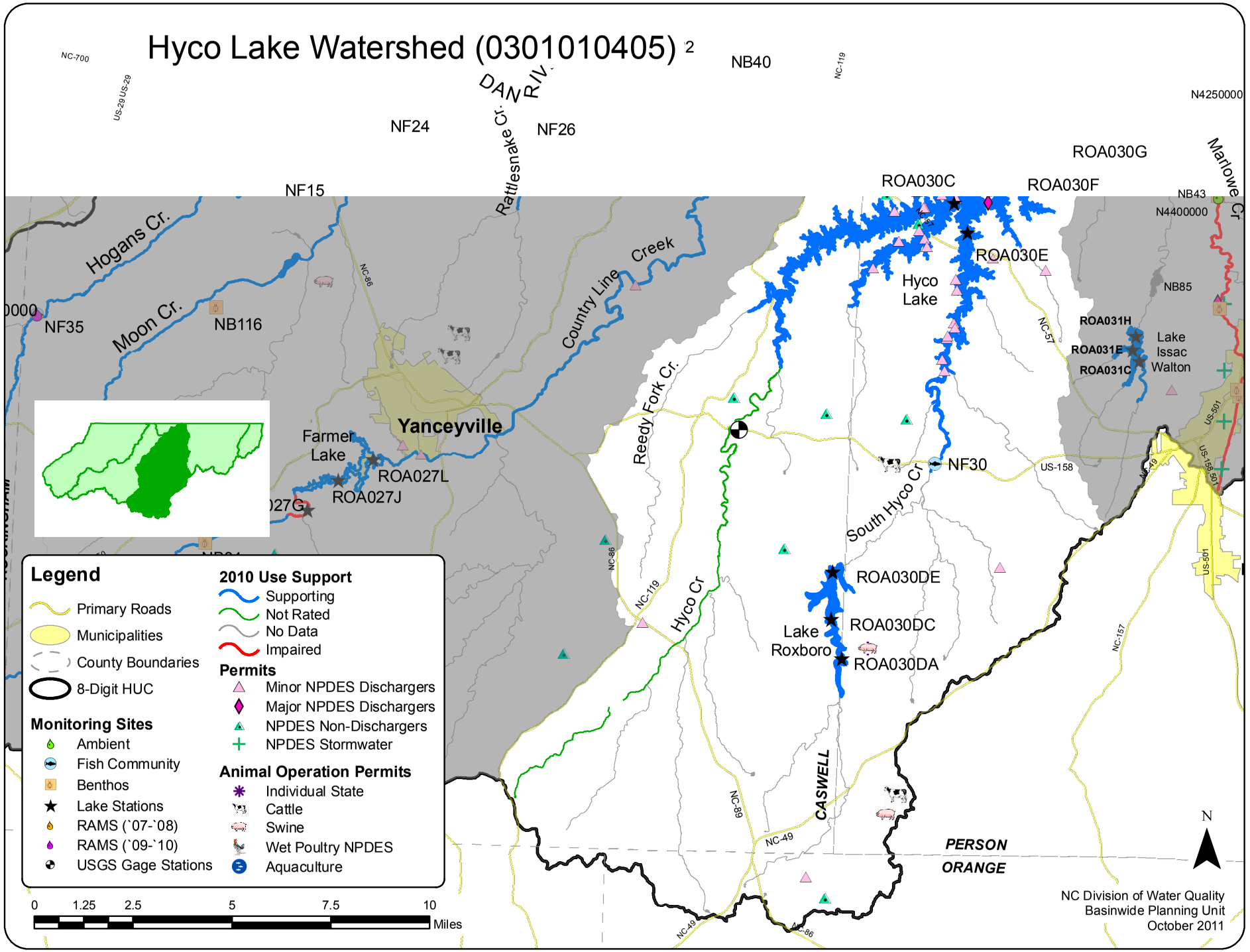
APPENDIX 2-D

10-DIGIT WATERSHED MAPS FOR THE LOWER DAN RIVER SUBBASIN

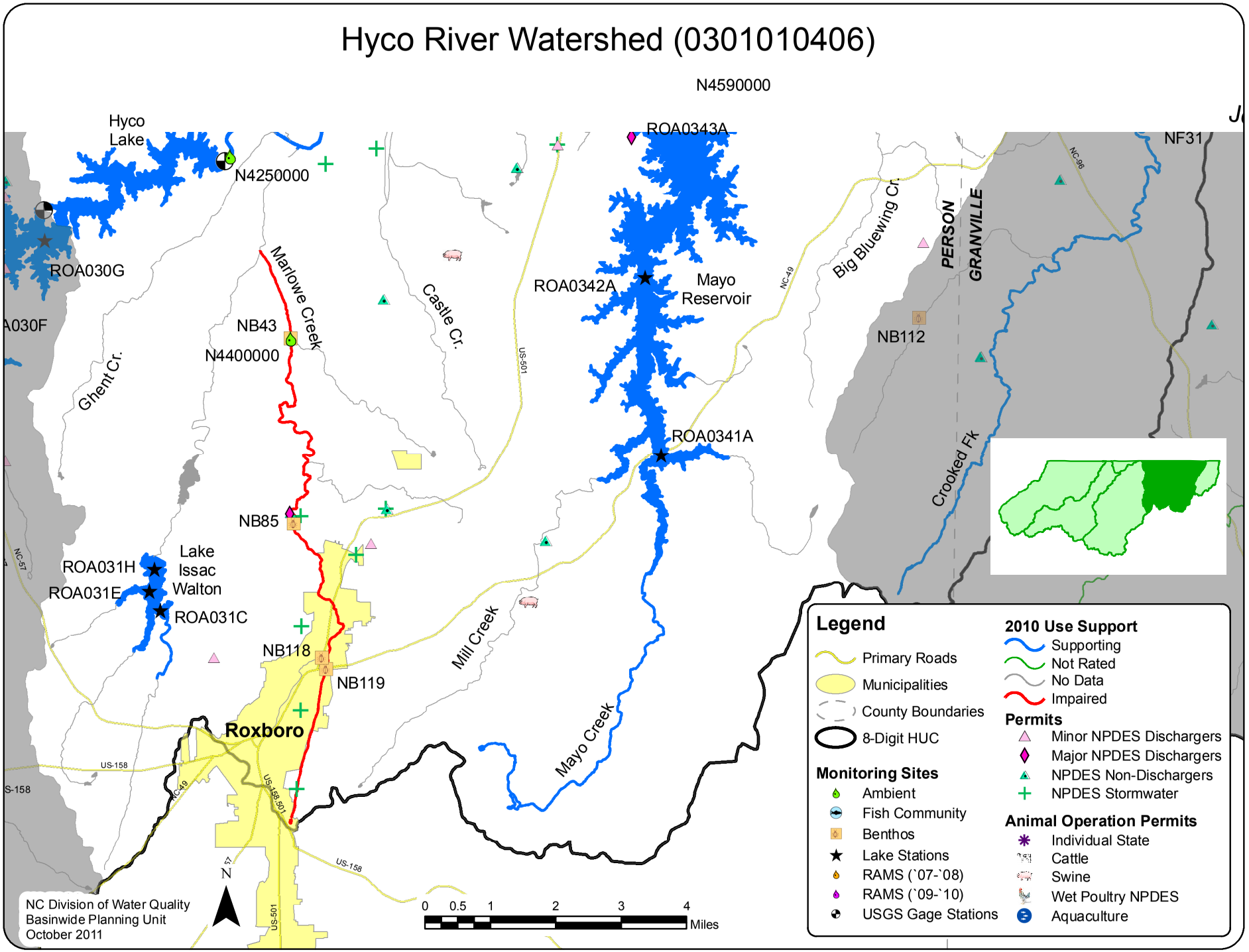

Hogan Creek-Dan River Watershed (0301010401)
N3500000
NB22
NB40
DAN RIVER
NF24
NF26
Rattlesnake Cr.
NF15
Hogans Cr.
N3410000
NF35
Moon Cr.
NB116
Country Line Cr
Yanceyville
Farmer Lake
ROA027L
ROA027J
ROA027G
NB84
Jones Cr.
ROCKINGHAM
CASWELL
Hogans Cr.
Reidsville
Country Line Cr
NC-770
NC-700
US-29 US-29
US-29-BUS
NC-86
US-158
NC-150
NC-62
NC-87
NC-14
NC-57
N
NC Division of Water Quality
Basinwide Planning Unit
August 2011
0 1 2 4 6 8
Miles
Legend
Primary Roads
Municipalities
County Boundaries
8-Digit HUC
Monitoring Sites
Ambient
Fish Community
Benthos
Lake Stations
RAMS (`07-`08)
RAMS (`09-`10)
USGS Gage Stations
2010 Use Support
Supporting
Not Rated
No Data
Impaired
Permits
Minor NPDES Dischargers
Major NPDES Dischargers
NPDES Non-Dischargers
NPDES Stormwater
Animal Operation Permits
Individual State
Cattle
Swine
Wet Poultry NPDES
Aquaculture

Country Line Creek Watershed (0301010402)

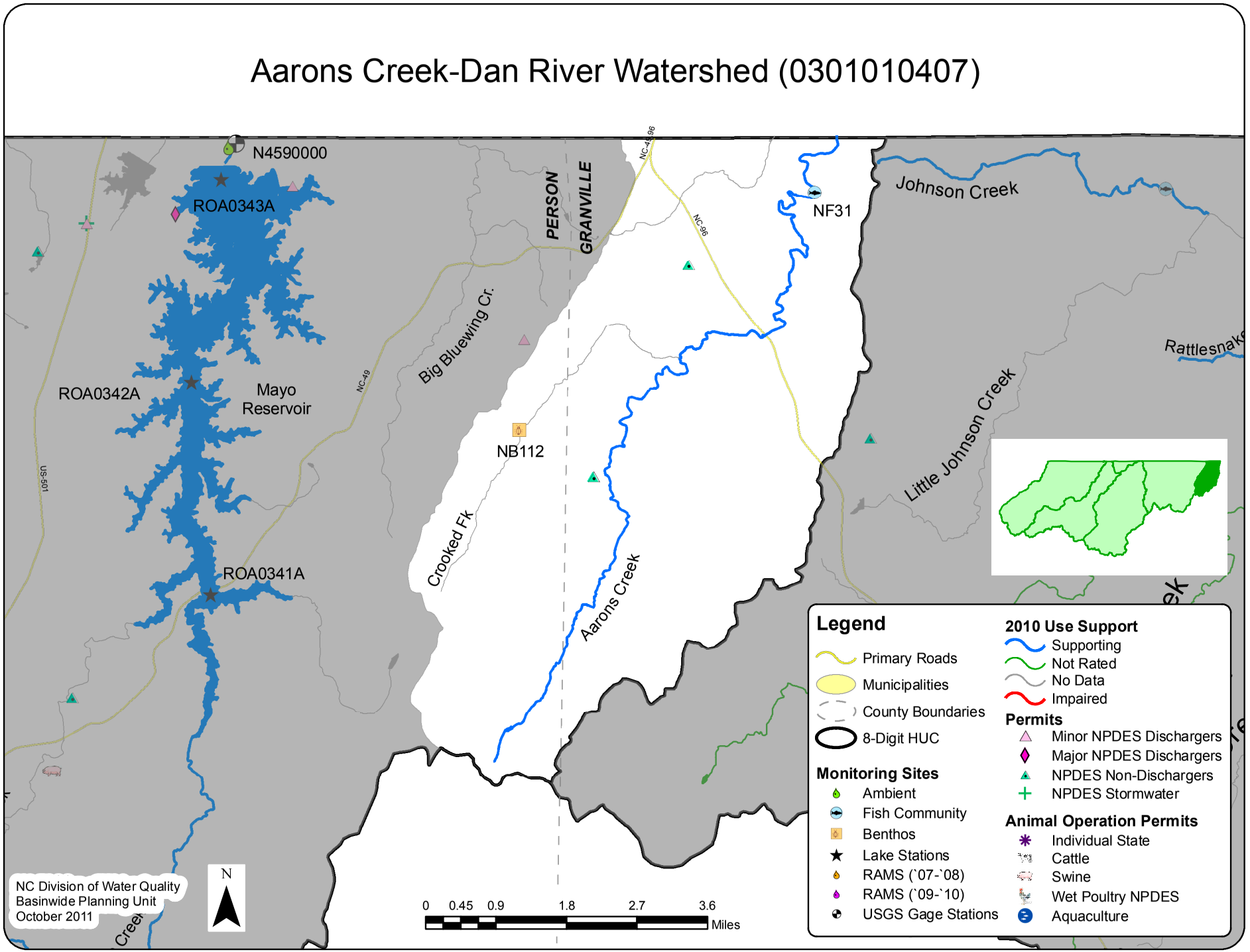


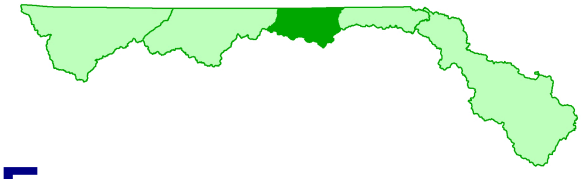

Hyco Lake Watershed (0301010405)
NC-700
US-29 US-29
NF24
DAN RIV
Rattlesnake Cr.
NF26
NB40
NC-119
N4250000
ROA030G
Marlowe Cr
NF15
ROA030C
ROA030F
NB43
N4400000
Hogans Cr.
Moon Cr.
NF35
NB116
NC-86
Country Line Creek
ROA030E
Hyco Lake
NB85
NC-57
ROA031H
ROA031E
ROA031C
Lake Issac Walton
Reedy Fork Cr.
Yanceyville
Farmer Lake
ROA027L
ROA027J
NF30
US-158
US-501
South Hyco Cr
ROA030DE
Hyco Cr
NC-119
Lake Roxboro
ROA030DC
ROA030DA
NC-157
CASWELL
NC-89
NC-49
PERSON
ORANGE
N
Legend
Primary Roads
Municipalities
County Boundaries
8-Digit HUC
Monitoring Sites
Ambient
Fish Community
Benthos
Lake Stations
RAMS (`07-`08)
RAMS (`09-`10)
USGS Gage Stations
2010 Use Support
Supporting
Not Rated
No Data
Impaired
Permits
Minor NPDES Dischargers
Major NPDES Dischargers
NPDES Non-Dischargers
NPDES Stormwater
Animal Operation Permits
Individual State
Cattle
Swine
Wet Poultry NPDES
Aquaculture
0 1.25 2.5 5 7.5 10
Miles
NC Division of Water Quality
Basinwide Planning Unit
October 2011

Hyco River Watershed (0301010406)



Aarons Creek-Dan River Watershed (0301010407)





CHAPTER 3

Middle Roanoke River Subbasin

HUC 03010102

Includes: Grassy Creek, Island Creek, Little Island Creek, Nutbush Creek & John H. Kerr Reservoir

Subbasin Water Quality Overview

The Middle Roanoke River Subbasin located around the middle of the basin along the North Carolina/Virginia state line, contains one Impaired stream; Nutbush Creek is Impaired for biological integrity. During this assessment cycle (2004-2009), the subbasin experienced prolonged drought between 2007 and 2008.

The John H. Kerr Dam and Reservoir Section 216 Feasibility Study project is partially located in this subbasin. The project area also includes HUCs 03010106 and 03010107. The study has focused on examining the feasibility of addressing downstream environmental resource concerns in the Lower Roanoke River drainage area through changes in operations or structures at the John H. Kerr Dam and Reservoir. Along with USACE, the non-federal cost sharing partners for this study are Virginia, and North Carolina. The process includes forming diverse workgroups, conducting a wide range of studies and developing a plan of recommendations. The project is currently completing phase 2 and beginning phase 3, the final phase. A more detailed description of the project is found in the Additional Study section.

Subbasin at a Glance

Counties:

Granville, Vance, & Warren

Municipalities:

Stovall, Henderson, & Middleburg

Ecoregions:

Southern Outer Piedmont, & Northern Outer Piedmont

Permitted Facilities:

NPDES Dischargers: 5
- Major 1
- Minor 2
- General 2

NPDES Non-Dischargers:.....4
Stormwater: 13
- General 13
- Individual 0

Animal Operations: 2

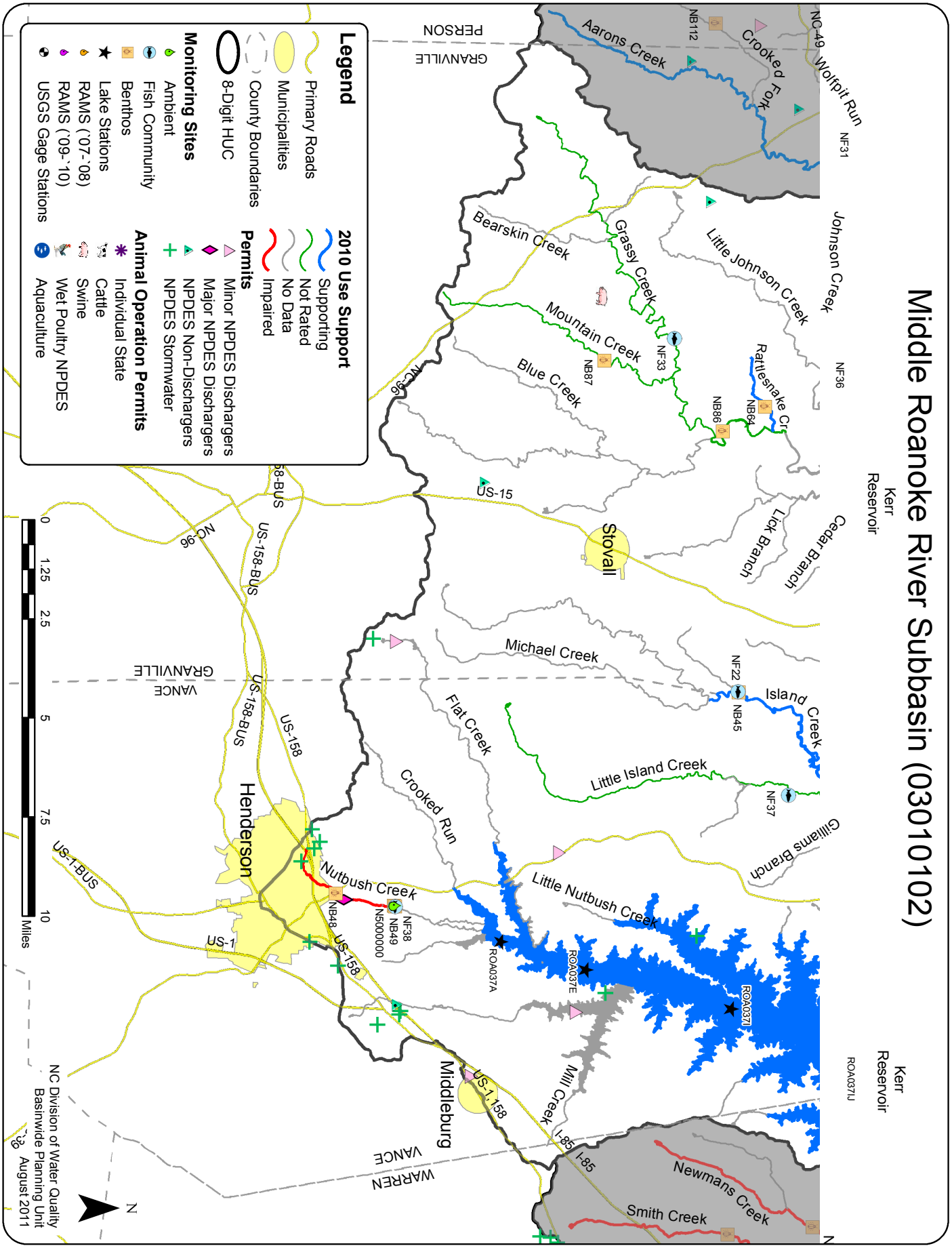
Population:

2010 Census.....22,444

2006 Land Cover:

Open Water.....5.4%
Developed.....6.0%
Forest 60.5%
Agriculture.....15.2%
Wetlands.....1.9%
Barren Land 0.2%
Shrub/Grassland 10.8%

FIGURE 3-1: MIDDLE ROANOKE RIVER SUBBASIN (03010102)



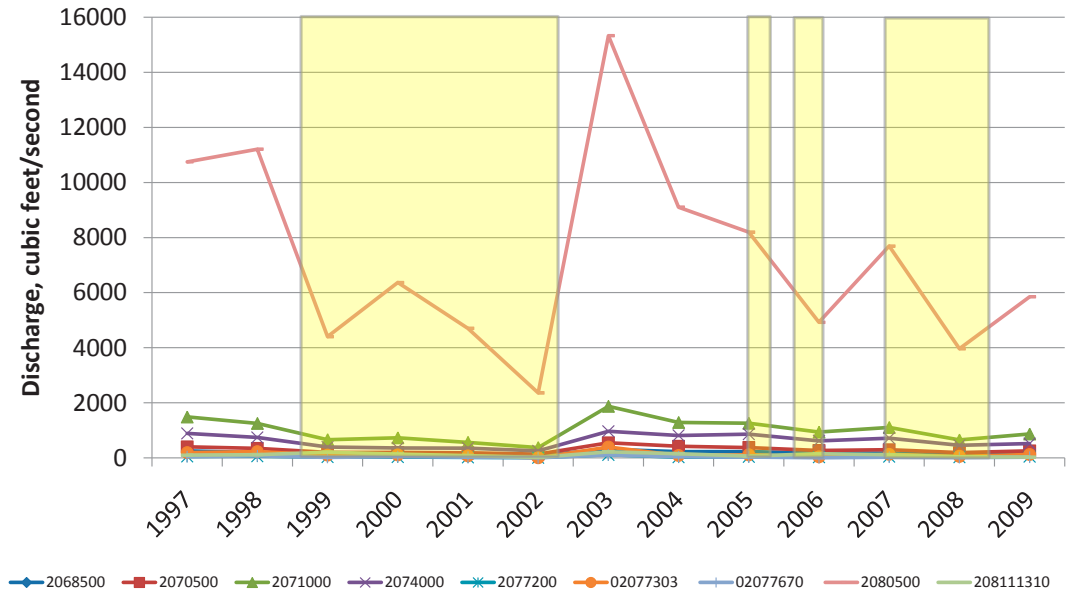
Water Quality Data Summary for this Subbasin

Monitoring stream flow, aquatic biology and chemical/physical parameters is a large part of the basinwide planning process. More detailed information about DWQ monitoring and the effects each parameter has on water quality is discussed in Chapters 2 and 3 of the Supplemental Guide to North Carolina's Basinwide Planning document.

Stream Flow

The basin experienced prolonged droughts from 1998-2002 and again from 2007-2008, with moderate droughts in 2005 and 2006 (Figure 3-2). More detail about flows in the Roanoke River Basin can be found in the 2010 Roanoke River Basinwide Assessment Report produced by DWQ-Environmental Science Section.

Figure 3-2: Yearly Flow Rates (cfs) of the USGS Gage Stations in the Roanoke River Basin Between 1997 & 2009



From Left to Right:

- 2068500: Dan River (Francisco)
- 2070500: Mayo River
- 2071000: Dan River (Wentworth)
- 2074000: Smith River
- 2077200: Hyco Creek (Leasburg)
- 2077303: Hyco Creek (McGehees)
- 2077670: Mayo Creek
- 2080500: Roanoke River
- 208111310: Cashie River

Biological Data

Biological samples were collected during the spring and summer months of 2009 by the DWQ-Environmental Sciences Section as part of the five year basinwide sampling cycle, in addition to special studies. Overall, seven biological sampling sites were monitored within the Middle Roanoke River Subbasin. The ratings for each station can be seen in Appendix 3-B.

Benthic Macroinvertebrate Sampling

Each benthic station monitored during the current cycle is shown in Figure 3-3 and color coded based on the current rating. Each of the sites are discussed in more detail in the watershed section below. Figure 3-5 is a comparison of benthic site ratings sampled during the last two basinwide cycles to indicate if there are any overall shifts in ratings. Benthic ratings from this cycle are similar to those received during the previous cycle indicating a relatively stable community.

Benthic Sampling Summary

Total Stations Monitored	4
Total Samples Taken	4
Number of New Stations	1

Figure 3-3: Benthic Stations Color Coded by Current Rating in the Middle Roanoke River Subbasin

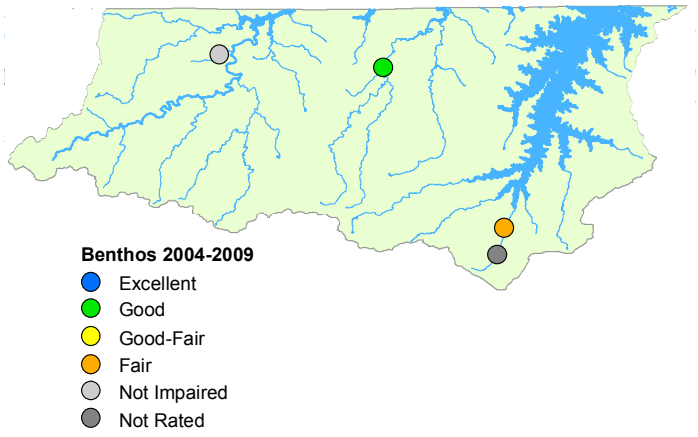


Figure 3-4: Current Benthic Site Ratings

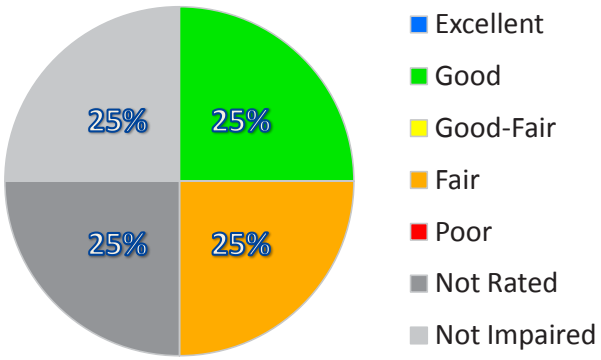
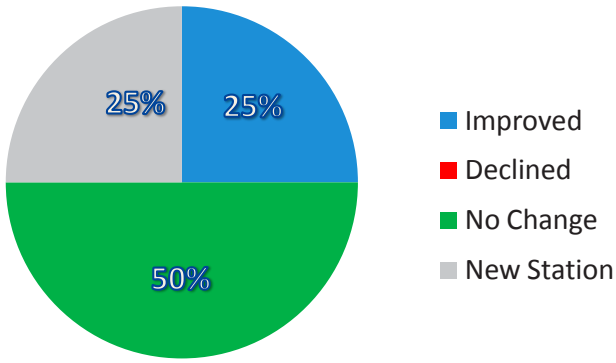


Figure 3-5: Change in Benthic Site Ratings



Fish Community Sampling

Each fish community station monitored during the current cycle is shown in Figure 3-6 and color coded based on the current rating. Each of the sites are discussed in more detail in the watershed section below. Figure 3-7 shows the percentages of each rating given during this sampling cycle within this subbasin. Figure 3-8 is a comparison of fish community site ratings sampled during the last two cycles to determine if there are any overall watershed shifts in ratings. Even though there was a 33% decline in ratings, overall the community is relatively stable.

Fish Com. Sampling Summary

Total Stations Monitored	3
Total Samples Taken	4
Number of New Stations	0

Figure 3-6: Fish Community Stations Color Coded by Current Rating in the Middle Roanoke River Subbasin

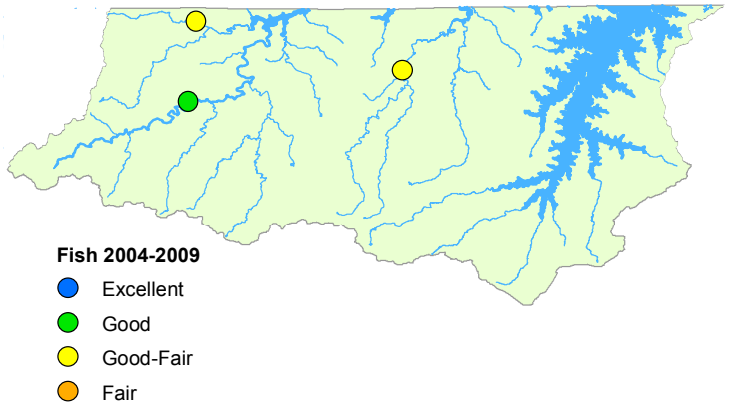


Figure 3-7: Current Fish Community Site Ratings

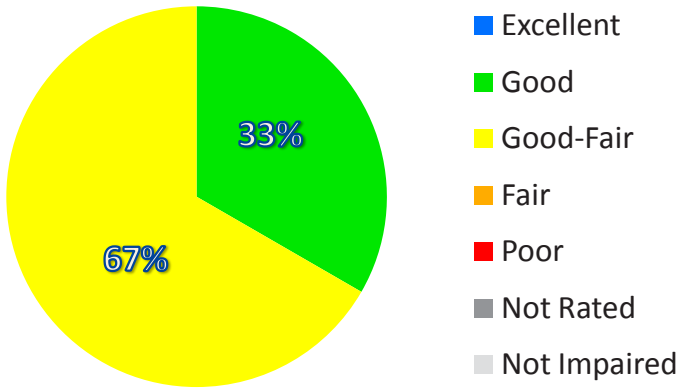
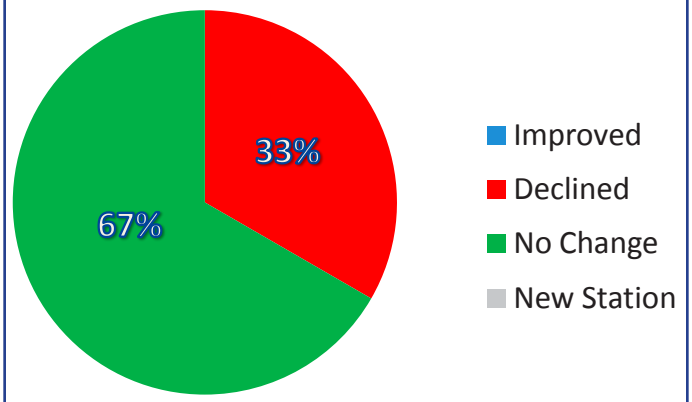


Figure 3-8: Change in Fish Community Site Ratings



For more information about biological data in this subbasin, see the 2010 Roanoke River Basinwide Assessment Report. Detailed data sheets for each sampling site can be found in Appendix 3-B.

Fish Kills/Spill Events During This Cycle

UT to Crooked Creek:

A pond located on a spring fed tributary to Nutbush creek experienced a fish kill event with a mortality count of about 500. A failing septic system from upstream had been piped into a tributary by a property owner for undetermined length of time. Low DO and Nitrates were noted in water samples taken by a private pond management company prior to calling DWQ. Aerators had been put in the pond by the time DWQ was contacted so DO levels were acceptable upon investigation. DWQ followed the progression of the pond for several weeks. Correcting the upstream problem appeared to solve the problems in the pond.

Ambient Data

The ambient data are used to develop use support ratings every two years, which are then reported to the EPA via the Integrated Report (IR). The IR is a collection of all monitored waterbodies in North Carolina and their water quality ratings. The most current IR is the 2010 version and is based on data collected between 2004 and 2008. The ambient data reported in this basin plan were collected between 2005 and 2009 and will be used for the 2012 IR. If a waterbody receives an Impaired rating, it is then placed on the 303(d) Impaired Waters List. The Roanoke River Basin portion of the 2010 IR can be found in Appendix 3-A and the full 2010 IR can be found on the Modeling & TMDL Unit's website.

One Ambient Monitoring System (AMS) station is located in the Middle Roanoke River subbasin (see Figure 3-1 for the station location). During the current sampling cycle (January 2005 and December 2009), samples were collected for all parameters on a monthly basis except metals which were sampled quarterly until May 2007 when metals sampling was suspended. For more information about the ambient monitoring, parameters, how data are used for use support assessment and other information, see Chapter 2 of the **Supplemental Guide to North Carolina's Basinwide Planning**.

Long Term Ambient Monitoring

The following discussion of ambient monitoring parameters of concern include graphs showing the median and mean concentration values for ambient station N5000000 in this subbasin by specific parameter over a 13 year period (1997-2009). The geometric mean is a type of mean or average, which indicates the central tendency or typical value of a set of numbers. The graphs are not intended to provide statistically significant trend information, but rather an idea of how changes in land use or climate conditions can affect parameter readings over the long term. The difference between median and mean results indicate the presence of outliers in the data set. Box and whisker plots of individual ambient stations were completed by parameter for data between 2005 and 2009 by DWQ's Environmental Sciences Section (ESS) and can be found in the **Roanoke River Basin Ambient Monitoring System Report**.

Fecal Coliform Bacteria

Fecal coliform bacteria (FCB) occurs in water as a result of nonpoint sources such as animal waste from wildlife, farm animals and/or pets, as well as from sanitary sewer overflows (SSOs). The FCB standard for freshwater streams is not to exceed the geometric mean of 200 colonies/100 ml, or 400 colonies/100 ml in 20% of the samples where five samples have been taken in a span of 30 days (5-in-30). Only results from a 5-in-30 study are used to indicate whether the stream is Impaired or Supporting. Waters with a use classification of B (primary recreational waters) receive priority for 5-in-30 studies. Other waters are studied as resources permit.

As seen in Figure 3-9, 10% of samples taken at station N5000000 during this cycle, resulted in levels over 400 colonies/100 ml. The geometric mean (calculated average) for this basinwide cycle was 115.9 colonies/100 ml at this station. When the geometric mean breaches 200 colonies/100 ml at a station, it is very likely a 5-in-30 study would result in an impairment. Possible sources of the elevated FCB levels at this station are discussed in the watershed section. Figure 3-10 shows the yearly geometric mean for all samples taken over the course of 13 years in the Middle Roanoke River subbasin. The highest yearly geometric mean was recorded in 2003 (222 colonies/100 ml). For additional data from this site, see **Appendix 3-C**.

Figure 3-9: Percentage of Samples with Elevated FCB Levels (2004-2008)

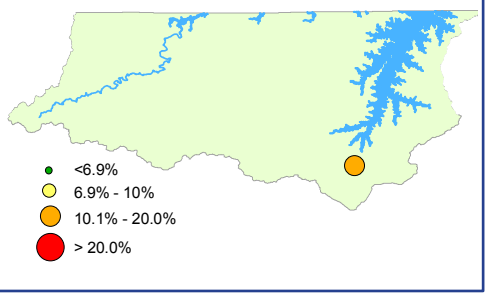
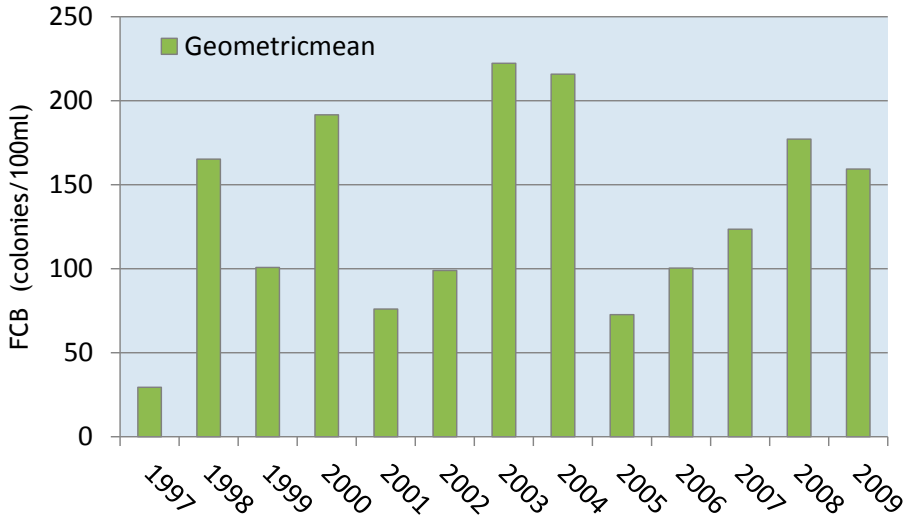


Figure 3-10: Summarized Fecal Coliform Bacteria Values for Data Collected at the Ambient Sampling Station in HUC 03010102



Additional information about possible causes of parameters discussed above for particular stations, see the stream write ups below. For more information regarding any of the parameters listed above, see Section 3.3 of the Supplemental Guide to North Carolina's Basinwide Planning. For additional information about ambient monitoring data collected in this river basin, see the Roanoke River Basin Ambient Monitoring System Report.

Understanding the Data

Biological & Ambient Ratings Converted to Use Support Categories

Biological (benthic and fish community) samples are given a bioclassification/rating based on the data collected at the site by DWQs Environmental Sciences Section (ESS). These bioclassifications include Excellent, Good, Good-Fair, Not Impaired, Not Rated, Fair and Poor. For specific methodology defining how these rating are given see Benthic Standard Operating Procedures (SOP) or the Fish Community SOP. Once a rating is given, it is then translated into a Use Support Category (see Figure 3-11).

Figure 3-11: Use Support Categories for Biological Ratings

Biological Ratings	Aquatic Life Use Support
Excellent	Supporting (Categories 1-2)
Good	
Good-Fair	
Not Impaired	
Not Rated	Not Rated (Category 3)
Fair	Impaired (Categories 4-5)
Poor	

Ambient monitoring data are analyzed based on the percent of samples exceeding the state standard for individual parameters for each site within a five year period. In general, if a standard is exceeded in greater than 10.0% of samples taken for a particular parameter, that stream segment is Impaired for that parameter. The fecal coliform bacteria parameter is exception to the rule. See the Fecal Coliform Bacteria section in the Ambient Data portion below.

Figure 3-12: Category Number to Use Support Rating

Category #	Use Support Rating
1	Supporting
2	
3	Not Rated
4	Impaired
5	

Each biological parameter (benthic and fish community) and each ambient parameter is assigned a Use Support Category based on its rating or percent exceedance. A detailed description of each category can be found on the first page of Appendix 3-A. Each monitored stream segment is given an overall category number which reflects the highest individual parameter category. Figure 3-12 shows how the category number is translated into the use support rating.

Example

Stream A had a benthic sample that rated Good-Fair and 12% of turbidity samples taken at the ambient station were exceeding the standard. The benthic sample would be given an individual category number of 1 (Figure 3-11) and the turbidity parameter would be given a category number of 5 since >10% of samples exceeded the standard. Therefore, stream A's overall category number would be a 5, indicating the stream has a use support rating of Impaired.

Additional Studies

John H. Kerr Dam & Reservoir Virginia & North Carolina (Section 216) Feasibility Study

Summary

The purpose of the feasibility study is to review the operation of the John H. Kerr Dam and Reservoir and provide recommendations to Congress on the advisability of modifying the structure or the structure's operation for improving the quality of the environment in the overall public interest, as authorized under Section 216 of Public Law 91-611, the River and Harbor and Flood Control Act of 1970. Based on the interests of the Sponsors and opportunities for improvement identified to date, the study has focused on examining the feasibility of addressing downstream environmental resource concerns in the Lower Roanoke River through changes in operations or structures at the John H. Kerr Dam and Reservoir. Along with USACE, the non-federal cost sharing partners for this study are the Commonwealth of Virginia, and the State of North Carolina.

The study area encompasses the John H. Kerr Reservoir (Kerr Reservoir) and approximately 1,917 square miles of watershed downstream of the John H. Kerr Dam (Kerr Dam), and is shown in Figure 3-14. The Kerr Dam is located on the Roanoke River, about 178.7 river-miles above the mouth (Figure 3-13). It is in Mecklenburg County, Virginia, 20.3 miles downstream from Clarksville, Virginia, 18 miles upstream from the Virginia-North Carolina border, and 80 miles southwest of Richmond, Virginia. Kerr Reservoir covers nearly 50,000 acres at its normal summer pool and extends about 39 miles up the Roanoke River. The study area includes the Kerr Dam and Reservoir project and the Roanoke River Basin from the Dam downstream to the Albemarle Sound. For this study, the area will be referred to as the Lower Roanoke River Basin. The study area is located in Charlotte, Halifax, Mecklenburg, and Brunswick Counties of Virginia, and in Granville, Vance, Warren, Halifax, Northampton, Bertie, Martin and Washington Counties of North Carolina, and it is located in the 4th and 5th Congressional District of Virginia and the 1st and 13th Congressional Districts of North Carolina.

Figure 3-13: Location of John H. Kerr Reservoir and Dam and downstream dams

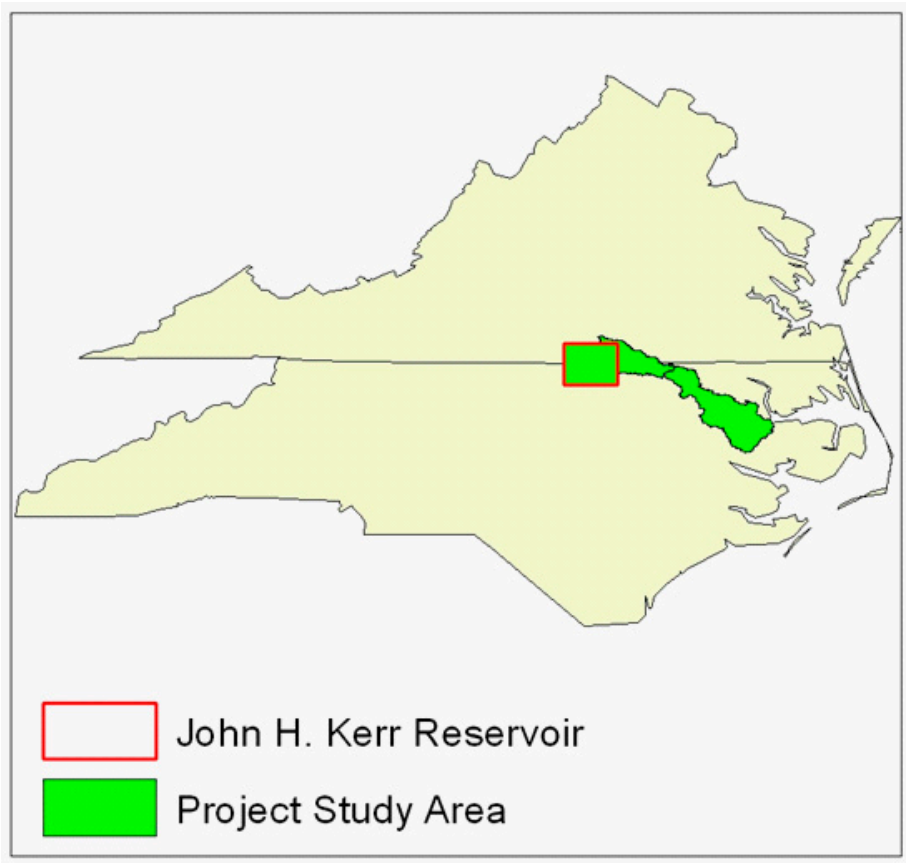
This feasibility study has proceeded in a 3 phase process. In the first phase, 11 subject area work groups were formed, consisting of members from state and federal agencies and non-profit and business organizations. These groups identified problems and opportunities in the watershed, provided input regarding planning objectives and identified constraints for the study, collected existing data, and identified needs for additional data and study. In Phase 2, which is ongoing but nearing completion, technical studies, data collection, and modeling were undertaken to address the needs identified in Phase 1. Phase 3, also currently ongoing, includes the formulation and evaluation of alternative plans, leading to the selection of a tentatively recommended plan and approval of an integrated feasibility report and NEPA Document.

The major problems of interest in the study area that have been identified are:

- Degradation of the lower Roanoke River bottomland hardwood ecosystem due to long-term inundation during flood operations, potentially leading to a 60% decline in habitat quality over the next 50 years in the without project condition.
- Impaired dissolved oxygen (DO) levels below Kerr Dam and in the lower Roanoke River, which has degraded in-stream habitat to a condition which is expected to persist in the future without project condition.
- Bank erosion in the lower Roanoke River, which is estimated at between 27 – 60 mm a year depending on location, and which will continue in the without project condition.
- Loss of connectivity in the Roanoke River due to the presence of the dams, which in particular have prevented and continue to prevent the American shad and American eel from populating upstream areas where they have historically occurred.

Based on the identified problems, opportunities, constraints, and established study planning objectives, a series of management measures, consisting of both structural and operational changes and activities, have been proposed. These measures have undergone a preliminary screening process based on the study planning constraints as well as a simplified cost-effectiveness analysis. The measures that remain from the screening process and that will require more detailed evaluation are:

FIGURE 3-14: LOCATION OF OVERALL PROJECT AREA



- Measure 6B with potentially a duration of release trigger. This operational measure would allow for more frequent 35,000 cfs releases at the reservoir from January 1st to June 30th, thus reducing the duration of 20,000 cfs releases during the growing season, with adjustments to the reservoir guide curve meant to minimize impacts to hydropower revenue.
- Quasi run of the river measure. Under this operational measure, releases from the reservoir would equal the inflows into the reservoir, up to 35,000 cfs, and would be implemented year round.
- Short bursts of higher (>20,000 cfs) releases from Roanoke Rapids Dam. This operational measure would involve having pulses of shorter duration releases at higher flows during the growing season.
- Plug man-made canals that breach the river levee. This structural change would involve identifying and plugging man-made canals that breach the natural river levee and currently allow high flows to enter the floodplain.
- Use Roanoke River Basin Reservoir Operations Model (RRBROM) probabilistic model forecasting. Use of the forecasting component of this model could be used to supplement to assist in water management decisions that could affect the duration of flooding in downstream areas.

- Place a fabric weir upstream of Kerr Dam. This is a structural measure for improving DO between Kerr and Gaston Dams.
- Oxygen or air injection upstream of Kerr Dam. This is a structural measure for improving DO between Kerr and Gaston Dams.
- Implement actions indicated by USGS water quality modeling. Ongoing USGS modeling efforts may suggest additional measures that could improve DO conditions in lower Roanoke River.

Adaptive management, which would include monitoring of project performance, would be a fundamental aspect of any of the remaining measures if they were to be implemented.

The benefits of measures identified to date are non-monetary, National Ecosystem Restoration (NER) benefits and will be quantified in terms of increases over the no-action alternative in average annual ecosystem habitat outputs. The models used for measuring benefits are Habitat Evaluation Procedures (HEP) Habitat Suitability Index (HSI) models, and a Roanoke River riparian wetland assessment model, based on Hydogeomorphic (HGM) principles, that was developed and calibrated specifically for use on this study. Additionally, some measures may result in a loss of National Economic Development (NED) hydropower or flood risk management benefits. Measures will be compared against each other using a trade-off analysis, as gains in one benefit category (NER/ecosystem restoration) will, in some cases, need to be compared to losses in other benefit categories (NED/hydropower and flood damage reduction, for example). The trade-off analysis will be displayed in a system of accounts format.

An appropriate NEPA (EA or EIS) document will be prepared, and will be integrated into the feasibility report. Additional information can be found on the **US Army Corps of Engineers** website or the **Kerr 216 Water Wiki** site.

Schedule

A schedule of completed and anticipated major study milestones over the next 2 years is below:

Task	Date
Feasibility Scoping Meeting	June 22, 2011
Alternative Formulation Briefing Meeting	April 2012
Submittal of Draft Feasibility Report to SAD/ HQ, USACE	December 2012
Distribute Draft Feasibility Report for NEPA/Public review	February 2013
Submit Final Feasibility Report to SAD	July 2013
SAD Submits Final Report to HQ, USACE	August 2013

Recommendations & Action Plans at the Subbasin Scale

DWQ Priority Summary

Table 3-1 is a list of waters in the Middle Roanoke River Subbasin that DWQ has prioritized for restoration/ protection. The order of priority is not based solely on the severity of the steam's impairment or impacts but rather by the need for particular actions to be taken. A stream that is currently supporting its designated uses may be prioritized higher within this table than a stream that is currently impaired. This is based on a more holistic evaluation of the drainage area which includes monitoring results, current and needed restoration/ protection efforts, land use and other activities that could potentially impact water quality in the area. Some supporting streams may have a more urgent need for protections than an impaired stream with restoration needs already being implemented.

The table also lists potential stressors and sources that may be impacting a stream including in-field observations, monitoring data, historical evidence and permit or other violations. Additional study may be needed to determine exact source(s) of the impact. The last column includes a list of recommended actions.

Table 3-1: Notable Waters in the Middle Roanoke River Subbasin (Not Ranked)

Stream Name	AU#	Class.	Potential Stressor(s)	Potential Source(s)	Qualitative Status	Actions Needed
Grassy Creek	23-2-(1) & (6)	C	Low DO, Turbidity	--	Not Rated	--
Johnson Creek	23-2-7-(1)	C	Low DO, Low Flows	--	Supporting	SS
Little Island Creek	23-4-3	C	--	Inactive Hazardous Site	Not Rated	M
Nutbush Creek	23-8-(1)a & b	C	Specific Conductivity, Nutrients	Urban Runoff	Impaired	SS
Kerr Reservoir (Nutbush Creek Arm)	23-8-(2)	B	--	--	Improving	--

Class.: Classification (e.g., C, B, WS-I, WS-II, WS-III, WS-IV, WS-V, Tr, HQW, ORW, SW, UWL)

Stressor: Chemical parameters or physical conditions that at certain levels prevent waterbodies from meeting the standards for their designated use (e.g., low/high DO, nutrients, toxicity, habitat degradation, etc.). Fecal Coliform Bacteria (FCB),

Source: The cause of the stressor. (Volume & Velocity: when a stream receives stormwater runoff at a much higher volume and velocity than it would naturally receive due to ditching, impervious surfaces, etc.)

Status: Impaired, Impacted, Supporting, Improving (For current Use Support Assessment see the Integrated Report.)

Actions Needed: Agriculture BMPs (**Ag**), Best Management Practices (**BMPs**), Daylight Stream (**DS**), Education (**E**), Forestry BMPs (**F**), Local Ordinance (**LO**), Monitoring (**M**), Nutrient Mgnt Controls (**NMC**), Protection (**P**), Restoration (**R**), Riparian Buffer Restoration (**RBR**), Stormwater Controls (**SC**), Sediment and Erosion Control BMPs (**SEC BMPs**), Species Protection Plan (**SPP**), Stressor Study (**SS**), .

Status & Recommendations for Monitored Waters

Understanding this Section

In this Section, more detailed information about stream health, special studies, aquatic life stressors and sources and other additional information is provided by each 10-digit Hydrological Unit Code (HUC). Waterbodies discussed in this Chapter include all monitored streams, whether monitored by DWQ or local agencies with approved methods. Use Support information on all monitored streams within this watershed can be seen on the map in Figure 3-1, and a Use Support list of all monitored waters in this basin can be found in the Use Support Chapter.

Use Support & Monitoring Box:

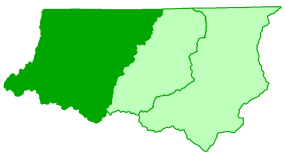
Each waterbody discussed in the Status & Recommendations for Monitored Waters within this Watershed section has a corresponding Use Support and Monitoring Box (Table 3-2). The top row indicates the 2010 Use Support and the length of that stream or stream segment. The next two rows indicate the overall Integrated Report category which further defines the Use Support for both the 2008 and the 2010 reports. These first three rows are consistent for all boxes in this Plan. The rows following are based on what type of monitoring stations are found on that stream or stream segment and may include benthic, fish community and/or ambient monitoring data. If one of these three types of monitoring sites is not shown, then that stream is not sampled for that type of data. The first column indicates the type of sampling in bold (e.g., **Benthos**) with the site ID below in parenthesis (e.g., CB79). The latest monitoring result/rating of that site is listed in the next column followed by the year that sample was taken. If there is more than one benthic site, for example, on that stream, the second site ID and site rating will be listed below the first. The last row in the sample box in Table 3-2 is the AMS data. The data window for all AMS sites listed in the boxes in this Plan is between 2004-2008. Only parameters exceeding the given standard are listed in the second column with the percent of exceedance listed beside each parameter.

Table 3-2: Example of a Use Support and Monitoring Box

Use Support: **Impaired** (14 mi)	
2008 IR Cat.	4a
2010 IR Cat.	4
Benthos (CB79) (CB80)	 Fair (2002) Fair (2002)
Fish Com (CF33)	 Good-Fair (2002)
AMS (C1750000)	Turbidity - 12% FCB - 48%

Please note any fecal coliform bacteria (FCB) listing in the last row (as seen in Table 3-2) only indicates elevated levels and a study of five samples in 30 days (5-in-30) must be conducted before a stream becomes Impaired for FCB.

Grassy Creek-John H Kerr Reservoir (0301010208)



Includes: Grassy Creek [AU#: 23-2-(1) & (6)]**, Johnson Creek** [AU#: 23-2-7-(1) & (2)]**, & Rattlesnake Creek** [AU#: 23-2-5]

Watershed contains a mix land use of agriculture, forested and some residential areas. There is one permitted swine animal operation located in the watershed and no point source discharger permits. There are also no waters on the 2010 Impaired Waters List within this watershed.

Grassy Creek [AU#: 23-2-(1) & (6)]

The first segment of Grassy Creek [AU#: 23-2-(1)] is approximately 18.3 miles from source to the second segment, which is the Grassy Creek arm of John H Kerr Reservoir [AU#: 23-2-(6)]. The majority of the drainage area is forestry

Use Support: **Not Rated** (18.3 mi)	
2008 IR Cat.	3
2010 IR Cat.	3
Benthos (NB86)	 Not Rated (2004)
Fish Com (NF33)	 Good (2009)

and agriculture with spots of residential areas. There is one two-house swine farm operation in the Grassy Creek drainage area. Both segments of the creek were given a Not Rated use support category for the 2010 Integrated Report (IR) based on the 2004 benthic sample.

Water Quality Status

Grassy Creek was monitored once during this sampling cycle. The fish site (located at Cornwall Rd; SR 1300) was somewhat effected by low flow conditions when sampled in 2009. This site had the lowest DO concentration (4.3 mg/l) and the fewest fish collected of any other site in the basin. During a sampling event at this site in 1999, 650 fish were collected where as the 2009 sample only collected a total of 81. Specific conductivity and turbidity levels were elevated. The habitat score was low (64 out of 100) mostly due to no riffle habitat and poor bottom substrate. However, it is estimated that the 2009 rating will move the segments from the Not Rated (3) use support category into the Supporting (2) category on the 2012 Integrated Report (IR).

Recommendations

The fish community site is a regional reference site and is suggested to be re-evaluated in 2014 or during a more normal flow year to determine if reference site status is still warranted.

Johnson Creek [AU#: 23-2-7-(1)]

Johnson Creek is approximately 8.3 miles from source to John H Kerr Reservoir [AU#: 23-2-(6)]. The majority of the drainage area is forestry and agriculture with spots of residential areas. The creek is in the Supporting use support category for the 2010 Integrated Report based on the 2004 fish community sample.

Use Support: Supporting (8.3 mi)	
2008 IR Cat.	2
2010 IR Cat.	2
Fish Com (NF36)	Good-Fair (2009)

Water Quality Status

The fish community site located on Johnson Creek was monitored in 2004 as well as 2009. Results from these two samples were very similar in ratings; however, the 2009 sample had one-third fewer fish than the 2004 sample and the lowest number of fish species collected in the basin. The site had the highest specific conductivity (127 µS/cm) of any other fish community site in the basin and recorded low DO levels (5.6 mg/l). Overall habitat was good but lacked adequate riffle habitat and had poor bottom substrate. Low flows during drought conditions and limited downstream re-colonization sources are suggested to be partial causes of the this lower rating. Johnson Creek will likely continue to be placed in the Supporting (2) category for the 2012 Integrated Report based on the 2009 fish community sample.

Rattlesnake Creek [AU#: 23-2-5]

Rattlesnake Creek is approximately 2.3 miles from source to Grassy Creek [AU#: 23-2-(1)]. The majority of the drainage area is agriculture and forestry with spots of residential areas. This creek was placed in the Supporting use support category of the 2010 IR due to the Not Impaired rating received in 2005.

Use Support: Supporting (2.3 mi)	
2008 IR Cat.	2
2010 IR Cat.	2
Benthos (NB64)	Not Impaired (2005)

Water Quality Status

A benthic sample was taken in 2005 as part of a special study to develop biocriteria for small streams in North Carolina. The sample was given a Not Impaired rating since the studies proposed criteria has yet to be approved. Habitat was rated high (79 out of 100) and the benthic community showed no signs of being impacted.

Mountain Creek [AU#: 23-2-3]

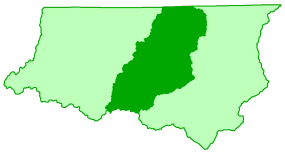
Mountain Creek is approximately 8.1 miles from source to Grassy Creek [AU#: 23-2-(1)]. The land use in this drainage area is largely agriculture with some forestry and residential areas. This creek was placed under the Not Rated use support category of the 2010 IR due to the benthic rating in 2004.

Use Support: Not Rated (8.1 mi)	
2008 IR Cat.	3
2010 IR Cat.	3
Benthos (NB87)	Not Rated (2004)

Water Quality Status

This site was sampled as a one time event in 2004 as part of a special study. However, the stream had very low flow even after a fair amount of rain four days prior to the sample being taken. Deeply incised and eroding banks suggested flashiness and unstable hydrology. For these reasons, the site was given a Not Rated and will remain in this use support category on the 2012 Integrated Report.

Butcher Creek John H Kerr Reservoir (0301010209)



Includes: Island Creek [AU#: 23-4] & Little Island Creek [AU#: 23-4-3]

This watershed contains a mix land use of agriculture, forested and some residential areas. There are no permitted facilities within this watershed. There are also no waters which appear on the 2010 Impaired Waters List.

Island Creek [AU#: 23-4]

Use Support: Supporting (6.4 mi)	
2008 IR Cat.	2
2010 IR Cat.	2
Benthos (NB45)	Good (2009)
Fish Com (NF22)	Good-Fair (2009) Good (2010)

Island Creek is approximately 6.4 miles from the confluence of Gill Creek [AU#: 23-4-1] and Michael Creek [AU#: 23-4-2] the North Carolina-Virginia state line. The land use in this drainage area is predominantly agriculture with some forestry and residential areas. This segment was placed under the Supporting use support category of the 2010 IR as a result of the Good-Fair benthic rating it received in 2004.

Water Quality Status

Island Creek was sampled twice during this sampling cycle. The benthic sample showed overall improved in the benthic community from the last time it was sampled in 2004 when it received a Good-Fair rating. The 2009 Good rating reflects an increase in the number of pollution intolerant species collected.

The fish community sample; however, did not show the same improvement. The rating actually fell from an Excellent in 1999 to a Good-Fair in 2009. The total number of fish collected for the sample dropped by three-fourths. There was still diversity among those captured but there were no pollution intolerant species. The site was re-evaluated in 2010 following a wetter winter and spring and received a Good rating.

This stream is expected to remain under the Supporting use support category on the 2012 IR.

Little Island Creek [AU#: 23-4-3]

Use Support: Not Rated (11.8 mi)	
2008 IR Cat.	3
2010 IR Cat.	3
Benthos (NB38)	Good-Fair (1988)
Fish Com (NF37)	Not Rated (2004)

Little Island Creek is approximately 11.8 miles from source to Island Creek [AU#: 23-4]. The majority of the drainage area is agriculture and forestry with residential areas mixed in. This segment was placed in the Not Rated use support category of the 2010 IR based on the 2004 fish community sample.

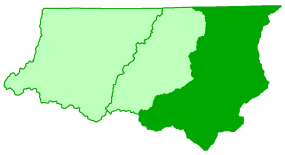
Water Quality Status

This site and the lower part of the adjacent Island Creek watershed encompass the defunct Tungsten Queen Mine, an inactive hazardous site. The mine ceased operations in 1971 but at one time was one of the largest tungsten mines in the country. The tailings (sands) in Little Island Creek appear to be similar to those at the tungsten mine and may have similar contaminant metals of concern including lead, arsenic, antimony, cadmium, and zinc. The surface water, ground water, sediments, and fish in Little Island Creek have not been monitored but have the potential to be contaminated with these metals. Currently, the area including the tailings (sands) is under a remedial action by the Inactive Hazardous Site Branch of Superfund.

Recommendations

If resources allow, benthic site NB38 should be sampled to ensure the water quality has not degraded since the previous sample was taken.

Nutbush Creek-John H Kerr Reservoir (0301010210)



Includes: Nutbush Creek Arm of John H Kerr Reservoir [AU#: 23-8-(2)]**, Nutbush Creek** [AU#: 23-8-(1)a, b & c]**, & Anderson Swamp Creek** [AU#: 23-8-6-(1)]

The majority of this watershed contains the John H Kerr Reservoir and is a mix land use of agriculture, residential and some forested areas. There are two minor NPDES permitted facilities and one permitted swine animal operation within the watershed. Nutbush Creek is the only waterbody on the 2010 Impaired Waters List.

Nutbush Creek Arm of John H Kerr Reservoir [AU#: 23-8-(2)]

The Nutbush Creek arm of John Kerr Reservoir is approximately 9,690 acres from Crooked Run [AU#: 23-8-3] to North Carolina-Virginia state line. The majority of the land use draining to the lake consist of agriculture and forestry with some residential area. The John H. Kerr Reservoir (also called Kerr Lake) is a multipurpose impoundment constructed and operated by the US Army Corps of Engineers to provide flood control, recreation and hydroelectric power. The reservoir crosses the North Carolina-Virginia state line with the majority of the lake located in Virginia. Kerr Reservoir is the first of three chain lake impoundments on the Roanoke River in North Carolina.

Use Support: **Supporting** (9,690 acres)	
2008 IR Cat.	2
2010 IR Cat.	2
Lake (ROA037A) (ROA037E) (ROA037I) (ROA037IJ)	No Exceedances

Water Quality Status

The Nutbush Creek arm of Kerr Reservoir was monitored at four lake monitoring stations during this sampling cycle. Parameters monitored all resulted in normal levels. Historically, the lake has either had high (eutrophic) or medium (mesotrophic) biological productivity. It was again found to be mesotrophic during the majority of the sampling season with exception of June. June 2009 was the first time the lake has ever recorded low (oligotrophic) productivity levels.

Section 216 Feasibility Study

This study has focused on examining the feasibility of addressing downstream environmental resource concerns in the Lower Roanoke River drainage area through changes in operations or structures at the John H. Kerr Dam and Reservoir. Along with USACE, the non-federal cost sharing partners for this study are the Commonwealth of Virginia, and the State of North Carolina. It is a three phase process that includes forming diverse workgroups, conducting a wide range of studies and developing a plan of recommendations. The project is currently completing phases 2 and beginning phase 3. A more detailed description of the project is found in the Additional Study section.

Nutbush Creek [AU#: 23-8-(1)a & b]

Nutbush Creek is approximately 3.3 miles from source within the Town of Henderson to SR 1317. The land use in this drainage area is urban in the headwaters and transitions to farm land outside of the Town of Henderson's city limits. This creek has been on the Impaired Waters list since 1998 based on benthic monitoring data.

Use Support: **Impaired** (3.3 mi)	
2008 IR Cat.	5
2010 IR Cat.	5
Benthos (NB48) (NB49)	Not Rated (2006) Fair (2009)
Fish Com (NF38)	Fair (2004)
AMS (N5000000)	No Exceedances

Water Quality Status

The first segment of Nutbush Creek ([AU#: 23-8-(1)a], 1.7 stream miles) was monitored once during this sampling cycle in 2006. This segment is almost entirely within the Town of Henderson's city limits. A benthic sample was taken in 2006 as part of a special study to develop biocriteria for small streams in North Carolina. The sample was given a Not Rated rating since the studies proposed criteria has yet to be approved. Habitat was poorly rated (58 out of 100) and the benthic community showed definite signs of being impacted.

The second segment of Nutbush Creek's ([AU#: 23-8-(1)b], 1.6 stream miles) benthic community was also monitored once during this sampling cycle in 2009. This segment begins just outside of the Town of Henderson's city limits and receives discharge from the towns Water Reclamation Facility. This benthic site has been monitored six times since 1988 and has received a Fair rating each time, with exception to the 1988 Poor rating. The 2009 sample continued to show a pollution tolerant macroinvertebrate community. This includes a species rarely collected here in the past but common within this sample that is generally collected only in degraded streams, as well an increase in the abundance of organic pollution tolerant species.

Habitat at the site ranked fairly high, scoring 86 out of 100; indicating the community is more likely being impacted by instream water quality pollution rather than poor habitat. This is reflected in the specific conductivity measured at the site which was the highest of any biological site within the basin (416 µS/cm). However, that level has been dropping since 1999 when it was measured at 633 µS/cm. A slight increase in benthic quality and an increase in dissolved oxygen may be a result of this decrease in specific conductivity.

An Ambient Monitoring Systems station is sampled monthly at this same location, about a mile downstream of the WRF. No parameters exceed the state standards at this station. Between 2005 and the end of 2009, fecal coliform bacteria levels, along with some nutrients (ammonia and TKN) levels had decrease. The fiftieth percentile for specific conductivity results reflects what was measured at the benthic site (458 µS/cm) with the highest result of 693 µS/cm. Other nutrient parameters (total phosphorus and NO_2 + NO_3) averages increased during this cycle. More detailed information about this AMS site as well as the biological site can be found on the site data sheets in Appendix 3-B.

Nutbush Creek is expected to remain on the Impaired Waters list in 2012.

References

References marked with (*) indicates a DWQ special study report. These reports are not currently available online. Contact the DWQ Environmental Science Section at (919) 743-8400 to receive a hardcopy.

North Carolina Department of Environment and Natural Resources (NCDENR). Division of Water Quality (DWQ). August 2004a. *Classifications and Water Quality Standards Applicable to Surface Waters and Wetlands of North Carolina*. North Carolina Administrative Code: 15A NCA 2B. Raleigh, NC. (http://h2o.enr.state.nc.us/csu/)

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Appendix 3-A

Use Support Ratings for All Monitored Waters in the Middle Roanoke River Subbasin

Draft 2010 IR Category	Integrated Reporting Categories for individual Assessment Unit/Use Support Category/ Parameter Assessments. A single AU can have multiple assessments depending on data available and classified uses.
1	All designated uses are monitored and supporting
1b	Designated use was impaired, other management strategy in place and no standards violations for the parameter of interest (POI)
1nc	DWQ have made field determination that parameter in exceedance is due to natural conditions
1r	Assessed as supporting watershed is in restoration effort status
1t	No criteria exceeded but approved TMDL for parameter of interest
2	Some designated uses are monitored and supporting none are impaired Overall only
2b	Designated use was impaired other management strategy in place and no standards violations Overall only
2r	Assessed as supporting watershed is in restoration effort status overall only
2t	No criteria exceeded but approved TMDL for POI Overall only
3a	Instream/monitoring data are inconclusive (DI)
3b	No Data available for assessment
3c	No data or information to make assessment
3n1	Chlorophyll a exceeds TL value and SAC is met-draft
3n2	Chlorophyll a exceeds EL value and SAC is not met first priority for further monitoring-draft
3n3	Chlorophyll a exceeds threshold value and SAC is not met first second priority for further monitoring-draft
3n4	Chlorophyll a not available determine need to collect-draft
3t	No Data available for assessment –AU is in a watershed with an approved TMDL
4b	Designated use impaired other management strategy expected to address impairment
4c	Designated use impaired by something other than pollutant
4cr	Recreation use impaired no instream monitoring data or screening criteria exceeded
4cs	Shellfish harvesting impaired no instream monitoring data- no longer used
4ct	Designated use impaired but water is subject to approved TMDL or under TMDL development
4s	Impaired Aquatic Life with approved TMDL for Aquatic Life POI or category 5 listing
4t	Designated use impaired approved TMDL
5	Designated use impaired because of biological or ambient water quality standards violations and needing a TMDL
5r	Assessed as impaired watershed is in restoration effort status

NC 2010 Integrated Report

All 13,123 Waters in NC are in Category 5-303(d) List for Mercury due to statewide fish consumption advice for several fish species

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Roanoke River Basin — **Grassy Creek-John H Kerr Reservoir Watershed** — **0301010208**

Roanoke River Basin — ı H Kerr Reservoir-Roanoke River Subbasin — 03010102

Roanoke River Basin — **Grassy Creek-John H Kerr Reservoir Watershed** — **0301010208**

⊙	**23-2-(1)**	**Grassy Creek (Grass Creek)**	From source to John H. Kerr Reservoir at Granville County SR 1431	**18.3**	**FW Miles**	C
	3a	**Ecological/biological Integrity Benthos**	Not Rated Bioclassification	Aquatic Life	2004	
⊙	**23-2-7-(1)**	**Johnson Creek**	From source to Little Johnson Creek	**5.3**	**FW Miles**	C
	1	**Ecological/biological Integrity FishCom**	Good-Fair Bioclassification	Aquatic Life	2004	
⊙	**23-2-3**	**Mountain Creek**	From source to Grassy Creek	**8.1**	**FW Miles**	C
	3a	**Ecological/biological Integrity Benthos**	Not Rated Bioclassification	Aquatic Life	2004	
⊙	**23-2-5**	**Rattlesnake Creek**	From source to Grassy Creek	**2.3**	**FW Miles**	C
	1	**Ecological/biological Integrity Benthos**	Not Impaired Bioclassification	Aquatic Life	2005	

Roanoke River Basin — **Butcher Creek-John H Kerr Reservoir Watershed** — **0301010209**

⊙	**23-4**	**Island Creek (Island Creek Reservoir)**	From source to North Carolina-Virginia State Line, including that portion of Island Creek Reservoir in North Carolina below normal operating elevation	**6.4**	**FW Miles**	C
	1	**Ecological/biological Integrity Benthos**	Good-Fair Bioclassification	Aquatic Life	2004	
⊙	**23-4-3**	**Little Island Creek (Vance County)**	From source to Island Creek Reservoir, Island Creek	**11.8**	**FW Miles**	C
	3a	**Ecological/biological Integrity FishCom**	Not Rated Bioclassification	Aquatic Life	2004	

Roanoke River Basin — **Nutbush Creek-John H Kerr Reservoir Watershed** — **0301010210**

⊙	**23-8-(1)a**	**Nutbush Creek (Including Nutbush Creek Arm of John H. Kerr Reservoir below normal pool elevation)**	From source to NC 39	**1.7**	**FW Miles**	C
	5	**Ecological/biological Integrity Benthos**	Fair Bioclassification	Aquatic Life	1994	1998

NC 2010 Integrated Report

All 13,123 Waters in NC are in Category 5-303(d) List for Mercury due to statewide fish consumption advice for several fish species

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
23-8-(1)b	Nutbush Creek (Including Nutbush Creek Arm of John H. Kerr Reservoir below normal pool elevation)	From NC 39 to SR 1317	1.6	FW Miles	C

Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year
5	Ecological/biological Integrity Benthos	Fair Bioclassification	Aquatic Life	2004	1998
5	Ecological/biological Integrity FishCom	Fair Bioclassification	Aquatic Life	2004	1998
1	Fecal Coliform (recreation)	No Criteria Exceeded	Recreation	2008	
1	Water Quality Standards Aquatic Life	No Criteria Exceeded	Aquatic Life	2008	

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
23-8-(2)	Nutbush Creek Arm of John H. Kerr Reservoir (below normal pool elevation 300 feet MSL or as this elevation may be adjusted by the Corps of Engineers)	From Crooked Run to North Carolina-Virginia State Line	9,690.1	FW Acres	B

Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year
1	Water Quality Standards Aquatic Life	No Criteria Exceeded	Aquatic Life	2008	

Roanoke River Basin: Middle Roanoke River Subbasin (HUC 03010102) Appendices

Appendix 3-B

Biological Sampling Site Data Sheets (Benthic Macroinvertebrate & Fish Community) for the Middle Roanoke River Subbasin

Biological Samples Taken During this Assessment Cycle

Station ID	Waterbody	County	Site Location	Sample Results
Benthic Sample Sites				
NB45	ISLAND CR	GRANVILLE	SR 1445	09 - Good
NB48	NUTBUSH CR	VANCE	NC 39	06 - Not Rated
NB49	NUTBUSH CR	VANCE	SR 1317	09 - Fair
NB64	RATTLESNAKE CR	GRANVILLE	SR 1437	05 - Not Impaired
Fish Community Sample Sites				
NF22	Island Cr	Granville	SR 1445	09 Good-Fair
NF33	Grassy Cr	Granville	SR 1300	09 - Good
NF36	Johnson Cr	Granville	SR 1440	09 - Good-Fair

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
GRASSY CR	SR 1300	05/26/09	NF33	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRANVILLE	6	03010102	36.47222222	-78.66444444	23-2-(1)	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	20.9	340	8	0.5	Yes

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	100	0	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	20.4
Dissolved Oxygen (mg/L)	4.3
Specific Conductance (µS/cm)	104
pH (s.u.)	6.4

Water Clarity	Turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	12
Bottom Substrate (15)	4
Pool Variety (10)	10
Riffle Habitat (16)	0
Erosion (7)	6
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**64**

Site Photograph

Substrate Cobble, gravel

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/26/09	2009-47	16	46	Good
06/09/99	99-43	15	46	Good

Most Abundant Species 2009 Highfin Shiner

Exotic Species 2009 Green Sunfish, Bluegill

Species Change Since Last Cycle

Gains -- Golden Shiner (n=11), Green Sunfish (n=6), Pumpkinseed (n=7), Warmouth (n=3), Carolina Darter (n=1). **Losses** -- Crescent Shiner (n=31), Margined Madtom (n=3), Fantail Darter (n=54).

Data Analysis

Watershed -- drains central Granville County, no municipalities in the watershed; tributary to Kerr Reservoir. **Habitats** -- primarily a run and slow moving pool upstream from the bridge, riffles absent, not much habitat in mid-channel, no coarse woody debris snags, some *Justicia* at the bridge, good riparian zones. **Water Quality** -- due to the low flow and pool conditions, the dissolved oxygen concentration was low, only at 48% of saturation. **2009** -- fewest fish collected at any site in 2009 (n=81), more than 650 fish were collected in 1999; metric scores and ratings for 2009 may be biased by this small sample size; Carolina Darter [Special Concern] collected for the first time. **1999 & 2009** -- only 19 species known from the site, including 3 species of darters, but no intolerant species; because it is a regional reference site, this site should be re-evaluated in 2014 or during a more normal flow year to determine if reference site status is still warranted.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
JOHNSON CR	SR 1440	05/26/09	NF36	Good-Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRANVILLE	6	03010102	36.53222222	-78.65861111	23-2-7-(1)	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	7.6	325	7	0.3	Yes

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	95	0	5	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	19.7
Dissolved Oxygen (mg/L)	5.6
Specific Conductance (µS/cm)	127
pH (s.u.)	6.3

Water Clarity	Clear, easily silted

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	8
Pool Variety (10)	10
Riffle Habitat (16)	5
Erosion (7)	5
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**78**

Site Photograph

Substrate Cobble, gravel

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/26/09	2009-46	13	44	Good-Fair
04/28/04	2004-26	13	44	Good-Fair

Most Abundant Species 2009 Fantail Darter (46%)

Exotic Species 2009 Green Sunfish, Bluegill

Species Change Since Last Cycle

Gains -- Golden Shiner, Chain Pickerel, Warmouth, Carolina Darter, Johnny Darter. **Losses** -- Satinfin Shiner, Margined Madtom, Snail Bullhead, Redbreast Sunfish. All species gained or lost were represented by 1-3 fish/species, except for Golden Shiner and Margined Madtom (n=8 and 53, respectively).

Data Analysis

Watershed -- drains the extreme north-central part of Granville County and a small portion of southeast Mecklenburg County, VA; no municipalities in the watershed; tributary to Grassy Creek and Kerr Reservoir, site is ~ 3.8 miles above the creek's confluence with the reservoir. **Habitats** -- a regional reference site, a typical Carolina Slate Belt-type stream with very shallow pools and many riffles out of water; very low flow. **Water Quality** -- specific conductance has always been slightly elevated (129 µS/cm in 2004), the highest of any site in the basin in 2009. **2009** -- one-third fewer fish in 2009 than in 2004 (232 vs. 339), noticeably absent were Margined Madtom, and the number of Fantail Darters decreased from 190 to 107; fewest species of any site in 2009 (n=13); Carolina Darter [Special Concern] was collected for the first time; greater darter diversity and a higher percentage of omnivores+herbivores were offset by lower percentages of piscivores and species with multiple ages classes; lingering effects from drought may still be evident. **2004 & 2009** -- 18 species known from this site, including 3 species of darters; dominant species is the Fantail Darter; lower than expected metric scores for this small drainage area reference site are attributable to the very low flows during droughts and limited downstream re-colonization sources.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
ISLAND CR	SR 1445	NB45	08/13/09	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRANVILLE	6	03010102	36.495240	-78.504200	23-4	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	32.5	330	9	0.1

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	80	0	0	20 (Fallow Fields)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	22.7
Dissolved Oxygen (mg/L)	6.3
Specific Conductance (µS/cm)	103
pH (s.u.)	6.7

Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	12
Pool Variety (10)	8
Riffle Habitat (16)	7
Bank Erosion (7)	2
Bank Vegetation (7)	5
Light Penetration (10)	9
Left Riparian Score (5)	2
Right Riparian Score (5)	4
Total Habitat Score (100)	72

Site Photograph

Substrate Mostly sand and silt with one long cobble riffle.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/13/09	10811	---	21	---	5.05	Good
06/29/04	9421	---	17	---	5.48	Good-Fair
08/24/94	6693	---	17	---	5.12	Good-Fair

Taxonomic Analysis

Four additional EPT taxa were collected since sampling began in 1994. The pollution sensitive edge-dwelling caddisfly *Mystacides sepulchralis* was common at this site in 2009. Additionally, the intolerant mayfly taxa *Acerpenna macdunnoughi* and *Leucrocuta spp.* were collected at this location. Other taxa not previously collected from this site include the Slate Belt Ecoregion endemic *Stenonema femoratum*; the stonefly *Leuctra spp.*; and the caddisflies *Pycnopsyche spp.* and *Hydroptila spp*.

Data Analysis

An improvement in water quality from Good-Fair in both 1994 and 2004 to Good in 2009 was observed at this sampling location. The EPTBI was the lowest and EPT taxa richness was the highest on BAU record at this sampling location suggesting a more intolerant benthic community and overall improved water quality. Upstream portions of this catchment are mostly rural with some agricultural land use. The site was not sampled in 1999 due to low flow conditions.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
ISLAND CR	SR 1445	05/27/09	NF22	Good-Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRANVILLE	6	03010102	36.495	-78.50444444	23-4	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	33.1	290	10	0.5	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	75	10	15	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	20.6
Dissolved Oxygen (mg/L)	5.5
Specific Conductance (µS/cm)	102
pH (s.u.)	6.4
Water Clarity	Slightly turbid, easily silted

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	10
Pool Variety (10)	10
Riffle Habitat (16)	3
Erosion (7)	6
Bank Vegetation (7)	7
Light Penetration (10)	8
Left Riparian Score (5)	3
Right Riparian Score (5)	5
Total Habitat Score (100)	**75**

Site Photograph

Substrate Cobble, gravel, sand, clay, boulder

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/16/10	2010-49	19	46	Good
05/27/09	2009-49	21	44	Good-Fair
06/09/99	99-44	24	54	Excellent
06/02/94	94-25	24	50	Good

Most Abundant Species 2009 Johnny Darter (20%)

Exotic Species 2009 Green Sunfish, Bluegill, Redear Sunfish

Species Change Since Last Cycle (2009 vs. 2004)

Gains -- Comely Shiner, Pirate Perch, Eastern Mosquitofish, Pumpkinseed, Redear Sunfish. **Losses** -- Rosyside Dace, Rosefin Shiner, Mountain Redbelly Dace, Golden Redhorse, Creek Chubsucker, Margined Madtom, Brown Bullhead, Flat Bullhead, Chain Pickerel. All species gained or lost were represented by 1-6 fish/species, except for Pirate Perch, Rosefin Shiner, and Golden Redhorse (n=13, 59, and 91, respectively).

Data Analysis

Watershed -- drains northeastern Granville and and northwestern Vance counties; no municipalities in the watershed; tributary to Kerr Reservoir. **Habitats** -- root mats, snags, pools, short, shallow riffles. **Water Quality** -- specific conductance has ranged from 90 to 106 µS/cm. **2009** -- the number of fish collected in 2009 was one-fourth the number in 1999 (208 *vs*. 895); the Crescent Shiner, the dominant species in 1999, was essentially absent in 2009 (435 *vs*. 1); greatest diversity of sunfish than at any other site (n=6); very skewed trophic structure along with decreases in the total number of fish and diversity of suckers were responsible for the decline in the NCIBI score and rating; lingering drought impacts. **1994 - 2009** -- diverse community with 30 species known from the site, including 6 species of sunfish, 3 species of suckers, and 3 species of darters including the Carolina Darter [Special Concern]; but no intolerant species; in 1994 and 1999 the dominant species was the Crescent Shiner. **Note:** the site was re-sampled in 2010 following a wetter winter and spring flow period and the community was rated Good.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
NUTBUSH CR	SR 1317	NB49	08/12/09	Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
VANCE	6	03010102	36.368770	-78.408520	23-8-(1)b	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	7.0	330	8	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	80	20	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Henderson Water Reclamation Facility	NC0020559	6.0

Water Quality Parameters

Temperature (°C)	25.9
Dissolved Oxygen (mg/L)	9.0
Specific Conductance (µS/cm)	416
pH (s.u.)	7.4
Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	20
Bottom Substrate (15)	13
Pool Variety (10)	8
Riffle Habitat (16)	12
Bank Erosion (7)	3
Bank Vegetation (7)	5
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	86

Site Photograph

Substrate Good mix of bedrock, boulder, rubble, and sand.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/12/09	10810	57	12	6.54	6.03	Fair
06/29/04	9420	64	9	7.00	6.70	Fair
08/25/99	7989	41	8	6.73	6.75	Fair
10/28/94	6738	50	8	6.74	6.31	Fair
08/24/94	6694	44	8	6.84	6.89	Fair

Taxonomic Analysis

A tolerant macroinvertebrate community was observed at this Basinwide sampling location in 2009. No stoneflies were collected at the site. *Maccaffertium modestum* and *Baetis flavistriga* were the abundant tolerant mayflies collected at the site. These mayfly species commonly occur in NC peidmont streams. The tolerant filter-feeding caddisfly taxa *Cheumatopsyche spp*. and *Hydropsyche betteni* were also abundant. A rarely collected mayfly *Paracloeodes fleeki* was common at this location. This taxa is generally collected in degraded streams. The organic pollution tolerant *Dicrotendipes neomodestus* was abundant along with other tolerant chironomids such as *Phaenopsectra punctipes gr*., *Polypedilum illinoense gr.,* and *P. scalaenum gr*. Only two intolerant taxa were collected including the caddisfly *Chimarra spp.* and the beetle *Psephenus herricki*.

Data Analysis

This stream received a bioclassification of Fair in 2009 despite the highest EPT taxa richness and lowest EPTBI and NCBI on record at this station. A generally tolerant benthic community was found at this location. A more diverse macroinvertebrate community would be expected due to adequate habitat found at the site. Conductivity was the highest compared to all other Roanoke Basinwide sites at 416 µS/cm. This is most likely due to the WWTP located approximately 1 mile upstream. In 2009, the elevated conductivity was lower than in 1999 (633 µS/cm) and in 2004 (501µS/cm) and dissolved oxygen was higher in 2009 potentially parallelling decreases in biotic indices. This site has been issued permit violations in the past and continues to suffer degraded conditions most likely from point source inputs.

APPENDIX 3-C

AMBIENT MONITORING SYSTEMS
STATION DATA SHEETS
FOR THE MIDDLE ROANOKE RIVER SUBBASIN

Ambient Monitoring System Station Summaries
NCDENR, Division of Water Quality
Basinwide Assessment Report

Location: NUTBUSH CRK AT SR 1317 NR HENDERSON
Station #: N5000000 **Hydrologic Unit Code:** 03010102
Latitude: 36.36914 **Longitude:** -78.40834 **Stream class:** C
Agency: NCAMBNT **NC stream index:** 23-8-(1)

Time period: 01/03/2005 to 11/18/2009

	# results	# ND	EL	Results not meeting EL #	%	%Conf	Percentiles Min	10th	25th	50th	75th	90th	Max
Field													
D.O. (mg/L)	47	0	<4	0	0		6.6	7	7.5	9.7	12.5	13.5	14.9
	47	0	<5	0	0		6.6	7	7.5	9.7	12.5	13.5	14.9
pH (SU)	47	0	<6	0	0		6.2	6.6	6.9	7.4	7.7	7.8	8.6
	47	0	>9	0	0		6.2	6.6	6.9	7.4	7.7	7.8	8.6
Salinity (ppt)	9	0	N/A				0.2	0.2	0.2	0.2	0.3	0.3	0.3
Spec. conductance (umhos/cm at 25°C)	48	0	N/A				221	300	360	458	572	630	693
Water Temperature (°C)	48	0	>32	0	0		5.9	7.5	10	14.9	22.5	24.3	26.1
Other													
Chlorophyll a (ug/L)	2	0	>40	0	0		4	4	4	7	10	10	10
TSS (mg/L)	19	10	N/A				2.5	2.5	2.5	6.2	12	13	15
Turbidity (NTU)	48	1	>50	0	0		1	1.4	1.8	2.2	4.8	8.7	31
Nutrients (mg/L)													
NH3 as N	47	36	N/A				0.02	0.02	0.02	0.02	0.02	0.04	0.08
NO2 + NO3 as N	46	0	N/A				4.1	5.99	7.5	11	15	18	23
TKN as N	45	7	N/A				0.2	0.2	0.35	0.55	0.6	0.69	0.89
Total Phosphorus	45	0	N/A				0.06	0.17	0.21	0.36	0.54	0.75	1
Metals (ug/L)													
Aluminum, total (Al)	9	0	N/A				84	84	98	140	185	320	320
Arsenic, total (As)	9	9	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	9	9	>2	0	0		1	1	2	2	2	2	2
Chromium, total (Cr)	9	9	>50	0	0		10	10	25	25	25	25	25
Copper, total (Cu)	9	2	>7	0	0		2	2	2	3	4	5	5
Iron, total (Fe)	9	0	>1000	0	0		130	130	190	270	330	640	640
Lead, total (Pb)	9	9	>25	0	0		10	10	10	10	10	10	10
Mercury, total (Hg)	8	8	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	9	9	>88	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	9	0	>50	0	0		15	15	16	18	23	34	34

Fecal Coliform Screening(#/100mL)

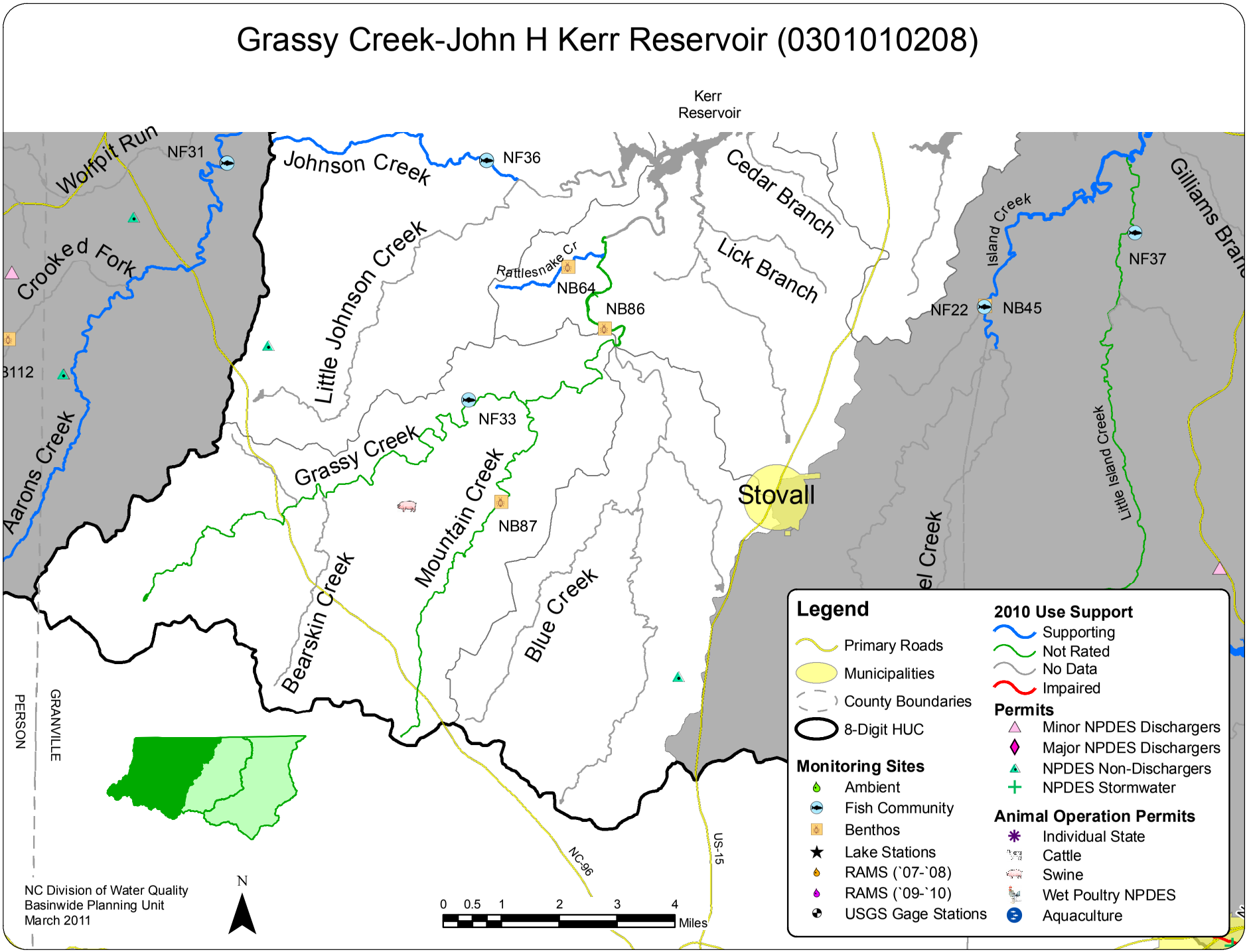
# results:	Geomean:	# > 400:	% > 400:	%Conf:
48	115.9	4	8.3	

Key:
result: number of observations
ND: number of observations reported to be below detection level (non-detect)
EL: Evaluation Level; applicable numeric or narrative water quality standard or action level
Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : States the percent statistical confidence that the actual percentage of exceedances is at least 10% (20% for Fecal Coliform)
Stations with less than 10 results for a given parameter were not evaluated for statistical confidence

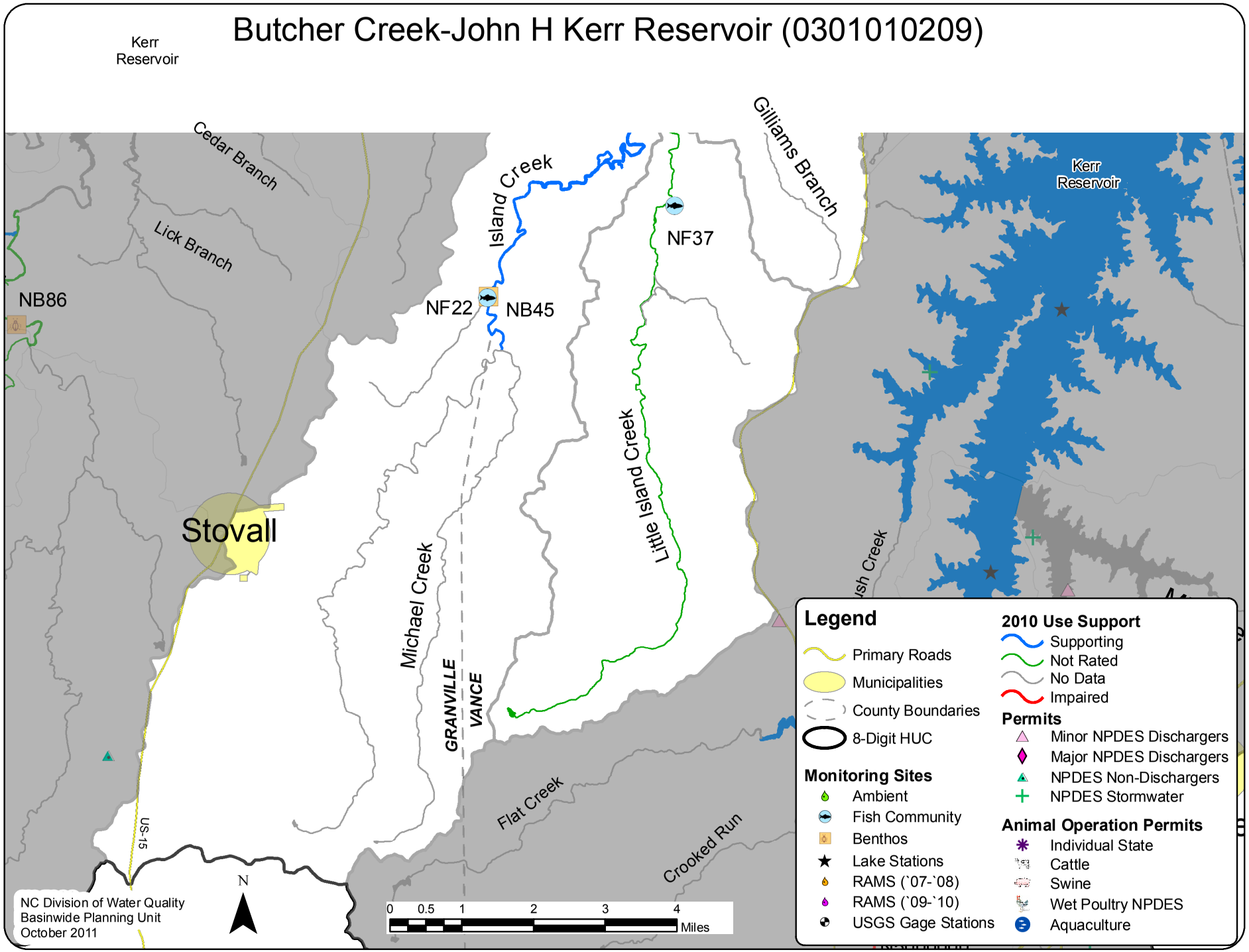
Appendix 3-D

10-Digit Watershed Maps for the Middle Roanoke River Subbasin

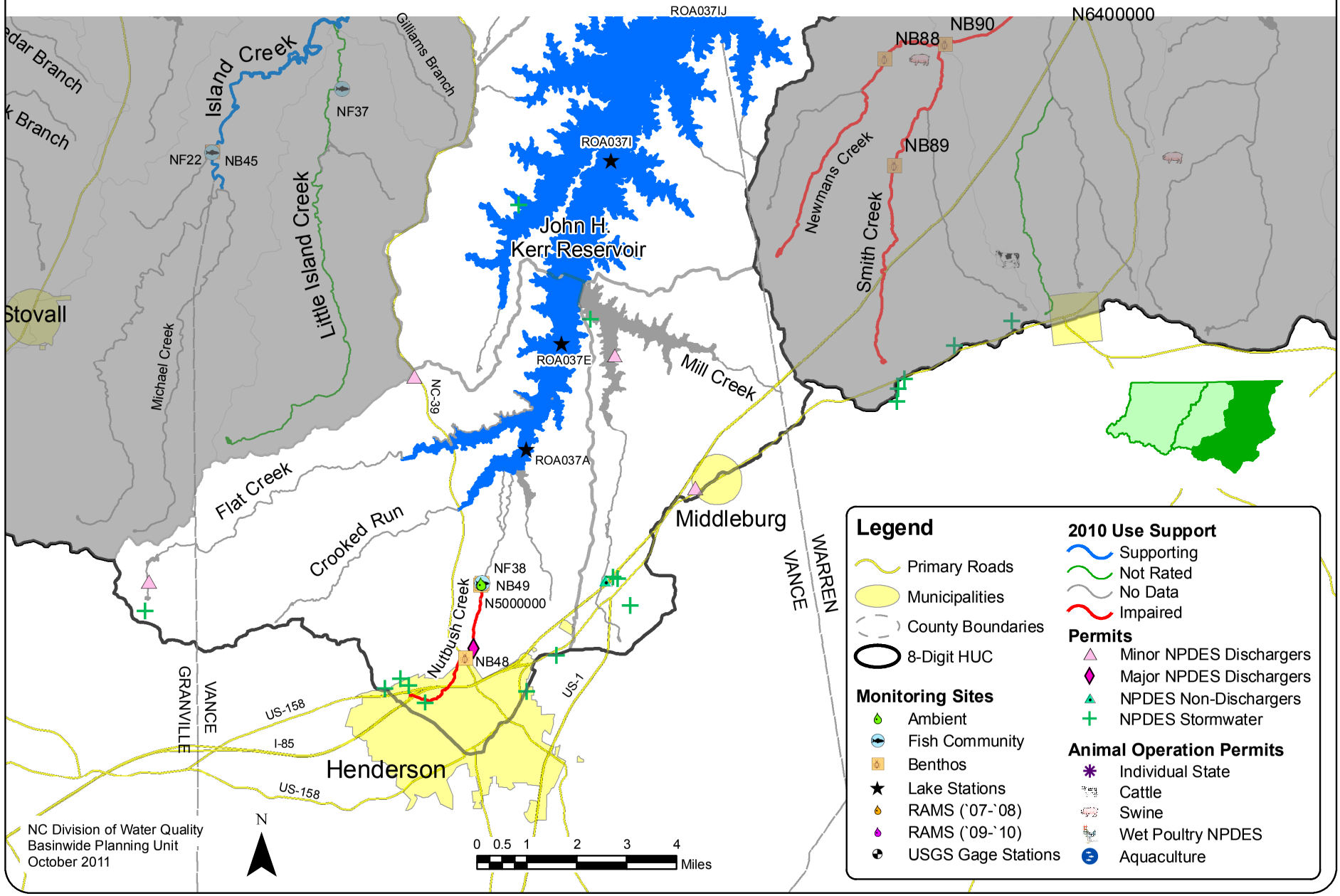
Grassy Creek-John H Kerr Reservoir (0301010208)



Butcher Creek-John H Kerr Reservoir (0301010209)

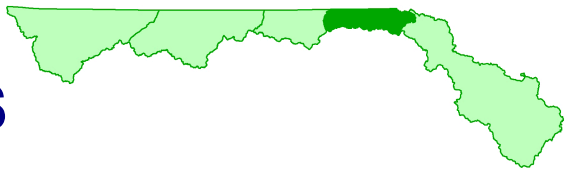


Nutbush Creek-John H Kerr Reservoir (0301010210)



CHAPTER 4

ROANOKE RAPIDS SUBBASIN



HUC 03010106

Includes: Newmans Creek, Smith Creek, Sixpound Creek, Lake Gaston & Roanoke Rapids Lake

SUBBASIN WATER QUALITY OVERVIEW

The Roanoke Rapids Subbasin is the second eastern most subbasin and runs along the North Carolina/Virginia state line. The subbasin contains two Impaired streams: Newmans Creek is Impaired for biological integrity; and Smith Creek are Impaired for low DO and the upper and lower segments are Impaired for biological integrity.

During this assessment cycle (2004-2009), the subbasin experienced a moderate drought in 2005 and 2006 as well as a prolonged drought between 2007 and 2008. Monitoring the biological community during this time did not indicate much change between cycles. There were no major ambient monitoring violations; however, there is a general downward long term pattern in pH levels and a few spikes in turbidity and fecal coliform bacteria levels were measured.

The John H. Kerr Dan and Reservoir Section 216 Feasibility Study project is partially located in this subbasin. The project area also includes HUCs 03010102 and 03010107. The study has focused on examining the feasibility of addressing downstream environmental resource concerns in the Lower Roanoke River drainage area through changes in operations or structures at the John H. Kerr Dam and Reservoir. Along with USACE, the non-federal cost sharing partners for this study are Virginia, and North Carolina. The process includes forming diverse workgroups, conducting a wide range of studies and developing a plan of recommendations. The project is currently completing phase 2 and beginning phase 3, the final phase. A more detailed description of the project is found in the Additional Study section in Chapter 3.

SUBBASIN AT A GLANCE

COUNTIES:

Warren, Halifax & Northampton

MUNICIPALITIES:

Littleton, Macon & Norlina

ECOREGIONS:

North Outer Piedmont & Rolling Coastal Plain

PERMITTED FACILITIES:

NPDES Dischargers:	1
Major	0
Minor	0
General	1
NPDES Non-Dischargers:	1
Stormwater:	7
General	7
Individual	0
Animal Operations:	16

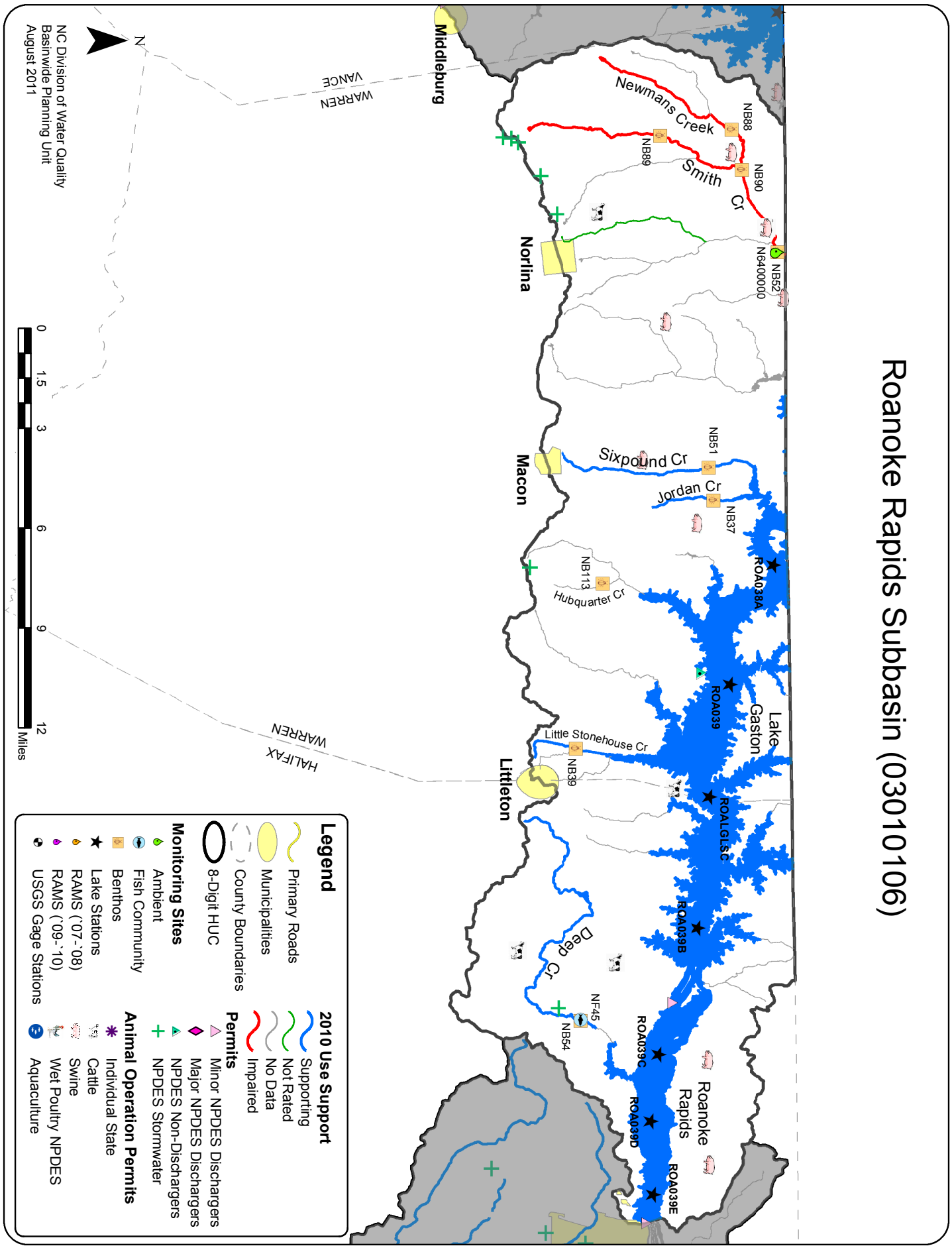
POPULATION:

2010 Census	13,846

2006 LAND COVER:

Open Water	10.3%
Developed	6.7%
Forest	57.5%
Agriculture	14.9%
Wetlands	2.7%
Barren Land	0.1%
Shrub/Grassland	7.8%

Figure 4-1: Roanoke Rapids Subbasin (03010106)



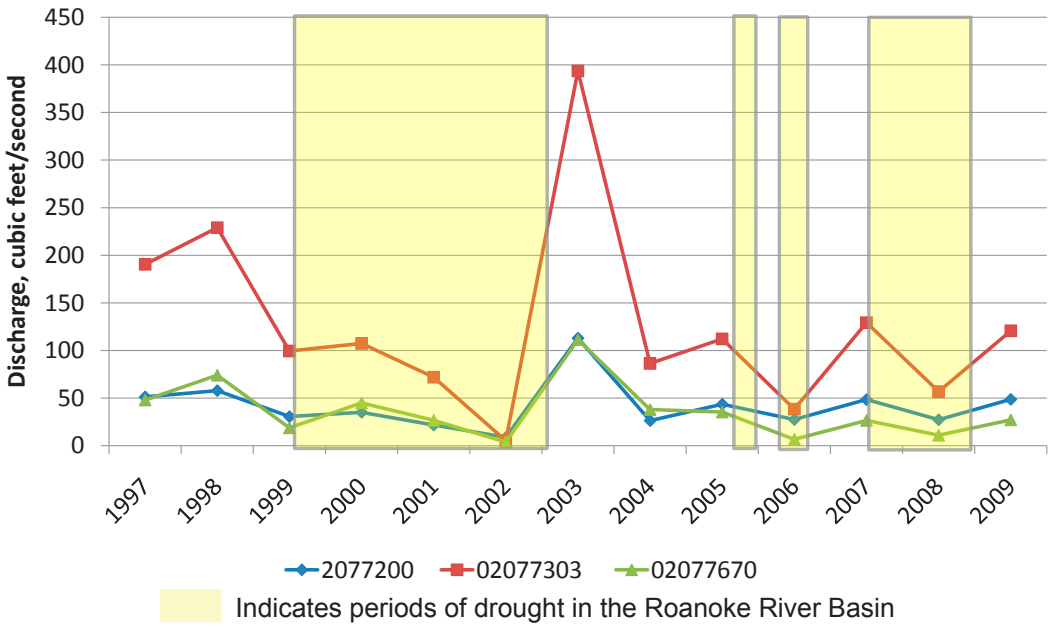
Water Quality Data Summary for this Subbasin

Monitoring stream flow, aquatic biology and chemical/physical parameters is a large part of the basinwide planning process. More detailed information about DWQ monitoring and the effects each parameter has on water quality is discussed in Chapters 2 and 3 of the Supplemental Guide to North Carolina's Basinwide Planning document.

Stream Flow

The basin experienced prolonged droughts from 1998-2002 and again from 2007-2008, with moderate droughts in 2005 and 2006 (Figure 4-2). More detail about flows in the Roanoke River Basin can be found in the 2010 Roanoke River Basinwide Assessment Report produced by DWQ-Environmental Science Section.

Figure 4-2: Yearly Flow Rates (cfs) of the USGS Gage Stations in the Roanoke Rapids Subbasin Between 1997 & 2009



From Left to Right:

- 2077200: Hyco Creek (Leasburg)
- 2077303: Hyco River (McGehees)
- 2077670: Mayo Creek (Bethel Hill)

Biological Data

Biological samples were collected during the spring and summer months of 2009 by the DWQ-Environmental Sciences Section as part of the five year basinwide sampling cycle, in addition to special studies. Overall, 6 biological sampling sites were monitored within the Roanoke Rapids Subbasin. The ratings for each of the sampling stations can be seen in Appendix 4-B.

Benthic Macroinvertebrate Sampling

Each benthic station monitored during the current cycle is shown in Figure 4-4 and color coded based on the current rating. Each of the sites are discussed in more detail in the watershed section below. Figure 4-5 is a comparison of benthic site ratings sampled during the last two basinwide cycles to indicate if there are any overall shifts in ratings. Benthic ratings from this cycle are similar to those received during the previous cycle indicating a stable community.

Benthic Sampling Summary

Total Stations Monitored	5
Total Samples Taken	6
Number of New Stations	3

Figure 4-3: Benthic Stations Color Coded by Current Rating in the Roanoke Rapids Subbasin

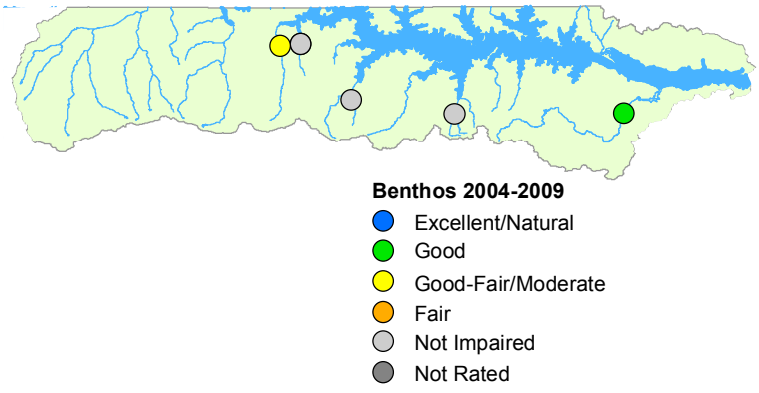


Figure 4-4: Current Benthic Site Ratings

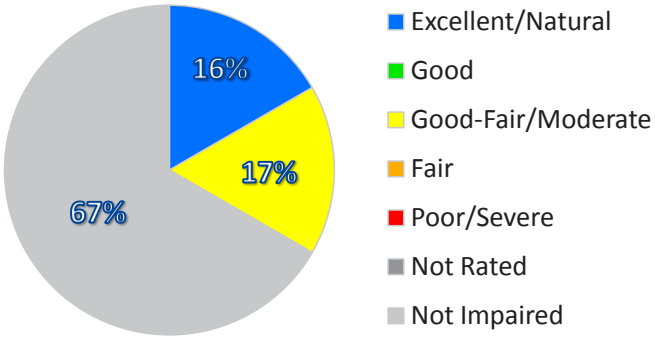
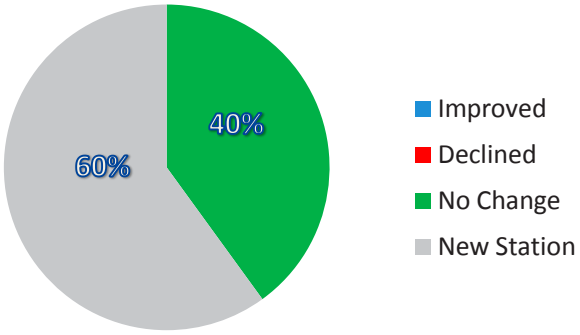


Figure 4-5: Change in Benthic Site Ratings



Fish Community Sampling

Each fish community station monitored during the current cycle is shown in Figure 4-6 and color coded based on the current rating. The site is discussed in more detail in the watershed section below. Figure 4-7 shows the percentages of each rating given during this sampling cycle within this subbasin. Figure 4-8 is a comparison of fish community site ratings sampled during the last two cycles to determine if there are any overall watershed shifts in ratings. Overall, the community at this site is stable.

Fish Com. Sampling Summary

Total Stations Monitored	1
Total Samples Taken	2
Number of New Stations	0

Figure 4-6: Fish Community Stations Color Coded by Current Rating in the Roanoke Rapids Subbasin

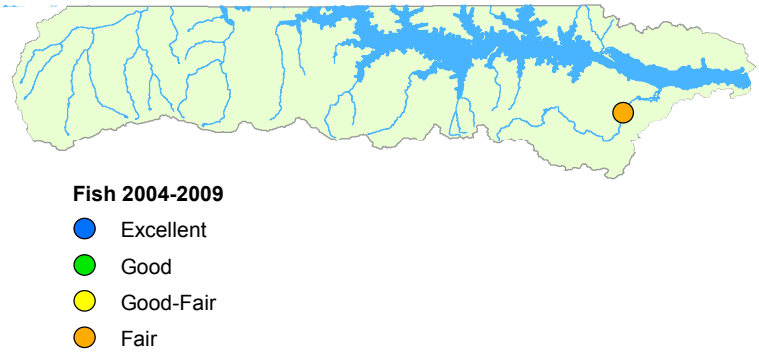


Figure 4-7: Current Fish Comm Site Ratings

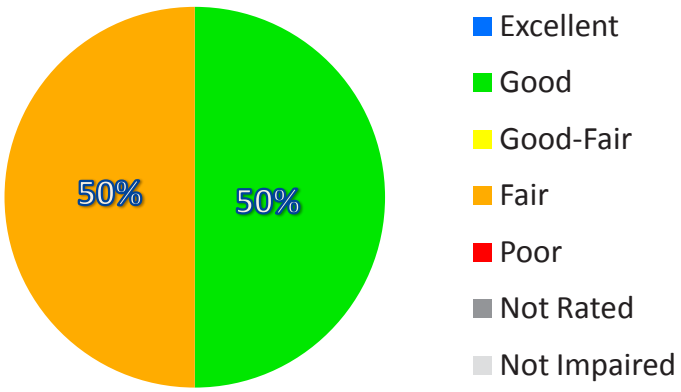
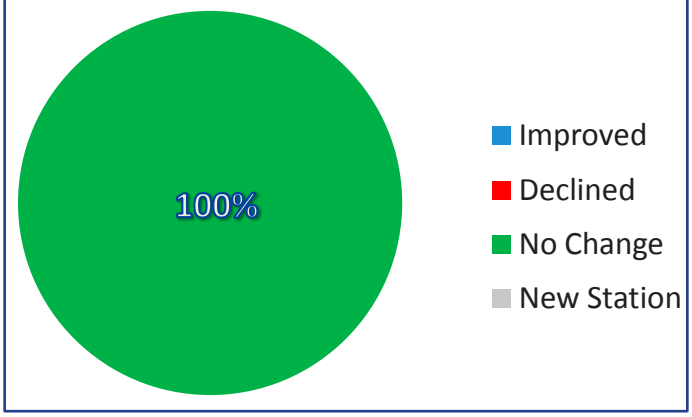


Figure 4-8: Change in Fish Comm Site Ratings



For more information about biological data in this subbasin, see the 2010 Roanoke River Basinwide Assessment Report. Detailed data sheets for each sampling site can be found in Appendix 4-B.

Ambient Data

The ambient data are used to develop use support ratings every two years, which are then reported to the EPA via the Integrated Report (IR). The IR is a collection of all monitored waterbodies in North Carolina and their water quality ratings. The most current IR is the 2010 version and is based on data collected between 2004 and 2008. The ambient data reported in this basin plan were collected between 2005 and 2009 and will be used for the 2012 IR. If a waterbody receives an Impaired rating, it is then placed on the 303(d) Impaired Waters List. The Roanoke River Basin portion of the 2010 IR can be found in Appendix 4-A and the full 2010 IR can be found on the Modeling & TMDL Unit's website.

Four Ambient Monitoring System (AMS) stations are located in the Roanoke Rapids subbasin (see Figure 4-1 for the station locations). During the current sampling cycle (January 2005 and December 2009), samples were collected for all parameters on a monthly basis except metals, which were sampled quarterly until May 2007 when metals sampling was suspended. For more information about the ambient monitoring, parameters, how data are used for use support assessment and other information, see Chapter 2 of the Supplemental Guide to North Carolina's Basinwide Planning.

Long Term Ambient Monitoring

The following discussion of ambient monitoring parameters of concern include graphs showing the median and mean concentration values for each ambient station in this subbasin by specific parameter over a 13 year period (1997-2009). The geometric mean is a type of mean or average, which indicates the central tendency or typical value of a set of numbers. The graphs are not intended to provide statistically significant trend information, but rather an idea of how changes in land use or climate conditions can affect parameter readings over the long term. The difference between median and mean results indicate the presence of outliers in the data set. Box and whisker plots of individual ambient stations were completed by parameter for data between 2005 and 2009 by DWQ's Environmental Sciences Section (ESS) and can be found in the Roanoke River Basin Ambient Monitoring System Report.

pH

Figure 4-10 shows the mean and median pH levels for all samples taken over the course of 13 years in the Roanoke Rapids Subbasin. The pH pattern seen during this time period is a steady decrease until 2009 when it jumps back up a bit. This pattern is seen in other parts of the southwestern portion of the state. Possible causes of the increasing levels in this subbasin could be atmospheric deposition, groundwater influences or precipitation influences. However, the exact reason is unknown at this time. Site N6400000 exceeded the low pH standard of 6.0 in 9.6% of samples as indicated by the orange dot in Figure 4-9.

Proper riparian buffers throughout the subbasin could reduce the impact of stormwater runoff, which can include nutrients from farm or lawn fertilizers, as well as impacts from acid rain. Trees within riparian buffers are also beneficial for shading streams and reducing water temperatures. It is recommended to continue monitoring pH levels within the subbasin and investigate possible causes.

Figure 4-9: Percentage of Samples Exceeding the pH Standards (2005-2009)

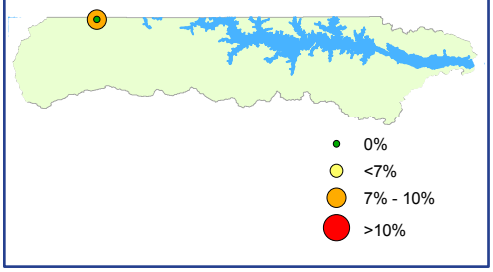
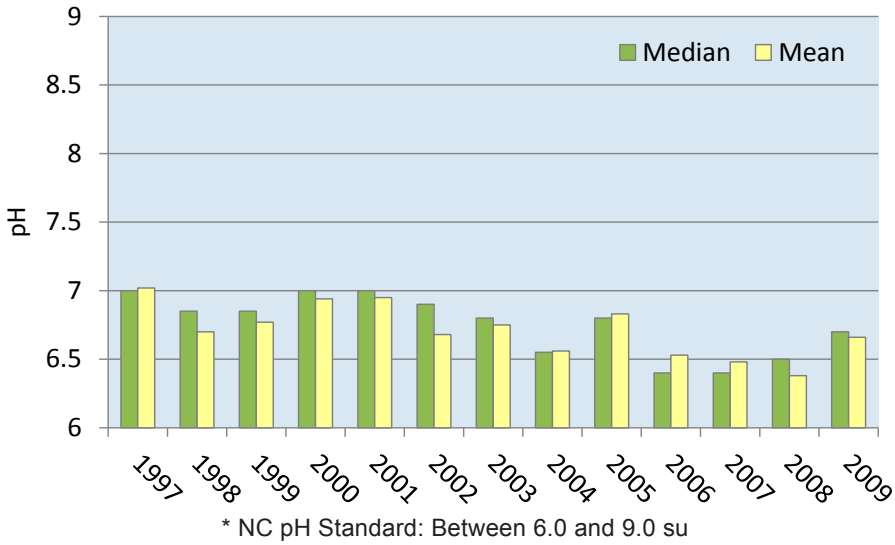


Figure 4-10: Summarized pH Values for All Data Collected at Ambient Sampling Stations in HUC 03010106



* NC pH Standard: Between 6.0 and 9.0 su

Turbidity

The AMS station in the Roanoke Rapids subbasin exceeded the state's turbidity standard in 6 percent of samples, as seen in Figure 4-11 indicated by the yellow dot. Possible sources of the elevated turbidity levels are discussed in the 10-digit watershed section. Figure 4-12 shows the mean and median turbidity levels for all samples taken over the course of 13 years in the Roanoke Rapids subbasin. The yearly averages are well below the state standard of 50 NTUs.

While some erosion is a natural phenomenon, human land use practices may accelerate the process to unhealthy levels for aquatic life. Construction sites, mining operations, agricultural operations, logging operations and excessive stormwater flow off impervious surfaces are all potential sources. Turbidity exceedances demonstrate the importance of **protecting and conserving stream buffers and natural areas**.

Figure 4-11: Percentage of Samples Exceeding the Turbidity Standard (2005-2009)

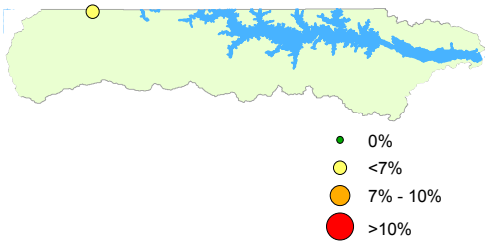
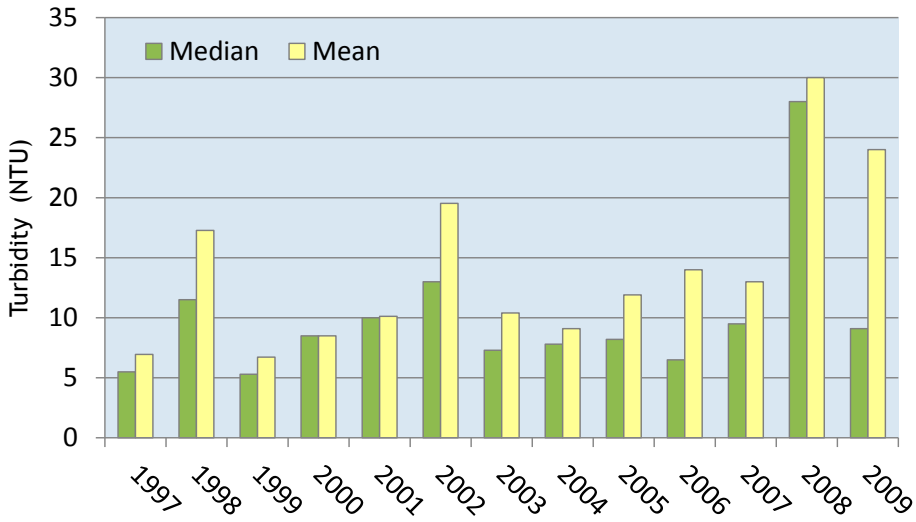


Figure 4-12: Summarized Turbidity Values for All Data Collected at Ambient Sampling Stations in HUC 03010106



* NC Turbidity Standard: 50 NUT

Dissolved Oxygen

As seen in Figure 4-13, the AMS site exceeded the DO standard in 22% of samples during this monitoring cycle. Figure 4-14 shows the mean and median of DO levels for all samples taken over the course of 13 years in the Roanoke Rapids subbasin. These averages are well within the normal DO range.

Figure 4-13: Percentage of Samples Exceeding the DO Standard (2005-2009)

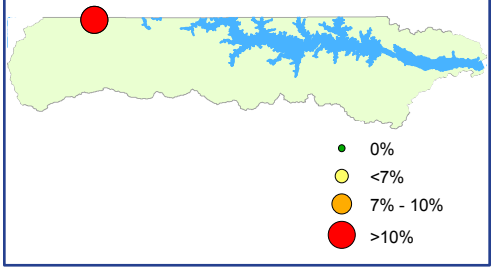
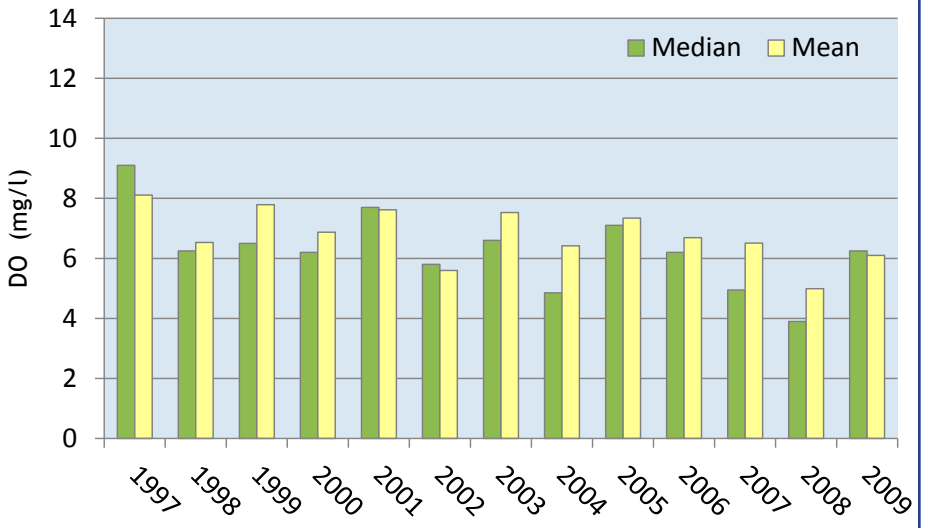


Figure 4-14: Summarized DO Values for All Data Collected at Ambient Sampling Stations in HUC 03010106

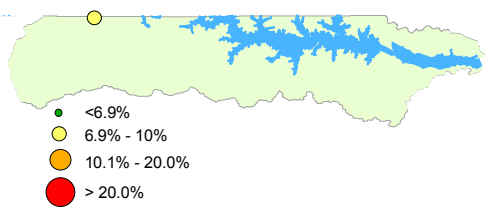


* NC DO Standard: Not < 5 mg/l daily avg. or not < 4 mg/l instantaneous

Fecal Coliform Bacteria

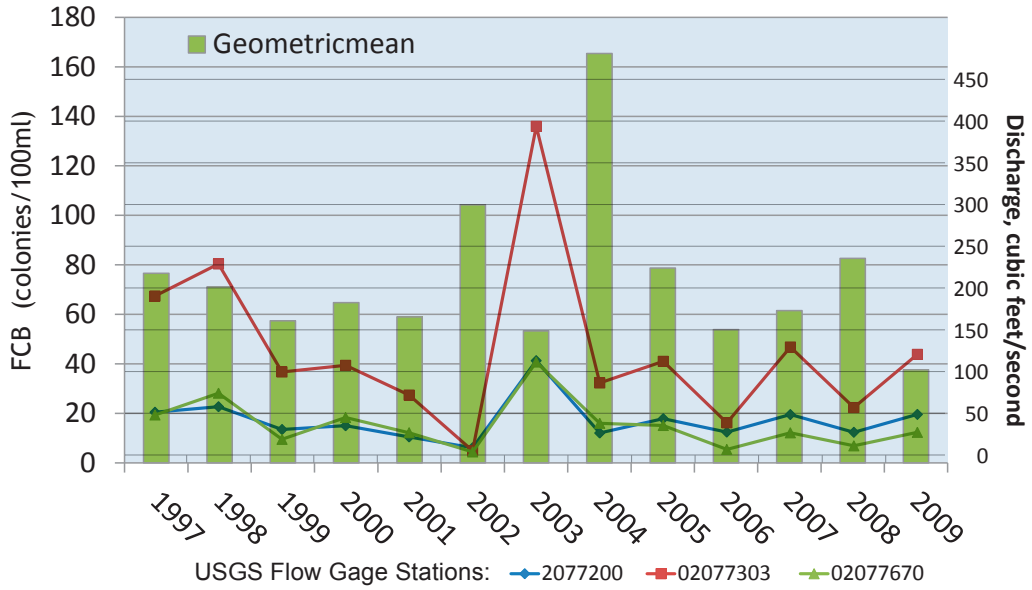
Fecal coliform bacteria (FCB) occurs in water as a result of nonpoint sources such as animal waste from wildlife, farm animals and/or pets, as well as from sanitary sewer overflows (SSOs). The FCB standard for freshwater streams is not to exceed the geometric mean of 200 colonies/100 ml, or 400 colonies/100 ml in 20% of the samples where five samples have been taken in a span of 30 days (5-in-30). Only results from a 5-in-30 study are used to indicate whether the stream is Impaired or Supporting. Waters with a use classification of B (primary recreational waters) receive priority for 5-in-30 studies. Other waters are studied as resources permit.

Figure 4-15: Percentage of Samples with Elevated FCB Levels (2005-2009)



As seen in Figure 4-15, the site had 9.6% of samples over 400 colonies/100 ml. Possible sources of elevated levels of FCB are discussed in the subwatershed sections. Figure 4-16 shows the yearly geometric mean (calculated average) for all samples taken over the course of 13 years in the Roanoke Rapids subbasin. The highest yearly geometric mean was recorded in 2001 (56 colonies/100 ml). The figure also includes the yearly average stream flow, as seen in Figure 4-2, to show how flow can be closely linked to FCB levels.

FIGURE 4-16: SUMMARIZED FECAL COLIFORM BACTERIA VALUES FOR ALL DATA COLLECTED AT AMBIENT SAMPLING STATIONS IN HUC 03010106 WITH OVERLAYING FLOW



* NC FCB Standard (5-in-30 data only): Geomean not > 200/100 ml or 400/100 ml in 20% of samples

Additional information about possible causes of parameters discussed above for particular stations, see the stream write ups below. For more information regarding any of the parameters listed above, see Section 3.3 of the **Supplemental Guide to North Carolina's Basinwide Planning**. For additional information about ambient monitoring data collected in this river basin, see the **Roanoke River Basin Ambient Monitoring System Report**.

Understanding the Data

Biological & Ambient Ratings Converted to Use Support Categories

Biological (benthic and fish community) samples are given a bioclassification/rating based on the data collected at the site by DWQs Environmental Sciences Section (ESS). These bioclassifications include Excellent, Good, Good-Fair, Not Impaired, Not Rated, Fair and Poor. For specific methodology defining how these rating are given see Benthic Standard Operating Procedures (SOP) or the Fish Community SOP. Once a rating is given, it is then translated into a Use Support Category (see Figure 4-17).

Figure 4-17: Use Support Categories for Biological Ratings

Biological Ratings	Aquatic Life Use Support
Excellent/ Natural	Supporting (Categories 1-2)
Good	
Good-Fair/ Moderate	
Not Impaired	
Not Rated	Not Rated (Category 3)
Fair	Impaired (Categories 4-5)
Poor/Severe	

Ambient monitoring data are analyzed based on the percent of samples exceeding the state standard for individual parameters for each site within a five year period. In general, if a standard is exceeded in greater than 10.0% of samples taken for a particular parameter, that stream segment is Impaired for that parameter. The fecal coliform bacteria parameter is exception to the rule. See the Fecal Coliform Bacteria section in the Ambient Data portion below.

Figure 4-18: Category Number to Use Support Rating

Category #	Use Support Rating
1	Supporting
2	
3	Not Rated
4	Impaired
5	

Each biological parameter (benthic and fish community) and each ambient parameter is assigned a Use Support Category based on its rating or percent exceedance. A detailed description of each category can be found on the first page of Appendix 4-A. Each monitored stream segment is given an overall category number which reflects the highest individual parameter category. Figure 4-18 shows how the category number is translated into the use support rating.

Example

Stream A had a benthic sample that rated Good-Fair and 12% of turbidity samples taken at the ambient station were exceeding the standard. The benthic sample would be given an individual category number of 1 (Figure 4-17) and the turbidity parameter would be given a category number of 5 since >10% of samples exceeded the standard. Therefore, stream A's overall category number would be a 5, indicating the stream has a use support rating of Impaired.

Recommendations & Action Plans at the Subbasin Scale

DWQ Priority Summary

Table 4-1 is a list of waters in the Middle Roanoke River Subbasin that DWQ has prioritized for restoration/ protection. The order of priority is not based solely on the severity of the steam's impairment or impacts but rather by the need for particular actions to be taken. A stream that is currently supporting its designated uses may be prioritized higher within this table than a stream that is currently impaired. This is based on a more holistic evaluation of the drainage area which includes monitoring results, current and needed restoration/ protection efforts, land use and other activities that could potentially impact water quality in the area. Some supporting streams may have a more urgent need for protections than an impaired stream with restoration needs already being implemented.

The table also lists potential stressors and sources that may be impacting a stream including in-field observations, monitoring data, historical evidence and permit or other violations. Additional study may be needed to determine exact source(s) of the impact. The last column includes a list of recommended actions.

Table 4-1: Notable Waters in the Roanoke Rapids Subbasin (Not Ranked)

Stream Name	AU#	Class.	Potential Stressor(s)	Potential Source(s)	Qualitative Status	Actions Needed
Lake Gaston	23-(12) & (20.2)	WS-V;B	Nutrients, Aquatic Weeds	--	Supporting	--
Roanoke Rapids Lake	23-(22.5)	WS-IV; B;CA	Nutrients, Aquatic Weeds	--	Supporting	--
Newmans Cr	23-10-2	C	Habitat Degradation, Erosion	High Volume/Velocity	Impaired	SC, SS, E, M
Smith Cr	23-10a, b & c	C	Low DO, Low Flow, Turbidity, Low pH	Runoff, Beaver Dams, Drought	Impaired	Ag, E

Class.: Classification (e.g., C, B, WS-I, WS-II, WS-III, WS-IV, WS-V, Tr, HQW, ORW, SW, UWL)

Stressor: Chemical parameters or physical conditions that at certain levels prevent waterbodies from meeting the standards for their designated use (e.g., low/high DO, nutrients, toxicity, habitat degradation, etc.). Fecal Coliform Bacteria (FCB),

Source: The cause of the stressor. (Volume & Velocity: when a stream receives stormwater runoff at a much higher volume and velocity than it would naturally receive due to ditching, impervious surfaces, etc.)

Status: Impaired, Impacted, Supporting, Improving (For current Use Support Assessment see the Integrated Report.)

Actions Needed: Agriculture BMPs (**Ag**), Best Management Practices (**BMPs**), Daylight Stream (**DS**), Education (**E**), Forestry BMPs (**F**), Local Ordinance (**LO**), Monitoring (**M**), Nutrient Mgnt Controls (**NMC**), Protection (**P**), Restoration (**R**), Riparian Buffer Restoration (**RBR**), Stormwater Controls (**SC**), Sediment and Erosion Control BMPs (**SEC BMPs**), Species Protection Plan (**SPP**), Stressor Study (**SS**), .

Status & Recommendations for Monitored Waters

Understanding this Section

In this Section, more detailed information about stream health, special studies, aquatic life stressors and sources and other additional information is provided by each 10-digit Hydrological Unit Code (HUC). Waterbodies discussed in this Chapter include all monitored streams, whether monitored by DWQ or local agencies with approved methods. Use Support information on all monitored streams within this watershed can be seen on the map in Figure 4-1, and a Use Support list of all monitored waters in this basin can be found in the Use Support Chapter.

Use Support & Monitoring Box:

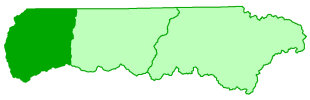
Each waterbody discussed in the Status & Recommendations for Monitored Waters within this Watershed section has a corresponding Use Support and Monitoring Box (Table 4-2). The top row indicates the 2010 Use Support and the length of that stream or stream segment. The next two rows indicate the overall Integrated Report category which further defines the Use Support for both the 2008 and the 2010 reports. These first three rows are consistent for all boxes in this Plan. The rows following are based on what type of monitoring stations are found on that stream or stream segment and may include benthic, fish community and/or ambient monitoring data. If one of these three types of monitoring sites is not shown, then that stream is not sampled for that type of data. The first column indicates the type of sampling in bold (e.g., **Benthos**) with the site ID below in parenthesis (e.g., CB79). The latest monitoring result/rating of that site is listed in the next column followed by the year that sample was taken. If there is more than one benthic site, for example, on that stream, the second site ID and site rating will be listed below the first. The last row in the sample box in Table 4-2 is the AMS data. The data window for all AMS sites listed in the boxes in this Plan is between 2004-2008. Only parameters exceeding the given standard are listed in the second column with the percent of exceedance listed beside each parameter.

Table 4-2: Example of a Use Support and Monitoring Box

Use Support: **Impaired** (14 mi)	
2008 IR Cat.	4a
2010 IR Cat.	4
Benthos (CB79) (CB80)	 Fair (2002) Fair (2002)
Fish Com (CF33)	 Good-Fair (2002)
AMS (C1750000)	Turbidity - 12% FCB - 48%

Please note any fecal coliform bacteria (FCB) listing in the last row (as seen in Table 4-2) only indicates elevated levels and a study of five samples in 30 days (5-in-30) must be conducted before a stream becomes Impaired for FCB.

Upper Lake Gaston-Roanoke River (0301010602)



Includes: Smith Creek [AU#: 23-10a, b & c] & Newmans Creek [AU#: 23-10-2]

This watershed contains a mix land use of agriculture, residential and some forested areas. There are three swine and one cattle permitted animal operations located with in the watershed. Two segments within this watershed (Newmans Creek & Smith Creek) are on the 2010 Impaired Waters List.

Newmans Creek [AU#: 23-10-2]

Newmans Creek is approximately six miles from source to Smith Creek [AU#: 23-10b]. Land cover for the majority of this drainage area is forest and agriculture. This creek was placed on the Impaired Waters list for the first time in 2008 as a result of a Fair benthic rating in 2004.

Use Support: **Impaired** (6.1 mi)	
2008 IR Cat.	5
2010 IR Cat.	5
Benthos (NB88)	 Fair (2004)

Water Quality Status

This creek was last monitored in 2004 as part of the Smith Creek TMDL study. At that time, the creek had poor habitat with deeply incised and vertical streambanks and severe bank erosion even though there were well established and intact riparian zones. The dominate nature of the pollution tolerant benthic species caused this site to receive a Fair rating and to be placed on the 2008 Impaired Waters List.

Smith Creek [AU#: 23-10a, b & c]

Smith Creek is approximately 11 miles from source to the Virginia/NC state line and is split into three segments. The majority of the drainage area is agriculture, forest and some residential area. There are two swine and two cattle operations permitted in Smith Creek's drainage area. Smith Creek has been on the Impaired Waters List since 1998 as a result of an unhealthy benthic community.

Use Support: Impaired (10.7 mi)	
2008 IR Cat.	5
2010 IR Cat.	5
Benthos	
(NB89)	Fair (2004)
(NB90)	Good-Fair (2004)
(NB52)	Fair (2004)
Fish Com	
(NF41)	Fair (2004)
AMS	
(N6400000)	DO - (23.4%)

Water Quality Status

The last biological samples taken in Smith Creek were part of a special study to determine stressors causing the Impairment within the creek and corresponding drainage area. Results of these samples are discussed in the **2006 Roanoke River Basinwide Water Quality Plan**. The study concluded that low or no flow conditions lead to both reduced edge habitat and low dissolved oxygen levels that likely caused the biological Impairment in the watershed. It indicates the low flows are likely due to beaver dams in the Blue Mud Creek tributary to Smith Creek that have been increasing over the past several years. There was also a steady increase in conductivity levels which suggests impacts from human activity as well. A connection was also made between the samples taken in the upper reaches of the watershed which had larger riparian zones and better biological scores and the lower reaches which had little riparian zones and lower biological scores.

An AMS site is located at US-1 near Paschall which is exceeding low dissolved oxygen (DO) levels in 23% of samples. This is an increase in exceedances of about 11% from the previous cycle. This increase could be contributed to the increase in beaver dams in the watershed as well as a decrease in rainfall since 2004. It should also be noted that average pH levels have been declining by about 0.3 su. Low pH exceedances (below 6.0) have increased from 3.6% last cycle to 8.3% this cycle, indicating the watershed is being impacted by low pH levels. Turbidity has also increased to 8.3% of samples exceeding the state standard. Specific conductivity levels increase during this cycle as well. Nutrient levels have, on average, remained the same, and fecal coliform bacteria has slightly declined.

Natural Conditions Assessment

In 2010, DWQ assessed Smith Creek to determine if the low DO levels were natural conditions or due to human impacts. The **December 2010 Draft Smith Creek Report** indicated that low DO levels were mainly originating from the Blue Mud tributary where multiple beaver dams were found. The beaver dams combined with natural low flows and decomposition of large inputs of vegetation from forested and agricultural areas which produce organic acids and increase oxygen demand, lower DO levels as the material decays and summer temperatures rise. Therefore, the report concluded that the low DO levels found in Smith Creek are natural.

Local Initiatives

In 2005, NC DSWC received $130,000 to complete the **Smith Creek Watershed Restoration Plan**, implement BMPs, and conduct education-outreach. The primary objective of the project was to address the severe sedimentation problems within the creek with the overall goal of removing Smith Creek from the Impaired Waters List. Below is a list of BMPs that were implemented as part of this grant.

- Grassed waterway
- Livestock exclusion fencing
- Water troughs

- Wells
- Heavy use protection areas
- Stream crossings
- Stock trails
- Crop conservation
- Agricultural road stabilization

Middle Lake Gaston-Roanoke River (0301010603)

Includes: Sixpound Creek [AU#: 23-13]**, Jordan Creek** [AU#: 23-14]**, Hawtree Creek** [AU#: 23-11-(1)] **& Lake Gaston** [AU#: 23-(12) & (20.2)]

This watershed contains a mix land use of agriculture, residential and forested areas. There are three permitted swine animal operations located within the watershed. No segments in this watershed are on the 2010 Impaired Waters List.

Lake Gaston [AU#: 23-(12) & (20.2)

Use Support: Supporting (11,939.2 ac)	
2008 IR Cat.	2
2010 IR Cat.	2
Lake Stations (ROA038A) (ROA039) (ROA039B)	No Exceedances

Lake Gaston is located on the North Carolina - Virginia border just downstream from the John H. Kerr Reservoir dam on the Roanoke River (~1,1939.2 ac). The drainage area for the lake is comprised of agricultural lands with some forested, residential and urbanized lands. The lake is classified as a Water Supply (WS-IV) and recreational waters (B) and currently Supporting its designated uses.

Water Quality Status

The lake is split into two segments that begin at the NC - Va. border and end a half mile upstream of the Lake Gaston Dam. There are three lake monitoring stations throughout the lake which were sampled five times each between May and September 2009. This data will be shown on the 2012 Integrated Report/Impaired Waters List. Assessment of parameters related to biological productivity indicated mesotrophic conditions and moderate biological productivity, as it did during the previous sampling cycle. However, average total nitrogen, TKN and chlorophyll *a* levels increased slightly. Total phosphorus levels remained the same.

As discussed in the previous *Roanoke River Basinwide Water Quality Plan*, the aquatic weed Hydrilla had become problematic. Since 2004, many steps have been taken to eradicate this noxious aquatic weed. In 2005, the Lake Gaston Stakeholder's Board developed and released *Managing Aquatic Plants in Lake Gaston: A Long-Term Action Plan*. The Lake Gaston Weed Control Council has been implementing this plan since that time. An update of the Council's actions can be found in the **Local Initiatives Chapter**.

Fish Consumption Advisory

A **fish consumption advisory** was put into place by the Division of Health and Human Services on November 18, 2009 for mercury found in walleye and largemouth bass.

Progress Energy Roxboro Steam Electric Power Plant (NC0003425)

CP&L DBA Progress Energy Carolinas, Inc. operates a steam electric power plant facility and holds an NPDES permit NC0003425 to discharge process control and industrial waste streams to Hyco Lake a Class WS-V;B water, in the Roanoke River Basin, in Person County.

Progress Energy Carolinas, Inc. installed wet limestone forced oxidation wet scrubbers on all operating units at the Roxboro Steam Electric Plant in response to requirements from the State of North Carolina under the Clean Smokestacks legislation. Accordingly, Progress Energy installed a Flue Gas Desulfurization (FGD) wastewater settling pond, a General Electric ABMet bioreactor (a new technology biological treatment system), and a FGD Flush Pond to treat wastewater generated by the recently added wet scrubbers.

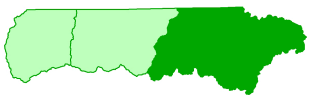
Since installation of FGD Settling Pond, FGD Flush Pond and GE ABMet bioreactor Progress Energy Carolinas, Inc. has:

- upgraded ash handling system to handle all fly ash at the plant as dry ash to reduce pollutant loading to the outfall.
- installed and uses the addition Sodium Hydroxide at the coal pile runoff pond.
- conducted pilot trial use of Met Clear treatment technology at the filter dam of the Ash Pond
- placed into service secondary hydrocyclones to reduce the amount of suspended solids in the blow down to the settling pond.
- experienced a structural failure of the FGD Flush pond and the FGD Settling Pond. These treatment units showed signs of structural stress that lead to a bypass of partially treated FGD wastewater to the ash pond.

Accordingly, additional monitoring, beyond the requirements of the NPDES permit was required by DWQ and sampling results from the FGD Treatment Units, NPDES Internal Outfall 002, and final NPDES Outfall 003 to Hyco Lake were reported by Progress Energy.

The repair and construction of the FGD Flush Pond, construction of new FGD Settling Pond (East Pond), and the refurbishment of the FGD Settling Pond (West Pond) are completed. Progress Energy has explained that any related or additional issues will be best addressed through the 2011 application for renewal of the Roxboro Plant's NPDES permit

Lower Lake Gaston-Roanoke River (0301010604)



Includes: Roanoke Rapids [AU#: 23-(22.5)]

This watershed contains a mix land use of agriculture, residential and forested areas. There are two minor NPDES permitted facilities along with three permitted cattle and two swine animal operations located within the watershed. No segments in this watershed are on the 2010 Impaired Waters List.

Roanoke Rapids Lake [AU#: 23-(22.5))

Roanoke Rapids Lake (~4,185 ac), located on the Roanoke River immediately downstream from Lake Gaston, is owned by the Virginia Electric and Power Company and used for hydropower generation as well as public recreation and as a water supply. The drainage area for the lake is comprised of mostly agricultural lands with some forested, residential and urbanized lands. There are four permitted animal operations and two minor NPDES permitted facilities. The lake was on the Impaired Waters list from 1998 to 2008 due to an infestation of aquatic weeds (Hydrilla). The development of a TMDL in 2006 has resulted in the lake being in the Supporting category.

Use Support: **Supporting** (4,185 ac)	
2008 IR Cat.	5
2010 IR Cat.	2
Lake Stations (ROA039C) (ROA039D) (ROA039E)	No Exceedances

Water Quality Status

The lake is one assessment unit spanning from the Lake Gaston Dam to the Roanoke Rapids Dam. Three lake monitoring stations were sampled five times each between May and September of 2009 throughout the lake. This data will be shown on the 2012 Integrated Report/Impaired Waters List. On average, nutrient levels increased from low to moderate levels. Chlorophyll *a* levels have also increased since the previous sampling cycle. This change indicates the lake has moderate biological productivity (mesotrophic). An Algal Growth Potential Test conducted at all three sites determined the lake to be nitrogen limited.

A sample taken in August 2009 at the most upstream station (ROA039C) showed the highest levels of DO, pH and chlorophyll *a* levels which are signs of elevated photosynthetic activity. A phytoplankton sample was taken at this site resulting in evidence of an algal bloom (*Aulacoseira sp.*). This bloom was not seen at the downstream monitoring station ROA039D. A significant amount of submerged aquatic plants were also present at the upstream station, which may have contributed to the elevated DO and pH readings at this site.

Aquatic Weed TMDL

A **TMDL for aquatic weeds** was developed and approved by EPA in 2006 for Roanoke Rapids Lake, along with a few other lakes within the state. For this lake, the TMDL addressed *Hydrilla verticillata, Myriphyllum spicatum* and *Egeria densa.* These species are all noxious, exotic weeds that will require extensive control. In 2003, the composition of aquatic weeds were dominated by Hydrilla (99%). This plant shades out native vegetation, provides poor habitat for fish and other wildlife, provides good breeding grounds for mosquitoes, and greatly interferes with recreational activities.

Management strategies to control these aquatic plants are discussed in detail within the TMDL. Two of these strategies include consecutive short-term draw downs of the lake levels during the summer months, when Hydrilla is most productive as well as the use of Grass Carp. If these strategies fail to control the plants, herbicides are suggested. However, improper application of the herbicides recommended can contaminate ground water and surface water.

References

References marked with (*) indicates a DWQ special study report. These reports are not currently available online. Contact the DWQ Environmental Science Section at (919) 743-8400 to receive a hardcopy.

North Carolina Department of Environment and Natural Resources (NCDENR). Division of Water Quality (DWQ). August 2004a. *Classifications and Water Quality Standards Applicable to Surface Waters and Wetlands of North Carolina*. North Carolina Administrative Code: 15A NCA 2B. Raleigh, NC. (http://h2o.enr.state.nc.us/csu/)

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____. *DWQ. ESS. BAU. Month Year. (B-#) *Report Name & Sample Date*. Raleigh, NC.

Pate, Travis. 2009. *Watershed Assessment in North Carolina: Building a Watershed Database with Population, Land Cover, and Impervious Cover Information*. Master Theses, University of North Carolina at Chapel Hill.

Appendix 4-A

Use Support Ratings for All Monitored Waters in the Roanoke Rapids Subbasin

Draft 2010 IR Category	Integrated Reporting Categories for individual Assessment Unit/Use Support Category/ Parameter Assessments. A single AU can have multiple assessments depending on data available and classified uses.
1	All designated uses are monitored and supporting
1b	Designated use was impaired, other management strategy in place and no standards violations for the parameter of interest (POI)
1nc	DWQ have made field determination that parameter in exceedance is due to natural conditions
1r	Assessed as supporting watershed is in restoration effort status
1t	No criteria exceeded but approved TMDL for parameter of interest
2	Some designated uses are monitored and supporting none are impaired Overall only
2b	Designated use was impaired other management strategy in place and no standards violations Overall only
2r	Assessed as supporting watershed is in restoration effort status overall only
2t	No criteria exceeded but approved TMDL for POI Overall only
3a	Instream/monitoring data are inconclusive (DI)
3b	No Data available for assessment
3c	No data or information to make assessment
3n1	Chlorophyll a exceeds TL value and SAC is met-draft
3n2	Chlorophyll a exceeds EL value and SAC is not met first priority for further monitoring-draft
3n3	Chlorophyll a exceeds threshold value and SAC is not met first second priority for further monitoring-draft
3n4	Chlorophyll a not available determine need to collect-draft
3t	No Data available for assessment –AU is in a watershed with an approved TMDL
4b	Designated use impaired other management strategy expected to address impairment
4c	Designated use impaired by something other than pollutant
4cr	Recreation use impaired no instream monitoring data or screening criteria exceeded
4cs	Shellfish harvesting impaired no instream monitoring data- no longer used
4ct	Designated use impaired but water is subject to approved TMDL or under TMDL development
4s	Impaired Aquatic Life with approved TMDL for Aquatic Life POI or category 5 listing
4t	Designated use impaired approved TMDL
5	Designated use impaired because of biological or ambient water quality standards violations and needing a TMDL
5r	Assessed as impaired watershed is in restoration effort status

NC 2010 Integrated Report

All 13,123 Waters in NC are in Category 5-303(d) List for Mercury due to statewide fish consumption advice for several fish species

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Roanoke River Basin — **Upper Lake Gaston-Roanoke River Watershed** — **0301010602**

Roanoke River Basin — Lake Gaston-Roanoke River Subbasin — 03010106

Roanoke River Basin — **Upper Lake Gaston-Roanoke River Watershed** — **0301010602**

23-10-2	**Newmans Creek (Little Deep Creek)**	From source to Smith Creek	**6.1 FW Miles**	C	
5	**Ecological/biological Integrity Benthos**	Fair Bioclassification	Aquatic Life	2004	2008
23-10a	**Smith Creek**	From source to Cabin Branch	**6.1 FW Miles**	C	
4s	**Ecological/biological Integrity Benthos**	Fair Bioclassification	Aquatic Life	2004	2002
5	**Low Dissolved Oxygen**	Standard Violation	Aquatic Life	2008	1998
23-10b	**Smith Creek**	From Cabin Branch to SR1208	**1.6 FW Miles**	C	
1	**Ecological/biological Integrity Benthos**	Good-Fair Bioclassification	Aquatic Life	2004	
5	**Low Dissolved Oxygen**	Standard Violation	Aquatic Life	2008	1998
23-10c	**Smith Creek**	From SR1208 to North Carolina-Virginia State Line	**3.0 FW Miles**	C	
4s	**Ecological/biological Integrity Benthos**	Fair Bioclassification	Aquatic Life	2004	
4s	**Ecological/biological Integrity FishCom**	Fair Bioclassification	Aquatic Life	2004	
1	**Fecal Coliform (recreation)**	No Criteria Exceeded	Recreation	2008	
5	**Low Dissolved Oxygen**	Standard Violation	Aquatic Life	2008	1998
23-10-3-2	**Terrapin Creek**	From source to Blue Mud Creek	**5.0 FW Miles**	C	
3a	**Ecological/biological Integrity Benthos**	Not Rated Bioclassification	Aquatic Life	2007	

Roanoke River Basin — **Middle Lake Gaston-Roanoke River Watershed** — **0301010603**

23-14	**Jordan Creek**	From source to Lake Gaston, Roanoke River	**2.6 FW Miles**	C	
1	**Ecological/biological Integrity Benthos**	Not Impaired Bioclassification	Aquatic Life	2006	
23-13	**Sixpound Creek**	From source to Lake Gaston, Roanoke River	**6.3 FW Miles**	C	
1	**Ecological/biological Integrity Benthos**	Good-Fair Bioclassification	Aquatic Life	2004	

Roanoke River Basin — **Lower Lake Gaston-Roanoke River Watershed** — **0301010604**

23-24-(1)	**Deep Creek**	From source to a point 0.5 mile upstream of mouth	**11.6 FW Miles**	WS-IV	
1	**Ecological/biological Integrity Benthos**	Natural Bioclassification	Aquatic Life	2004	
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	
23-19	**Little Stonehouse Creek**	From source to Lake Gaston, Roanoke River	**2.8 FW Miles**	C	
1	**Ecological/biological Integrity Benthos**	Not Impaired Bioclassification	Aquatic Life	2006	

NC 2010 Integrated Report

All 13,123 Waters in NC are in Category 5-303(d) List for Mercury due to statewide fish consumption advice for several fish species

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Roanoke River Basin — **Lower Lake Gaston-Roanoke River Watershed** — **0301010604**

⊙ **23-(22.5)**	**ROANOKE RIVER (Lake Gaston below normal full power pool elevation 200 MSL and Roanoke Rapids Lake below normal full power pool elevation 132 feet MSL)**	From a line across Lake Gaston 0.5 mile upstream of Lake Gaston Dam to Roanoke Rapids Dam	**4,185.0 FW Acres**		WS-IV,B;CA

3t	**Aquatic Weeds**	Data Inconclusive	Aquatic Life	2000	2000
1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	
1	**Water Quality Standards Water Supply**	No Criteria Exceeded	Water Supply	2008	

⊙ **23-(12)**	**ROANOKE RIVER (Lake Gaston below normal full power pool elevation 200 MSL)**	From North Carolina-Virginia State Line to a line across Lake Gaston following the Warren-Northampton County Line	**7,964.8 FW Acres**		WS-V,B

1	**Water Quality Standards Water Supply**	No Criteria Exceeded	Water Supply	2008	

⊙ **23-(20.2)**	**ROANOKE RIVER (Lake Gaston below normal full power pool elevation 200 MSL)**	From a line across Lake Gaston following the Warren-Northampton County Line to a line across Lake Gaston 0.5 mile upstream of Lake Gaston Dam	**3,974.4 FW Acres**		WS-IV,B

1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	
1	**Water Quality Standards Water Supply**	No Criteria Exceeded	Water Supply	2008	

Appendix 4-B

Biological Sampling Site Data Sheets (Benthic Macroinvertebrate & Fish Community) for the Roanoke Rapids Subbasin

Biological Samples Taken During this Assessment Cycle

Station ID	Waterbody	County	Site Location	Sample Results
Benthic Sample Sites				
NB113	HUBQUARTER CR	WARREN	SR 1337	06 - Not Impaired
NB37	JORDAN CR	WARREN	SR 1306	06 - Not Impaired
NB37	JORDAN CR	WARREN	SR 1306	05 - Not Impaired
NB39	L STONEHOUSE CR	WARREN	SR 1358	06 - Not Impaired
NB51	SIXPOUND CR	WARREN	SR 1306	09 - Good-Fair
NB54	DEEP CR	HALIFAX	US 158	09 - Natural
Fish Community Sample Sites				
NF45	Deep Cr	Halifax	US 158	09 - Fair

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
SIXPOUND CR	SR 1306	NB51	08/13/09	Good-Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WARREN	7	03010106	36.510000	-78.079444	23-13	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	9.6	220	7	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	100	0	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	_	_

Water Quality Parameters

Temperature (°C)	23.8
Dissolved Oxygen (mg/L)	8.5
Specific Conductance (µS/cm)	62
pH (s.u.)	6.6
Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	5
Pool Variety (10)	8
Riffle Habitat (16)	7
Bank Erosion (7)	5
Bank Vegetation (7)	5
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	73

Site Photograph

Substrate Sand and silt was the dominant substrata.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/13/09	10812	58	13	5.75	4.69	Good-Fair
06/29/04	9418	62	15	6.43	5.44	Good-Fair
07/16/99	7923	54	14	5.50	5.03	Good-Fair
08/22/94	6643	12	12	5.51	5.51	Fair

Taxonomic Analysis

Only one stonefly larvae was collected at the sampling location. EPT taxa richness was low (13) and most are tolerant and common taxa found in North Carolina Peidmont streams. The intolerant caddisfly *Pycnopsyche spp* . was abundant at the site. Chironomid richness (12) and biomass was low with tolerant and slightly intolerant taxa present. No chironomid taxa were abundant at the site. Odonate richness (11) was high and several taxa were common or abundant at the site including *Argia spp.* , *Boyeria vinosa* , *Calopteryx spp.* , *Gomphus spp.* , and *Macromia spp.*

Data Analysis

No NPDES dischargers are located upstream from this location and land use is mostly rural with some agricultural portions. This site received a bioclassification of Good-Fair for the third year in a row. The NCBI and EPTBI dropped since 2004 potentially due to half as many chironomid taxa present in 2009. Also *Pycnopsyche spp.* were found rare at the site in 2004 and abundant in 2009. It was noted that water in the channel in certain sections did not reach the bottom of both banks, flows were low, and detritius was abundant similar to that found in swamp-like conditions. These observations and the presence of so many odonates suggests the site suffers from low flow conditions. Physical parameters such as infrequent embedded riffles and low flows may limit habitat necessary for colonization of some rheophilic macroinvertebrates such as long-lived stonefly taxa.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
DEEP CR	US 158	NB54	02/03/09	Natural

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HALIFAX	8	03010106	36.451389	-77.781944	23-24-(1)	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV	23.3	145	7	0.5

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	90	0	0	10 (US 158)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	6.5
Dissolved Oxygen (mg/L)	11.4
Specific Conductance (µS/cm)	69
pH (s.u.)	5.9
Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	15
Instream Habitat (20)	18
Bottom Substrate (15)	15
Pool Variety (10)	9
Riffle Habitat (16)	0
Bank Erosion (7)	7
Bank Vegetation (7)	7
Light Penetration (10)	9
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	90

Site Photograph

Substrate Rubble, gravel, sand, silt, and detritus.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/03/09	10527	67	21	6.11	5.06	Natural
02/23/04	9339	63	23	5.54	4.42	Natural

Taxonomic Analysis

The primary reason for the jump in EPTBI in 2009 relative to previous samples was the first time collection of the pollution tolerant mayflies *Caenis spp.* and *Stenacron interpunctatum*. In addition, several intolerant stoneflies collected in 2004 were absent in 2009 (*Shipsa rotunda* and *Eccoptura xanthenes*) as was the intolerant caddisfly *Neophylax oligius*. The 2009 assessment produced a substantial increase in the diversity and abundance of pollution-tolerant chironmids relative to the the 2004 sample. Indeed the 2009 sample produced 23 chironomid taxa while the 2004 sample had 12. This shift in community composition was largely responsible for the increase in the BI from 2004 to 2009.

Data Analysis

Bioclassification and macroinvertebrate metrics have generally been stable at this location since sampling commenced in 2004 with both winter samples producing Natural bioclassifications. However, the slight increase in both the BI and EPTBI in 2009 relative to the 2004 sample correlates to the increasing trend in conductivity observed at this site as previous measurements in 1999 (21 µS/cm) and 2004 (47 µS/cm) were much lower than the 2009 measurement (69 µS/cm). These data combined may suggest a slight decrease in overall physical conditions at this site.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
DEEP CR	US 158	05/27/09	NF45	Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HALIFAX	8	03010106	36.45138889	-77.7825	23-24-(1)	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-IV	23.5	145	8	0.4	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	75	25	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	20.4
Dissolved Oxygen (mg/L)	6.3
Specific Conductance (µS/cm)	89
pH (s.u.)	6.6
Water Clarity	Clear, slightly tannin stained

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	4
Pool Variety (10)	10
Riffle Habitat (16)	5
Erosion (7)	6
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**73**

Site Photograph

Substrate Gravel, cobble, sand, silt

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/16/10	2010-50	22	48	Good
05/27/09	2009-48	18	38	Fair
05/26/04	2004-59	28	46	Good
09/21/94	94-39	21	50	Good

Most Abundant Species 2009 Spottail Shiner (37%)

Exotic Species 2009 Green Sunfish, Bluegill

Species Change Since Last Cycle (2009 vs. 2004)

Gains -- Eastern Silvery Minnow, Notchlip Redhorse, Flier. **Losses** -- Crescent Shiner, Rosefin Shiner, Satinfin Shiner, Creek Chubsucker, V-lip Redhorse, Flat Bullhead, Redfin Pickerel, Eastern Mudminnow, Eastern Mosquitofish, Pumpkinseed, Warmouth, Redear Sunfish, Largemouth Bass. All species gained or lost were represented by 1-9 fish/species, except for Eastern Mosquitofish, Flat Bullhead, and Satinfin Shiner (n= 11, 14, and 21, respectively).

Data Analysis

Watershed -- drains north-central Halifax County; no municipalities in the watershed; tributary to Roanoke Rapids Lake, site is ~ 1.4 miles upstream from the reservoir. **Habitats** -- straddles the Northern Outer Piedmont and the Rolling Coastal Plain Level IV ecoregions; good root mats, snags, undercuts, deadfalls, short and shallow riffles, high quality riparian zones. **2009** -- number of fish collected was not much lower than in 2004 (289 *vs* 316), but 10 fewer species were present; very low percentage of the species with multiple age classes (28%); high percentage of tolerant fish (primarily Redbreast Sunfish and Green Sunfish); skewed trophic structure due to the abundance of the omnivorous Spottail Shiner. **1994 - 2009** -- very diverse community, 31 species known from the site, including 8 species of sunfish, 5 species of catfish, but no intolerant species; in 1994 and 2004 the dominant species was the Redbreast Sunfish. **Note:** the site was re-sampled in 2010 following a wetter winter and spring flow period and the community was rated Good.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
DEEP CR	**US 158**	**NB54**	**02/03/09**	**Natural**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HALIFAX	8	03010106	36.451389	-77.781944	23-24-(1)	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV	23.3	145	7	0.5

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	90	0	0	10 (US 158)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (℃)	6.5
Dissolved Oxygen (mg/L)	11.4
Specific Conductance (µS/cm)	69
pH (s.u.)	5.9
Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	15
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Pool Variety (10)	9
Riffle Habitat (16)	0
Bank Erosion (7)	7
Bank Vegetation (7)	7
Light Penetration (10)	9
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	90

Site Photograph

Substrate Rubble, gravel, sand, silt, and detritus.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
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	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	75	25	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	20.4
Dissolved Oxygen (mg/L)	6.3
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Water Clarity	Clear, slightly tannin stained

Habitat Assessment Scores (max)

Channel Modification (5)	5
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Bottom Substrate (15)	4
Pool Variety (10)	10
Riffle Habitat (16)	5
Erosion (7)	6
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**73**

Site Photograph

Substrate Gravel, cobble, sand, silt

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
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05/26/04	2004-59	28	46	Good
09/21/94	94-39	21	50	Good

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APPENDIX 4-C

AMBIENT MONITORING SYSTEMS
STATION DATA SHEETS
FOR THE ROANOKE RAPIDS SUBBASIN

Ambient Monitoring System Station Summaries
NCDENR, Division of Water Quality
Basinwide Assessment Report

Location: SMITH CRK AT US 1 NR PASCHALL
Station #: N6400000 **Hydrologic Unit Code:** 03010106
Latitude: 36.54087 **Longitude:** -78.19514 **Stream class:** C
Agency: NCAMBNT **NC stream index:** 23-10

Time period: 01/03/2005 to 11/18/2009

	# results	# ND	EL	Results not meeting EL #	%	%Conf	Percentiles Min	10th	25th	50th	75th	90th	Max
Field													
D.O. (mg/L)	47	0	<4	11	23.4	99.8	2.3	3.2	4.1	5.3	8.5	11.3	12.8
	47	0	<5	18	38.3	100	2.3	3.2	4.1	5.3	8.5	11.3	12.8
pH (SU)	48	0	<6	4	8.3		5.1	6	6.4	6.6	6.8	7.1	7.4
	48	0	>9	0	0		5.1	6	6.4	6.6	6.8	7.1	7.4
Salinity (ppt)	9	0	N/A				0	0	0	0	0.1	0.1	0.1
Spec. conductance (umhos/cm at 25°C)	48	0	N/A				63	74	76	90	128	158	180
Water Temperature (°C)	48	0	>32	0	0		1.7	5.4	8.9	16.8	21.7	25	26.1
Other													
TSS (mg/L)	19	8	N/A				2.8	3	5	6.2	7	16	18
Turbidity (NTU)	48	0	>50	4	8.3		2.6	3.6	4.1	9.1	26.8	41.1	120
Nutrients (mg/L)													
NH3 as N	48	25	N/A				0.02	0.02	0.02	0.02	0.05	0.29	0.59
NO2 + NO3 as N	47	32	N/A				0.02	0.02	0.02	0.02	0.05	0.08	0.2
TKN as N	45	0	N/A				0.21	0.29	0.38	0.48	0.68	1.02	1.4
Total Phosphorus	46	0	N/A				0.03	0.04	0.05	0.07	0.08	0.15	0.92
Metals (ug/L)													
Aluminum, total (Al)	9	0	N/A				56	56	68	92	130	240	240
Arsenic, total (As)	9	9	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	9	9	>2	0	0		1	1	2	2	2	2	2
Chromium, total (Cr)	9	9	>50	0	0		10	10	25	25	25	25	25
Copper, total (Cu)	9	9	>7	0	0		2	2	2	2	2	2	2
Iron, total (Fe)	9	0	>1000	7	77.8		820	820	1405	2200	3600	8500	8500
Lead, total (Pb)	9	9	>25	0	0		10	10	10	10	10	10	10
Mercury, total (Hg)	8	8	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	9	9	>88	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	9	8	>50	0	0		10	10	10	10	10	11	11

Fecal Coliform Screening(#/100mL)

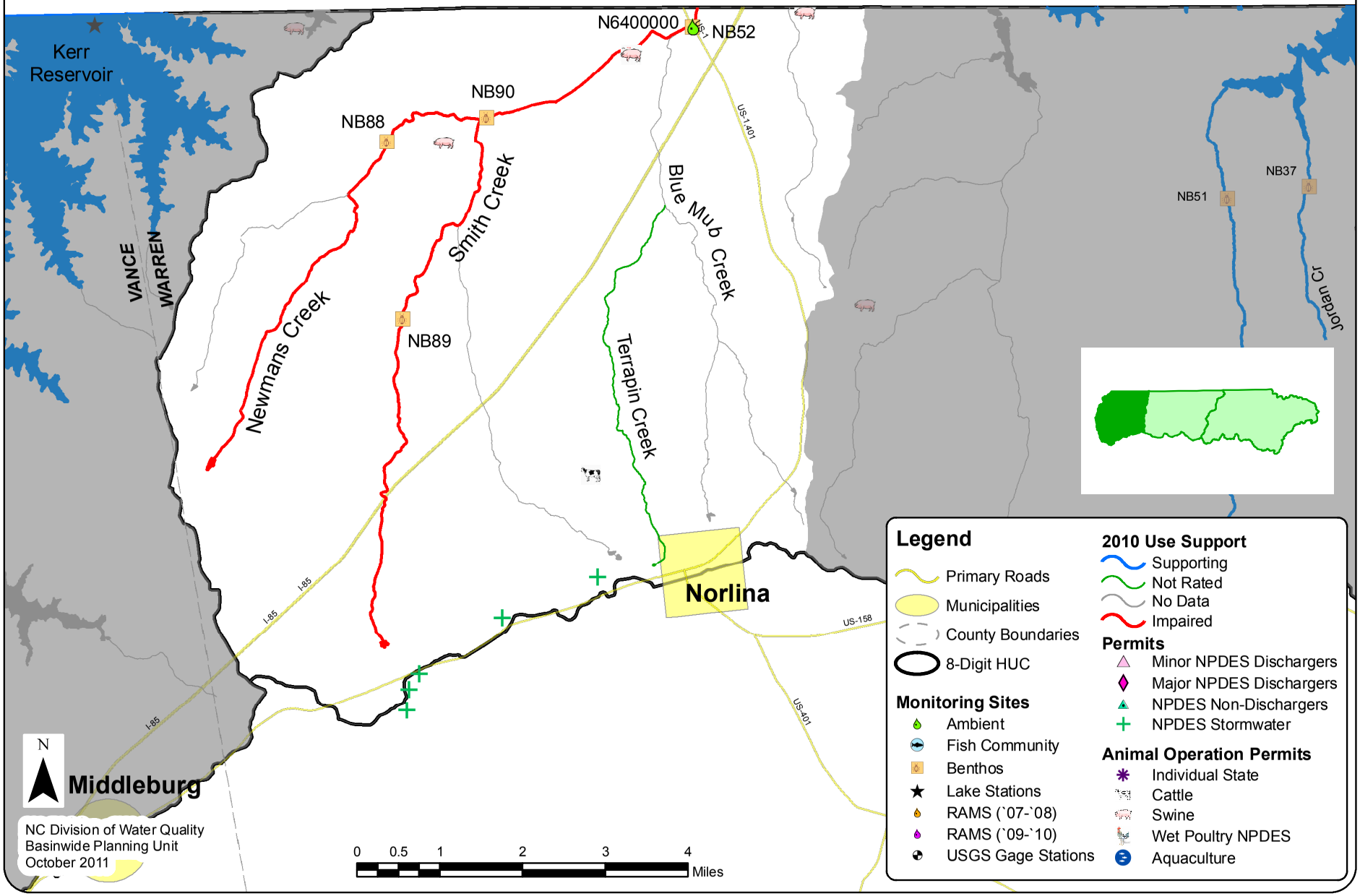
# results:	Geomean:	# > 400:	% > 400:	%Conf:
48	61.3	2	4.2	

Key:
result: number of observations
ND: number of observations reported to be below detection level (non-detect)
EL: Evaluation Level; applicable numeric or narrative water quality standard or action level
Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : States the percent statistical confidence that the actual percentage of exceedances is at least 10% (20% for Fecal Coliform)
Stations with less than 10 results for a given parameter were not evaluated for statistical confidence

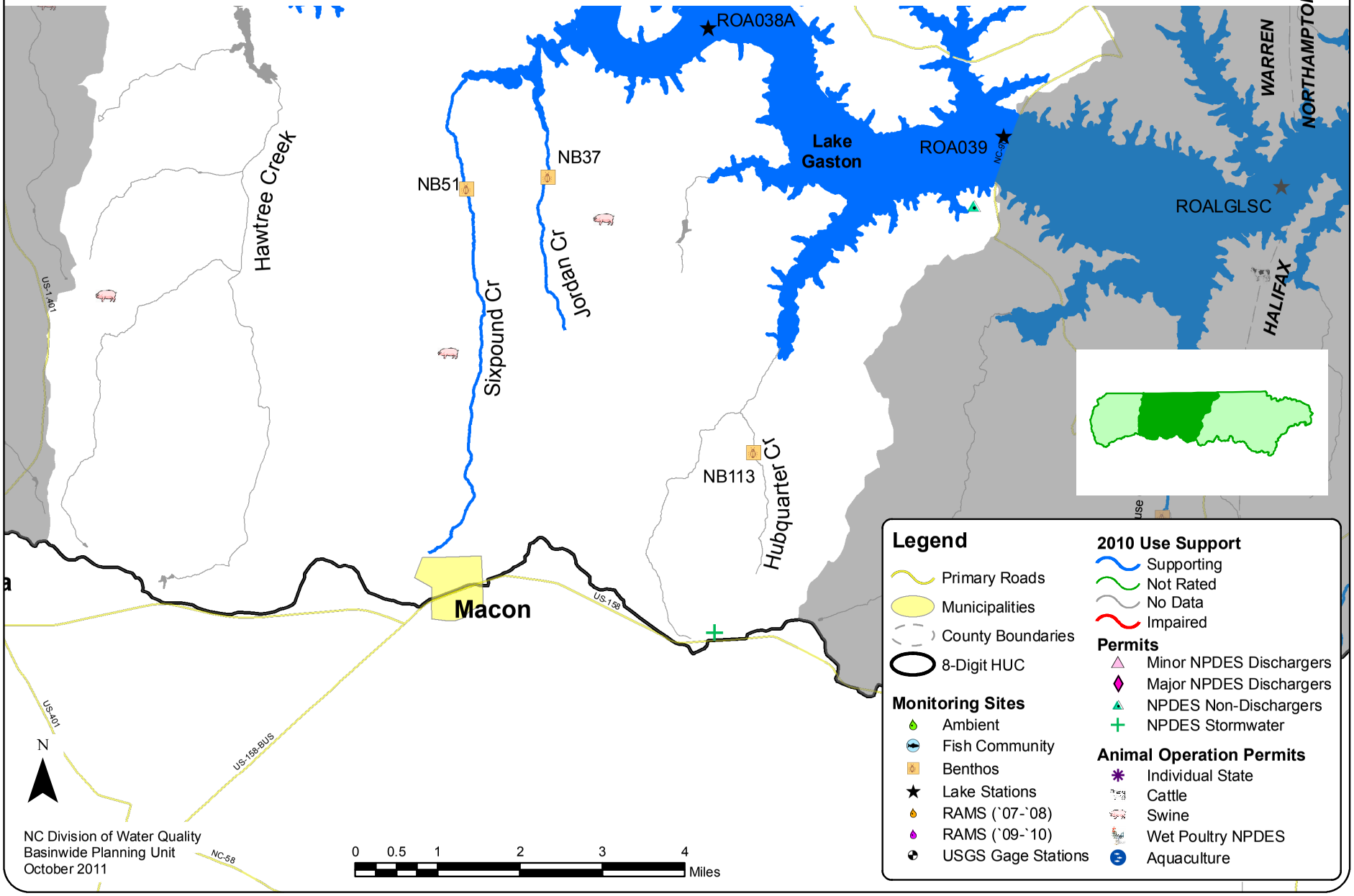
Appendix 4-D

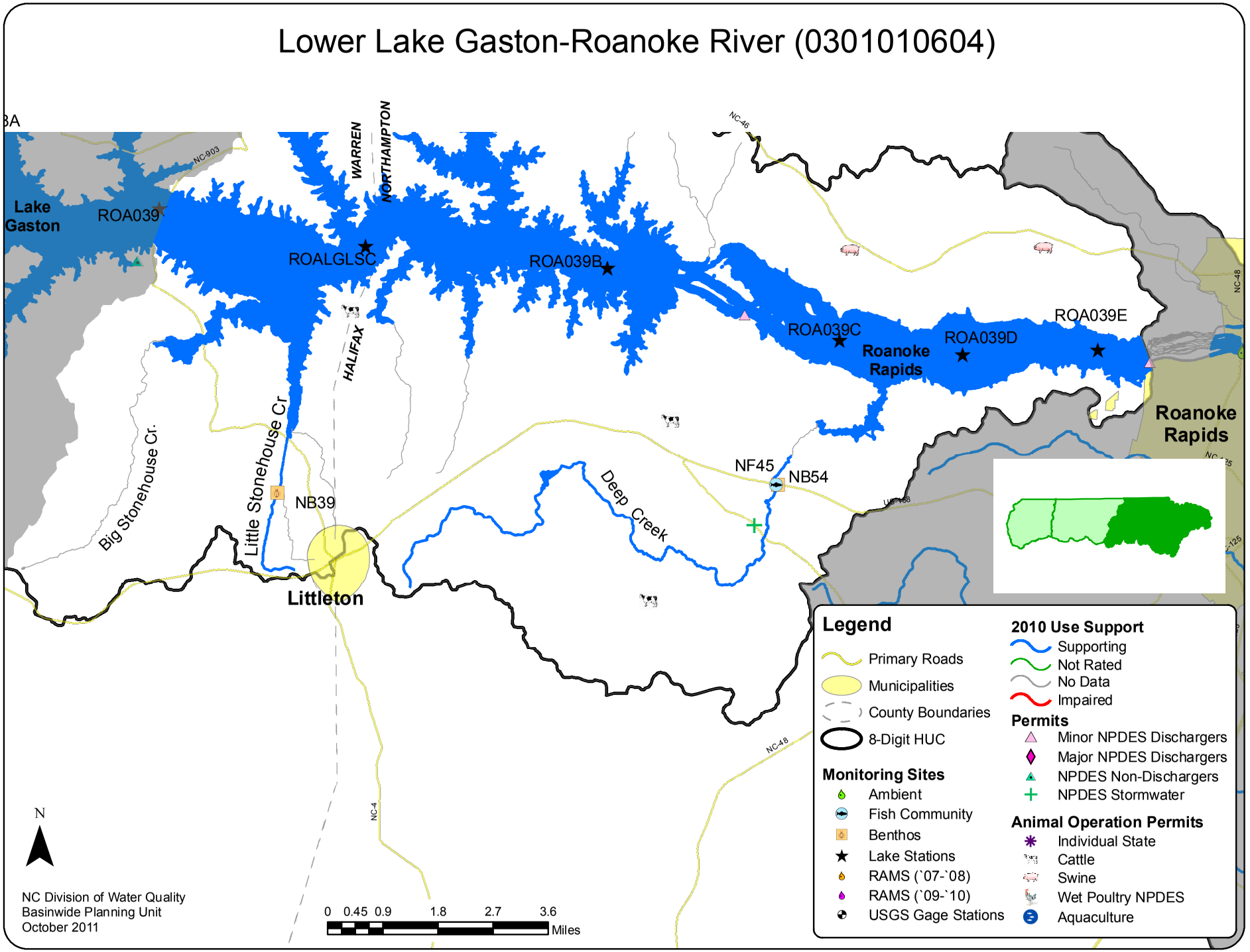
10-Digit Watershed Maps for the Roanoke Rapids Subbasin

Upper Lake Gaston-Roanoke River (0301010602)



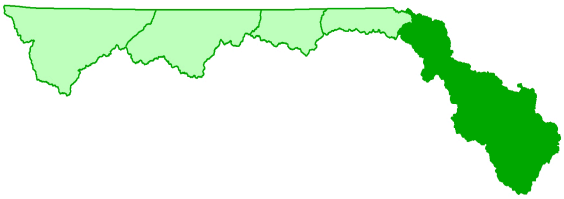
Middle Lake Gaston-Roanoke River (0301010603)




Lower Lake Gaston-Roanoke River (0301010604)
Lake Gaston
ROA039
ROALGLSC
ROA039B
ROA039C
ROA039D
ROA039E
Roanoke Rapids
WARREN
NORTHAMPTON
HALIFAX
Big Stonehouse Cr.
Little Stonehouse Cr
NB39
Littleton
Deep Creek
NF45
NB54
NC-903
NC-46
NC-48
NC-4
Legend
Primary Roads
Municipalities
County Boundaries
8-Digit HUC
Monitoring Sites
Ambient
Fish Community
Benthos
Lake Stations
RAMS (`07-`08)
RAMS (`09-`10)
USGS Gage Stations
2010 Use Support
Supporting
Not Rated
No Data
Impaired
Permits
Minor NPDES Dischargers
Major NPDES Dischargers
NPDES Non-Dischargers
NPDES Stormwater
Animal Operation Permits
Individual State
Cattle
Swine
Wet Poultry NPDES
Aquaculture
N
NC Division of Water Quality
Basinwide Planning Unit
October 2011
0 0.45 0.9 1.8 2.7 3.6
Miles

CHAPTER 5

Lower Roanoke River Subbasin



HUC 03010107

Includes: Roanoke River, Quankey Creek, Cashie River & Welch Creek

Subbasin Water Quality Overview

The Lower Roanoke River Subbasin is the eastern most subbasin and empties into Albemarle Sound. The subbasin contains three Impaired stream: one segment of Quankey Creek is Impaired for biological integrity; Welch Creek is Impaired for dioxin and low pH. One of the two most downstream segments of the Roanoke River is Impaired for low DO and the other is Impaired for dioxin.

During this basinwide cycle (2004-2009), the subbasin experienced a moderate drought in 2005 and 2006 as well as a prolonged drought between 2007 and 2008. Monitoring the biological community showed only a small percent declined and some improved. There were no major ambient monitoring violations.

The John H. Kerr Dam and Reservoir Section 216 Feasibility Study project is partially located in this subbasin. The project area also includes HUCs 03010102 and 03010106. The study has focused on examining the feasibility of addressing downstream environmental resource concerns in the Lower Roanoke River drainage area through changes in operations or structures at the John H. Kerr Dam and Reservoir. Along with USACE, the non-federal cost sharing partners for this study are Virginia, and North Carolina. The process includes forming diverse workgroups, conducting a wide range of studies and developing a plan of recommendations. The project is currently completing phase 2 and beginning phase 3, the final phase. A more detailed description of the project is found in the Additional Study section in Chapter 3.

Subbasin at a Glance

Counties:

Bertie, Halifax, Martin, Northampton & Washington

Municipalities:

Askewville, Aulander, Garysburg, Gaston, Halifax, Hamilton, Hassell, Hodgood, Jackson, Kelford, Lewiston Woodville, Oak City, Plymouth, Rich Square, Roanoke Rapids, Roxobel, Scotland Neck, Weldon, Williamston & Windsor,

Ecoregions:

Northern Outer Piedmont, Rolling Coastal Plain, Southeastern Floodplains and Low Terraces, Mid-Atlantic Flatwoods, Mid-Atlantic Floodplains and Low Terraces & Chesapeake-Pamlico Lowlands and Tidal Marshes

Permitted Facilities:

NPDES Dischargers:	24
Major	7
Minor	11
General	6
NPDES Non-Dischargers:	11
Stormwater:	58
General	50
Individual	8
Animal Operations:	46
Aquaculture	45

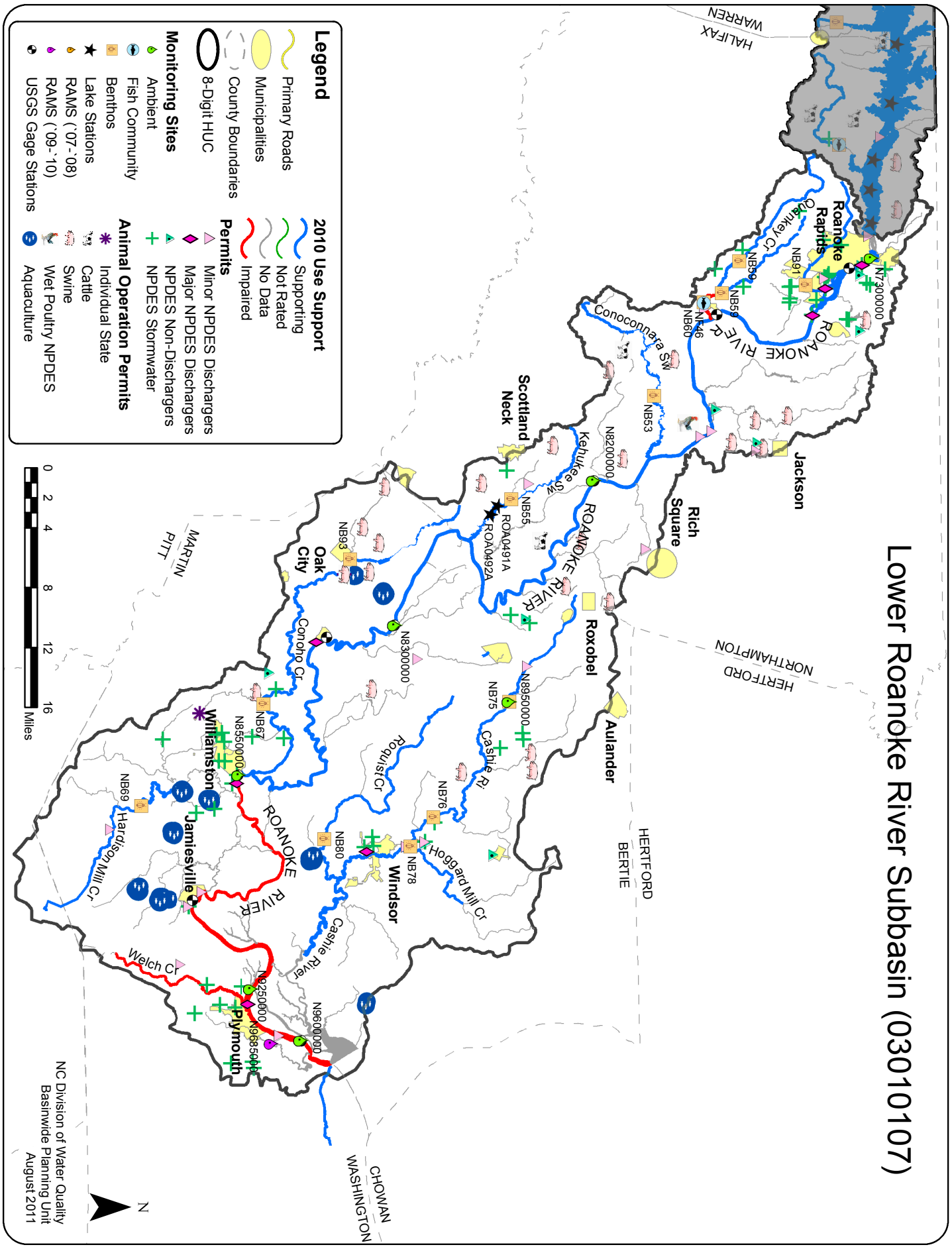
Population:

2010 Census	78,568

2006 Land Cover:

Open Water	1.7%
Developed	6.1%
Forest	25.9%
Agriculture	26.0%
Wetlands	29.6%
Barren Land	0.1%
Shrub/Grassland	10.5%

FIGURE 5-1: LOWER ROANOKE RIVER SUBBASIN (03010107)



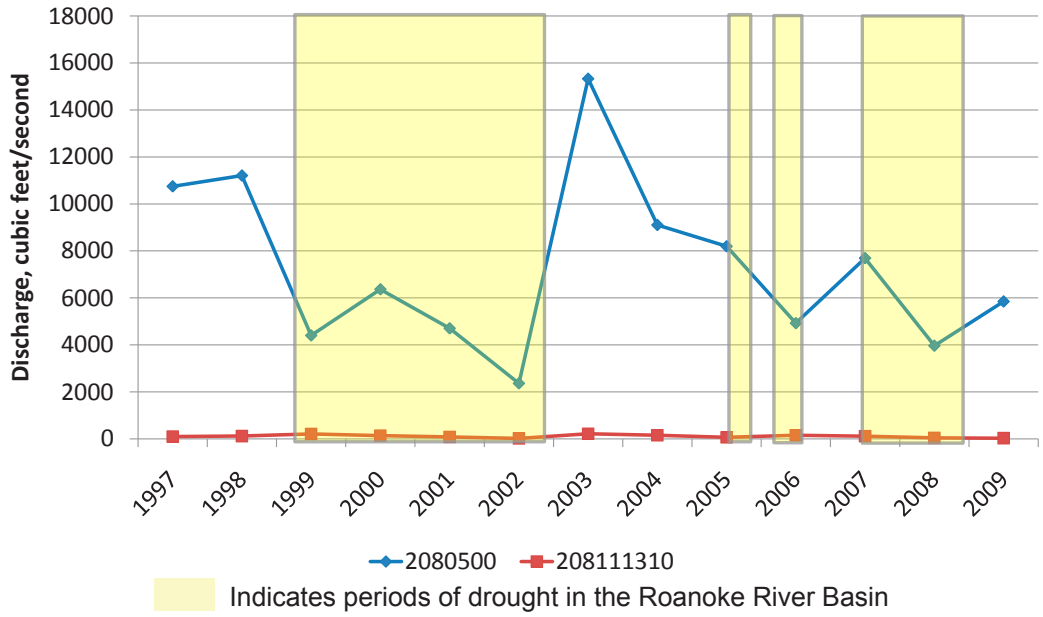
Water Quality Data Summary for this Subbasin

Monitoring stream flow, aquatic biology and chemical/physical parameters is a large part of the basinwide planning process. More detailed information about DWQ monitoring and the effects each parameter has on water quality is discussed in Chapters 2 and 3 of the Supplemental Guide to North Carolina's Basinwide Planning document.

Stream Flow

The basin experienced prolonged droughts from 1998-2002 and again from 2007-2008, with moderate droughts in 2005 and 2006 (Figure 5-2). More detail about flows in the Roanoke River Basin can be found in the 2010 Roanoke River Basinwide Assessment Report produced by DWQ-Environmental Science Section.

Figure 5-2: Yearly Flow Rates (cfs) of the USGS Gage Stations in the Lower Roanoke River Subbasin Between 1997 & 2009



From Left to Right:

- 2080500: Roanoke River at Roanoke Rapids
- 208111310: Cashie River (Windsor)

Biological Data

Biological samples were collected mostly during the spring and summer months of 2009 by the DWQ-Environmental Sciences Section as part of the five year basinwide sampling cycle, in addition to special studies. Overall, 10 biological sampling sites were monitored within the Roanoke Rapids Subbasin. The ratings for each of the sampling stations can be seen in Appendix 5-B.

Benthic Macroinvertebrate Sampling

Each benthic station monitored during the current cycle is shown in Figure 5-3 and color coded based on the current rating. Each of the sites are discussed in more detail in the watershed section below. Figure 5-5 is a comparison of benthic site ratings sampled during the last two basinwide cycles to indicate if there are any overall shifts in ratings. Benthic ratings from this cycle are similar to those received during the previous cycle indicating a stable community.

Benthic Sampling Summary

Total Stations Monitored	9
Total Samples Taken	9
Number of New Stations	0

Figure 5-3: Benthic Stations Color Coded by Current Rating in the Lower Roanoke River Subbasin

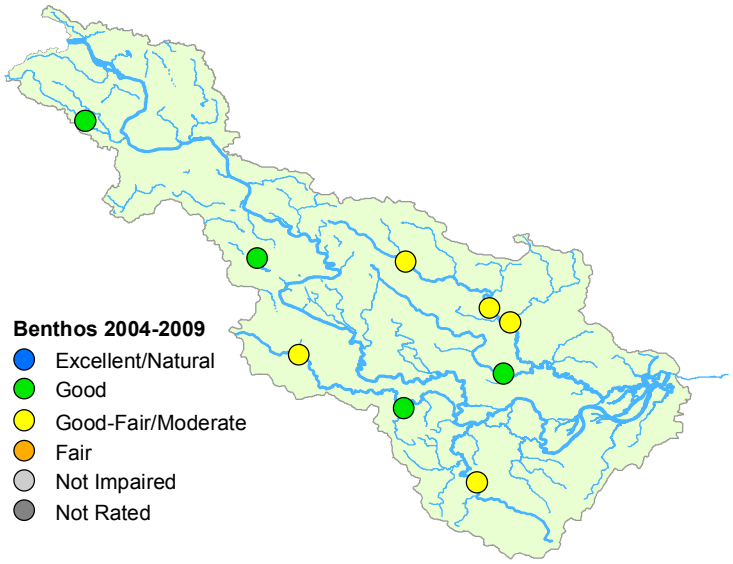


Figure 5-4: Current Benthic Site Ratings

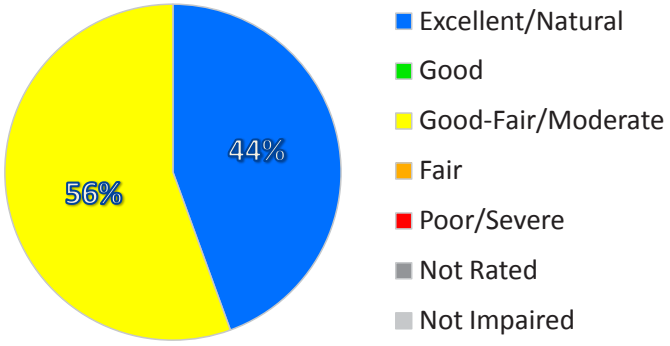
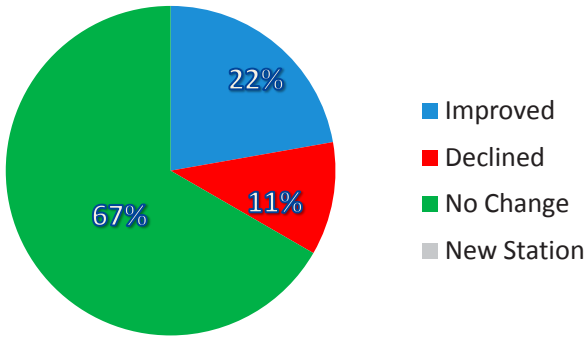


Figure 5-5: Change in Benthic Site Ratings



Fish Community Sampling

Each fish community station monitored during the current cycle is shown in Figure 5-6 and color coded based on the current rating. The site is discussed in more detail in the watershed section below. Figure 5-7 shows the percentages of each rating given during this sampling cycle within this subbasin. Figure 5-8 is a comparison of fish community site ratings sampled during the last two cycles to determine if there are any overall watershed shifts in ratings. Overall, the community at this site is stable.

Fish Com. Sampling Summary

Total Stations Monitored	1
Total Samples Taken	1
Number of New Stations	0

Figure 5-6: Fish Community Stations Color Coded by Current Rating in the Lower Roanoke River Subbasin

Figure 5-7: Current Fish Comm Site Ratings

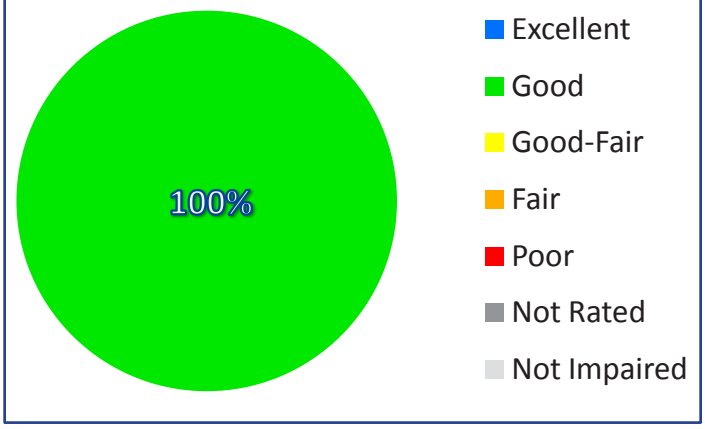
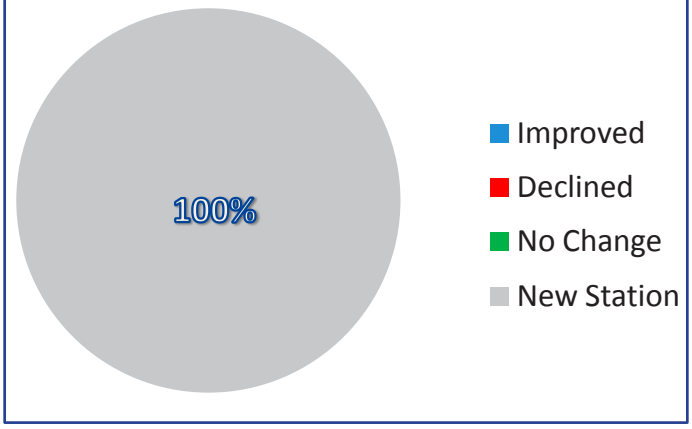


Figure 5-8: Change in Fish Comm Site Ratings



For more information about biological data in this subbasin, see the **2010 Roanoke River Basinwide Assessment Report**. Detailed data sheets for each sampling site can be found in **Appendix 5-B**.

Ambient Data

The ambient data are used to develop use support ratings every two years, which are then reported to the EPA via the Integrated Report (IR). The IR is a collection of all monitored waterbodies in North Carolina and their water quality ratings. The most current IR is the 2010 version and is based on data collected between 2004 and 2008. The ambient data reported in this basin plan were collected between 2005 and 2009 and will be used for the 2012 IR. If a waterbody receives an Impaired rating, it is then placed on the 303(d) Impaired Waters List. The Roanoke River Basin portion of the 2010 IR can be found in **Appendix 5-A** and the full 2010 IR can be found on the **Modeling & TMDL Unit's** website.

Seven Ambient Monitoring System (AMS) station is located in the Roanoke Rapids subbasin (see Figure 5-1 for the station locations). During the current sampling cycle (January 2005 and December 2009), samples were collected for all parameters on a monthly basis except metals which were sampled quarterly until May

2007 when metals sampling was suspended. For more information about the ambient monitoring, parameters, how data are used for use support assessment and other information, see Chapter 2 of the Supplemental Guide to North Carolina's Basinwide Planning.

Long Term Ambient Monitoring

The following discussion of ambient monitoring parameters of concern include graphs showing the median and mean concentration values for each ambient station in this subbasin by specific parameter over a 13 year period (1997-2009). The geometric mean is a type of mean or average, which indicates the central tendency or typical value of a set of numbers. The graphs are not intended to provide statistically significant trend information, but rather an idea of how changes in land use or climate conditions can affect parameter readings over the long term. The difference between median and mean results indicate the presence of outliers in the data set. Box and whisker plots of individual ambient stations were completed by parameter for data between 2005 and 2009 by DWQ's Environmental Sciences Section (ESS) and can be found in the Roanoke River Basin Ambient Monitoring System Report.

pH

Three out of the seven stations measured samples below the standard range in 1% to 4% of samples taken during this cycle. This is represented in Figure 5-9 by the yellow dots. No samples measured above the standard range which are represented by the green dots (0%). Figure 5-10 shows the mean and median pH levels for all samples taken over the course of 13 years in the Lower Roanoke River Subbasin. The pH pattern seen in this subbasin during this time period appears to be closely linked with flow levels. As flow levels go up pH levels appear to fall. This could be caused by the saltwater wedge traveling more upstream during these times.

Figure 5-9: Percentage of Samples Exceeding the pH Standards (2005-2009)

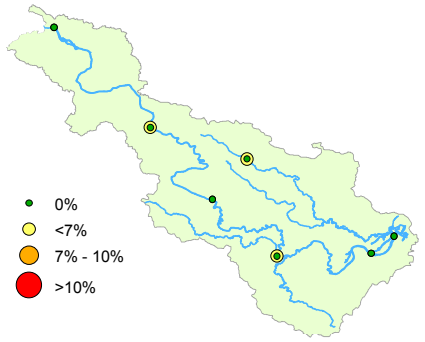
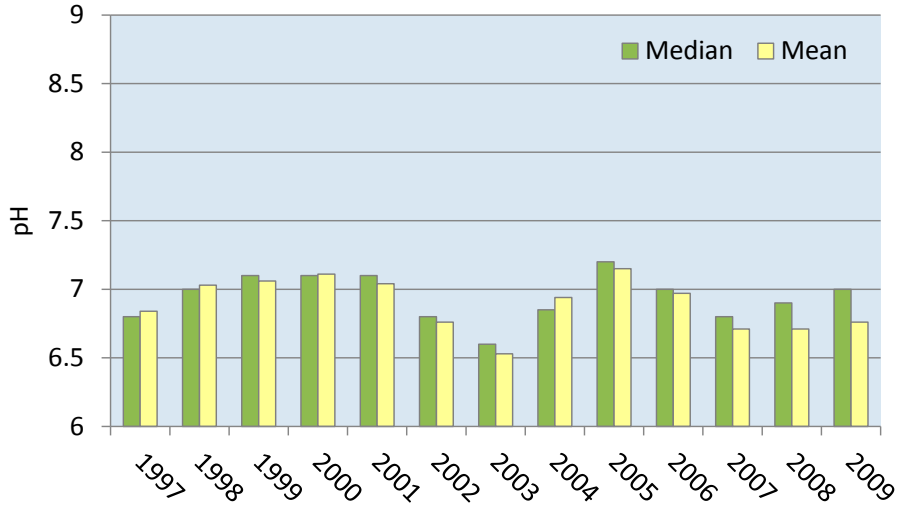


Figure 5-10: Summarized pH Values for All Data Collected at Ambient Sampling Stations in HUC 03010107



* NC pH Standard: Between 6.0 and 9.0 su for Class C; 4.3 and 9.0 for SW

Turbidity

One of the seven stations in the Roanoke Rapids subbasin exceeded the state's turbidity standard in 6 percent of samples, as seen in Figure 5-11 indicated by the yellow dot. Possible sources of the elevated turbidity levels are discussed in the 10-digit watershed section. Figure 5-12 shows the mean and median turbidity levels for all samples taken over the course of 13 years in the Lower Roanoke River subbasin. The yearly averages are well below the state standard of 50 NTUs but have slightly increased over the years.

While some erosion is a natural phenomenon, human land use practices may accelerate the process to unhealthy levels for aquatic life. Construction sites, mining operations, agricultural operations, logging operations and excessive stormwater flow off impervious surfaces are all potential sources. Turbidity exceedances demonstrate the importance of protecting and conserving stream buffers and natural areas.

Figure 5-11: Percentage of Samples Exceeding the Turbidity Standard (2005-2009)

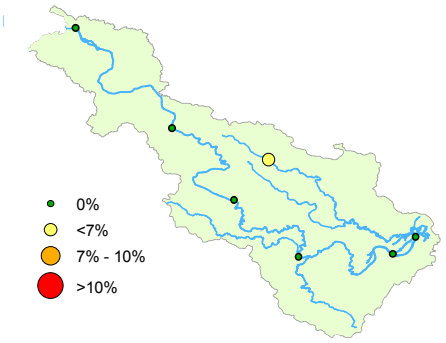
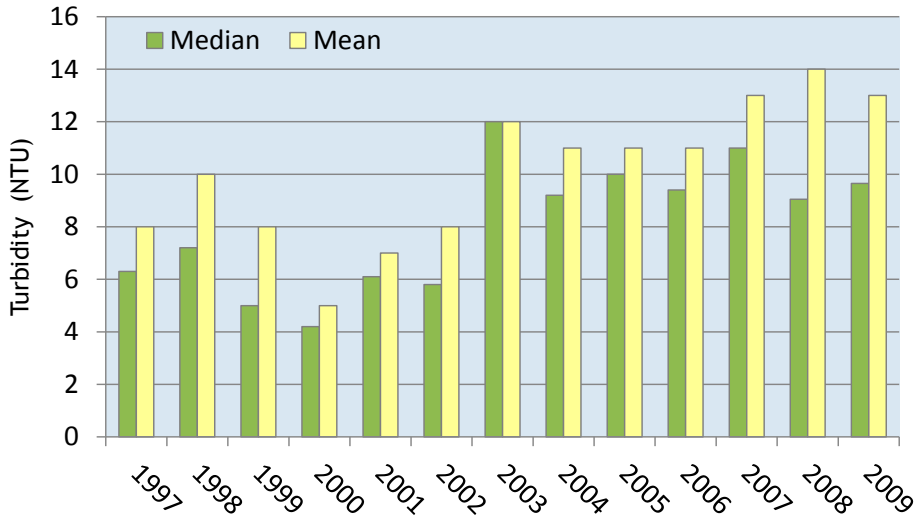


Figure 5-12: Summarized Turbidity Values for All Data Collected at Ambient Sampling Stations in HUC 03010107



* NC Turbidity Standard: 50 NUT

Dissolved Oxygen

As seen in Figure 5-13, one of the seven sites exceeded the DO standard in 2% of samples during this monitoring cycle. Figure 5-14 shows the mean and median of DO levels for all samples taken over the course of 13 years in the Lower Roanoke River subbasin. These averages are well within the normal DO range; however, a slight decline is seen in the last four years.

Figure 5-13: Percentage of Samples Exceeding the DO Standard (2005-2009)

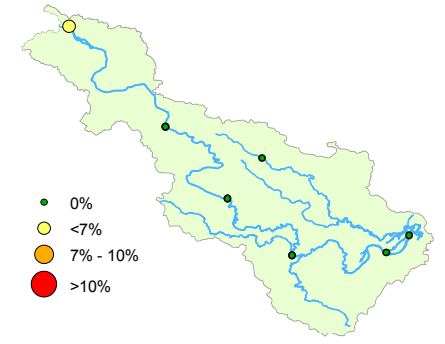
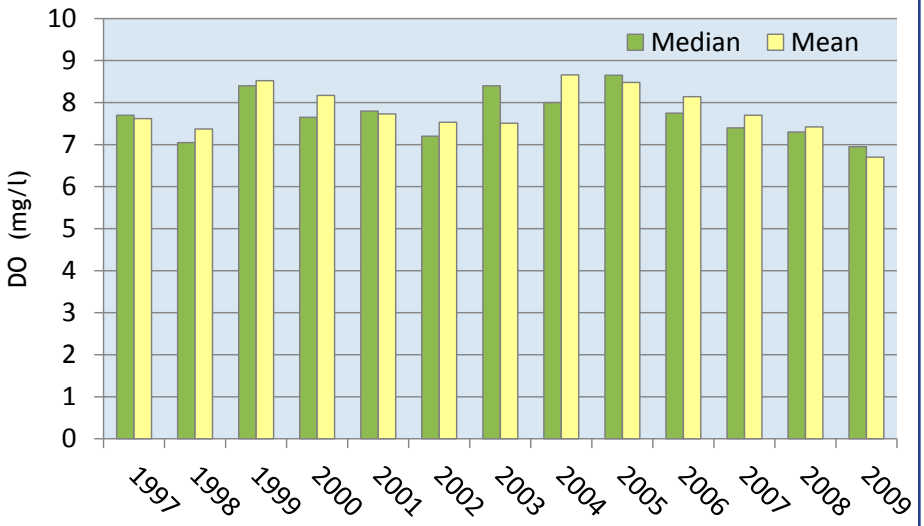


Figure 5-14: Summarized DO Values for All Data Collected at Ambient Sampling Stations in HUC 03010107

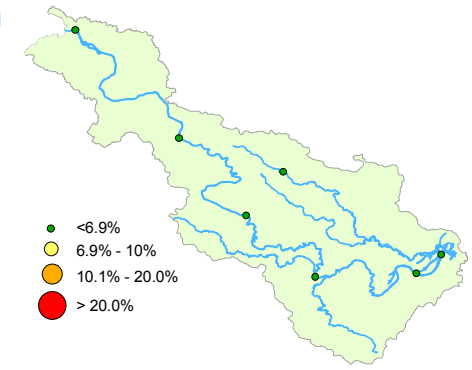


* NC DO Standard: Not < 5 mg/l daily avg. or not < 4 mg/l instantaneous

Fecal Coliform Bacteria

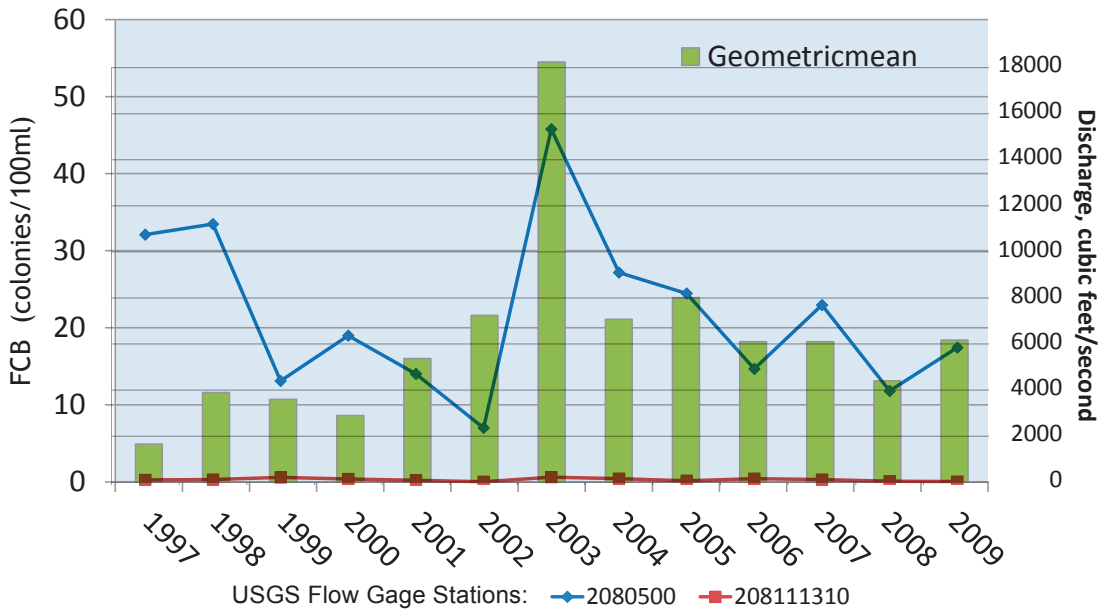
Fecal coliform bacteria (FCB) occurs in water as a result of nonpoint sources such as animal waste from wildlife, farm animals and/or pets, as well as from sanitary sewer overflows (SSOs). The FCB standard for freshwater streams is not to exceed the geometric mean of 200 colonies/100 ml, or 400 colonies/100 ml in 20% of the samples where five samples have been taken in a span of 30 days (5-in-30). Only results from a 5-in-30 study are used to indicate whether the stream is Impaired or Supporting. Waters with a use classification of B (primary recreational waters) receive priority for 5-in-30 studies. Other waters are studied as resources permit.

Figure 5-15: Percentage of Samples with Elevated FCB Levels (2005-2009)



As seen in Figure 5-15, all seven sites had less than 6% of samples over 400 colonies/100 ml. Possible sources of elevated levels of FCB are discussed in the subwatershed sections. Figure 5-16 shows the yearly geometric mean (calculated average) for all samples taken over the course of 13 years in the Lower Roanoke River subbasin. The highest yearly geometric mean was recorded in 2001 (56 colonies/100 ml). The figure also includes the yearly average stream flow, as seen in Figure 5-2, to show how flow can be closely linked to FCB levels.

Figure 5-16: Summarized Fecal Coliform Bacteria Values for All Data Collected at Ambient Sampling Stations in HUC 03010107 with Overlaying Flow



* NC FCB Standard (5-in-30 data only): Geomean not > 200/100 ml or 400/100 ml in 20% of samples

Additional information about possible causes of parameters discussed above for particular stations, see the stream write ups below. For more information regarding any of the parameters listed above, see Section 3.3 of the Supplemental Guide to North Carolina's Basinwide Planning. For additional information about ambient monitoring data collected in this river basin, see the Roanoke River Basin Ambient Monitoring System Report.

Understanding the Data

Biological & Ambient Ratings Converted to Use Support Categories

Biological (benthic and fish community) samples are given a bioclassification/rating based on the data collected at the site by DWQs Environmental Sciences Section (ESS). These bioclassifications include Excellent, Good, Good-Fair, Not Impaired, Not Rated, Fair and Poor. For specific methodology defining how these rating are given see Benthic Standard Operating Procedures (SOP) or the Fish Community SOP. Once a rating is given, it is then translated into a Use Support Category (see Figure 5-17).

Figure 5-17: Use Support Categories for Biological Ratings

Biological Ratings	Aquatic Life Use Support
Excellent/ Natural	Supporting (Categories 1-2)
Good	
Good-Fair/ Moderate	
Not Impaired	
Not Rated	Not Rated (Category 3)
Fair	Impaired (Categories 4-5)
Poor/Severe	

Ambient monitoring data are analyzed based on the percent of samples exceeding the state standard for individual parameters for each site within a five year period. In general, if a standard is exceeded in greater than 10.0% of samples taken for a particular parameter, that stream segment is Impaired for that parameter. The fecal coliform bacteria parameter is exception to the rule. See the Fecal Coliform Bacteria section in the Ambient Data portion below.

Figure 5-18: Category Number to Use Support Rating

Category #	Use Support Rating
1	Supporting
2	
3	Not Rated
4	Impaired
5	

Each biological parameter (benthic and fish community) and each ambient parameter is assigned a Use Support Category based on its rating or percent exceedance. A detailed description of each category can be found on the first page of Appendix 5-A. Each monitored stream segment is given an overall category number which reflects the highest individual parameter category. Figure 5-18 shows how the category number is translated into the use support rating.

Example

Stream A had a benthic sample that rated Good-Fair and 12% of turbidity samples taken at the ambient station were exceeding the standard. The benthic sample would be given an individual category number of 1 (Figure 5-17) and the turbidity parameter would be given a category number of 5 since >10% of samples exceeded the standard. Therefore, stream A's overall category number would be a 5, indicating the stream has a use support rating of Impaired.

Recommendations & Action Plans at the Subbasin Scale

DWQ Priority Summary

Table 5-1 is a list of waters in the Middle Roanoke River Subbasin that DWQ has prioritized for restoration/ protection. The order of priority is not based solely on the severity of the steam's impairment or impacts but rather by the need for particular actions to be taken. A stream that is currently supporting its designated uses may be prioritized higher within this table than a stream that is currently impaired. This is based on a more holistic evaluation of the drainage area which includes monitoring results, current and needed restoration/ protection efforts, land use and other activities that could potentially impact water quality in the area. Some supporting streams may have a more urgent need for protections than an impaired stream with restoration needs already being implemented.

The table also lists potential stressors and sources that may be impacting a stream including in-field observations, monitoring data, historical evidence and permit or other violations. Additional study may be needed to determine exact source(s) of the impact. The last column includes a list of recommended actions.

Table 5-1: Notable Waters in the Lower Roanoke River Subbasin (Not Ranked)

Stream Name	AU#	Class.	Potential Stressor(s)	Potential Source(s)	Qualitative Status	Actions Needed
Roanoke R	23-(26)b3	C	Low DO	--	Impaired	SS
Quankey Cr	23-30b	C	--	--	Impaired	M
Hardison Mill Cr	23-50-3	C	--	--	Supporting	SS
Cashie R	24-2-(1)a, b, (9), (11) & (15)	C;SW	Low pH	--	Supporting	--

Class.: Classification (e.g., C, B, WS-I, WS-II, WS-III, WS-IV, WS-V, Tr, HQW, ORW, SW, UWL)

Stressor: Chemical parameters or physical conditions that at certain levels prevent waterbodies from meeting the standards for their designated use (e.g., low/high DO, nutrients, toxicity, habitat degradation, etc.). Fecal Coliform Bacteria (FCB),

Source: The cause of the stressor. (Volume & Velocity: when a stream receives stormwater runoff at a much higher volume and velocity than it would naturally receive due to ditching, impervious surfaces, etc.)

Status: Impaired, Impacted, Supporting, Improving (For current Use Support Assessment see the Integrated Report.)

Actions Needed: Agriculture BMPs (**Ag**), Best Management Practices (**BMPs**), Daylight Stream (**DS**), Education (**E**), Forestry BMPs (**F**), Local Ordinance (**LO**), Monitoring (**M**), Nutrient Mgnt Controls (**NMC**), Protection (**P**), Restoration (**R**), Riparian Buffer Restoration (**RBR**), Stormwater Controls (**SC**), Sediment and Erosion Control BMPs (**SEC BMPs**), Species Protection Plan (**SPP**), Stressor Study (**SS**), .

Status & Recommendations for Monitored Waters

Understanding this Section

In this Section, more detailed information about stream health, special studies, aquatic life stressors and sources and other additional information is provided by each 10-digit Hydrological Unit Code (HUC). Waterbodies discussed in this Chapter include all monitored streams, whether monitored by DWQ or local agencies with approved methods. Use Support information on all monitored streams within this watershed can be seen on the map in Figure 5-1, and a Use Support list of all monitored waters in this basin can be found in the Use Support Chapter.

Use Support & Monitoring Box:

Each waterbody discussed in the Status & Recommendations for Monitored Waters within this Watershed section has a corresponding Use Support and Monitoring Box (Table 5-2). The top row indicates the 2010 Use Support and the length of that stream or stream segment. The next two rows indicate the overall Integrated Report category which further defines the Use Support for both the 2008 and the 2010 reports. These first three rows are consistent for all boxes in this Plan. The rows following are based on what type of monitoring stations are found on that stream or stream segment and may include benthic, fish community and/or ambient monitoring data. If one of these three types of monitoring sites is not shown, then that stream is not sampled for that type of data. The first column indicates the type of sampling in bold (e.g., **Benthos**) with the site ID below in parenthesis (e.g., CB79). The latest monitoring result/rating of that site is listed in the next column followed by the year that sample was taken. If there is more than one benthic site, for example, on that stream, the second site ID and site rating will be listed below the first. The last row in the sample box in Table 5-2 is the AMS data. The data window for all AMS sites listed in the boxes in this Plan is between 2004-2008. Only parameters exceeding the given standard are listed in the second column with the percent of exceedance listed beside each parameter.

Table 5-2: Example of a Use Support and Monitoring Box

Use Support: **Impaired** (14 mi)	
2008 IR Cat.	4a
2010 IR Cat.	4
Benthos (CB79) (CB80)	 Fair (2002) Fair (2002)
Fish Com (CF33)	 Good-Fair (2002)
AMS (C1750000)	Turbidity - 12% FCB - 48%

Please note any fecal coliform bacteria (FCB) listing in the last row (as seen in Table 5-2) only indicates elevated levels and a study of five samples in 30 days (5-in-30) must be conducted before a stream becomes Impaired for FCB.

Roanoke River within 03010107

AU#'s: 23-(26)a, 23-(26)b1 & 23-(26)b2

These three segments are approximately 103.8 miles combined. They begin 50 feet downstream of the Roanoke Rapids dam and run to the Highway 17 bridge in Williamston. The drainage area is mostly agricultural with some forest and urban areas. There are four major and eight minor NPDES permitted facilities as well as several permitted aquaculture and animal operations. The three segments were on the Impaired Waters List from 2000 to 2008 for fish consumption due to mercury as well as dioxin fish consumption advisor for the lower segment 23-(53). Aquatic life and recreation assessments for the segments were Supporting during that time.

Use Support: **Supporting** (103.8 mi)	
2008 IR Cat.	5
2010 IR Cat.	2
AMS (N8200000) (N8300000) (N8550000)	 No Exceedances

Water Quality Status

During this sampling cycle, three AMS stations were monitored along these three segments. There were no exceedances during this time and results showed similar water quality as found during the previous cycle. The segments are therefore Supporting of aquatic life and recreational parameters.

The Town of Weldon's WWTP discharges effluent about 30 miles upstream of AMS station N8200000. Between 2004 and 2010, this facility has had several permit violations. Majority of these violations were for exceeding the BOD weekly average limits and resulted in enforcement cases. The facility had eight FCB violations several times greater than permit limits which also resulted in enforcement cases. By July 2009, the facility had solved the issue and no longer received violations for elevated BOD or FCB.

These segments were delisted in 2010 from the Impaired Waters List due to the development of a **Statewide Mercury TMDL**. The fish consumption advisory for this area is no longer in place, and the river will no longer be listed due to this advisory.

AU#: 23-(26)b3

This segment is approximately 18 miles long from the Town of Halifax to the southeast corner of the Town of Jamesville. The drainage area has a mixture of forest and agricultural lands. As seen in Figure 5-19, majority of the forested land is located in the flood plain of the river. This segment of the river has been on the Impaired Waters List for low DO since 2008.

Use Support: Impaired (17.8 mi)	
2008 IR Cat.	5
2010 IR Cat.	5

Figure 5-19: 2010 Satellite Image of HUC 0301010706

Water Quality Status

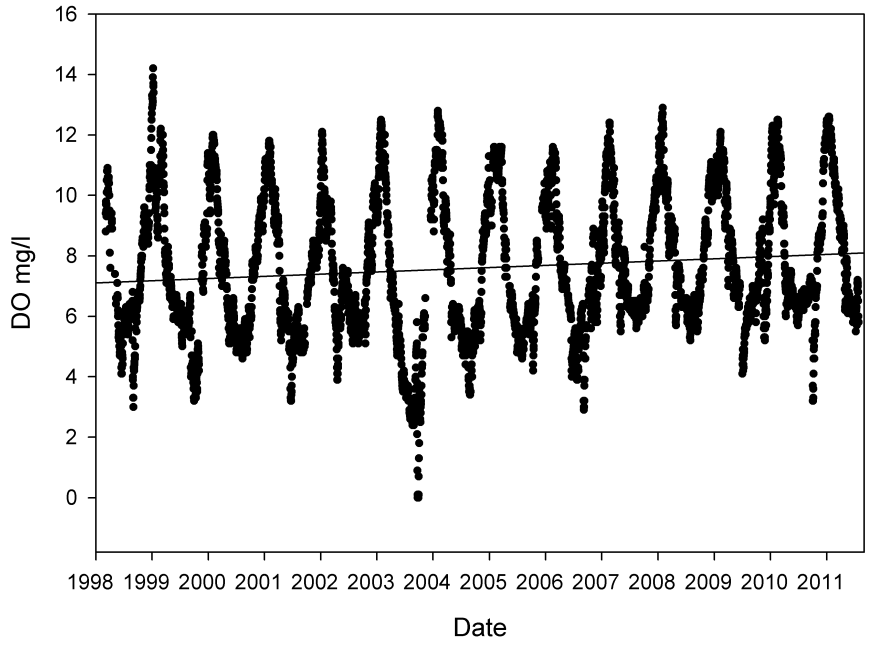
During the previous planning cycle, US Geological Survey (USGS) conducted a study entitled "Relations Among Floodplain Water Levels, Instream Dissolved-Oxygen (DO) Conditions, and Streamflow in the Lower Roanoke River, NC, 1997-2001". Data from this study indicated that from September 1999 through August 2004, 16.3% of the samples taken were below the continuous monitoring DO standard for the daily average of 5 mg/l. Therefore, this segment of the Roanoke River was placed on the Impaired Waters List in 2008 for low DO.

Data from the same station located on the eastern edge of the Town of Jamesville, showed an increase in DO levels between 2006 and 2010. During that time only 3.78% of samples were below the daily average of 5 mg/l. This slight increase can be seen in Figure 5-20 which displays the daily DO averages between 1998 to 2011.

It was reported in the last plan that the McMurray Fabrics Inc. facility had significant noncompliance for their Whole Effluent Toxicity (WET) testing. In 2005, the facility passed two tests and failed two test. By the end of 2005, the facility ceased discharging to the Roanoke River.

The Town of Williamston WWTP (NC0020044) was also reported on in the previous plan. The facility had chronic problems exceeding their discharge limits for fecal coliform bacteria (FCB) and total suspended solids (TSS). A Special Order of Consent (SOC) was issued in February 2006 allowing the facility to monitor FCB levels without being penalized for exceeding the FCB limit assigned in their permit until December 2007. This provided time for the facility to make the necessary upgrades to reduce risk of further violations. All upgrades were completed within the period of the SOC and previous FCB permit limits once again applied. The facility has had no FCB or TSS violations since that time.

Figure 5-20: Daily Average DO Data taken at USGS Gage Station 02081094 (1998-2011)



AU#: 23-(53)

This is the last segment (18.3 miles) of the Roanoke River before it empties into Swan Bay of the Albemarle Sound. This drainage area is mostly agriculture with some forested area in the floodplain and urban areas in and around the Town of Plymouth. There is one major and two minor NPDES permitted facilities along this segment of the Roanoke River. This segment has been on the Impaired Waters List since 2000 for fish consumption-dioxins.

Use Support: **Impaired** (18.3 mi)	
2008 IR Cat.	5
2010 IR Cat.	4t
AMS (N9250000) (N9600000)	No Exceedances

Water Quality Status

During this sampling cycle, this segment was monitored at two AMS stations. There were no exceedances during this time and results showed similar water quality as found during the previous cycle. The segments are there for Supporting of aquatic life and recreational parameters.

This segment was also listed in 2002 for fish consumption-mercury. The mercury portion of the Impairment was removed in 2010 due to development of a Statewide Mercury TMDL. However, it remains on the Impaired Waters List for the fish consumption-dioxin Impairment. Dioxins are a by-product in some manufacturing processes, herbicide productions and used for bleaching paper. There is no current indication of the specific source of dioxins in this segment. The fish consumption advisory for catfish and carp along this segment was issued by the NC Department of Health and Human Resources.

Quankey Creek-Roanoke River (0301010701)

Includes: Roanoke River [AU#: 23-(26)a]**, Quankey Creek** [AU#: 23-30b] **& Chockoyotte Creek** [AU#: 23-29]

This watershed contains a mix land use of urban, agriculture, residential and some forested areas. There are three major and two minor NPDES permitted facilities along with one permitted swine animal operations located within the watershed. There is only one stream segment (Quankey Creek) within this watershed on the 2010 Impaired Waters List.

Quankey Creek [AU#: 23-30b]

This segment of Quankey Creek is approximately 3.4 miles from the confluence of Little Quankey Creek [AU#: 23-30-1] to the Roanoke River [AU#: 23-(26)a]. The majority of the drainage area is agricultural lands with some residential and commercial land cover. The Town of Halifax runs along a portion of this segment. The Halifax WWTP holds a Minor NPDES permit to discharge to the creek. The creek was placed on the Impaired Water List in 1998 for Biological Integrity/Benthos.

Use Support: Impaired (3.4 mi)	
2008 IR Cat.	5
2010 IR Cat.	5
Benthos (NB60)	Fair (1999)
Fish Com (NF46)	Good (2009)

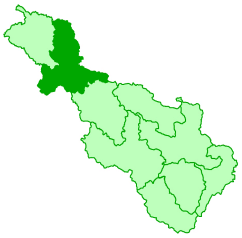
Water Quality Status

A fish community sample was taken at this site for the first time and resulted in a Good rating. The habitat scored high due to high quality instream and riparian buffer habitat. pH levels were below the state standard of 6.0; however, the upstream watershed is swamp-like where low pH values are to be expected. The types of fish collected show some signs of nutrient enrichment.

Recommendations

It is recommended that the benthic station NB60 be sampled during the next monitoring cycle to determine if benthic conditions have improved.

Conoconnara Swamp-Roanoke River (0301010702)



Includes: Roanoke River [AU#: 23-(26)a]**, Conoconnara Swamp** [AU#: 23-33]**, & Wheeler Creek** [AU#: 23-32]

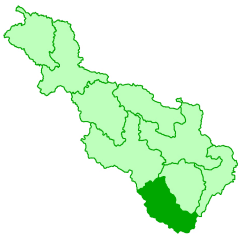
This watershed contains a mix land use of agriculture, residential, wetlands, forested and some urban areas. There is one minor NPDES permitted facility along with five swine and one cattle permitted animal operations located within the watershed. There are no waters on the 2010 Impaired Waters List within this watershed.

Kehukee Swamp-Roanoke River (0301010703)

Includes: Roanoke River [AU#: 23-(26)a & b1]**, Kehukee Swamp** [AU#: 23-42]**, & Sandy Run** [AU#: 23-37]

This watershed contains a mix land use of agriculture, residential, wetlands and forested areas. There are four minor NPDES permitted facilities along with seven swine, one poultry and one cattle permitted animal operations located within the watershed. There are no waters on the 2010 Impaired Waters List within this watershed.

Sweetwater Creek (0301010704)



Includes: Sweetwater Creek [AU#: 23-50]**, Hardison Mill Creek** [AU#: 23-50-3]**, & Peter Swamp** [AU#: 23-50-4]

This watershed contains agriculture with some residential and forested areas. There is one minor NPDES permitted facility along with eight aquaculture permits located within the watershed. There are no waters on the 2010 Impaired Waters List within this watershed.

Hardison Mill Creek [AU#: 23-50-3]

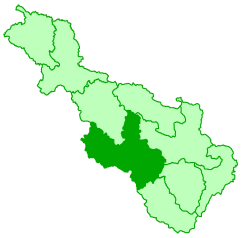
Use Support: Supporting (19.9 mi)	
2008 IR Cat.	2
2010 IR Cat.	2
Benthos (NB69)	Moderate (2009)

Hardison Mill Creek is approximately 20 miles from source to Sweetwater Creek [AU#: 23-50]. Land cover for the majority of this drainage area is agriculture. This creek is currently supporting all designated uses.

Water Quality Status

This creek was monitored at Yarrell Creek Road (SR 1528) for the third time since 1999 and has been rated Moderate for all three samples. However, during the 2009 sample there was a noticeable decline in benthic health and population. There was a total absence of the flow-dependent blackflies that have been abundant or common in all previous collections. There was also a drastic decrease in the diversity of chironomid larvae. These declines may be due to the drastically higher specific conductivity in 2009 (179 µS/cm) versus levels measured in 2004 (58 µS/cm) as well as the decline in pH (4.3). The absence of the blackflies also suggests the stream is experiencing low flow conditions.

Conoho Creek-Roanoke River (0301010705)



Includes: Roanoke River [AU#: 23-(26)b2], **Conoho Creek** [AU#: 23-49a & b], **& Coniott Creek** [AU#: 23-48]

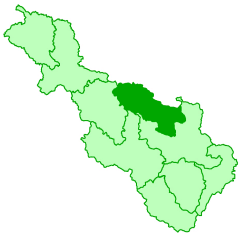
This watershed contains agriculture and wetlands with some residential, urban and forested areas. There two major and one minor NPDES permitted facilities along with seven swine permitted animal operations and nine aquaculture permits located within the watershed. There are no waters on the 2010 Impaired Waters List within this watershed.

Gardener Creek-Roanoke River (0301010706)

Includes: Roanoke River [AU#: 23-(26)b3 & (53)], **Devils Gut** [AU#: 23-52], **& Gardners Creek** [AU#: 23-52-1]

This watershed contains agriculture and wetlands with some residential, urban and forested areas. There two minor NPDES permitted facilities along with 21 aquaculture permits located within the watershed. The two segments of the Roanoke River in this watershed are on the 2010 Impaired Waters List and are discussed at the beginning of this section.

Headwaters Cashie River (0301010707)



Includes: Cashie River [AU#: 24-2-(1)a & (1)b], **Connaritsa Swamp** [AU#: 24-2-3], **& Wahtom Swamp** [AU#: 24-2-2]

This watershed contains a mix land use of agriculture, residential, wetlands and forested areas. There are two minor NPDES permitted facilities along with three permitted swine animal operations located within the watershed. There are no waters on the 2010 Impaired Waters List within this watershed.

Cashie River [AU#: 24-2-(1)a & (1)b]

Use Support: Supporting (45.3 mi)	
2008 IR Cat.	5
2010 IR Cat.	2
Benthos (NB75) (NB76)	Moderate (2009) Moderate (2009)
AMS (N8950000)	No Exceedances

These two segments of Cashie River are approximately 45 miles from source to just upstream of the Bertie County line. However about 15 miles of the second segment is located in the Outlet Cashie River Watershed (0301010708). The majority of the drainage area is agriculture with some residential areas and a small amount of urban area downstream. There is one minor NPDES permitted facility and three permitted swine operations discharging to the river. The Cashie River was placed on the 2002 Impaired Waters List due to a NC DHHS fish advisory-mercury; however, the advisory was lifted and the river was removed from the list in 2010. The river is currently supporting all uses.

Water Quality Status

Cashie River was monitored at two benthic stations within this watershed. Location of these stations can be seen in Figure 5-1. Both sites had decent habitat ratings, long term decreasing pH levels, increasing specific conductivity and signs of possible upstream point or nonpoint source pollution inputs. The downstream site (NB76) dropped a rating from Natural to Moderate due to the lower number and pollution tolerance level of the taxa collected.

An AMS station was also monitored during this sampling cycle and is located at the upstream benthic station (NB75). Parameters monitored at the station were consistent with those results from the previous cycle with the exception of pH levels. Long term monitoring results (1998-2009) showed a slight decrease from the mid 6's to roughly 5.7.

Since 2002, the Cashie River has been on the Impaired Waters List due to a fish consumption advisory. This advisory was put in place by NC DHHS as a result of a 2003 study of mercury in fish tissue. This advisory has been lifted causing the river to be removed from the list. A Statewide Mercury TMDL is also in development stages to address this issue. *Need to make this more consistent with text above in Roanoke River write up.*

Recommendations

A source study is recommended to determine the source of increasing conductivity levels and decreasing pH levels.

Outlet Cashie River (0301010708)

Includes: Cashie River [AU#: 24-2-(1)b, (9), (11) & (15)], Roquist Creek [AU#: 24-2-7], & Hoggard Mill Creek [AU#: 24-2-6]

This watershed contains a mix land use of agriculture, residential, wetlands and forested areas. There are one minor and one major NPDES permitted facilities along with five permitted aquaculture operations located within the watershed. There are no waters on the 2010 Impaired Waters List within this watershed.

Cashie River [AU#: 24-2-(9), (11) & (15)]

Use Support: No Data (9.3 mi)	
2008 IR Cat.	5
2010 IR Cat.	3c

These three segments of the Cashie River are approximately nine miles from just downstream of the Bertie County line to the Albemarle Sound (Batchelor Bay) [AU#: 24]. The majority of the drainage area is agriculture and forested area.

Water Quality Status

Since 2002, the Cashie River has been on the Impaired Waters List due to a fish consumption advisory. This advisory was put in place by NC DHHS as a result of a 2003 study of mercury in fish tissue. This advisory has been lifted causing the River to be removed from the list. A Statewide Mercury TMDL is also in development stages to address this issue.

These three segments have moved from the Impaired category to No Data because there are not current monitoring stations along this stretch of river.

Plymouth-Roanoke River (0301010709)

Includes: Welch Creek [AU#: 23-55], Roanoke River [AU#: 23-(53)], & Conaby Creek [AU#: 23-56]

This watershed contains a mix land use of agriculture, urban, residential, and wetland areas. There are two minor and one major NPDES permitted facilities along with two permitted aquaculture operations located within the watershed. Two streams (Welch Creek and the downstream most segment of the Roanoke River) are on the 2010 Impaired Waters List within this watershed.

Welch Creek [AU#: 23-55]

Welch Creek is approximately 13 miles from source to the Roanoke River [AU#: 23-(53)]. The majority of the drainage area is agriculture with some industrial and a small percentage of urban area. Welch Creek is currently Impaired for dioxin due to a fish consumption advisory.

Use Support: Impaired (13.3 mi)	
2008 IR Cat.	5
2010 IR Cat.	5

Water Quality Status

Welch Creek was not monitored during this cycle.

References

References marked with (*) indicates a DWQ special study report. These reports are not currently available online. Contact the DWQ Environmental Science Section at (919) 743-8400 to receive a hardcopy.

North Carolina Department of Environment and Natural Resources (NCDENR). Division of Water Quality (DWQ). August 2004a. *Classifications and Water Quality Standards Applicable to Surface Waters and Wetlands of North Carolina*. North Carolina Administrative Code: 15A NCA 2B. Raleigh, NC. (http://h2o.enr.state.nc.us/csu/)

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____. *DWQ. ESS. BAU. Month Year. (B-#) *Report Name & Sample Date*. Raleigh, NC.

Pate, Travis. 2009. *Watershed Assessment in North Carolina: Building a Watershed Database with Population, Land Cover, and Impervious Cover Information*. Master Theses, University of North Carolina at Chapel Hill.

USGS Water-Resources Investigations Report 03-4295: "Relations Among Floodplain Water Levels, Instream DO Conditions, and Streamflow in the Lower Roanoke River, NC, 1997-2001"

Appendix 5-A

Use Support Ratings for All Monitored Waters in the Lower Roanoke River Subbasin

Draft 2010 IR Category	Integrated Reporting Categories for individual Assessment Unit/Use Support Category/ Parameter Assessments. A single AU can have multiple assessments depending on data available and classified uses.
1	All designated uses are monitored and supporting
1b	Designated use was impaired, other management strategy in place and no standards violations for the parameter of interest (POI)
1nc	DWQ have made field determination that parameter in exceedance is due to natural conditions
1r	Assessed as supporting watershed is in restoration effort status
1t	No criteria exceeded but approved TMDL for parameter of interest
2	Some designated uses are monitored and supporting none are impaired Overall only
2b	Designated use was impaired other management strategy in place and no standards violations Overall only
2r	Assessed as supporting watershed is in restoration effort status overall only
2t	No criteria exceeded but approved TMDL for POI Overall only
3a	Instream/monitoring data are inconclusive (DI)
3b	No Data available for assessment
3c	No data or information to make assessment
3n1	Chlorophyll a exceeds TL value and SAC is met-draft
3n2	Chlorophyll a exceeds EL value and SAC is not met first priority for further monitoring-draft
3n3	Chlorophyll a exceeds threshold value and SAC is not met first second priority for further monitoring-draft
3n4	Chlorophyll a not available determine need to collect-draft
3t	No Data available for assessment –AU is in a watershed with an approved TMDL
4b	Designated use impaired other management strategy expected to address impairment
4c	Designated use impaired by something other than pollutant
4cr	Recreation use impaired no instream monitoring data or screening criteria exceeded
4cs	Shellfish harvesting impaired no instream monitoring data- no longer used
4ct	Designated use impaired but water is subject to approved TMDL or under TMDL development
4s	Impaired Aquatic Life with approved TMDL for Aquatic Life POI or category 5 listing
4t	Designated use impaired approved TMDL
5	Designated use impaired because of biological or ambient water quality standards violations and needing a TMDL
5r	Assessed as impaired watershed is in restoration effort status

NC 2010 Integrated Report

All 13,123 Waters in NC are in Category 5-303(d) List for Mercury due to statewide fish consumption advice for several fish species

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Roanoke River Basin — **Quankey Creek-Roanoke River Watershed** — **0301010701**

Roanoke River Basin — Roanoke River Subbasin — 03010107

Roanoke River Basin — **Quankey Creek-Roanoke River Watershed** — **0301010701**

23-29	**Chockoyotte Creek**	From source to Roanoke River		**10.6 FW Miles**	C	
1	**Ecological/biological Integrity Benthos**	Moderate Bioclassification	Aquatic Life	2004		
3a	**Ecological/biological Integrity FishCom**	Not Rated Bioclassification	Aquatic Life	2004		
23-30-1	**Little Quankey Creek**	From source to Quankey Creek		**9.5 FW Miles**	C	
1	**Ecological/biological Integrity Benthos**	Moderate Bioclassification	Aquatic Life	2004		
23-30a	**Quankey Creek**	From source to Little Quankey Creek		**16.0 FW Miles**	C	
1	**Ecological/biological Integrity Benthos**	Natural Bioclassification	Aquatic Life	2004		
23-30b	**Quankey Creek**	From Little Quankey Creek to Roanoke River		**3.4 FW Miles**	C	
5	**Ecological/biological Integrity Benthos**	Fair Bioclassification	Aquatic Life	1999	1998	
23-(25.5)	**ROANOKE RIVER**	From a point 0.6 mile upstream of N.C. Hwy. 48 bridge to a line across river 50 feet downstream of N.C. Hwy. 48 (City of Roanoke Rapids, Town of Weldon water supply intakes)		**1.7 FW Miles**	WS-IV;CA	
1	**Fecal Coliform (recreation)**	No Criteria Exceeded	Recreation	2008		
1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008		
1	**Water Quality Standards Water Supply**	No Criteria Exceeded	Water Supply	2008		
23-(26)a	**ROANOKE RIVER**	From a line across the river 50 ft downstream of NC Hwy 48 bridge to the confluence of Sandy Run Cr at the Bertie Northampton Halifax Co. line		**50.1 FW Miles**	C	
1	**Fecal Coliform (recreation)**	No Criteria Exceeded	Recreation	2008		
1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008		

Roanoke River Basin — **Conoconnara Swamp-Roanoke River Watershed** — **0301010702**

23-33	**Conoconnara Swamp**	From source to Roanoke River		**17.7 FW Miles**	C	
1	**Ecological/biological Integrity Benthos**	Moderate Bioclassification	Aquatic Life	2004		

Roanoke River Basin — **Kehukee Swamp-Roanoke River Watershed** — **0301010703**

23-42	**Kehukee Swamp (White Millpond)**	From source to Roanoke River		**10.6 FW Miles**	C	
1	**Ecological/biological Integrity Benthos**	Moderate Bioclassification	Aquatic Life	2004		

NC 2010 Integrated Report

All 13,123 Waters in NC are in Category 5-303(d) List for Mercury due to statewide fish consumption advice for several fish species

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Roanoke River Basin — Kehukee Swamp-Roanoke River Watershed — 0301010703

23-(26)b1 ROANOKE RIVER — From the confluence of Sandy Run Cr at the Bertie/Northampton/Halifax Co. line to subbasin 8/9 boundary — **24.8 FW Miles** C

1	Fecal Coliform (recreation)	No Criteria Exceeded	Recreation	2008	
1	Water Quality Standards Aquatic Life	No Criteria Exceeded	Aquatic Life	2008	

Roanoke River Basin — Sweetwater Creek Watershed — 0301010704

23-50-3 Hardison Mill Creek — From source to Sweetwater Creek — **19.9 FW Miles** C

1	Ecological/biological Integrity Benthos	Moderate Bioclassification	Aquatic Life	2004	

Roanoke River Basin — Conoho Creek-Roanoke River Watershed — 0301010705

23-49a Conoho Creek — From source to Martin Co 1417 below Beaverdam Cr — **24.5 FW Miles** C

1	Ecological/biological Integrity Benthos	Moderate Bioclassification	Aquatic Life	2004	

23-49b Conoho Creek — From Martin Co 1417 to Roanoke River — **7.0 FW Miles** C

1	Ecological/biological Integrity Benthos	Natural Bioclassification	Aquatic Life	2004	

23-(26)b2 ROANOKE RIVER — From subbasin 8/9 boundary to Hwy 17 Bridge in Williamston — **28.9 FW Miles** C

1	Fecal Coliform (recreation)	No Criteria Exceeded	Recreation	2008	
1	Water Quality Standards Aquatic Life	No Criteria Exceeded	Aquatic Life	2008	

23-(26)b3 ROANOKE RIVER — From Hwy 17 bridge at Williamston to the 18 mile marker at Jamesville — **17.8 FW Miles** C

5	Low Dissolved Oxygen	Standard Violation	Aquatic Life	2006	2008

Roanoke River Basin — Headwaters Cashie River Watershed — 0301010707

24-2-(1)a Cashie River — From source to Bertie County SR 1225 — **15.2 FW Miles** C;Sw

1	Ecological/biological Integrity Benthos	Moderate Bioclassification	Aquatic Life	2004	
1	Fecal Coliform (recreation)	No Criteria Exceeded	Recreation	2008	
1	Water Quality Standards Aquatic Life	No Criteria Exceeded	Aquatic Life	2008	

Roanoke River Basin — Outlet Cashie River Watershed — 0301010708

24-2-(1)b Cashie River — From Bertie County SR 1225 to a point 1 mile upstream from Bertie Co. SR 1500 — **30.1 FW Miles** C;Sw

1	Ecological/biological Integrity Benthos	Natural Bioclassification	Aquatic Life	2004	

24-2-6 Hoggard Mill Creek — From source to Cashie River — **7.4 FW Miles** C;Sw

1	Ecological/biological Integrity Benthos	Moderate Bioclassification	Aquatic Life	2004	

24-2-7 Roquist Creek — From source to Cashie River — **26.3 FW Miles** C;Sw

1	Ecological/biological Integrity Benthos	Natural Bioclassification	Aquatic Life	2004	

Roanoke River Basin — Plymouth-Roanoke River Watershed — 0301010709

NC 2010 Integrated Report

All 13,123 Waters in NC are in Category 5-303(d) List for Mercury due to statewide fish consumption advice for several fish species

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Roanoke River Basin		**Plymouth-Roanoke River Watershed**			**0301010709**
23-(53)	**ROANOKE RIVER**	From 18 mile marker at Jamesville to Albemarle Sound (Batchelor Bay)	**18.3**	**FW Miles**	C;Sw

Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year
4t	**Dioxin**	Standard Violation	Fish Consumption	2008	2000
1	**Fecal Coliform (recreation)**	No Criteria Exceeded	Recreation	2008	
1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
23-55	**Welch Creek**	From source to Roanoke River	**13.3**	**FW Miles**	C;Sw

Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year
4t	**Dioxin**	Standard Violation	Fish Consumption	1996	2000
1	**Fecal Coliform (recreation)**	No Criteria Exceeded	Recreation	2008	
5	**Low pH**	Standard Violation	Aquatic Life	2008	2002

Appendix 5-B

Biological Sampling Site Data Sheets (Benthic Macroinvertebrate & Fish Community) for the Lower Roanoke River Subbasin

Biological Samples Taken During this Assessment Cycle

Station ID	Waterbody	County	Site Location	Sample Results
Benthic Sample Sites				
NB55	KEHUKEE SWP	HALIFAX	SR 1804	09 - Natural
NB59	QUANKEY CR	HALIFAX	NC 903	09 - Natural
NB67	CONOHO CR	MARTIN	SR 1417	09 - Natural
NB69	HARDISON MILL CR	MARTIN	SR 1528	09 - Moderate
NB75	CASHIE R	BERTIE	SR 1219	09 - Moderate
NB76	CASHIE R	BERTIE	SR 1257	09 - Moderate
NB78	HOGGARD MILL CR	BERTIE	SR 1301	09 - Moderate
NB80	ROQUIST SWP	BERTIE	US 17	09 - Natural
NB93	CONOHO CR	MARTIN	NC 11-42	09 - Moderate
Fish Community Sample Sites				
NF46	Quankey Cr	Halifax	US 301/NC 903/NC 125	09 - Good

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
QUANKEY CR	NC 903	NB59	02/03/09	Natural

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HALIFAX	8	03010107	36.353333	-77.643889	23-30a	Rolling Coastal Plain

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	33.6	113	5	0.5

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	90	0	0	10 (NC 903)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (℃)	6.6
Dissolved Oxygen (mg/L)	10.6
Specific Conductance (µS/cm)	74
pH (s.u.)	5.4
Water Clarity	Tannic

Habitat Assessment Scores (max)

Channel Modification (5)	15
Instream Habitat (20)	18
Bottom Substrate (15)	15
Pool Variety (10)	10
Riffle Habitat (16)	0
Bank Erosion (7)	6
Bank Vegetation (7)	7
Light Penetration (10)	9
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	90

Site Photograph

Substrate Gravel, sand, silt, and detritus.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/03/09	10528	51	15	5.80	4.77	Natural
02/23/04	9351	52	17	5.81	4.05	Natural
02/16/99	7823	40	9	6.66	5.93	Natural

Taxonomic Analysis

Pollution tolerant taxa present in 1999 but absent from 2004 and 2009 include the oligochaete *Limnodrilus spp*., the gastropod *Physa spp*., the beetle *Tropisternus spp*., and the chironomids *Dicrotendipes neomodestus*, and *D. nervosus*. Conversely, many pollution intolerant taxa were present in 2004 and 2009 but absent in 1999 and included the mayfly *Ephemerella doris*, the caddisfly *Ceraclea transversa* and *Polycentropus spp*. Most notably, the 1999 sample lacked nine stonefly taxa collected from the subsequent samples that included *Allocapnia spp*., *Suwallia basalis*, *Leuctra spp*., *Shipsa rotunda*, *Perlesta spp*., *Perlinella drymo*, *Clioperla clio*, *Isoperla namata*, and *I. transmarina*.

Data Analysis

The 2009 sample continues the trend of improving benthic macroinvertebrate community metrics from the first sample here in 1999. The S, EPTS, BI and EPTBI have all improved in 2004 and 2009 from the initial assessment. Although specific conductance has been fairly stable here with the 1999 sample resulting in a measurement of 70 µS/cm, 61 µS/cm in 2004, and 74 µS/cm in 2009, the benthic macroinvertebrate data suggest improving physical conditions at this site since 1999.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
KEHUKEE SWP	SR 1804	NB55	02/03/09	Natural

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HALIFAX	8	03010107	36.129167	-77.363333	23-42	Southeastern Floodplains and Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	19.2	44	6	0.6

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	100	0	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (℃)	6.6
Dissolved Oxygen (mg/L)	8.8
Specific Conductance (µS/cm)	93
pH (s.u.)	5.4
Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	15
Instream Habitat (20)	18
Bottom Substrate (15)	6
Pool Variety (10)	10
Riffle Habitat (16)	0
Bank Erosion (7)	7
Bank Vegetation (7)	7
Light Penetration (10)	9
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	82

Site Photograph

Substrate Sand, silt, and detritus,

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/03/09	10598	66	12	6.79	6.06	Natural
02/24/04	9343	46	7	7.08	5.89	Moderate
02/11/99	7811	59	8	7.11	6.64	Moderate

Taxonomic Analysis

The 2009 sampled produced the highest EPT taxa richness and the lowest BI since sampling commenced here in 1999. EPT taxa present in 2009 but absent previously included the intolerant caddisflies *Triaenodes ignitus*, *Ptilostomis spp*., and *Chimarra spp*. Additionally, several tolerant taxa that were either abundant or common in previous collections were absent or rare in 2009 including the molluscs *Physa spp*., *Micromenetus dilatatus*, and *Sphaerium spp*.

Data Analysis

The 2009 collection established the highest EPT, ST and the lowest BI since sampling first started here in 1999 and resulted in a subsequent improvement in the bioclassification to Natural. Although the specific conductance was somewhat higher in 2009 (92 µS/cm) relative to 2004 (78 µS/cm) and 1999 (74 µS/cm), the evidence based on the shift from a facultative benthic macroinvertebrate community to a slightly more pollution intolerant community suggest an overall improvement in conditions at this site from previous samples. This improvement may be related to a decrease in non-point pollution as a result of the drought.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CONOHO CR	NC 11-42	NB93	02/03/09	Moderate

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Martin	9	03010107	35.971667	-77.295278	23-49a	Mid-Atlantic Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	38.5	42	6	0.6

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	100	---	---	---

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (℃)	3.9
Dissolved Oxygen (mg/L)	11.6
Specific Conductance (µS/cm)	143
pH (s.u.)	5.2
Water Clarity	clear/tannic

Habitat Assessment Scores (max)

Channel Modification (5)	15
Instream Habitat (20)	15
Bottom Substrate (15)	5
Pool Variety (10)	9
Riffle Habitat (16)	0
Bank Erosion (7)	10
Bank Vegetation (7)	10
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	84

Site Photograph

Substrate Mostly silt with detrital pools, some sand.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/03/09	10599	29	3	7.20	6.78	Moderate
02/25/04	9345	31	4	7.70	7.10	Moderate

Taxonomic Analysis

Only the second time sampled, there was a 25% reduction in EPT taxa richness from 4 species obtained in 2004 to 3 species in 2009. The winter stonefly *Taeniopteryx* and the silt-loving mayfly *Caenis* were absent in 2009 while the caddisfly *Polycentropus* was collected for the first time. Additionally, fewer tolerant crustaceans, oligochaetes, and midges were also collected in 2009 leading to a decrease in the overall benthic biotic index.

Data Analysis

Located just northeast of Oak City, this headwater segment of Conoho Creek is mostly forested in the immediate vicinity of the sampling site although the catchment is overwhelmingly dominated by agricultural farms. A total absence of NPDES permitted dischargers indicates the high specific conductance measured is a result of nonpoint source runoff. Despite the presence of good macroinvertebrate habitat and decent flows, Conoho Creek received a Moderate bioclassification, driven in part by the paucity of EPT taxa. However, this Moderate rating is on the cusp of a Natural rating, as it was in 2004, leading to the conclusion that the water quality in this stream has not changed since that time.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CONOHO CR	SR 1417	NB67	02/04/09	Natural

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Martin	9	03010107	35.885556	-77.124444	23-49b	Mid-Atlantic Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	98.2	12	8	0.6

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	100	---	---	---

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (℃)	4.5
Dissolved Oxygen (mg/L)	10.7
Specific Conductance (µS/cm)	177
pH (s.u.)	5.3
Water Clarity	clear/tannic

Habitat Assessment Scores (max)

Channel Modification (5)	15
Instream Habitat (20)	16
Bottom Substrate (15)	5
Pool Variety (10)	9
Riffle Habitat (16)	0
Bank Erosion (7)	10
Bank Vegetation (7)	10
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	85

Site Photograph

Substrate: Detritus with silt, some sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/04/09	10600	32	6	6.43	5.23	Natural
02/24/04	9344	38	6	6.80	5.40	Natural
02/24/99	7834	39	5	6.27	4.80	Natural

Taxonomic Analysis

This sampling site maintained it's EPT richness of 6 taxa from the previous sampling event. Two species of mayflies collected in 2004, *Caenis* and *Eurylophella doris* were absent in 2009 as was the caddisfly *Platycentropus*. *Ironoquia punctatissima*, a caddisfly often found in swamp-like conditions, was collected for the first time in 10 years. Additionally, total taxa richness decreased from 2004 levels reflected in fewer tolerant midges, oligohaetes and crustacea collected. Although still higher than that measured in 1999, the biotic index was lower than in 2004 due in part to the more intolerant EPT community observed.

Data Analysis

This sampling site is low in the watershed of Conoho Creek and is very large. Much like the upstream site, agriculture dominates the landuse of Conoho Creek's watershed. Non-point source pollutants are likely diluted by the time they reach this segment and thereby have less impact on the macroinvertebrate community. Although this site did receive a Natural rating compared to the upstream rating (Moderate), the upstream site very nearly obtained a Natural rating suggesting water quality differences between these two sites are not so great. The macroinvertebrate community here appears to be relatively stable.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
HARDISON MILL CR	SR 1528	NB69	02/04/09	Moderate

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MARTIN	9	03010107	35.764722	-77.006111	23-50-3	Mid-Atlantic Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C	49.7	18	11	0.7

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	100	0	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (℃)	5.8
Dissolved Oxygen (mg/L)	8.0
Specific Conductance (µS/cm)	179
pH (s.u.)	4.3
Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	11
Instream Habitat (20)	15
Bottom Substrate (15)	5
Pool Variety (10)	6
Riffle Habitat (16)	0
Bank Erosion (7)	7
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	71

Site Photograph

Substrate Detritus and silt.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/04/09	10601	15	1	7.61	6.40	Moderate
02/24/04	9331	36	2	7.54	5.20	Moderate
02/12/99	7817	27	3	7.32	7.67	Moderate

Taxonomic Analysis

The 2009 sample produced a drastic decline in chironomid taxa relative to previous collections. Given the increase in specific conductance, it would have been expected that the diversity of the generally pollution tolerant chironomids would have increased or at least maintained levels previously recorded from this station. It is unclear as to why this reduction was observed in 2009 but it might be related to the very low pH (4.3) which was lower than previous collections (4.6 in 2004, 5.5 in 1999). However, the most significant change in this community was the total absence of the flow-dependent blackflies *Simulium spp* . and *Stegopterna spp* . which were both abundant or common from all previous collections. Their absence in 2009 strongly suggests that poor flows have been persistent at this location and may have had a role in the lowered ST and higher BI although the extremely low pH likely exacerbated this condition.

Data Analysis

Although the ST and EPT metrics reached all time lows for 2009, the BI, although higher, was generally comparable to previous collections. Moreover, the EPTBI in 2009 was intermediate between the two previous records. The primary difference in the benthic macroinvertebrate community observed at this location in 2009 relative to previous assessments was the drastic decrease in the diversity of chironomid larvae. Indeed, only two chironomid taxa were collected in 2009 versus 20 in 2004 and seven in 1999. The absence of the flow-dependent blackflies suggest that there have been persistent low flow conditions at this site. Indeed, flow conditions were marginal at the time of sampling. This likely explains, at least in part, the increased BI and lowered ST. However, specific conductance at this site was drastically higher in 2009 (179.1 µS/cm) versus levels measured in 2004 (58 µS/cm) and 1999 (65µS/cm). Consequently, deleterious anthropogenic influence at this station cannot be ruled out. In addition to the low flows and elevated conductivity, the very low pH likely played a role in the decline in the invertebrate community. Indeed, benthic macroinvertebrate communities are known to degrade with very low pH .

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CASHIE R	**SR 1219**	**NB75**	**02/05/09**	**Moderate**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
BERTIE	10	03010107	36.123611	-77.121667	24-2-(1)a	Mid-Atlantic Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;Sw	35.4	45	6	0.6

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	100	0	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Lewiston-Woodville WWTP (~2.5 miles upstream)	NC0023116	0.15

Water Quality Parameters

Temperature (℃)	2.2
Dissolved Oxygen (mg/L)	9.1
Specific Conductance (µS/cm)	190
pH (s.u.)	4.7
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	16
Bottom Substrate (15)	4
Pool Variety (10)	9
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	84

Site Photograph

Substrate Detritus and fine particulate organic matter was dominant.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/05/09	10602	26	2	8.15	7.10	Moderate
02/23/04	9328	29	3	7.49	7.03	Moderate
02/11/99	7812	41	6	7.51	7.24	Natural
06/26/84	3242	41	2	8.20	7.00	Not Rated
07/14/83	3057	34	2	8.55	7.00	Not Rated

Taxonomic Analysis

A mostly tolerant benthic community was observed at this sampling location in 2009. No stoneflies or mayflies were collected at this monitoring station. Caddisflies present in the sample included *Ironoquia punctatissima* and *Ptilostomis spp.* These are common somewhat tolerant caddisflies found in North Carolina swamp benthic communities. Chironomid taxa richness was also low (8) with only two taxa that were common and abundant including *Orthocladius obumbratus* and the recently described *Tvetenia sp. NC* (Epler 2001) respectively.

Data Analysis

A Moderate bioclassication was retained at this site in 2009. Total taxa richness (26) and EPT taxa richness (2) dropped slightly compared to 2004. The NCBI was elevated from the 2004 sample. Despite the Moderate bioclassification, water quality parameters suggests some degradation. Conductivity was twice as high (190 µS/cm) and acidic conditions (pH=4.7) were observed in 2009 compared to 1999 (82 µS/cm, pH=6.2). Physico-chemical data was not collected at this site in 2004. The elevated conductivity suggest the possibility of upstream point source pollution inputs from the Lewiston-Woodeville WWTP. Additionally, naturally acidic waters occur in North Carolina swamp ecosystems and can lead to reductions in benthic taxa richness. A small beaverdam was observed within the sampling area in 2004 and 2009 and low flow conditions with nearly homogenous detrital substrate were noted in 2009 compared to other Roanoke Basinwide swamp sites. This lack of flow and lack of mixed substrate could lead to the absence of some mayflies and stoneflies adapted to those conditions.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CASHIE R	SR 1257	NB76	02/09/09	Moderate

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
BERTIE	10	03010107	36.047778	-76.985556	24-2-(1)b	Mid-Atlantic Floodplains and Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;Sw	108.6	10	8	0.7

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	100	0	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Lewiston-Woodville WWTP (>4 miles upstream)	NC0023116	0.15

Water Quality Parameters

Temperature (℃)	4.4
Dissolved Oxygen (mg/L)	9.5
Specific Conductance (µS/cm)	133
pH (s.u.)	5.1
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	17
Bottom Substrate (15)	5
Pool Variety (10)	9
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	86

Site Photograph

Substrate Fine particulate organic matter and detritus was dominant.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/09/09	10603	34	3	7.40	6.59	Moderate
02/24/04	9330	35	7	6.59	4.90	Natural
02/15/99	7827	34	7	6.80	6.09	Natural

Taxonomic Analysis

EPT taxa collected at this station were similar to that upstream including the caddisflies *Ironoquia punctatissima* and *Ptilostomis spp*. Additionally, the winter stonefly *Taeniopteryx spp*. was collected in abundance at this monitoring station. A low chironomid taxa richness (11) was present at this location similar to upstream, however, intolerant chironomid taxa were present in the sample including *Eukiefferiella devonica gr.* and *Lopescladius spp*. Rarely collected chironomid taxa in the sample included *Parakiefferiella sp. D* and *Tvetenia sp. NC*. The swamp endemic megalopteran *Chauliodes rasticornis* was found rare at the site.

Data Analysis

Total taxa richness remained similar to samples in the past, however, EPT taxa richness dropped from seven taxa in 1999 and 2004 to only three in 2009. This drop in EPT richness in addition to the highest NCBI and EPTBI recorded from this site lowered the bioclassification from Natural in 2004 to Moderate in 2009. Habitat parameters in 2009 (86) were higher than that observed in 2004 (70), yet similar to that observed in 1999 (85) suggesting no reduction in the bioclassification due to physical parameters. More acidic conditions were found in 2009 (pH=5.1) compared to 2004 (pH=5.6) and 1999 (pH=6.4) which could lead to the recent depletion of EPT taxa. Additionally, conductivity was elevated in 2009 (133 µS/cm) compared to in 2004 (64 µS/cm) and 1999 (72 µS/cm) similar to the upstream site at SR 1219 suggesting inputs from an upstream discharger or another unknown source.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
HOGGARD MILL CR	**SR 1301**	**NB78**	**02/05/09**	**Moderate**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
BERTIE	10	03010107	36.025000	-76.951389	24-2-6	Mid-Atlantic Floodplains and Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Sw	48.2	5	4	0.5

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	90	0	10	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (℃)	3.4
Dissolved Oxygen (mg/L)	10.2
Specific Conductance (µS/cm)	89
pH (s.u.)	5.1
Water Clarity	Tannic

Habitat Assessment Scores (max)

Channel Modification (5)	12
Instream Habitat (20)	16
Bottom Substrate (15)	6
Pool Variety (10)	9
Riffle Habitat (16)	0
Bank Erosion (7)	7
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	77

Site Photograph

Substrate Sand, silt, and detritus.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/05/09	10604	24	3	7.40	7.57	Moderate
02/23/04	9327	30	3	7.18	5.65	Moderate
02/15/99	7826	46	7	6.81	6.38	Natural

Taxonomic Analysis

The 2009 sample continues the trend observed here since the 1999 collection in that there has been a decline in intolerant taxa and an increase in tolerant taxa. For 2009, this trend in reduced presence (or total absence) of intolerant taxa is exemplified by the lack of the stonefly *Amphinemura spp*., a substantial decrease in the abundance of the stonefly *Taeniopteryx spp*. (abundant in 1999 and 2004, rare in 2009), the absence of the caddisfly *Platycentropus spp*, and the first time appearance of the the tolerant beetle *Coptotomus spp*., the hemipteran *Pelocoris spp*., as well as the tolerant chironomids *Cricotopus annulator* and *Cricotopus bicinctus*.

Data Analysis

As can be seen from the BI (and to a lesser extent the EPTBI data), as well as the ST and (to a lesser extent) the EPTS, the benthic macroinvertebrate community metrics continue to decline at this site since its first assessment in 1999. The data show a continuing shift from pollution intolerant taxa to more pollution tolerant taxa. It is possible that the prolonged drought may have resulted in very low flow conditions at this site for much of the year before the February sample and that may have caused natural stress due to lowered dissolved oxygen levels. Although dissolved oxygen data is extremely variable, it does not support this conclusion as the dissolved oxygen levels in 2009 (10.2 mg/l) was higher than in either 2004 (8.9 mg/l) or 1999 (8.6 mg/l). Conversely, the much higher specific conductance at this location (89.4 µS/cm) in 2009 relative to levels measured from previous observations in 2004 (60 µS/cm) and 1999 (70 µS/cm) may suggest a possible anthropogenic component to the increasing biotic indicies observed at this location since 1999.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
ROQUIST SWP	US 17	NB80	02/06/09	Natural

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
BERTIE	10	03010107	35.941667	-76.962222	24-2-7	Mid-Atlantic Floodplains and Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Sw	45.7	10	6	0.6

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	90	0	0	10 (US 13/17)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (℃)	0.8
Dissolved Oxygen (mg/L)	8.8
Specific Conductance (µS/cm)	83
pH (s.u.)	5.0

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	13
Instream Habitat (20)	16
Bottom Substrate (15)	6
Pool Variety (10)	9
Riffle Habitat (16)	0
Bank Erosion (7)	7
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	78

Site Photograph

Substrate Sand, silt, and detritus.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/06/09	10605	30	3	6.73	2.28	Natural
02/24/04	9329	38	4	7.14	6.46	Natural
02/11/99	7813	31	4	6.99	5.50	Natural

Taxonomic Analysis

The 2009 collection produced the first record at this location for the facultative caddisfly *Ptilostomis spp*. and the intolerant caddisfly *Lepidostoma spp*. In addition, the previous two collections included the collection of the pollution tolerant mayfly *Caenis spp*. but was absent in 2009. Other pollution tolerant taxa collected from 1999 and 2004 but absent from 2009 sample included the chironomids *Kiefferulus spp*, *Procladius spp,* as well as the gastropods *Micromenetus dilatatus* and *Ferrissia spp*.

Data Analysis

Although the ST and EPT have been relatively stable at this site since sampling commenced in 1999 the EPTBI and BI both dropped in 2009 with the EPTBI dropping substantially. The decline in both the EPTBI and BI were due to the presence of several intolerant taxa collected for the first time in 2009 and the lack of several pollutant tolerant taxa absent from the 2009 collection but present in the previous samples. The shift in the benthic macroinvertebrate community represented by these taxa from 2009 relative to the 2004 and 1999 collections may reflect the drought and the reduced presence of non-point runoff at this site.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
QUANKEY CR	US 301/NC 903/NC 125	06/18/09	NF46	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HALIFAX	8	03010107	36.318589	-77.594832	23-30b	Rolling Coastal Plain

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	33.6	65	6	0.4	No

	Forested/Wetland	Residential	Agriculture	Other (describe)
Visible Landuse (%)	95	5	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	22.0
Dissolved Oxygen (mg/L)	5.4
Specific Conductance (µS/cm)	120
pH (s.u.)	5.6

Water Clarity	Clear, tannin stained

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	19
Bottom Substrate (15)	12
Pool Variety (10)	10
Riffle Habitat (16)	15
Erosion (7)	7
Bank Vegetation (7)	7
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**92**

Site Photograph

Substrate	Gravel, cobble, boulder, clay, silt

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/18/09	2009-66	24	50	Good

Most Abundant Species 2009	Eastern Silvery Minnow (16%), Redbreast Sunfish (15%), Bluehead Chub (14%)	**Exotic Species 2009**	Bluegill

Species Change Since Last Cycle **N/A**

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- drains east-central Halifax County including the southern portion of the Town of Halifax; tributary to the Roanoke River; site is ~ 2 miles upstream of the creek's confluence with the river. **Habitat** -- upstream from the bridge Coastal Plain-like, downstream from the bridge Piedmont-like gorge with very high quality instream and riparian habitats -- riffles, runs, pools, *Podostemum,* and bluffs along both banks. **Water Quality** -- dissolved oxygen saturation only 62%; pH less than 6 s.u., but upstream watershed is swamp-like where low pH values are to be expected. **2009** -- a very diverse fish community with Coastal Plain and Piedmont species present, but only one species of sucker, one intolerant species, and only two species of darters; some evidence of nutrient enrichment based upon the high percentage of omnivores+herbivores collected such as Eastern Silvery Minnow, Bluehead Chub, and Spottail Shiner.

APPENDIX 5-C

AMBIENT MONITORING SYSTEMS
STATION DATA SHEETS
FOR THE LOWER ROANOKE RIVER SUBBASIN

Ambient Monitoring System Station Summaries
NCDENR, Division of Water Quality
Basinwide Assessment Report

Location: ROANOKE RIV AT NC 48 AT ROANOKE RAPIDS
Station #: N7300000 **Hydrologic Unit Code:** 03010107
Latitude: 36.48151 **Longitude:** -77.64526 **Stream class:** WS-IV CA
Agency: NCAMBNT **NC stream index:** 23-(25.5)

Time period: 01/27/2005 to 11/23/2009

	# results	# ND	EL	Results not meeting EL #	%	%Conf	Percentiles Min	10th	25th	50th	75th	90th	Max
Field													
D.O. (mg/L)	43	0	<4	0	0		4.8	5.2	6.6	9.1	11.3	12.6	15.6
	43	0	<5	2	4.7		4.8	5.2	6.6	9.1	11.3	12.6	15.6
pH (SU)	47	0	<6	0	0		6	6.3	6.6	6.9	7.2	7.7	8
	47	0	>9	0	0		6	6.3	6.6	6.9	7.2	7.7	8
Salinity (ppt)	9	0	N/A				0	0	0	0	0.1	0.1	0.1
Spec. conductance (umhos/cm at 25°C)	48	0	N/A				90	97	102	109	113	119	139
Water Temperature (°C)	48	0	>32	0	0		4.2	6.8	9.4	17.1	24.8	27.3	29.8
Other													
TSS (mg/L)	19	11	N/A				2.5	2.5	5	6.2	7	12	12
Turbidity (NTU)	48	0	>50	0	0		1.3	1.6	2.2	3.5	5.5	11.2	22
Nutrients (mg/L)													
NH3 as N	48	39	N/A				0.02	0.02	0.02	0.02	0.02	0.02	0.04
NO2 + NO3 as N	48	4	>10	0	0		0.02	0.02	0.04	0.09	0.18	0.23	0.29
TKN as N	47	2	N/A				0.2	0.23	0.25	0.28	0.32	0.36	0.44
Total Phosphorus	48	8	N/A				0.02	0.02	0.02	0.02	0.03	0.07	0.19
Metals (ug/L)													
Aluminum, total (Al)	9	1	N/A				50	50	78	120	230	1000	1000
Arsenic, total (As)	9	8	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	9	9	>2	0	0		1	1	2	2	2	2	2
Chromium, total (Cr)	9	9	>50	0	0		10	10	25	25	25	25	25
Copper, total (Cu)	9	7	>7	0	0		2	2	2	2	2	3	3
Iron, total (Fe)	9	0	>1000	1	11.1		57	57	105	200	355	1200	1200
Lead, total (Pb)	9	9	>25	0	0		10	10	10	10	10	10	10
Manganese, total (Mn)	9	0	>200	0	0		38	38	40	57	76	190	190
Mercury, total (Hg)	8	8	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	9	9	>25	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	9	8	>50	0	0		10	10	10	10	10	18	18

Fecal Coliform Screening(#/100mL)

# results:	Geomean:	# > 400:	% > 400:	%Conf:
48	7.4	0	0	

Key:
result: number of observations
ND: number of observations reported to be below detection level (non-detect)
EL: Evaluation Level; applicable numeric or narrative water quality standard or action level
Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : States the percent statistical confidence that the actual percentage of exceedances is at least 10% (20% for Fecal Coliform)
Stations with less than 10 results for a given parameter were not evaluated for statistical confidence

Location: ROANOKE RIV AT US 258 NR SCOTLAND NECK

Station #: N8200000 **Hydrologic Unit Code:** 03010107

Latitude: 36.20925 **Longitude:** -77.38387 **Stream class:** C

Agency: NCAMBNT **NC stream index:** 23-(26)

Time period: 01/27/2005 to 11/23/2009

	# results	# ND	EL	Results not meeting EL #	%	%Conf	Percentiles Min	10th	25th	50th	75th	90th	Max
Field													
D.O. (mg/L)	43	0	<4	0	0		5.9	6	6.6	8.5	10.6	12.2	14.8
	43	0	<5	0	0		5.9	6	6.6	8.5	10.6	12.2	14.8
pH (SU)	47	0	<6	1	2.1		5.9	6.4	6.6	7	7.3	7.5	7.6
	47	0	>9	0	0		5.9	6.4	6.6	7	7.3	7.5	7.6
Salinity (ppt)	9	0	N/A				0	0	0	0	0.1	0.1	0.1
Spec. conductance (umhos/cm at 25°C)	48	0	N/A				95	100	110	118	128	133	143
Water Temperature (°C)	48	0	>32	0	0		4.8	7.2	9.7	17.7	25.2	27.8	29.7
Other													
TSS (mg/L)	19	1	N/A				6	7.8	11	12	15	21	47
Turbidity (NTU)	48	0	>50	0	0		3.6	6.3	7.6	9.9	13.8	22.1	33
Nutrients (mg/L)													
NH3 as N	48	33	N/A				0.02	0.02	0.02	0.02	0.02	0.02	0.03
NO2 + NO3 as N	47	1	N/A				0.02	0.08	0.1	0.14	0.21	0.28	0.36
TKN as N	46	1	N/A				0.2	0.23	0.27	0.3	0.34	0.36	0.5
Total Phosphorus	47	0	N/A				0.03	0.03	0.03	0.04	0.05	0.06	0.08
Metals (ug/L)													
Aluminum, total (Al)	9	0	N/A				150	150	380	430	540	1200	1200
Arsenic, total (As)	9	9	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	9	9	>2	0	0		1	1	2	2	2	2	2
Chromium, total (Cr)	9	9	>50	0	0		10	10	25	25	25	25	25
Copper, total (Cu)	9	4	>7	0	0		2	2	2	2	3	4	4
Iron, total (Fe)	9	0	>1000	1	11.1		390	390	515	610	750	1500	1500
Lead, total (Pb)	9	9	>25	0	0		10	10	10	10	10	10	10
Mercury, total (Hg)	8	8	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	9	9	>88	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	9	9	>50	0	0		10	10	10	10	10	10	10

Fecal Coliform Screening(#/100mL)

# results:	Geomean:	# > 400:	% > 400:	%Conf:
48	35.6	0	0	

Key:
result: number of observations
ND: number of observations reported to be below detection level (non-detect)
EL: Evaluation Level; applicable numeric or narrative water quality standard or action level
Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : States the percent statistical confidence that the actual percentage of exceedances is at least 10% (20% for Fecal Coliform)
Stations with less than 10 results for a given parameter were not evaluated for statistical confidence

Ambient Monitoring System Station Summaries
NCDENR, Division of Water Quality
Basinwide Assessment Report

Location: ROANOKE RIV AT NC 11 NR LEWISTON
Station #: N8300000 **Hydrologic Unit Code:** 03010107
Latitude: 36.01400 **Longitude:** -77.21487 **Stream class:** C
Agency: NCAMBNT **NC stream index:** 23-(26)

Time period: 01/19/2005 to 10/17/2007

	# results	# ND	EL	Results not meeting EL #	%	%Conf	Percentiles Min	10th	25th	50th	75th	90th	Max
Field													
D.O. (mg/L)	29	0	<4	0	0		6.1	6.6	6.8	8.4	10.4	12.6	15.2
	29	0	<5	0	0		6.1	6.6	6.8	8.4	10.4	12.6	15.2
pH (SU)	29	0	<6	0	0		6.4	6.8	7	7.4	7.6	7.9	8.2
	29	0	>9	0	0		6.4	6.8	7	7.4	7.6	7.9	8.2
Salinity (ppt)	29	0	N/A				0.03	0.04	0.04	0.05	0.05	0.06	0.07
Spec. conductance (umhos/cm at 25°C)	29	0	N/A				93	100	102	112	122	130	146
Water Temperature (°C)	29	0	>32	0	0		4.4	7.6	10.1	17.8	25.7	28.7	30.1
Other													
TSS (mg/L)	11	0	N/A				12	12	13	17	29	60.4	68
Turbidity (NTU)	29	0	>50	0	0		7.1	9.4	11.5	15	19	24	48
Nutrients (mg/L)													
NH3 as N	29	21	N/A				0.02	0.02	0.02	0.02	0.02	0.03	0.04
NO2 + NO3 as N	28	1	N/A				0.02	0.11	0.17	0.22	0.29	0.31	0.44
TKN as N	28	1	N/A				0.2	0.23	0.28	0.31	0.36	0.4	0.44
Total Phosphorus	29	0	N/A				0.04	0.05	0.05	0.07	0.08	0.1	0.27
Metals (ug/L)													
Aluminum, total (Al)	9	0	N/A				190	190	400	550	775	1700	1700
Arsenic, total (As)	9	9	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	9	9	>2	0	0		1	1	2	2	2	2	2
Chromium, total (Cr)	9	9	>50	0	0		10	10	25	25	25	25	25
Copper, total (Cu)	9	4	>7	0	0		2	2	2	2	3	3	3
Iron, total (Fe)	9	0	>1000	3	33.3		610	610	715	850	1150	2600	2600
Lead, total (Pb)	9	9	>25	0	0		10	10	10	10	10	10	10
Mercury, total (Hg)	8	8	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	9	9	>88	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	9	6	>50	0	0		10	10	10	10	14	22	22

Fecal Coliform Screening(#/100mL)

# results:	Geomean:	# > 400:	% > 400:	%Conf:
29	38.9	0	0	

Key:
result: number of observations
ND: number of observations reported to be below detection level (non-detect)
EL: Evaluation Level; applicable numeric or narrative water quality standard or action level
Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : States the percent statistical confidence that the actual percentage of exceedances is at least 10% (20% for Fecal Coliform)
Stations with less than 10 results for a given parameter were not evaluated for statistical confidence

Location: ROANOKE RIV AT US 13 AND US 17 AT WILLIAMSTON

Station #: N8550000 **Hydrologic Unit Code:** 03010107

Latitude: 35.85986 **Longitude:** -77.04009 **Stream class:** C

Agency: NCAMBNT **NC stream index:** 23-(26)

Time period: 01/19/2005 to 12/03/2009

	# results	# ND	EL	Results not meeting EL #	%	%Conf	Percentiles Min	10th	25th	50th	75th	90th	Max
Field													
D.O. (mg/L)	59	0	<4	0	0		5.4	6.2	6.7	7.8	10	11.1	13.1
	59	0	<5	0	0		5.4	6.2	6.7	7.8	10	11.1	13.1
pH (SU)	59	0	<6	1	1.7		5.8	6.7	6.8	7.1	7.4	7.6	8
	59	0	>9	0	0		5.8	6.7	6.8	7.1	7.4	7.6	8
Salinity (ppt)	59	0	N/A				0.03	0.04	0.04	0.05	0.05	0.06	0.06
Spec. conductance (umhos/cm at 25°C)	59	0	N/A				92	100	104	117	126	132	138
Water Temperature (°C)	59	0	>32	0	0		4.2	7.7	10.5	17.7	26	28.3	30.2
Other													
TSS (mg/L)	20	2	N/A				6.2	6.4	10.1	14.5	21.8	38	39
Turbidity (NTU)	61	0	>50	0	0		6.2	9.4	12	15	19	26.8	41
Nutrients (mg/L)													
NH3 as N	58	36	N/A				0.02	0.02	0.02	0.02	0.02	0.04	0.05
NO2 + NO3 as N	58	0	N/A				0.08	0.15	0.17	0.21	0.26	0.29	0.34
TKN as N	57	2	N/A				0.2	0.25	0.29	0.33	0.38	0.46	0.63
Total Phosphorus	59	0	N/A				0.04	0.05	0.05	0.06	0.07	0.09	0.1
Metals (ug/L)													
Aluminum, total (Al)	9	0	N/A				200	200	395	650	850	1700	1700
Arsenic, total (As)	9	9	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	9	9	>2	0	0		1	1	2	2	2	2	2
Chromium, total (Cr)	9	9	>50	0	0		10	10	25	25	25	25	25
Copper, total (Cu)	9	5	>7	0	0		2	2	2	2	2	3	3
Iron, total (Fe)	9	0	>1000	3	33.3		540	540	670	1000	1300	2000	2000
Lead, total (Pb)	9	9	>25	0	0		10	10	10	10	10	10	10
Mercury, total (Hg)	8	8	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	9	9	>88	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	9	7	>50	0	0		10	10	10	10	11	14	14

Fecal Coliform Screening(#/100mL)

# results:	Geomean:	# > 400:	% > 400:	%Conf:
60	30.7	1	1.7	

Key:
result: number of observations
ND: number of observations reported to be below detection level (non-detect)
EL: Evaluation Level; applicable numeric or narrative water quality standard or action level
Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : States the percent statistical confidence that the actual percentage of exceedances is at least 10% (20% for Fecal Coliform)
Stations with less than 10 results for a given parameter were not evaluated for statistical confidence

Ambient Monitoring System Station Summaries
NCDENR, Division of Water Quality
Basinwide Assessment Report

Location: CASHIE RIV AT SR 1219 NR LEWISTON
Station #: N8950000 **Hydrologic Unit Code:** 03010107
Latitude: 36.12376 **Longitude:** -77.12140 **Stream class:** C Sw
Agency: NCAMBNT **NC stream index:** 24-2-(1)

Time period: 01/19/2005 to 12/03/2009

	# results	# ND	EL	Results not meeting EL #	%	%Conf	Percentiles Min	10th	25th	50th	75th	90th	Max
Field													
D.O. (mg/L)	52	0	N/A				0.2	0.7	1.3	3.7	6.8	9.9	12.6
pH (SU)	52	0	<4.3	2	3.8		3.9	4.8	5.5	5.9	6.2	6.5	7.8
	52	0	>9	0	0		3.9	4.8	5.5	5.9	6.2	6.5	7.8
Salinity (ppt)	52	0	N/A				0.01	0.02	0.03	0.04	0.05	0.08	0.25
Spec. conductance (umhos/cm at 25°C)	52	0	N/A				54	68	78	100	116	177	493
Water Temperature (°C)	52	0	>32	0	0		0.1	4.6	8.3	14.8	21.8	24.8	27.3
Other													
TSS (mg/L)	18	7	N/A				2.5	2.9	5.6	9.2	18	35.4	39
Turbidity (NTU)	52	0	>50	4	7.7		1.8	2.9	5.3	10.1	31.5	50	95
Nutrients (mg/L)													
NH3 as N	51	33	N/A				0.02	0.02	0.02	0.02	0.03	0.12	0.24
NO2 + NO3 as N	52	42	N/A				0.02	0.02	0.02	0.02	0.03	0.1	0.43
TKN as N	47	0	N/A				0.35	0.51	0.62	0.91	1.4	1.82	2.4
Total Phosphorus	52	0	N/A				0.03	0.05	0.08	0.2	0.43	0.59	1.5
Metals (ug/L)													
Aluminum, total (Al)	7	0	N/A				93	93	180	220	270	310	310
Arsenic, total (As)	7	7	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	7	7	>2	0	0		1	1	2	2	2	2	2
Chromium, total (Cr)	7	7	>50	0	0		10	10	25	25	25	25	25
Copper, total (Cu)	7	6	>7	0	0		2	2	2	2	2	2	2
Iron, total (Fe)	7	0	>1000	4	57.1		560	560	760	1700	3400	8600	8600
Lead, total (Pb)	7	7	>25	0	0		10	10	10	10	10	10	10
Mercury, total (Hg)	6	6	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	7	7	>88	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	7	5	>50	0	0		10	10	10	10	12	20	20

Fecal Coliform Screening(#/100mL)

# results:	Geomean:	# > 400:	% > 400:	%Conf:
52	64.8	4	7.7	

Key:
result: number of observations
ND: number of observations reported to be below detection level (non-detect)
EL: Evaluation Level; applicable numeric or narrative water quality standard or action level
Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : States the percent statistical confidence that the actual percentage of exceedances is at least 10% (20% for Fecal Coliform)
Stations with less than 10 results for a given parameter were not evaluated for statistical confidence

Ambient Monitoring System Station Summaries
NCDENR, Division of Water Quality
Basinwide Assessment Report

Location: ROANOKE RIV 1.3 MI UPS WELCH CRK NR PLYMOUTH

Station #: N9250000 **Hydrologic Unit Code:** 03010107

Latitude: 35.86767 **Longitude:** -76.78541 **Stream class:** C Sw

Agency: NCAMBNT **NC stream index:** 23-(53)

Time period: 01/11/2005 to 12/07/2009

	# results	# ND	EL	Results not meeting EL #	%	%Conf	Percentiles Min	10th	25th	50th	75th	90th	Max
Field													
D.O. (mg/L)	59	0	N/A				4.4	5.9	6.8	7.6	9.8	11.3	11.9
pH (SU)	59	0	<4.3	0	0		4.5	6.6	6.9	7.1	7.3	7.4	7.6
	59	0	>9	0	0		4.5	6.6	6.9	7.1	7.3	7.4	7.6
Salinity (ppt)	59	0	N/A				0.03	0.03	0.04	0.05	0.05	0.06	0.06
Spec. conductance (umhos/cm at 25°C)	59	0	N/A				80	94	106	116	125	134	140
Water Temperature (°C)	59	0	>32	0	0		5.1	6.9	10.2	18.6	25.8	29.1	31.5
Other													
Chlorophyll a (ug/L)	55	0	>40	0	0		1	1	2	4	8	9	19
TSS (mg/L)	20	6	N/A				3.5	5.8	6.2	8.4	10.8	12.9	14
Turbidity (NTU)	59	0	>50	0	0		2.8	5.8	7.1	9.3	12	18	30
Nutrients (mg/L)													
NH3 as N	59	35	N/A				0.02	0.02	0.02	0.02	0.03	0.05	0.08
NO2 + NO3 as N	59	0	N/A				0.02	0.09	0.15	0.2	0.25	0.29	0.39
TKN as N	58	1	N/A				0.2	0.29	0.31	0.34	0.38	0.44	0.54
Total Phosphorus	59	1	N/A				0.02	0.04	0.05	0.05	0.06	0.07	0.12
Metals (ug/L)													
Aluminum, total (Al)	10	0	N/A				170	181	332	425	512	673	680
Arsenic, total (As)	10	10	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	10	9	>2	1	10	73.6	1	1.1	2	2	2	6.5	7
Chromium, total (Cr)	10	10	>50	0	0		10	10	21	25	25	25	25
Copper, total (Cu)	10	8	>7	0	0		2	2	2	2	2	3	3
Iron, total (Fe)	10	0	>1000	2	20	93	460	467	575	720	1025	1280	1300
Lead, total (Pb)	10	10	>25	0	0		10	10	10	10	10	10	10
Mercury, total (Hg)	8	8	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	10	10	>88	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	10	7	>50	0	0		10	10	10	10	11	16	16

Fecal Coliform Screening(#/100mL)

# results:	Geomean:	# > 400:	% > 400:	%Conf:
59	8.7	0	0	

Key:
result: number of observations
ND: number of observations reported to be below detection level (non-detect)
EL: Evaluation Level; applicable numeric or narrative water quality standard or action level
Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : States the percent statistical confidence that the actual percentage of exceedances is at least 10% (20% for Fecal Coliform)
Stations with less than 10 results for a given parameter were not evaluated for statistical confidence

Ambient Monitoring System Station Summaries
NCDENR, Division of Water Quality
Basinwide Assessment Report

Location: ROANOKE RIV AT NC 45 AT SANS SOUCI
Station #: N9600000 **Hydrologic Unit Code:** 03010107
Latitude: 35.91469 **Longitude:** -76.72252 **Stream class:** C Sw
Agency: NCAMBNT **NC stream index:** 23-(53)

Time period: 01/11/2005 to 12/07/2009

	# results	# ND	EL	Results not meeting EL #	%	%Conf	Percentiles Min	10th	25th	50th	75th	90th	Max
Field													
D.O. (mg/L)	59	0	N/A				4	5.6	6.1	7.4	9.6	11	12
pH (SU)	59	0	<4.3	0	0		6.3	6.6	6.9	7.1	7.2	7.4	7.6
	59	0	>9	0	0		6.3	6.6	6.9	7.1	7.2	7.4	7.6
Salinity (ppt)	59	0	N/A				0.04	0.04	0.05	0.06	0.08	0.1	0.4
Spec. conductance (umhos/cm at 25°C)	59	0	N/A				104	108	126	149	185	222	763
Water Temperature (°C)	59	0	>32	0	0		5.4	7.6	10.2	19	25.5	29.6	31.6
Other													
Chlorophyll a (ug/L)	54	2	>40	0	0		1	1	2	3	6	10	17
TSS (mg/L)	19	9	N/A				2.5	3.5	6	6.2	8	16	20
Turbidity (NTU)	59	0	>50	0	0		2	4.6	5.8	7.6	11	14	25
Nutrients (mg/L)													
NH3 as N	59	7	N/A				0.02	0.02	0.03	0.05	0.1	0.14	0.2
NO2 + NO3 as N	59	0	N/A				0.02	0.1	0.15	0.19	0.24	0.28	0.32
TKN as N	57	0	N/A				0.29	0.32	0.36	0.42	0.48	0.52	0.61
Total Phosphorus	59	0	N/A				0.02	0.05	0.05	0.06	0.07	0.08	0.12
Metals (ug/L)													
Aluminum, total (Al)	9	0	N/A				61	61	210	270	415	850	850
Arsenic, total (As)	9	9	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	9	9	>2	0	0		1	1	2	2	2	2	2
Chromium, total (Cr)	9	9	>50	0	0		10	10	25	25	25	25	25
Copper, total (Cu)	9	7	>7	0	0		2	2	2	2	2	3	3
Iron, total (Fe)	9	0	>1000	1	11.1		120	120	505	810	955	1100	1100
Lead, total (Pb)	9	9	>25	0	0		10	10	10	10	10	10	10
Mercury, total (Hg)	8	8	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	9	9	>88	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	9	9	>50	0	0		10	10	10	10	10	10	10

Fecal Coliform Screening(#/100mL)

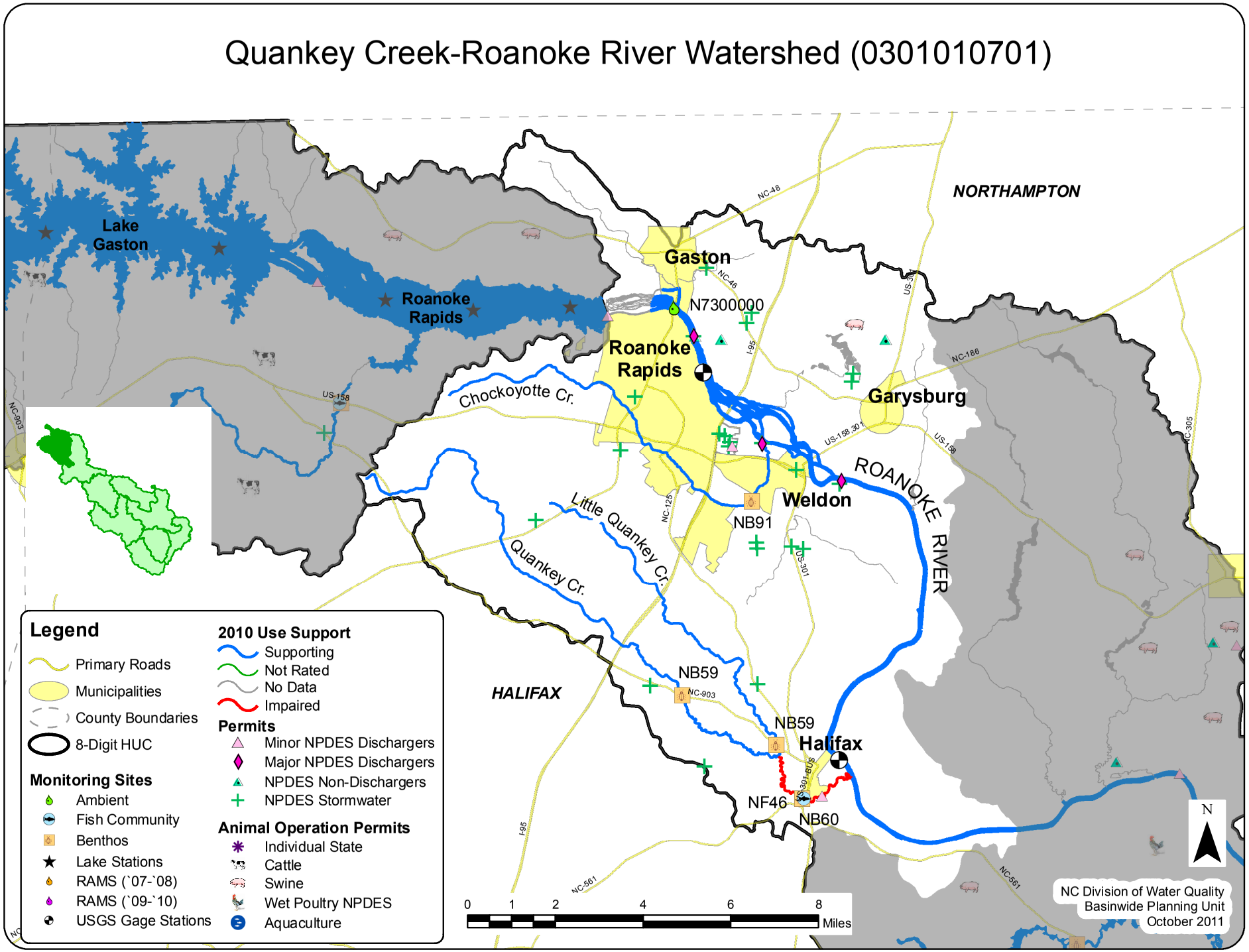
# results:	Geomean:	# > 400:	% > 400:	%Conf:
59	7	0	0	

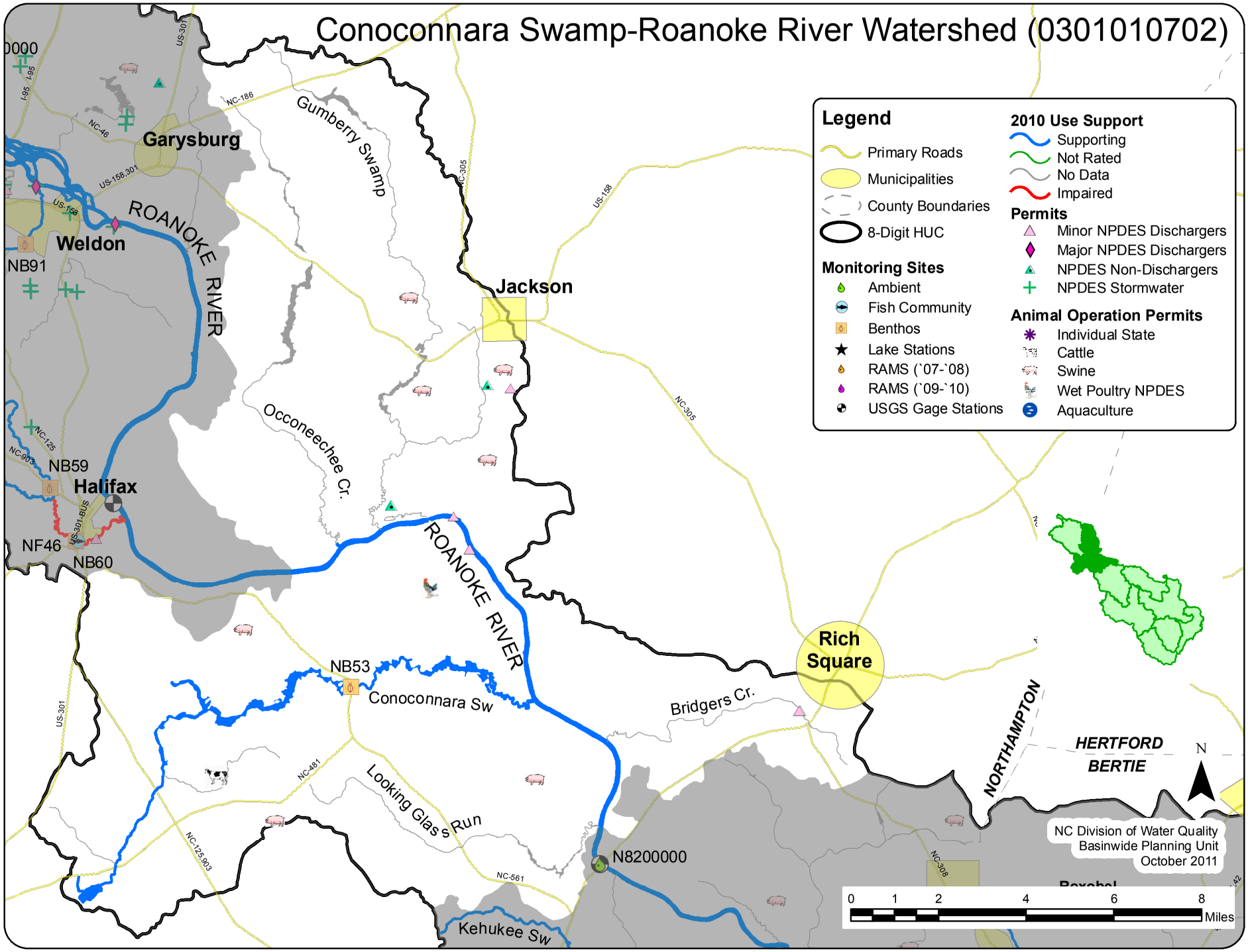
Key:
result: number of observations
ND: number of observations reported to be below detection level (non-detect)
EL: Evaluation Level; applicable numeric or narrative water quality standard or action level
Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : States the percent statistical confidence that the actual percentage of exceedances is at least 10% (20% for Fecal Coliform)
Stations with less than 10 results for a given parameter were not evaluated for statistical confidence

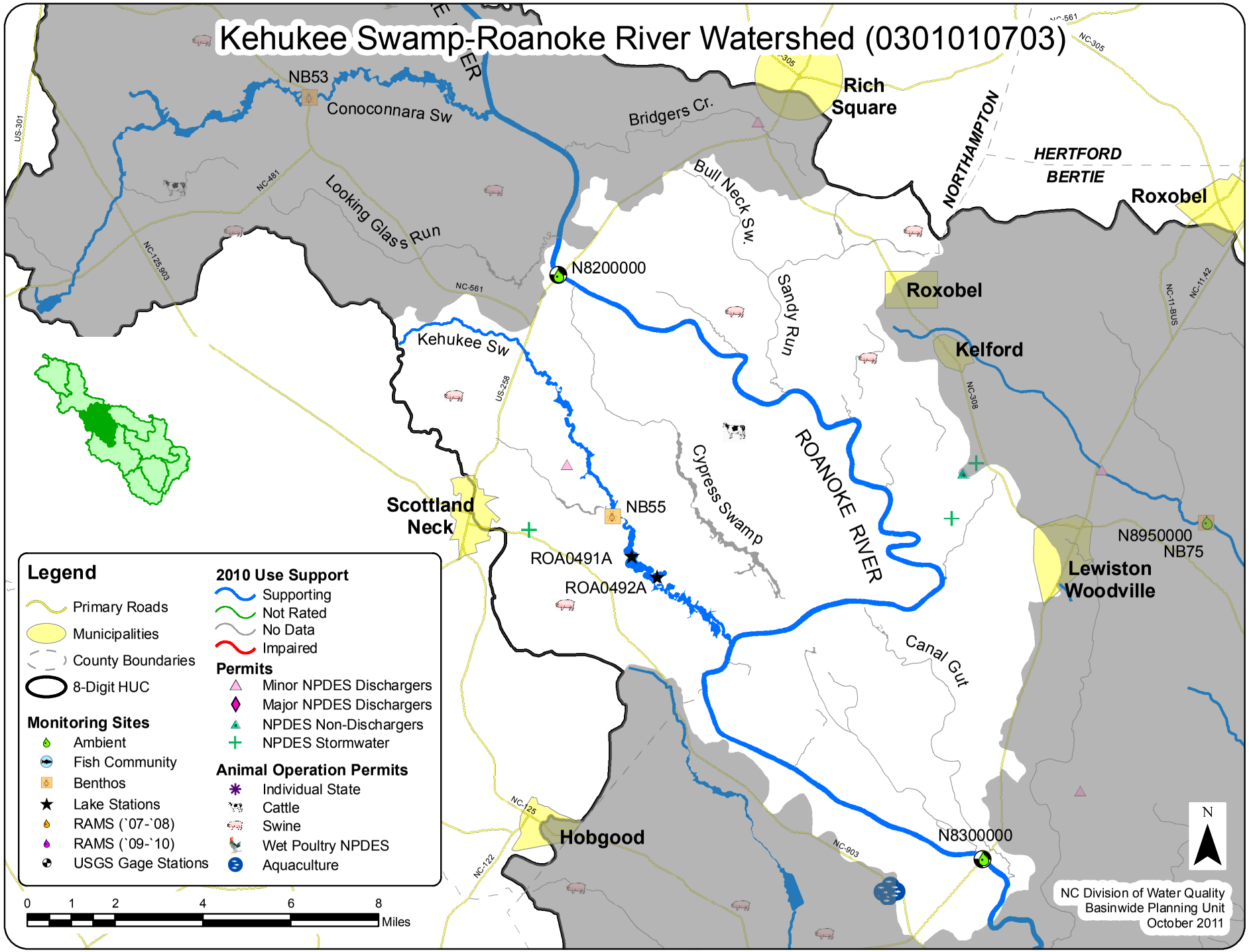
Appendix 5-D

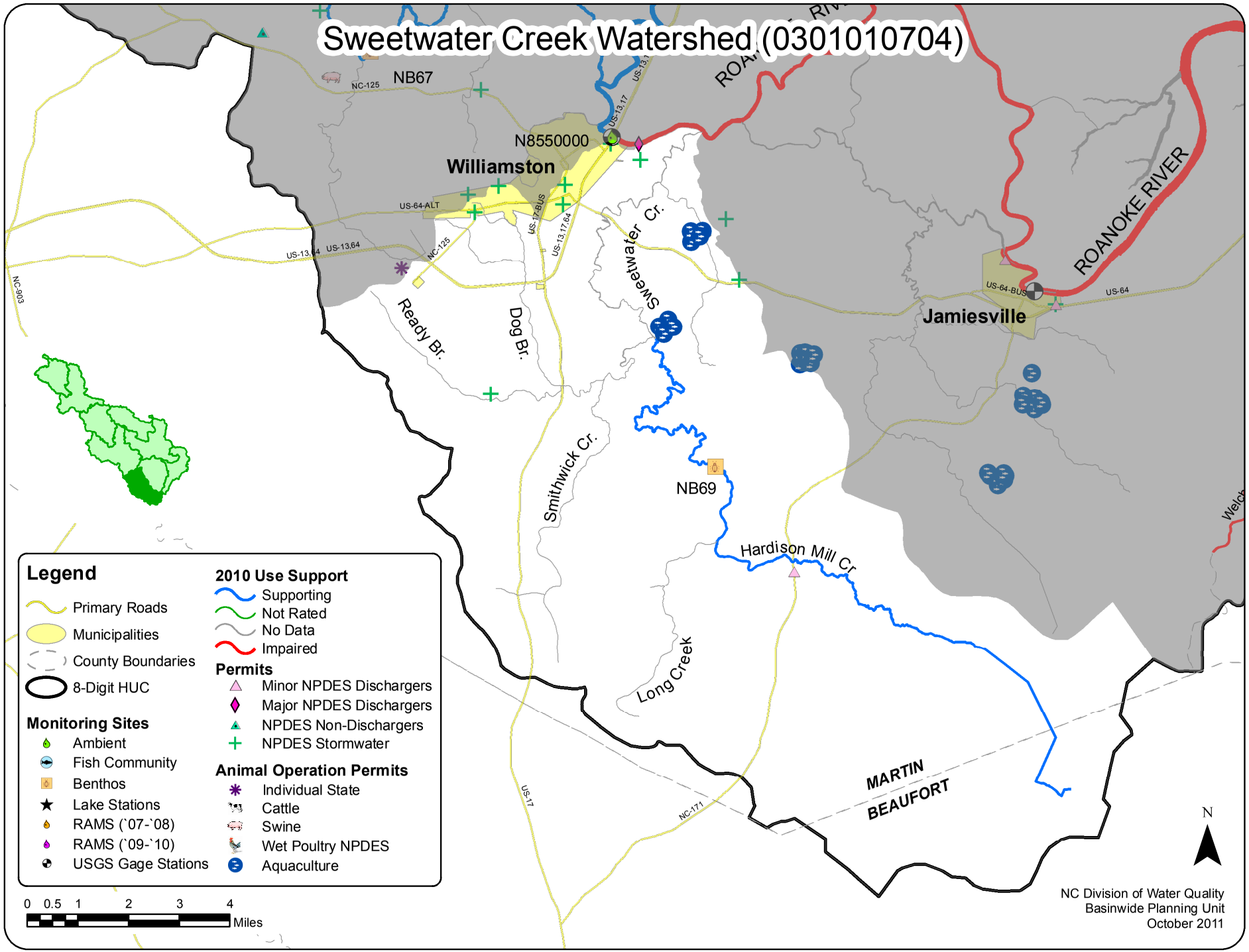
10-Digit Watershed Maps for the Lower Roanoke River Subbasin

Quankey Creek-Roanoke River Watershed (0301010701)

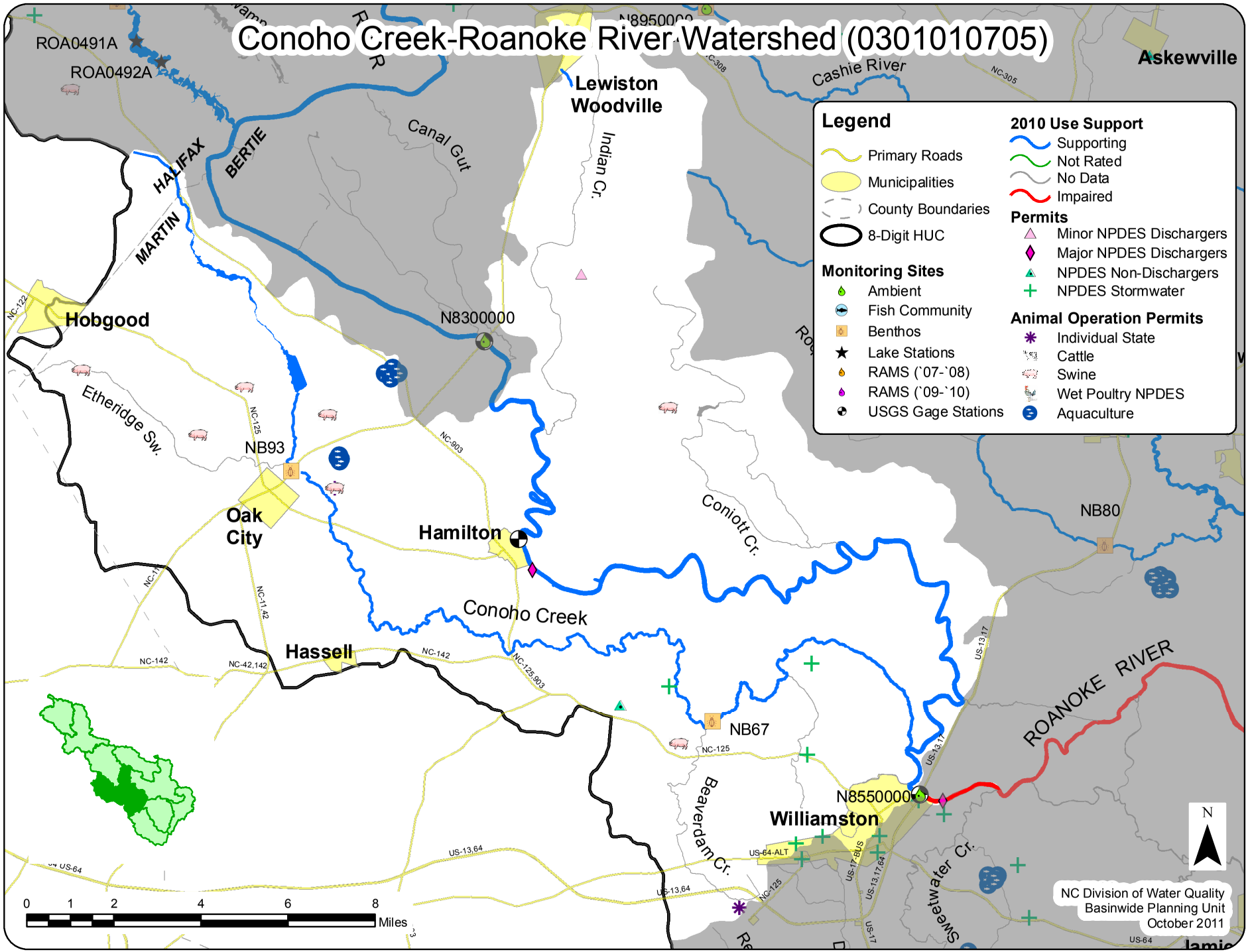


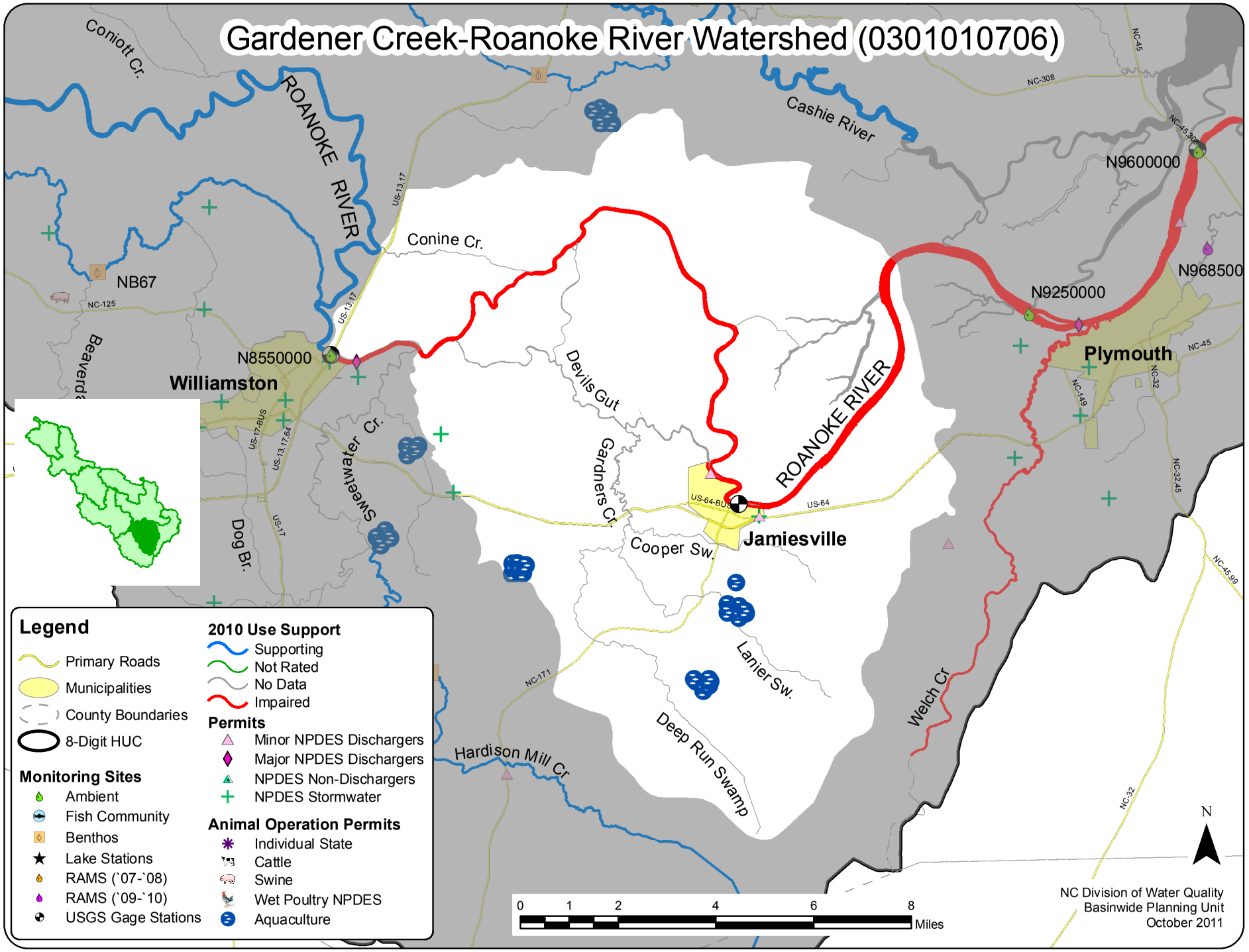

Conoconnara Swamp-Roanoke River Watershed (0301010702)
Legend
Primary Roads
Municipalities
County Boundaries
8-Digit HUC
Monitoring Sites
Ambient
Fish Community
Benthos
Lake Stations
RAMS (`07-`08)
RAMS (`09-`10)
USGS Gage Stations
2010 Use Support
Supporting
Not Rated
No Data
Impaired
Permits
Minor NPDES Dischargers
Major NPDES Dischargers
NPDES Non-Dischargers
NPDES Stormwater
Animal Operation Permits
Individual State
Cattle
Swine
Wet Poultry NPDES
Aquaculture
Garysburg
Weldon
NB91
Jackson
Halifax
NB59
NF46
NB60
Rich Square
NB53
Conoconnara Sw
Gumberry Swamp
Occoneechee Cr.
Bridgers Cr.
Looking Glass Run
Kehukee Sw
N8200000
ROANOKE RIVER
NORTHAMPTON
HERTFORD
BERTIE
NC Division of Water Quality
Basinwide Planning Unit
October 2011
0 1 2 4 6 8
Miles
N


Kehukee Swamp-Roanoke River Watershed (0301010703)
NB53
Conoconnara Sw
Looking Glass Run
Bridgers Cr.
Bull Neck Sw.
Sandy Run
Kehukee Sw
Cypress Swamp
ROANOKE RIVER
Canal Gut
N8200000
NB55
ROA0491A
ROA0492A
N8950000
NB75
N8300000
Rich Square
NORTHAMPTON
HERTFORD
BERTIE
Roxobel
Roxobel
Kelford
Scottland Neck
Lewiston Woodville
Hobgood
US-301
NC-481
NC-125.903
NC-561
US-258
NC-308
NC-11-BUS
NC-11.42
NC-305
NC-125
NC-122
NC-903
Legend
Primary Roads
Municipalities
County Boundaries
8-Digit HUC
Monitoring Sites
Ambient
Fish Community
Benthos
Lake Stations
RAMS (`07-`08)
RAMS (`09-`10)
USGS Gage Stations
2010 Use Support
Supporting
Not Rated
No Data
Impaired
Permits
Minor NPDES Dischargers
Major NPDES Dischargers
NPDES Non-Dischargers
NPDES Stormwater
Animal Operation Permits
Individual State
Cattle
Swine
Wet Poultry NPDES
Aquaculture
0 1 2 4 6 8
Miles
N
NC Division of Water Quality
Basinwide Planning Unit
October 2011

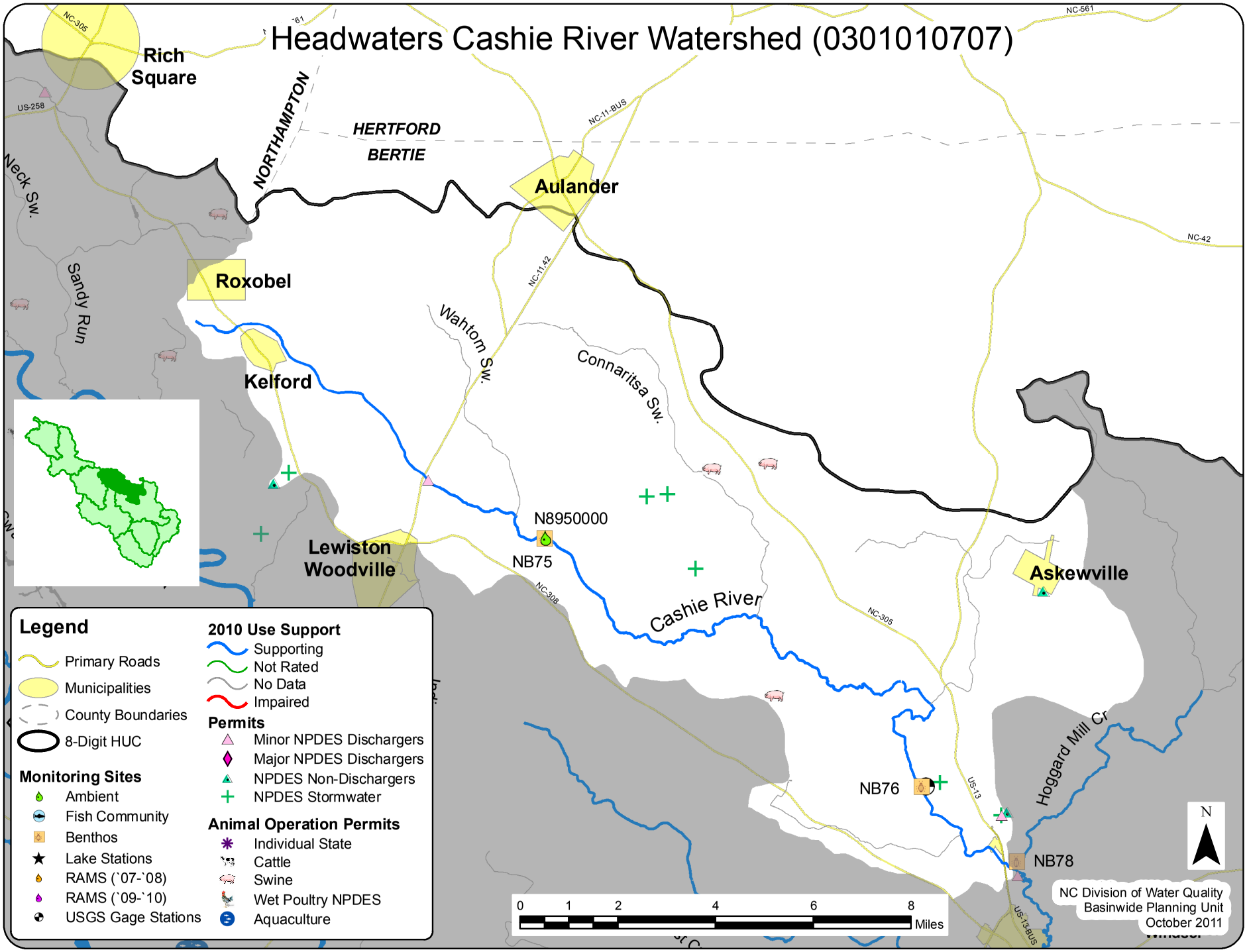

Sweetwater Creek Watershed (0301010704)
NB67
N8550000
Williamston
US-64-ALT
US-13,64
NC-125
US-17-BUS
US-13,17,64
US-13,17
Sweetwater Cr.
ROANOKE RIVER
US-64-BUS
US-64
Jamiesville
Ready Br.
Dog Br.
Smithwick Cr.
NB69
Hardison Mill Cr
Long Creek
MARTIN
BEAUFORT
NC-171
US-17
NC-903
Legend
Primary Roads
Municipalities
County Boundaries
8-Digit HUC
Monitoring Sites
Ambient
Fish Community
Benthos
Lake Stations
RAMS (`07-`08)
RAMS (`09-`10)
USGS Gage Stations
2010 Use Support
Supporting
Not Rated
No Data
Impaired
Permits
Minor NPDES Dischargers
Major NPDES Dischargers
NPDES Non-Dischargers
NPDES Stormwater
Animal Operation Permits
Individual State
Cattle
Swine
Wet Poultry NPDES
Aquaculture
0 0.5 1 2 3 4
Miles
N
NC Division of Water Quality
Basinwide Planning Unit
October 2011

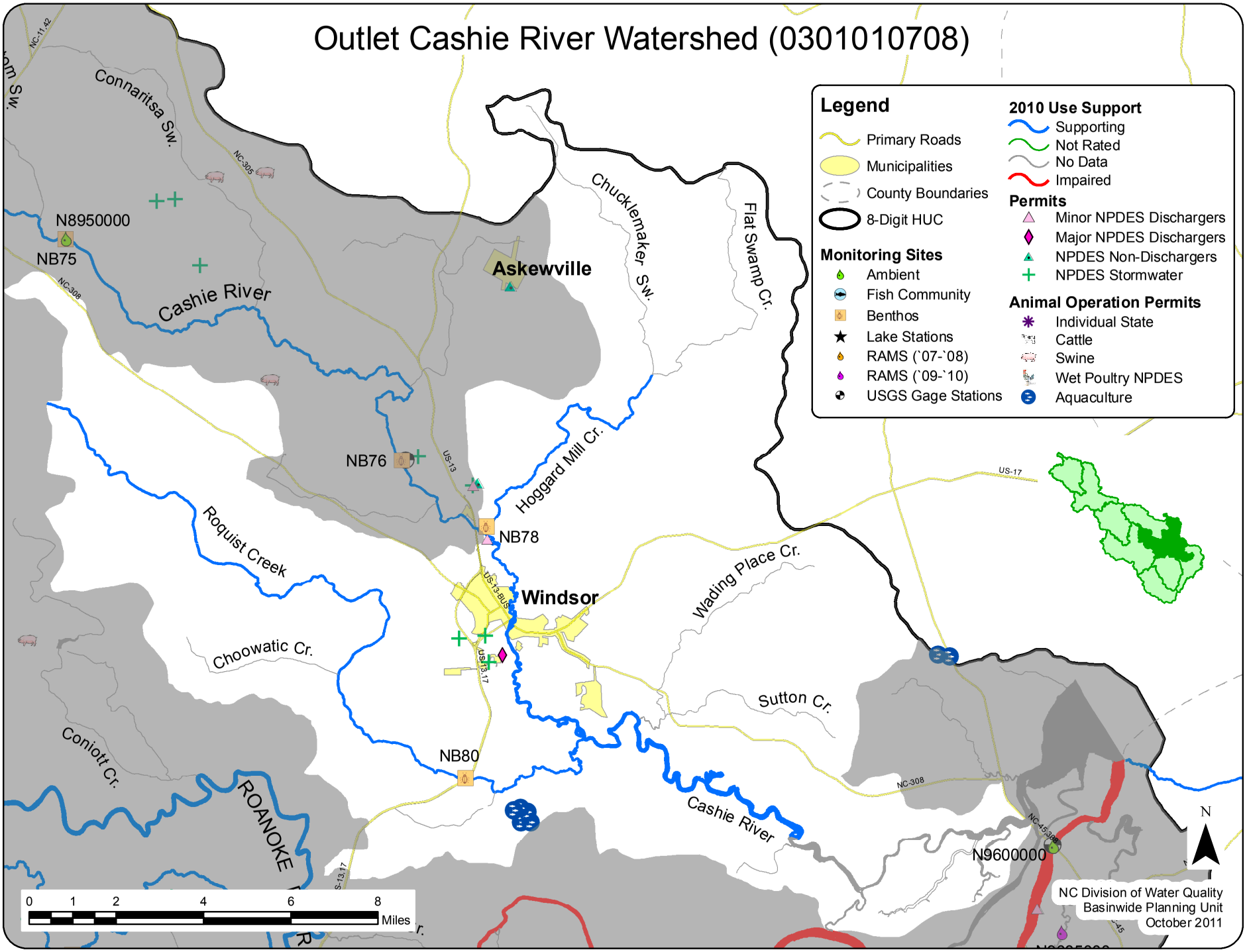
5-D.6


Conoho Creek-Roanoke River Watershed (0301010705)
ROA0491A
ROA0492A
Lewiston Woodville
Askewville
Cashie River
Canal Gut
Indian Cr.
HALIFAX
BERTIE
MARTIN
Hobgood
N8300000
Etheridge Sw.
NB93
Oak City
Hamilton
Coniott Cr.
NB80
Conoho Creek
Hassell
ROANOKE RIVER
NB67
N8550000
Williamston
Beaverdam Cr.
Sweetwater Cr.
Legend
Primary Roads
Municipalities
County Boundaries
8-Digit HUC
Monitoring Sites
Ambient
Fish Community
Benthos
Lake Stations
RAMS (`07-`08)
RAMS (`09-`10)
USGS Gage Stations
2010 Use Support
Supporting
Not Rated
No Data
Impaired
Permits
Minor NPDES Dischargers
Major NPDES Dischargers
NPDES Non-Dischargers
NPDES Stormwater
Animal Operation Permits
Individual State
Cattle
Swine
Wet Poultry NPDES
Aquaculture
0 1 2 4 6 8
Miles
N
NC Division of Water Quality
Basinwide Planning Unit
October 2011

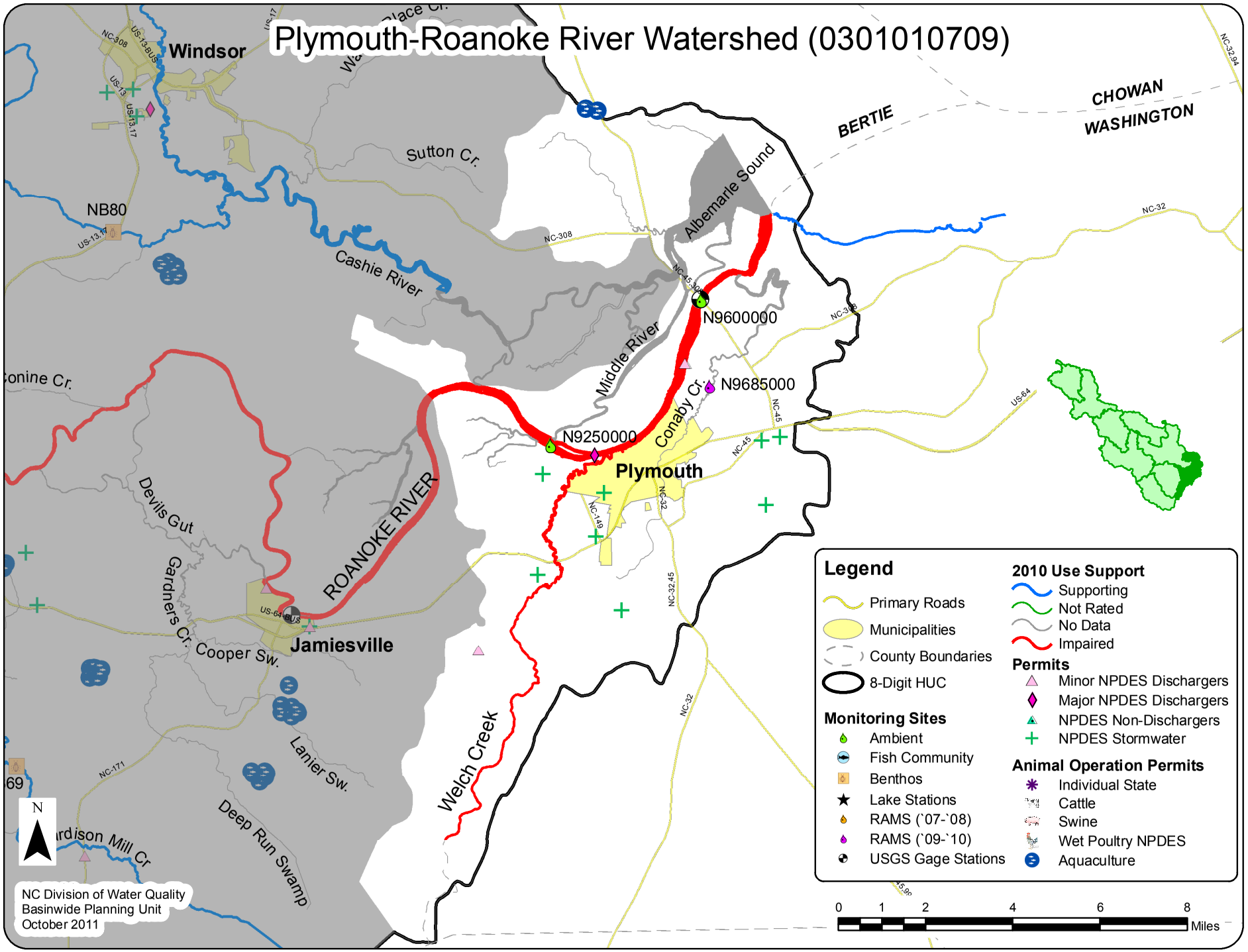

Gardener Creek-Roanoke River Watershed (0301010706)
Coniott Cr.
ROANOKE RIVER
Cashie River
Conine Cr.
NB67
N8550000
Williamston
Beaverdam
Sweetwater Cr.
Dog Br.
Devils Gut
Gardners Cr.
ROANOKE RIVER
Cooper Sw.
Jamiesville
Lanier Sw.
Deep Run Swamp
Hardison Mill Cr
Welch Cr
N9600000
N9250000
N968500
Plymouth
NC-125
US-13,17
US-17-BUS
US-13,17-64
US-17
US-64-BUS
US-64
NC-308
NC-45
NC-45,308
NC-32
NC-149
NC-32,45
NC-45,99
NC-171
Legend
Primary Roads
Municipalities
County Boundaries
8-Digit HUC
Monitoring Sites
Ambient
Fish Community
Benthos
Lake Stations
RAMS (`07-`08)
RAMS (`09-`10)
USGS Gage Stations
2010 Use Support
Supporting
Not Rated
No Data
Impaired
Permits
Minor NPDES Dischargers
Major NPDES Dischargers
NPDES Non-Dischargers
NPDES Stormwater
Animal Operation Permits
Individual State
Cattle
Swine
Wet Poultry NPDES
Aquaculture
0 1 2 4 6 8
Miles
N
NC Division of Water Quality
Basinwide Planning Unit
October 2011

5-D.8


Headwaters Cashie River Watershed (0301010707)
Rich Square
NORTHAMPTON
HERTFORD
BERTIE
Aulander
Roxobel
Kelford
Lewiston Woodville
Askewville
Neck Sw.
Sandy Run
Wahtom Sw.
Connaritsa Sw.
Cashie River
Hoggard Mill Cr
N8950000
NB75
NB76
NB78
NC-305
NC-308
NC-11-BUS
NC-11-42
NC-42
NC-561
US-258
US-13
US-13-BUS
Legend
Primary Roads
Municipalities
County Boundaries
8-Digit HUC
Monitoring Sites
Ambient
Fish Community
Benthos
Lake Stations
RAMS (`07-`08)
RAMS (`09-`10)
USGS Gage Stations
2010 Use Support
Supporting
Not Rated
No Data
Impaired
Permits
Minor NPDES Dischargers
Major NPDES Dischargers
NPDES Non-Dischargers
NPDES Stormwater
Animal Operation Permits
Individual State
Cattle
Swine
Wet Poultry NPDES
Aquaculture
0 1 2 4 6 8 Miles
N
NC Division of Water Quality
Basinwide Planning Unit
October 2011


Outlet Cashie River Watershed (0301010708)
Legend
Primary Roads
Municipalities
County Boundaries
8-Digit HUC
Monitoring Sites
Ambient
Fish Community
Benthos
Lake Stations
RAMS (`07-`08)
RAMS (`09-`10)
USGS Gage Stations
2010 Use Support
Supporting
Not Rated
No Data
Impaired
Permits
Minor NPDES Dischargers
Major NPDES Dischargers
NPDES Non-Dischargers
NPDES Stormwater
Animal Operation Permits
Individual State
Cattle
Swine
Wet Poultry NPDES
Aquaculture
Connaritsa Sw.
Chucklemaker Sw.
Flat Swamp Cr.
Cashie River
Askewville
Windsor
Hoggard Mill Cr.
Roquist Creek
Choowatic Cr.
Wading Place Cr.
Sutton Cr.
Coniott Cr.
ROANOKE R.
N8950000
NB75
NB76
NB78
NB80
N9600000
NC-11-42
NC-305
NC-308
US-13
US-13-BUS
US-13-17
US-17
NC-45-BUS
0 1 2 4 6 8 Miles
N
NC Division of Water Quality
Basinwide Planning Unit
October 2011

5-D.10


Plymouth-Roanoke River Watershed (0301010709)
Windsor
Sutton Cr.
NB80
Cashie River
BERTIE
CHOWAN
WASHINGTON
Albemarle Sound
N9600000
N9685000
N9250000
Middle River
Conaby Cr.
Plymouth
ROANOKE RIVER
Devils Gut
Gardners Cr.
Cooper Sw.
Jamiesville
Welch Creek
Lanier Sw.
Deep Run Swamp
Legend
Primary Roads
Municipalities
County Boundaries
8-Digit HUC
Monitoring Sites
Ambient
Fish Community
Benthos
Lake Stations
RAMS (`07-`08)
RAMS (`09-`10)
USGS Gage Stations
2010 Use Support
Supporting
Not Rated
No Data
Impaired
Permits
Minor NPDES Dischargers
Major NPDES Dischargers
NPDES Non-Dischargers
NPDES Stormwater
Animal Operation Permits
Individual State
Cattle
Swine
Wet Poultry NPDES
Aquaculture
0 1 2 4 6 8
Miles
N
NC Division of Water Quality
Basinwide Planning Unit
October 2011

CHAPTER 6

Local Initiatives & Voluntary Incentive Programs

In the Roanoke River Basin

Chapter Topics

- Local Initiatives
- CG&L
- 319 Grants
- SWCD

Local Initiatives

In addition to local initiatives that have been planned or implemented throughout this planning cycle, this Section includes a list of watershed groups and natural resource agencies focused on improving water quality across the basin. There may be additional groups and agencies active within the basin. Please contact the DWQ **Roanoke River Basin Planner** to have your water quality improvement or protection program/projects listed here.

The Importance of Local Initiatives

Local initiatives to protect water quality are essential to any community because local citizens make decisions that affect change in their own communities. There are a variety of limitations local initiatives can overcome including limited and diminishing state government budgets and staff resources, absence of regulations for land use management, and many others. Local organizations and agencies are able to combine professional expertise in a watershed, thus allowing groups to holistically understand the challenges and opportunities of different water quality efforts. Involving a wide array of people in water quality projects also brings together a wide range of knowledge and interests and encourages others to become involved and invested in these projects.

By working in coordination across jurisdictions and agency lines, more funding opportunities may be realized. This potentially allows local entities to do more work and be involved in more activities because their funding sources are diversified. The most important aspect of local endeavors is that the more localized the project, the better the chances for ongoing success.

The collaboration of local efforts are key to water quality improvements. There are good examples of local agencies and groups using these cooperative strategies throughout the basin and specific groups and projects are discussed within each of the 10-digit watershed write ups in the Subbasin Chapters. Some of these groups are listed below. DWQ applauds the foresight and proactive response of local watershed groups and local governments to address a number of water quality problems.

LAKE GASTON WEED CONTROL COUNCIL

**Information submitted by: Wally Sayko, Brunswick County (Va) Director, Chairman Public Affairs Committee August 8, 2011.*

Current activities by the LGWCC:

The second chemical application has been applied to some 1,200 acres. This product is called Sonar and is a time released product that lasts for about 40 days. Three applications are applied about 30-35 days apart. During this period tests are run to assure that the proper level of product is present to provide continuous impact on the Hydrilla.

Planned activity by LGWCC:

A company is under contract to survey the lake in the fall to determine the amount of vegetation in the lake and determine how many acres of potential Hydrilla is present. This will provide three important pieces of data to us for the following year. First, it will verify the effectiveness of this year's contracted treatment. Second, it will establish how many acres of Hydrilla still exists to determine if we need to add Grass Carp and the third is of course what areas of the lake that have Hydrilla that can be treated by chemical. Not all areas can be treated. Water over 10 feet deep for instance is not very effective and also the flow of water is critical since the chemical will be moved from the desired location.

Completed activities by the LGWCC:

We put into the lake this year over 8,400 grass carp. They were put into two locations - Big Stonehouse Creek in North Carolina and the Route 1 Bridge in Virginia. Based upon a formula that has been developed by NC Wildlife Resources Commission, this data is put into a program to determine the number of grass carp per infested acre of Hydrilla. The goal is to maintain grass carp at 15 per acre. Insertion of the 8,400 grass carp this year will bring the current rate to that level.

Activities that did not happen by LGWCC:

We were planning a significant effort to plant more controlled native plants in given areas of the lake. This effort was to be coordinated with the U.S. Army Corps of Engineers. Because of a lack of funding for the COE this plan was not carried out.

Activities by the Lake Gaston Association: (LGA)

The LGA supports the Weed Control Council efforts in a number of ways. First, it lobbies the five county governments surrounding the lake to provide full funding ($116,000 each) for weed control efforts during the annual budgeting cycle. Second, it provides volunteers in support of a lake wide weed survey each year and the native plant re-vegetation program. Third, the LGA responds to inquiries from concerned property owners regarding weed control issues. This support is provided by the LGA's Lake Environment Committee. Specifically this year, the Environment Committee:

- Repaired over 50 native plant cages in the water on the lake in conjunction with the Corps' re-vegetation program. Some of the cages suffered physical damage from boaters and some from animals. In one cage we found over 20 turtles that had to be released and in another a 3 foot Gar Fish. These areas were all repaired and any damage and plant success recorded for the COE. The monitoring and reporting of these locations is ongoing by the LGA.

- Completed training of over 26 new volunteers to participate in our annual lake aquatic plant survey. Our goal this year is to survey more than 90% of the lake with volunteers. This data is then sent to NC State, to Rob Richardson and his organization for input into a map source. This data is then shared with the LGWCC for additional information into the annual lake survey they conduct. The survey will begin in late August.

- Was instrumental in convincing two counties to maintain full weed control funding, another to restore full funding from none the previous year, and another to increase its funding from $25,000 to $75,000.

- Responded to a number of concerns by property owners that were checked out by committee members and reported back to the proper organizations. These have included concerns over runoff from farms and a Moto Cross track, to questions about types of weeds they may have near their shoreline and the effort to remove an abandoned house boat on Poplar Creek.

In May the LGA sponsored a Lake Clean Up campaign in all 5 counties. It was the first effort of this type on the lake. A lot of trash was cleaned from the lake.

Partners on the lake:

- Lake Gaston Weed Control Council, Dr. Elton Brown, President
- Lake Gaston Association, Doug Hughes, President
- Stake Holders, Pete Deschenes, Chairman
- Technical Advisory Group (TAG), Rob Richardson, Chairman
- North Carolina State University, Rob Richardson, Steve Hoyle
- Virginia Tech.
- Dominion Power, Jim Thornton
- Virginia Dept. of Inland Fisheries, Vic Dicenzo
- North Carolina Dept. of Natural Resources, Kirk Rundel

Federal, State & Local Incentive Programs

Construction Grants & Loans

The NC Construction Grants and Loans (CG&L) Section of DWQ provides grants and loans to local government agencies for the construction, upgrades and expansion of wastewater collection and treatment systems. As a financial resource, the section administers five major programs that assist local governments. Of these, two are federally funded programs administered by the state, the Clean Water State Revolving Fund (SRF) Program and the State and Tribal Assistance Grants (STAG). The STAG is a direct congressional appropriations for a specific “special needs” project within NC. The High Unit Cost Grant (SRG) Program, the State Emergency Loan (SEL) Program and the State Revolving Loan (SRL) Program are state funded programs, with the latter two being below market revolving loan money. The Section also received an additional Capitalization Grant authorized by the American Recovery and Reinvestment Act of 2009 in the amount of $70,729,100. These funds are administered according to SRF procedures. All projects must be eligible under title VI of the Clean Water Act. For more information, please see the CG&L website.

TABLE 6-1: CG&L PROJECTS FUNDED DURING 2004-2009 IN THE ROANOKE RIVER BASIN

LOCATION	PROJECT DESCRIPTION	DATE	AMOUNT	8 DIGIT HUC	FUNDING
Eden, City of	Dry Creek and Smith River Sewer Rehabilitation	5/8/2009	$714,303	03010103	ARRA
Rich Square, Town of	Rich Square Collection System Rehabilitation	5/21/2009	$1,728,180	03010107	ARRA
Roanoke Rapids SD	Replace the Disinfection System	7/31/2009	$1,241,156	03010107	SRF
Rich Square	Sewer Rehabilitation and a Spray Irrigation System	4/14/2004	$2,999,940	03010107	SRG

SECTION 319 GRANT PROGRAM

Section 319 of the Clean Water Act provides grant money for nonpoint source demonstration and restoration projects. In 2009/2010, approximately $450,000 was available annually through base funding for demonstration and education projects across the state. An additional $2 million was available annually through incremental funding for restoration projects on impaired waters statewide. All projects must provide non-federal matching funds of at least 40 percent of the project's total costs. Project proposals are reviewed and selected by the North Carolina Nonpoint Source Workgroup, made up of state and federal agencies involved in regulation or research associated with nonpoint source pollution. Information on the North Carolina Section 319 Grant Program **application process** is available online as well as **descriptions of projects and general Section 319 Program information**.

There were two projects in the Roanoke River basin that were funded through the Section 319 Program between 2004 and 2010. The first project, the Smith Creek Agricultural Sediment Initiative, was active from 2005 to 2008. The main objective of the project was to address severe sedimentation problems in the Smith Creek watershed in Warren County, specifically targeting segments of Smith Creek on North Carolina's 303(d) list of impaired waters. The NC Division of Soil and Water Conservation contracted with the Warren Soil and Water Conservation District to prepare a comprehensive watershed restoration plan. The plan helped guide the installation of best management practices (BMPs) within the watershed to reduce sediment delivery to the impaired waters. Eighteen cooperating landowners were involved in implementing BMPs to improve water quality.

The other project funded by the 319 Grant Program extends from 2008 to 2011 and is also with the NC Division of Soil and Water Conservation, in partnership with Stokes, Rockingham, and Caswell County Soil and Water Conservation Districts. The primary objective of this project is to install BMPs throughout the Dan River watershed to reduce sediment delivery and fecal coliform bacteria to help restore impaired waters on the state's 303(d) list. BMPs to be installed include: livestock exclusion fencing, water tanks, field borders, grassed waterways, heavy use area protection, and non-agricultural BMPs such as wetlands and rain gardens. Installation of the proposed BMPs should help prevent the off-site movement of nutrients and pesticides, and improve streambank stability and habitat for fish and macroinvertebrates. This project will build on earlier planning efforts by updating and supplementing existing documents to produce a watershed restoration plan that satisfies EPA's nine required elements. Numerous outreach and educational opportunities are also being conducted during the project to inform local citizens, students and elected officials about the purpose and effectiveness of the BMPs.

Table 6-2: 319 Grant Contracts in the Roanoke River Basin Between 2004 & 2009

Fiscal Year	Contract Number	Name	Description	8-Digit HUC	Agency	Funding
2005	EW06022	Smith Creek Agricultureal Sediment Initiative: Phase II	Agricultural BMP Implementation	03010106	DSWC	$130,000
2008	1585	Dan River Watershed BMP Implementation	BMP Implementation	03010103	DSWC	$399,900
Total Funded:						**$529,900**

Soil & Water Conservation

The North Carolina Agricultural Cost Share Program

The NC Agricultural Cost Share Program (NCACSP) helps reduce agricultural nonpoint runoff into the state's waters. The program, administered by the NC Division of Soil and Water Conservation (now within the NC Department of Agriculture and Consumer Services as of 2011) and managed by the local districts, helps owners and renters of established agricultural operations improve their on-farm management by using best management practices (BMPs). These BMPs include vegetative, structural or management systems that can improve the efficiency of farming operations while reducing the potential for surface and groundwater pollution. A full listing of all the BMPs and the categories they are grouped in is available at the following link (under Section V: Best Management Practice Guidelines)

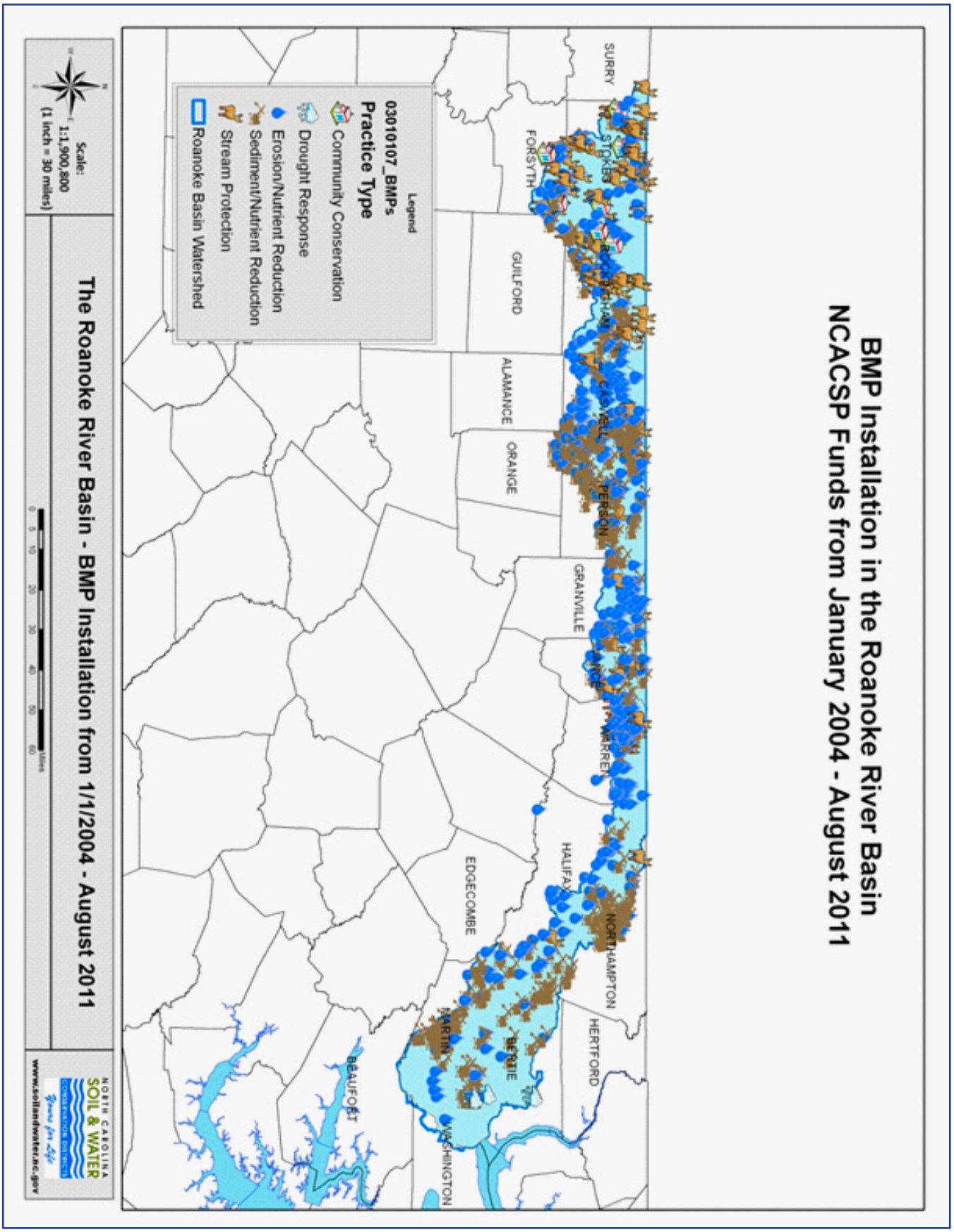
Across the Roanoke River Basin, 4,167 individual Best Management Practices were installed from January 1, 2004 through August 1, 2011. Below is a map (Figure 6-1) showing the geographic location of those 4,167 practices installed.

The western portion of the basin tends to have more Stream Protection practices installed than the eastern portion of the watershed. Moving east, there is a considerable shift into Erosion/Nutrient Reduction and Sediment/Nutrient Reduction practices. This is due to different ecoregions.

Table 6-3: Total Benefits Derived Across the Entire Basin for Those Practices Installed Through the NC Agricultural Cost Share Program Between January 1, 2004 through August 1, 2011:

Derived Benefits	Benefit Parameter	Benefit Value
Acres Affected	Acre	36,960
Nitrogen Saved	Pounds	421,609
Phosphorus Saved	Pounds	81,458
Soil Saved	Tons	166,646
Waste-N Managed	Pounds	341,306
Waste-P Managed	Pounds	230,317

FIGURE 6-1: ACSP BMP INSTALLATION IN THE ROANOKE RIVER BASIN BETWEEN JANUARY 2004 THROUGH AUGUST 2011



Clean Water Act, Section 205(j) Funded Projects

The DWQ and EPA awarded the Kerr-Tar Regional Council of Governments funding from the 2009 American Recovery and Reinvestment Act of $34,760 to complete the Roanoke River Basin Bi-State Commission and North Carolina Roanoke River Advisory Committee Activity and Project Development Operational and Coordination Support Project. The North Carolina and Virginia Roanoke River Basin Advisory Committees and the Roanoke River Basin Bi-State Commission were created by the North Carolina and Virginia legislatures in 2003. Their purposes included addressing bi-state issues of water quality, quantity, assimilative capacity, developing policy recommendations and supporting coordination between the states. This grant which concluded in 2011, provided support for the planning activities to achieve the legislative intent of these committees and commission. Over the past few quarters the Committees and Commission have been actively reviewing the issues of lifting the 1982 ban on uranium mining in Virginia and developing a more detailed charge to the Ad hoc Water Allocation Committee concerning a water allocation proposal that is acceptable to both states.

American Rivers

In 2011 American Rivers ranked the Roanoke River as the third most endangered river in America due to the possibility of uranium mining. Extracting uranium ore requires intensive use of water and chemicals, and leaves behind massive amounts of radioactive and contaminated waste. The mining, processing, and waste disposal have the possibility of leave a toxic, radioactive legacy in the watershed for centuries if not done in an environmentally sensitive manner.

More information about this ranking is found on the American Rivers website.

CHAPTER 7

CHAPTER TOPICS

- EEP
- Forestry

OTHER NATURAL RESOURCE PROGRAMS

IN THE ROANOKE RIVER BASIN

NATURAL RESOURCE PROGRAMS

The efforts of several Natural Resource Programs are discussed throughout this basin plan. Many of these programs are mentioned in the Subbasin Chapters as part of a coordinated effort to protect and/or restore water quality and are locally based. Other programs which have similar purposes but have a basinwide, state or national focus are discussed in more detail in this chapter. This chapter is by no means a complete listing of Natural Resource Programs that are active in the Roanoke River basin, but rather a discussion of a few highly active programs and their involvement in restoration and/or protection efforts within the basin.

Several locally based Natural Resource Programs and their efforts during this planning cycle are discussed in the Voluntary Incentive Programs & Local Initiatives Chapter.

ECOSYSTEM ENHANCEMENT PROGRAM (EEP)

EEP uses watershed planning at two scales (basinwide and local) to identify the best locations to implement stream, wetland and riparian buffer restoration/enhancement and preservation projects. The planning process considers where mitigation is needed and how mitigation efforts might contribute to the improvement of water quality, habitat and other vital watershed functions in the state. Watershed planning requires GIS data analysis, stakeholder involvement, water quality monitoring, habitat assessment and consideration of local land uses and ordinances. It is a multi-dimensional process that considers science, policy and partnerships.

River Basin Restoration Priorities

EEP River Basin Restoration Priorities (RBRPs) are focused on the identification of Targeted Local Watersheds (TLWs) within the 8-digit Cataloging Units (subbasins) that comprise individual river basins. TLWs represent priority areas (14-digit HUCs) for the implementation of stream and wetland mitigation projects. GIS screening factors considered in the selection of TLWs include (among others): documented water quality impairment and habitat degradation, the presence of critical habitat or significant natural heritage areas, the presence of water supply watersheds or other high quality waters, the condition of riparian buffers, estimates of impervious cover, existing or planned transportation projects, and the opportunity for local partnerships. Recommendations from local resource agency professionals and the presence of existing watershed projects are given significant weight in the selection of TLWs. RBRP documents (and TLW selections) for each of the 17 river basins in North Carolina are updated periodically to account for changing watershed conditions, increasing development pressures and local stakeholder priorities.

Table 7-1: Roanoke River TLWs & LWPs by Subbasin (as of October 2009)

HUC	TLWs (#)	LWPs (# - Names)
03010102	1	None to date
03010103	7	None to date
03010104	3	None to date
03010106	1	None to date
03010107	15	None to date
Total:	**27**	**0**

The most recent updates to the Roanoke River Basin TLWs occurred in 2009. In total, 27 14-digit HUCs have been designated TLWs by EEP in the Roanoke Catalog Units (Table 7-2). This updated RBRP, including a summary table and map of Targeted Local Watersheds, can be found at EEP's website for the 2009 report.

Local Watershed Planning

EEP Local Watershed Planning (LWP) initiatives are conducted in specific priority areas (typically a cluster of two or three Targeted Local Watersheds) where EEP and the local community have identified a need to address critical watershed issues. The LWP process typically takes place over a two-year period, covers a planning area around 50 to 150 square miles, and includes three distinct phases: I - existing data review and preliminary watershed characterization (largely GIS-based); II – detailed watershed assessment (including water quality & biological monitoring and field assessment of potential mitigation sites); and III – development of a final Project Atlas and Watershed Management Plan. EEP collaborates with local stakeholders and resource professionals throughout the process to identify projects and management strategies to restore, enhance, and protect local watershed resources. Currently, EEP has not undertaken any LWP initiatives in the Roanoke River Basin.

EEP Projects in the Roanoke River Basin

As of August 2011, EEP had a total of 19 mitigation projects in some stage of being completed in the Roanoke Basin. These stages include identification/acquisition; design; construction; monitoring (construction complete); and long-term stewardship. Table 7-3 provides details on these projects that include stream and wetland restoration/enhancement and preservation projects. In total, EEP is in some stage of restoration or enhancement on over 57,000 feet of stream and 403 acres of wetlands in the Roanoke. In addition, the program is in some stage of preservation on over 89,000 feet of stream and 5,200 acres of wetlands. For additional information about EEP's Project Implementation efforts, go to the EEP Project Implementation webpage. To view the locations of these project sites, go to EEP's Portal Map site.

Table 7-2: EEP Projects in Some Stage of Completion in the Roanoke River Basin By Subbasin

HUC	Projects (#)	Stream Restoration/ Enhancement (ft)	Stream Preservation (ft)	Wetland Restoration/ Enhancement (ac)	Wetland Preservation (ac)
03010102	1	2,539	12,710	0	0
03010103	5	15,666	9,575	0	0
03010104	4	18,033	15,623	89	19
03010106	1	5,062	0	0	0
03010107	8	16,199	51,911	314	5,232
Total:	**19**	**57,499**	**89,819**	**403**	**5,251**

For more information on EEP Planning in the Roanoke, please call Rob Breeding at 919-733-5311 or send email to rob.breeding@ncdenr.gov.

For more on mitigation projects in the Roanoke, please call or email the following project managers:

- Robin Hoffman (03010102) at 919-715-5836 or robin.hoffman@ncdenr.gov
- Perry Sugg (03010103 & 03010104) at 919-715-1359 or perry.sugg@ncdenr.gov
- Kristie Corson (03010104) at 919-715-1954 or kristie.corson@ncdenr.gov
- Heather Smith (03010106 & 03010107) at 919-715-5590 or heather.c.smith@ncdenr.gov
- Tracy Stapleton (03010107) at 919-715-1657 or tracy.stapleton@ncdenr.gov
- Stephanie Horton (High Quality Preservation Projects in 03010103, 03010104, and 03010107) at 919-715-1263 or stephanie.horton@ncdenr.gov

Forestry

Forestland Ownership*

Approximately 85% of the forestland in the basin is privately-owned. The most notable public forested lands in the basin include Hanging Rock State Park, Kerr Lake State Park, and the Roanoke River National Wildlife Refuge. Within North Carolina's portion of this river basin, there are no State Forest or National Forest lands.

* The ownership estimates come from the most recent data published by the USDA-Forest Service ("Forest Statistics for North Carolina, 2002." Brown, Mark J. Southern Research Station Resource Bulletin SRS-88. January 2004).

Forest Water Quality Regulations

Forestry operations in North Carolina are subject to regulation under the Sedimentation Pollution Control Act of 1973 (Article 4-GS113A, referred to as "SPCA"). However, forestry operations may be exempted from specific requirements of the SPCA if the operations meet the compliance performance standards outlined in the *Forest Practices Guidelines Related to Water Quality* (15A NCAC 1I .0100 - .0209, referred to as "FPGs") and General Statutes regarding stream and ditch obstructions (GS 77-13 and GS 77-14).

The FPG performance standard rule-codes and topics include:

- .0201: Streamside Management Zone (SMZ)
- .0202: Prohibition of Debris Entering Streams and Waterbodies
- .0203: Access Road and Skid Trail Stream Crossings
- .0204: Access Road Entrances
- .0205: Prohibition of Waste Entering Streams, Waterbodies, and Groundwater
- .0206: Pesticide Application
- .0207: Fertilizer Application
- .0208: Stream Temperature
- .0209: Rehabilitation of Project Site

The NC Forest Service (NCFS) is delegated the authority to monitor and evaluate forestry operations for compliance with these aforementioned laws and/or rules. In addition, the NCFS works to resolve identified FPG compliance questions brought to its attention through citizen complaints. Violations of the FPG performance standards that cannot be resolved by the NCFS are referred to the appropriate State agency for enforcement action. During the period January 1, 2004 through December 31, 2010 there were 2,782 sites in the basin inspected for FPG compliance; approximately 95% of the sites were in compliance upon the initial site inspection.

Other Water Quality Regulations

In addition to the multiple State regulations noted above, NCFS monitors the implementation of the following Federal rules relating to water quality and forestry operations:

- The Section 404 silviculture exemption under the Clean Water Act for activities in wetlands;
- The federally-mandated 15 best management practices (BMPs) related to road construction in wetlands;
- The federally-mandated BMPs for mechanical site preparation activities for the establishment of pine plantations in wetlands of the southeastern U.S.

Water Quality Foresters

The entire river basin is included within the coverage area of a Water Quality Forester. Statewide, there is a Water Quality Forester position in 9 of NCFS 13 operating districts. Water Quality Foresters handle FPG inspection and follow-ups, assist with BMP implementation, develop pre-harvest plans, and provide training opportunities for landowners, loggers and the public regarding water quality issues related to forestry. These foresters also assist County Rangers on follow-up site inspections and provide enhanced technical assistance to local agency staff. Water Quality Foresters are the primary point of contact in their districts for responding to water quality or timber harvesting questions or concerns that are suspected to be related to forestry activities.

Forestry Best Management Practices

Implementing forestry Best Management Practices (BMPs) is strongly encouraged to efficiently and effectively protect the water resources of North Carolina. In 2006, the first ever revision to the North Carolina forestry BMP manual was completed. This comprehensive update to the forestry BMP manual is the result of nearly four years of effort by the NCFS and a forestry Technical Advisory Committee consisting of multiple sector stakeholders, supported by two

technical peer-reviews. The forestry BMP manual describes measures that may be implemented to help comply with the forestry regulations while protecting water quality. Copies of the forestry BMP manual can be obtained at a County or District office, or online.

In the basin during this period, the NCFS assisted with or observed more than 4,500 forestry activities in which BMPs were either implemented or recommended, encompassing a total area greater than 227,000 acres.

From 2006 to 2008, the NCFS conducted its second cycle of BMP implementation site assessment surveys to evaluate the use of forestry BMPs, and qualitatively assess the strengths and weaknesses of BMPs in regards to protecting water quality. In total, the BMP evaluations were completed on 212 active logging sites, with 23 sites located in this river basin. The statewide average BMP implementation rate observed during this survey was 85%, while the rate of BMP implementation on those sites located in this river basin was 84%. A copy of the survey report (PDF, 5MB) is available from the website. These periodic, recurring BMP surveys serve as a basis for focused efforts in the forestry community to address water quality concerns through better and more effective BMP development, implementation and training.

Protecting Stream Crossings with Bridgemats

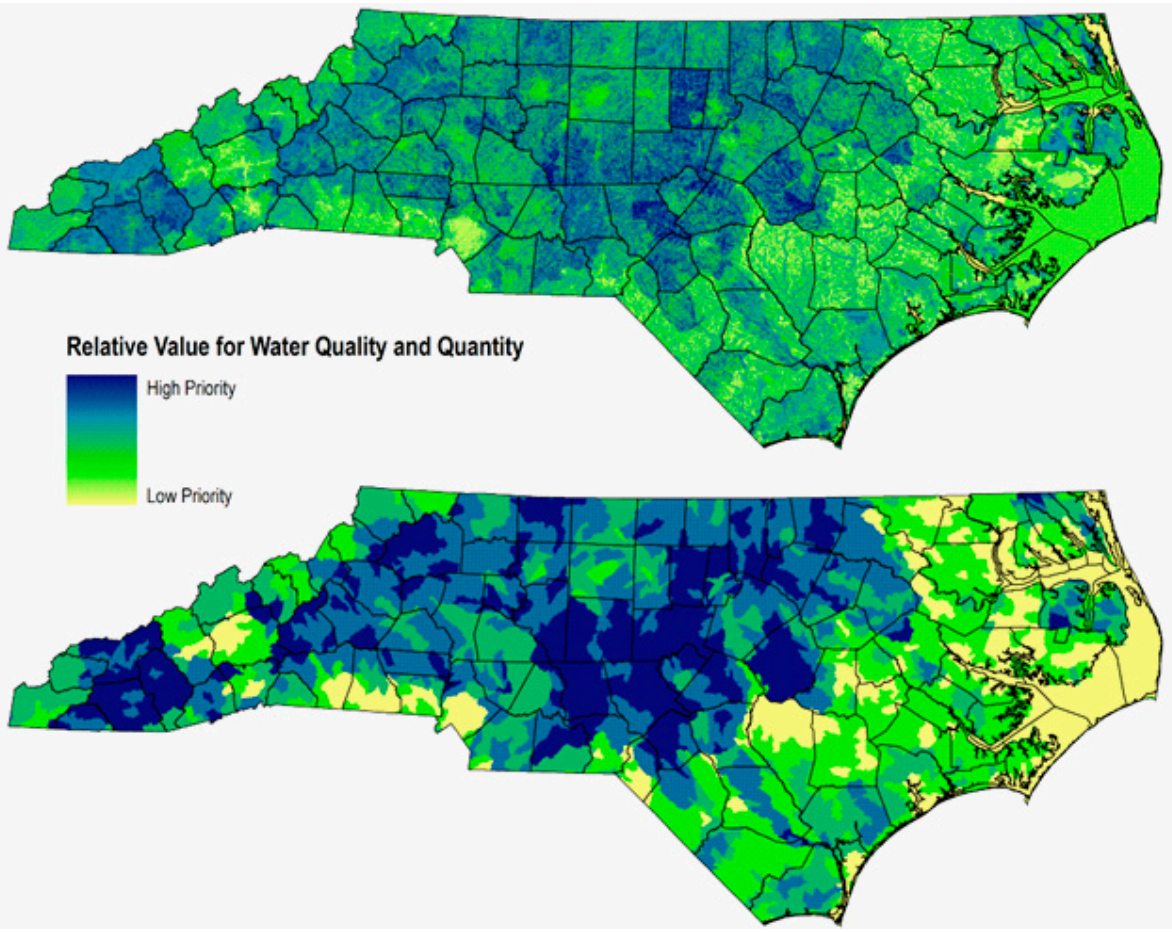
The NCFS provides bridgemats on loan to loggers for establishing temporary stream crossings during harvest activities in an effort to educate loggers about the benefits of installing crossings in this manner. Temporary bridges can be a very effective solution for stream crossings, since the equipment and logs stay completely clear of the water channel. Bridgemats are available for use in this river basin, and have been for several years. Periodic status reports, a list of bridgemat suppliers, and additional information are available on the NCFS Bridgemat webpage.

Forest Regeneration & Planning

Forest management is a valued and prevalent land-use across much of the river basin. As a testament to this, over 66,000 acres of land were established or regenerated with forest trees across the basin from January 1, 2004 through December 31, 2010. During this same time period, more than 4,300 individual forestry-related plans were produced for landowners, encompassing nearly 242,000 of forestland.

In 2010, a comprehensive long-range forest assessment and strategy report was completed, entitled North Carolina's Forest Resource Assessment-2010. This report includes an overall assessment of the state's forestland as well as strategies to promote long-term sustainability of the forests. As part of the assessment, a spatial analysis was conducted to identify forestlands that are critical for sustaining clean and abundant water supplies, and several sections of the Roanoke River basin were indicated as high priority (indicated by Figures 4f-8a and 4f-8b in the assessment report, Figure 7-1), including much of the Dan River system and portions of the central river basin near the existing lakes system. This statewide forest resource assessment is available on the 2010 NC Forest Assessment website.

FIGURE 7-1: PRIORITY FORESTS FOR WATER QUALITY AND QUANTITY, NCFS, D.JONES, 2010



BOTTOMLAND HARDWOOD/CYPRESS SWAMPS

Across the lower reach of the Roanoke River basin, (and elsewhere in North Carolina) there are prime examples of high-quality and highly productive bottomland hardwood/cypress swamps. These swamps have provided a sustainable source of wood fiber for well over 200 years, and served as the foundation for the creation of the forest products industry in eastern North Carolina. Since the settlement of North Carolina in colonial times, our forests have been harvested multiple times, including these hard-to-access swamps. Practically-speaking, it is inconceivable that any "old growth" or "virgin" timber remain in this region.

A diversity of forest tree species are adapted to grow in these bottomland swamps, some regenerating by seed and others primarily by sprouting from severed stumps. Nearly all swamp-adapted tree species require full sunlight to adequately regenerate, thus necessitating a removal of the shading overstory. The planting of trees to regenerate a swamp after a timber harvest is not commonly observed as a suitable or viable silviculture practice due to the cyclic nature of the hydrology in a specific swamp, fluctuations in the water table, and the obvious difficulty of site access for tree planting.

Management of a swamp forest is relatively passive when compared with pine or upland hardwood forest areas. Once the new stand of trees has successfully regenerated, there is usually little need to conduct intermediate stand treatments that might otherwise be suitable on pine or upland hardwood forests. Implementing a silviculturally-sound swamp timber harvest in a manner that minimizes soil and water impacts has shown to be the practical and viable prescription for forest management in swamps.

Regardless of the method used to harvest timber, measures should be taken to promote timely regeneration of native forest tree species in the harvested area. In addition, timber harvesting conducted during high water levels (such as flooding or seasonal high water tables) may create turbidity levels that can exceed natural background turbidity levels. Timber harvesting should ideally be conducted during relatively dry periods and should implement appropriate BMPs to minimize impacts to water and soil resources.

North Carolina Forest Service (NC-DFR) Contacts for the Roanoke River Basin:

Additional contact information, including specific counties, is available online.

Table 7-3: NC Division of Forestry Resources Contacts in the Roanoke River Basin

Office Location	Contact Person	Phone
Lexington District - D10 (upper Roanoke, Dan R.)	Water Quality Forester	(336) 956-2111
Hillsborough District - D11 (Caswell co. to Vance co.)	Water Quality Forester	(919) 732-8105
Rocky Mount District - D5 (Warren, Halifax, N-hampton co)	Water Quality Forester	(252) 442-1626
Elizabeth City District - D7 (lower Roanoke)	Water Quality Forester	(252) 331-4781
Eastern region - Region I	Asst. Regional Forester for Forest Management	(252) 520-2402
Central region - Region II	Asst. Regional Forester for Forest Management	(919) 542-1515
State Central Office, Raleigh	Nonpoint Source Branch - Forest Hydrologist	(919) 857-4856
Griffiths Forestry Center, Clayton	Water Quality & Wetlands Staff Forester	(919) 553-6178 Ext. 230

2010 Use Support & Methodology

In the Roanoke River Basin

2010 IR Category	Integrated Reporting Categories for individual Assessment Unit/Use Support Category/Parameter Assessments. A single AU can have multiple assessments depending on data available and classified uses.
1	All designated uses are monitored and supporting
1b	Designated use was impaired, other management strategy in place and no standards violations for the parameter of interest (POI)
1nc	DWQ have made field determination that parameter in exceedance is due to natural conditions
1r	Assessed as supporting watershed is in restoration effort status
1t	No criteria exceeded but approved TMDL for parameter of interest
2	Some designated uses are monitored and supporting none are impaired Overall only
2b	Designated use was impaired other management strategy in place and no standards violations Overall only
2r	Assessed as supporting watershed is in restoration effort status overall only
2t	No criteria exceeded but approved TMDL for POI Overall only
3a	Instream/monitoring data are inconclusive (DI)
3b	No Data available for assessment
3c	No data or information to make assessment
3n1	Chlorophyll a exceeds TL value and SAC is met-draft
3n2	Chlorophyll a exceeds EL value and SAC is not met first priority for further monitoring-draft
3n3	Chlorophyll a exceeds threshold value and SAC is not met first second priority for further monitoring-draft
3n4	Chlorophyll a not available determine need to collect-draft
3t	No Data available for assessment –AU is in a watershed with an approved TMDL
4b	Designated use impaired other management strategy expected to address impairment
4c	Designated use impaired by something other than pollutant
4cr	Recreation use impaired no instream monitoring data or screening criteria exceeded
4cs	Shellfish harvesting impaired no instream monitoring data-no longer used
4ct	Designated use impaired but water is subject to approved TMDL or under TMDL development
4s	Impaired Aquatic Life with approved TMDL for Aquatic Life POI or category 5 listing
4t	Designated use impaired approved TMDL
5	Designated use impaired because of biological or ambient water quality standards violations and needing a TMDL
5r	Assessed as impaired watershed is in restoration effort status

NC 2010 Integrated Report

All 13,123 Waters in NC are in Category 5-303(d) List for Mercury due to statewide fish consumption advice for several fish species

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Roanoke River Basin — **Grassy Creek-John H Kerr Reservoir Watershed** — **0301010208**

Roanoke River Basin — ı H Kerr Reservoir-Roanoke River Subbasin — 03010102

Roanoke River Basin — **Grassy Creek-John H Kerr Reservoir Watershed** — **0301010208**

⊙ **23-2-(1)**	**Grassy Creek (Grass Creek)**	From source to John H. Kerr Reservoir at Granville County SR 1431	**18.3 FW Miles**		C
3a	**Ecological/biological Integrity Benthos**	Not Rated Bioclassification	Aquatic Life	2004	
⊙ **23-2-7-(1)**	**Johnson Creek**	From source to Little Johnson Creek	**5.3 FW Miles**		C
1	**Ecological/biological Integrity FishCom**	Good-Fair Bioclassification	Aquatic Life	2004	
⊙ **23-2-3**	**Mountain Creek**	From source to Grassy Creek	**8.1 FW Miles**		C
3a	**Ecological/biological Integrity Benthos**	Not Rated Bioclassification	Aquatic Life	2004	
⊙ **23-2-5**	**Rattlesnake Creek**	From source to Grassy Creek	**2.3 FW Miles**		C
1	**Ecological/biological Integrity Benthos**	Not Impaired Bioclassification	Aquatic Life	2005	

Roanoke River Basin — **Butcher Creek-John H Kerr Reservoir Watershed** — **0301010209**

⊙ **23-4**	**Island Creek (Island Creek Reservoir)**	From source to North Carolina-Virginia State Line, including that portion of Island Creek Reservoir in North Carolina below normal operating elevation	**6.4 FW Miles**		C
1	**Ecological/biological Integrity Benthos**	Good-Fair Bioclassification	Aquatic Life	2004	
⊙ **23-4-3**	**Little Island Creek (Vance County)**	From source to Island Creek Reservoir, Island Creek	**11.8 FW Miles**		C
3a	**Ecological/biological Integrity FishCom**	Not Rated Bioclassification	Aquatic Life	2004	

Roanoke River Basin — **Nutbush Creek-John H Kerr Reservoir Watershed** — **0301010210**

⊙ **23-8-(1)a**	**Nutbush Creek (Including Nutbush Creek Arm of John H. Kerr Reservoir below normal pool elevation)**	From source to NC 39	**1.7 FW Miles**		C
5	**Ecological/biological Integrity Benthos**	Fair Bioclassification	Aquatic Life	1994	1998

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AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Roanoke River Basin — **Nutbush Creek-John H Kerr Reservoir Watershed** — **0301010210**

⊙ **23-8-(1)b**	**Nutbush Creek (Including Nutbush Creek Arm of John H. Kerr Reservoir below normal pool elevation)**	From NC 39 to SR 1317	**1.6**	**FW Miles**	C

5	**Ecological/biological Integrity Benthos**	Fair Bioclassification	Aquatic Life	2004	1998
5	**Ecological/biological Integrity FishCom**	Fair Bioclassification	Aquatic Life	2004	1998
1	**Fecal Coliform (recreation)**	No Criteria Exceeded	Recreation	2008	
1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	

⊙ **23-8-(2)**	**Nutbush Creek Arm of John H. Kerr Reservoir (below normal pool elevation 300 feet MSL or as this elevation may be adjusted by the Corps of Engineers)**	From Crooked Run to North Carolina-Virginia State Line	**9,690.1**	**FW Acres**	B

1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	

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AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Roanoke River Basin — **Little Dan River-Dan River Watershed** — **0301010301**

Roanoke River Basin — Dan River Headwaters Subbasin — 03010103

Roanoke River Basin — **Little Dan River-Dan River Watershed** — **0301010301**

⊙	**22-2**	**Archies Creek**	North Carolina portion	**7.3**	**FW Miles**	C;Tr
1	**Ecological/biological Integrity FishCom**	Excellent Bioclassification	Aquatic Life	2004		
⊙	**22-9**	**Big Creek**	From source to Dan River	**19.9**	**FW Miles**	C;Tr
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004		
⊙	**22-12-(2)b**	**Cascade Creek**	From dam at swimming lake to Dan River	**4.3**	**FW Miles**	B
1	**Ecological/biological Integrity Benthos**	Not Impaired Bioclassification	Aquatic Life	2005		
⊙	**22-12-(2)a**	**Cascade Creek (Hanging Rock Lake)**	From backwaters to dam at swimming lake	**12.2**	**FW Acres**	B
1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008		
⊙	**22-(1)a**	**DAN RIVER (North Carolina portion)**	From North Carolina-Virginia State Line to Little Dan River	**5.1**	**FW Miles**	C;Tr
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004		
⊙	**22-(1)b**	**DAN RIVER (North Carolina portion)**	From Little Dan River to Peters Creek	**11.6**	**FW Miles**	C;Tr
1	**Ecological/biological Integrity Benthos**	Excellent Bioclassification	Aquatic Life	2004		
1	**Fecal Coliform (recreation)**	No Criteria Exceeded	Recreation	2008		
3a	**High Water Temperature**	Potential Standards Violation	Aquatic Life	2008		
5	**Turbidity**	Standard Violation	Aquatic Life	2008		2008
⊙	**22-5**	**Elk Creek**	From North Carolina-Virginia State Line to Dan River	**2.9**	**FW Miles**	C;Tr
1	**Ecological/biological Integrity FishCom**	Good-Fair Bioclassification	Aquatic Life	2004		
⊙	**22-13-(2)**	**Indian Creek**	From Window Falls to Dan River	**2.7**	**FW Miles**	C
1	**Ecological/biological Integrity Benthos**	Not Impaired Bioclassification	Aquatic Life	2005		
⊙	**22-18**	**Mill Creek**	From source to Dan River	**4.7**	**FW Miles**	C
1	**Ecological/biological Integrity Benthos**	Not Impaired Bioclassification	Aquatic Life	2005		
⊙	**22-10**	**North Double Creek**	From source to Dan River	**14.0**	**FW Miles**	C
1	**Ecological/biological Integrity Benthos**	Good Bioclassification	Aquatic Life	2004		
1	**Ecological/biological Integrity FishCom**	Good-Fair Bioclassification	Aquatic Life	2004		
⊙	**22-6**	**Peters Creek**	From North Carolina-Virginia State Line to Dan River	**9.1**	**FW Miles**	C;Tr
1	**Ecological/biological Integrity FishCom**	Excellent Bioclassification	Aquatic Life	2004		

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Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Roanoke River Basin — **Little Dan River-Dan River Watershed** — **0301010301**

22-11	**South Double Creek**	From source to Dan River	**9.9**	**FW Miles**	B
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	

Roanoke River Basin — **Town Fork Creek Watershed** — **0301010302**

22-25-1	**Brushy Fork Creek**	From source to Town Fork Creek	**3.0**	**FW Miles**	C
1	**Ecological/biological Integrity Benthos**	Good Bioclassification	Aquatic Life	2004	
22-25a	**Town Fork Creek**	From source to Timmons Cr.	**8.0**	**FW Miles**	C
1	**Ecological/biological Integrity Benthos**	Good Bioclassification	Aquatic Life	2004	
22-25b	**Town Fork Creek**	From Timmons Cr. to Dan River	**18.0**	**FW Miles**	C
1	**Ecological/biological Integrity Benthos**	Good Bioclassification	Aquatic Life	2004	
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	

Roanoke River Basin — **Belews Lake-Dan River Watershed** — **0301010303**

22-27-(7)	**Belews Creek (including Belews Lake below elevation 725) (1)**	From Southern Railroad Bridge to to a point 1.8 mile downstream of Forsyth-Stokes County Line	**789.7**	**FW Acres**	C
1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	
22-27-(7.5)	**Belews Creek (including Belews Lake below elevation 725) (1)**	From a point 1.8 mile downstream of the Forsyth-Stokes County Line to Dan River, excluding the Arm of Belews Lake described below which are classified "WS-IV&B"	**1,283.8**	**FW Acres**	WS-IV
1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	
1	**Water Quality Standards Water Supply**	No Criteria Exceeded	Water Supply	2008	
22-27-(1.5)	**Belews Creek (Kernersville Lake)**	From a point 0.5 mile upstream of backwaters of Kernersville Lake to Town of Kernersville Water Supply Dam	**46.1**	**FW Acres**	WS-IV;CA
3n	**Chlorophyll a**	Potential Standards Violation	Aquatic Life	2008	
1	**Water Quality Standards Water Supply**	No Criteria Exceeded	Water Supply	2008	
22-29	**Big Beaver Island Creek**	From source to Dan River	**15.2**	**FW Miles**	C
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	
22-(8)	**DAN RIVER**	From Big Creek to to a point 0.2 mile downstream of Town Fork Creek	**25.9**	**FW Miles**	WS-V
1	**Ecological/biological Integrity Benthos**	Good Bioclassification	Aquatic Life	2004	

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Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Roanoke River Basin — **Belews Lake-Dan River Watershed** — **0301010303**

22-20-9	**Lynn Branch (Lynn Creek)**	From source to Snow Creek	**3.1**	**FW Miles**	C
1	**Ecological/biological Integrity Benthos**	Not Impaired Bioclassification	Aquatic Life	2005	
22-20-4	**Raccoon Creek**	From source to Snow Creek	**3.4**	**FW Miles**	C
1	**Ecological/biological Integrity Benthos**	Not Impaired Bioclassification	Aquatic Life	2005	
22-20	**Snow Creek**	From source to Dan River	**18.9**	**FW Miles**	C
1	**Ecological/biological Integrity Benthos**	Good Bioclassification	Aquatic Life	2004	
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	
22-27-9-(4)	**West Belews Creek (West Belews Creek Arm of of Belews Lake below elevation 725)**	From a point 0.4 mile downstream of Powerplant to Belews Creek	**582.4**	**FW Acres**	WS-IV
1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	
1	**Water Quality Standards Water Supply**	No Criteria Exceeded	Water Supply	2008	
22-21	**Wood Benton Branch**	From source to Dan River	**3.7**	**FW Miles**	C
1	**Ecological/biological Integrity Benthos**	Not Impaired Bioclassification	Aquatic Life	2005	

Roanoke River Basin — **Mayo River Watershed** — **0301010304**

22-30-2-2	**Crooked Creek (North Carolina portion)**	From source to last crossing of North Carolina-Virginia State Line	**8.5**	**FW Miles**	C
1	**Ecological/biological Integrity FishCom**	Good-Fair Bioclassification	Aquatic Life	2007	
1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	
22-30-5	**Hickory Creek**	From source to Mayo River	**4.0**	**FW Miles**	C
1	**Ecological/biological Integrity Benthos**	Not Impaired Bioclassification	Aquatic Life	2006	
22-30-2-2-2	**Little Crooked Creek**	From source to Crooked Creek	**4.7**	**FW Miles**	C
1	**Ecological/biological Integrity Benthos**	Good Bioclassification	Aquatic Life	2008	
22-30-(1)	**Mayo River**	From North Carolina-Virginia State Line to a point 0.6 mile downstream of Hickory Creek	**3.5**	**FW Miles**	WS-V
1	**Ecological/biological Integrity Benthos**	Good Bioclassification	Aquatic Life	2004	
1	**Fecal Coliform (recreation)**	No Criteria Exceeded	Recreation	2008	
1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	
1	**Water Quality Standards Water Supply**	No Criteria Exceeded	Water Supply	2008	

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Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Roanoke River Basin — **Mayo River Watershed** — **0301010304**

22-30-6-(2)	**Pawpaw Creek**	From a point 1.3 mile upstream of Rockingham County SR 1360 to Mayo R.	**1.8**	**FW Miles**	WS-IV

1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	

Roanoke River Basin — **Matrimony Creek-Dan River Watershed** — **0301010305**

22-32-1	**Brushy Creek (West Prong Jacobs Creek)**	From source to Jacobs Creek	**4.3**	**FW Miles**	C

1	**Ecological/biological Integrity Benthos**	Not Impaired Bioclassification	Aquatic Life	2007	

22-(31.5)a	**DAN RIVER**	From a point 0.7 mile upstream of Jacobs Creek to subbasin 03-02-02/03 boundary	**4.8**	**FW Miles**	WS-IV

4t	**Fecal Coliform (recreation)**	No Criteria Exceeded	Recreation	2008	2008
4t	**Turbidity**	Data Inconclusive	Aquatic Life	2008	2002
1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	
1	**Water Quality Standards Water Supply**	No Criteria Exceeded	Water Supply	2008	

22-(31.5)b	**DAN RIVER**	From 03-02-02 boundary to a point 0.8 mile downstream of Matrimony Creek	**9.4**	**FW Miles**	WS-IV

4t	**Fecal Coliform (recreation)**	Standard Violation	Recreation	2008	2008
4t	**Turbidity**	Data Inconclusive	Aquatic Life	2008	2002
1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	
1	**Water Quality Standards Water Supply**	No Criteria Exceeded	Water Supply	2008	

22-(38.5)	**DAN RIVER**	From a point 0.8 mile downstream of Matrimony Creek to Mill Branch (Town of Eden water supply intake)	**0.6**	**FW Miles**	WS-IV;CA

4t	**Fecal Coliform (recreation)**	Standard Violation	Recreation	2008	2008
5	**Turbidity**	Standard Violation	Aquatic Life	2008	2008

22-31	**Hogans Creek**	From source to Dan River	**12.7**	**FW Miles**	C

1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	

22-32-(3)	**Jacobs Creek**	From N.C. Hwy. 704 to Dan River	**1.8**	**FW Miles**	WS-IV

1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	

22-38	**Matrimony Creek (North Carolina portion)**	From source to Dan River	**11.2**	**FW Miles**	WS-IV

1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	

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Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Roanoke River Basin — Matrimony Creek-Dan River Watershed — 0301010305

⊙ 22-30-(10)	Mayo River	From dam at Mayodan Water Supply Intake to Dan River	2.4	FW Miles	C
1	Ecological/biological Integrity Benthos	Good-Fair Bioclassification	Aquatic Life	1999	
⊙ 22-34-(2)	Rock House Creek	From Rockingham Countly SR 2381 to Dan River	6.5	FW Miles	WS-IV
1	Ecological/biological Integrity Benthos	Good-Fair Bioclassification	Aquatic Life	2001	
1	Ecological/biological Integrity FishCom	Good Bioclassification	Aquatic Life	2004	

Roanoke River Basin — Lower Smith River Watershed — 0301010308

⊙ 22-40-(1)	Smith River	From North Carolina-Virginia State Line to a point 0.8 mile downstream of Rockingham County SR 1714 (Aiken Road)	2.8	FW Miles	WS-IV
5	Copper	Standard Violation	Aquatic Life	2008	2008
4s	Ecological/biological Integrity Benthos	Fair Bioclassification	Aquatic Life	1999	2008
4t	Fecal Coliform (recreation)	Standard Violation	Recreation	2008	2008
1	Water Quality Standards Water Supply	No Criteria Exceeded	Water Supply	2008	
⊙ 22-40-(2.5)	Smith River	From a point 0.8 mile downstream of Rockingham County SR 1714 (Aiken Road) to Fieldcrest Mills Water Supply Intake	0.5	FW Miles	WS-IV;CA
5	Copper	Standard Violation	Aquatic Life	2008	2008
4s	Ecological/biological Integrity Benthos	Fair Bioclassification	Aquatic Life	1999	2008
4t	Fecal Coliform (recreation)	Standard Violation	Recreation	2008	2008
1	Water Quality Standards Water Supply	No Criteria Exceeded	Water Supply	2008	

Roanoke River Basin — Cascade Creek-Dan River Watershed — 0301010309

⊙ 22-48-4	Birch Fork	From source to Wolf Island Creek	8.4	FW Miles	C
1	Ecological/biological Integrity Benthos	Not Impaired Bioclassification	Aquatic Life	2007	
⊙ 22-(39)a	DAN RIVER (North Carolina portion)	From Mill Branch to NC/VA crossing downstream of Wolf Island Creek	13.8	FW Miles	C
4t	Fecal Coliform (recreation)	Standard Violation	Recreation	2008	2008
5	Turbidity	Standard Violation	Aquatic Life	2008	2008
⊙ 22-40-(3)	Smith River	From Fieldcrest Mills Water Supply Intake to Dan River	1.8	FW Miles	C
5	Copper	Standard Violation	Aquatic Life	2008	2008
4s	Ecological/biological Integrity Benthos	Fair Bioclassification	Aquatic Life	1999	2008
4t	Fecal Coliform (recreation)	Standard Violation	Recreation	2008	2008

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AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Roanoke River Basin — **Cascade Creek-Dan River Watershed** — **0301010309**

◉ **22-48**	**Wolf Island Creek**	From source to Dan River	**21.8**	**FW Miles**	C
1	**Ecological/biological Integrity FishCom**	Excellent Bioclassification	Aquatic Life	2004	

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AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Roanoke River Basin — **Hogans Creek-Dan River Watershed** — **0301010401**

Roanoke River Basin — Dan River Subbasin — 03010104

Roanoke River Basin — **Hogans Creek-Dan River Watershed** — **0301010401**

⊙	**22-54**	**Cane Creek**	From North Carolina-Virginia State Line to Dan River	**0.8 FW Miles**	C
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	
⊙	**22-(39)b**	**DAN RIVER (North Carolina portion)**	From NC/VA crossing downstream of Wolf Island Creek to last crossing of North Carolina-Virginia State Line	**9.6 FW Miles**	C
4t	**Fecal Coliform (recreation)**	Standard Violation	Recreation	2008	2008
5	**Turbidity**	Standard Violation	Aquatic Life	2008	2008
⊙	**22-50**	**Hogans Creek**	From source to Dan River	**29.1 FW Miles**	C
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	
⊙	**22-50-3**	**Jones Creek (Lake Wade)**	From source to Hogans Creek	**7.6 FW Miles**	C
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	
⊙	**22-51**	**Moon Creek (Wildwood Lake)**	From source to Dan River	**17.0 FW Miles**	C
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	
⊙	**22-52**	**Rattlesnake Creek**	From source to Dan River	**2.7 FW Miles**	C
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	

Roanoke River Basin — **Country Line Creek Watershed** — **0301010402**

⊙	**22-56-(1)**	**Country Line Creek**	From source to a point 0.5 mile upstream of mouth of Nats Fork	**10.5 FW Miles**	WS-II;HQW
1	**Ecological/biological Integrity Benthos**	Good Bioclassification	Aquatic Life	2004	
⊙	**22-56-(3.7)**	**Country Line Creek**	From dam at Farmer Lake to Dan River	**24.5 FW Miles**	C
1	**Ecological/biological Integrity Benthos**	Good Bioclassification	Aquatic Life	2004	
⊙	**22-56-(3.5)a**	**Country Line Creek (Farmers Lake)**	Upper reservoir- From a point 0.5 mile upstream of mouth Nats Fork to dam at Farmer Lake (Town of Yanceyville water supply intake located 1.8 mile upstream of N.C. Hwy. 62)	**90.7 FW Acres**	WS-II;HQW,CA
5	**Chlorophyll a**	Standard Violation	Aquatic Life	2008	2010
5	**Turbidity**	Standard Violation	Aquatic Life	2008	2010
1	**Water Quality Standards Water Supply**	No Criteria Exceeded	Water Supply	2008	

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AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Roanoke River Basin — Country Line Creek Watershed 0301010402

22-56-(3.5)b	Country Line Creek (Farmers Lake)	Lower reservoir-From a point 0.5 mile upstream of mouth Nats Fork to dam at Farmer Lake (Town of Yanceyville water supply intake located 1.8 mile upstream of N.C. Hwy. 62)	271.1	FW Acres	WS-II;HQW,CA

1	Water Quality Standards Aquatic Life	No Criteria Exceeded	Water Supply	2008	
1	Water Quality Standards Water Supply	No Criteria Exceeded	Water Supply	2008	

Roanoke River Basin — Hyco Lake Watershed 0301010405

22-58-1	Hyco Creek (North Hyco Creek)	From source to Hyco Lake, Hyco River	16.8	FW Miles	C

3a	Ecological/biological Integrity FishCom	Not Rated Bioclassification	Aquatic Life	2004	

22-58-(0.5)	Hyco River, including Hyco Lake below elevation 410	From source in Hyco Lake to dam of Hyco Lake, including tributary arms below elevation 410	4,297.9	FW Acres	WS-V,B

1	Water Quality Standards Aquatic Life	No Criteria Exceeded	Aquatic Life	2008	
1	Water Quality Standards Water Supply	No Criteria Exceeded	Water Supply	2008	

22-58-4-(3)	South Hyco Creek	From a point 0.6 mile downstream of Double Creek to Hyco Lake, Hyco River (City of Roxboro water supply intake)	0.7	FW Miles	WS-II;HQW,CA

1	Ecological/biological Integrity FishCom	Good Bioclassification	Aquatic Life	2004	

22-58-4-(1.4)	South Hyco Creek (Lake Roxboro)	From backwaters of Lake Roxboro to dam at Lake Roxboro	493.6	FW Acres	WS-II,B;HQW

3n	Chlorophyll a	Potential Standards Violation	Aquatic Life	2008	
1	Water Quality Standards Water Supply	No Criteria Exceeded	Water Supply	2008	

Roanoke River Basin — Hyco River Watershed 0301010406

22-58-(9.5)	Hyco River	From dam of Hyco Lake to North Carolina-Virginia State Line, including all portions in North Carolina	6.8	FW Miles	C

1	Fecal Coliform (recreation)	No Criteria Exceeded	Recreation	2008	
1	Water Quality Standards Aquatic Life	No Criteria Exceeded	Aquatic Life	2008	

22-58-12-6a	Marlowe Creek	From source to Mitchell Creek	6.6	FW Miles	C

5	Ecological/biological Integrity Benthos	Fair Bioclassification	Aquatic Life	2004	1998

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AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Roanoke River Basin — **Hyco River Watershed** — **0301010406**

22-58-12-6b	**Marlowe Creek**	From Mithcell Creek to Storys Creek	**4.5**	**FW Miles**	C

5	**Copper**	Standard Violation	Aquatic Life	2008	2008
1	**Ecological/biological Integrity Benthos**	Good-Fair Bioclassification	Aquatic Life	2004	
1	**Ecological/biological Integrity FishCom**	Good-Fair Bioclassification	Aquatic Life	2004	
1	**Fecal Coliform (recreation)**	No Criteria Exceeded	Recreation	2008	
5	**Zinc**	Standard Violation	Aquatic Life	2008	2008

22-58-15-(3.5)	**Mayo Creek (Maho Creek)**	From dam of Mayo Reservoir to North Carolina-Virginia State Line	**0.5**	**FW Miles**	C

1	**Fecal Coliform (recreation)**	No Criteria Exceeded	Recreation	2008	
1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	

22-58-15-(0.5)	**Mayo Creek (Maho Creek) (Mayo Reservoir)**	From source to dam of Mayo Reservoir	**2,613.8**	**FW Acres**	WS-V

1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	
1	**Water Quality Standards Water Supply**	No Criteria Exceeded	Water Supply	2008	

22-58-12-(1.5)	**Storys Creek [Roxboro City Lake (Lake Issac Walton)]**	From a point 0.9 mile downstream of N.C. Hwy. 57 to Roxboro City Lake Dam	**189.5**	**FW Acres**	WS-II;HQW,CA

1	**Water Quality Standards Water Supply**	No Criteria Exceeded	Water Supply	2008	

Roanoke River Basin — **Aarons Creek-Dan River Watershed** — **0301010407**

22-59	**Aarons Creek**	From source to North Carolina-Virginia State Line	**8.6**	**FW Miles**	C

1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	

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AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Roanoke River Basin — **Upper Lake Gaston-Roanoke River Watershed** — **0301010602**

Roanoke River Basin — Lake Gaston-Roanoke River Subbasin — 03010106

Roanoke River Basin — **Upper Lake Gaston-Roanoke River Watershed** — **0301010602**

23-10-2 **Newmans Creek (Little Deep Creek)** — From source to Smith Creek — **6.1 FW Miles** C

5	Ecological/biological Integrity Benthos	Fair Bioclassification	Aquatic Life	2004	2008

23-10a **Smith Creek** — From source to Cabin Branch — **6.1 FW Miles** C

4s	Ecological/biological Integrity Benthos	Fair Bioclassification	Aquatic Life	2004	2002
5	Low Dissolved Oxygen	Standard Violation	Aquatic Life	2008	1998

23-10b **Smith Creek** — From Cabin Branch to SR1208 — **1.6 FW Miles** C

1	Ecological/biological Integrity Benthos	Good-Fair Bioclassification	Aquatic Life	2004	
5	Low Dissolved Oxygen	Standard Violation	Aquatic Life	2008	1998

23-10c **Smith Creek** — From SR1208 to North Carolina-Virginia State Line — **3.0 FW Miles** C

4s	Ecological/biological Integrity Benthos	Fair Bioclassification	Aquatic Life	2004	
4s	Ecological/biological Integrity FishCom	Fair Bioclassification	Aquatic Life	2004	
1	Fecal Coliform (recreation)	No Criteria Exceeded	Recreation	2008	
5	Low Dissolved Oxygen	Standard Violation	Aquatic Life	2008	1998

23-10-3-2 **Terrapin Creek** — From source to Blue Mud Creek — **5.0 FW Miles** C

3a	Ecological/biological Integrity Benthos	Not Rated Bioclassification	Aquatic Life	2007	

Roanoke River Basin — **Middle Lake Gaston-Roanoke River Watershed** — **0301010603**

23-14 **Jordan Creek** — From source to Lake Gaston, Roanoke River — **2.6 FW Miles** C

1	Ecological/biological Integrity Benthos	Not Impaired Bioclassification	Aquatic Life	2006	

23-13 **Sixpound Creek** — From source to Lake Gaston, Roanoke River — **6.3 FW Miles** C

1	Ecological/biological Integrity Benthos	Good-Fair Bioclassification	Aquatic Life	2004	

Roanoke River Basin — **Lower Lake Gaston-Roanoke River Watershed** — **0301010604**

23-24-(1) **Deep Creek** — From source to a point 0.5 mile upstream of mouth — **11.6 FW Miles** WS-IV

1	Ecological/biological Integrity Benthos	Natural Bioclassification	Aquatic Life	2004	
1	Ecological/biological Integrity FishCom	Good Bioclassification	Aquatic Life	2004	

23-19 **Little Stonehouse Creek** — From source to Lake Gaston, Roanoke River — **2.8 FW Miles** C

1	Ecological/biological Integrity Benthos	Not Impaired Bioclassification	Aquatic Life	2006	

NC 2010 Integrated Report

All 13,123 Waters in NC are in Category 5-303(d) List for Mercury due to statewide fish consumption advice for several fish species

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Roanoke River Basin — **Lower Lake Gaston-Roanoke River Watershed** — **0301010604**

⊙ **23-(22.5)**	**ROANOKE RIVER (Lake Gaston below normal full power pool elevation 200 MSL and Roanoke Rapids Lake below normal full power pool elevation 132 feet MSL)**	From a line across Lake Gaston 0.5 mile upstream of Lake Gaston Dam to Roanoke Rapids Dam	**4,185.0 FW Acres**	WS-IV,B;CA	

3t	**Aquatic Weeds**	Data Inconclusive	Aquatic Life	2000	2000
1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	
1	**Water Quality Standards Water Supply**	No Criteria Exceeded	Water Supply	2008	

⊙ **23-(12)**	**ROANOKE RIVER (Lake Gaston below normal full power pool elevation 200 MSL)**	From North Carolina-Virginia State Line to a line across Lake Gaston following the Warren-Northampton County Line	**7,964.8 FW Acres**	WS-V,B

1	**Water Quality Standards Water Supply**	No Criteria Exceeded	Water Supply	2008	

⊙ **23-(20.2)**	**ROANOKE RIVER (Lake Gaston below normal full power pool elevation 200 MSL)**	From a line across Lake Gaston following the Warren-Northampton County Line to a line across Lake Gaston 0.5 mile upstream of Lake Gaston Dam	**3,974.4 FW Acres**	WS-IV,B

1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	
1	**Water Quality Standards Water Supply**	No Criteria Exceeded	Water Supply	2008	

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AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Roanoke River Basin — **Quankey Creek-Roanoke River Watershed** — **0301010701**

Roanoke River Basin — Roanoke River Subbasin — 03010107

Roanoke River Basin — **Quankey Creek-Roanoke River Watershed** — **0301010701**

23-29	**Chockoyotte Creek**	From source to Roanoke River	**10.6 FW Miles**	C	
1	**Ecological/biological Integrity Benthos**	Moderate Bioclassification	Aquatic Life	2004	
3a	**Ecological/biological Integrity FishCom**	Not Rated Bioclassification	Aquatic Life	2004	
23-30-1	**Little Quankey Creek**	From source to Quankey Creek	**9.5 FW Miles**	C	
1	**Ecological/biological Integrity Benthos**	Moderate Bioclassification	Aquatic Life	2004	
23-30a	**Quankey Creek**	From source to Little Quankey Creek	**16.0 FW Miles**	C	
1	**Ecological/biological Integrity Benthos**	Natural Bioclassification	Aquatic Life	2004	
23-30b	**Quankey Creek**	From Little Quankey Creek to Roanoke River	**3.4 FW Miles**	C	
5	**Ecological/biological Integrity Benthos**	Fair Bioclassification	Aquatic Life	1999	1998
23-(25.5)	**ROANOKE RIVER**	From a point 0.6 mile upstream of N.C. Hwy. 48 bridge to a line across river 50 feet downstream of N.C. Hwy. 48 (City of Roanoke Rapids, Town of Weldon water supply intakes)	**1.7 FW Miles**	WS-IV;CA	
1	**Fecal Coliform (recreation)**	No Criteria Exceeded	Recreation	2008	
1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	
1	**Water Quality Standards Water Supply**	No Criteria Exceeded	Water Supply	2008	
23-(26)a	**ROANOKE RIVER**	From a line across the river 50 ft downstream of NC Hwy 48 bridge to the confluence of Sandy Run Cr at the Bertie Northampton Halifax Co. line	**50.1 FW Miles**	C	
1	**Fecal Coliform (recreation)**	No Criteria Exceeded	Recreation	2008	
1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	

Roanoke River Basin — **Conoconnara Swamp-Roanoke River Watershed** — **0301010702**

23-33	**Conoconnara Swamp**	From source to Roanoke River	**17.7 FW Miles**	C	
1	**Ecological/biological Integrity Benthos**	Moderate Bioclassification	Aquatic Life	2004	

Roanoke River Basin — **Kehukee Swamp-Roanoke River Watershed** — **0301010703**

23-42	**Kehukee Swamp (White Millpond)**	From source to Roanoke River	**10.6 FW Miles**	C	
1	**Ecological/biological Integrity Benthos**	Moderate Bioclassification	Aquatic Life	2004	

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AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Roanoke River Basin — Kehukee Swamp-Roanoke River Watershed — 0301010703

23-(26)b1	ROANOKE RIVER	From the confluence of Sandy Run Cr at the Bertie/Northampton/Halifax Co. line to subbasin 8/9 boundary	24.8	FW Miles	C
1 Fecal Coliform (recreation)	No Criteria Exceeded	Recreation	2008		
1 Water Quality Standards Aquatic Life	No Criteria Exceeded	Aquatic Life	2008		

Roanoke River Basin — Sweetwater Creek Watershed — 0301010704

23-50-3	Hardison Mill Creek	From source to Sweetwater Creek	19.9	FW Miles	C
1 Ecological/biological Integrity Benthos	Moderate Bioclassification	Aquatic Life	2004		

Roanoke River Basin — Conoho Creek-Roanoke River Watershed — 0301010705

23-49a	Conoho Creek	From source to Martin Co 1417 below Beaverdam Cr	24.5	FW Miles	C
1 Ecological/biological Integrity Benthos	Moderate Bioclassification	Aquatic Life	2004		
23-49b	Conoho Creek	From Martin Co 1417 to Roanoke River	7.0	FW Miles	C
1 Ecological/biological Integrity Benthos	Natural Bioclassification	Aquatic Life	2004		
23-(26)b2	ROANOKE RIVER	From subbasin 8/9 boundary to Hwy 17 Bridge in Williamston	28.9	FW Miles	C
1 Fecal Coliform (recreation)	No Criteria Exceeded	Recreation	2008		
1 Water Quality Standards Aquatic Life	No Criteria Exceeded	Aquatic Life	2008		
23-(26)b3	ROANOKE RIVER	From Hwy 17 bridge at Williamston to the 18 mile marker at Jamesville	17.8	FW Miles	C
5 Low Dissolved Oxygen	Standard Violation	Aquatic Life	2006	2008	

Roanoke River Basin — Headwaters Cashie River Watershed — 0301010707

24-2-(1)a	Cashie River	From source to Bertie County SR 1225	15.2	FW Miles	C;Sw
1 Ecological/biological Integrity Benthos	Moderate Bioclassification	Aquatic Life	2004		
1 Fecal Coliform (recreation)	No Criteria Exceeded	Recreation	2008		
1 Water Quality Standards Aquatic Life	No Criteria Exceeded	Aquatic Life	2008		

Roanoke River Basin — Outlet Cashie River Watershed — 0301010708

24-2-(1)b	Cashie River	From Bertie County SR 1225 to a point 1 mile upstream from Bertie Co. SR 1500	30.1	FW Miles	C;Sw
1 Ecological/biological Integrity Benthos	Natural Bioclassification	Aquatic Life	2004		
24-2-6	Hoggard Mill Creek	From source to Cashie River	7.4	FW Miles	C;Sw
1 Ecological/biological Integrity Benthos	Moderate Bioclassification	Aquatic Life	2004		
24-2-7	Roquist Creek	From source to Cashie River	26.3	FW Miles	C;Sw
1 Ecological/biological Integrity Benthos	Natural Bioclassification	Aquatic Life	2004		

Roanoke River Basin — Plymouth-Roanoke River Watershed — 0301010709

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AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Roanoke River Basin — **Plymouth-Roanoke River Watershed 0301010709**

23-(53)	**ROANOKE RIVER**	From 18 mile marker at Jamesville to Albemarle Sound (Batchelor Bay)	**18.3 FW Miles**	C;Sw	
4t	**Dioxin**	Standard Violation	Fish Consumption	2008	2000
1	**Fecal Coliform (recreation)**	No Criteria Exceeded	Recreation	2008	
1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	
23-55	**Welch Creek**	From source to Roanoke River	**13.3 FW Miles**	C;Sw	
4t	**Dioxin**	Standard Violation	Fish Consumption	1996	2000
1	**Fecal Coliform (recreation)**	No Criteria Exceeded	Recreation	2008	
5	**Low pH**	Standard Violation	Aquatic Life	2008	2002

North Carolina Division of Water Quality

2010
Use Assessment Methodology

EPA Approved August 31, 2010

Table of Contents

Purpose

Section 303(d) of the federal Clean Water Act (CWA) which Congress enacted in 1972 requires States, Territories and authorized Tribes to identify and establish a priority ranking for waterbodies for which technology-based effluent limitations required by section 301 are not stringent enough to attain and maintain applicable water quality standards, establish total maximum daily loads (TMDLs) for the pollutants causing impairment in those waterbodies, and submit, from time to time, the list of impaired waterbodies and TMDLs to the U.S. Environmental Protection Agency (EPA). Current federal rules require states to submit 303(d) lists biennially, by April 1st of every even numbered year. The "303(d) list" is technically considered the impaired waters listed as Category 5, requiring a TMDL. EPA is required to approve or disapprove the state-developed §303(d) list within 30 days. For each water quality limited segment impaired by a pollutant and identified in the §303(d) list, a Total Maximum Daily Load (TMDL) must be developed.

Assessment Units and Water Quality Classifications

Water quality assessments are based on water quality classifications as well as data availability. Water quality classifications are associated with a stream reach or area that is described in the schedule of classifications. Reaches vary in length or area and are sometimes split into smaller units to represent application of water quality data. Classifications are represented by a series of numbers called index numbers, 27-33-43-(1), as an example. Water quality assessments are applied to assessment units or AUs. AUs are, for the most part, the same as index numbers. When an AU is subdivided because of data applicability a letter is added to indicate this smaller unit. For example, if Index number 27-33-43-(1) (12 miles in length) is divided into three different segments because of three different available data types the new segments would be 27-33-43-(1)a, 27-33-43-(1)b and 27-33-43-(1)c. The combined mileage of the AUs would be 12 miles.

Decisions on the length or area to apply data to are based on the data type, waterbody characteristics, stations indicating similar water quality, watershed information and landmarks on which to base descriptions. The AUs where water quality concerns are evident are used as markers. Solutions to water quality concerns, including TMDLs, typically encompass entire watersheds.

Data Window/Assessment Period

The data window for the 2010 Water Quality Use Assessment (305(b) and 303(d) Integrated Reporting) includes data collected in calendar years 2004 through 2008 (five years). Some AUs may have biological data collected earlier for waters that have not been resampled during this data window or where the current impairment is based on that sample. The data collection year is noted for each AU.

Data Availability and Quality

Data are collected by various state and federal agencies. NC Department of Environment and Natural Resources (NCDENR) Division of Water Quality (DWQ) collects most of the data used for water quality assessments. There are significant data sets collected by NCDENR Division of Environmental Health (DEH) for use in coastal water quality assessment. The United States Geological Survey (USGS) also provides data in several AUs. Local governments and environmental groups as well as industry, municipal and university coalitions also provide data. Submitted data sets must include an approved Quality Assurance Project Plan (QAPP) or other documentation to assure that the data were collected in a manner consistent with agency data. A standing solicitation for data is maintained on the DWQ website. DWQ evaluates all data and information submitted.

Use Support Categories and Water Quality Standards

There are numerical and narrative water quality standards that are in place to protect the various best uses of North Carolina waters. Best uses include aquatic life or biological integrity, recreation or swimming, fish consumption, shellfish harvesting and water supply. Water quality assessments are based on the standards and data availability for the applicable use support category- aquatic life, recreation etc. Dissolved oxygen standards are used to assess aquatic life and pathogen indicators are used to assess recreation for example. Standards assessment criteria have been developed for each parameter assessed. The standards assessment criteria are used to make water quality assessments- not the standards themselves. While the standards assessment criteria are based on the standards they are different in that a frequency term is included. The details of how each standard is assessed are discussed in the following sections.

Aquatic Life Assessment Methodology

Numerical Water Quality Standards

The aquatic life numerical water quality standards are assessed using a 10% exceedance of the standard criterion. These assessments use ambient monitoring data from the five year assessment period (2004-2008). If no aquatic life numerical water quality standards exceed the 10% criterion then the AU is Supporting aquatic life water quality standards. This AU/multiple-parameters assessment is a Category 1 listing not requiring a TMDL. If greater than 10% of the

samples exceed the numerical standard and there are at least 10 samples, then the AU is Impaired for that parameter. The AU/parameter assessment is listed in Category 5, requiring a TMDL. If the 10% criterion was exceeded and fewer than 10 samples were collected the AU was Not Rated and targeted for further sampling. This is a Category 3a listing not requiring a TMDL. The NC DWQ "Redbook" contains the complete descriptions of water quality standards and surface water classifications [15a NCAC 02B .0200 - .0300]

Dissolved Oxygen (DO) Standards

Freshwater dissolved oxygen: not less than 6.0 mg/l for trout waters; for non-trout waters, not less than a daily average of 5.0 mg/l with a minimum instantaneous value of not less than 4.0 mg/l; swamp waters, lake coves or backwaters, and lake bottom waters may have lower values if caused by natural conditions.

Salt water dissolved oxygen: not less than 5.0 mg/l, except that swamp waters, poorly flushed tidally influenced streams or embayments, or estuarine bottom waters may have lower values if caused by natural conditions.

Freshwater Dissolved Oxygen (DO) Assessment (Class C, B, WS)

A fresh non-swamp water AU was assessed as Impaired for aquatic life when greater than 10% of samples were below 4 mg/l for instantaneous samples (monthly) or when greater than 10% of samples are below a daily average of 5mg/l. A minimum of 10 samples was needed to rate the water as Impaired.

Saltwater Dissolved Oxygen (DO) Assessment (Class SC, SB, SA)

A saline/estuarine non-swamp water AU was assessed as Impaired for aquatic life when greater than 10% of samples were below 5 mg/l. A minimum of 10 samples was needed to rate the water as Impaired.

Trout Water Dissolved Oxygen (DO) Assessment (Supplemental Class Tr)

A supplemental classified Trout water AU was assessed as Impaired for aquatic life when greater than 10% of samples were below 6 mg/l. A minimum of 10 samples was needed to rate the water as Impaired.

Swamp Water Dissolved Oxygen (DO) Assessment (Supplemental Class Sw)

A supplemental classified swamp (Sw) AU was Not Rated for aquatic life when greater than 10% of samples were below 4 mg/l (5 mg/l for salt) for instantaneous samples (monthly) or when greater than 10% of samples were below a daily average of 5 mg/l (freshwater only). There is not a numerical standard for these waterbodies and natural background conditions cannot be determined. This is a category 3a listing not requiring a TMDL.

A swamp like AU (not classified Sw) was Not Rated for aquatic life when greater than 10% of samples were below 4 mg/l (5 mg/l for salt) for instantaneous samples

(monthly) or when greater than 10% of samples were below a daily average of 5mg/l (freshwater only) and when greater than 10% of samples were below a pH of 6.0 (SU) for freshwater or 6.8 (SU) for saltwater. Geographic location, biological data, tributary classifications, discharges and land use were considered when assigning use support ratings to waters considered to be swamp like or receiving significant swamp water input.

pH

pH Standards

Freshwater pH: shall be normal for the waters in the area, which generally shall range between 6.0 and 9.0 except that swamp waters may have a pH as low as 4.3 if it is the result of natural conditions;

Saltwater pH: shall be normal for the waters in the area, which generally shall range between 6.8 and 8.5 except that swamp waters may have a pH as low as 4.3 if it is the result of natural conditions;

Low pH Assessment (Class C, SC, B, SB, SA, WS)

A non-swamp water AU was assessed as Impaired for aquatic life when greater than 10% of samples were below a pH of 6.0 (SU) for freshwater or 6.8 (SU) for saltwater.

A swamp like AU (not classified Sw) was Not Rated for aquatic life when greater than 10% of samples were below a pH of 6.0 (SU) for freshwater or 6.8 (SU) for saltwater or when greater than 10% of samples were below a dissolved oxygen of 4 mg/l (5 mg/l for salt) for instantaneous samples (monthly) or when greater than 10% of samples were below a daily average of 5mg/l (freshwater only) Geographic location, biological data, tributary classifications, discharges and land use were considered when making use support determinations on waters considered to be swamp like or receiving significant swamp water input.

High pH Assessment (Class C, SC, B, SB, SA, WS)

An AU was assessed as Impaired for aquatic life when greater than 10% of samples were greater than a pH of 9 (SU) for freshwater or 8.5 (SU) for saltwater. A minimum of 10 samples was needed to rate the water as Impaired. This is a Category 5 listing requiring a TMDL.

If the 10% criterion was exceeded and fewer than 10 samples were collected the AU was Not Rated and targeted for further sampling. This is a Category 3a listing not requiring a TMDL.

Swamp Water Low pH Assessment (Supplemental Class Sw)

A supplemental classified swamp (Sw) AU was assessed as Impaired when greater than 10% of samples were below 4.3 (SU). A minimum of 10 samples was needed to rate the water as Impaired. This is a Category 5 listing requiring a TMDL.

If the 10% criterion was exceeded and fewer than 10 samples were collected the AU was Not Rated and targeted for further sampling. This is a Category 3a listing not requiring a TMDL.

Temperature Use Assessment

Temperature Standards

For freshwaters- Temperature: not to exceed 2.8°C (5.04°F) above the natural water temperature, and in no case to exceed 29°C (84.2°F) for mountain and upper piedmont waters and 32°C (89.6°F) for lower piedmont and coastal plain waters. The temperature for trout waters shall not be increased by more than 0.5°C (0.9°F) due to the discharge of heated liquids, but in no case to exceed 20°C (68°F).

Lower piedmont and coastal plain waters mean those waters of the Catawba River Basin below Lookout Shoals Dam; the Yadkin River Basin below the junction of the Forsyth, Yadkin, and Davie County lines; and all of the waters of Cape Fear, Lumber, Roanoke, Neuse, Tar-Pamlico, Chowan, Pasquotank, and White Oak River Basins; except tidal salt waters which are assigned S classifications.

Mountain and upper piedmont waters mean all of the waters of the Hiwassee; Little Tennessee, including the Savannah River drainage area; French Broad; Broad; New; and Watauga River Basins; and those portions of the Catawba River Basin above Lookout Shoals Dam and the Yadkin River Basin above the junction of the Forsyth, Yadkin, and Davie County lines.

For saltwaters- Temperature: shall not be increased above the natural water temperature by more than 0.8°C (1.44°F) during the months of June, July, and August nor more than 2.2°C (3.96°F) during other months and in no cases to exceed 32°C (89.6°F) due to the discharge of heated liquids.

Temperature Assessment

A mountain or upper piedmont AU was assessed as Impaired for aquatic life when greater than 10% of samples were greater than 29°C. A minimum of 10 samples was needed to rate the water as Impaired.

A lower piedmont or coastal plain stream AU was assessed as Impaired for aquatic life when greater than 10% of samples were greater than 32°C. A minimum of 10 samples was needed to rate the water as Impaired.

If the 10% criterion was exceeded and fewer than 10 samples were collected the water was Not Rated and targeted for further sampling. This is a Category 3a listing not requiring a TMDL.

Temperature Screening Criteria for Trout Waters (Supplemental Class Tr)

A supplemental classified trout water (Tr) AU was Not Rated for aquatic life when greater than 10% of samples were greater than 20°C. The presence of heated discharges was not determined. This is a Category 3a listing not requiring a TMDL.

Assessment of Extreme Temperature Conditions

A waterbody that exceeds the above criteria may be Not Rated for aquatic life because of meteorological conditions that occur on a regular basis. These conditions must be documented and reassessment will occur after more normal conditions return. This is a Category 3a listing not requiring a TMDL. Examples of extreme conditions may include extreme drought, reservoir drawdown, hurricane impacts and flooding, dam failure, and saltwater encroachment. Other extreme conditions may be documented as needed for future assessments

Chlorophyll *a*

Chlorophyll *a* Standard

Chlorophyll *a* (corrected): not greater than 40 μg/l in sounds, estuaries, and other waters subject to growths of macroscopic or microscopic vegetation.

Other waters subject to growths are interpreted by DWQ to include dam backwaters, lakes and reservoirs.

Chlorophyll *a* Standards Assessment

An AU was assessed as Impaired for aquatic life when greater than 10% of samples were greater than 40 μg/l. A minimum of 10 samples was needed to rate the water as Impaired. This is a Category 5 listing requiring a TMDL.

If the 10% criterion was exceeded and fewer than 10 samples were collected the AU was Not Rated and targeted for further sampling. Some reservoirs in North Carolina are sampled fewer than 10 times during the assessment period. These data are used to document eutrophication issues. Reservoirs are targeted for increased monitoring to determine if there are standards violations using the above methodology. This is a Category 3a listing not requiring a TMDL.

Toxic Substances and Action Levels Metals

Toxic Substances Numerical Standards

Refer to the NC DWQ "Redbook" for complete text of standards
Arsenic: 50 ug/l
Beryllium: 6.5 ug/l;
Cadmium: 0.4 ug/l for trout waters and 2.0 ug/l for non-trout waters;
Chlorine, total residual: 17 ug/l;
Chromium, total recoverable: 50 ug/l;
Cyanide: 5.0 ug/l
Fluorides: 1.8 mg/l;
Lead, total recoverable: 25 ug/l;
Mercury (assessed in fish consumption category)
Nickel: 88 ug/l; 8.3 ug/l
Chlorides: 230mg/l; (note this is an action level standard)

Metals Action Level Standards

Action Level Copper: 7 ug/l FW or 3 ug/l SW
Action Level Silver: 0.06 ug/l;
Action Level Zinc: 50 ug/l;

Toxic Substances and Action Level Metals Assessment

An AU was assessed as Impaired for aquatic life when greater than 10% of samples were greater than the above standards or action level standards. A minimum of 10 samples was needed to rate the water as Impaired. These are Category 5 listings requiring a TMDL.

If the 10% criterion was exceeded and fewer than 10 samples were collected the AU was Not Rated and targeted for further sampling. This is a Category 3a listing not requiring a TMDL.

The action level standard for Iron was not assessed during this assessment period because the standard is being reevaluated and the Iron exceedances of the Action Level have been shown to be a natural condition.

Action levels are used for permitting purposes and are not used as the only information to assess aquatic life uses. Copper and Zinc may be indicators of potential impacts to aquatic life. DWQ will review Copper and Zinc assessments that result in Category 5 listings. The review will be used to determine if the Category 5 listing is appropriate. The following criteria will be used to determine if a review is warranted.

1. A collocated Good, Excellent, Natural or Not Impaired biological rating or

2. A collocated Good-Fair, Moderate or Not Rated biological rating and less than 25% of Copper or Zinc samples exceed the evaluation level.
3. There are no biological data available and less than 25% of Copper or Zinc samples exceed the evaluation level.

The Water Quality Assessment Team will evaluate and integrate the following lines of watershed information to determine if a Category 5 listing for Copper and/or Zinc is warranted.

1- Analysis of duration, frequency and magnitude of exceedances.
2- Historical data and trends for the parameter of interest.
3- Detailed assessment of all available biological data.
4- Qualitative aquatic habitat information.
5- Natural or background conditions assessment including current imagery.
6- Sample quality (note that Zinc samples can be easily contaminated)
7- Waterbody classifications and other designated uses.
8- Exceedances of other likely associated metals.
9- Biological data in nearby Assessment Units.
10- Potential Sources of metals
11- Site specific hardness

After review the Assessment team will determine if the AU/parameter assessment is more appropriately listed in a Category other than 5. Each reviewed assessment will require documented justification for a final Integrate Report category other than Category 5.

Turbidity

Turbidity Standards

Turbidity: the turbidity in the receiving water shall not exceed 50 Nephelometric Turbidity Units (NTU) in streams not designated as trout waters and 10 NTU in streams, lakes or reservoirs designated as trout waters; for lakes and reservoirs not designated as trout waters, the turbidity shall not exceed 25 NTU; if turbidity exceeds these levels due to natural background conditions, the existing turbidity level cannot be increased.

Turbidity Assessment

An AU was assessed as Impaired for aquatic life when greater than 10% of samples were greater than 50 NTU or 10 NTU for Tr waters or 25 NTU for lakes, reservoirs and estuarine waters. A minimum of 10 samples was needed to rate the water as Impaired. This is a Category 5 listing requiring a TMDL.

If the 10% criterion was exceeded and fewer than 10 samples were collected the AU was Not Rated and targeted for further sampling. This is a Category 3a listing not requiring a TMDL.

Ecological/Biological Integrity

Aquatic Life Narrative Standards

The aquatic life narrative water quality standard is assessed using a biological integrity index criterion (or bioclassification). Biological integrity means the ability of an aquatic ecosystem to support and maintain a balanced and indigenous community of organisms having species composition, diversity, population densities and functional organization similar to that of reference conditions. Waters shall be suitable for aquatic life propagation and maintenance of biological integrity, wildlife, secondary recreation, and agriculture. Sources of water pollution which preclude any of these uses on either a short-term or long-term basis shall be considered to be violating a water quality standard.

Aquatic Life Assessment

An AU was assessed as Impaired for aquatic life when a fish or benthic macroinvertebrate community sample received a bioclassification of Severe, Poor or Fair and there were no other Aquatic Life standards violations. This is a Category 5 listing requiring a TMDL.

An AU was assessed as Impaired for aquatic life when a fish or benthic macroinvertebrate community sample received a bioclassification of Severe, Poor or Fair and there were other Aquatic Life numeric standards violations. This is a Category 4s listing requiring a TMDL for the identified aquatic life numerical standards violation (Category 5 or 4t listing) impairing the ecological/biological integrity of the waterbody.

An AU was assessed as Impaired for aquatic life when a fish or benthic macroinvertebrate community sample received a bioclassification of Severe, Poor or Fair and an approved TMDL for an aquatic life numerical water quality standard has been completely implemented. This is a Category 5s listing requiring a TMDL.

Recreation Assessment Methodology

Recreation standards were assessed using fecal coliform bacteria data collected at DWQ ambient stations and special study sites and enterrococci data collected at DEH Recreational Monitoring sites in coastal waters. Screening criteria were used to assess areas for potential standards violations. DEH advisory postings were also used for recreation assessments as well. The following criteria were used to assess waters for recreation.

Pathogen Indicator Standards

Organisms of coliform group: fecal coliforms not to exceed geometric mean of 200/100 ml (MF count) based on at least five consecutive samples examined during any 30-day period and not to exceed 400/100 ml in more than 20 percent of the samples examined during such period.

Enterococcus, including *Enterococcus faecalis, Enterococcus faecium, Enterococcus avium* and *Enterococcus gallinarium*: not to exceed a geometric mean of 35 enterococci per 100 ml based upon a minimum of five samples within any consecutive 30 days.

Fecal Coliform Bacteria Assessment Criteria

An AU was assessed as Impaired when the geometric mean was greater than 200 colonies/100ml or greater than 20% of the samples were higher than 400 colonies/100ml. At least 5 samples must have been collected within the same 30-day period. This is a Category 5 listing requiring a TMDL.

Fecal Coliform Bacteria Screening Assessment

An AU was Not Rated when the geometric mean was greater than 200 colonies/100ml or greater than 20% of the samples were higher than 400 colonies/100ml. Samples were not collected in the same 30-day period. This is a Category 3a listing not requiring a TMDL. These AUs are prioritized for resampling 5 times in 30 days based on classification and available resources. Data are reviewed yearly for prioritization.

Enterrococci Assessment Criteria

An AU was assessed as Impaired when the geometric mean was greater than 35 colonies/100ml. At least 5 samples must have been collected within the same 30-day period. This is a Category 5 listing requiring a TMDL.

Enterrococcus Screening Assessment

An AU was Not Rated when the geometric mean was greater than 35 colonies/100ml. Samples were not collected in the same 30-day period. This is a Category 3a listing not requiring a TMDL.

Advisory Posting Assessment

An AU was assessed as Impaired when a swimming advisory was posted for greater than 61 days in any 5 year period (includes permanent postings). This is a Category 4cr listing not requiring a TMDL.

Shellfish Harvesting Assessment Methodology

Shellfish Harvesting standards were assessed using DEH growing area classifications. The following criteria were used to assess waters for shellfish harvesting.

Shellfish Harvesting Standards

Organisms of coliform group: fecal coliform group not to exceed a median MF of 14/100 ml and not more than 10% of the samples shall exceed an MF count of 43/100 ml in those areas most probably exposed to fecal contamination during the most unfavorable hydrographic and pollution conditions.

Fecal Coliform Bacteria Assessment Criteria

DEH fecal coliform data were not assessed to determine standards violations. Category 5 impairments were based on Growing Area Classifications alone.

DEH Shellfish Sanitation Growing Area Classification Assessment

An AU was assessed as Impaired when the DEH growing area classification was Prohibited or conditionally approved. This is a Category 5 listing requiring a TMDL.

Water Supply Assessment Methodology

Water Supply standards were assessed using data collected at DWQ ambient stations located in Class WSI-WSV waters. The following criteria were used to Impair waters for water supply. Category 5 listings were only made when Standards Assessment Criteria (SAC) were exceeded.

Water Supply Standards

Refer to Water Quality "Redbook" for complete text of standards
Barium: 1.0 mg/l;
Chloride: 250 mg/l;
Manganese: 200 ug/l; (not human health or aquatic life- not assessed)
Nickel: 25 ug/l;
Nitrate nitrogen: 10.0 mg/l;
2,4-D: 100 ug/l;
2,4,5-TP (Silvex): 10 ug/l;
Sulfates: 250 mg/l;

Water Supply Assessment

An AU was assessed as Impaired for water supply when greater than 10% of samples were greater than the above standards except for manganese. A minimum of 10 samples was needed to rate the water as Impaired. This is a Category 5 listing requiring a TMDL.

If the 10% criterion was exceeded and fewer than 10 samples were collected the AU was Not Rated and targeted for further sampling. This is a Category 3a listing not requiring a TMDL.

Fish Consumption Assessment Methodology

Fish Consumption was assessed based on site-specific fish consumption advisories. The advisories were based on the NC Department of Health and Human Services (DHHS) consumption advisories developed using fish tissue data that exceed standards. The following criteria were used to Impair waters for fish consumption. Because of the statewide Mercury advice there were no use cases for Supporting fish consumption and therefore no overall Category 1 waters.

Polychlorinated biphenyls (PCBs) Assessment Criteria

An AU was assessed as Impaired when a site-specific advisory was posted for PCBs. This is a Category 5 listing requiring a TMDL.

Dioxin Assessment Criteria

An AU was assessed as Impaired when a site-specific advisory was posted for dioxins. This is a Category 5 listing requiring a TMDL.

Mercury Assessment Criteria

An AU was assessed as Impaired for fish consumption when greater than 10% of samples were greater than 0.012 μg/l. A minimum of 10 samples was needed to rate the water as Impaired. This is a Category 5 listing requiring a TMDL.

If the 10% criterion was exceeded and fewer than 10 samples were collected the AU was Not Rated and targeted for further sampling. This is a Category 3a listing not requiring a TMDL.

Statewide advice for Mercury in fish tissue was not assessed because it was not associated with a specific AU but was applied to all waters of the state. All AUs are considered Impaired and in Category 5 for the statewide Mercury fish consumption advice. Previous site specific listings for Mercury will no longer be listed in Category 5. DWQ continues to monitor mercury in fish tissue, and has identified specific locations where Mercury levels exceed 0.4mg/kg of fish tissue.