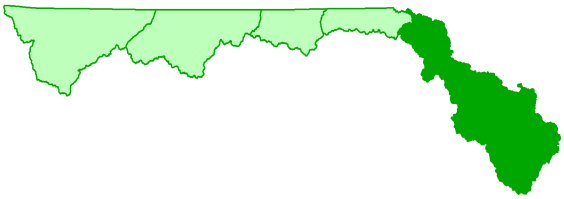
CHAPTER 5

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

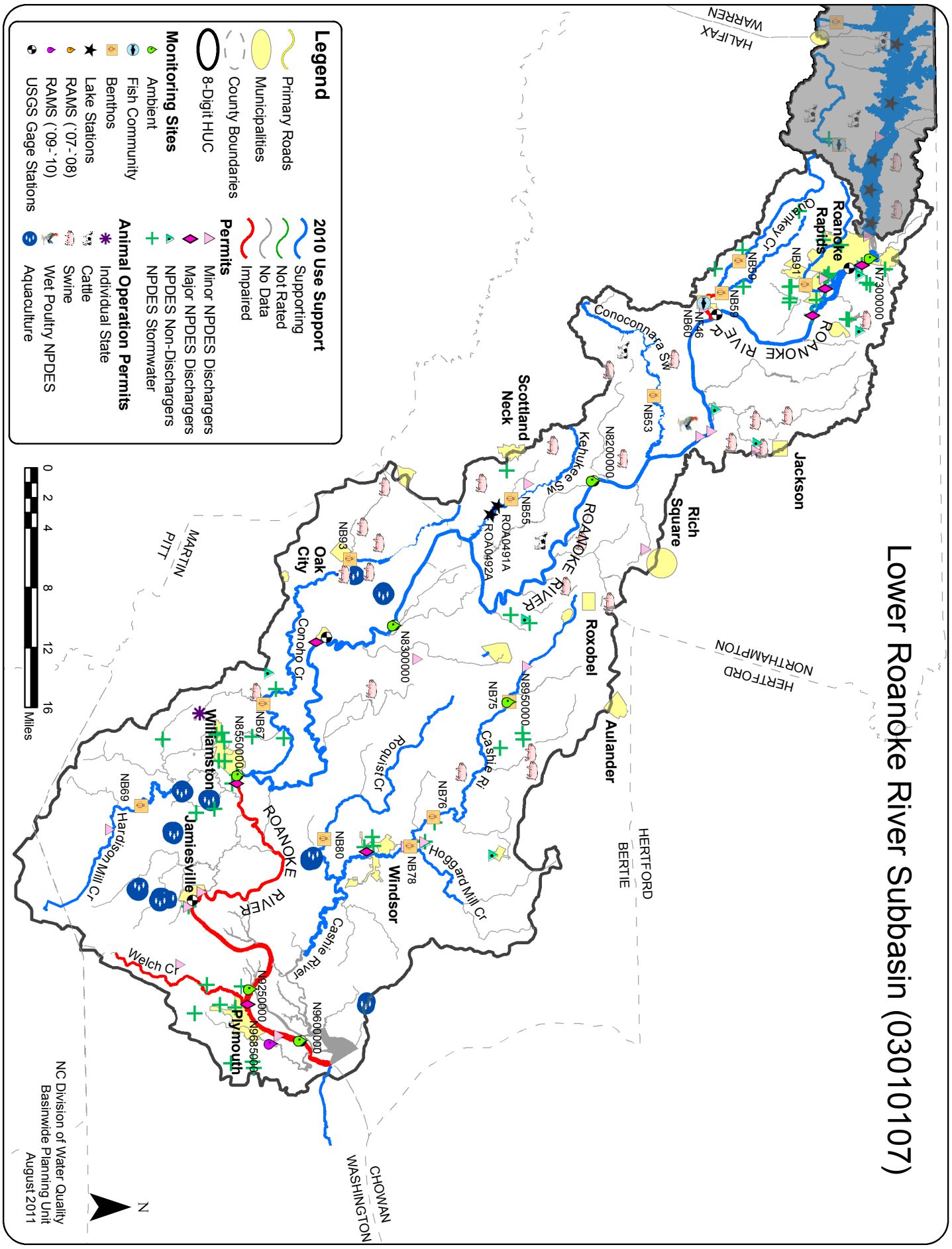
Population:

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)



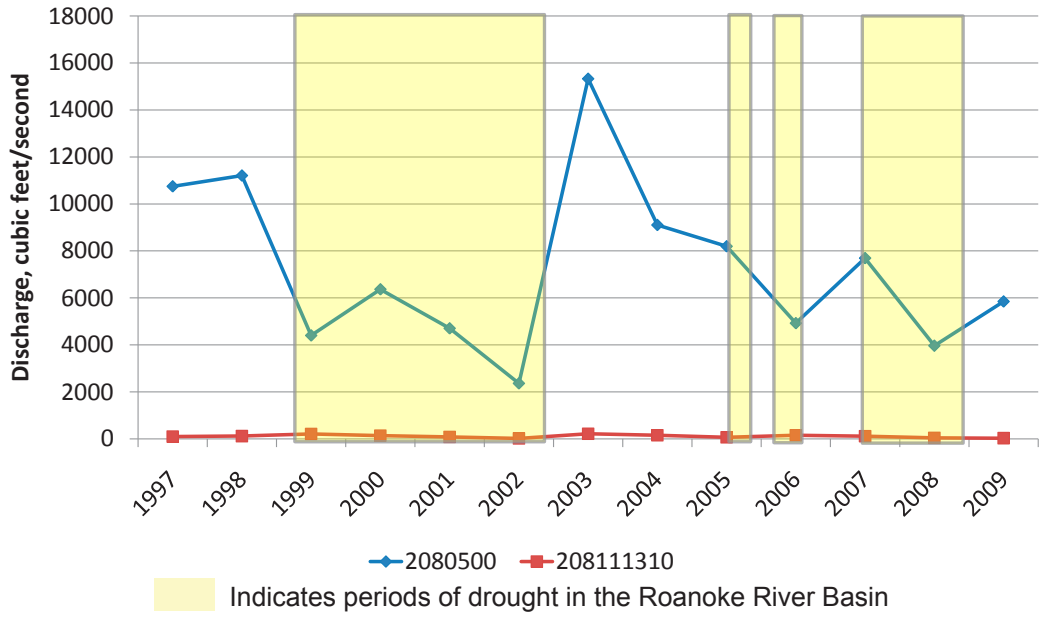
Water Quality Data Summary for this Subbasin

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

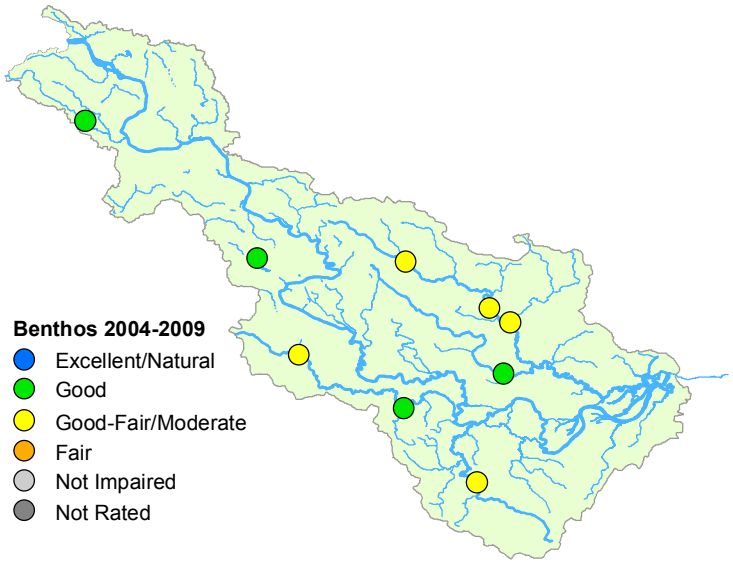


Figure 5-4: Current Benthic Site Ratings

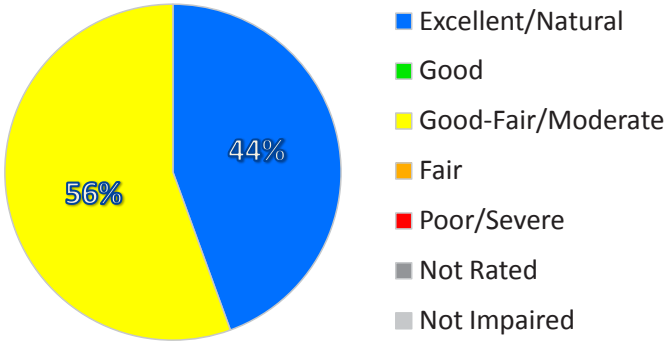
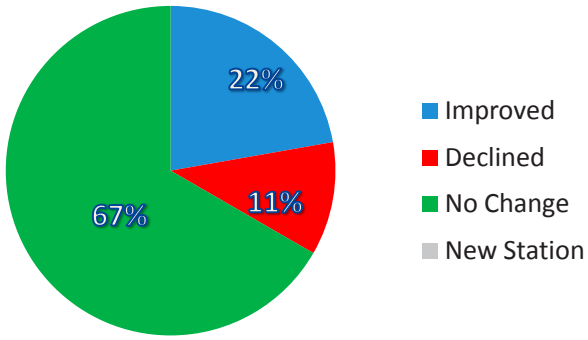


Figure 5-5: Change in Benthic Site Ratings



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

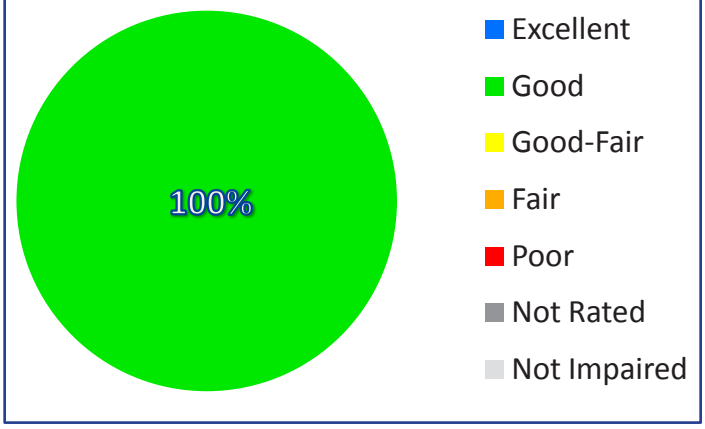
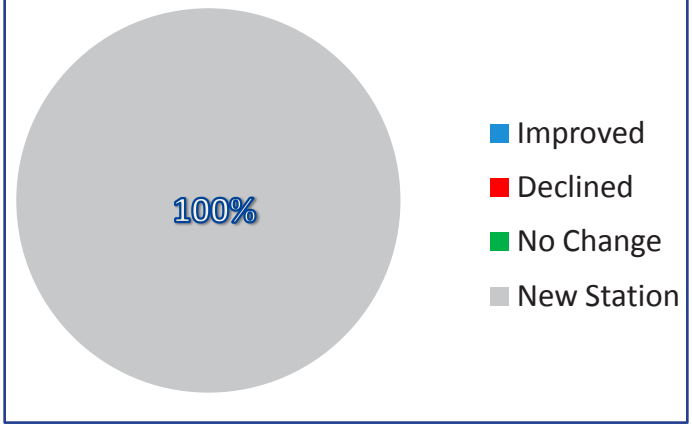


Figure 5-8: Change in Fish Comm Site Ratings



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)

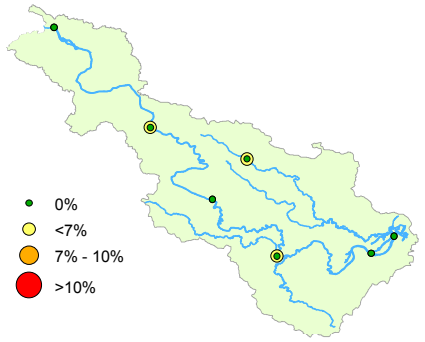
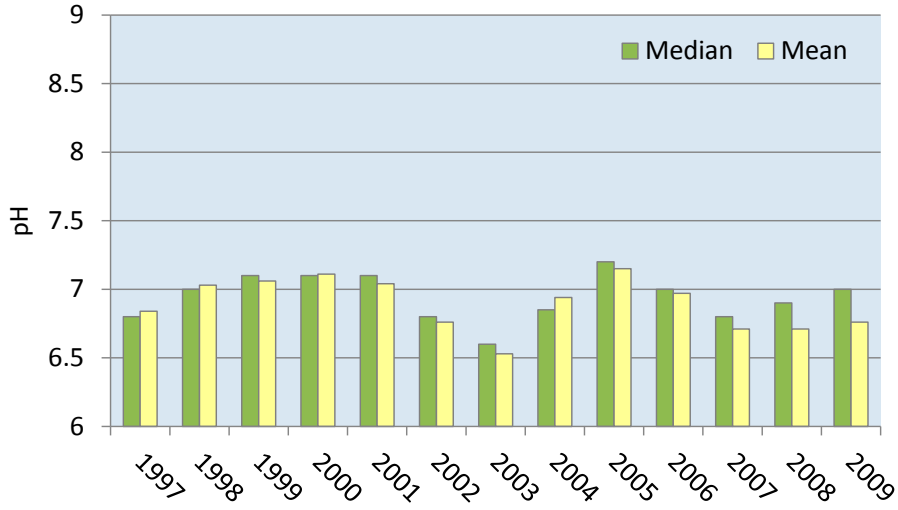


Figure 5-10: Summarized pH Values for All Data Collected at Ambient Sampling Stations in HUC 03010107



* 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)

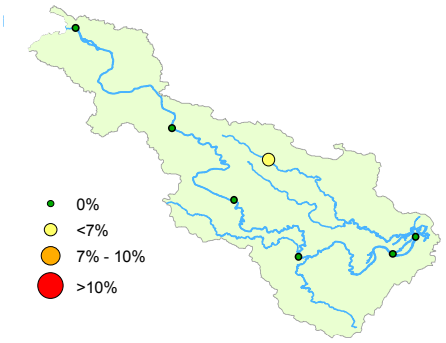
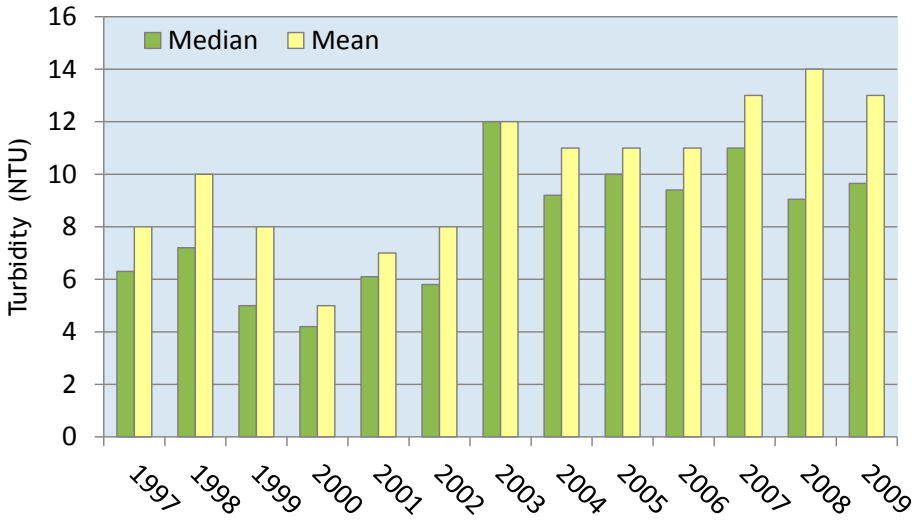


Figure 5-12: Summarized Turbidity Values for All Data Collected at Ambient Sampling Stations in HUC 03010107



* 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)

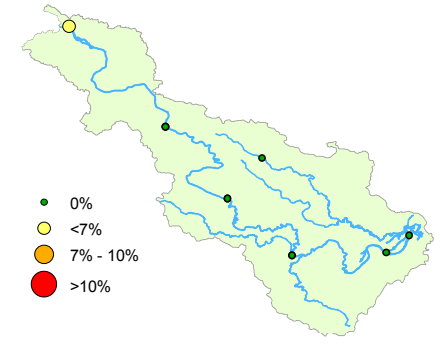
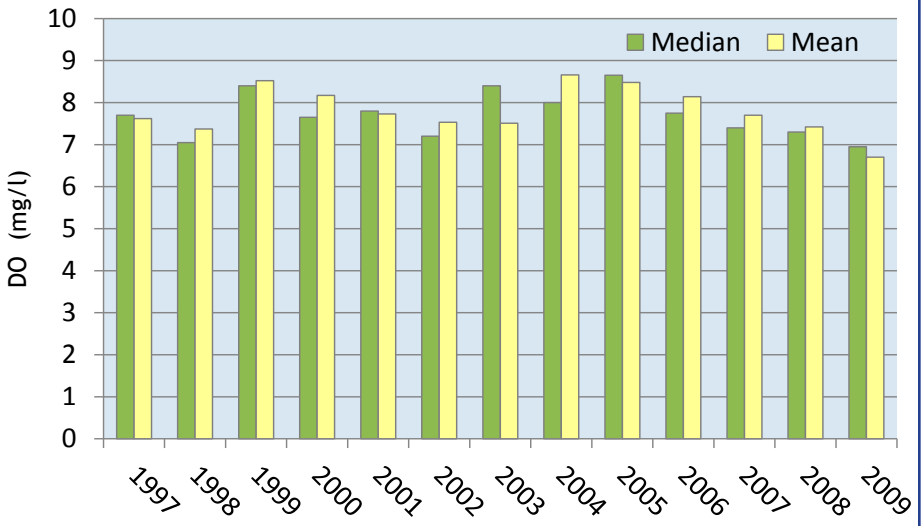


Figure 5-14: Summarized DO Values for All Data Collected at Ambient Sampling Stations in HUC 03010107

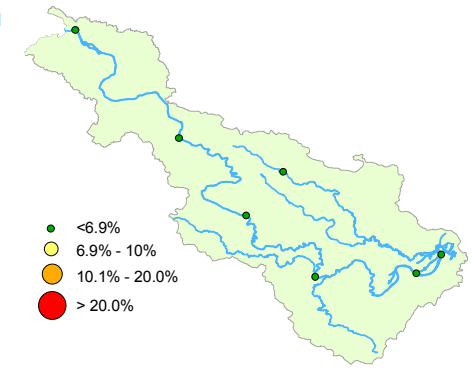


* NC DO Standard: Not < 5 mg/l daily avg. or not < 4 mg/l instantaneous

Fecal Coliform Bacteria

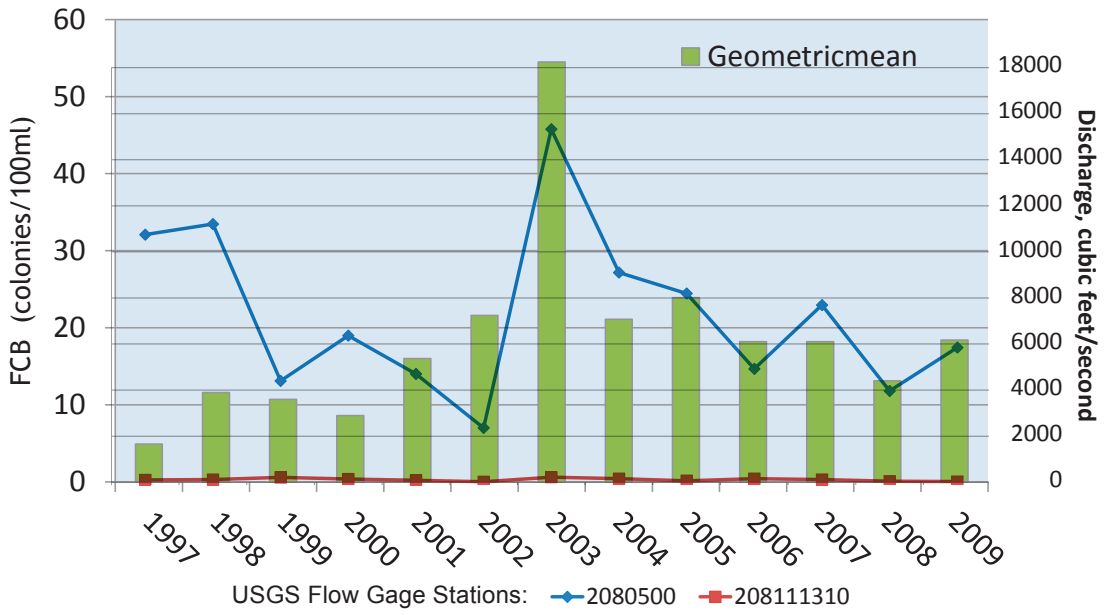
Fecal coliform bacteria (FCB) occurs in water as a result of nonpoint sources such as animal waste from wildlife, farm animals and/or pets, as well as from sanitary sewer overflows (SSOs). The FCB standard for freshwater streams is not to exceed the geometric mean of 200 colonies/100 ml, or 400 colonies/100 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

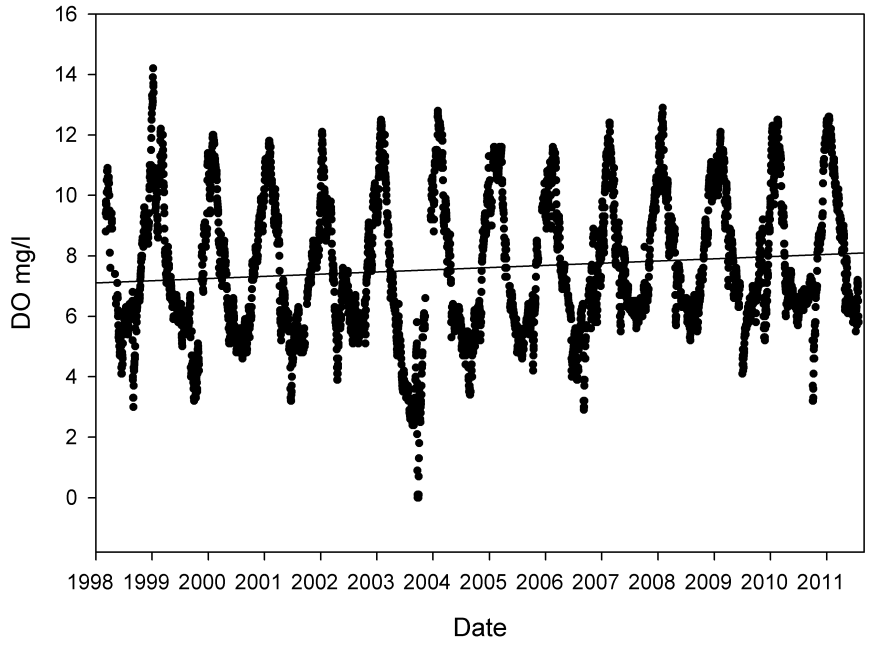
During the previous planning cycle, US Geological Survey (USGS) conducted a study entitled "Relations Among Floodplain Water Levels, Instream Dissolved-Oxygen (DO) Conditions, and Streamflow in the Lower Roanoke River, NC, 1997-2001". Data from this study indicated that from September 1999 through August 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)

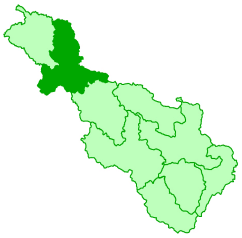
Water Quality Status

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]

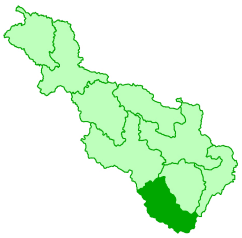
This watershed contains a mix land use of agriculture, residential, wetlands, forested and some urban areas. There is one minor NPDES permitted facility along with five swine and one cattle permitted animal operations located within the watershed. There are no waters on the 2010 Impaired Waters List 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]

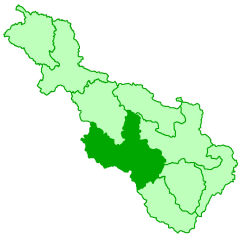
Use Support: Supporting (19.9 mi)	
2008 IR Cat.	2
2010 IR Cat.	2
Benthos (NB69)	Moderate (2009)

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]

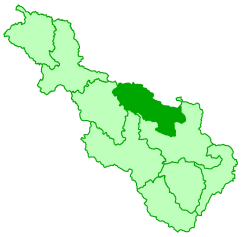
This watershed contains agriculture and wetlands with some residential, urban and forested areas. There two major and one minor NPDES permitted facilities along with seven swine permitted animal operations and nine aquaculture permits located within the watershed. There are no waters on the 2010 Impaired 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. Environmental Sciences Section (ESS). Biological Assessment Unit (BAU). December 2010. *Basinwide Assessment Report: Roanoke River Basin*. Raleigh, NC. (http://portal.ncdenr.org/c/document_library/get_file?uuid=e3dd1d8b-bbc5-42c9-9999-1d99dd4c7455&groupId=38364)

____. *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

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)

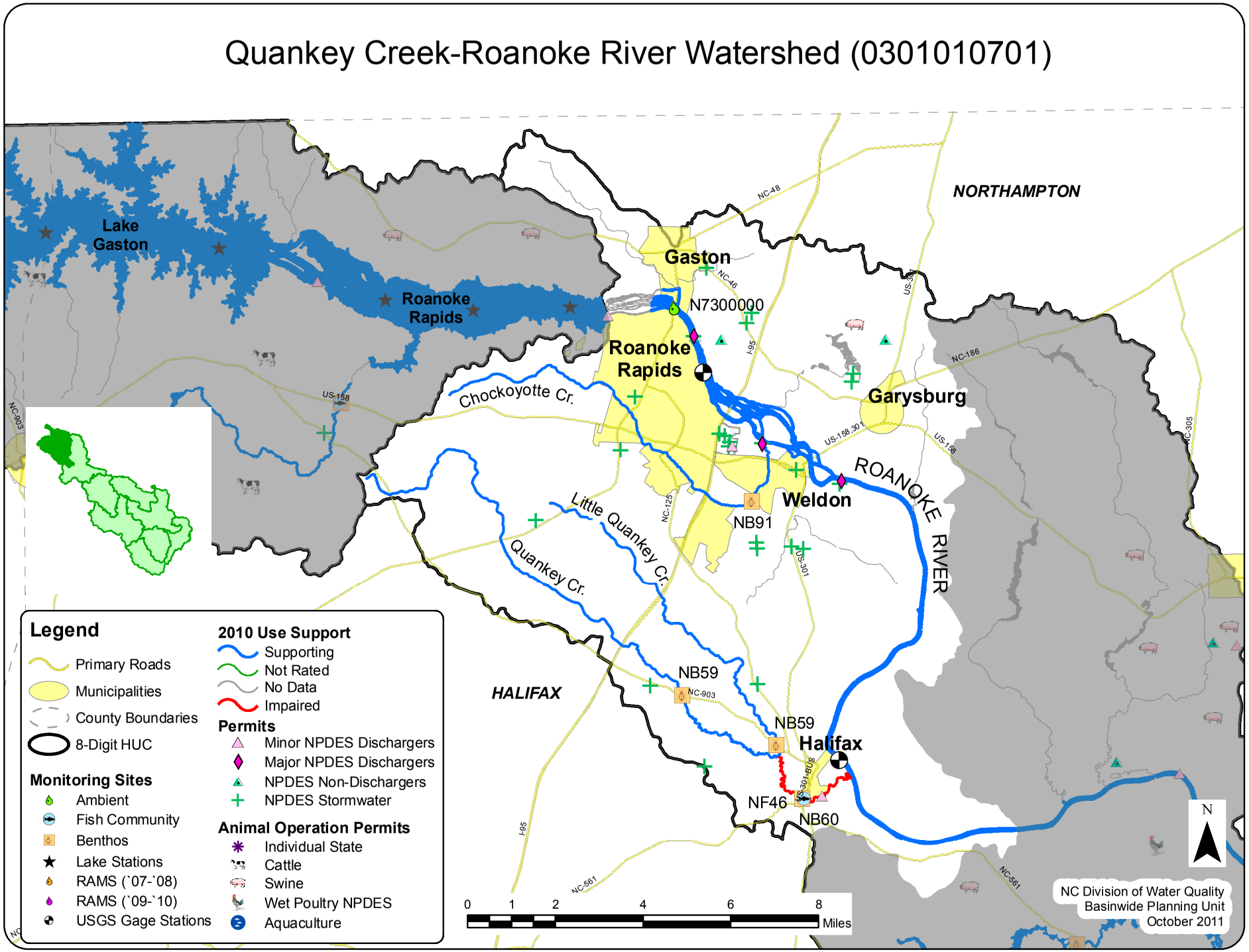
# results:	Geomean:	# > 400:	% > 400:	%Conf:
59	7	0	0	

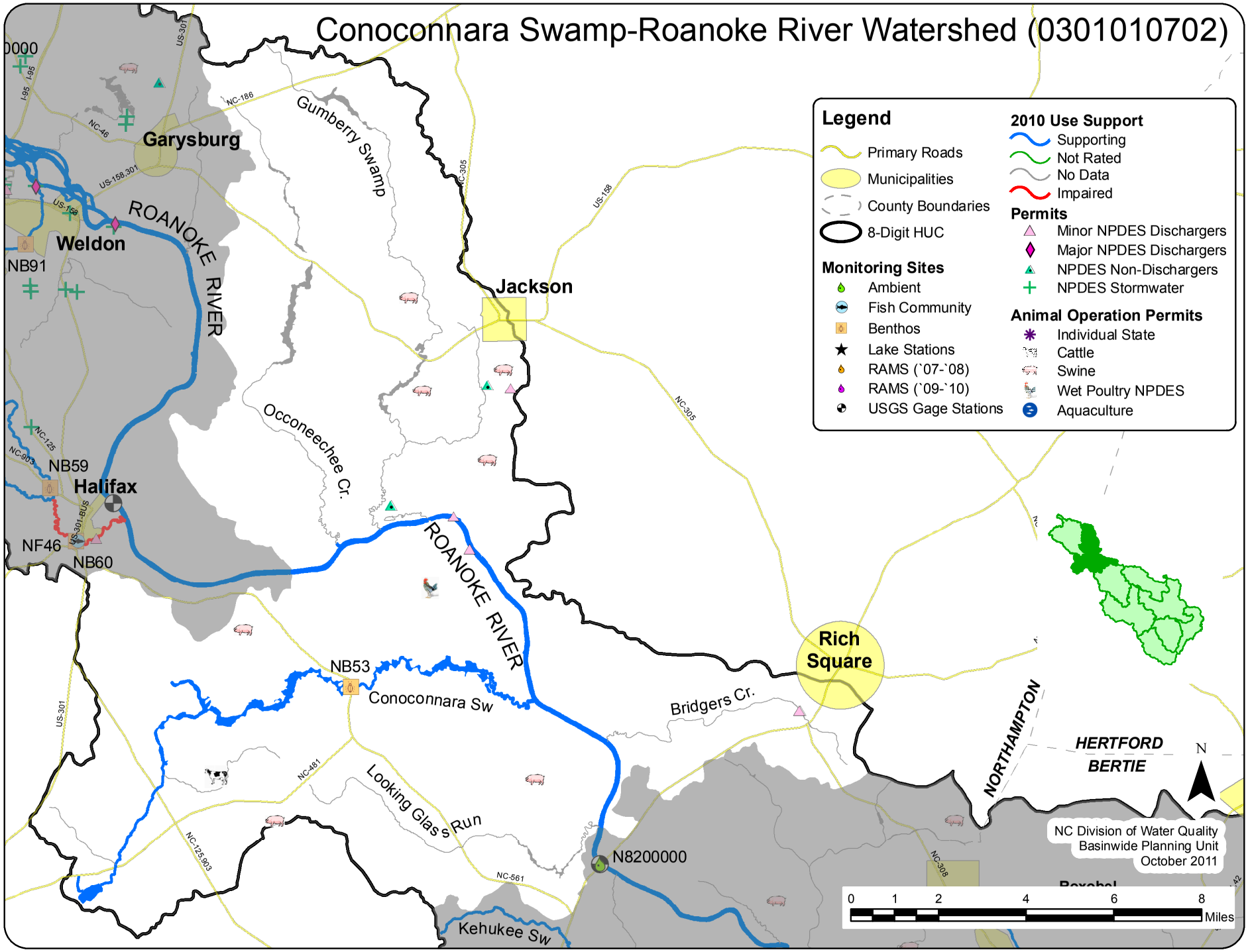
Key:
result: number of observations
ND: number of observations reported to be below detection level (non-detect)
EL: Evaluation Level; applicable numeric or narrative water quality standard or action level
Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : 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

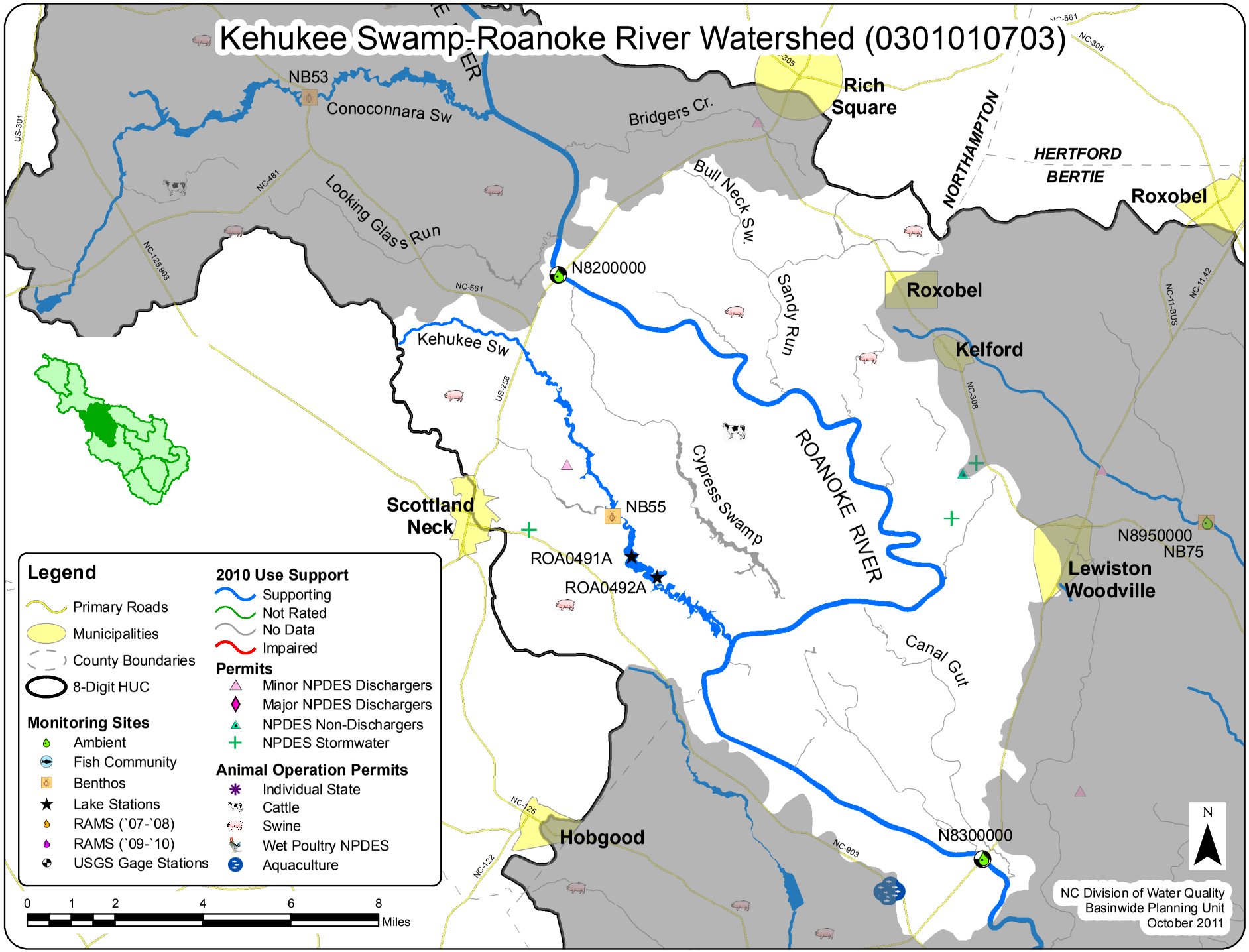
Appendix 5-D

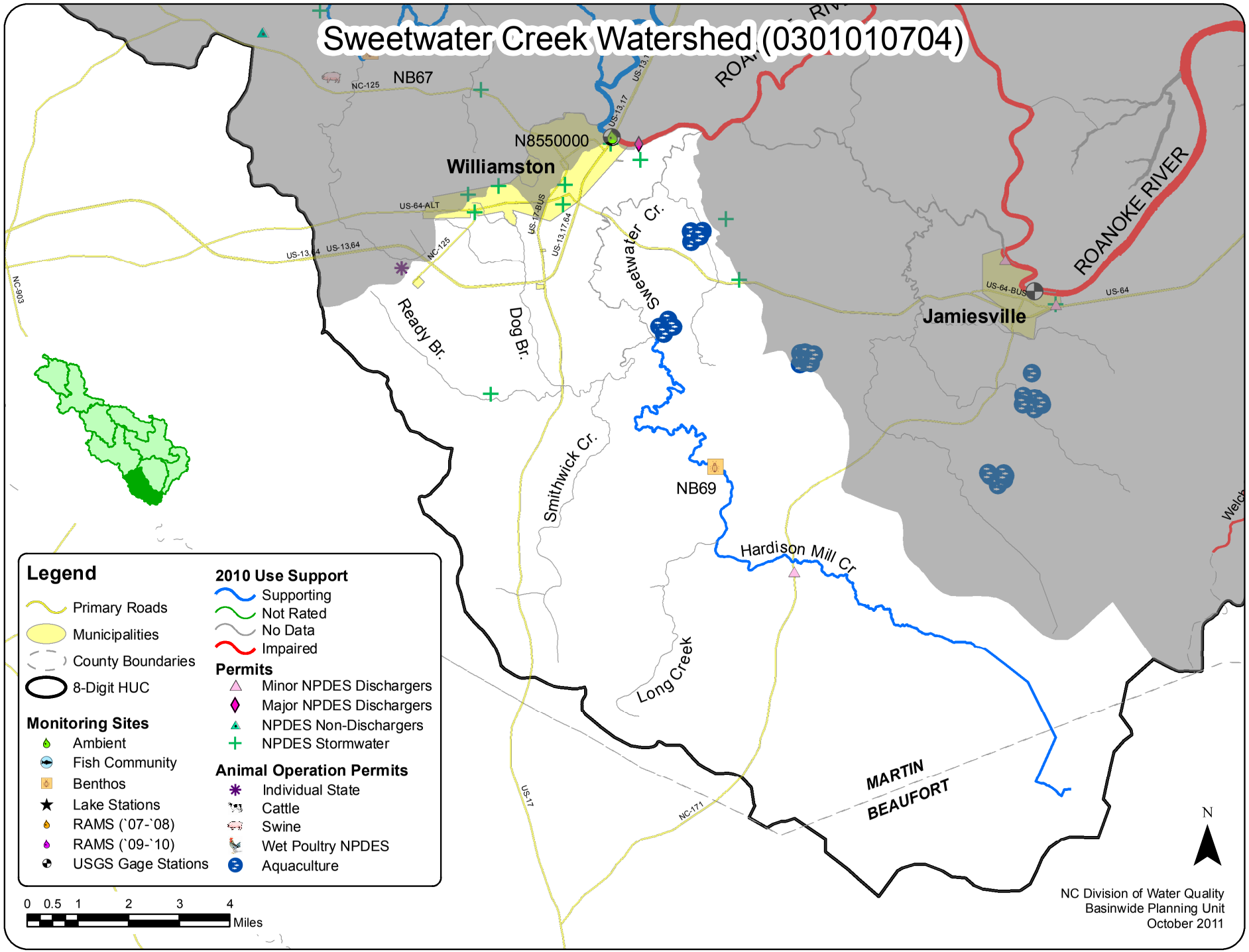
10-Digit Watershed Maps for the Lower Roanoke River Subbasin

Quankey Creek-Roanoke River Watershed (0301010701)

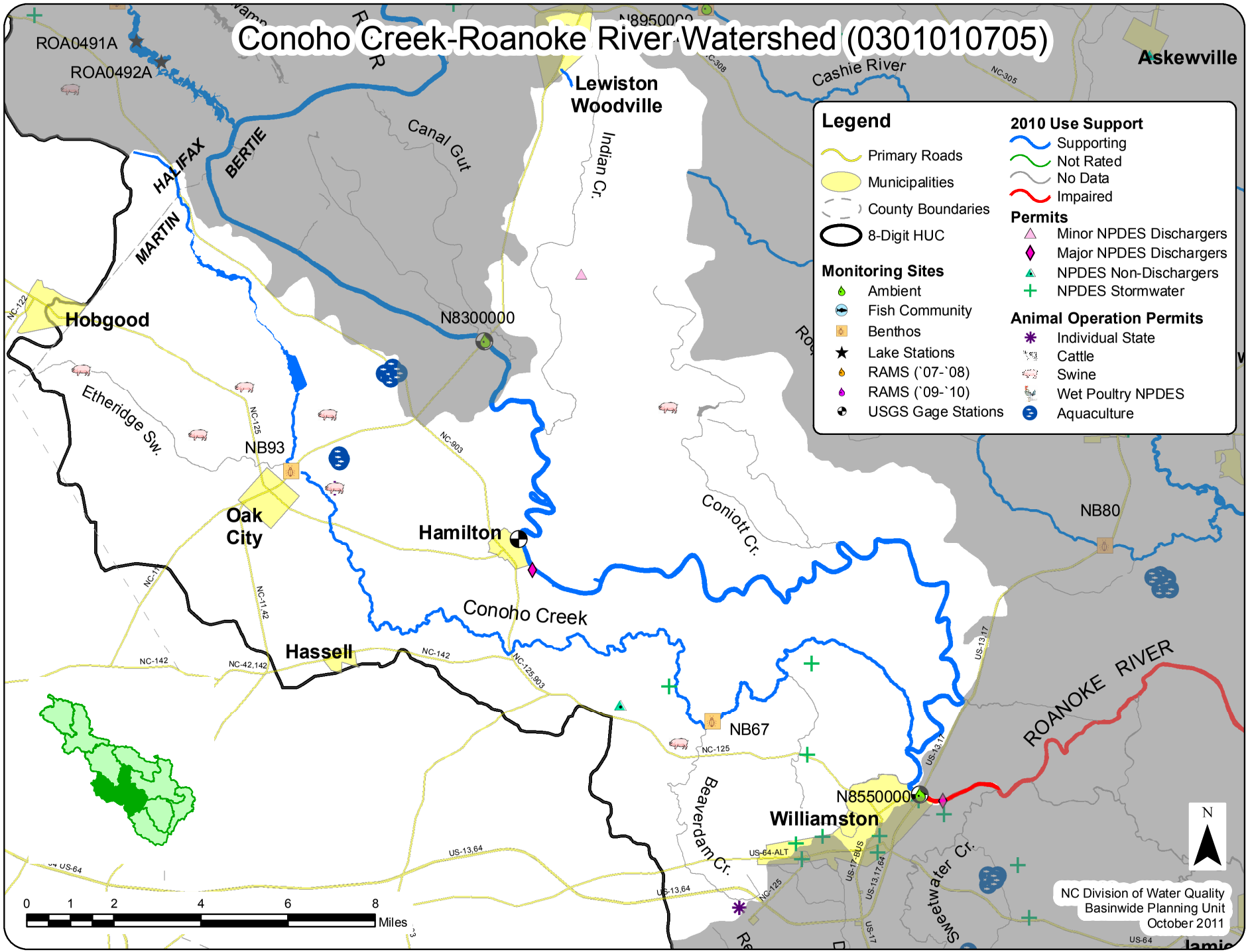


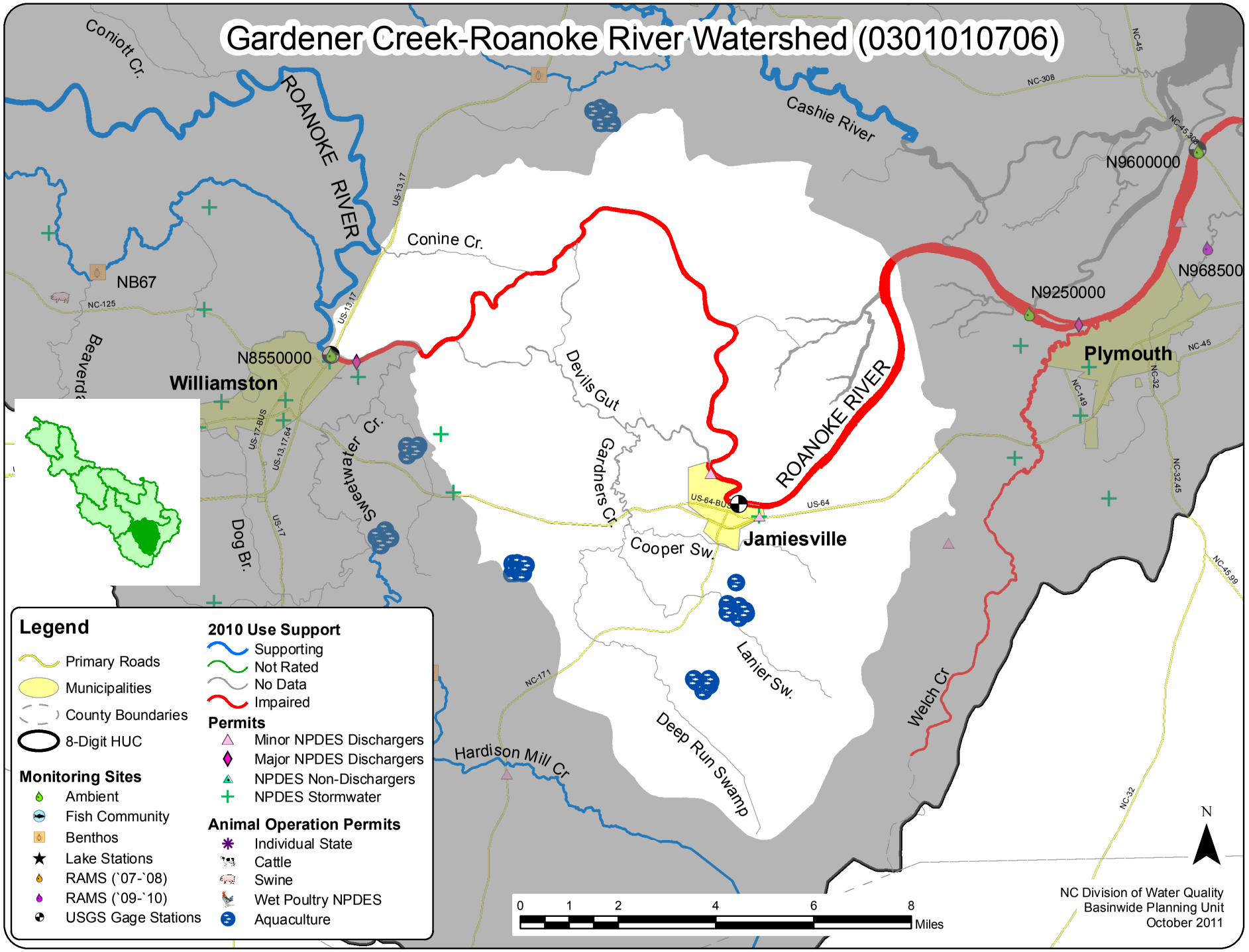

Conoconnara Swamp-Roanoke River Watershed (0301010702)
Legend
Primary Roads
Municipalities
County Boundaries
8-Digit HUC
Monitoring Sites
Ambient
Fish Community
Benthos
Lake Stations
RAMS (`07-`08)
RAMS (`09-`10)
USGS Gage Stations
2010 Use Support
Supporting
Not Rated
No Data
Impaired
Permits
Minor 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
N
NC Division of Water Quality
Basinwide Planning Unit
October 2011
0 1 2 4 6 8
Miles


Kehukee Swamp-Roanoke River Watershed (0301010703)
NB53
Conoconnara Sw
Looking Glass Run
Bridgers Cr.
Bull Neck Sw.
Rich Square
NORTHAMPTON
HERTFORD
BERTIE
Roxobel
N8200000
Sandy Run
Kehukee Sw
Kelford
Cypress Swamp
ROANOKE RIVER
Scottland Neck
NB55
ROA0491A
ROA0492A
N8950000
NB75
Lewiston Woodville
Canal Gut
Hobgood
N8300000
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

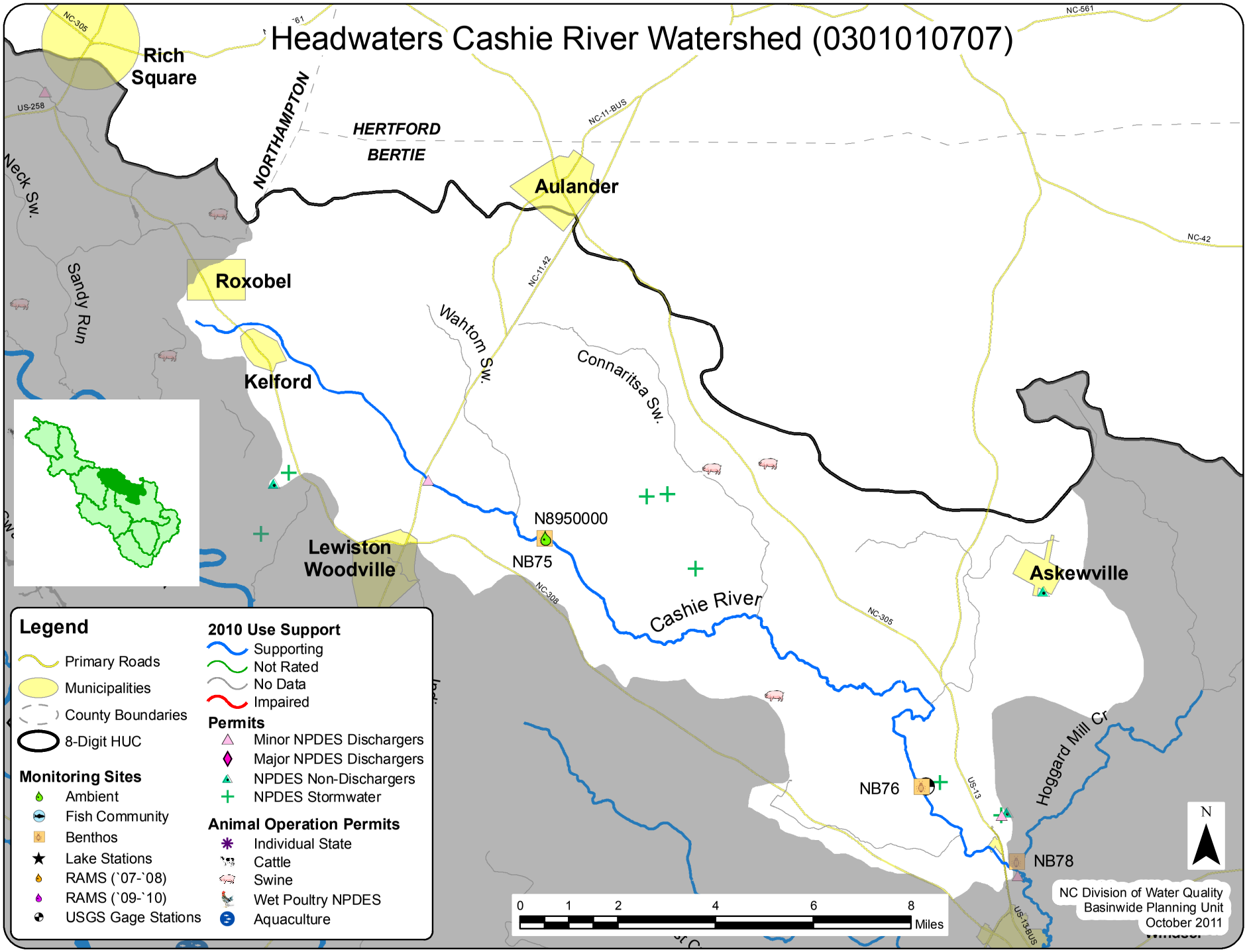

Sweetwater Creek Watershed (0301010704)
NB67
N8550000
Williamston
US-64-ALT
US-13,64
NC-125
US-17-BUS
US-13,17,64
US-13,17
Sweetwater Cr.
ROANOKE RIVER
US-64-BUS
US-64
Jamiesville
Ready Br.
Dog Br.
Smithwick Cr.
NB69
Hardison Mill Cr
Long Creek
MARTIN
BEAUFORT
US-17
NC-171
NC-903
Legend
Primary Roads
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

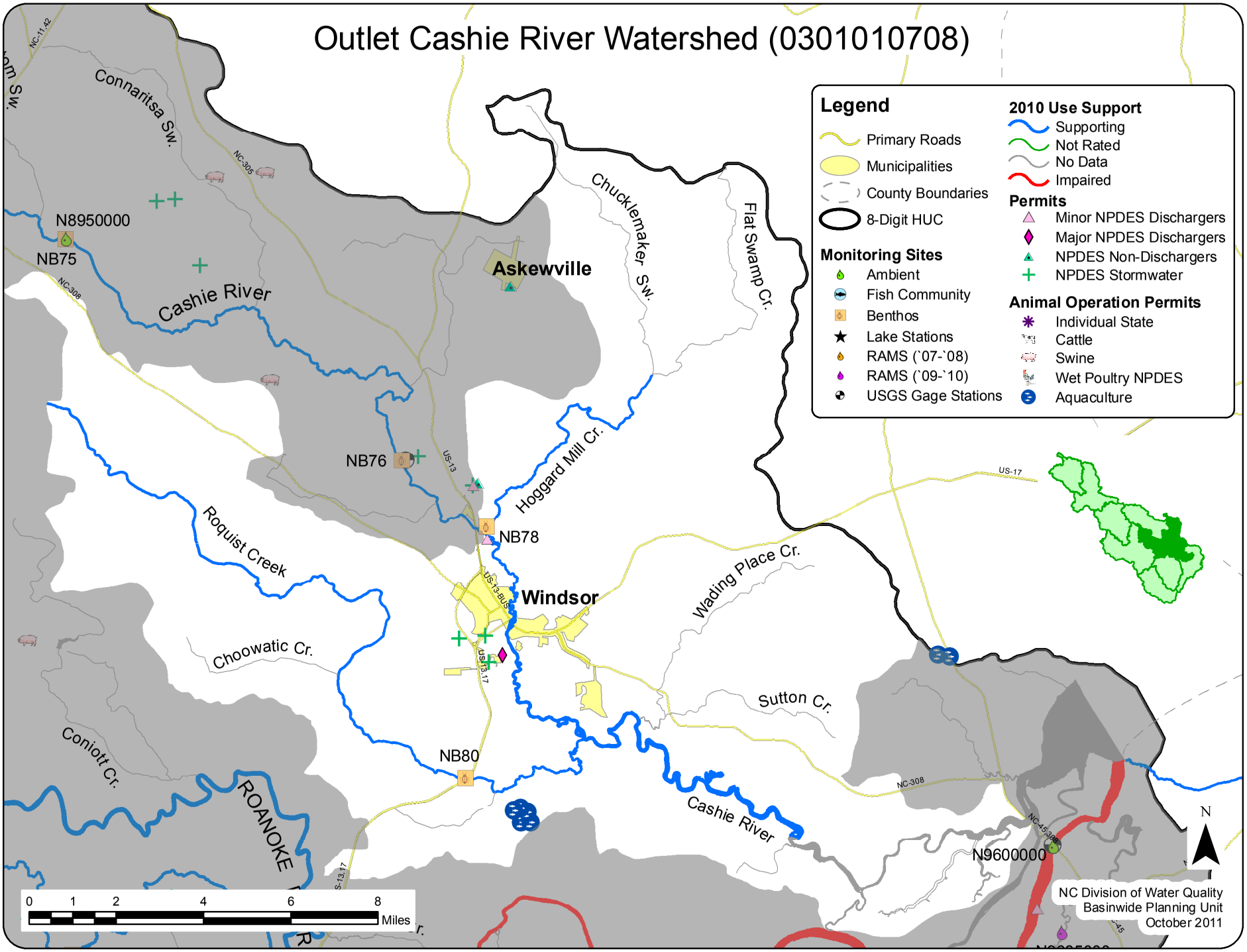
5-D.6

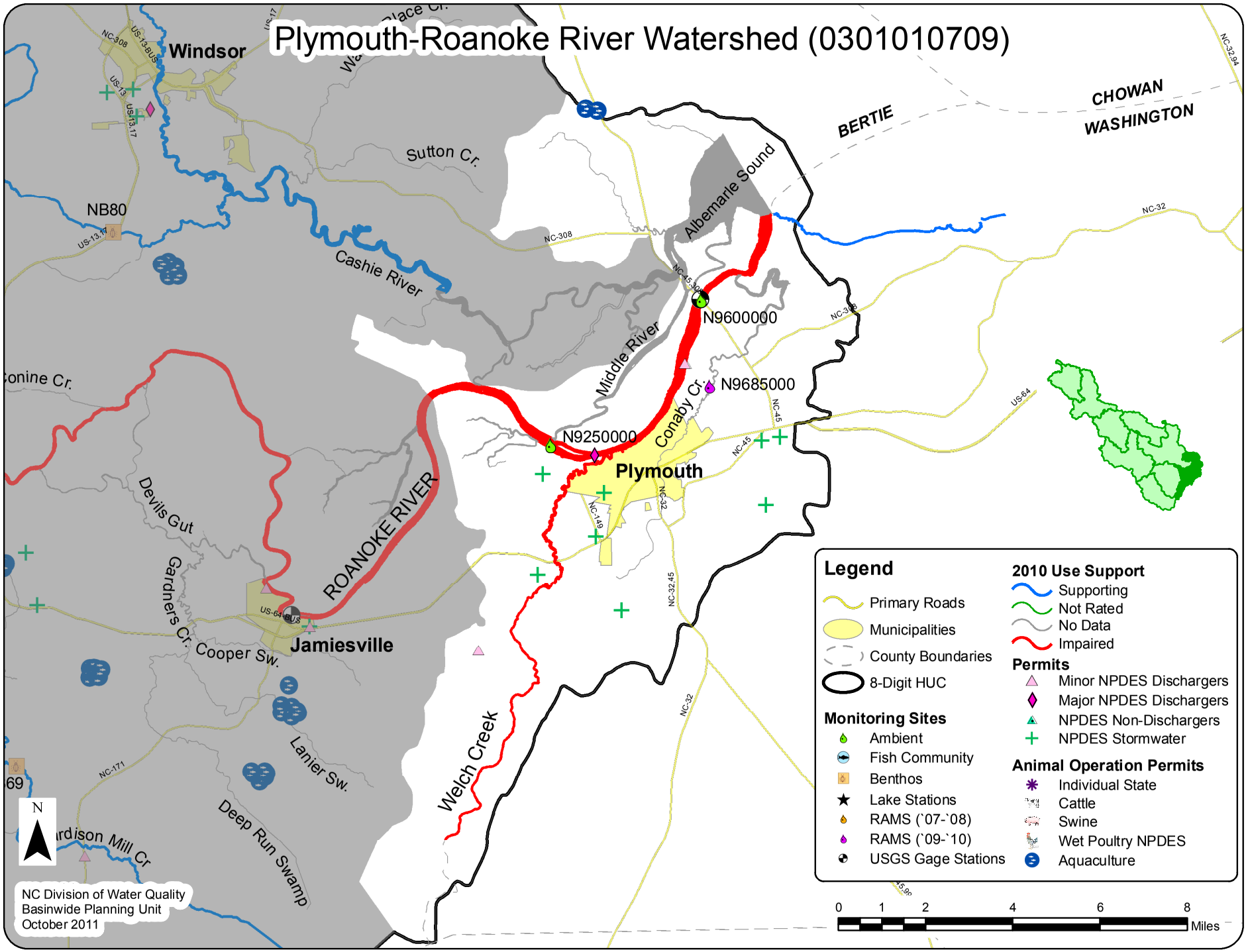

Conoho Creek-Roanoke River Watershed (0301010705)
ROA0491A
ROA0492A
Lewiston Woodville
Askewville
Cashie River
Canal Gut
Indian Cr.
HALIFAX
BERTIE
MARTIN
Hobgood
N8300000
Etheridge Sw.
NB93
Oak City
Hamilton
Coniott Cr.
NB80
Conoho Creek
Hassell
ROANOKE RIVER
NB67
N8550000
Williamston
Beaverdam Cr.
Sweetwater 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
NC-125
N8550000
Williamston
Beaverdam
US-13,17
US-17-BUS
US-13,17-64
US-17
Sweetwater Cr.
Dog Br.
Devils Gut
Gardners Cr.
ROANOKE RIVER
US-64-BUS
US-64
Jamiesville
Cooper Sw.
Lanier Sw.
Deep Run Swamp
Hardison Mill Cr
NC-171
Welch Cr
N9600000
N9250000
N968500
Plymouth
NC-45
NC-308
NC-45,308
NC-32
NC-149
NC-32,45
NC-45,99
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
US-13
US-13-BUS
US-17
NC-308
NC-305
NC-11-42
NC-45-BUS
0 1 2 4 6 8 Miles
N
NC Division of Water Quality
Basinwide Planning Unit
October 2011


Plymouth-Roanoke River Watershed (0301010709)
Windsor
Sutton Cr.
NB80
Cashie River
BERTIE
CHOWAN
WASHINGTON
Albemarle Sound
NC-308
NC-32
N9600000
Middle River
N9685000
Conaby Cr.
N9250000
Plymouth
ROANOKE RIVER
Devils Gut
Gardners Cr.
Cooper Sw.
Jamiesville
Welch Creek
Lanier Sw.
Deep Run Swamp
NC-171
US-64
NC-45
NC-32
NC-149
NC-32.45
US-64
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