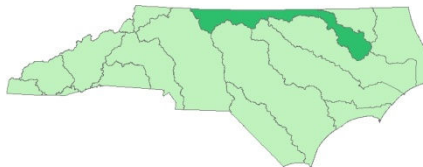# Roanoke River Basin
Ambient Monitoring System Report

January 1, 2005 through December 31, 2009

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Evaluation Levels

In order to assist the reader in developing a rapid understanding of the summary statistics provided throughout this data review, concentrations of water quality variables may be compared to an Evaluation Level (EL). Evaluation levels may be a water quality standard, an action level, an ecological threshold, or simply an arbitrary threshold that facilitates a rapid data review. Evaluation levels are further examined for frequency to determine if they have been exceeded in more than 10 percent of the observed samples. This summary approach facilitates a rapid and straightforward presentation of the data but may not be appropriate for making specific use support decisions necessary for identification of impaired waters under the Clean Water Act's requirements for 303(d) listings. The reader is advised to review the states 303(d) listing methodology for this purpose. (see http://portal.ncdenr.org/web/wq/ps/mtu/assessment).

TABLES

FIGURES

APPENDIXES

EXECUTIVE SUMMARY

A general understanding of human activities and natural forces that affect pollution loads and their potential impacts on water quality can be obtained through routine sampling from fixed water quality monitoring stations. During this assessment period (January 1, 2005 through December 31, 2009) chemical and physical measurements were obtained by the Division of Water Quality (DWQ) from 20 stations located in the Roanoke River Basin.

In order to evaluate acceptable water quality criteria at least 10 observations are desired. If at least 10 results were collected for a given site for a given parameter, the results are then compared to water quality evaluation levels. The water quality evaluation level may be an ecological evaluation level, a narrative or a numeric standard. If less than 10 results were collected, then no comparison to evaluation levels was made. When more than 10 percent of the results exceeded the evaluation level (10% criteria), a binomial statistical test was employed to determine how much statistical confidence there is that the results statistically exceed the 10% criteria. If at least 95% confidence was found that a 10% exceedance occurred, then that is termed a statistically significant exceedance (SSE). This method was applied for all parameters with an evaluation level, except for fecal coliform bacteria, which uses a 20% criteria in most waters as well as a geometric mean criteria. See page 9-10 for an explanation of fecal coliform methods. The results of the data analysis are displayed in tables, box plots, scatter plots, and maps. For complete summaries on each station, reference the AMS Station Summary Sheets located in Appendix A.

This review of water quality exceedances was performed using data that were collected between January 1, 2005 and December 31, 2009 at 20 sites in the Roanoke Basin. A total of four sites were found with SSEs. None of these sites were found to have more than one SSE, however. SSEs were found for turbidity at three sites, and dissolved oxygen at one site. Four sites with 10% exceedances did not rise to the level of SSEs, and 12 sites did not have any 10% exceedances.

Table 1 summarizes areas of potential concern in the Roanoke River Basin using these criteria. While reading the table please note the following: The majority of the parameters listed are compared directly to their standards. There is one exception, however. The fecal coliform standard requires that five samples be taken in the span of 30 days, which was not done for this data. Therefore any fecal coliform reviews should be taken as a screening only.

With three of the four SSEs being for turbidity and three more having 10% exceedances, turbidity appears to be the most common issue in the basin. Degraded vegetative buffers and increasing acreage of impervious surface may be related to the turbidity exceedances. Otherwise there are no areas of particular concern in the Roanoke River Basin using these criteria. However, long term trending indicates that specific conductance is increasing over time at multiple locations. This may indicate that impacts to the river basin are increasing and there may be increases in exceedances in the future.

Table 1. Areas of Concern in the Roanoke River Basin

station	Location	Stream Class	Parameter	%Exceed	%Conf
HUC 03010103: Dan River Headwaters					
N0150000	Dan River at NC 704 near Francisco	C Tr	Turbidity (> 10 NTU)	22.4%	99.9%
N1400000	Mayo River at SR 1358 near Price	WS-V	Turbidity (> 50 NTU)	10.2%	62.3%
N2300000	Dan River at SR 2150 near Wentworth	WS-IV	Turbidity (> 50 NTU)	14.8%	92.0%
N2430000	Smith River at SR 1714 near Eden	WS-IV	Turbidity (> 50 NTU)	11.7%	75.2%
N3000000	Dan River at SR 1761 near Mayfield	C	Turbidity (> 50 NTU)	18.6%	98.7%
HUC 03010104: Dan River					
N3500000	Dan River at NC 57 at VA line at Milton	C	Fecal coliform (# colonies per 100 mL)	22.8%	76.2%
			Turbidity (> 50 NTU)	22.8%	99.9%
HUC 03010106: Lake Gaston					
N6400000	Smith Creek at US 1 near Paschall	C	D.O. (< 4 mg/L)	23.4%	99.8%
HUC 03010205: Albemarle Sound					
N9700000	Albemarle Sound at Batchelor Bay near Black Walnut	SB	pH (SU)	13.6%	86.9%

INTRODUCTION

The DWQ's Ambient Monitoring System (AMS) is a network of stream, lake, and estuarine stations strategically located for the collection of physical and chemical water quality data. The stations are located at convenient access points (e.g. bridge crossings) that are sampled on a monthly basis. These locations were chosen to characterize the effects of point source dischargers and nonpoint sources such as agriculture, animal operations, and urbanization within watersheds.

The data are used to identify long term trends within watersheds, to develop Total Maximum Daily Loads (TMDLs) and to compare measured values with water quality standards to identify possible areas of impairment. Parametric coverage is determined by freshwater or saltwater waterbody classification and corresponding water quality standards. Under this arrangement, core parameters are based on Class C waters with additional parameters added when justified (**Table 2**).

Within this document, an analysis of how monitoring results compare with water quality standards and evaluation levels is presented. An educational and conceptual overview of water quality standards is provided at: http://www.epa.gov/waterscience/standards. Specific information on North Carolina water quality standards is provided at: http://portal.ncdenr.org/web/wq/ps/mtu/assessment. A summary of selected water quality standards are listed in **Table 3**.

Water quality data are evaluated in five year periods. Some stations have little or no data for several parameters over the period. However, for the purpose of standardization, data summaries for each station are included in this report. DWQ monitored water quality and collected samples at 6 stations in the basin throughout the assessment period. The locations of the sampling sites are illustrated in **Figure 1**, and listed in **Table 4**.

In January 2007 the DWQ began collection of samples from a series of randomly determined sites. A description of the Random Ambient Monitoring System (RAMS) can be found here: http://portal.ncdenr.org/web/wq/ess/eco/rams. There are currently two RAMS sites located in the Roanoke River Basin. Because this report assesses in a five-year window and RAMS stations will only have 2 years of data, they are not included in the ambient report. Once a sufficient number of samples have been collected statewide, RAMS data will be discussed in a separate report.

Table 2. Parametric coverage for the Ambient Monitoring System.

Parameter
Dissolved oxygen (s)
pH (s)
Specific conductance
Temperature (s)
Total phosphorus
Ammonia as N
Total Kjeldahl as N
Nitrate+nitrite as N (s)
Total suspended solids
Turbidity (s)
Fecal coliform bacteria (s)
Chlorophyll *a* (s)

Notes:
An 's' indicates the parameter has a numeric standard.
Chlorophyll *a* and nutrient sampling is only done in areas of concern, such as NSW, estuaries, lakes, and areas with known enrichment issues.

Table 3. Selected Water Quality Standards

	Standards for All Freshwater			Standards to Support Additional Uses		
Parameter	Aquatic Life	Human Health	Water Supply Classifications	Trout Water	HQW	Swamp Waters
Chloride (mg/l)	230		250			
Chlorophyll *a* (ug/L)	40[2]			15[2]		
Coliform, total (MFTCC/100 ml)[3]			50[2] (WS-I only)			
Coliform, fecal (MFFCC/100 ml)[4]		200[2]				
Dissolved oxygen (mg/L)	4.0[5,6]			6.0		[2,6]
Hardness, total (mg/L)			100			
Nitrate nitrogen (mg/L)			10			
pH (units)	6.0 - 9.0[2,6]					[2,6]
Solids, total suspended (mg/L)					10 Trout, 20 other[7]	
Turbidity (NTU)	50, 25[2]			10[2]		

Notes:
Standards apply to all classifications. For the protection of water supply and supplemental classifications, standards listed under Standards to Support Additional Uses should be used unless standards for aquatic life or human health are listed and are more stringent. Standards are the same for all water supply classifications (Administrative Code 15A NCAC 2B 0200, eff. August 1, 2005).
[2]Refer to 2B.0211 for narrative description of limits.
[3]Membrane filter total coliform count per 100 ml of sample.
[4]Membrane filter fecal coliform count per 100 ml of sample.
[5]An instantaneous reading may be as low as 4.0 mg/L, but the daily average must be 5.0 mg/L or more.
[6]Designated swamp waters may have a dissolved oxygen less than 5.0 mg/L and a pH as low as 4.3, if due to natural conditions.
[7]For effluent limits only, refer to 2B.0224(1)(b)(ii).

	Standards for All Saltwater			Standards To Support Additional Uses	
Parameter (µg/L, unless noted)	Aquatic Life	Human Health[1]	Class SA[2]	HQW	Swamp Waters
Chlorophyll *a* (corrected)	40[3]				
Coliform, fecal (MFFCC/100ml)[4]		200[3]	14[3]		
Dissolved oxygen (mg/L)	5.0[8]			6.0	[3,5]
PH (units)	6.8 - 8.5[5]				[3,5]
Solids, total suspended (mg/L)				10 PNA[6], 20 other[7]	
Turbidity (NTU)	25[3]				

[1]Standards are based on consumption of fish only unless dermal contact studies are available, see 2B.0208 for equation.
[2]Class SA = shellfishing waters, see 2B.0101 for description.
[3]See 2B.0220 for narrative description of limits.
[4]MFFCC/100ml means membrane filter fecal coliform count per 100 ml of sample.
[5]Designated swamp waters may have a dissolved oxygen less than 5.0 mg/L and a pH as low as 4.3 s.u., if due to natural conditions.
[6]PNA = Primary Nursery Areas.
[7]For effluent limits only, see 2B.0224.
[8]Swamp waters, poorly flushed tidally influenced streams, or embayments, or estuarine bottom waters may have lower values if caused by natural conditions.

Figure 1. DWQ's Ambient Monitoring System in the Roanoke River Basin.
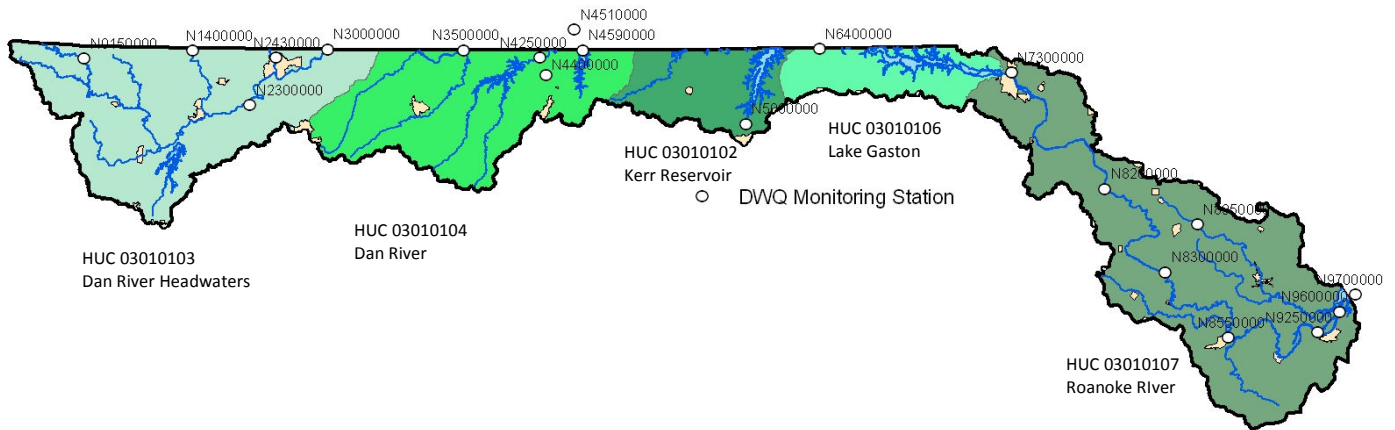
Table 4. Monitoring stations in the Roanoke River Basin

Station	Location	Stream Class	First Sample	Latitude	Longitude
Dan River Headwaters: HUC 03010103					
N0150000	Dan Riv At Nc 704 Nr Francisco	C Tr	1/26/1981	36.5146	-80.3028
N1400000	Mayo Riv At Sr 1358 Nr Price	WS-V	7/1/1984	36.5351	-79.9912
N2300000	Dan Riv At Sr 2150 Nr Wentworth	WS-IV	9/26/1968	36.4106	-79.8269
N2430000	Smith Riv At Sr 1714 Nr Eden	WS-IV	6/1/2000	36.5209	-79.7528
N3000000	Dan Riv At Sr 1761 Nr Mayfield	C	9/10/1973	36.5414	-79.6053
Dan River: HUC 03010104					
N3500000	Dan Riv At Nc 57 At Va Line At Milton	C	9/10/1968	36.5408	-79.2142
N4250000	Hyco Riv Below Afterbay Dam Nr Mcghees Mill	C	11/20/1980	36.5235	-78.996
N4400000	Marlowe Crk At Sr 1322 Nr Woodsdale	C	6/10/1968	36.4833	-78.9794
N4510000	Hyco Riv At Us 501 Nr Denniston Va	III NT	10/15/1984	36.5881	-78.8981
N4590000	Mayo Crk At Sr 1501 Nr Bethel Hill	C	10/15/1984	36.5402	-78.8736
Kerr Reservoir: HUC 03010102					
N5000000	Nutbush Crk At Sr 1317 Nr Henderson	C	9/10/1973	36.3691	-78.4083
Lake Gaston: HUC 03010106					
N6400000	Smith Crk At Us 1 Nr Paschall	C	12/27/1972	36.5409	-78.1951
Roanoke River: HUC 03010107					
N7300000	Roanoke Riv At Nc 48 At Roanoke Rapids	WS-IV CA	9/23/1968	36.4815	-77.6453
N8200000	Roanoke Riv At Us 258 Nr Scotland Neck	C	11/1/1974	36.2093	-77.3839
N8300000	Roanoke Riv At Nc 11 Nr Lewiston	C	10/1/1973*	36.014	-77.2149
N8550000	Roanoke Riv At Us 13 And Us 17 At Williamston	C	5/14/1982	35.8599	-77.0401
N8950000	Cashie Riv At Sr 1219 Nr Lewiston	C Sw	8/1/1984	36.1238	-77.1214
N9250000	Roanoke Riv 1.3 Mi Ups Welch Crk Nr Plymouth	C Sw	5/14/1982	35.8677	-76.7854
N9600000	Roanoke Riv At Nc 45 At Sans Souci	C Sw	3/18/1974	35.9147	-76.7225
Albemarle Sound: HUC 03010205					
N9700000	Albemarle Sound At Batchelor Bay Nr Black Walnut	SB	3/16/1973	35.9533	-76.676

notes:

N8300000 became inactive after 11/1/2007.

Primary Water Use Classifications	Secondary Water Use Classifications
C: Aquatic Life	Sw: Swamp Water
B: Primary Recreation	HQW: High Quality Water
WS-I, WS-II, WS-III, WS-IV, WS-V: Water Supply	ORW: Outstanding Resource Water
SA: Saltwater Shellfish Harvesting	Tr: Trout Waters
SB: Saltwater Primary Recreation	CA, +: Critical Area
SC: Saltwater Aquatic Life	

PARAMETERS

Dissolved Oxygen

Dissolved oxygen is one of the most important of all the chemical measurements. Dissolved oxygen provides valuable information about the ability of the water to support aquatic life and the capacity of water to assimilate point and nonpoint discharges. Water quality standards for dissolved oxygen vary depending on the classification of the body of water. For freshwaters, 15A NCAC 02B .0211 (3)(b) specifies:

Dissolved oxygen: not less than 6.0 mg/l for trout waters; for non-trout waters, not less than a daily average of 5.0 mg/l with a minimum instantaneous value of not less than 4.0 mg/l; swamp waters, lake coves or backwaters, and lake bottom waters may have lower values if caused by natural conditions.

For saltwaters, 15A NCAC 02B .0220 (3)(b) applies instead:

Dissolved oxygen: not less than 5.0 mg/l, except that swamp waters, poorly flushed tidally influenced streams or embayments, or estuarine bottom waters may have lower values if caused by natural conditions.

pH

The pH of natural waters can vary throughout the state. Low values, such as less than 7.0 Standard Units (SU), can be found in waters rich in dissolved organic matter, such as swamp lands. High values, such as greater than 7.0 SU may be found during algal blooms. Point source dischargers can also influence the pH of a stream. The measurement of pH is relatively easy; however the accuracy of field measurements is limited by the abilities of the field equipment, which is generally accurate to within 0.2 SU. This is due, in part, because the scale for measuring pH is logarithmic (i.e. a pH of 8 is ten times less concentrated in hydrogen ions than a pH of 7). The water quality standards for pH in freshwaters consider values less than 6.0 SU. or greater than 9.0 SU to warrant attention. In swamp waters, a pH below 4.3 SU. is of concern. For saltwaters, the acceptable range is more strict: 6.8 SU to 8.5 SU.

Specific Conductance

In this report, conductivity is synonymous with specific conductance. It is reported in micro-mhos per centimeter (µmhos/cm) at 25°C. Conductivity is a measure of the ability of water to conduct an electric current. The presence of ions and temperature are major factors in the ability of water to conduct a current. Clean freshwater has a low conductivity, whereas high conductivities may indicate polluted water or saline conditions. Measurements reported are corrected for temperature, thus the range of values reported over a period of time indicate the relative presence of ions in water. North Carolina freshwater streams have a natural conductance range of 17-65 µmhos/cm (USGS 1992).

Conductivity can be used to evaluate variations in dissolved mineral concentrations (ions) among sites with varying degrees of impact resulting from point source discharges. Generally, impacted sites show elevated and widely ranging values for conductivity. Water bodies that contain saltwater will also have high conductivities. Therefore those wishing to use conductivity as an indicator for problems must first account for salinity.

Turbidity

Turbidity data may denote episodic high values on particular dates or within narrow time periods. These can often be the result of intense or sustained rainfall events; however elevated values can occur at other times. In coastal areas, tidal surges can also disturb shallow estuarine sediments and naturally increase turbidity.

Nutrients

Compounds of nitrogen and phosphorus are major components of living organisms and thus are essential to maintain life. These compounds are collectively referred to as "nutrients." Nitrogen compounds include ammonia-nitrogen (NH_3-N), total Kjeldahl nitrogen (TKN) and nitrite+nitrate nitrogen (NO_2+NO_3-N). Phosphorus is measured as total phosphorus. When nutrients are introduced to an aquatic ecosystem from municipal and industrial treatment processes, or runoff from urban or agricultural land, the excessive growth of algae and other plants may occur (i.e. algal blooms and infestations).

At neutral pH in water, ammonia normally forms an ionized solution of ammonium hydroxide, with only a small amount of ammonia. However, as pH increases, more ammonia is left unionized. Unionized ammonia is toxic to fish and other aquatic organisms.

Fecal Coliform Bacteria

Concentrations of fecal coliform bacteria can vary greatly. The descriptive statistics used to evaluate fecal coliform bacteria data include the geometric mean and the median depending on the classification of the waterbody. For all sites in the Roanoke River Basin, the standard specified in Administrative Code 15A NCAC 02B.0211 (3)(e) (May 1, 2007) is applicable:

"Organisms of the coliform group: fecal coliforms shall not exceed a geometric mean of 200/100ml (MF count) based upon at least five consecutive samples examined during any 30 day period, nor exceed 400/100ml in more than 20 percent of the samples examined during such period; violations of the fecal coliform standard are expected during rainfall events and, in some cases, this violation is expected to be caused by uncontrollable nonpoint source pollution; all coliform concentrations are to be analyzed using the membrane filter technique unless high turbidity or other adverse conditions necessitate the tube dilution method; in case of controversy over results, the MPN 5-tube dilution technique shall be used as the reference method."

For waters where commercial shellfishing is done (Class SA), an additional water quality standard is applied (15A NCAC 02B .0221 (3)(d) (May 1, 2007):

Organisms of coliform group: fecal coliform group not to exceed a median MF of 14/100 ml and not more than 10 percent of the samples shall exceed and MF count of 43/100 ml in those areas most probably exposed to fecal contamination during the most unfavorable hydrographic and pollution conditions.

While the Roanoke River Basin contains salt waters, it does not contain Class SA waters. All sites where the geometric mean was greater than 200 colonies/100ml, or where greater than 20 percent of the results exceed 400 colonies/100ml (i.e. all sites that exceed the evaluation level) are indicated on the respective station summary sheets.

Fecal coliform problems are screened using annual summaries of Ambient sampling results. If the screening indicates that the station may be in violation of the standard, the standard is assessed using the method required by law. All such class B (and class SB/SA in coastal basins) waters are assessed, and other waters as resources permit. The required assessment method is known as "5 in 30", collecting a minimum five samples within a span of 30 days. If a water body exceeds the standard more then 20% of the time during the 30-day period or the geomean for the 30-day period is greater than 200, then that water body is considered impaired and is added to the impaired water list, the 303(d) list.

In addition, for all tidal salt waters, the following is applicable 15A NCAC 02B .0220 (3)(e) (May 1, 2007):

Enterococcus, including Enterococcus faecalis, Enterococcus faecium, Enterococcus avium, and Enterococcus gallinarium: not to exceed a geometric mean of 35 enterococci per 100 ml based upon a minimum of five samples within any consecutive 30 days.

DWQ does not collect Enterococcus samples. The N.C. Recreational Water Quality Program (NCRWQP) collects enterococcus samples. Their mission is to protect the public health by monitoring the quality of N.C.'s coastal recreational waters and notifying the public when bacteriological standards for safe bodily contact are exceeded. The coastal waters monitored include the ocean beaches, sounds, bays and estuarine rivers.

Enterococcus bacteria is an indicator organism found in the intestines of warm-blooded animals. While it may not cause illness itself, its presence is correlated with that of organisms that can cause illness. The program tests 239 ocean and sound-side areas. Swimming season begins on April 1st and ends Sept. 30th. All ocean beaches and high-use sound-side beaches (Tier 1) are tested weekly. Lower-use beaches (Tier 2 and Tier 3) are tested twice a month. All sites are tested twice a month in October and monthly from November through March. The NCRWQP currently uses single sample test to determine compliance with their rules (15A NCAC 18A .3402):

(a) The Enterococcus level in a Tier I swimming area shall not exceed either:
> *(1)   A geometric mean of 35 enterococci per 100 milliliter of water, that includes a minimum of at least five samples collected within 30 days; or*
> *(2)   A single sample of 104 enterococci per 100 milliliter of water.*

(b) The enterococcus level in a tier II swimming area shall not exceed a single sample of 276 enterococci per 100 milliliter of water.

(c) The enterococcus level in a tier III swimming area shall not exceed two consecutive samples of 500 enterococci per 100 milliliter of water"

The results of their sampling can be found on their website:
 http://www.deh.enr.state.nc.us/shellfish/Water_Monitoring/RWQweb/home.htm

WATER QUALITY MONITORING RESULTS SUMMARY

Water Quality within the basin during the evaluation period is summarized in the following tables. **Table 5** shows how often water quality evaluation levels were exceeded. **Table 6** shows average values, for comparison against HUC and basinwide averages.

Table 5. Frequency of Evaluation Level Exceedances

Station ID	Stream Class	Dissolved Oxygen (<4 mg/L)	Dissolved Oxygen (<5 mg/L) Salt Waters	pH (<6 SU)	pH (<4.3 SU) Swamp Water	pH (<6.8 SU) Salt Water	Turbidity (>10 NTU) Trout Waters	Turbidity (>50 NTU)	Fecal Coliform (>400 colonies/100 mL)
HUC 03010103 - Dan River Headwaters									
N0150000	C Tr	NA	NA	0.0%	NA	NA	22.4%	NA	6.9%
N1400000	WS-V	0.0%	NA	0.0%	NA	NA	NA	10.2%	15.5%
N2300000	WS-IV	0.0%	NA	0.0%	NA	NA	NA	14.8%	16.4%
N2430000	WS-IV	0.0%	NA	0.0%	NA	NA	NA	11.7%	18.3%
N3000000	C	0.0%	NA	0.0%	NA	NA	NA	18.6%	18.6%
HUC 03010104 - Dan River									
N3500000	C	0.0%	NA	0.0%	NA	NA	NA	22.8%	22.8%
N4250000	C	0.0%	NA	2.1%	NA	NA	NA	0.0%	0.0%
N4400000	C	0.0%	NA	0.0%	NA	NA	NA	4.3%	10.6%
N4510000	III NT	NA	NA	NA	NA	NA	NA	NA	NA
N4590000	C	0.0%	NA	0.0%	NA	NA	NA	0.0%	2.2%
HUC 03010102 - Kerr Reservoir									
N5000000	C	0.0%	NA	0.0%	NA	NA	NA	0.0%	8.3%
HUC 03010105 - Lake Gaston									
N6400000	C	23.4%	NA	8.3%	NA	NA	NA	8.3%	4.2%
HUC 03010106 - Roanoke River									
N7300000	WS-IV CA	0.0%	NA	0.0%	NA	NA	NA	0.0%	0.0%
N8200000	C	0.0%	NA	2.1%	NA	NA	NA	0.0%	0.0%
N8300000	C	0.0%	NA	0.0%	NA	NA	NA	0.0%	0.0%
N8550000	C	0.0%	NA	1.7%	NA	NA	NA	0.0%	1.7%
N8950000	C Sw	0.0%	NA	NA	3.8%	NA	NA	7.7%	7.7%
N9250000	C Sw	0.0%	NA	NA	0.0%	NA	NA	0.0%	0.0%
N9600000	C Sw	0.0%	NA	NA	0.0%	NA	NA	0.0%	0.0%
HUC 03010205 - Albemarle Sound									
N9700000	SB	NA	1.7%	NA	NA	13.6%	NA	NA	0.0%

notes:

NA: This evaluation level is **Not Applicable** for this parameter in this stream class.

NC: Samples for this parameter were **Not Collected**.

L10: **Less than ten** samples were collected for this parameter.

If there are no exceedances for a given combination of evaluation level, stream class, and parameter, then that column is not included in the table.

1. There were no exceedances for **water temperature** or **chlorophyll a** during the assessment period.
2. There were no exceedances for **dissolved oxygen in trout waters** during the assessment period.
3. There were no exceedances for **turbidity in salt waters** during the assessment period.
4. There were no exceedances for **nitrates & nitrites in water supply waters** during the assessment period.

Table 6a. Summary of Water Quality Parameter Averages

Station	Stream Class	Water Temperature (°C)		D.O. (mg/L)		pH (SU)		Spec. conductance (umhos/cm at 25°C)		Turbidity (NTU)		Fecal coliform (# colonies per 100mL)		Chlorophyll a (ug/L)	
		n	mean	n	mean	n	mean	n	mean	n	mean	n	mean	n	mean
Entire Basin		1054	16.6	1033	9.0	1051	7.1	1040	190.6	1053	18.8	1047	34	165	4.9
HUC 03010103		296	15.7	295	10.2	296	7.5	287	78.7	297	34.3	296	81	0	NC
N0150000	C Tr	58	14.9	57	10.7	58	7.6	56	52.0	58	22.5	58	42	0	NC
N1400000	WS-V	59	15.1	59	10.5	59	7.6	57	59.2	59	45.7	58	100	0	NC
N2300000	WS-IV	60	16.2	60	9.9	60	7.4	58	81.1	61	39.5	61	102	0	NC
N2430000	WS-IV	60	15.1	60	10.4	60	7.5	58	80.3	60	26.1	60	93	0	NC
N3000000	C	59	17.1	59	9.7	59	7.5	58	119.7	59	37.6	59	87	0	NC
HUC 03010104		249	16.5	241	9.4	249	7.1	244	179.7	245	14.5	241	34	0	NC
N3500000	C	57	17.4	57	9.5	57	7.5	56	144.9	57	40.3	57	95	0	NC
N4250000	C	48	17.0	46	9.1	48	7.0	47	154.0	47	5.3	44	9	0	NC
N4400000	C	48	15.1	46	9.9	48	7.1	47	314.1	47	9.4	47	82	0	NC
N4510000	III NT	48	16.0	46	8.9	48	6.9	47	171.6	47	10.7	47	61	0	NC
N4590000	C	48	16.6	46	9.4	48	7.0	47	120.7	47	1.6	46	8	0	NC
HUC 03010102		48	15.7	47	9.9	47	7.3	48	462.4	48	3.9	48	116	2	7.0
N5000000	C	48	15.7	47	9.9	47	7.3	48	462.4	48	3.9	48	116	2	7.0
HUC 03010105		48	15.4	47	6.4	48	6.6	48	104.0	48	18.1	48	61	0	NC
N6400000	C	48	15.4	47	6.4	48	6.6	48	104.0	48	18.1	48	61	0	NC
HUC 03010106		354	17.4	344	7.8	352	6.9	354	125.1	356	12.7	355	19	109	4.8
N7300000	WS-IV CA	48	17.3	43	9.1	47	7.0	48	108.4	48	5.0	48	7	0	NC
N8200000	C	48	17.5	43	8.8	47	6.9	48	118.4	48	11.5	48	36	0	NC
N8300000	C	29	18.0	29	9.0	29	7.3	29	113.6	29	17.1	29	39	0	NC
N8550000	C	59	17.8	59	8.4	59	7.1	59	116.4	61	16.5	60	31	0	NC
N8950000	C Sw	52	15.0	52	4.4	52	5.8	52	118.6	52	21.0	52	65	0	NC
N9250000	C Sw	59	18.0	59	8.2	59	7.0	59	115.1	59	10.5	59	9	55	5.2
N9600000	C Sw	59	18.2	59	7.8	59	7.0	59	174.2	59	8.6	59	7	54	4.4
HUC 03010205		59	17.8	59	8.8	59	7.2	59	1022.8	59	7.7	59	4	54	4.9
N9700000	SB	59	17.8	59	8.8	59	7.2	59	1022.8	59	7.7	59	4	54	4.9

notes:

NC: Samples for this parameter were **Not Collected**.

All means are arithmetic except for fecal coliform, which are geometric.

Table 6b. Summary of Water Quality Parameter Averages (Nutrients)

Station	Stream Class	Total Inorganic Nitrogen (mg/L)		Total Organic Nitrogen (mg/L)		NH3 as N (mg/L)		NO2 + NO3 as N (mg/L)		TKN as N (mg/L)		Total Phosphorus (mg/L)	
		n	mean	n	mean	n	mean	n	mean	n	mean	n	mean
Entire Basin		626	1.03	626	0.40	626	0.04	623	1.00	608	0.43	623	0.10
HUC 03010103		119	0.28	119	0.32	119	0.03	119	0.26	119	0.35	119	0.07
N0150000	C Tr	58	0.37	58	0.29	58	0.03	58	0.34	58	0.32	58	0.06
N1400000	WS-V	0	NC	0	NC	0	NC	0	NC	0	NC	0	NC
N2300000	WS-IV	61	0.20	61	0.35	61	0.02	61	0.18	61	0.37	61	0.08
N2430000	WS-IV	0	NC	0	NC	0	NC	0	NC	0	NC	0	NC
N3000000	C	0	NC	0	NC	0	NC	0	NC	0	NC	0	NC
HUC 03010104		1	0.89	1	0.51	1	0.02	1	0.87	1	0.53	1	0.30
N3500000	C	0	NC	0	NC	0	NC	0	NC	0	NC	0	NC
N4250000	C	0	NC	0	NC	0	NC	0	NC	0	NC	0	NC
N4400000	C	1	0.89	1	0.51	1	0.02	1	0.87	1	0.53	1	0.30
N4510000	III NT	0	NC	0	NC	0	NC	0	NC	0	NC	0	NC
N4590000	C	0	NC	0	NC	0	NC	0	NC	0	NC	0	NC
HUC 03010102		47	11.40	47	0.46	47	0.02	46	11.38	45	0.49	45	0.41
N5000000	C	47	11.40	47	0.46	47	0.02	46	11.38	45	0.49	45	0.41
HUC 03010105		48	0.12	48	0.47	48	0.08	47	0.04	45	0.55	46	0.09
N6400000	C	48	0.12	48	0.47	48	0.08	47	0.04	45	0.55	46	0.09
HUC 03010106		352	0.19	352	0.41	352	0.03	351	0.16	340	0.44	353	0.09
N7300000	WS-IV CA	48	0.13	48	0.27	48	0.02	48	0.11	47	0.29	48	0.04
N8200000	C	48	0.18	48	0.28	48	0.02	47	0.16	46	0.30	47	0.04
N8300000	C	29	0.25	29	0.29	29	0.02	28	0.23	28	0.32	29	0.08
N8550000	C	58	0.24	58	0.32	58	0.02	58	0.22	57	0.35	59	0.06
N8950000	C Sw	51	0.09	51	1.02	51	0.05	52	0.04	47	1.06	52	0.27
N9250000	C Sw	59	0.22	59	0.33	59	0.03	59	0.20	58	0.35	59	0.06
N9600000	C Sw	59	0.26	59	0.36	59	0.07	59	0.19	57	0.43	59	0.06
HUC 03010205		59	0.17	59	0.38	59	0.04	59	0.14	58	0.42	59	0.05
N9700000	SB	59	0.17	59	0.38	59	0.04	59	0.14	58	0.42	59	0.05

notes:

NC: Samples for this parameter were **Not Collected**.

ASSESSMENT AND INTERPRETATION METHODS

Monitoring and sampling results considered in this report represent samples collected or measurements taken at less than one-meter depth, except for chlorophyll a, which may be collected as a composite over the entire photic depth.

Percentile statistics were calculated for most of the data using JMP statistical software (version 8.02; SAS Institute, Cary, NC). Values less than the minimum reporting level (non-detects) were evaluated as equal to the reporting level. Box and whisker plots (constructed using SigmaPlot version 9) and maps are presented for most water quality parameters collected at each monitoring station. Significant trends in water quality parameters (constructed using Microsoft Excel) are illustrated as scatterplots. Significant trends are found by assessing the probability that the linear model explains the data no better than chance. If that chance is 5% or less (an observed significance probability of 0.05 or less) then that is considered evidence of a regression effect in

this document. The strength of the regression effect is given as an r^2 value, the portion of the data that is explained by the linear model. There are many other types of modeling (non-linear) that can be used to explore trends, but they were not used in this document.

Assessment Considerations

Total Metals

The North Carolina Division of Water Quality is currently reviewing water quality standards for metals. Review of historical total metals data and biological data has shown that no correlation exists between exceedance of total metals ambient standards and biological impairment. Therefore, as of May 2007 DWQ has suspended collection of total metals at AMS stations.

Providing Confidence in the Exceedance of Water Quality Standards

Historically, NC DWQ has used guidance provided by the US EPA for determining when the number of results that exceed a water quality standard indicate potential water quality issues. The US EPA has suggested that management actions be implemented when 10 percent of the results exceeded a water quality standard. This interpretation is the same whether 1 out of 10, or 5 out of 50, or 25 out of 250 results exceed a standard. Evaluating exceedances in this manner is termed the "raw-score" approach. Although this "10 percent exceedance criterion" defines a point where potential water quality issues may be present, it does not consider uncertainty. Some results are subject to chance or other factors such as calibration errors or sample mishandling. Uncertainty levels change with sample size. The smaller the sample size, the greater the uncertainty.

This document uses a nonparametric procedure (Lin *et al.* 2000) to identify when a sufficient number of exceedances have occurred that indicate a true exceedance probability of 10 percent. Calculating the minimum number of exceedances needed for a particular sample size was done using the BINOMDIST function in Microsoft Excel[®]. This statistical function suggests that at least three exceedances need to be observed in a sample of 10 in order to be [about] 95 percent confident that the results statistically exceed the water quality standard more than 10% of the time. For example, there is less statistical confidence associated with a 1 exceedance out of 10 (74 percent) than when there are 3 exceedances out of 10 (99 percent confidence) (**Table 7**).

Table 7. Exceedance Confidence

Number of Samples	Number of Exceedances																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
10	74%	93%	99%	100%	100%	100%	100%	100%	100%	100%							
12	66%	89%	97%	100%	100%	100%	100%	100%	100%	100%	100%	100%					
14	58%	84%	96%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%			
16	51%	79%	93%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
18	45%	73%	90%	97%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
20	39%	68%	87%	96%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
22	34%	62%	83%	94%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
24	29%	56%	79%	91%	97%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
26	25%	51%	74%	89%	96%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
28	22%	46%	69%	86%	94%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
30	18%	41%	65%	82%	93%	97%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
32	16%	37%	60%	79%	91%	96%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
34	13%	33%	55%	75%	88%	95%	98%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%
36	11%	29%	51%	71%	85%	94%	98%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%
38	10%	25%	46%	67%	83%	92%	97%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%
40	8%	22%	42%	63%	79%	90%	96%	98%	99%	100%	100%	100%	100%	100%	100%	100%	100%
42	7%	20%	38%	59%	76%	88%	95%	98%	99%	100%	100%	100%	100%	100%	100%	100%	100%
44	6%	17%	35%	55%	73%	85%	93%	97%	99%	100%	100%	100%	100%	100%	100%	100%	100%
46	5%	15%	31%	51%	69%	83%	92%	96%	99%	100%	100%	100%	100%	100%	100%	100%	100%
48	4%	13%	28%	47%	65%	80%	90%	95%	98%	99%	100%	100%	100%	100%	100%	100%	100%
50	3%	11%	25%	43%	62%	77%	88%	94%	98%	99%	100%	100%	100%	100%	100%	100%	100%
52	3%	10%	22%	40%	58%	74%	86%	93%	97%	99%	100%	100%	100%	100%	100%	100%	100%
54	2%	8%	20%	36%	54%	71%	83%	91%	96%	98%	99%	100%	100%	100%	100%	100%	100%
56	2%	7%	18%	33%	51%	67%	81%	90%	95%	98%	99%	100%	100%	100%	100%	100%	100%
58	2%	6%	16%	30%	47%	64%	78%	88%	94%	97%	99%	100%	100%	100%	100%	100%	100%
60	1%	5%	14%	27%	44%	61%	75%	86%	93%	97%	99%	99%	100%	100%	100%	100%	100%
62	1%	5%	12%	24%	40%	57%	72%	84%	91%	96%	98%	99%	100%	100%	100%	100%	100%
64	1%	4%	11%	22%	37%	54%	69%	81%	90%	95%	98%	99%	100%	100%	100%	100%	100%
66	1%	3%	9%	20%	34%	51%	66%	79%	88%	94%	97%	99%	99%	100%	100%	100%	100%
68	1%	3%	8%	18%	31%	47%	63%	76%	86%	93%	96%	98%	99%	100%	100%	100%	100%
70	1%	2%	7%	16%	29%	44%	60%	74%	84%	91%	96%	98%	99%	100%	100%	100%	100%
72	0%	2%	6%	14%	26%	41%	57%	71%	82%	90%	95%	97%	99%	100%	100%	100%	100%
74	0%	2%	5%	13%	24%	38%	54%	68%	80%	88%	94%	97%	99%	99%	100%	100%	100%
76	0%	1%	5%	11%	22%	35%	51%	65%	77%	86%	93%	96%	98%	99%	100%	100%	100%
78	0%	1%	4%	10%	20%	33%	48%	62%	75%	85%	91%	95%	98%	99%	100%	100%	100%
80	0%	1%	4%	9%	18%	30%	45%	59%	72%	83%	90%	95%	97%	99%	99%	100%	100%

Note: Bold entries indicate that there is at least 95% confidence that at least 10% of the possible samples exceed the evaluation level.

Methods Used to Summarize Results

Methods used to summarize the results in this report encompass both tabular and graphical formats. Box and whisker plots, scatterplots, and maps were used to depict data for a variety of water quality parameters throughout the basin. For the box plots, stations with fewer then 10 data points for a given parameter were not included. This occasionally occurred when a new station was added, an old station was removed, or a station was moved to a new location in the basin.

Individual station summary sheets provide details on station location, stream classification, along with specifics on what parameters were measured, the number of samples taken (i.e. sample size), the number of results below reporting levels, the number of results exceeding a water quality standard or evaluation level, statistical confidence that 10% of results exceeded the evaluation level, and a general overview of the distribution of the results using percentiles. These station summary sheets provide the greatest details on a station-by-station basis. They are included as **Appendix A** to this report.

The results were depicted in the following ways:
- Comparing stations – box plots
- Assessing stations – tables
- Illustrating regional variation – maps

Box and Whisker Plots

One method of analyzing data in this report is through the use of box and whisker plots. **Figure 2** is an annotated example of a box and whisker plot that illustrates the distribution of the results for a particular parameter at a single site. This box plot contains both the median and mean values. Differences between the median and mean can illustrate the distribution of the results. For example, if the mean is considerably larger then the median, then there are likely a few very high concentrations raising the mean. Another useful measure is to compare the 90th percentile against the evaluation level. For most parameters, 10% exceedance of the evaluation levels is considered a violation. Therefore the 90th (or 10th in the case of minimum evaluation levels) percentile exceeding the evaluation level is an equivalent statement. Box plots for each station are included in **Appendix B**.
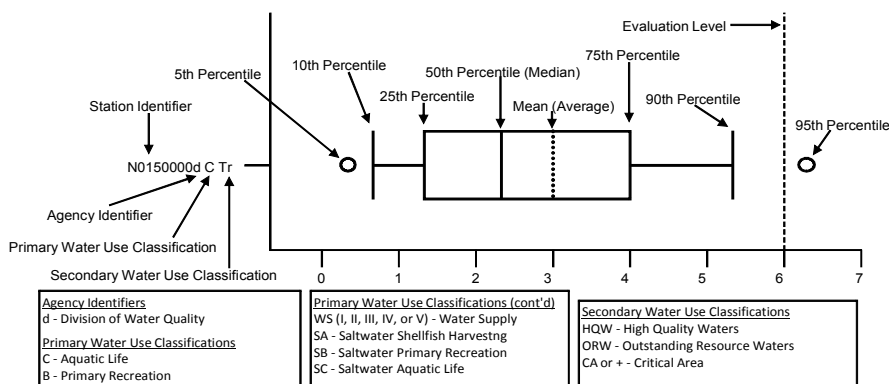
Figure 2. An Example Box Plot for a Station

Figure 3 is an example of a box and whisker plot that is comparing four HUCs for a single parameter. In this case the box plots are vertical instead of horizontal. Also note that a "mean diamond" is present on each. The center line of each diamond is the average. The short lines above and below the center are called "overlap marks" and represent a 95% confidence interval for the mean. To compare means, extend the overlap marks as shown in the figure. If the overlap mark of one diamond is closest to the mean line of another diamond then the two averages are not significantly different. If the overlap line is closer to the other diamond's overlap mark, then they are significantly different. Because there is only one HUC in the North Carolina Roanoke River basin, this type of analysis was not used.
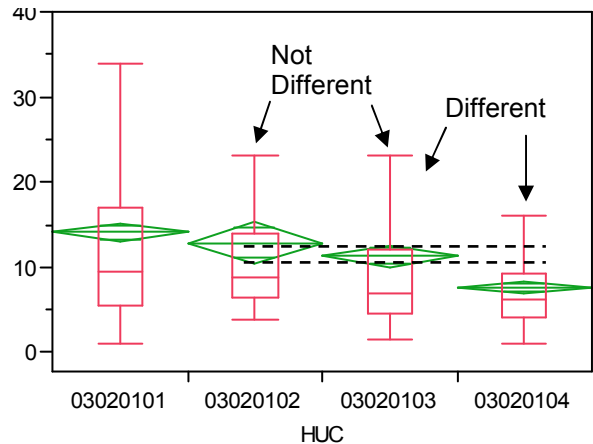
Figure 3. A Box Plot for Comparing HUCs

Scatter Plots – Change Over Time and Trends

Constructing trends helps us to answer the question, "Are things getting better or worse?" In this document change over time trends are illustrated in scatterplots. If there is at least 95% confidence that a particular linear trend explains the data better then random chance (Prob > F of 0.05 or less) then that linear trend was included on the graph. Unfortunately clear trends are rare. Confounding effects, such as flow and seasonal change can mimic or obscure a trend. The figure below on the left shows dissolved oxygen data exhibiting a strong seasonal pattern. In order to search for an underlying trend we first need to remove the seasonal component.

Linear regression can remove the seasonal effect by comparing the target parameter to another seasonally variable parameter, (in this case water temperature) and removing the variation that is common to both. Variation due to flow can be removed in the same fashion. The graph on the right shows the same dissolved oxygen data, but with the seasonal component removed. The data is considerably less variable now (as shown in the variance). The new graph still displays a trend, weaker then it was when influenced by water temperature.

Figure 4. Scatter Plot Example, Dissolved Oxygen over Time

Linear Trend r^2: 0.0529   Variance: 4.73   Linear Trend r^2: 0.0486   Variance: 1.49
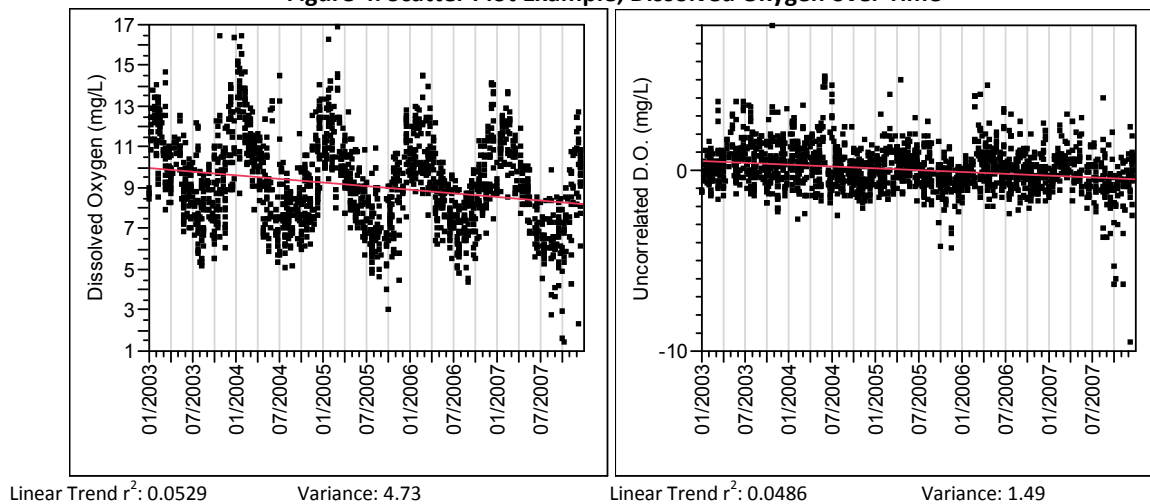
Maps

Maps are used to display data for the whole basin at once, so that the relationship of stations to each other can be seen, and regional patterns become clear. The colors signify the degree of water quality exceedance at each location.

Figure 5. Example Map
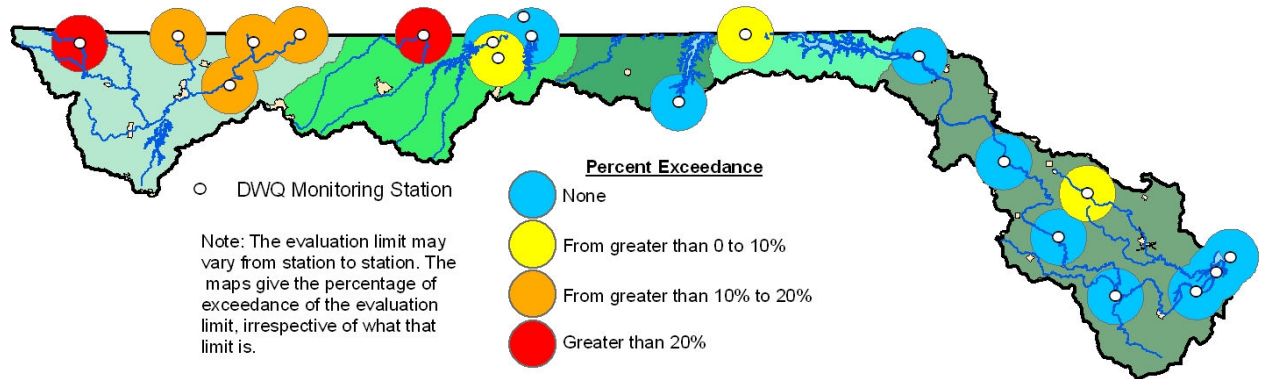
WATER QUALITY ANALYSIS

Stream Flow and Drought

The rate at which a volume of water moves through a stream (the flow rate) can have an impact on the measurement of other parameters. In particular, droughts can have major effects on parameters such as dissolved oxygen, turbidity, pH, and others by reducing stream flow. Therefore it is useful to track changes in stream flow over the course of the assessment period, to see when drought or high flow events might be present. A drought affected the Roanoke River Basin from May 2007 through March 2008, and again from June 2008 through November 2008. Figure 6 displays average monthly flows for two stations on the Dan River, located in the upper portion of the Roanoke River Basin. Data from the lower portions of the Roanoke basin are not used or displayed because of the presence of dams, which obscure flow effects.

Figure 6. Average Monthly Flow in the Roanoke River Basin
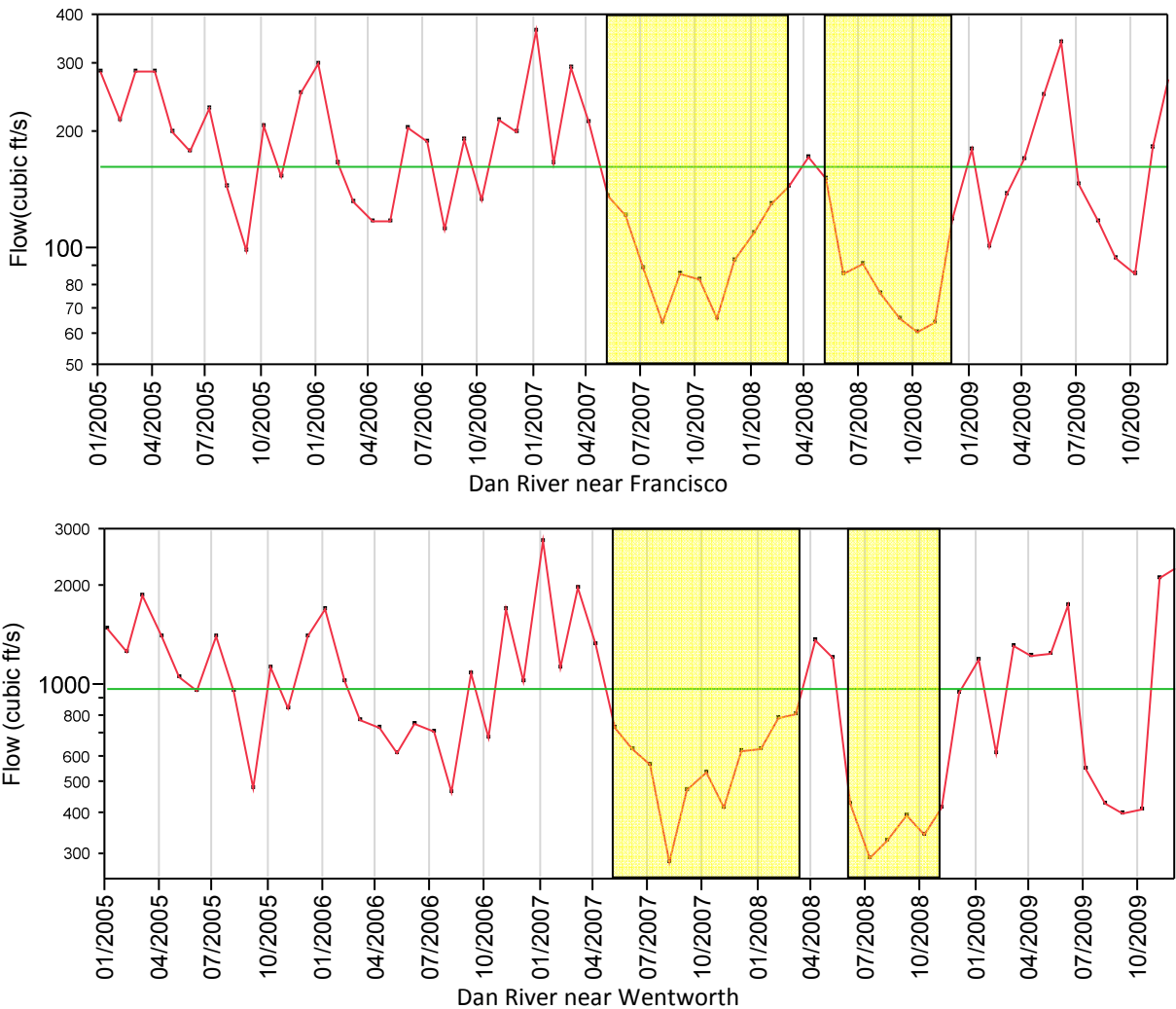
Long Term Trends

In order to develop useful long term trends, it is important to remove as many confounding effects as possible. The most common confounding effect is flow rate. Many environmental parameters can be affected by flow rate. If flow is not accounted for, a drought may accidentally be interpreted as a significant historical shift. In addition, some parameters have strong seasonal components that can be removed in order to see an underlying trend. In the following figures, confounding effects were removed when possible.

Water Quality Data collected by DWQ for the period 1980 through 2009 was downloaded from the EPA STORET database. Flow data from the USGS website was also downloaded for three stations in the Dan Headwaters Hydrologic Unit (03010103) for the same period. Flow data elsewhere in the Roanoke River basin was not used because of flow limiting controls such as dams. Flow controls can mask the relationship between flow and water quality parameters. If flow or other confounding trends were found in the data, it was removed using linear regression. Linear regression and best professional judgment was then used to evaluate change over time. Each of the three stations are presented separately.

N0150000 – Dan River at NC 704 near Francisco

Two trends were found at this station: an increasing trend for ammonia (+0.004 mg/L per year) and an increasing trend for specific conductance (+0.60 umhos/cm per year) The trends could explain 16% and 34% of the variability, respectively.

Figure 7. Long Term Trends at N0150000
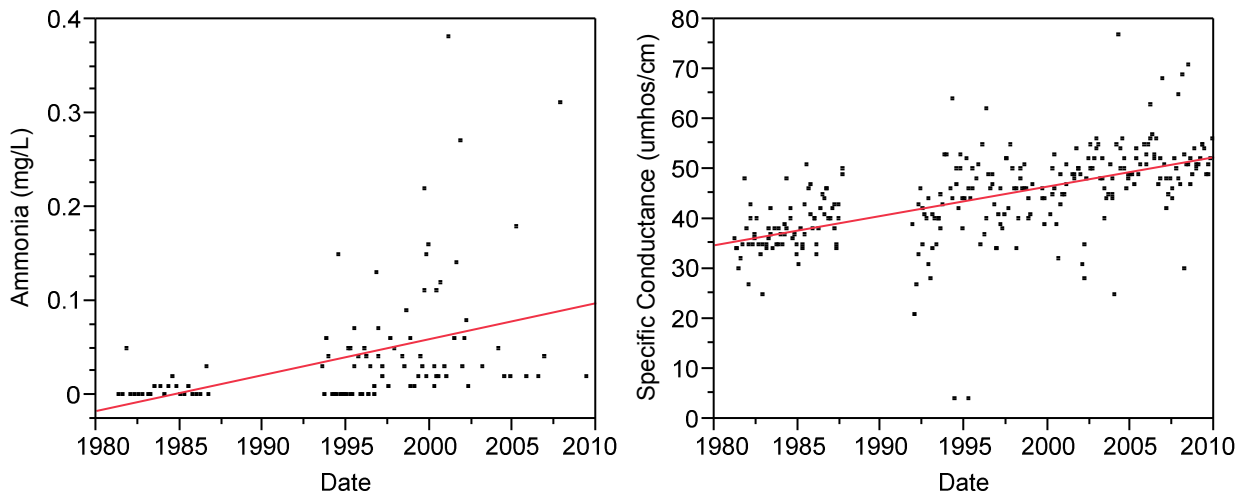
N1400000 – Mayo River at State Route 1358 near Price

One trend was found at this station: an increasing trend for specific conductance (+1.02 umhos/cm per year) The trend could explain 31% of the variability.

Figure 8. Long Term Trends at N1400000
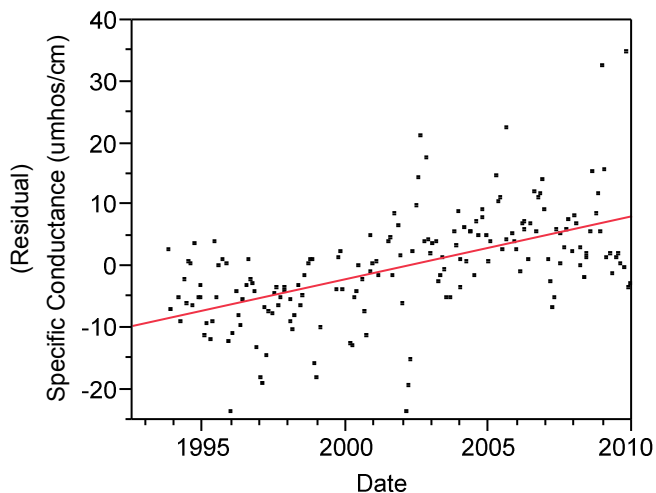
Specific Conductance was found to be correlated with flow at this station. Therefore variation in the specific conductance data related to flow was removed first, and the remaining variation (the residual) graphed versus time.

N2300000 – Dan River at State Route 2150 near Wentworth

Two trends were found at this station: an increasing trend for specific conductance (+1.0 umhos/cm per year) and an increasing trend for pH (+0.02 SU per year) The trends could explain 20% and 11% of the variability, respectively.

Figure 9. Long Term Trends at N2300000
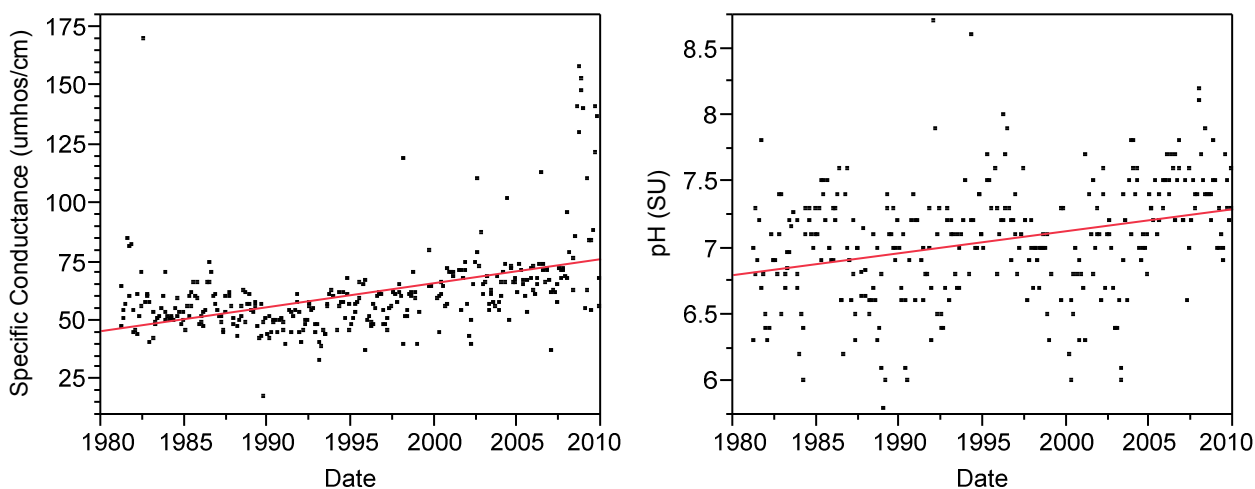
Statistically significant trends were found for specific conductance at all three sites. Clean freshwater generally has a low conductivity, whereas high conductivities may indicate polluted water. Therefore this may imply a slow change in water quality in this region of the basin.

Geographic Assessment

Figure 10. Turbidity in the Roanoke River Basin

O   DWQ Monitoring Station

Note: The evaluation limit may vary from station to station. The maps give the percentage of exceedance of the evaluation limit, irrespective of what that limit is.

Percent Exceedance

None
From greater than 0 to 10%
From greater than 10% to 20%
Greater than 20%
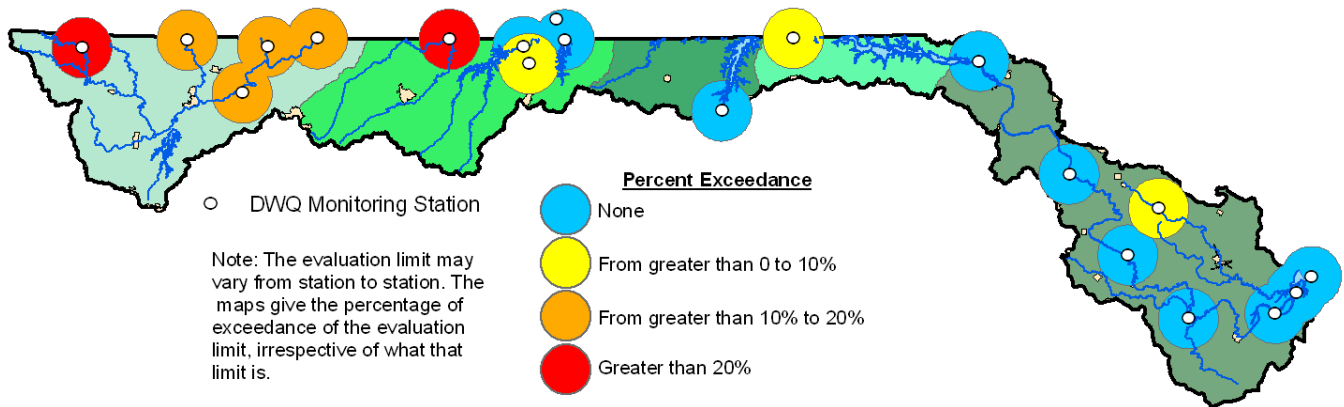
Turbidity exceedances were largely restricted to the Dan River. Episodic turbidity can be caused by heavy rains that wash sediment into streams, erode streambanks, and suspend streambed sediment. The effect is exacerbated by impermeable surfaces and a lack of vegetative buffers around streams, causing rapid increases in flow rate and avoiding the filtering and calming effects of vegetation. Other areas of the Roanoke Basin are somewhat protected from turbidity issues by dams.

Figure 11. Fecal Coliform in the Roanoke River Basin

Note: The evaluation limit may vary from station to station. The maps give the percentage of exceedance of the evaluation limit, irrespective of what that limit is.

Percent Exceedance

None
From greater than 0 to 10%
From greater than 10% to 20%
Greater than 20%
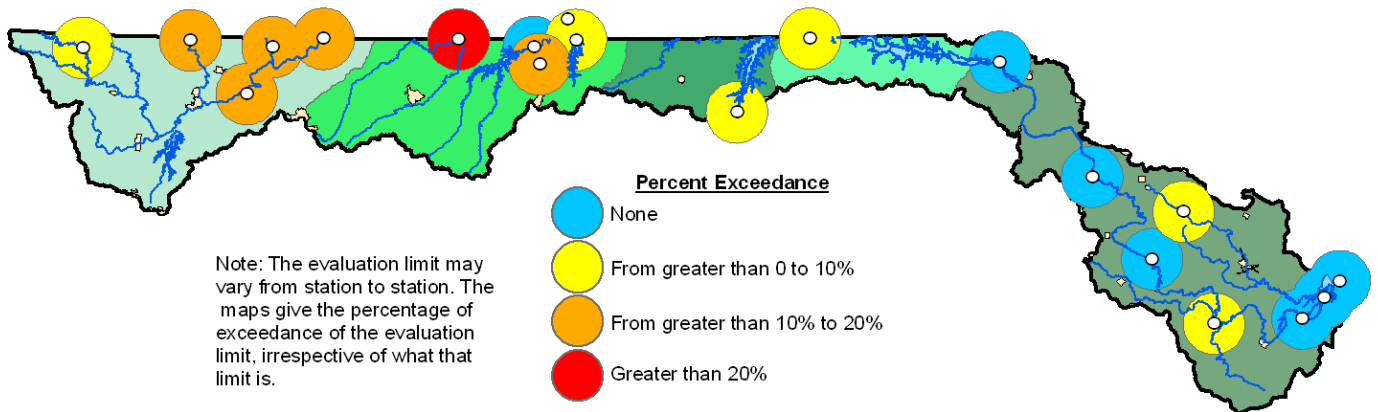
Fecal coliform exceedances are similar in distribution to turbidity, but more widespread. Turbidity and fecal coliform are often correlated as both can be caused by heavy rains. Sources of fecal coliform include urban runoff, agricultural runoff, malfunctioning septic tanks, and broken sewer lines. Additionally, fecal coliform in a streambed can be re-suspended by high flow.

Figure 12. Dissolved Oxygen in the Roanoke River Basin
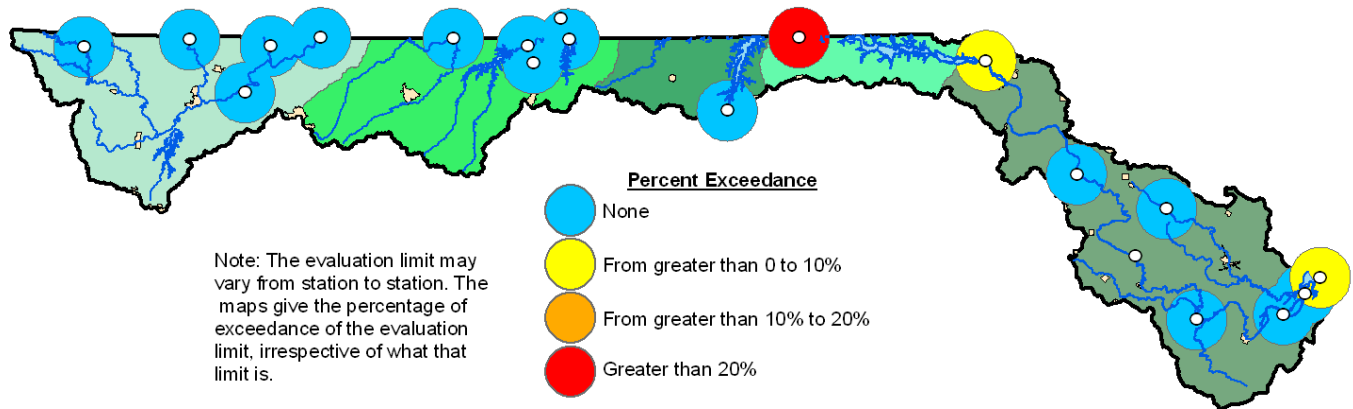
Only one station in the Roanoke Basin had more than occasional exceedance of the dissolved oxygen standard during the monitoring period. This station, N6400000, located on Smith Creek has been impaired for dissolved oxygen since at least 1996. There are no dischargers in the watershed. Therefore it is probable that the impairment is caused by either non-point sources such as several permitted agricultural operations in the area, or by natural causes, such as upstream swamp conditions.

Figure 13. pH in the Roanoke River Basin
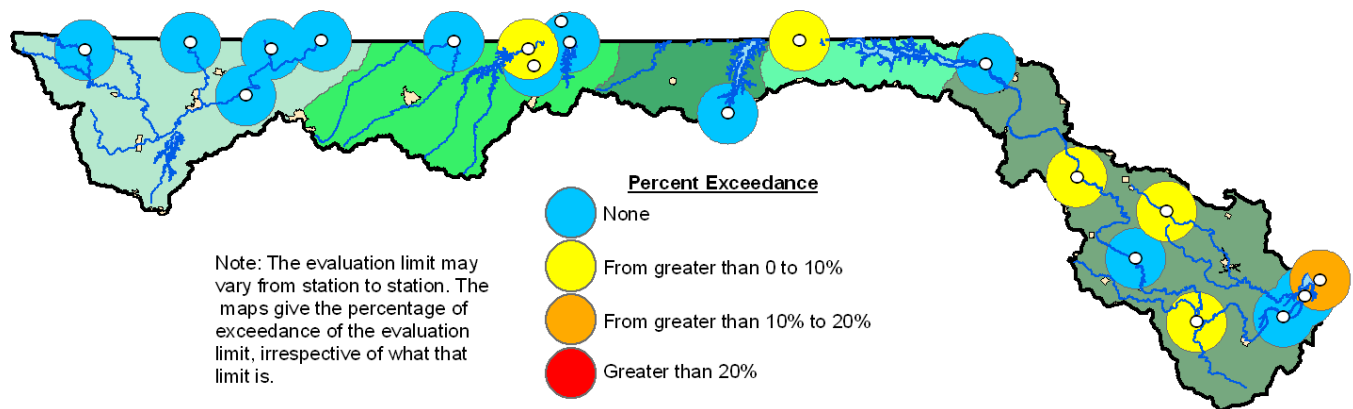
While there are several stations with occasional pH exceedances, only one station has greater than 10% exceedances, N9700000 in Albemarle sound. This station was below the standard of 6.8 SU eight out of 59 times, with the lowest recorded result being 6.4. This station is located downstream of swamp waters and has a pH similar to those upstream swamp stations. Therefore it is possible that the causes are natural.

Other Issues

Other than those already addressed in the previous section, no significant issues were identified in the Roanoke River basin. Information on specific parameters and specific stations can be found in **Appendix A** (station summary sheets) and **Appendix B** (box plots). Box plots were constructed for each of the following parameters: water temperature, dissolved oxygen, pH, specific conductance, turbidity, fecal coliform, ammonia, total kjeldahl nitrogen, total nitrates and nitrites, and total phosphorus.

Appendix A: Station Summary Sheets

Location: DAN RIV AT NC 704 NR FRANCISCO

Station #: N0150000	**Hydrologic Unit Code:** 03010103	
Latitude: 36.51459 **Longitude:** -80.30282	**Stream class:** C Tr	
Agency: NCAMBNT	**NC stream index:** 22-(1)	

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

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

Fecal Coliform Screening(#/100mL)

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

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

Location: MAYO RIV AT SR 1358 NR PRICE

Station #: N1400000   **Hydrologic Unit Code:** 03010103
Latitude: 36.53514   **Longitude:** -79.99117   **Stream class:** WS-V
Agency: NCAMBNT   **NC stream index:** 22-30-(1)

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

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

Fecal Coliform Screening(#/100mL)

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

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

Location: DAN RIV AT SR 2150 NR WENTWORTH

Station #: N2300000   **Hydrologic Unit Code:** 03010103

Latitude: 36.41055   **Longitude:** -79.82693   **Stream class:** WS-IV

Agency: NCAMBNT   **NC stream index:** 22-(31.5)

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

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

Fecal Coliform Screening(#/100mL)

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

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

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

Location: SMITH RIV AT SR 1714 NR EDEN

Station #: N2430000   **Hydrologic Unit Code:** 03010103

Latitude: 36.52087   **Longitude:** -79.75281   **Stream class:** WS-IV

Agency: NCAMBNT   **NC stream index:** 22-40-(1)

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

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

Fecal Coliform Screening(#/100mL)

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

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

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

Location: DAN RIV AT SR 1761 NR MAYFIELD

Station #: N3000000   **Hydrologic Unit Code:** 03010103

Latitude: 36.54142   **Longitude:** -79.60525   **Stream class:** C

Agency: NCAMBNT   **NC stream index:** 22-(39)

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

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

Fecal Coliform Screening(#/100mL)

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

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

Location: DAN RIV AT NC 57 AT VA LINE AT MILTON

Station #: N3500000		**Hydrologic Unit Code:** 03010104
Latitude: 36.54079	**Longitude:** -79.21422	**Stream class:** C
Agency: NCAMBNT		**NC stream index:** 22-(39)

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

	# results	# ND	EL	Results not meeting EL #	%	%Conf	Percentiles Min	10th	25th	50th	75th	90th	Max
Field													
D.O. (mg/L)	57	0	<4	0	0		6	6.6	7.3	9.5	11.4	13	13.9
	57	0	<5	0	0		6	6.6	7.3	9.5	11.4	13	13.9
pH (SU)	57	0	<6	0	0		6.4	7	7.2	7.5	7.7	7.8	8.2
	57	0	>9	0	0		6.4	7	7.2	7.5	7.7	7.8	8.2
Spec. conductance (umhos/cm at 25°C)	56	0	N/A				68	84	102	127	165	258	293
Water Temperature (°C)	57	0	>32	0	0		4.4	7.2	10.6	17.3	25.1	27.2	29.8
Other													
TSS (mg/L)	20	4	N/A				3	5.8	8.9	12	18.2	172	185
Turbidity (NTU)	57	0	>50	13	22.8	99.9	2.5	3.7	5.9	11	35.5	164	240
Metals (ug/L)													
Aluminum, total (Al)	8	0	N/A				120	120	335	515	2480	5100	5100
Arsenic, total (As)	9	9	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	9	9	>2	0	0		1	1	2	2	2	2	2
Chromium, total (Cr)	9	9	>50	0	0		10	10	25	25	25	25	25
Copper, total (Cu)	9	5	>7	0	0		2	2	2	2	4	6	6
Iron, total (Fe)	8	0	>1000	3	37.5		410	410	755	1000	3575	7100	7100
Lead, total (Pb)	9	9	>25	0	0		10	10	10	10	10	10	10
Mercury, total (Hg)	8	8	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	9	9	>88	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	9	6	>50	0	0		10	10	10	10	15	46	46

Fecal Coliform Screening(#/100mL)

# results:	Geomean	# > 400:	% > 400:	%Conf:
57	95	13	22.8	76.2

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

Location: HYCO RIV BELOW AFTERBAY DAM NR MCGHEES MILL
Station #: N4250000   **Hydrologic Unit Code:** 03010104
Latitude: 36.52353   **Longitude:** -78.99600   **Stream class:** C
Agency: NCAMBNT   **NC stream index:** 22-58-(9.5)

Time period: 01/10/2005 to 11/16/2009

	# results	# ND	EL	Results not meeting EL #	%	%Conf	Percentiles Min	10th	25th	50th	75th	90th	Max
Field													
D.O. (mg/L)	46	0	<4	0	0		6.3	6.7	7.1	9	10.9	11.8	12.6
	46	0	<5	0	0		6.3	6.7	7.1	9	10.9	11.8	12.6
pH (SU)	48	0	<6	1	2.1		5.9	6.4	6.6	7.1	7.3	7.4	7.8
	48	0	>9	0	0		5.9	6.4	6.6	7.1	7.3	7.4	7.8
Salinity (ppt)	8	0	N/A				0	0	0.1	0.1	0.1	0.1	0.1
Spec. conductance (umhos/cm at 25°C)	47	0	N/A				104	107	110	124	178	255	285
Water Temperature (°C)	48	0	>32	0	0		5.2	7.9	9.5	17.3	23.3	26.1	28.9
Other													
TSS (mg/L)	18	7	N/A				3	3.7	4.7	6.2	6.6	10.2	12
Turbidity (NTU)	47	0	>50	0	0		2.3	3.2	4	4.9	5.9	8.5	9.7
Metals (ug/L)													
Aluminum, total (Al)	8	0	N/A				160	160	160	215	368	410	410
Arsenic, total (As)	9	9	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	9	9	>2	0	0		1	1	2	2	2	2	2
Chromium, total (Cr)	9	9	>50	0	0		10	10	25	25	25	25	25
Copper, total (Cu)	9	6	>7	0	0		2	2	2	2	2	2	2
Iron, total (Fe)	8	0	>1000	0	0		250	250	275	405	520	860	860
Lead, total (Pb)	9	9	>25	0	0		10	10	10	10	10	10	10
Mercury, total (Hg)	8	8	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	9	9	>88	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	9	7	>50	0	0		10	10	10	10	12	17	17

Fecal Coliform Screening(#/100mL)

# results:	Geomean	# > 400:	% > 400:	%Conf:
44	9.1	0	0	

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

Location: MARLOWE CRK AT SR 1322 NR WOODSDALE

Station #: N4400000   **Hydrologic Unit Code:** 03010104

Latitude: 36.48325   **Longitude:** -78.97941   **Stream class:** C

Agency: NCAMBNT   **NC stream index:** 22-58-12-6

Time period: 01/10/2005 to 11/16/2009

	# results	# ND	EL	Results not meeting EL #	%	%Conf	Min	10th	25th	50th	75th	90th	Max
Field													
D.O. (mg/L)	46	0	<4	0	0		6.5	6.9	7.6	9.3	12.1	13.5	14.2
	46	0	<5	0	0		6.5	6.9	7.6	9.3	12.1	13.5	14.2
pH (SU)	48	0	<6	0	0		6.2	6.5	6.8	7.1	7.4	7.7	8.8
	48	0	>9	0	0		6.2	6.5	6.8	7.1	7.4	7.7	8.8
Salinity (ppt)	8	0	N/A				0.1	0.1	0.1	0.1	0.2	0.3	0.3
Spec. conductance (umhos/cm at 25°C)	47	0	N/A				114	156	184	263	405	582	729
Water Temperature (°C)	48	0	>32	0	0		2.2	6.2	9.9	15.1	21.9	23.6	26.3
Other													
TSS (mg/L)	18	8	N/A				2.5	3.7	6.2	7	12.5	22.8	66
Turbidity (NTU)	47	0	>50	2	4.3		1.2	2.4	3.6	4.9	8.8	21	65
Nutrients (mg/L)													
NH3 as N	1	1	N/A				0.02	0.02	0.02	0.02	0.02	0.02	0.02
NO2 + NO3 as N	1	0	N/A				0.87	0.87	0.87	0.87	0.87	0.87	0.87
TKN as N	1	0	N/A				0.53	0.53	0.53	0.53	0.53	0.53	0.53
Total Phosphorus	1	0	N/A				0.3	0.3	0.3	0.3	0.3	0.3	0.3
Metals (ug/L)													
Aluminum, total (Al)	9	0	N/A				100	100	170	360	755	1000	1000
Arsenic, total (As)	9	9	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	9	9	>2	0	0		1	1	2	2	2	2	2
Chromium, total (Cr)	9	9	>50	0	0		10	10	25	25	25	25	25
Copper, total (Cu)	9	1	>7	2	22.2		2	2	4	4	7	16	16
Iron, total (Fe)	9	0	>1000	1	11.1		190	190	415	570	845	2200	2200
Lead, total (Pb)	9	9	>25	0	0		10	10	10	10	10	10	10
Mercury, total (Hg)	8	8	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	9	9	>88	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	9	0	>50	4	44.4		12	12	26	46	57	630	630

Fecal Coliform Screening(#/100mL)

# results:	Geomean	# > 400:	% > 400:	%Conf:
47	81.7	5	10.6	

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

Location: HYCO RIV AT US 501 NR DENNISTON VA

Station #: N4510000		**Hydrologic Unit Code:** 03010104	
Latitude: 36.58805	**Longitude:** -78.89814	**Stream class:** III NT	
Agency: NCAMBNT		**NC stream index:**	

Time period: 01/10/2005 to 11/16/2009

	# results	# ND	EL	Results not meeting EL #	%	%Conf	Min	10th	25th	50th	75th	90th	Max
Field													
D.O. (mg/L)	46	0	N/A				5.9	6.4	6.9	8.7	10.8	11.7	12.6
pH (SU)	48	0	N/A				6.2	6.2	6.7	7	7.2	7.5	7.9
Salinity (ppt)	8	0	N/A				0.1	0.1	0.1	0.1	0.1	0.1	0.1
Spec. conductance (umhos/cm at 25°C)	47	0	N/A				102	130	144	168	193	234	265
Water Temperature (°C)	48	0	N/A				3.9	5.7	9	15.3	23.6	26	27.2
Other													
TSS (mg/L)	18	10	N/A				2.5	2.5	3.9	6.2	6.9	21.5	35
Turbidity (NTU)	47	0	N/A				1.7	2.8	4.1	6.3	10	27	95
Metals (ug/L)													
Aluminum, total (Al)	9	0	N/A				87	87	109	200	660	1600	1600
Arsenic, total (As)	9	9	N/A				5	5	5	5	5	5	5
Cadmium, total (Cd)	9	9	N/A				1	1	2	2	2	2	2
Chromium, total (Cr)	9	9	N/A				10	10	25	25	25	25	25
Copper, total (Cu)	9	3	N/A				2	2	2	2	3	4	4
Iron, total (Fe)	9	0	N/A				99	99	470	580	1095	2300	2300
Lead, total (Pb)	9	9	N/A				10	10	10	10	10	10	10
Manganese, total (Mn)	4	0	N/A				120	120	128	155	160	160	160
Mercury, total (Hg)	8	8	N/A				0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	9	9	N/A				10	10	10	10	10	10	10
Zinc, total (Zn)	9	6	N/A				10	10	10	10	16	41	41

Fecal Coliform Screening(#/100mL)

# results:	Geomean	# > 400:	% > 400:	%Conf:
47	61	1	2.1	

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

Location: MAYO CRK AT SR 1501 NR BETHEL HILL

Station #: N4590000   **Hydrologic Unit Code:** 03010104

Latitude: 36.54021   **Longitude:** -78.87362   **Stream class:** C

Agency: NCAMBNT   **NC stream index:** 22-58-15-(3.5)

Time period: 01/10/2005 to 11/16/2009

	# results	# ND	EL	Results not meeting EL #	%	%Conf	Min	10th	25th	50th	75th	90th	Max
Field													
D.O. (mg/L)	46	0	<4	0	0		6.4	7	8.1	9.5	11.1	11.6	12.6
	46	0	<5	0	0		6.4	7	8.1	9.5	11.1	11.6	12.6
pH (SU)	48	0	<6	0	0		6.1	6.4	6.5	7	7.3	7.7	8.4
	48	0	>9	0	0		6.1	6.4	6.5	7	7.3	7.7	8.4
Salinity (ppt)	8	0	N/A				0	0	0	0.05	0.1	0.1	0.1
Spec. conductance (umhos/cm at 25°C)	47	0	N/A				92	97	113	119	128	140	160
Water Temperature (°C)	48	0	>32	0	0		4.7	7.2	9.8	16.3	22.1	24.9	31.6
Other													
TSS (mg/L)	18	14	N/A				2.5	2.5	2.5	6.2	6.2	6.3	7
Turbidity (NTU)	47	10	>50	0	0		1	1	1	1.3	2	2.9	3.9
Metals (ug/L)													
Aluminum, total (Al)	9	3	N/A				50	50	50	58	76	210	210
Arsenic, total (As)	9	9	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	9	9	>2	0	0		1	1	2	2	2	2	2
Chromium, total (Cr)	9	9	>50	0	0		10	10	25	25	25	25	25
Copper, total (Cu)	9	7	>7	0	0		2	2	2	2	2	3	3
Iron, total (Fe)	9	3	>1000	0	0		50	50	50	72	102	670	670
Lead, total (Pb)	9	9	>25	0	0		10	10	10	10	10	10	10
Mercury, total (Hg)	8	8	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	9	9	>88	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	9	7	>50	0	0		10	10	10	10	11	14	14

Fecal Coliform Screening(#/100mL)

# results:	Geomean	# > 400:	% > 400:	%Conf:
46	7.6	1	2.2	

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

Location: NUTBUSH CRK AT SR 1317 NR HENDERSON

Station #: N5000000   **Hydrologic Unit Code:** 03010105

Latitude: 36.36914   **Longitude:** -78.40834   **Stream class:** C

Agency: NCAMBNT   **NC stream index:** 23-8-(1)

Time period: 01/03/2005 to 11/18/2009

	# results	# ND	EL	Results not meeting EL #	%	%Conf	Min	10th	25th	50th	75th	90th	Max
Field													
D.O. (mg/L)	47	0	<4	0	0		6.6	7	7.5	9.7	12.5	13.5	14.9
	47	0	<5	0	0		6.6	7	7.5	9.7	12.5	13.5	14.9
pH (SU)	47	0	<6	0	0		6.2	6.6	6.9	7.4	7.7	7.8	8.6
	47	0	>9	0	0		6.2	6.6	6.9	7.4	7.7	7.8	8.6
Salinity (ppt)	9	0	N/A				0.2	0.2	0.2	0.2	0.3	0.3	0.3
Spec. conductance (umhos/cm at 25°C)	48	0	N/A				221	300	360	458	572	630	693
Water Temperature (°C)	48	0	>32	0	0		5.9	7.5	10	14.9	22.5	24.3	26.1
Other													
Chlorophyll a (ug/L)	2	0	>40	0	0		4	4	4	7	10	10	10
TSS (mg/L)	19	10	N/A				2.5	2.5	2.5	6.2	12	13	15
Turbidity (NTU)	48	1	>50	0	0		1	1.4	1.8	2.2	4.8	8.7	31
Nutrients (mg/L)													
NH3 as N	47	36	N/A				0.02	0.02	0.02	0.02	0.02	0.04	0.08
NO2 + NO3 as N	46	0	N/A				4.1	5.99	7.5	11	15	18	23
TKN as N	45	7	N/A				0.2	0.2	0.35	0.55	0.6	0.69	0.89
Total Phosphorus	45	0	N/A				0.06	0.17	0.21	0.36	0.54	0.75	1
Metals (ug/L)													
Aluminum, total (Al)	9	0	N/A				84	84	98	140	185	320	320
Arsenic, total (As)	9	9	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	9	9	>2	0	0		1	1	2	2	2	2	2
Chromium, total (Cr)	9	9	>50	0	0		10	10	25	25	25	25	25
Copper, total (Cu)	9	2	>7	0	0		2	2	2	3	4	5	5
Iron, total (Fe)	9	0	>1000	0	0		130	130	190	270	330	640	640
Lead, total (Pb)	9	9	>25	0	0		10	10	10	10	10	10	10
Mercury, total (Hg)	8	8	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	9	9	>88	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	9	0	>50	0	0		15	15	16	18	23	34	34

Fecal Coliform Screening(#/100mL)

# results:	Geomean	# > 400:	% > 400:	%Conf:
48	115.9	4	8.3	

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

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

Location: SMITH CRK AT US 1 NR PASCHALL

Station #: N6400000	**Hydrologic Unit Code:** 03010106	
Latitude: 36.54087 **Longitude:** -78.19514	**Stream class:** C	
Agency: NCAMBNT	**NC stream index:** 23-10	

Time period: 01/03/2005 to 11/18/2009

	# results	# ND	EL	#	%	%Conf	Min	10th	25th	50th	75th	90th	Max
Field													
D.O. (mg/L)	47	0	<4	11	23.4	99.8	2.3	3.2	4.1	5.3	8.5	11.3	12.8
	47	0	<5	18	38.3	100	2.3	3.2	4.1	5.3	8.5	11.3	12.8
pH (SU)	48	0	<6	4	8.3		5.1	6	6.4	6.6	6.8	7.1	7.4
	48	0	>9	0	0		5.1	6	6.4	6.6	6.8	7.1	7.4
Salinity (ppt)	9	0	N/A				0	0	0	0	0.1	0.1	0.1
Spec. conductance (umhos/cm at 25°C)	48	0	N/A				63	74	76	90	128	158	180
Water Temperature (°C)	48	0	>32	0	0		1.7	5.4	8.9	16.8	21.7	25	26.1
Other													
TSS (mg/L)	19	8	N/A				2.8	3	5	6.2	7	16	18
Turbidity (NTU)	48	0	>50	4	8.3		2.6	3.6	4.1	9.1	26.8	41.1	120
Nutrients (mg/L)													
NH3 as N	48	25	N/A				0.02	0.02	0.02	0.02	0.05	0.29	0.59
NO2 + NO3 as N	47	32	N/A				0.02	0.02	0.02	0.02	0.05	0.08	0.2
TKN as N	45	0	N/A				0.21	0.29	0.38	0.48	0.68	1.02	1.4
Total Phosphorus	46	0	N/A				0.03	0.04	0.05	0.07	0.08	0.15	0.92
Metals (ug/L)													
Aluminum, total (Al)	9	0	N/A				56	56	68	92	130	240	240
Arsenic, total (As)	9	9	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	9	9	>2	0	0		1	1	2	2	2	2	2
Chromium, total (Cr)	9	9	>50	0	0		10	10	25	25	25	25	25
Copper, total (Cu)	9	9	>7	0	0		2	2	2	2	2	2	2
Iron, total (Fe)	9	0	>1000	7	77.8		820	820	1405	2200	3600	8500	8500
Lead, total (Pb)	9	9	>25	0	0		10	10	10	10	10	10	10
Mercury, total (Hg)	8	8	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	9	9	>88	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	9	8	>50	0	0		10	10	10	10	10	11	11

Fecal Coliform Screening(#/100mL)

# results:	Geomean	# > 400:	% > 400:	%Conf:
48	61.3	2	4.2	

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

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

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

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	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

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	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	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

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	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	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

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	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

Location: ALBEMARLE SOUND AT BATCHELOR BAY NR BLACK WALNUT

Station #: N9700000   **Hydrologic Unit Code:** 03010205

Latitude: 35.95327   **Longitude:** -76.67603   **Stream class:** SB

Agency: NCAMBNT   **NC stream index:** 30

**Time period:** 01/11/2005 to 12/07/2009

	# results	# ND	EL	Results not meeting EL #	%	%Conf	Min	10th	25th	50th	75th	90th	Max
Field													
D.O. (mg/L)	59	0	<5	1	1.7		4.5	6.6	7.3	8.3	10.1	11.6	13.9
pH (SU)	59	0	<6.8	8	13.6	86.9	6.4	6.6	7	7.2	7.4	7.5	8
	59	0	>8.5	0	0		6.4	6.6	7	7.2	7.4	7.5	8
Salinity (ppt)	59	0	N/A				0.04	0.04	0.06	0.18	0.74	1.57	3.7
Spec. conductance (umhos/cm at 25°C)	59	0	N/A				102	106	130	365	1391	2822	6606
Water Temperature (°C)	59	0	>32	0	0		5.5	7.2	10	18.6	25.1	28.4	30.7
Other													
Chlorophyll a (ug/L)	54	4	>40	0	0		1	1	2	3	8	12	15
TSS (mg/L)	20	10	N/A				2.5	3.1	5.2	6.2	6.2	11.6	18
Turbidity (NTU)	59	0	>25	0	0		1.6	3	3.8	6.5	11	16	19
Nutrients (mg/L)													
NH3 as N	59	22	N/A				0.02	0.02	0.02	0.03	0.04	0.07	0.11
NO2 + NO3 as N	59	3	N/A				0.02	0.05	0.09	0.14	0.18	0.23	0.31
TKN as N	58	0	N/A				0.24	0.3	0.37	0.43	0.46	0.5	0.56
Total Phosphorus	59	0	N/A				0.02	0.03	0.04	0.05	0.06	0.07	0.12
Metals (ug/L)													
Aluminum, total (Al)	10	0	N/A				140	147	210	290	632	679	680
Arsenic, total (As)	10	10	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	10	10	>5	0	0		1	1	1.8	2	2	2	2
Chromium, total (Cr)	10	10	>20	0	0		10	10	21	25	25	25	25
Copper, total (Cu)	10	8	>3	1	10	73.6	2	2	2	2	2	4	4
Iron, total (Fe)	10	0	N/A				210	222	510	745	915	1086	1100
Lead, total (Pb)	10	10	>25	0	0		10	10	10	10	10	10	10
Mercury, total (Hg)	8	8	>0.025	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	10	10	>8.3	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	10	8	>86	0	0		10	10	10	10	10	11	11

Fecal Coliform Screening(#/100mL)

# results:	Geomean	# > 400:	% > 400:	%Conf:
59	3.9	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

Appendix B: Station Box & Whisker Plots

Figure 14. Box Plots of Water Temperature in the Roanoke River Basin
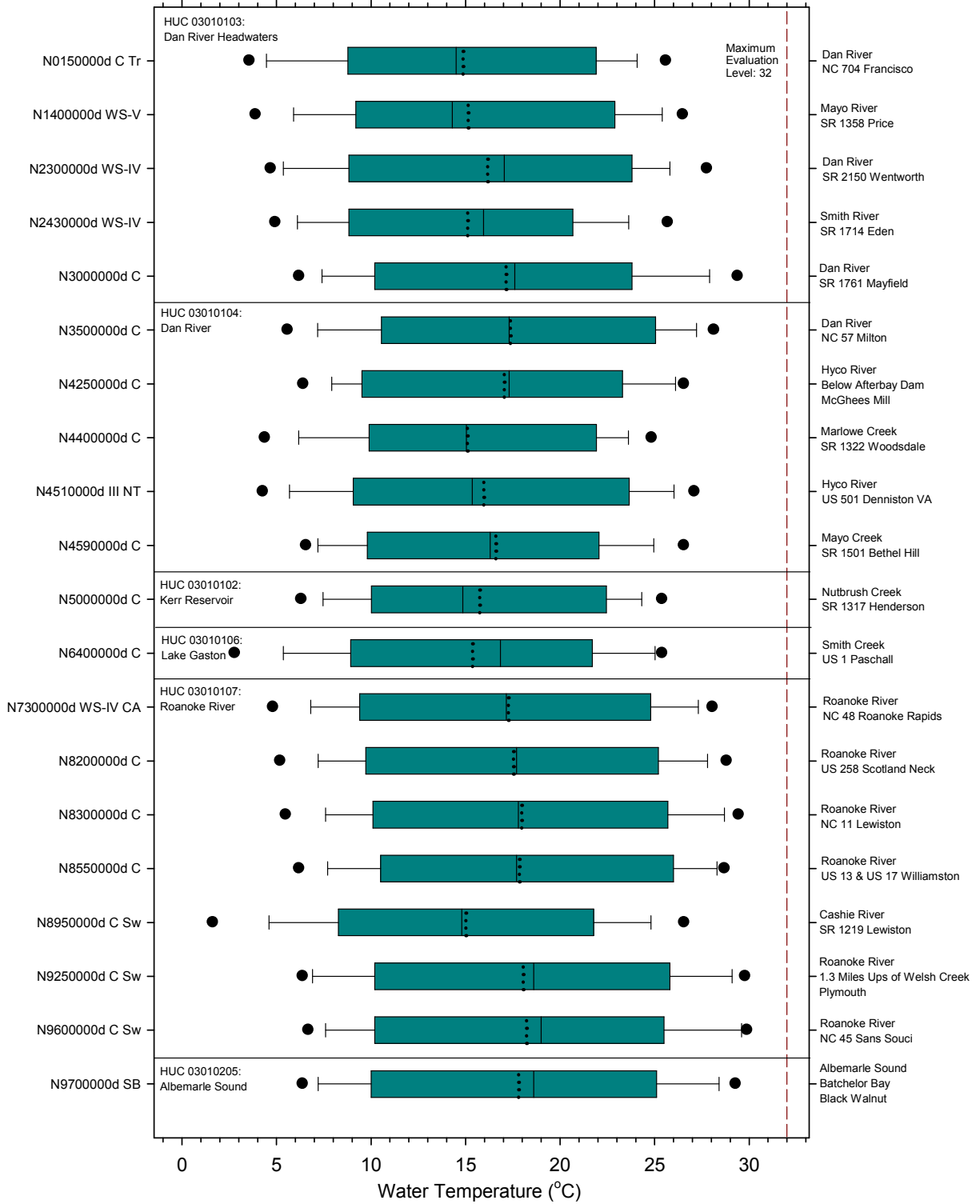
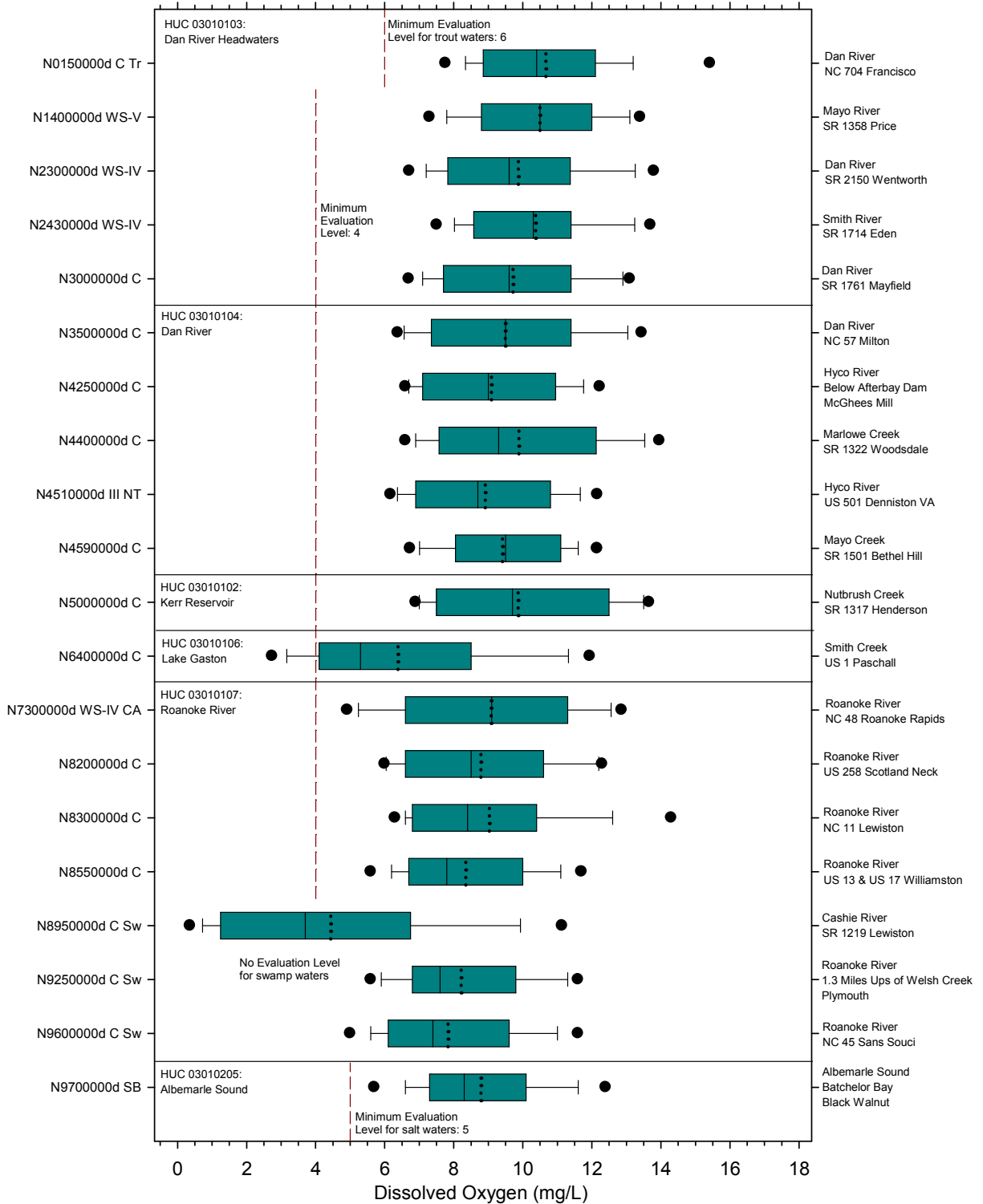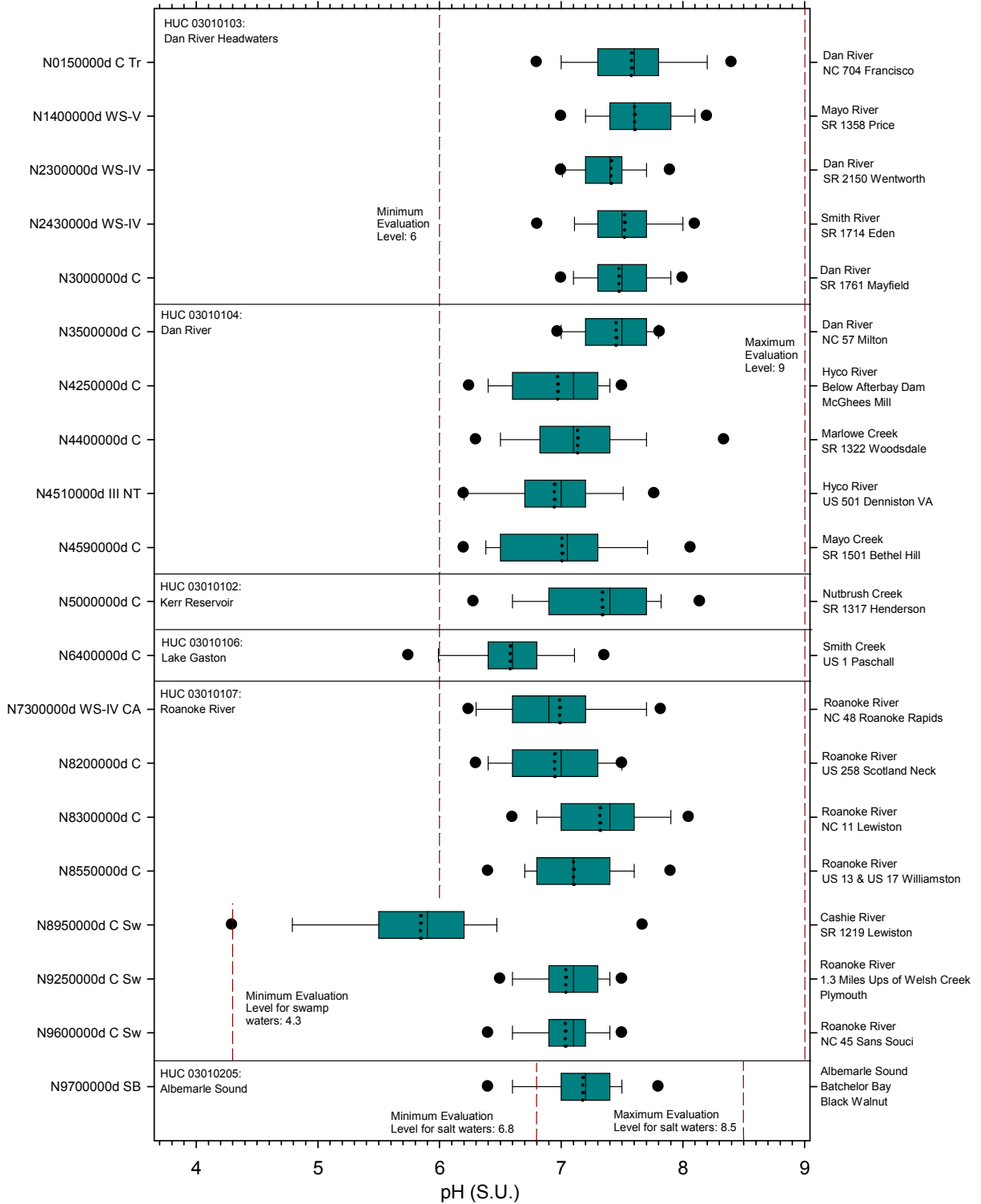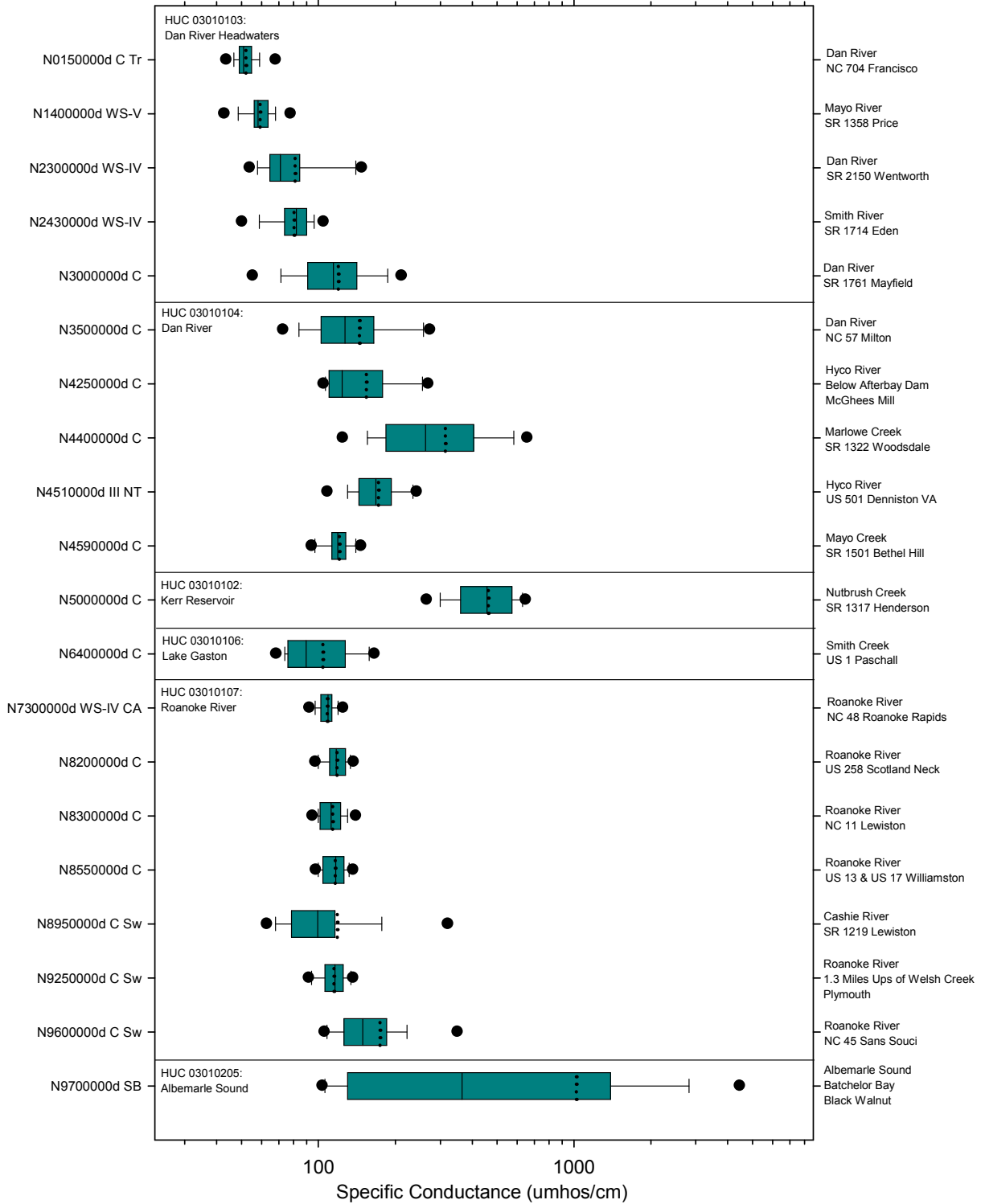**Figure 15. Box Plots of Dissolved Oxygen in the Roanoke River Basin**

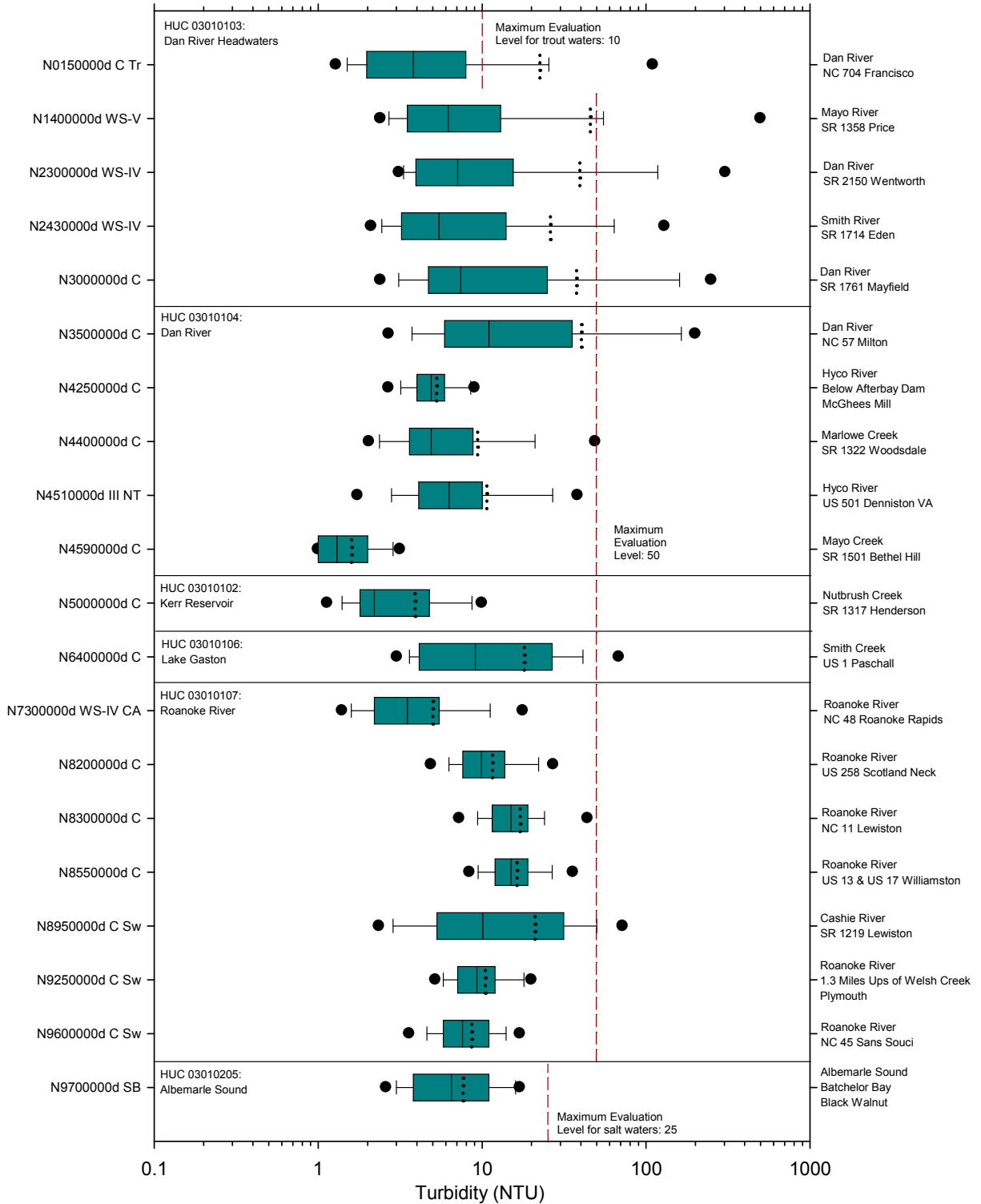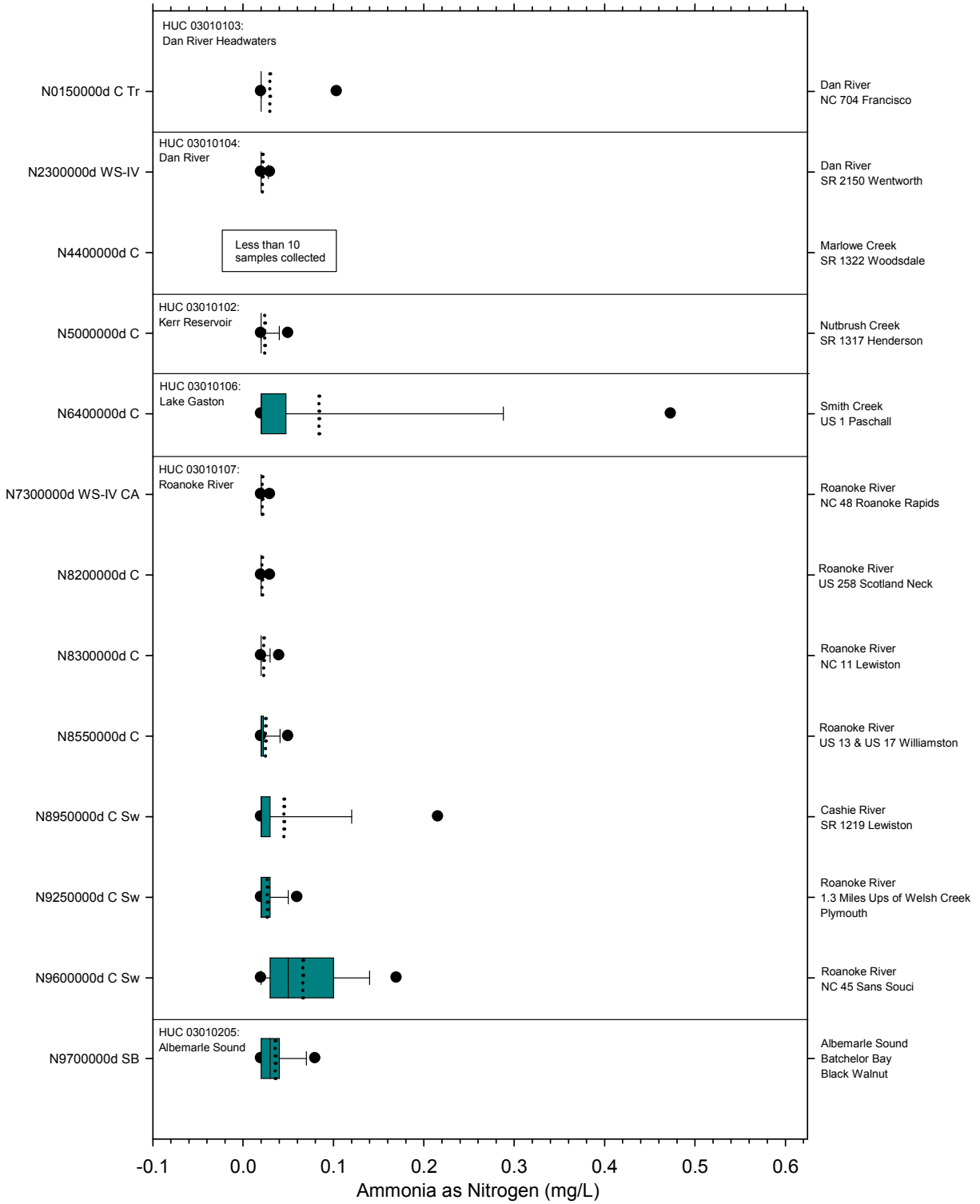**Figure 16. Box Plots of pH in the Roanoke River Basin**

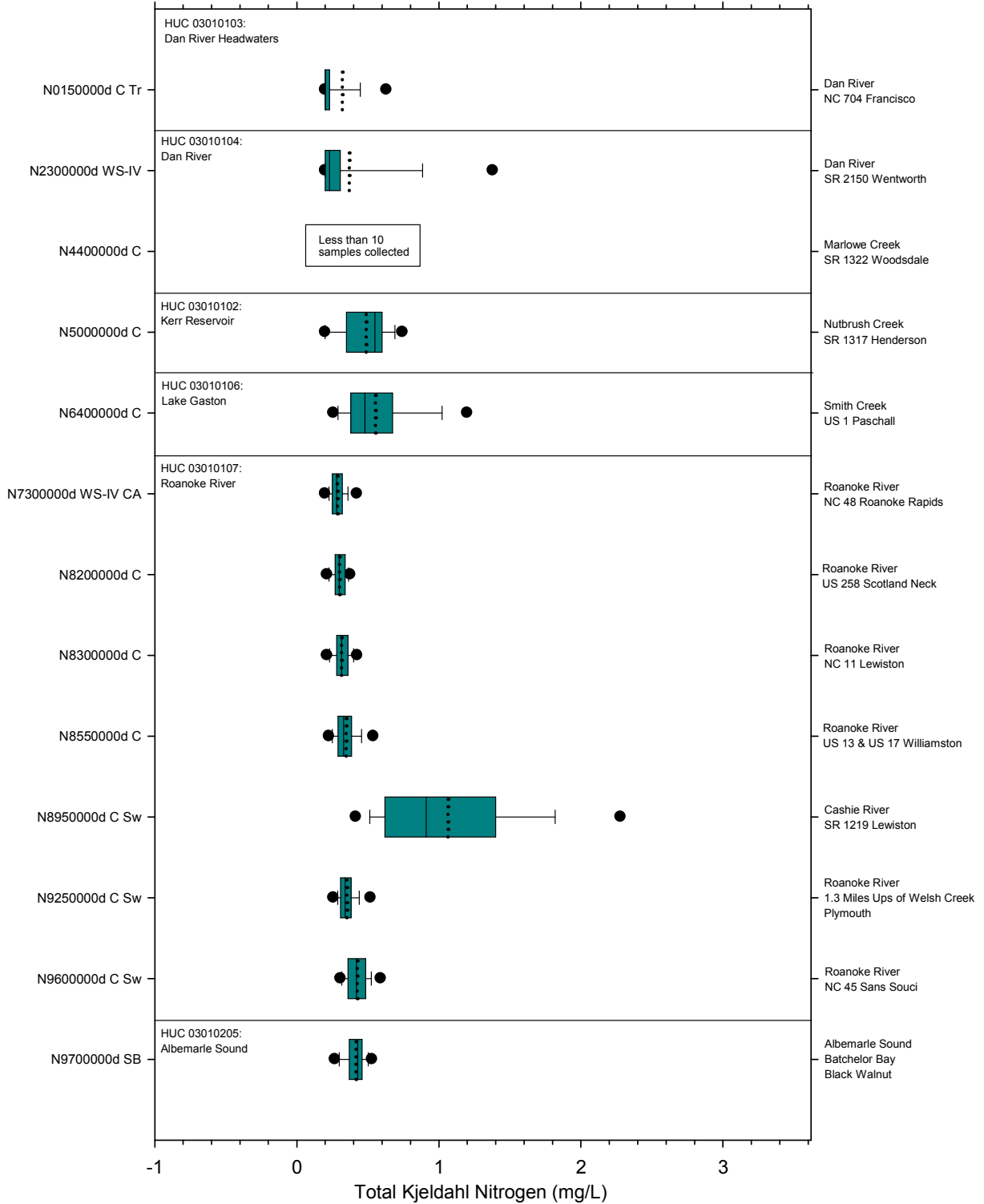**Figure 17. Box Plots of Specific Conductance in the Roanoke River Basin**

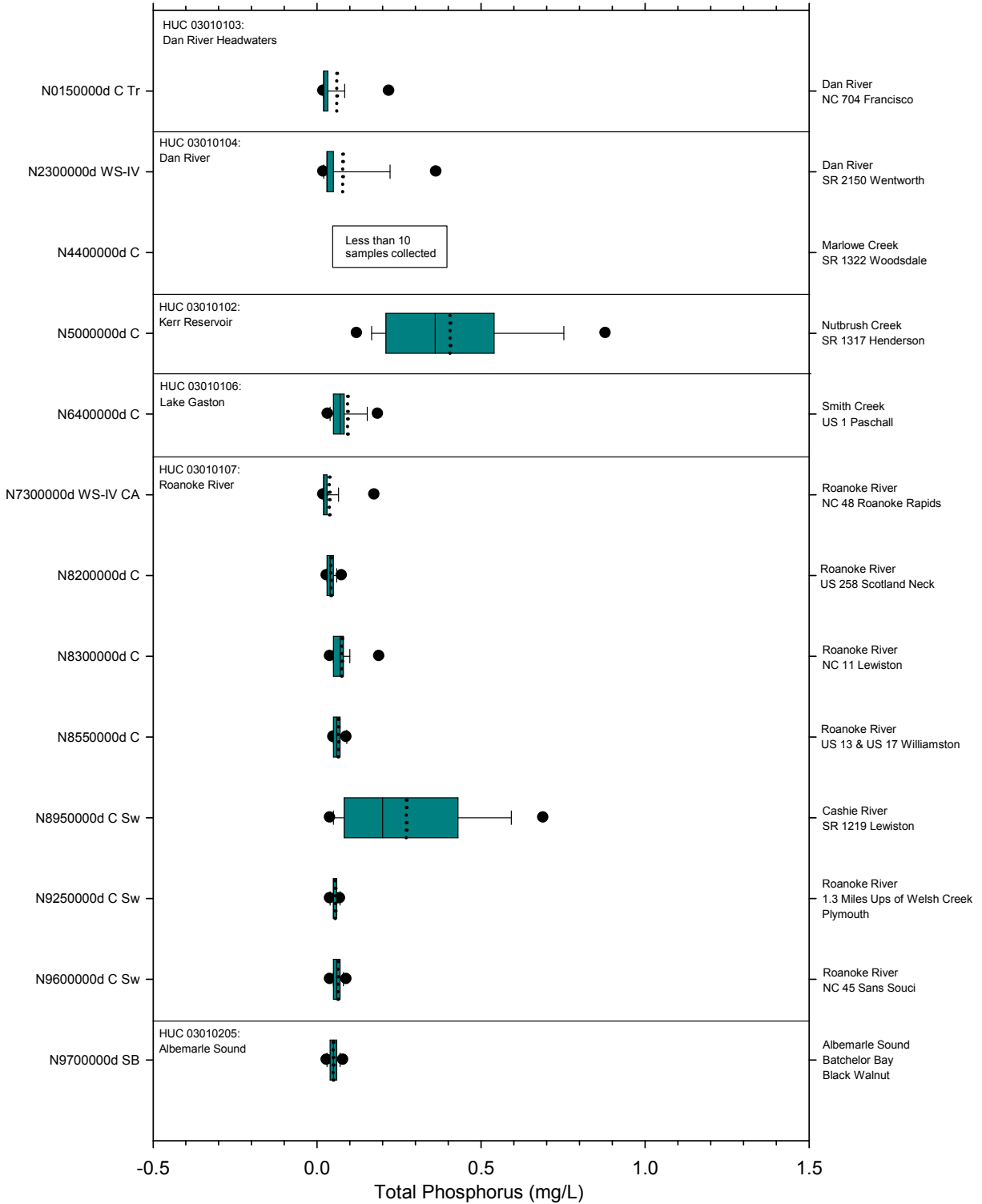**Figure 18. Box Plots of Turbidity in the Roanoke River Basin**

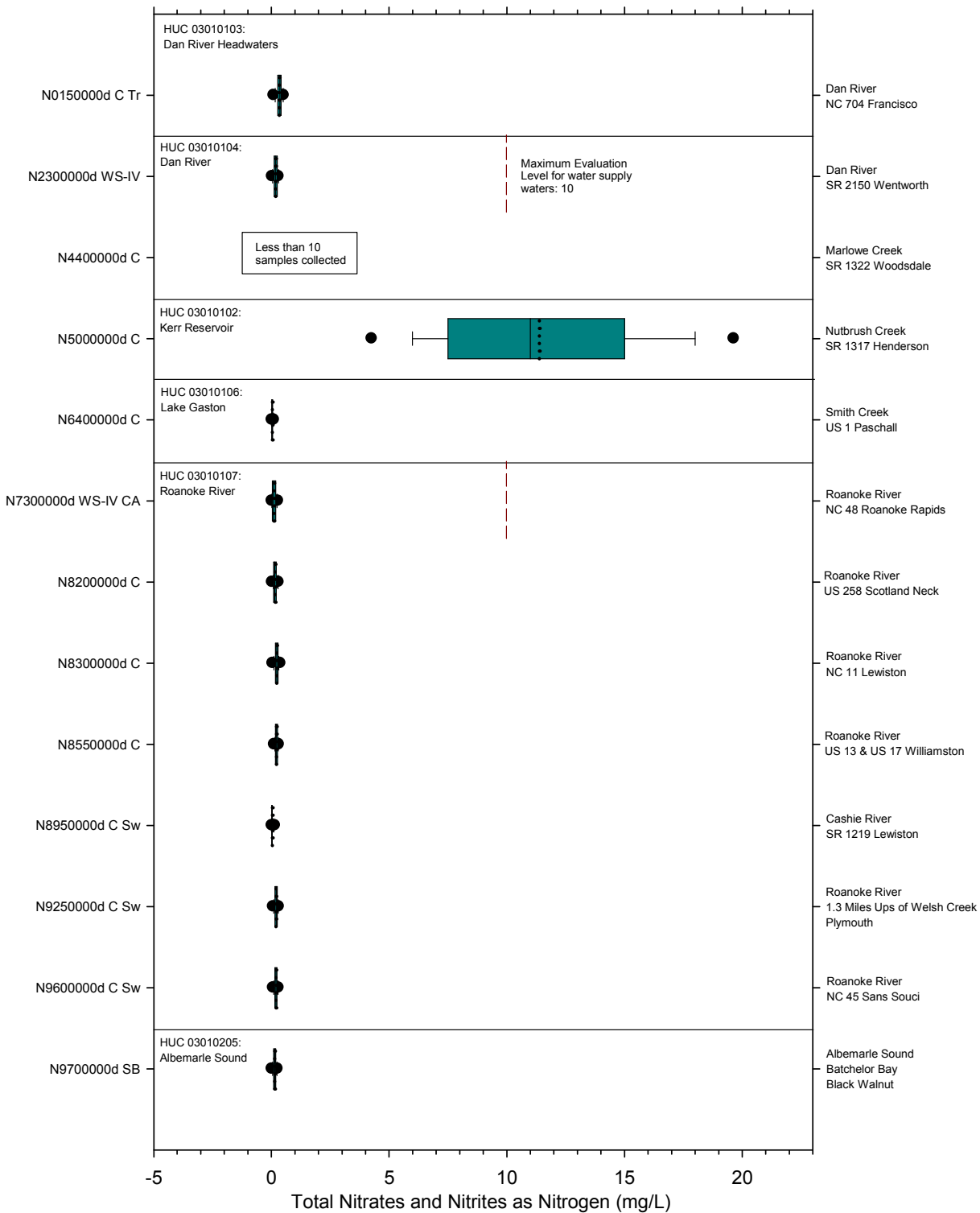# Figure 19. Box Plots of Ammonia in the Roanoke River Basin

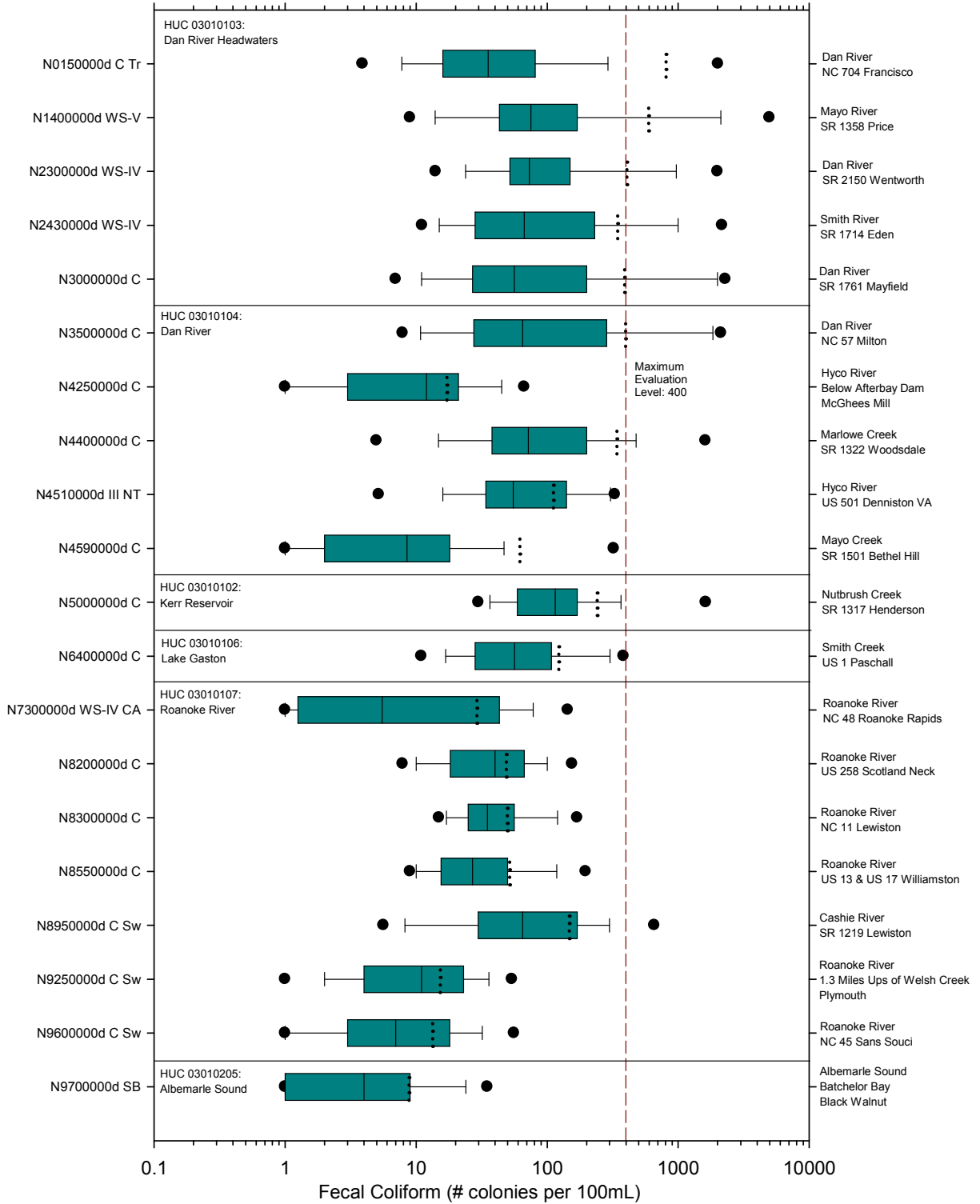**Figure 20. Box Plots of Total Kjeldahl Nitrogen in the Roanoke River Basin**

Figure 21. Box Plots of Total Phosphorus in the Roanoke River Basin

Figure 22. Box Plots of Nitrates/Nitrites in the Roanoke River Basin

Figure 23. Box Plots of Fecal Coliform in the Roanoke River Basin

Appendix C: References

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