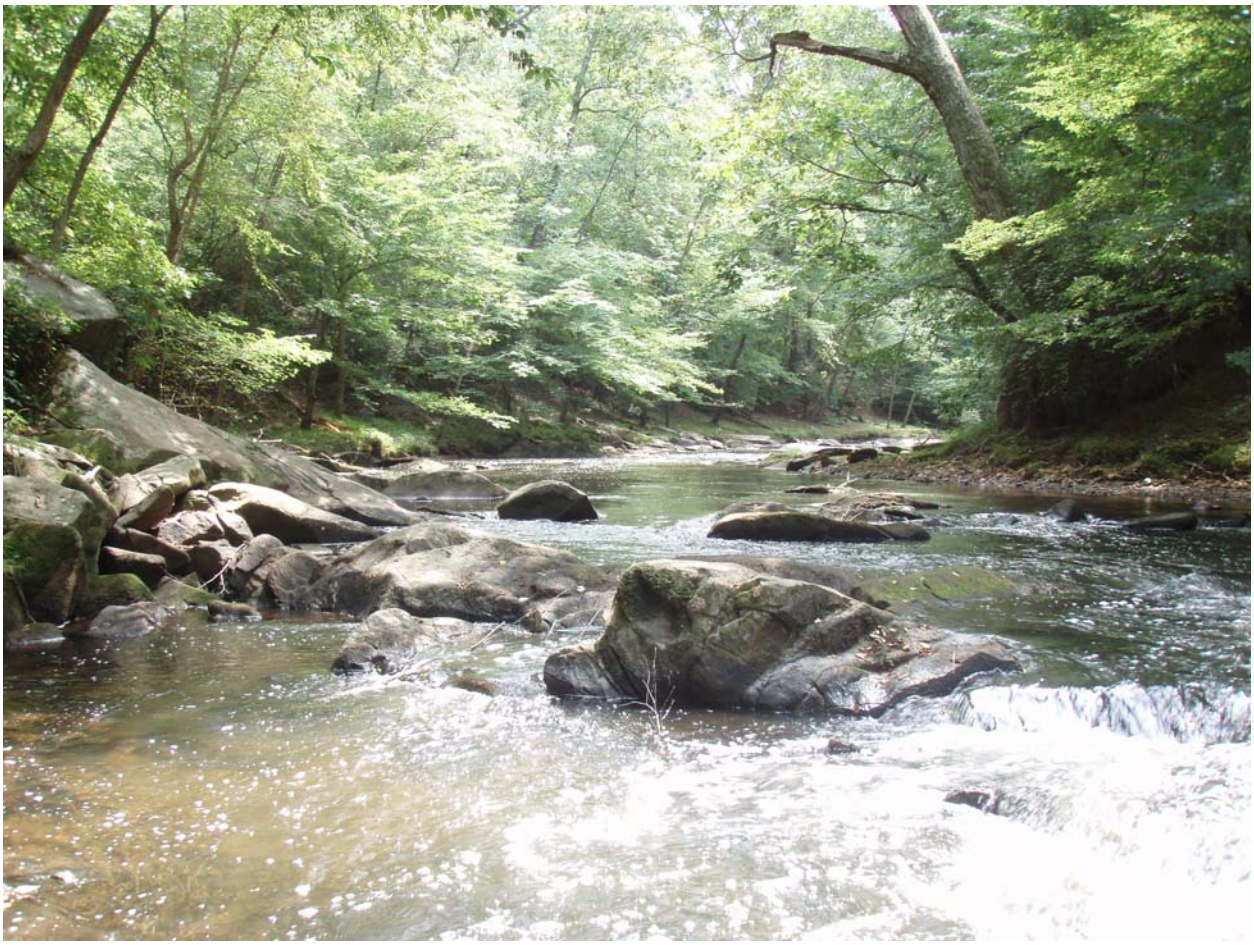
BASINWIDE ASSESSMENT REPORT
NEUSE RIVER BASIN



NCDENR

NORTH CAROLINA
DEPARTMENT OF ENVIRONMENT
AND NATURAL RESOURCES
Division of Water Quality
Environmental Sciences Section

January 2012

DIVISION OF WATER QUALITY
DWQ

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION TO PROGRAM METHODS

The Division of Water Quality uses a basinwide approach to water quality management. Activities within the Division, including permitting, monitoring, modeling, nonpoint source assessments, and planning are coordinated and integrated for each of the 17 major river basins within the state. All basins are reassessed every five years. The Neuse River basin has been sampled by the Environmental Sciences Section (ESS) five times for basinwide monitoring: 1991, 1995, 2000, 2005, and 2010. For a complete list of all historic benthic macroinvertebrate samples obtained by the BAU (including data for the Neuse River Basin) please refer to the following link: http://portal.ncdenr.org/web/wq/benthosdata. Fish community data can be found at: http://portal.ncdenr.org/web/wq/ess/bau/ncibi-data. In this document, a summary of bioclassification trends for benthic macroinvertebrate data can be found in Appendix 1 while a summary of bioclassification trends for fish community data can be found in Appendix 4.

The ESS collects a variety of biological, chemical, and physical data that can be used in a myriad of ways within the basinwide-planning program. In some program areas there may be adequate data to allow a fairly comprehensive analysis of ecological integrity or water quality. In other areas, data may be limited to one program area, such as only benthic macroinvertebrate data or only fisheries data, with no other information available. Such data may or may not be adequate to provide a definitive assessment of water quality, but can provide general indications of water quality. The primary program areas from which data were drawn for this assessment of the Neuse River basin include benthic macroinvertebrates and fish community data. Details of biological sampling methods (including habitat evaluation), rating criteria, and biological assessment summaries can be found in Appendices 1-5. Technical terms are defined in the Glossary.

This document is structured with physical, geographical, and biological data discussions presented in hydrologic units (HUCs). General water quality conditions are given in an upstream to downstream format. Lakes data, ambient chemistry data and aquatic toxicity data, with summaries, are presented in separate reports.

BASIN DESCRIPTION

The Neuse River basin is the third largest basin in North Carolina and is one of only three basins that are located entirely within the state. The Neuse River Basin covers 6,192 square miles and spans 19 counties and originates northwest of the city of Durham in Person and Orange counties. The uppermost 22 miles of the river's main stem is impounded behind Falls of the Neuse Reservoir dam just northeast of the city of Raleigh. Downstream of the dam, the river continues its course for approximately 185 miles southeasterly past the cities of Raleigh, Smithfield, Goldsboro, and Kinston after which it reaches the tidal waters near Street's Ferry just upstream of New Bern. Downstream of Street's Ferry, the Neuse River significantly broadens and changes into a tidal estuary that empties into the Pamlico Sound. Overall, much of the land use in the Neuse River Basin is agriculture or forest with the only major area of protected forest associated with the Croatan National Forest located in the lower reaches of the basin in Jones and Craven counties. However, there are several areas of rapidly expanding urban land use particularly associated with the cities of Durham, Raleigh, Clayton, Goldsboro, Kinston, and New Bern.

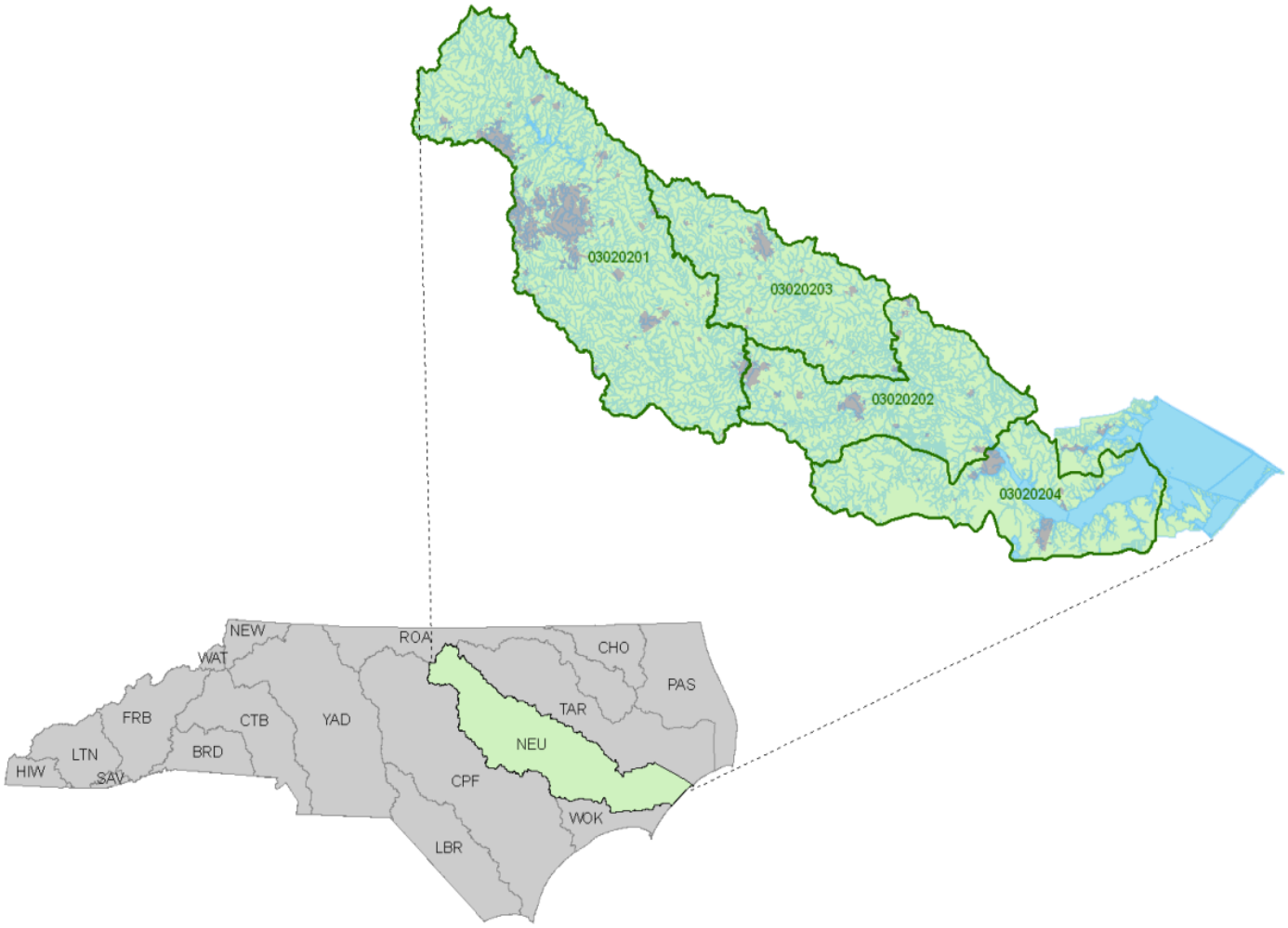


Figure 1. Geographical relationships of the Neuse River basin.

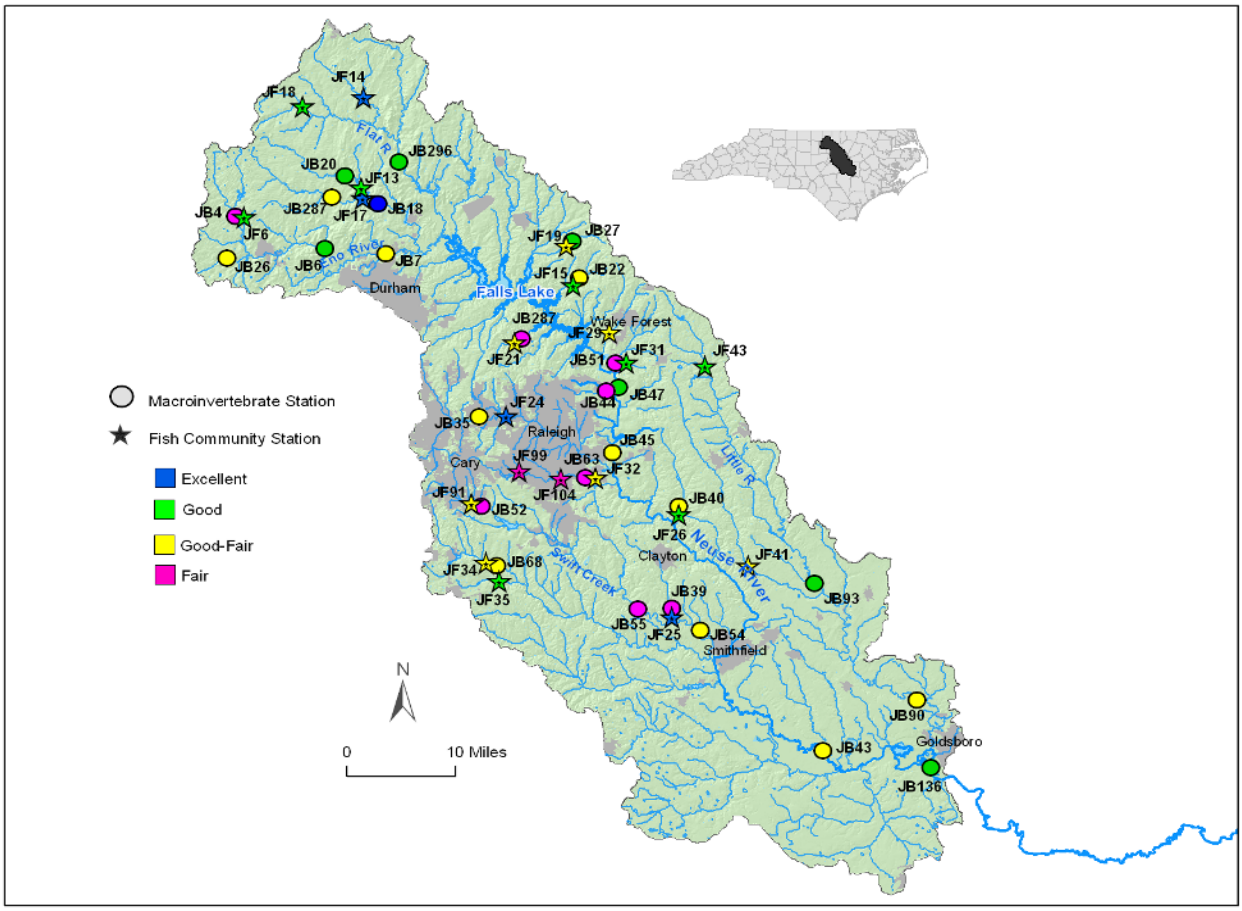


Figure 2. Sampling sites in HUC 03020201 (2010).

River and Stream Assessment

Several sites sampled during the most recent basinwide cycle in 2005 were not sampled in 2010 due to staffing reductions. These sites are noted below in Table 1. Site IDs ending with "B" denote benthos samples, those ending with "F" denote fish samples.

Table 1. Waterbodies monitored in HUC 03020201 (2005-2010).

Site ID	Waterbody	County	Location	2005	2010
JB26	Sevenmile Cr	Orange	SR 1120	Good-Fair	Good-Fair
JB4	Eno R	Orange	SR 1336	Good-Fair	Fair
JB6	Eno R	Orange	SR 1569	Good-Fair	Good
JB7	Eno R	Durham	US 15/501	Good-Fair	Good-Fair
JB3	Eno R	Durham	SR 1004	Good-Fair	Not Sampled
JB18	Little R	Durham	SR 1461	Good	Excellent
JB287	S Fk Little R	Orange	SR 1538	Good	Good-Fair
JB20	N Fk Little R	Orange	SR 1538	Good	Good
JB296	Flat R	Durham	SR 1614	Good	Good
JB1	Deep Cr	Person	SR 1715	Good	Not Sampled
JB27	Smith Cr	Granville	SR 1710	Good-Fair	Good
JB22	New Light Cr	Wake	SR 1912	Good-Fair	Good-Fair
JB28	Upper Barton Cr	Wake	NC 50	Fair	Fair

Table 1 (Continued). Waterbodies monitored in HUC 03020201 (2005-2010).

JB44	Neuse R	Wake	US 401	Good-Fair	Good
JB45	Neuse R	Wake	US 64	Good-Fair	Good-Fair
JB51	Smith Cr	Wake	SR 2045	Good-Fair	Fair
JB138	Toms Cr	Wake	SR 2044	Poor	Not Sampled
JB47	Perry Cr	Wake	SR 2006	Fair	Fair
JB36	Crabtree Cr	Wake	NC 54	Poor	Not Sampled
JB35	Crabtree Cr	Wake	Umstead Park	Good-Fair	Good-Fair
JB37	Crabtree Cr	Wake	US 1	Fair	Not Sampled
JB41	Marsh Cr	Wake	near US 1	Fair	Not Sampled
JB63	Walnut Cr	Wake	SR 2442	Fair	Fair
JB42	Neuse R	Johnston	NC 42	Good-Fair	Not Sampled
JB43	Neuse R	Johnston	SR 1201	Good	Good-Fair
JB40	Marks Cr	Johnston	SR 1714	Good-Fair	Good-Fair
JB52	Swift Cr	Wake	SR 1152	Fair	Fair (2009)
JB55	Swift Cr	Johnston	SR 1555	Good-Fair	Fair
JB54	Swift Cr	Johnston	SR 1501	Good	Good-Fair
JB39	Little Cr	Johnston	SR 1562	Fair	Fair
JB68	Middle Cr	Wake	SR 1375	Good-Fair	Good-Fair
JB70	Black Cr	Johnston	SR 1330	Not Rated	Not Sampled
JB71	Hannah Cr	Johnston	SR 1009	Not Rated	Not Sampled
JB73	Mill Cr	Johnston	SR 1009	Not Rated	Not Sampled
JB136	Neuse R	Wayne	US 117	Good	Good
JB91	Little R	Wake	NC 96	Good-Fair	Not Sampled
JB93	Little R	Johnston	SR 2130	Good	Good
JB90	Little R	Wayne	NC 581	Good	Good-Fair
JF6	Eno R	Orange	SR 1336	Excellent	Good
JF17	S Fk Little R	Durham	SR 1461	Excellent	Excellent
JF13	N Fk Little R	Durham	SR 1461	Good	Good
JF14	Flat R	Person	SR 1715	Good	Excellent
JF18	Flat R	Person	NC 157	Good	Good
JF21	Upper Barton Cr	Wake	NC 50	Good	Good-Fair
JF19	Smith Cr	Granville	SR 1710	Good-Fair	Good-Fair
JF15	Newlight Cr	Wake	SR 1911	Good	Good
JF29	Richland Cr	Wake	US 1	Excellent	Good-Fair
JF31	Smith Cr	Wake	SR 2045	Fair	Good
JF24	Crabtree Cr	Wake	SR 1664	Excellent	Excellent
JF99	Walnut Cr	Wake	SR 1348	Poor (1995)	Fair
JF104	Walnut Cr	Wake	South State Street	---	Fair
JF32	Walnut Cr	Wake	SR 2544	Good-Fair	Good-Fair
JF26	Marks Cr	Johnston	SR 1714	Good	Good
JF91	Swift Cr	Wake	SR 1152	air/Good-Fa	Good-Fair
JF25	Little Cr	Johnston	SR 1562	Good	Excellent
JF34	Middle Cr	Wake	SR 1375	Excellent	Good-Fair
JF35	Terrible Cr	Wake	SR 2751	Good	Good
JF43	Little R	Wake	SR 2224	Good	Good
JF41	Buffalo Cr	Johnston	SR 1941	Good-Fair	Good-Fair
JF104	Walnut Cr	Wake	South State Street	---	Fair

SPECIAL STUDIES (2005-2010).
The following special studies were conducted in this HUC ("F" denotes a fish assessment while a "B" denotes a benthic assessment):

BAU Memo (F-20051017; Perry and Marsh Creeks).

BAU Memo (F-20051221; Deep Creek).

BAU Memo (F-20051010; Terrible Creek).

BAU Memo (B-20051220; Rocky Branch).

BAU Memo (B-20060109; Middle Creek, Hannah Creek, Buffalo Creek and the Little River).

BAU Memo (B-20060207, B-20060725 and B-20070905; Eno River and its tributaries).

BAU Memo (B-20090804; Swift Creek).

In addition, the following studies (memorandum pending) were also conducted in this HUC and included a TMDL stressor study on Mine Creek, an EEP study conducted on Beaverdam Branch and UT Flat Swamp and two samples taken at the Division of Forest Resource's Claridge Nursery (The Canal) and at Clemmons Educational Forest (Beddingfield Creek).

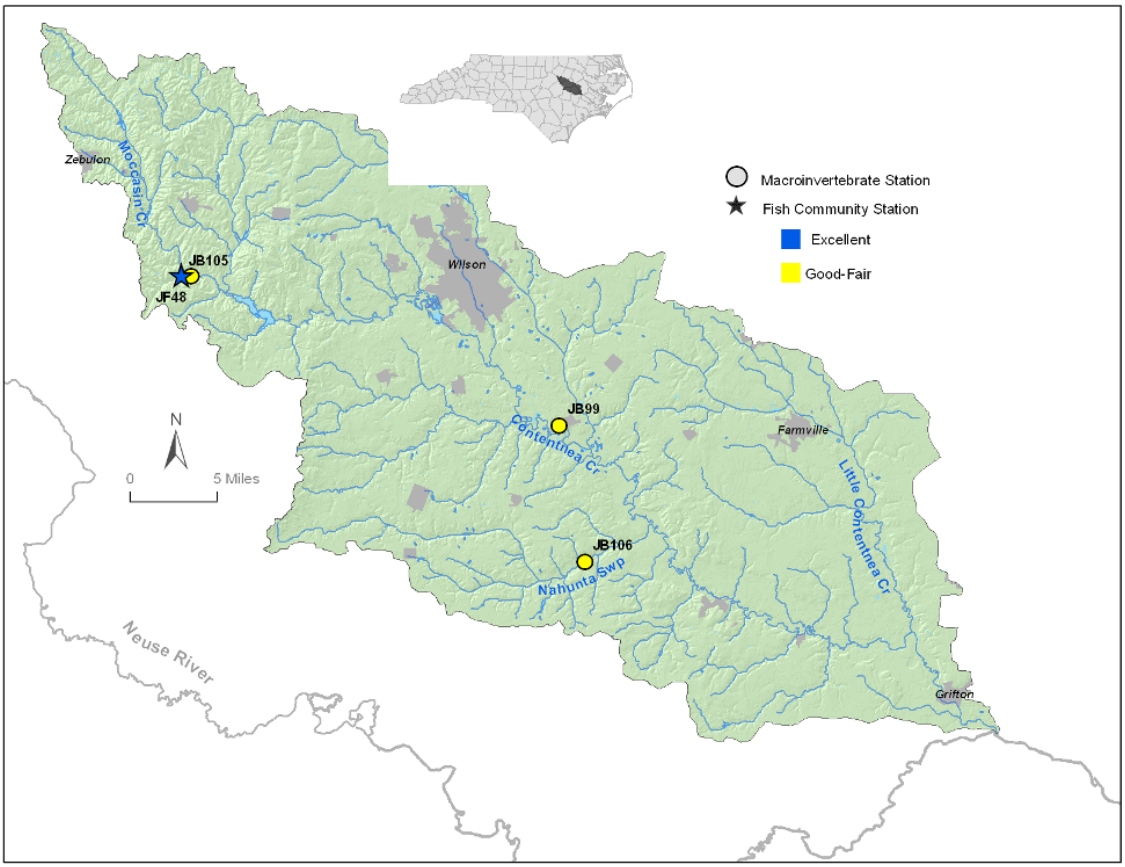


Figure 3. Sampling sites in HUC 03020203 (2010).

River and Stream Assessment

Two sites sampled during the most recent basinwide cycle in 2005 were not sampled in 2010 due to staffing reductions. These sites include Toisnot Swamp at US 264A (Wilson County) and Little Contentnea Creek at US 264 (Pitt County; Table 2). As the majority of this HUC occurs in the coastal plain there is a paucity of stream fish community monitoring data and there is only one non-coastal plain fish community site here (Moccasin Creek at NC 231). Currently, there are no biocritiera in place to assign bioclassifications to coastal plain streams using fish community data. Site IDs ending with “B” denote benthos samples, those ending with “F” denote fish samples.

Table 2. Waterbodies monitored in HUC 03020203 (2005-2010).

SITE ID	Waterbody	County	Location	2005	2010
JB105	Moccasin Cr	Nash	NC 231	Good-Fair	Good-Fair
JB99	Contentnea Cr	Wilson	NC 222	Good	Good-Fair
JB110	Toisnot Swp	Wilson	US 264A	Good-Fair	Not Sampled
JB106	Nahunta Swp	Greene	SR 1058	Good-Fair	Good-Fair
JB104	L Contentnea Cr	Pitt	US 264A	Fair	Not Sampled
JF48	Moccasin Cr	Johnston	NC 231	Good	Excellent

SPECIAL STUDIES (2005-2010).
The following special studies were conducted in this HUC ("F" denotes a fish assessment while a "B" denotes a benthic assessment):

BAU Memo (B-20060131; UT Moccasin Creek, Toisnot Swamp, Nahunta Swamp, Contentnea Creek, Hominy Swamp).

NEUSE RIVER HUC 03020202

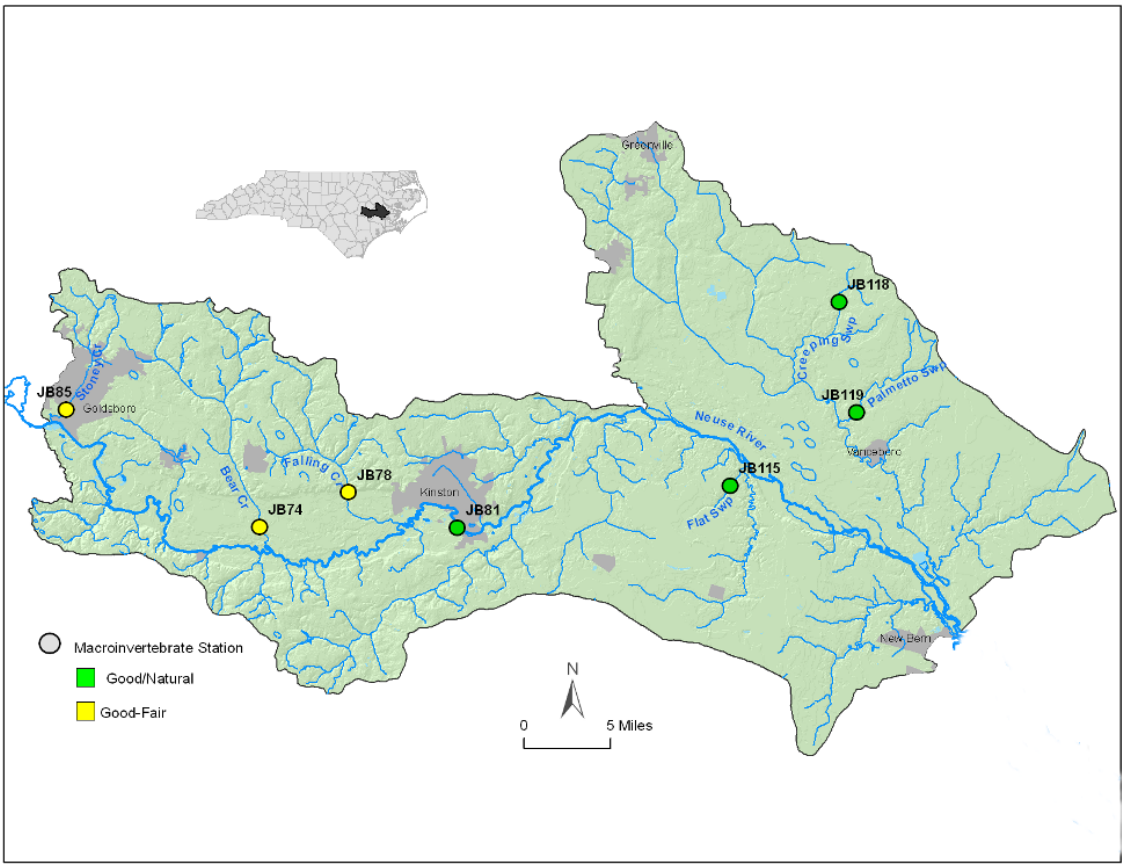


Figure 4. Sampling sites in HUC 03020202 (2010).

River and Stream Assessment

Three sites sampled during the most recent basinwide cycle in 2005 were not sampled in 2010 due to staffing reductions. These sites included Core Creek at NC 55 (Craven County), Swift Creek at NC 118 (Craven County) and Clayroot Swamp at SR 1941 (Pitt County; Table 3). There were no fish community collections in this HUC as there are no methods or biocritiera currently in place to assign bioclassifications to coastal plain streams using fish community data. Site IDs ending with “B” denote benthos samples, those ending with “F” denote fish samples.

Table 3. Waterbodies monitored in HUC 03020202 (2005-2010).

SITE ID	Waterbody	County	Location	2005	2010
JB85	Stoney Cr	Wayne	SR 1920	Fair	Good-Fair
JB74	Bear Cr	Lenior	SR 1311	Good-Fair	Good-Fair
JB81	Neuse R	Lenoir	NC 58	Good	Good
JB78	Falling Cr	Lenoir	Near SR 1546	Good-Fair	Good-Fair
JB113	Core Creek	Craven	NC 55	Good-Fair	Not Sampled
JB115	Flat Swamp	Craven	NC 55	Natural	Natural
JB120	Swift Cr	Craven	NC 118	Fair	Not Sampled
JB117	Clayroot Swp	Pitt	SR 1941	Good-Fair	Not Sampled
JB118	Creeping Swp	Pitt	NC 102	Moderate	Natural
JB119	Palmetto Swp	Craven	NC 43	Natural	Natural

SPECIAL STUDIES (2005-2010).
The following special studies were conducted in this HUC ("F" denotes a fish assessment while a "B" denotes a benthic assessment):

BAU Memo (B-20051130; Bear Creek)

BAU Memo (B-20070323; UT Neuse River)

BAU Memo (B-20060131; Core Creek and Swift Creek).

NEUSE RIVER HUC 03020204

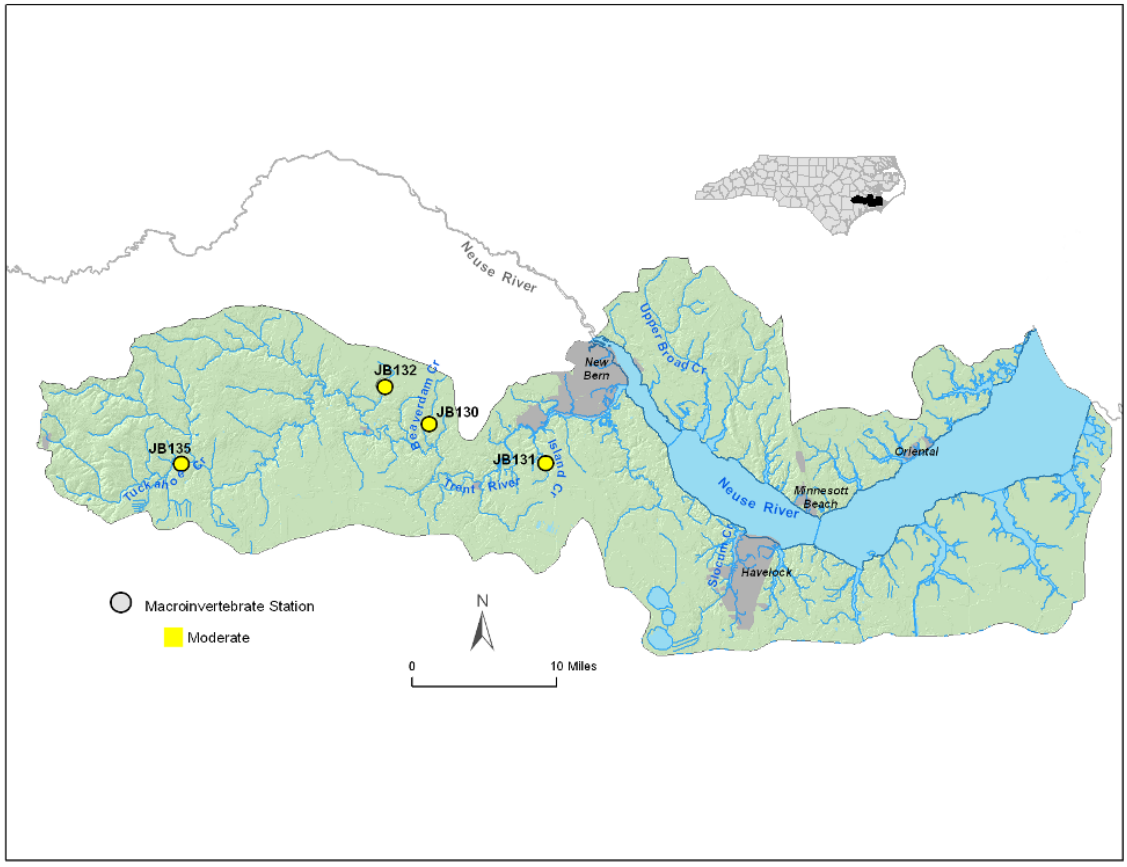


Figure 5. Sampling sites in HUC 03020204 (2010).

River and Stream Assessment

Four sites sampled during the most recent basinwide cycle in 2005 were not sampled in 2010 due to staffing reductions. These sites are noted below in Table 4. There were no fish community collections in this HUC as there are no methods or biocritiera currently in place to assign bioclassifications to coastal plain streams using fish community data. Site IDs ending with "B" denote benthos samples, those ending with "F" denote fish samples.

Table 4. Waterbodies monitored in HUC 03020204 (2005-2010).

SITE ID	Waterbody	County	Location	2005	2010
JB134	Trent R	Jones	SR 1153	Moderate	Not Sampled
JB133	Trent R	Jones	Beck's Bank Near Comfort	Good-Fair	Not Sampled
JB135	Tuckahoe Cr	Jones	SR 1142	Natural	Moderate
JB132	Musselshell Cr	Jones	SR 1320	Severe	Moderate
JB130	Beaverdam Cr	Jones	SR 1002	Moderate	Moderate
JB131	Island Cr	Jones	SR 1004	Natural	Moderate
JB19	Upper Broad Cr	Craven	NC 55	Natural	Not Sampled
JB126	SW Prong Slocum Cr	Craven	SR 1746	Moderate	Not Sampled

SPECIAL STUDIES (2005-2010).

The following special studies were conducted in this HUC ("F" denotes a fish assessment while a "B" denotes a benthic assessment):

BAU Memo (B-20050913; Mill Swamp, Upper Broad Creek, East Prong Slocum Creek, Cedar Gut, Fork Run, and UT West Prong Clubfoot Creek).

GLOSSARY

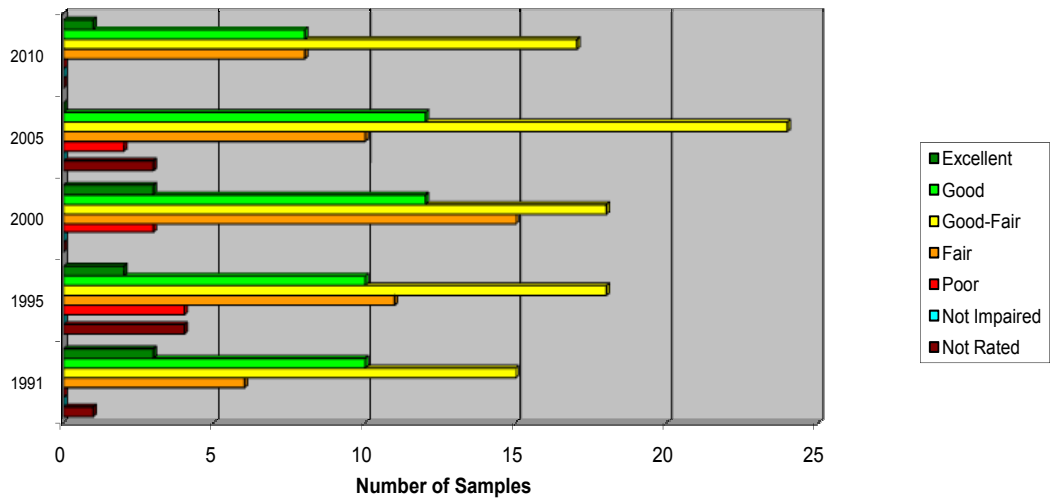
7Q10	A value which represents the lowest average flow for a seven day period that will recur on a ten year frequency. This value is applicable at any point on a stream. 7Q10 flow (in cfs) is used to allocate the discharge of toxic substances to streams.
Bioclass	Criteria have been developed to assign bioclassifications ranging from Poor to Excellent to each benthic sample based on the number of taxa present in the intolerant groups (EPT) and the Biotic Index value.
cfs	Cubic feet per second, generally the unit in which stream flow is measured.
Chl *a*	Chlorophyll *a*.
Class C Waters	Freshwaters protected for secondary recreation, fishing, and aquatic life including propagation and survival, and wildlife. All freshwaters shall be classified to protect these uses at a minimum.
Conductivity	In this report, synonymous with specific conductance and reported in the units of μmhos/cm at 25 ^{o}C. Conductivity is a measure of the resistance of a solution to electrical flow. Resistance is reduced with increasing content of ionized salts.
Division	The North Carolina Division of Water Quality.
D.O.	Dissolved Oxygen.
Ecoregion	An area of relatively homogeneous environmental conditions, usually defined by elevation, geology, and soil type. Examples include Southern Outer Piedmont, Carolina Flatwoods, Sandhills, and Slate Belt.
EPT	The insect orders (Ephemeroptera, Plecoptera, Trichoptera); as a whole, the most intolerant insects present in the benthic community.
EPT N	The abundance of Ephemeroptera, Plecoptera, Trichoptera insects present, using values of 1 for Rare, 3 for Common and 10 for Abundant.
EPT S	Taxa richness of the insect orders Ephemeroptera, Plecoptera and Trichoptera. Higher taxa richness values are associated with better water quality.
HQW	High Quality Waters. Waters which are rated as excellent based on biological and physical/chemical characteristics through Division monitoring or special studies; primary nursery areas designated by the Marine Fisheries Commission; and all Class SA waters.
IWC	Instream Waste Concentration. The percentage of a stream comprised of an effluent calculated using permitted flow of the effluent and 7Q10 of the receiving stream.
Major Discharger	Greater than or equal to one million gallons per day discharge (≥ 1 MGD).

MGD	Million Gallons per Day, generally the unit in which effluent discharge flow is measured.
Minor Discharger	Less than one million gallons per day discharge (< 1 MGD).
NPDES	National Pollutant Discharge Elimination System.
NCBI (EPT BI)	North Carolina Biotic Index, EPT Biotic Index. A summary measure of the tolerance values of organisms found in the sample, relative to their abundance. Sometimes noted as the NCBI or EPT BI.
NCIBI	North Carolina Index of Biotic Integrity (NCIBI); a summary measure of the effects of factors influencing the fish community.
NSW	Nutrient Sensitive Waters. Waters subject to growths of microscopic or macroscopic vegetation requiring limitations on nutrient inputs.
NTU	Nephelometric Turbidity Unit.
ORW	Outstanding Resource Waters. Unique and special waters of exceptional state or national recreational or ecological significance, which require special protection to maintain existing uses.
Parametric Coverage	A listing of parameters measured and reported.
SOC	A consent order between an NPDES permittee and the Environmental Management Commission that specifically modifies compliance responsibility of the permittee, requiring that specified actions be taken to resolve non-compliance with permit limits.
Total S (or S)	The number of different taxa present in a benthic macroinvertebrate sample.
UT	Unnamed tributary.
WWTP	Wastewater treatment plant.

Appendix 1. Summary of Benthic Macroinvertebrate Data.

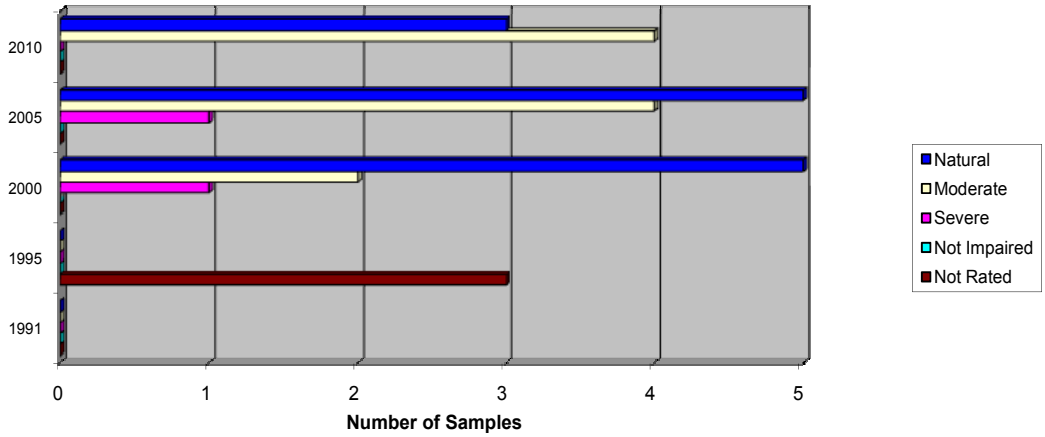
Since 1991, the largest trend noted among the river and stream samples was a small reduction in the number of Excellent bioclassifications and an overall increase in the number of Fair bioclassifications (Figure 6). In terms of Excellent bioclassifications, the sources of these changes both occurred at the Eno River (SR 1569 and US 15/501). The SR 1569 location rated Excellent in 1991, 1995, and 2000 while the US 15/501 received an Excellent rating in 2000. However, both of these stations have failed to attain an Excellent rating in either the 2005 or 2010 sampling period. In terms of the increase in Fair bioclassifications, the Eno River at SR 1336 received a Fair rating in 2010 but had been Good-Fair in 1991, 1995, and 2005 and Good in 2000. In addition, Upper Barton Creek at NC 50 was Fair in both 2005 and 2010 but had previously been Good in 1991 and Good-Fair in both 1995 and 2000 while Swift Creek at SR 1555 was Fair in 2010 but had previously been Good-Fair in 2000 and 2005. The trend of decreasing bioclassification at these locations over time suggests a decline in physico-chemical conditions in these waterbodies. Although there was a decrease in Poor bioclassifications from 1995 to 2010 there were two stations (Toms Creek at SR 2044 and Crabtree Creek at NC 54) that were Poor in previous monitoring cycles but were not sampled in 2010 due to staffing cuts. These stations would likely have rated Poor again in 2010 had they been sampled. Therefore, the apparent reducing trend in Poor bioclassifications since 1995 cannot be viewed as definitive.

Figure 6. Bioclassification Trends in the Neuse River Basin: 1990-2010.



The most notable trend among swamp samples from 1991-2010 is a decrease in the number of Natural bioclassifications and an overall increase in Moderate bioclassifications (Figure 7). Sites responsible for this trend included Tuckahoe Creek at SR 1142, Island Creek at SR 1004 and Upper Broad Creek at NC 55. Specefically, all of these stations were Natural in previous monitoring periods (2000-2005) but Moderate in 2010. The trend of decreasing bioclassification at these locations over time suggests a decline in physico-chemical conditions in these waterbodies. Conversely, one station (Musselshell Creek at SR 1320) improved in 2010 to Moderate where it had previously been Severe.

Figure 7. Bioclassification Trends in the Neuse River Basin: 1990-2010. Swamp Samples.



Appendix 2. Benthic Macroinvertebrate Sampling Methods

Standard Qualitative (Full Scale) Method

The Biological Assessment Unit's standard qualitative (Full Scale) sampling procedure comprises 10 components: two kick-net collections, three sweeps, two rock or log washes, one sand collection, one leaf-pack collection, and visual collections from large rocks and logs.[i] Invertebrates are removed from the matrix ("picked") on-site. The purpose of these collections is to inventory the aquatic fauna and produce an indication of relative abundance for each taxon. Organisms are classified as Rare (1 - 2 specimens), Common (3 - 9 specimens), or Abundant (≥ 10 specimens).

EPT Method

Benthic macroinvertebrates can also be collected using the EPT sampling procedure. Four, rather than 10, composite qualitative samples are taken at each site: one kick, one sweep, one leaf-pack, and visual collections. Only EPT taxa are collected and identified and only EPT taxa richness is used to assign a bioclassification.

Swamp Stream Method

The Biological Assessment Unit defines "swamp streams" as those streams that are within the coastal plain ecoregion and that normally have no visible flow during a part of the year. The low flow period usually occurs during the summer; flowing water should be present in swamp streams during the winter. Sampling during the winter, high-flow period provides the best opportunity for detecting differences between natural and stressed benthic communities in these systems. The swamp stream must have visible flow in this winter period, with flow comparable to a coastal plain stream that would have acceptable flow for sampling in summer. Swamp streams with pH values of 4.0 s.u. or lower can not be rated; those streams with pH values between 4.0 and 4.5 s.u. are difficult to evaluate.

The swamp sampling method utilizes a variety of collection techniques to inventory the macroinvertebrate fauna at a site. Nine sweep samples (one series of three by each field team member) are collected from each of the following habitats: macrophytes, root mats/undercut banks, and detritus deposits. If one of these habitat types is not present, a sweep from one of the other habitats is substituted. A sweep is defined as the area that can be reached from a given standing location. Each sweep should be emptied into a tub before the next sweep is collected, to prevent clogging of the net, but all three sweeps can be combined in the same tub. Three log/debris washes are also collected. Visual collections are the final technique used at each site.

For all three sampling methods (full-scale, boat, and swamp), organisms are removed from each sample at the field site and preserved in 95% ethanol. The purpose of these collections is to inventory the aquatic fauna and produce an indication of relative abundance for each taxon. Organisms are classified as Rare (1 - 2 specimens), Common (3 - 9 specimens), or Abundant (≥ 10 specimens).

Habitat Evaluation

Habitat assessment forms have been developed by the Biological Assessment Unit to evaluate the physical habitat of mountain/piedmont and coastal streams. The habitat score, which ranges between 1 and 100, is based on the evaluation of channel modification, amount of instream habitat, type of bottom substrate, pool variety, bank stability, light penetration, and riparian zone width. Higher numbers suggest better habitat quality, but no criteria have been developed to assign impairment ratings.

Appendix 3. Benthic Macroinvertebrate Data Analysis and Critieria

Data Analysis

Bioclassifications for the Full Scale assessment method are based on EPT Richness and North Carolina Biotic Index (NCBI, sometimes just identified as BI) values. Both tolerance values for individual taxa and community biotic index values have a range of zero through 10, with higher numbers indicating more tolerant taxa and more polluted conditions respectively. NCBI scores are averaged with EPT taxa richness scores to produce a final bioclassification. Bioclassifications for the EPT sample method are based on the total number of EPT taxa present in the sample. EPT abundance and overall taxa richness can also be used to help examine between-site differences in water quality.

EPT Richness and BI values are affected by seasonal changes. DWQ criteria for assigning bioclassifications are based on summer sampling, which occurs from June through September. For samples collected outside the summer sampling period, EPT Richness is often adjusted by removing the number of winter/spring Plecoptera taxa present to give a seasonally corrected value. Adjustments for seasonality may also be performed based upon site-specific differences between summer and non-summer samples if such data are available. The BI values also are seasonally adjusted for samples outside the summer season.

No criteria are in place for small-stream samples collected from sites with a drainage area less than or equal to 3.0 square miles that are subject to anthropogenic disturbance and collected outside of the April to June seasonal window. Such sites are assigned a “Not Impaired” if they would earn a classification of either Excellent, Good, or Good-Fair using EPT criteria for larger stream sites, or a “Not Rated” otherwise.

Standard Qualitative (Full-Scale) and EPT Criteria

Criteria for bioclassifications for standard qualitative (Full-Scale) samples in piedmont and Coastal Plain ecoregions are given below in Table 5 and are based on EPT S and the NCBI. Criteria for bioclassifications for the EPT sample method are provided in Table 6 and are based on EPT taxa richness.

Tolerance values for individual species and biotic index values have a range of 0 - 10, with higher numbers indicating more tolerant species or more polluted conditions. Water quality scores (5 = Excellent, 4 = Good, 3 = Good-Fair, 2 = Fair and 1 = Poor) assigned with the biotic index numbers are averaged with EPT taxa richness scores to produce a final bioclassification. Criteria for piedmont and coastal plain streams are used for the Neuse River basin. EPT abundance and Total taxa richness calculations also are used to help examine between-site differences in water quality.

Table 5. Criteria for Standard Qualitative (Full Scale) Samples.

Score	BI Values		EPT Values	
	Piedmont	Coastal Plain (CA)	Piedmont	Coastal Plain (CA)
5	<5.14	< 5.42	>33	>29
4.6	5.14—5.18	5.47—5.46	32-33	28
4.4	5.19—5.23	5.47—5.51	30-31	27
4	5.24—5.73	5.52—6.00	26-29	22-26
3.6	5.74—5.78	6.01—6.05	24-25	21
3.4	5.79—5.83	6.06—6.10	22-23	20
3	5.84—6.43	6.11—6.67	18-21	15-19
2.6	6.44—6.48	6.68—6.72	16-17	14
2.4	6.49—6.53	6.73—6.77	14-15	13
2	6.54—7.43	6.78—7.68	10-13	8-12
1.6	7.44—7.48	7.69—7.73	8-9	7
1.4	7.49—7.53	7.74—7.79	6-7	6
1	> 7.53	>7.79	0-5	0-5

Table 6. Criteria for EPT Samples.

Score	EPT Values	EPT Values
	Piedmont	Coastal Plain (CA)
Excellent	>27	>23
Good	21-27	18-23
Good-Fair	14-20	12-17
Fair	7-13	6-11
Poor	0-6	0-5

Swamp Stream Criteria

Swamp stream criteria are used to evaluate a stream based on three benthic macroinvertebrate metrics (total taxa richness, EPT taxa richness, and the Biotic Index) and the coastal plain habitat score.

In the following, raw measures for total taxa richness, EPT richness, biotic index, and habitat are referred to as “values.” After adjustments are made for swamp criteria, the measures are referred to as “scores.” The convention is made to reduce confusion.

Swamps in the Neuse River basin is classified as A, B, or P depending on geographic location. The metric scores derived below depend on the swamp classification and, in some cases, pH.

If the stream channel is braided, the value for total taxa richness is increased by eight. Corrected total taxa richness is determined from Table 7 for Swamp A and Swamp B streams. Find the pH for the collection on the left. Find the set of three columns which correspond to the stream type (Swamp A or Swamp B), the find the range which corresponds to the total taxa richness for the site (corrected for a braided stream as indicated above, if necessary). Find the corrected total taxa richness score at the top of the appropriate column.

Table 7. Determination of Corrected Taxa Richness Scores for Swamp A and B Streams Adjusted for pH.

	Corrected Total Taxa Richness Score					
	Swamp A			**Swamp B**		
	5	**3**	**1**	**5**	**3**	**1**
pH						
≥5.5	>51	35-51	<35	>38	25-38	<25
5.4	>49	32-49	<32	>36	23-36	<23
5.3	>46	29-46	<29	>34	21-34	<21
5.2	>43	26-43	<26	>32	19-32	<19
5.1	>40	23-40	<23	>30	17-30	<17
5.0	>37	20-37	<20	>28	≤28	ND
4.9	>35	17-35	<17	>26	≤26	ND
4.8	>33	13-33	<13	>24	≤24	ND
4.7	>30	10-30	<10	>22	≤22	ND
4.6	>28	0-28	ND	>20	≤20	ND
4.5	>26	0-26	ND	>18	≤18	ND
4.4	>23	0-23	ND			
4.3	>20	0-20	ND			
4.2	>17	0-17	ND			
4.1	>14	0-14	ND			

Corrected total taxa richness scores are assigned as follows for Swamp C streams:

if the total taxa richness > 34, total taxa richness score = 5
if the total taxa richness is ≤ 34, total taxa richness score = 3

Biotic index scores for Swamp A, B, and C streams are derived using Table 8.

Table 8. Determination of Biotic Index Scores for Swamp A, B, and C Streams

	Swamp A	**Swamp B**	**Swamp C**
BI Score			
5	<6.8	<7.0	<7.2
3	6.8-7.5	7.0-7.9	7.2-8.1
1	>7.5	>7.9	>8.1

For EPT taxa richness add two to the value if the channel is braided, no matter the stream type.

For Swamp A streams, the EPT richness score is determined from Table 9. Find the pH for the collection in the left column. Move to the right to find the appropriate range for the EPT Richness value. Read the corrected EPT richness score from the top of the column.

Table 9. EPT Richness Scores for Swamp A streams adjusted for pH.

	Corrected EPT Richness Value		
	5	**3**	**1**
pH			
≥5.5	>17	7-17	0-6
5.4	>15	6-15	0-5
5.3	>13	5-13	0-4
5.2	>11	4-11	0-3
5.1	>9	3-9	0-2
5.0	>8	0-8	ND
4.9	>7	0-7	ND
4.8	>6	0-6	ND
4.7	>5	0-5	ND
4.6	>4	0-4	ND
4.5	>4	ND	ND

For Swamp B streams, the EPT richness score is not dependant on pH; scores are assigned as follows:

if EPT richness value > 5, EPT richness score = 5
if EPT richness value is between 2 and 4 inclusive, EPT richness score = 3
if EPT richness value is 0 or 1, EPT richness score = 1

For all Swamp C streams the EPT richness score is assigned a 1. An adjustment for very low numbers of EPT taxa in Swamp C streams will be made after the site score is determined.

Habitat scores are assigned irrespective of stream type:

if habitat value > 79, habitat score = 5
if habitat value is between 60 and 79 inclusive, habitat score = 3
if habitat value is < 60, habitat score = 1

The site score is calculated from the following:

Site Score = [(2xBI score + habitat score + EPT S score + Taxa Richness score) – 5]/2

For Swamp C streams, add two to the site score.

Stress ratings based on the scores are: Natural (9 - 10), Moderate (4 - 8) and Severe (1 - 3).

Appendix 4. Summary of fish community assessment data.

Monitoring efforts for 2010 for the Neuse River basin are summarized:

- Twenty-two sites were assessed as part of the basinwide monitoring cycle.
- All of the sites, except two, had been sampled during the previous basinwide cycle in 2004-2005.
- Two sites on Walnut Creek had never been assessed (South State Street) or had not been assessed since 1995 (SR 1348).
- Sites sampled in 2010 that were on the §303 (d) impaired streams list for biological integrity were: Upper Barton Creek (Assessment Unit Number 27-15-(1)), Smith Creek (27-23-(2)), Richlands Creek (27-33-11), Walnut Creek (27-34-(1.7)), and Little Creek (27-43-12).
- No special studies were conducted in the basin during the intervening years between 2005 and 2010.

The most widely distributed species collected at all 22 sites were the Swallowtail Shiner, Redbreast Sunfish, and Bluegill. The Bluehead Chub and White Shiner were the most abundant species, representing 19% and 17%, respectively of all the fish collected. All streams were evaluated and rated using the North Carolina Index of Biotic Integrity (NCIBI) (Appendix 5). The NCIBI scores ranged from 34 to 58 and the NCIBI ratings ranged from Fair to Excellent; 59% of the sites rated Good or Excellent (Figures 8 and 9).

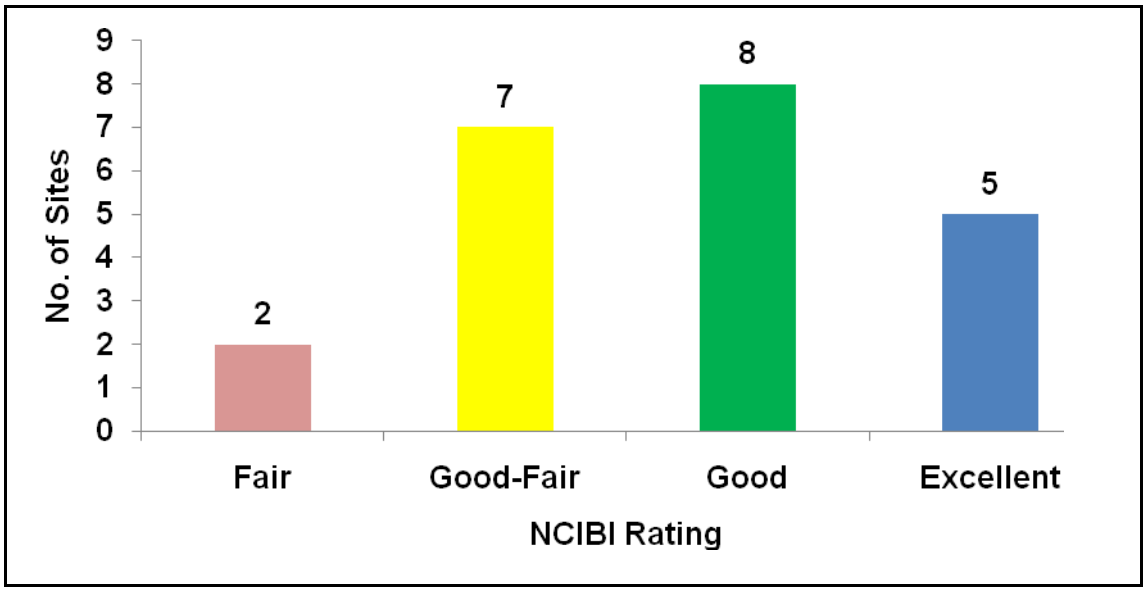


Figure 8. Fish community ratings in the Neuse River basin, 2010.

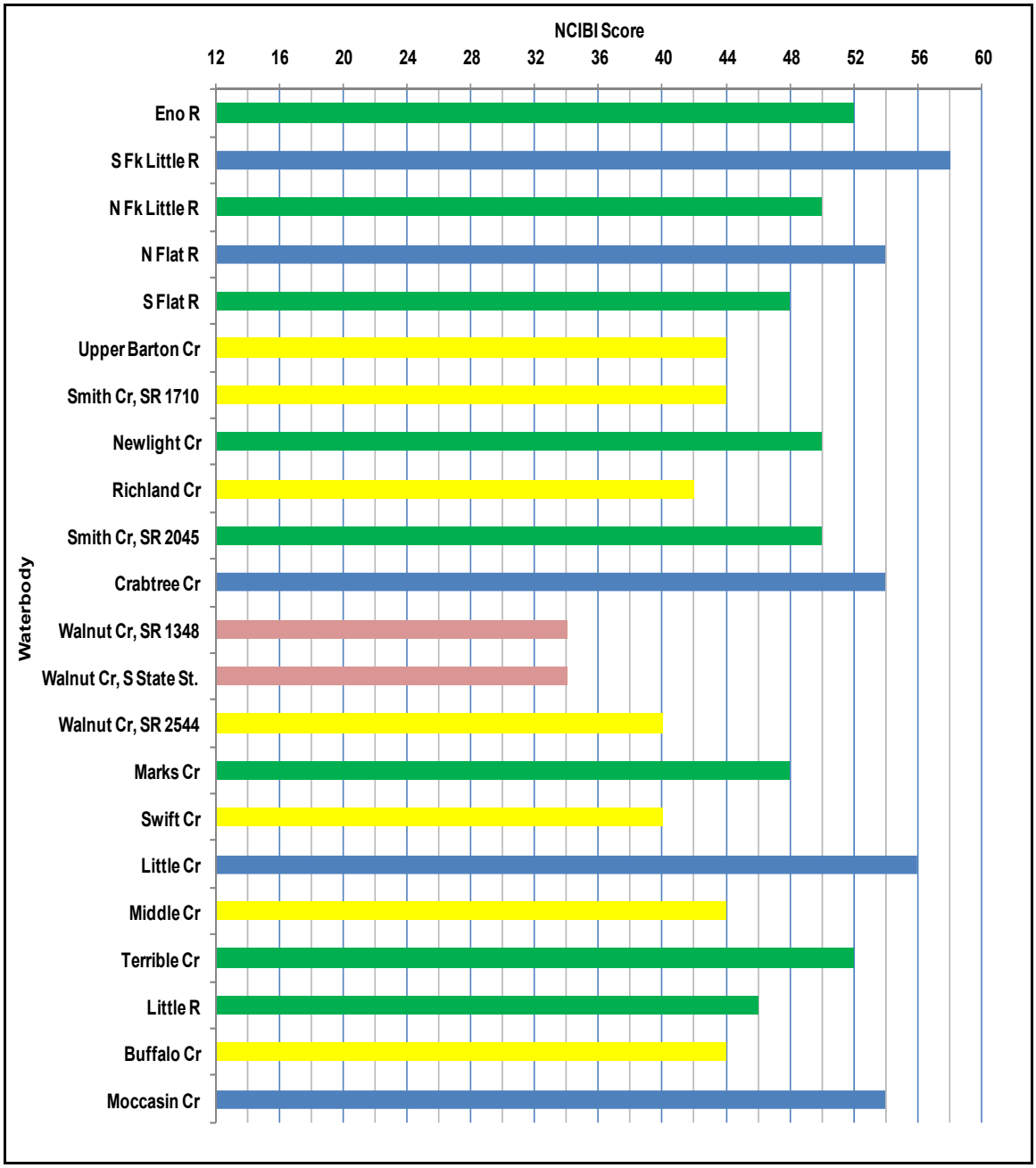


Figure 9. **Fish community scores and ratings of the Neuse River basin, 2010. Blue = Excellent, Green = Good, Yellow = Good-Fair, and Pink = Fair sites.**

Twenty of the same sites had been sampled during the 2010 and 2004-2005 monitoring cycles. In 2004-2005, 70% of the sites rated Good or Excellent; in 2010, 65% of the sites rated Good or Excellent (Figure 10). By contrast, 20% of the sites rated Good-Fair in 2004-2005 and 35% in 2010. Overall, the number of Excellent sites did not change, but the number of Good sites declined as the number of Good-Fair sites increased.

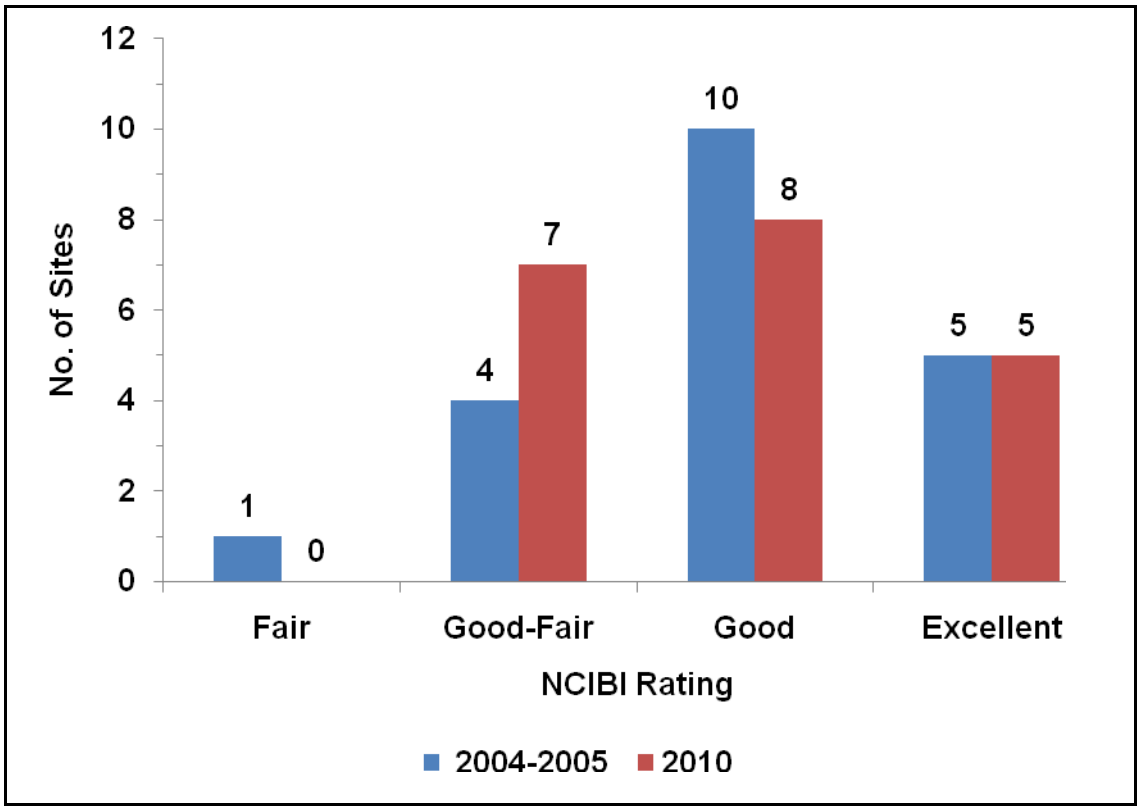


Figure 10. Fish community ratings of repeat fish sites in the Neuse River basin, 2004/2005-2010.

Twenty-one sites had been sampled two or more times during previous basinwide monitoring cycles (Figure 11). Comparing the NCIBI ratings for the two most recent monitoring cycles for each site, 71% of the sites (n=15) had no appreciable change, 14% of the sites (n=3) had ratings that increased one or two classes, and 14% of the sites (n=3) had ratings that decreased one or two classes (Figure 11).

The substantial improvements in the NCIBI scores and NCIBI ratings at North Flat River, Smith Creek at SR 2045, and Little Creek were due to unknown reasons or perhaps more efficient collection of fish at lower flows (North Flat River and Little Creek). The proximity of the Smith Creek site relative to the Neuse River (< 1 mile from its confluence with the river) may affect the recruitment of fish and the total species diversity of the community. This close spatial relationship may be partially responsible for the fish community's widely variable NCIBI metric scores and ratings since monitoring began in 1995 at the site.

Declines in the NCIBI scores and ratings at Eno River, Richland Creek, and Middle Creek may be attributed to several factors such as altered hydrology due to upstream reservoir releases resulting in extremes in flows (Eno River), increasing developmental pressures resulting in habitat alterations, altered hydrology, and sediment runoff (Richland Creek), and possible poor performance of upstream wastewater treatment plants including notice of violations and proceedings to enforcement actions for total phosphorus, biochemical oxygen demand, ammonia-nitrogen, and fecal coliform bacteria limit violations (Middle Creek).

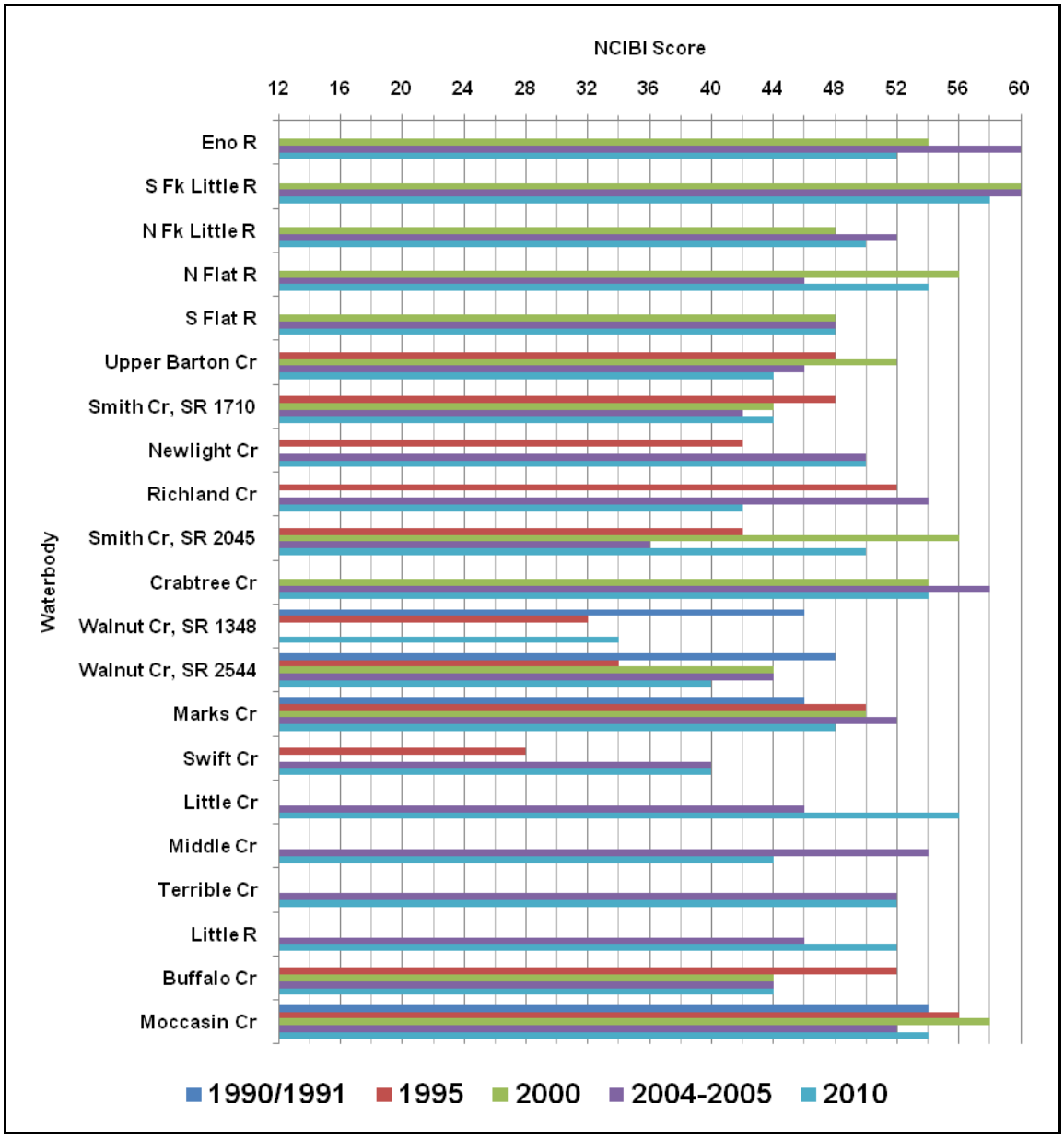


Figure 11. Fish community scores of 21 repeat fish sites in the Neuse River basin, 1990/1991-2010.

Repeat/verification sampling should be conducted at two sites in 2011 to determine why the NCIBI scores and ratings declined or changed substantially at Middle Creek at SR 1375 in Wake County; and Richland Creek at US 1 in Wake County. Two waterbodies qualify for consideration for reclassification to Outstanding Resource Waters or High Quality Waters: North Flat River at SR 1715 in Person County, and Moccasin Creek at NC 231 in Johnston County.

Appendix 5. Fish community sampling methods and criteria.

Sampling Methods

Fish community assessments were performed adhering to all methods in the existing standard operating procedures (NCDENR 2006). At each site, a 600 ft. section of stream was selected and measured. The fish in the delineated reach were then collected using two backpack electrofishing units and two persons netting the stunned fish. A seine was also used where there were substantial riffles. After collection, all readily identifiable fish were examined for sores, lesions, fin damage, or skeletal anomalies, measured (total length to the nearest 1 mm), and then released. Those fish that were not readily identifiable were preserved and returned to the laboratory for identification, examination, and total length measurement. These fish have been deposited as voucher specimens with the North Carolina State Museum of Natural Sciences in Raleigh.

NCIBI (North Carolina Index of Biotic Integrity) Analysis, Evaluation, and Scoring Criteria

The NCIBI is a modification of the Index of Biotic Integrity initially proposed by Karr (1981) and Karr, *et al*. (1986). The IBI method was developed for assessing a stream's biological integrity by examining the structure and health of its fish community. The scores derived from this index are a measure of the ecological health of the waterbody and may not directly correlate to water quality. For example, a stream with excellent water quality, but with poor or fair fish habitat, would not be rated excellent with this index. However, in many instances, a stream which rated excellent on the NCIBI should be expected to have excellent water quality.

The Index of Biological Integrity incorporates information about species richness and composition, trophic composition, fish abundance, and fish condition. The NCIBI summarizes the effects of all factors that influence aquatic faunal communities (water quality, energy source, habitat quality, flow regime, and biotic interactions). While change within a fish community can be caused by many factors, certain aspects of the community are generally more responsive to specific influences. Species composition measurements reflect habitat quality effects. Information on trophic composition reflects the effect of biotic interactions and energy supply. Fish abundance and condition information indicate additional water quality effects. It should be noted, however, that these responses may overlap. For example, a change in fish abundance may be due to decreased energy supply or a decline in habitat quality, not necessarily a change in water quality.

The assessment of biological integrity using the North Carolina Index of Biotic Integrity (NCIBI) is provided by the cumulative assessment of 12 parameters or metrics. The values provided by the metrics are converted into scores on a 1, 3, or 5 scale. A score of 5 represents conditions which would be expected for undisturbed reference streams in the specific river basin or ecoregion, while a score of 1 indicates that the conditions deviate greatly from those expected in undisturbed streams of the region. Each metric is designed to contribute unique information to the overall assessment. The scores for all metrics are then summed to obtain the overall NCIBI score. Finally, the score (an even number between 12 and 60) is then used to determine the ecological integrity class of the stream from which the sample was collected.

In 2001 the NCIBI was revised with bioclassifications and criteria recalibrated against regional reference site data (Biological Assessment Unit Memorandum F-20010922; NCDENR 2006). To qualify as a reference site, the site had to satisfy all seven criteria in Table 10 in the order listed. Reference sites represent the least impacted streams. In the Neuse River basin six streams have been identified as reference sites (Table 11). Criteria and ratings that have been developed are applicable only to wadeable streams in the piedmont region of the Neuse River basin (Tables 12 and 13). The definition of piedmont is based on a map of North Carolina watersheds by Fels (1997) and Griffith *et al*. (2002). Metrics and ratings should not be applied to non-wadeable streams nor to Coastal Plain streams; these streams are currently not rated. The focus continues to apply and restrict the use of the NCIBI to wadeable streams that can be sampled by a crew of four persons.

Table 10. Reference site selection hierarchy.

Criterion	Qualification
1 -- Habitat	Total habitat score ≥ 65
2 – NPDES dischargers	No NPDES dischargers ≥ 0.01 MGD above the site or if there are small dischargers (~≤ 0.01 MGD), the dischargers are more than one mile upstream
3 – Percent urbanization	< 10% of the watershed is urban or residential areas
4 – Percent forested	≥ 70% of the watershed is forested or in natural vegetation
5 – Channel incision	At the site, the stream is not incised beyond natural conditions
6 – Riparian zone integrity	No breaks in the riparian zones or, if there are breaks, the breaks are rare
7 – Riparian zone width	Piedmont streams – width of the riparian zone along both banks is ≥ 12 m Coastal Plain streams – width of the riparian zone along both banks is ≥ 18 m
Exception 1	If the site satisfied Criteria 1 - 6, except one of the two riparian widths was less than one unit optimal, then the site still qualified as a reference site
Exception 2	If the site satisfied Criteria 1 - 3 and 5 - 7, but the percentage of the watershed in forest or natural vegetations was ≥ 60% (rather than ≥ 70%), then the site still qualified as a reference site. [Note: in the New River Basin this last exception is ≥ 50%.]

Table 11. Regional reference sites in the piedmont region of the Neuse River basin.

Waterbody	Station	County	Level IV Ecoregion
Deep Creek	SR 1734	Person	Carolina Slate Belt
North Fork Little River	SR 1461	Durham	Carolina Slate Belt
South Fork Little River	SR 1461	Durham	Carolina Slate Belt
Buckquarter Creek	Buckquarter Cr Trail (Eno River State Park)	Orange	Carolina Slate Belt
Rhodes Creek	off SR 1582	Orange	Carolina Slate Belt
Stones Creek	US 70	Orange	Carolina Slate Belt

Table 12. Revised scores and classes for evaluating the fish community of a wadeable stream using the North Carolina Index of Biotic Integrity in the Outer Piedmont (Cape Fear, Neuse, Roanoke, and Tar River basins).

NCIBI Scores	NCIBI Classes
54, 56, 58, or 60	Excellent
46, 48, 50, or 52	Good
40, 42, or 44	Good-Fair
34, 36, or 38	Fair
≤ 32	Poor

Table 13. Scoring criteria for the NCIBI for wadeable streams in the Outer Piedmont of the Neuse, Cape Fear, Roanoke, and Tar River basins ranging between 3.1 and 328 mi^2.

No.	Metric		Score
1	**No. of species**		
	≥ 16 species		5
	10-15 species		3
	< 10 species		1
2	**No. of fish**		
	≥ 225 fish		5
	150-224 fish		3
	< 150 fish		1
3	**No. of species of darters**		
	Cape Fear	Neuse, Roanoke, and Tar	
	≥ 2 species	≥ 3 species	5
	1 species	1 or 2 species	3
	0 species	0 species	1
4	**No. of species of sunfish**		
	≥ 4 species		5
	3 species		3
	0, 1, or 2 species		1
5	**No. of species of suckers**		
	Cape Fear	Neuse, Roanoke, and Tar	
	≥ 2 species	≥ 3 species	5
	1 species	1 or 2 species	3
	0 species	0 species	1
6	**No. of intolerant species**		
	Cape Fear	Neuse, Roanoke, and Tar	
	≥ 1 species	≥ 3 species	5
	no middle score	1 or 2 species	3
	0 species	0 species	1
7	**Percentage of tolerant individuals**		
	≤ 35%		5
	36-50%		3
	> 50%		1
8	**Percentage of omnivorous and herbivorous individuals**		
	10-35%		5
	36-50%		3
	> 50%		1
	< 10%		1
9	**Percentage of insectivorous individuals**		
	65-90%		5
	45-64%		3
	< 45%		1
	> 90%		1
10	**Percentage of piscivorous individuals**		
	≥ 1.4-15%		5
	0.4-1.3%		3
	< 0.4%		1
	> 15%		1
11	**Percentage of diseased fish (DELT = diseased, fin erosion, lesions, and tumors)**		
	≤ 1.75%		5
	1.76-2.75%		3
	> 2.75%		1
12	**Percentage of species with multiple age groups**		
	≥ 50% of all species have multiple age groups		5
	35-49% all species have multiple age groups		3
	< 35% all species have multiple age groups		1

Table 14. Tolerance ratings and adult trophic guild assignments for fish in the Neuse River basin. Common and scientific names follow Nelson, et al. (2004), except for *Chrosomus* and *Scartomyzon*.

Family/Species	Common Name	Tolerance Rating	Trophic Guild of Adults
Petromyzontidae	**Lampreys**		
Lampetra aepyptera	Least Brook Lamprey	Intermediate	Non-feeding
Petromyzon marinus	Sea Lamprey	Intermediate	Parasitic
Acipenseridae	**Sturgeons**		
Acipenser oxyrinchus	Atlantic Sturgeon	Intermediate	Insectivore
Lepisosteidae	**Gars**		
Lepisosteus osseus	Longnose Gar	Tolerant	Piscivore
Amiidae	**Bowfins**		
Amia calva	Bowfin	Tolerant	Piscivore
Anguillidae	**Eels**		
Anguilla rostrata	American Eel	Intermediate	Piscivore
Clupeidae	**Herrings and Shads**		
Alosa aestivalis	Blueback Herring	Intermediate	Insectivore
A. mediocris	Hickory Shad	Intermediate	Insectivore
A. pseudoharengus	Alewife	Intermediate	Insectivore
A. sapidissima	American Shad	Intermediate	Insectivore
Dorosoma cepedianum	Gizzard Shad	Intermediate	Omnivore
D. petenense	Threadfin Shad	Intermediate	Omnivore
Cyprinidae	**Carps and Minnows**		
Carassius auratus	Goldfish	Tolerant	Omnivore
Chrosomus oreas	Mountain Redbelly Dace	Intermediate	Herbivore
Clinostomus funduloides	Rosyside Dace	Intermediate	Insectivore
Ctenopharyngodon idella	Grass Carp	Tolerant	Herbivore
Cyprinella analostana	Satinfin Shiner	Tolerant	Insectivore
Cyprinus carpio	Common Carp	Tolerant	Omnivore
Hybognathus regius	Silvery Minnow	Intermediate	Herbivore
Luxilus albeolus	White Shiner	Intermediate	Insectivore
L. cerasinus	Crescent Shiner	Intermediate	Insectivore
Lythrurus matutinus	Pinewoods Shiner	Intermediate	Insectivore
Nocomis leptocephalus	Bluehead Chub	Intermediate	Omnivore
N. raneyi	Bull Chub	Intermediate	Omnivore
Notemigonus crysoleucas	Golden Shiner	Tolerant	Omnivore
Notropis altipinnis	Highfin Shiner	Intermediate	Insectivore
N. amoenus	Comely Shiner	Intermediate	Insectivore
N. bifrenatus	Bridle Shiner	Intermediate	Omnivore
N. chalybaeus	Ironcolor Shiner	Intolerant	Insectivore
N. cummingsae	Dusky Shiner	Intermediate	Insectivore
N. hudsonius	Spottail Shiner	Intermediate	Omnivore
N. procne	Swallowtail Shiner	Intermediate	Insectivore
N. volucellus	Mimic Shiner	Intolerant	Insectivore
Pimephales promelas	Fathead Minnow	Tolerant	Omnivore
Semotilus atromaculatus	Creek Chub	Tolerant	Insectivore
Catostomidae	**Suckers**		
Catostomus commersoni	White Sucker	Tolerant	Omnivore
Erimyzon oblongus	Creek Chubsucker	Intermediate	Omnivore
E. sucetta	Lake Chubsucker	Intermediate	Insectivore
Hypentelium nigricans	Northern Hog Sucker	Intermediate	Insectivore
Ictiobus bubalus	Smallmouth Buffalo	Intermediate	Omnivore
Minytrema melanops	Spotted Sucker	Intermediate	Insectivore
Moxostoma collapsum	Notchlip Redhorse	Intermediate	Insectivore
M. macrolepidotum	Shorthead Redhorse	Intermediate	Insectivore
M. pappillosum	V-Lip Redhorse	Intermediate	Insectivore
Scartomyzon cervinus	Blacktip Jumprock	Intermediate	Insectivore
Ictaluridae	**North American Catfishes**		
Ameiurus brunneus	Snail Bullhead	Intermediate	Insectivore
A. catus	White Catfish	Tolerant	Omnivore
A. natalis	Yellow Bullhead	Tolerant	Omnivore
A. nebulosus	Brown Bullhead	Tolerant	Omnivore
A. platycephalus	Flat Bullhead	Tolerant	Insectivore
Ictalurus furcatus	Blue Catfish	Intermediate	Piscivore
I. punctatus	Channel Catfish	Intermediate	Omnivore
Noturus furiosus	Carolina Madtom	Intolerant	Insectivore
N. gyrinus	Tadpole Madtom	Intermediate	Insectivore
N. insignis	Margined Madtom	Intermediate	Insectivore

Table 14 (continued).

Family/Species	Common Name	Tolerance Rating	Trophic Guild of Adults
Pylodictis olivaris	Flathead Catfish	Intermediate	Piscivore
Esocidae	**Pikes**		
Esox americanus	Redfin Pickerel	Intermediate	Piscivore
E. niger	Chain Pickerel	Intermediate	Piscivore
Umbridae	**Mudminows**		
Umbra pygmaea	Eastern Mudminnow	Intermediate	Insectivore
Aphredoderidae	**Pirate Perches**		
Aphredoderus sayanus	Pirate Perch	Intermediate	Insectivore
Amblyopsidae	**Cavefishes**		
Chologaster cornuta	Swampfish	Intermediate	Insectivore
Atherinidae	**Silversides**		
Menidia beryllina	Inland Silverside	Intermediate	Insectivore
Fundulidae	**Topminnows**		
Fundulus diaphanus	Banded Killifish	Intermediate	Insectivore
F. lineolatus	Lined Topminnow	Intermediate	Insectivore
F. rathbuni	Speckled Killifish	Intermediate	Insectivore
Poeciliidae	**Livebearers**		
Gambusia holbrooki	Eastern Mosquitofish	Tolerant	Insectivore
Moronidae	**Temperate Basses**		
Morone americana	White Perch	Intermediate	Piscivore
M. chrysops	White Bass	Intermediate	Piscivore
M. saxatilis	Striped Bass	Intermediate	Piscivore
Centrarchidae	**Sunfishes**		
Acantharchus pomotis	Mud Sunfish	Intermediate	Insectivore
Ambloplites cavifrons	Roanoke Bass	Intermediate	Piscivore
Centrarchus macropterus	Flier	Intermediate	Insectivore
Enneacanthus chaetodon	Blackbanded Sunfish	Intermediate	Insectivore
E. gloriosus	Bluespotted Sunfish	Intermediate	Insectivore
E. obesus	Banded Sunfish	Intermediate	Insectivore
Lepomis auritus	Redbreast Sunfish	Tolerant	Insectivore
L. cyanellus	Green Sunfish	Tolerant	Insectivore
L. gibbosus	Pumpkinseed	Intermediate	Insectivore
L. gulosus	Warmouth	Intermediate	Insectivore
L. macrochirus	Bluegill	Intermediate	Insectivore
L. marginatus	Dollar Sunfish	Intermediate	Insectivore
L. microlophus	Redear Sunfish	Intermediate	Insectivore
Lepomis sp.	Hybrid Sunfish	Tolerant	Insectivore
Micropterus dolomieu	Smallmouth Bass	Intolerant	Piscivore
M. salmoides	Largemouth Bass	Intermediate	Piscivore
Pomoxis annularis	White Crappie	Intermediate	Piscivore
P. nigromaculatus	Black Crappie	Intermediate	Piscivore
Percidae	**Perches**		
Etheostoma collis	Carolina Darter	Intermediate	Insectivore
E. flabellare	Fantail Darter	Intermediate	Insectivore
E. fusiforme	Swamp Darter	Intermediate	Insectivore
E. nigrum	Johnny Darter	Intermediate	Insectivore
E. olmstedi	Tessellated Darter	Intermediate	Insectivore
E. serrifer	Sawcheek Darter	Intolerant	Insectivore
E. vitreum	Glassy Darter	Intermediate	Insectivore
Perca flavescens	Yellow Perch	Intermediate	Piscivore
Percina nevisense	Chainback Darter	Intolerant	Insectivore
P. roanoka	Roanoke Darter	Intolerant	Insectivore
Elassomatidae	**Pygmy Sunfishes**		
Elassoma zonatum	Banded Pygmy Sunfish	Intermediate	Insectivore

Blackspot and Other Diseases

Blackspot and yellow grub diseases are naturally occurring, common infections of fish by an immature stage of flukes. The life cycle involves fish, snails, and piscivorous birds. Heavy, acute infections can be fatal, especially to small fish. However, fish can carry amazingly high worm burdens without any apparent ill effects (Noga 1996). The infections may often be disfiguring and render the fish aesthetically unpleasing (Figure 12).

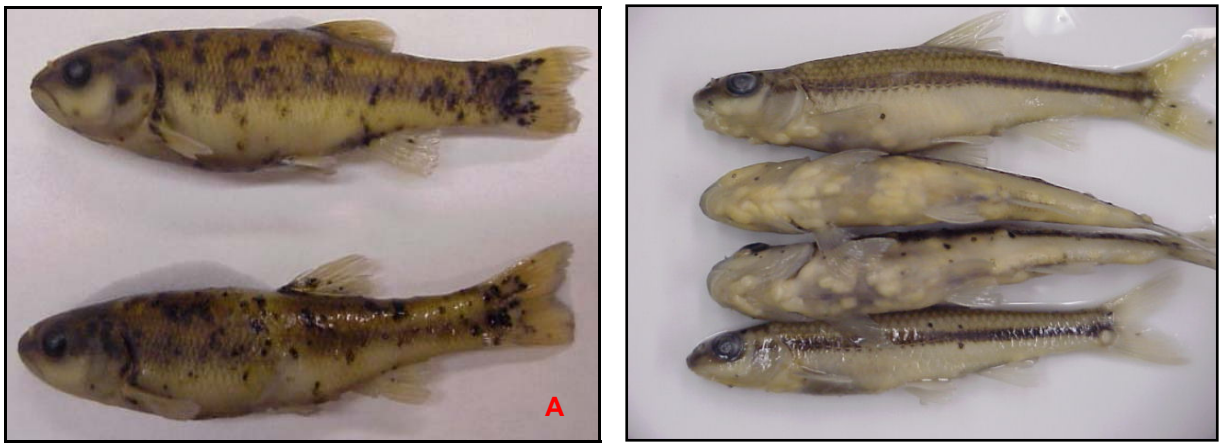


Figure 12. Heavy infestation of blackspot disease in Creek Chub (A) and yellow grub in Bigeye Chub (B).

Although some researchers incorporate the incidence of black spot and yellow grub into indices of biotic integrity (e.g., Steedman 1991), others, because of a lack of a consistent, inverse relationship to environmental quality, do not (e.g., Sanders *et al*. 1999). The diseases are not considered in the NCIBI because it is widespread, affecting fish in all types of streams. Because of its commonness throughout the state in so many species, regrettably, its occurrence is not consistently recorded at all sites. It was recorded for Spottail Shiner in Newlight Creek. Other diseases observed in 2010 included very low incidences of scoliosus in White Shiner in Crabtree and Terrible creeks and very high incidences of "popeye" or exopthalmos in Bluegill, Redear Sunfish, and Redbreast Sunfish, especially in Walnut and Swift creeks. Almost 25% of the fish in Walnut Creek at SR 1348 were infected. The disease is caused by a round worm infection (Figure 13) and is indicative of a stressed fish community.

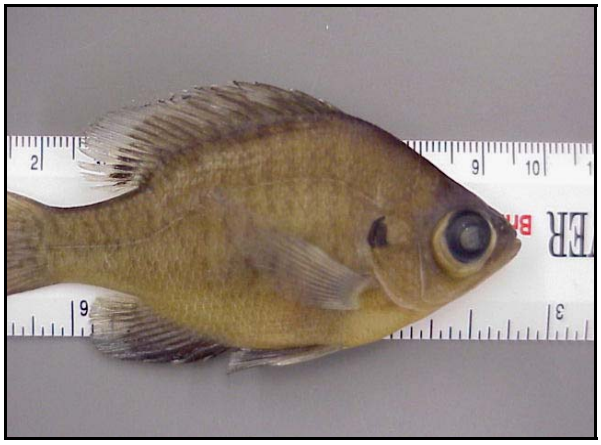


Figure 13. Popeye caused by nematode infection in Bluegill, Hardee Creek.

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Upper Neuse River (HUC 03020201)

Benthos Template Reports

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
SEVENMILE CR	**SR 1120**	**JB26**	**07/20/10**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
ORANGE	1	03020201	36.065833	-79.168889	27-2-6-(0.5)	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-II; HQW, NSW	7.7	607	5	0.2

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	80	20	0	0	

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

Water Quality Parameters

Temperature (°C)	25.7
Dissolved Oxygen (mg/L)	5.0
Specific Conductance (µS/cm)	90
pH (s.u.)	5.7
Water Clarity	turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	11
Bottom Substrate (15)	11
Pool Variety (10)	10
Riffle Habitat (16)	12
Bank Erosion (7)	7
Bank Vegetation (7)	5
Light Penetration (10)	7
Left Riparian Score (5)	4
Right Riparian Score (5)	4
Total Habitat Score (100)	76

Site Photograph

Substrate Mix of cobble, gravel and sand with some bedrock and a few boulders

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/20/10	11045	19	19	5.14	5.14	Good-Fair
06/29/05	9646	20	20	4.75	4.75	Good-Fair
08/07/00	8205	18	18	4.86	4.86	Good-Fair
08/01/95	6889	21	21	5.01	5.01	Good
07/08/91	5630	20	20	5.35	5.35	Good-Fair

Data Analysis

At the time of sampling in 2010, Sevenmile Creek was at very low flow. There was no flow at all above or below the reach. The only visible flow was through a rocky riffle and most margin habitat was out of the water. Silt on the rocks and a low DO suggest that the stream had been at low flow for some time. While the BI at this location increased over the 2000 value, it retained a bioclass of Good-Fair. The EPT diversity has remained fairly constant at this site, and EPT abundance was higher in 2010 (103) than 2005 (86). The slight decline during this last sampling effort was likely due to low flows.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
ENO R	**SR 1336**	**JB4**	**07/20/10**	**Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
ORANGE	1	03020201	36.123611	-79.155000	27-2-(1)	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-II; HQW, NSW	25.4	592	5	0.4

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

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

Water Quality Parameters

Temperature (°C)	25.1
Dissolved Oxygen (mg/L)	5.3
Specific Conductance (µS/cm)	79
pH (s.u.)	5.9
Water Clarity	turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	19
Bottom Substrate (15)	12
Pool Variety (10)	10
Riffle Habitat (16)	12
Bank Erosion (7)	6
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	91

Site Photograph

Substrate A mix of all substrates with 40% sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/20/10	11047	12	12	4.88	4.88	Fair
05/16/05	9911	83	16	6.31	4.88	Good-Fair
06/29/05	9647	16	16	5.18	5.18	Good-Fair
08/07/00	8249	21	21	4.79	4.79	Good
07/24/95	6869	20	20	5.17	5.17	Good-Fair
07/08/91	5627	20	20	4.42	4.42	Good-Fair

Data Analysis

This section of the Eno River is located upstream of Hillsborough. The habitat was good with an excellent mature forest in the riparian. At the time of sampling in 2010, the water was low and turbid with a milky sheen. This site has shown a decline since 2000 when it was rated Good. Two samples in 2005 were rated Good-Fair. In 2010, only twelve EPT taxa were found and the rating dropped again to a borderline Fair. The stonefly *Acroneuria abnormis* was absent in 2005 and only one specimen was found in 2010.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
ENO R	**SR 1569**	**JB6**	**07/26/10**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
ORANGE	1	03020201	36.079444	-79.008333	27-2-(10)	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV, B; NSW	65.2	415	25	0.3

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

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Hillsbourough WWTP	NC0026433	3.00

Water Quality Parameters

Temperature (°C)	27.8
Dissolved Oxygen (mg/L)	5.8
Specific Conductance (µS/cm)	137
pH (s.u.)	6.1

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	14
Pool Variety (10)	10
Riffle Habitat (16)	7
Bank Erosion (7)	6
Bank Vegetation (7)	7
Light Penetration (10)	4
Left Riparian Score (5)	4
Right Riparian Score (5)	4
Total Habitat Score (100)	77

Site Photograph

Substrate Cobble and gravel with a few larger rocks. Some sand at margins

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/26/10	11048	61	23	4.90	4.44	Good
05/16/06	9912	81	29	5.65	4.31	Good
06/28/05	9645	67	20	5.09	4.14	Good-Fair
09/05/02	8995	0	21	0.00	4.22	Good
08/07/00	8211	75	26	4.63	4.15	Excellent
10/14/96	7144	88	28	5.38	4.52	Good
07/28/95	6888	85	27	4.97	4.12	Excellent
07/09/91	5614	97	33	4.90	4.16	Excellent
06/21/88	4580	92	30	5.61	4.14	Good

Data Analysis

This location on the Eno River lies within the Eno River State Park downstream from the city of Hillsborough. The Hillsborough WWTP is located about 4 miles above this site. The river is wide and shallow here and is used as a crossing as well as a location for school children and other groups to sample. Past samples from this site have ranged from Excellent to a low of Good-Fair in 2005. A sample in the summer of 2006 was rated Good and the most recent effort in 2010 was also Good.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
ENO R	**US 15-501**	**JB7**	**07/20/10**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
DURHAM	1	03020201	36.071944	-78.908056	27-2-(19)	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV; NSW	138.0	308	15	0.3

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	60	40	0	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Hillsborough WWTP	NC0026433	3.00

Water Quality Parameters

Temperature (°C)	27.7
Dissolved Oxygen (mg/L)	6.6
Specific Conductance (µS/cm)	99
pH (s.u.)	6.1

Water Clarity	turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	11
Pool Variety (10)	10
Riffle Habitat (16)	7
Bank Erosion (7)	6
Bank Vegetation (7)	7
Light Penetration (10)	7
Left Riparian Score (5)	3
Right Riparian Score (5)	5
Total Habitat Score (100)	77

Site Photograph

Substrate Mix of cobble, gravel, and sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/20/10	11046	50	19	5.99	4.89	Good-Fair
05/24/06	9913	80	20	6.37	4.73	Good-Fair
06/28/05	9644	75	17	5.93	4.88	Good-Fair
08/08/00	8213	83	36	5.37	4.81	Excellent
07/28/95	6877	70	23	5.35	4.48	Good
07/11/90	5341	87	30	5.53	4.69	Good
07/14/88	4628	90	27	6.09	5.05	Good
07/07/86	3835	82	28	5.61	4.51	Good

Data Analysis

This site is situated in the Eno River State Park in Durham and (outside of the park) has a predominately commercial and residential landuse. At the time of sampling the water was very turbid and there was a large amount of trash strewn about the riparian zone. The 2010 sample was very similar to the collection in 2005. BI and EPTBI were nearly identical, however, total taxa richness was significantly less. Some EPT taxa that were common or abundant in 2000, but were not found in 2005, were again collected in 2010.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
LITTLE R	**SR 1461**	**JB18**	**07/26/10**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
DURHAM	1	03020201	36.141667	-78.920556	27-2-21-(3.5)	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-II; HQW, NSW, CA	72.4	404	18	0.4

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

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

Water Quality Parameters

Temperature (°C)	31.1
Dissolved Oxygen (mg/L)	5.8
Specific Conductance (µS/cm)	89
pH (s.u.)	7.0

Water Clarity	turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	13
Pool Variety (10)	6
Riffle Habitat (16)	8
Bank Erosion (7)	6
Bank Vegetation (7)	7
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	78

Site Photograph

Substrate Mixture of boulder, rubble, and gravel.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/26/10	11051	28	28	4.18	4.18	Excellent
01/11/08	10377	11	11	4.87	4.87	Not Rated
06/30/05	9651	91	30	5.26	4.35	Good
10/01/03	9278	29	29	4.21	4.21	Excellent
05/06/03	9125	23	23	4.49	4.49	Good-Fair
01/09/03	9037	19	19	4.30	4.30	Good-Fair
09/05/02	8996	7	7	4.59	4.59	Not Rated
08/08/00	8212	88	34	5.18	4.29	Excellent
07/28/95	6881	81	28	5.54	4.57	Good

Data Analysis

The Little R at SR 1461 has 80% of the channel filled with macrophytes. Habitat is largely limited to the macrophytes and larger rocks. There was silt on the tops of rocks that were not in the best flow. This location was rated Excellent in 2000 but dropped to Good in 2005 with the loss of some intolerant EPT taxa. One of those taxa was the stonefly *Agnetina* , which was again common in 2010. The long lived stonefly *Acroneuria abnormis* was abundant indicating long-term good health of the system. The BI decreased to 4.18 which is the lowest value recorded for this site and the rating returned to Excellent.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
S FK LITTLE R	**SR 1538**	**JB287**	**07/26/10**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
ORANGE	1	03020201	36.150278	-78.996389	27-2-21-2	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-II; HQW, NSW	0.0	479	8	0.4

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

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

Water Quality Parameters

Temperature (°C)	26.8
Dissolved Oxygen (mg/L)	4.6
Specific Conductance (µS/cm)	101
pH (s.u.)	5.9
Water Clarity	turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	15
Bottom Substrate (15)	12
Pool Variety (10)	10
Riffle Habitat (16)	3
Bank Erosion (7)	3
Bank Vegetation (7)	7
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	71

Site Photograph

Substrate Mostly cobble, gravel, and sand with a few larger boulders.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/26/10	11049	18	18	4.92	4.92	Good-Fair
06/29/05	9649	24	24	4.55	4.55	Good
08/04/00	8204	23	23	4.29	4.29	Good
08/01/95	6890	19	19	4.46	4.46	Good-Fair

Data Analysis

This site on the South Fork Little River had very low flow. The only riffle was formed by rubble around the bridge. There was very little flow above or below the sampled reach. Silt on the top of rocks and the presence of sponge suggested low flow conditions were prolonged. The water was turbid and appeared a little milky in color. This location was rated Good in the previous two sampling efforts in 2000 and 2005. However, eight EPT taxa that were all rare in 2005, including the intolerant stoneflies *Eccoptura xanthenes* and *Paragnatina* were not found in 2010. This decline increased the BI and dropped the rating to Good-Fair. The low flow conditions were consistent with those found in the North Fork Flat River, suggesting that the entire watershed was in a drought.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
N FK LITTLE R	**SR 1538**	**JB20**	**07/26/10**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
ORANGE	1	03020201	36.180000	-78.975556	27-2-21-3b	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-II; HQW, NSW	19.2	537	4	0.2

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

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

Water Quality Parameters

Temperature (°C)	28.8
Dissolved Oxygen (mg/L)	5.6
Specific Conductance (µS/cm)	79
pH (s.u.)	5.9
Water Clarity	turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	12
Pool Variety (10)	10
Riffle Habitat (16)	14
Bank Erosion (7)	3
Bank Vegetation (7)	7
Light Penetration (10)	7
Left Riparian Score (5)	3
Right Riparian Score (5)	3
Total Habitat Score (100)	80

Site Photograph

Substrate Mostly cobble and gravel with some large boulders.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/26/10	11050	21	21	4.80	4.80	Good
06/30/05	9650	24	24	4.28	4.28	Good
08/08/00	8250	20	20	4.23	4.23	Good-Fair
07/24/95	6873	99	29	5.63	4.64	Good

Data Analysis

At the time of sampling in 2010, North Fork Flat River had low flow and turbid water. There were several areas of eroded banks and silt on top of the rocks in the stream. A low DO (5.9 mg/L) and the presence of sponges suggested that the flow had been low for some time. A small decline in the number of intolerant EPT taxa increased the BI from 4.28 in 2005 to 4.80 in 2010. Since habitat scores were the same for both years, the loss can likely be attributed to the low flow conditions. Even with the decline, this location narrowly retains the rating of Good in 2010.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
FLAT R	**SR 1614**	**JB296**	**07/08/10**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
DURHAM	1	03020201	36.200278	-78.886389	27-3-(1)	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-III; NSW	144.3	388	17	0.5

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

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

Water Quality Parameters

Temperature (°C)	26.6
Dissolved Oxygen (mg/L)	6.5
Specific Conductance (µS/cm)	82
pH (s.u.)	6.7

Water Clarity	turbid

Habitat Assessment Scores (max)

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

Site Photograph

Substrate A even mix of bedrock, boulder, cobble, gravel and sand.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/08/10	11052	86	25	5.67	4.54	Good
07/01/05	9653	96	27	5.50	4.18	Good
10/01/03	9121	22	22	4.25	4.25	Good
04/02/03	9079	19	19	3.90	3.90	Good-Fair
01/09/03	9034	18	18	4.06	4.06	Good-Fair
09/05/02	8997	10	10	4.82	4.82	Not Rated
08/03/00	8248	90	30	5.38	4.63	Good
10/14/96	7201	75	28	5.66	4.67	Good
07/24/95	6874	86	27	5.70	4.87	Good

Data Analysis

The Flat River at SR 1614 is an ambient monitoring station and has been sampled numerous times since 1984. The substrate here is a mix of boulder and bedrock with sand and gravel areas in between. There were high flows from heavy rains one week prior to sampling in 2010, and rocks were covered with a thin layer of mud and sediment. A few intolerant taxa collected in prior sampling efforts were not found in 2010 which increased the BI and EPTBI values. However the increase was not enough to change the Good bioclassification.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
SMITH CR	**SR 1710**	**JB27**	**07/19/10**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRANVILLE	1	03020201	36.088611	-78.603611	27-12-2-(2)	Triassic Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV; NSW	6.1	0	3	0.2

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	80	20	0	0	

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

Water Quality Parameters

Temperature (°C)	25.3
Dissolved Oxygen (mg/L)	6.5
Specific Conductance (µS/cm)	67
pH (s.u.)	6.0
Water Clarity	turbid

Habitat Assessment Scores (max)

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

Site Photograph

Substrate Predominately sand and gravel with a litle cobble.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/19/10	11044	74	18	5.00	4.25	Good
06/27/05	9642	76	20	5.69	5.00	Good-Fair
08/10/00	8218	0	21	0.00	5.03	Good
07/25/95	6894	85	24	5.83	5.23	Good-Fair
03/02/95	6763	90	31	5.13	4.49	Good
04/24/92	5839	84	30	5.15	4.47	Good

Data Analysis

Smith Creek at SR 1710 has erosion problems creating numerous sand bars and an embedded substrate. Otherwise habitat and flow are good, and the riparian zone is intact. This location continues to fluctuate between a rating of Good-Fair and Good. The 2010 collection showed a significant improvement in the BI (5.00) and EPTBI (4.25) scores which are the lowest values recorded for this site. The long lived stonefly *Acroneuria abnormis,* collected here for the first time in 2010, was abundant. Ten of the remaining EPT taxa were also abundant.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
NEW LIGHT CR	**SR 1912**	**JB22**	**07/19/10**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WAKE	1	03020201	36.037500	-78.592500	27-13-(0.1)	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV; NSW	9.7	301	3	0.2

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	40	20	40	0	

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

Water Quality Parameters

Temperature (°C)	24.2
Dissolved Oxygen (mg/L)	6.6
Specific Conductance (µS/cm)	72
pH (s.u.)	5.8
Water Clarity	turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	15
Bottom Substrate (15)	11
Pool Variety (10)	10
Riffle Habitat (16)	10
Bank Erosion (7)	3
Bank Vegetation (7)	5
Light Penetration (10)	10
Left Riparian Score (5)	4
Right Riparian Score (5)	4
Total Habitat Score (100)	77

Site Photograph

Substrate Mostly sand and gravel

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/19/10	10938	17	17	5.04	5.04	Good-Fair
06/28/05	9643	18	18	4.99	4.99	Good-Fair
12/05/01	8665	30	30	5.09	5.09	Good
08/10/00	8217	23	23	5.12	5.12	Good
03/21/95	6764	24	24	4.82	4.82	Good

Data Analysis

New Light Creek has a heavily sedimented channel along with severe erosion and bank failure creating numerous sand bars and an embedded substrate. Instream habitat is sparse with few riffles and root mats.Conditions have changed little at this site since 2005. EPT diversity (17) in 2010 is the lowest number collected in an EPT sample here. EPTBI was nearly identical in 2005 (4.99) and 2010 (5.04) The long-lived stonefly *Acroneuria abnormis*, which was not collected in 2005 and rare in 2000, was common in 2010. New Light Creek retains a bioclass of Good-Fair.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
UPPER BARTON CR	**NC 50**	**JB28**	**07/19/10**	**Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WAKE	1	03020201	35.952778	-78.686944	27-15-(1)	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV; NSW	6.2	314	3	0.4

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

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

Water Quality Parameters

Temperature (°C)	23.8
Dissolved Oxygen (mg/L)	5.6
Specific Conductance (µS/cm)	298
pH (s.u.)	6.0

Water Clarity: slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	15
Bottom Substrate (15)	14
Pool Variety (10)	10
Riffle Habitat (16)	10
Bank Erosion (7)	6
Bank Vegetation (7)	7
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	84

Site Photograph

Substrate: Mostly sand and gravel

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/19/10	10937	10	10	5.87	5.87	Fair
06/27/05	9640	7	7	6.02	6.02	Fair
09/24/02	9023	14	14	5.23	5.23	Good-fair
04/10/01	8444	78	18	5.56	4.49	Good-fair
08/10/00	8228	14	14	5.37	5.37	Good-fair
12/09/96	7215	13	13	4.95	4.95	Fair
07/25/95	6876	15	15	4.76	4.76	Good-fair
02/23/95	6771	32	32	4.06	4.06	Good
02/14/95	6752	29	29	4.10	4.10	Good

Data Analysis

This location has shown a steady decline from early sampling efforts in 1995 to the present. The 2010 collection indicated a slight improvement from 2005, but the bioclassification remains Fair. Increased development in the area has contributed to sedimentation and degredation of instream habitat, eliminating most intolerant taxa. A high conductivity value and the presence of trash in the riparian indicates urban influences.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
NEUSE R	**US 401**	**JB44**	**07/14/10**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WAKE	2	03020201	35.884527	-78.528184	27-(22.5)a	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;NSW	817.4	200	30	1.2

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

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Town of Wake Forest WWTP	NC0030759	6.0

Water Quality Parameters

Temperature (°C)	28.9
Dissolved Oxygen (mg/L)	9.3
Specific Conductance (µS/cm)	104
pH (s.u.)	5.9
Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	13
Bottom Substrate (15)	3
Pool Variety (10)	4
Riffle Habitat (16)	3
Bank Erosion (7)	5
Bank Vegetation (7)	6
Light Penetration (10)	2
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	51

Site Photograph

Substrate Mostly sand and silt.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/14/10	11025	60	24	5.58	4.86	Good
08/25/05	9734	56	14	5.96	5.17	Good-Fair
07/06/00	8137	63	21	5.60	4.73	Good
07/25/95	6895	56	22	5.80	4.83	Good-Fair

Data Analysis

Neuse River at US 401 continues to alternate between Good (2010 and 2000) and Good-Fair (2005 and 1995). In 2010, EPT richness (24) was higher than any previous basinwide sample suggesting a slight improvement in water quality. The town of Wake Forest WWTP is approximately three miles upstream.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
NEUSE R	**US 64**	**JB45**	**07/15/10**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WAKE	2	03020201	35.793333	-78.538889	27-(22.5)b	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;NSW	870.3	150	28	0.5

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

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Heater Utilities Beachwood WWTP	NC0060577	0.1

Water Quality Parameters

Temperature (°C)	29.2
Dissolved Oxygen (mg/L)	6.9
Specific Conductance (µS/cm)	108
pH (s.u.)	5.9

Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	14
Bottom Substrate (15)	3
Pool Variety (10)	10
Riffle Habitat (16)	5
Bank Erosion (7)	4
Bank Vegetation (7)	7
Light Penetration (10)	2
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	60

Site Photograph

Substrate Mostly sand and gravel.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/15/10	11027	67	20	5.79	5.03	Good-Fair
08/26/05	9737	47	17	5.71	5.14	Good-Fair
09/11/00	8299	45	16	5.70	4.94	Good-Fair
07/26/95	6897	62	22	5.46	4.68	Good

Data Analysis

This site rated Fair when it was initially sampled in 1986 following a dairy waste spill. Recovery was documented in 1991 when it rated Good-Fair and in 1995 the rating further increased to Good. The bioclassification rating declined to Good-Fair following Hurricane Fran in 1996. Since then, the site has rated Good-Fair and the NCBI has been gradually increasing suggesting the benthic community is becoming more pollution tolerant. In addition, this stream reach is forested and has moderately good habitat available for macroinvertebrate colonization.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
SMITH CR	**SR 2045**	**JB51**	**07/14/10**	**Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WAKE	2	03020201	35.918611	-78.533333	27-23-(2)	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; NSW	22.7	200	6	0.2

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

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Ira D. Lee Associates Whippoorwill Valley WWTP	NC0073318	0.2

Water Quality Parameters

Temperature (°C)	27.6
Dissolved Oxygen (mg/L)	9.6
Specific Conductance (µS/cm)	120
pH (s.u.)	6.0

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	11
Bottom Substrate (15)	8
Pool Variety (10)	4
Riffle Habitat (16)	7
Bank Erosion (7)	6
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	68

Site Photograph

Substrate Sand and gravel with a small amount of silt.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/14/10	11026	---	11	---	5.58	Fair
08/12/05	9728	---	14	---	4.82	Good-Fair
07/06/00	8140	---	12	---	5.16	Fair
07/25/95	6885	---	15	---	5.54	Good-Fair

Data Analysis

Smith Creek is a tributary of the Neuse River and its headwaters drain the rapidly developing towns of Wake Forest and Rosesville. Three minor NPDES dischargers are located within five miles upstream: Wake Forest WWTP, Jones Dairy Farm and Whippoorwill Valley WWTP, which lies within a mile upstream. At this location, the bioclassification continues to alternate between Fair (2010 and 2000) and Good-Fair (2005 and 1995). With the exception of presence/absence of rare species, the benthic community composition is relatively similar across all sampling cycles. Therefore, the fluctuation in bioclassification is difficult to determine. This fluctuation may reflect differences in historic flows and this location's close proximity to the Neuse River or nonpoint source pollution from the developing towns of Wake Forest and Rolesville or point source pollution from the dischargers located upstream or a combination thereof.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
PERRY CR	**SR 2006**	**JB47**	**07/14/10**	**Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WAKE	2	03020201	35.879722	-78.548056	27-25-(2)	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; NSW	11.6	200	7	0.2

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

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

Water Quality Parameters

Temperature (°C)	24.8
Dissolved Oxygen (mg/L)	10.2
Specific Conductance (µS/cm)	105
pH (s.u.)	6.5

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	8
Pool Variety (10)	5
Riffle Habitat (16)	5
Bank Erosion (7)	5
Bank Vegetation (7)	6
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	70

Site Photograph

Substrate Mostly sand with a small amount of gravel.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/14/10	11024	---	11	---	5.82	Fair
08/24/05	9732	---	11	---	5.82	Fair
07/06/00	8141	---	8	---	5.32	Fair
07/25/95	6887	---	8	---	6.02	Fair

Data Analysis

Perry Creek is a sandy, shallow tributary of the Neuse River with forested and urban visual landuse occuring upstream. This creek is on the EPA's 303d list as impaired due to ecological and biological integrity. This segment has received a Fair bioclassification since 1995 and both benthic measurements (EPTS=15 and EPTBI=4.73) have remained the same since 2005.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CRABTREE CR	UMSTEAD ST PK	JB35	07/15/10	Good-Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WAKE	2	03020201	35.844444	-78.756389	27-33-(3.5)b	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B;NSW	54.0	300	13	0.5

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

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Town of Cary WWTP	NC0048879	12

Water Quality Parameters

Temperature (°C)	28.1
Dissolved Oxygen (mg/L)	5.1
Specific Conductance (µS/cm)	339
pH (s.u.)	6.6
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	10
Pool Variety (10)	10
Riffle Habitat (16)	16
Bank Erosion (7)	4
Bank Vegetation (7)	3
Light Penetration (10)	4
Left Riparian Score (5)	3
Right Riparian Score (5)	3
Total Habitat Score (100)	76

Site Photograph

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

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/15/10	11028	40	12	6.19	5.78	Good-Fair
08/24/05	9729	35	10	6.38	5.65	Fair
07/05/00	8134	55	13	6.16	5.81	Good-Fair
07/24/95	6882	54	13	6.28	5.73	Good-Fair

Data Analysis

This segment of Crabtree Creek is located within Umstead State Park and drains urbanized areas of Morrisville and Cary as well as a six mile section of the I-40 corridor. Visible land use is completely forested. Due to lower than average flows during the 2010 basin cycle, this was the only basin site on Crabtree Creek that had sufficient flow to sample. Sufficient flow at this location was most likely due to the 12 MGD of water discharged from the Cary WWTP located approximately one mile upstream. In 2005, this site received a Fair bioclassification down from the Good-Fair bioclassification it had recieved in the previous two basin cycles (1995 and 2000). In 2010 it again recieved a Good-Fair bioclassification.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
WALNUT CR	**SR 2442**	**JB63**	**07/10/10**	**Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WAKE	2	03020201	35.758333	-78.583333	27-34-(4)a	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; NSW	29.0	225	7	0.3

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

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

Water Quality Parameters

Temperature (°C)	25.3
Dissolved Oxygen (mg/L)	7.5
Specific Conductance (µS/cm)	207
pH (s.u.)	6.0

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	10
Pool Variety (10)	6
Riffle Habitat (16)	12
Bank Erosion (7)	6
Bank Vegetation (7)	6
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	81

Site Photograph

Substrate Mix of bedrock, boulder, cobble and sand.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/10/10	110230	55	8	6.38	5.89	Fair
08/26/05	9736	51	12	6.65	5.56	Fair
07/16/91	5644	9	9	6.17	6.17	Fair

Data Analysis

Walnut Creek drains urban areas of northeast Cary and southern Raleigh. Due to the large amount of impervious surfaces located within this watershed, the stream is very flashy. Rapid changes in the natural flow regime of streams are major causes of aquatic life impairment in many areas. This location has received a Fair bioclassification since 1991. As a result, this segment of Walnut Creek is on the EPA's 303d list as impaired due to ecological and biological integrity. EPT richness decreased by about 30% from 12 taxa in 2005 to 8 taxa in 2010. Conductivity was slightly higher (207 mmos/cm) in 2010 than that measured in 2005 (148 mmos/cm). The elevated conductivity coupled with lower than average flows may have contributed to the decreased EPT richness.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
NEUSE R	**SR 1201**	**JB43**	**07/12/10**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
JOHNSTON	2	03020201	35.375556	-78.199167	27-(49.5)a	Southeastern Floodplains and Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV; NSW	1664.2	0	30	0.8

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

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

Water Quality Parameters

Temperature (°C)	28.0
Dissolved Oxygen (mg/L)	5.7
Specific Conductance (µS/cm)	175
pH (s.u.)	6.0

Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	11
Bottom Substrate (15)	3
Pool Variety (10)	4
Riffle Habitat (16)	3
Bank Erosion (7)	0
Bank Vegetation (7)	5
Light Penetration (10)	2
Left Riparian Score (5)	4
Right Riparian Score (5)	4
Total Habitat Score (100)	41

Site Photograph

Substrate Sand with a small amount of silt.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/12/10	11018	48	16	5.50	4.56	Good-Fair
08/08/05	9654	47	20	5.09	4.49	Good
10/13/00	8335	61	23	5.45	4.07	Good
08/03/95	6892	60	25	5.19	4.17	Good
07/10/91	5619	64	24	5.54	4.42	Good

Data Analysis

This Neuse River site rated Good-Fair in 2010, a decrease from the Good ratings it received in previous cycles. The number of EPT taxa was the lowest ever recorded at this site. This reach earned a low habitat scorce (41) due to limited in-stream habitat consisting of only a few snags and logs, substrate that is nearly all sand and severely eroded stream banks with sparse vegetation. *Acroneuria abnormis* and *Paragnetina kansensis* , two intolerant stoneflies that had been collected in previous cycles were absent from the 2010 collection. The biological data suggest deteriorating physico-chemical conditions at this location from previous samples.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
MARKS CR	**SR 1714**	**JB40**	**07/13/10**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
JOHNSTON	2	03020201	35.705833	-78.431667	27-38	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; NSW	26.4	150	6	0.5

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

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

Water Quality Parameters

Temperature (°C)	24.8
Dissolved Oxygen (mg/L)	7.8
Specific Conductance (µS/cm)	79
pH (s.u.)	5.6

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	3
Pool Variety (10)	9
Riffle Habitat (16)	4
Bank Erosion (7)	6
Bank Vegetation (7)	6
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	66

Site Photograph

Substrate Nearly all sand.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/13/10	11022	---	17	---	4.89	Good-Fair
08/09/05	9705	---	16	---	4.75	Good-Fair
09/08/00	8297	---	19	---	5.01	Good-Fair
07/27/95	6903	---	18	---	4.94	Good-Fair
07/15/91	5639	---	17	---	4.50	Good-Fair

Data Analysis

Marks Creek is located near Garner in an area of transition from Piedmont to Coastal Plain. This site has consistently received a Good-Fair rating. No major changes in water quality have been observed from benthic data since this site was first sampled in 1991. Homogenous sandy substrate coupled with infrequent riffle habitats as well as increasing development in Garner could limit the presence of a more diverse EPT community at this site.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
SWIFT CR	**SR 1152**	**JB52**	**05/04/09**	**Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WAKE	2	03020201	35.719167	-78.753056	27-43-(1)b	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-III;NSW	18.9	0	5	0.3

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

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

Water Quality Parameters

Temperature (°C)	20.7
Dissolved Oxygen (mg/L)	4.3
Specific Conductance (µS/cm)	116
pH (s.u.)	6.1

Water Clarity: slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	11
Pool Variety (10)	8
Riffle Habitat (16)	13
Bank Erosion (7)	3
Bank Vegetation (7)	5
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	81

Site Photograph

Substrate: Gravel, sand and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
05/04/09	10660	58	8	6.59	6.43	Fair
08/12/05	9727	9	9	6.13	6.13	Fair
04/09/01	8390	55	10	6.65	6.43	Fair
07/05/00	8135	9	9	6.45	6.45	Fair
04/24/00	8104	56	12	6.87	5.92	Fair
07/24/95	6868	7	7	6.36	6.36	Fair
03/06/89	4840	9	9	6.33	6.33	Fair

Data Analysis

This segment of Swift Creek drains large portions of Cary and experiences frequent fluctuations in discharge as a result of high impervious surface concentrations upstream. Including the 2009 sample, this site has been sampled seven times with each sample producing a Fair bioclassification. The consistently low EPT richness and elevated BI and EPTBI strongly suggest persistent and unfavorable physico-chemical conditions at this location.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
SWIFT CR	**SR 1555**	**JB55**	**07/12/10**	**Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
JOHNSTON	2	03020201	35.574722	-78.498889	27-43-(8)	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; NSW	114.5	150	8	0.4

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

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

Water Quality Parameters

Temperature (°C)	26.8
Dissolved Oxygen (mg/L)	7.2
Specific Conductance (µS/cm)	109
pH (s.u.)	6.6

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	14
Bottom Substrate (15)	8
Pool Variety (10)	10
Riffle Habitat (16)	4
Bank Erosion (7)	4
Bank Vegetation (7)	4
Light Penetration (10)	7
Left Riparian Score (5)	4
Right Riparian Score (5)	4
Total Habitat Score (100)	64

Site Photograph

Substrate Mix of cobble, gravel and sand.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/12/10	11021	---	10	---	4.94	Fair
08/09/05	9704	---	16	---	4.70	Good-Fair
10/02/00	8326	---	16	---	5.46	Good-Fair

Data Analysis

This segment of Swift Creek received a Fair bioclassification in 2010. In the previous two basinwide cycles, the site had received a Good-Fair bioclassification. Visual land use is mostly forested with some urban influence. Six minor dischargers are located within 14 miles upstream. Moderately good structure for macroinvertebrate colonization such as rocks, snags, logs, sticks and leafpacks was available; However, bottom subtrates were embedded. In addition, a milky tinge to the water, lower than average flows, and heavy algal growth were also noted. With regards to water chemistry, conductivity was slightly higher (109 µmos/cm) than measurements recorded from the 2005 basinwide cycle (84 µmos/cm) and the 2000 basinwide cycle (75 µmos/cm). These data suggest a decline in physico-chemical conditions at this location from previous assessments.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
SWIFT CR	**SR 1501**	**JB54**	**07/12/10**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
JOHNSTON	2	03020201	35.544444	-78.397778	27-43-(8)	Rolling Coastal Plain

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; NSW	146.0	125	10	0.3

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	80	0	10	0	

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

Water Quality Parameters

Temperature (°C)	27.0
Dissolved Oxygen (mg/L)	9.0
Specific Conductance (µS/cm)	114
pH (s.u.)	6.1

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	15
Bottom Substrate (15)	3
Pool Variety (10)	8
Riffle Habitat (16)	10
Bank Erosion (7)	0
Bank Vegetation (7)	5
Light Penetration (10)	9
Left Riparian Score (5)	4
Right Riparian Score (5)	4
Total Habitat Score (100)	63

Site Photograph

Substrate Nearly all sand.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/12/10	11019	58	15	5.71	4.55	Good-Fair
08/08/05	9655	82	29	5.17	4.45	Good
10/02/00	8325	67	21	5.47	4.78	Good
07/27/95	6901	58	18	5.51	4.88	Good

Data Analysis

Located in an area intermediate between the Piedmont and Coastal Plain ecoregions, this is the most downstream basin site on Swift Creek. Visual land use is mostly forested with some agriculture present in the watershed. This Swift Creek site rated Good-Fair in 2010, a decrease from the Good ratings it received in previous cycles. The number of EPT taxa was the lowest ever recorded at this site. Despite a moderate habitat scorce (63), the substrate here is nearly all sand. Homogenous sandy substrate coupled with lower than average flows could limit the presence of a more diverse EPT community.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
LITTLE CR	**SR 1562**	**JB39**	**07/12/10**	**Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
JOHNSTON	2	03020201	35.575000	-78.443889	27-43-12	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; NSW	17.3	150	6	0.3

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

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

Water Quality Parameters

Temperature (°C)	24.0
Dissolved Oxygen (mg/L)	4.1
Specific Conductance (µS/cm)	114
pH (s.u.)	5.9

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	12
Bottom Substrate (15)	3
Pool Variety (10)	5
Riffle Habitat (16)	3
Bank Erosion (7)	4
Bank Vegetation (7)	5
Light Penetration (10)	7
Left Riparian Score (5)	4
Right Riparian Score (5)	4
Total Habitat Score (100)	52

Site Photograph

Substrate Mostly sand with small patches of cobble, gravel and silt.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/12/10	11020	---	11	---	5.19	Fair
08/08/05	9656	---	11	---	5.50	Fair
09/08/00	8298	---	11	---	5.85	Fair
07/27/95	6900	---	10	---	5.62	Fair
08/19/91	5706	---	13	---	5.43	Fair

Data Analysis

Little Creek is a tributary to Swift Creek that drains all of southern Clayton. Although this stream is technically a Piedmont stream, it lies within a portion of the subbasin in transition between the Piedmont and the Coastal Plain. A 10 meter section of this reach cuts through an old stream bed to form a small gravel riffle. As a result, Piedmont criteria were used to assign bioclassification ratings since the stream was first sampled using these criteria in 1991. This site has consistently received a Fair rating. No major changes in water quality have been observed from benthic data since this site was first sampled in 1991. EPT taxa richness has remained at 11 for the past three basin cycles.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
MIDDLE CR	**SR 1375**	**JB68**	**08/12/10**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WAKE	3	03020201	35.635556	-78.728889	27-43-15-(4)a1	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; NSW	35.6	285	7	0.3

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

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Cary WWTP	NC0065102	16

Water Quality Parameters

Temperature (°C)	29.0
Dissolved Oxygen (mg/L)	6.2
Specific Conductance (µS/cm)	299
pH (s.u.)	6.6

Water Clarity	clear

Habitat Assessment Scores (max)

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

Site Photograph

Substrate Mostly sand with patches of boulder, cobble, gravel, and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/12/10	11073	52	16	5.86	5.34	Good-Fair
07/25/05	9666	46	13	5.86	5.29	Good-Fair
08/21/00	8270	42	13	6.05	5.63	Good-Fair
08/11/95	6931	39	10	5.95	5.66	Fair
07/25/91	5686	55	11	6.20	5.62	Good-Fair

Data Analysis

This segment of Middle Creek is located northeast of Fuquay Varina. Visible land use is mostly forested with some nearby residential properties. This station was first sampled in 1986, when it received a bioclassfication of Fair due to the high BI (6.67). Since that time the NCBI (5.86 in 2010) has remained consistently lower. In 2010, EPTBI (16) was higher than any previous basinwide sample suggesting a slight water quality improvement. Conductivity has remained elevated between 220 and 300 µS/cm since 2000 suggesting some pollution inputs from upstream. Using Peidmont criteria; the habitat score was 75 in 2010 exhibiting good structure for macroinvertebrate colonization such as rocks, root mats along undercut banks, snags and logs, and leaf packs. This segment is located three miles south of the Cary Wastewater Treatment Plant major discharger (16MGD) (NC0065102). Despite increases in EPT richness, conductivity remains elevated suggesting some upstream pollutant inputs from point and nonpoint sources.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
LITTLE R	**SR 2130**	**JB93**	**08/04/10**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
JOHNSTON	6	03020201	35.609167	-78.210556	27-57-(8.5)a	Rolling Coastal Plain

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-V; NSW	126.0	150	11	0.2

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

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

Water Quality Parameters

Temperature (°C)	27.6
Dissolved Oxygen (mg/L)	7.6
Specific Conductance (µS/cm)	70
pH (s.u.)	5.9

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	12
Pool Variety (10)	8
Riffle Habitat (16)	7
Bank Erosion (7)	6
Bank Vegetation (7)	6
Light Penetration (10)	10
Left Riparian Score (5)	4
Right Riparian Score (5)	5
Total Habitat Score (100)	79

Site Photograph

Substrate Good mix of boulder, cobble, gravel, and sand.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/04/10	11071	79	25	5.37	4.39	Good
07/28/05	9674	97	28	5.57	4.76	Good
08/15/00	8259	66	19	5.37	4.60	Good
08/24/95	6960	75	16	5.85	4.96	Good-Fair
07/25/91	5670	23	23	4.40	4.40	Good

Data Analysis

This segment of the Little River received a Good bioclassification in 2010. Water quality in this river segment has remained similar since 2000. The site is mostly a sandy run with infrequent but large riffles. The habitat score of 79 in 2010 reflects little channel modification, a good mix of in-stream habitat such as root mats, sticks and leafpacks, a diverse but slightly embedded channel substrata, diverse pool sizes, little erosion, and a healthy riparian zone. A high EPT richness (25) and consistently low BI (5.37) and EPTBI (4.39) for a Piedmont river system reflects continued good water quality and minimal upstream pollution sources. Conductivity (70 µS/cm) and dissolved oxygen (7.6 mg/L) observed in 2010 were also similar in 2005 reflecting physiochemical parameters supportive of the mostly intolerant benthic community.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
LITTLE R	**NC 581**	**JB90**	**08/03/10**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WAYNE	6	03020201	35.445278	-78.045833	27-57-(20.2)b	Southeastern Floodplains and Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV; NSW	280.0	84	15	0.2

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

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

Water Quality Parameters

Temperature (°C)	26.3
Dissolved Oxygen (mg/L)	8.0
Specific Conductance (µS/cm)	119
pH (s.u.)	6.0

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	15
Instream Habitat (20)	19
Bottom Substrate (15)	12
Pool Variety (10)	8
Riffle Habitat (16)	0
Bank Erosion (7)	9
Bank Vegetation (7)	9
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	92

Site Photograph

Substrate Good mix of boulder, cobble, gravel, sand, and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/03/10	11067	52	13	5.77	4.68	Good-Fair
07/28/05	9676	95	21	5.81	4.57	Good
08/24/00	8277	60	17	5.47	4.47	Good-Fair
08/24/95	6961	69	17	6.07	4.53	Good-Fair
07/24/91	5684	78	25	5.50	4.57	Good

Data Analysis

The bioclassification in this segment of the Little River continues to fluctuate between Good (2005) and Good-Fair (2010). In-stream macroinvertebrate habitats are noticeably diverse resulting in a high habitat score (92), however, in 2010 EPT richness (13) and total richness (52) were drastically less than in 2005 (EPTS=21 and ST=95). The EPTBI (4.68) and BI (5.77) in 2010 have remained similar since 1991 and reflect the presence of both tolerant and intolerant taxa. Dominant taxa included the intolerant philopotamid caddisfly, *Chimarra spp* .and the more tolerant hydropsychid, *Cheumatopsyche spp* . The intolerant long-lived stonefly, *Acroneuria abnormis* was present in 2005 and absent in 2010. This significant reduction in EPT taxa coupled with the dense algae and aquatic macrophyte presence could suggest nutrient enrichment from upstream, however, the origin of the invertebrate richness reduction is not clear.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
NEUSE R	US 117	JB136	07/30/10	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WAYNE	12	03020201	35.349840	-78.024720	27-(56)a	Southeastern Floodplains and Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; NSW	2366.0	47	28	0.6

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	50	20	30	0	

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

Water Quality Parameters

Temperature (°C)	29.8
Dissolved Oxygen (mg/L)	5.7
Specific Conductance (µS/cm)	214
pH (s.u.)	6.8
Water Clarity	turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	13
Bottom Substrate (15)	3
Pool Variety (10)	0
Riffle Habitat (16)	3
Bank Erosion (7)	6
Bank Vegetation (7)	7
Light Penetration (10)	2
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	48

Site Photograph

Substrate Sand with silt along the margins

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/30/10	11053	55	22	5.54	4.62	Good
10/06/05	9759	71	24	5.30	4.27	Good
08/29/00	8290	66	23	5.88	4.55	Good-Fair
08/08/95	6936	53	16	5.35	4.53	Good-Fair
07/19/91	5739	77	29	5.29	4.40	Good

Data Analysis

This section of the Neuse river near Goldboro is wide and relatively shallow with a sand substrate. Instream habitat is poor with no riffles and very little leaf packs or root mats. Most invertebrates were found on woody debris. An elevated conductivity value of 214µS/cm reflects the proximity of the city of Goldsboro. EPT diversity was slightly lower in 2010 (22 species verses 24 collected in 2005), but EPT abundance(163) was the highest recorded for this location. Fifteen EPT taxa were abundant, including the stonefly *Neoperla* . Even though conditions declined slightly from those in 2005, the bioclassification remains Good.

Upper Neuse River (HUC 03020201)

Fish Community Template Reports

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
ENO R	**SR 1336**	**04/23/10**	**JF6**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
ORANGE	1	03020201	36.12333333	-79.15555556	27-2-(1)	Carolina Slate Belt

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-II,HQW,NSW	26.7	630	8	0.4	No

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

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

Water Quality Parameters

Temperature (°C)	15.1
Dissolved Oxygen (mg/L)	7.3
Specific Conductance (µS/cm)	73
pH (s.u.)	5.8

Water Clarity	Turbid

Habitat Assessment Scores (max)

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

Site Photograph

Substrate Sand, silt, cobble, bedrock

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/23/10	2010-13	17	52	Good
04/07/05	2005-15	18	60	Excellent
04/04/00	2000-11	18	54	Excellent

Most Abundant Species, 2010 Redbreast Sunfish (29%)

Exotic Species Green Sunfish (n=7), Redear Sunfish (n=6)

Species Change Since Last Cycle

Gains -- first collection for Creek Chubsucker, Snail Bullhead, Flat Bullhead, and Margined Madtom; Pumpkinseed, Redear Sunfish. **Lost** -- Golden Shiner, Northern Hog Sucker, Blacktip Jumprock, Notchlip Redhorse, Speckled Killifish, Largemouth Bass, Chainback Darter. All species gained or lost were represented by 1-6 fish/species, except Notchlip Redhorse (n=17).

Data Analysis

Watershed -- drains northwest Orange County upstream from Hillsborough; no NPDES permitted dischargers or municipalities in the watershed; below the historic Halls Mill Dam; flows are regulated by releases from WS-II reservoirs Lake Orange and West Fork Reservoir; tributary to Falls Reservoir. **Habitats** -- same as in 2005; silty pools, coarse woody debris, riffles, one large deep pool at the end of the reach. **Water Quality** -- specific conductance relatively stable since 2000, ranging from 73 µS/cm to 83 µS/cm. **2010** -- the loss of three species of suckers and one intolerant darter and the absence of piscivores (Largemouth Bass) led to the decline in the NCIBI score and rating. **2000-2010** -- 26 species known from the site, including 4 species each of suckers and darters and 3 intolerant species; dominant species vary from Swallowtail Shiner (2000) to Bluehead Chub (2005) to Redbreast Sunfish (2010); the percentage of tolerant Redbreast Sunfish has steadily increased from 5% to 14% to 29% during the past three monitoring cycles as has the overall percentage of tolerant fish while the percentage of piscivores has steadily decreased, suggesting declines in the biological integrity of the fish community and water quality. **Recommendation** -- continue basinwide monitoring of this site to determine if the decline in the biological integrity of the community is attributable to altered hydrology, declining water quality, or both factors and to determine if the declines are permanent or just temporary.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
S FK LITTLE R	**SR 1461**	**04/27/10**	**JF17**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
DURHAM	1	03020201	36.14972222	-78.94638889	27-2-21-2	Carolina Slate Belt

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-II,HQW,NSW	39	370	11	0.5	Yes

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	25	10	65	0

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

Water Quality Parameters

Temperature (°C)	16.5
Dissolved Oxygen (mg/L)	9.0
Specific Conductance (µS/cm)	97
pH (s.u.)	6.6

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	13
Pool Variety (10)	10
Riffle Habitat (16)	16
Erosion (7)	5
Bank Vegetation (7)	5
Light Penetration (10)	8
Left Riparian Score (5)	4
Right Riparian Score (5)	3
Total Habitat Score (100)	**87**

Site Photograph

Substrate Cobble, boulder

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/27/10	2010-15	19	58	Excellent
04/07/05	2005-16	20	60	Excellent
04/07/00	2000-12	24	60	Excellent

Most Abundant Species, 2010 Bluehead Chub (20%), Redbreast Sunfish (18%)

Exotic Species Green Sunfish (n =53), Redear Sunfish (n =1)

Species Change Since Last Cycle

Gains -- Northern Hog Sucker, Redear Sunfish, Yellow Perch. **Lost** -- Bull Chub, Notchlip Redhorse, Yellow Bullhead, Pumpkinseed. All species gained or lost were represented by 1-3 fish/species, except Notchlip Redhorse (n = 9).

Data Analysis

Watershed -- drains north-central Orange and northwest Durham counties; no NPDES permitted dischargers or municipalities in the watershed; tributary to Little River Reservoir. **Habitats** -- a typical high quality Carolina Slate Belt-type stream with abundant periphyton, slick rocks, shallow riffles and pools, and side undercuts; flows were much lower in 2010 than in 2005 (30 *vs.* 70 cfs, respectively). **Water Quality** -- specific conductance during the last three cycles has ranged from 79 µS/cm to 97 µS/cm. **2010** -- highest NCIBI score of any fish community site in the basin in 2010. **2000-2010** -- 25 species known from the site, including 4 species of suckers, 3 species of darters, the endemic Roanoke Bass, and 3 other intolerant species; dominant species have been Redbreast Sunfish and Bluehead Chub; no substantial change in the biological integrity or water quality of this HQW stream.
Recommendation -- continue basinwide monitoring of this site to document support of its High Quality Waters status in the face of the potential urbanization of the watershed.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
N FK LITTLE R	**SR 1461**	**04/27/10**	**JF13**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
DURHAM	1	03020201	36.16361111	-78.94916667	27-2-21-3b	Carolina Slate Belt

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-II,HQW,NSW	29.7	460	12	0.4	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	80	20	0	0

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

Water Quality Parameters

Temperature (°C)	16.7
Dissolved Oxygen (mg/L)	8.9
Specific Conductance (µS/cm)	90
pH (s.u.)	6.1

Water Clarity	Slightly turbid, easily silted

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	12
Pool Variety (10)	10
Riffle Habitat (16)	14
Erosion (7)	7
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**93**

Site Photograph

Substrate Cobble, boulder

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/27/10	2010-16	17	50	Good
04/07/05	2005-17	16	52	Good
04/07/00	2000-13	14	48	Good

Most Abundant Species, 2010 Bluehead Chub (43%)

Exotic Species Green Sunfish (n=19)

Species Change Since Last Cycle

Gains -- first collection for Golden Shiner, Mountain Redbelly Dace, Creek Chubsucker, and Notchlip Redhorse. **Lost** -- Northern Hog Sucker, Flat Bullhead, Largemouth Bass. All species gained or lost were represented by 1 or 2 fish/species, except for Mountain Redbelly Dace (n=4).

Data Analysis

Watershed -- drains north-central Orange and northwest Durham counties; no NPDES permitted dischargers or municipalities in the watershed; tributary to Little River Reservoir. **Habitats** -- same as in 2005; a typical high quality Carolina Slate Belt-type stream with riffles, runs, pools, *Fissidens,* rocks slick with periphyton; low flow. **Water Quality** -- specific conductance has ranged from 72 µS/cm to 90 µS/cm. **2010** -- total species diversity gradually increasing; slight change in the diversity of suckers and abundance of piscivores. **2000-2010** -- 22 species known from this site, including 4 species of suckers, 3 species of darters, the endemic Roanoke Bass, and 3 other intolerant species; dominant species has been the Bluehead Chub, an indicator of some consistent nonpoint nutrient enrichment; no substantial change in the biological integrity or water quality of this WS-II High Quality Waters stream. **Recommendation** -- continue basinwide monitoring of this site to document the potential urbanization of the watershed.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
N FLAT R	**SR 1715**	**04/27/10**	**JF14**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
PERSON	1	03020201	36.29	-78.94527778	27-3-2	Carolina Slate Belt

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-III;NSW	33	490	10	0.4	No

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

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

Water Quality Parameters

Temperature (°C)	16.6
Dissolved Oxygen (mg/L)	10.2
Specific Conductance (µS/cm)	83
pH (s.u.)	6.4

Water Clarity	Slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	17
Bottom Substrate (15)	12
Pool Variety (10)	9
Riffle Habitat (16)	14
Erosion (7)	5
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**89**

Site Photograph

Substrate Cobble, boulder, gravel

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/27/10	2010-17	17	54	Excellent
04/06/05	2005-13	19	46	Good
04/06/00	2000-09	21	56	Excellent
06/10/99	99-45	18	50	Good

Most Abundant Species, 2010 Bluehead Chub (31%)

Exotic Species Green Sunfish (n=6), Redear Sunfish (n=1)

Species Change Since Last Cycle

Gains -- first collection for Pirate Perch and Warmouth; Pinewoods Shiner, Creek Chubsucker, Redear Sunfish. **Lost** -- Satinfin Shiner, Creek Chub, Notchlip Redhorse, Yellow Bullhead, Flat Bullhead, Speckled Killifish, Largemouth Bass. All species gained or lost were represented by 1-4 fish/species, except for Pinewoods Shiner (n=31).

Data Analysis

Watershed -- drains south-central Person County; no NPDES permitted dischargers in the watershed; headwaters are southwest of the City of Roxboro; tributary to Flat River and Lake Michie. **Habitats** -- same as in 2005; a typical high quality Carolina Slate Belt-type stream with angular rocks slick with periphyton, riffles, runs, pools, undercuts, and snags; flows were much lower in 2010 than in 2005 (~ 50 *vs.* ~ 120 cfs, respectively). **Water Quality** -- specific conductance during the first three cycles had been gradually declining from 92 to 72 to 56 µS/cm, respectively, although a greater value (83 µS/cm) was recorded in 2010. **2010** -- a more balanced trophic structure and a greater diversity of sunfish and intolerant species were responsible for the increase in the NCIBI score and rating. **1999-2010** -- 28 species known from the site, including 4 species each of suckers and darters and 3 intolerant species; dominant species are the Bluehead Chub and White Shiner. **Recommendation** -- continue basinwide monitoring of this site to document the potential urbanization of the watershed and for possible reclassification to High Quality Waters.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
S FLAT R	**NC 157**	**04/23/10**	**JF18**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
PERSON	1	03020201	36.2775	-79.045	27-3-3b	Southern Outer Piedmont

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-III,NSW	17.3	550	10	0.4	No

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

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

Water Quality Parameters

Temperature (°C)	13.9
Dissolved Oxygen (mg/L)	8.2
Specific Conductance (µS/cm)	91
pH (s.u.)	5.9

Water Clarity	Slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	5
Pool Variety (10)	6
Riffle Habitat (16)	7
Erosion (7)	3
Bank Vegetation (7)	6
Light Penetration (10)	8
Left Riparian Score (5)	3
Right Riparian Score (5)	5
Total Habitat Score (100)	**64**

Site Photograph

Substrate Sand, gravel, cobble, boulder, bedrock

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/23/10	2010-14	24	48	Good
04/06/05	2005-14	18	48	Good
04/06/00	2000-10	17	48	Good

Most Abundant Species, 2010 Bluehead Chub (46%)

Exotic Species Green Sunfish (n=14), Redear Sunfish (n=1)

Species Change Since Last Cycle

Gains -- first collection for Rosyside Dace, Creek Chub, Northern Hog Sucker, Pirate Perch, Eastern Mosquitofish, Pumpkinseed, Black Crappie, and Chainback Darter. **Lost** -- Golden Shiner, Largemouth Bass. All species gained or lost were represented by 1-3 fish/species.

Data Analysis

Watershed -- drains south-central and southwest Person County; no NPDES permitted dischargers or municipalities in the watershed; site is below historic Hurdle Mills; tributary to Flat River and Lake Michie. **Habitats** -- same as in 2005; a high quality Carolina Slate Belt-type stream with angular rocks, riffles, *Podostemum* and periphyton abundant above the bridge, sandy runs and pools with some severely entrenched banks below the bridge. **Water Quality** -- specific conductance during the last three cycles has ranged from 69 µS/cm to 91 µS/cm. **2010** -- greatest total species diversity of any of the monitoring cycles, including 7 species of sunfish; trophic metric values relatively constant. **2000-2010** -- 28 species are known from the site, including 3 species each of darters and intolerants and 2 species of suckers; dominant species is the Bluehead Chub; no substantial change in the biological integrity or water quality of this stream. **Recommendation** -- continue basinwide monitoring of this site to document the potential urbanization of the watershed.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
UPPER BARTON CR	**NC 50**	**04/06/10**	**JF21**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WAKE	1	03020201	35.95166667	-78.68722222	27-15-(1)	Northern Outer Piedmont

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-IV;NSW,CA	5.8	295	5	0.4	No

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	60	0	40 (horse farm)	0

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

Water Quality Parameters

Temperature (°C)	18.1
Dissolved Oxygen (mg/L)	7.6
Specific Conductance (µS/cm)	169
pH (s.u.)	6.2

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	6
Pool Variety (10)	8
Riffle Habitat (16)	12
Erosion (7)	5
Bank Vegetation (7)	6
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**78**

Site Photograph

Substrate Cobble, gravel, bedrock

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/06/10	2010-01	16	44	Good-Fair
04/04/05	2005-05	14	46	Good
04/03/00	2000-01	21	52	Good
05/18/95	95-44	17	48	Good

Most Abundant Species, 2010 Bluehead Chub (46%) **Exotic Species** Green Sunfish (n=3)

Species Change Since Last Cycle **Gains** -- Creek Chub (n=8), Pirate Perch (n=1). **Lost** -- none

Data Analysis

Watershed -- drains the increasingly urbanized area of northwest Wake County west of NC 50 (Creedmoor Road); one NPDES permitted discharger in the watershed (NC0049662, Hawthorn Subdivision WWTP, Q_w = 0.25 MGD, located ~3.8 miles upstream); tributary to Falls Reservoir. **Habitats** -- riffles, ledges, pools along the left bank, undercuts, periphyton abundant. **Water Quality** -- elevated specific conductance due to upstream discharger, nonpoint runoff, and stormwater runoff; has ranged from 95 µS/cm in 2005 to 169 µS/cm in 2010. **2010** -- an extremely abundant fish community for a small stream, the most fish collected from any site in 2010 (n=1,284) and about twice as many as in 2005; abundance of Bluehead Chub and periphyton indicated point and nonpoint sources nutrient enrichment. **1995-2010** -- 26 species are known from the site, including 3 species each of suckers and darters and 1 intolerant species; the intolerant Roanoke Darter has not been collected since 1995; dominant species are the White Shiner and Bluehead Chub. **Recommendation** -- continue basinwide monitoring of this site to document the watershed's increasing urbanization.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
SMITH CR	**SR 1710**	**04/06/10**	**JF19**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRANVILLE	1	03020201	36.08833333	-78.60222222	27-12-2-(2)	Triassic Basins

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-IV;NSW	6.2	310	5	0.4	No

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

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

Water Quality Parameters

Temperature (°C)	18.8
Dissolved Oxygen (mg/L)	8.1
Specific Conductance (µS/cm)	75
pH (s.u.)	6.1

Water Clarity	Clear

Habitat Assessment Scores (max)

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

Site Photograph

Substrate Sand, gravel, cobble

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/06/10	2010-02	14	44	Good-Fair
04/04/05	2005-06	13	42	Good-Fair
04/04/00	2000-03	15	44	Good-Fair
04/11/95	95-18	20	48	Good

Most Abundant Species, 2010 White Shiner (41%)

Exotic Species Green Sunfish (n=9)

Species Change Since Last Cycle **Gains** -- Rosyside Dace (n=17), Yellow Bullhead (n=1). **Lost** -- Pumpkinseed (n=1)

Data Analysis

Watershed -- a small watershed draining southeastern Granville County; no NPDES permitted dischargers or municipalities in the watershed; tributary to Falls Reservoir; as a Triassic Basins stream it may go intermittent during prolonged droughts. **Habitats** -- same as in 2005; side snags, riffles, runs, coarse woody debris and deadfalls, eroded and entrenched right bank. **Water Quality** -- specific conductance during the last three cycles has ranged from 67 µS/cm to 75 µS/cm; a lower value (52 µS/cm) was recorded in 1995. **2010** -- improvement in trophic metrics (due to less dominance by the omnivorous Bluehead Chub), but no change in the rating. **1995-2010** -- 22 species are known from this site, including 2 species each of suckers and darters, but no intolerant species; Redfin Pickerel, Northern Hog Sucker, Eastern Mosquitofish, and Black Crappie have not been collected since 1995; dominant species are the White Shiner and Bluehead Chub; no other substantial changes in the biological integrity or water quality of this stream since 2000.
Recommendation -- continue basinwide monitoring of this site to document the potential urbanization of the watershed.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
NEWLIGHT CR	**SR 1911**	**04/06/10**	**JF15**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WAKE	1	03020201	36.02694444	-78.60166667	27-13-(0.1)	Northern Outer Piedmont

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-IV;NSW	12.2	280	8	0.4	No

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

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

Water Quality Parameters

Temperature (°C)	21.7
Dissolved Oxygen (mg/L)	10.2
Specific Conductance (µS/cm)	71
pH (s.u.)	6.6

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	12
Bottom Substrate (15)	4
Pool Variety (10)	10
Riffle Habitat (16)	7
Erosion (7)	3
Bank Vegetation (7)	6
Light Penetration (10)	4
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**61**

Site Photograph

Substrate Sand, gravel

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/06/10	2010-03	21	50	Good
04/04/05	2005-07	16	50	Good
05/16/95	95-43	16	42	Good-Fair

Most Abundant Species, 2010 Spottail Shiner (33%)

Exotic Species Green Sunfish (n=8)

Species Change Since Last Cycle

Gains -- first collection for V-lip Redhorse, White Perch, Flier, and Yellow Perch; Creek Chub, Roanoke Darter. **Lost** -- Northern Hog Sucker, Speckled Killifish, Eastern Mosquitofish. All species gained or lost were represented by 1 or 2 fish/species, except Yellow Perch (n=10), and V-lip Redhorse and Eastern Mosquitofish (n=21, each).

Data Analysis

Watershed -- drains south Granville and northern Wake counties; no NPDES permitted dischargers or municipalities in the watershed; tributary to Falls Reservoir. **Habitats** -- wide and shallow with sandy and gravelly runs, undercuts, deeper pools and snags along the sides; fairly open canopy, no instream coarse woody debris, past evidence of bank-full high water. **Water Quality** -- specific conductance during the last two cycles has been 72 µS/cm and 71 µS/cm; data were not recorded in 1995. **2010** -- greatest total species diversity of any of the monitoring cycles; trophic metrics were adversely affected by an abundance of Spottail Shiner and Bluehead Chub, but these declines were offset by an increase in the percentage of piscivores and an additional species of darter. **1995-2010** -- 26 species are known from the site, including 3 species each of suckers and darters, 2 intolerant species, and migrants from the reservoir such as Yellow Perch and White Perch; dominant species are Bluehead Chub, Swallowtail Shiner, and Spottail Shiner; no substantial change in the biological integrity or water quality of this stream during the past two cycles. **Recommendation** -- continue basinwide monitoring of this site to document potential urbanization of the watershed.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
RICHLAND CR	**US 1**	**04/07/10**	**JF29**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WAKE	2	03020201	35.96166667	-78.5425	27-21-(1.5)	Northern Outer Piedmont

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-IV;NSW	10.5	220	6	0.4	No

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	40	60	0	0

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

Water Quality Parameters

Temperature (°C)	16.9
Dissolved Oxygen (mg/L)	8.3
Specific Conductance (µS/cm)	104
pH (s.u.)	6.1

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	11
Bottom Substrate (15)	3
Pool Variety (10)	10
Riffle Habitat (16)	2
Erosion (7)	0
Bank Vegetation (7)	4
Light Penetration (10)	4
Left Riparian Score (5)	4
Right Riparian Score (5)	5
Total Habitat Score (100)	**48**

Site Photograph

Substrate Sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/07/10	2010-04	15	42	Good-Fair
04/04/05	2005-08	19	54	Excellent
04/12/95	95-20	18	52	Good

Most Abundant Species, 2010 White Shiner (29%)

Exotic Species None

Species Change Since Last Cycle

Gains -- first collection for Creek Chub; Yellow Bullhead. **Lost** -- Bull Chub, Notchlip Redhorse, V-lip Redhorse, Green Sunfish, Redear Sunfish, Largemouth Bass. All species gained or lost were represented by 1-5 fish/species.

Data Analysis

Watershed -- drains an area west of Wake Forest and Youngsville in northeast Wake and southwest Franklin counties, including the US 1 (Capital Blvd.) and NC 98 corridors; no NPDES permitted dischargers in the watershed; an extremely flashy creek that is a tributary to the Neuse River, site is ~ 2.7 miles upstream of the creek's confluence with the river. **Habitats** -- a shifting and sinuous channel with large woody debris, good snag habitats, but with few fish in them; massive bank erosion and entrenchment. **Water Quality** -- specific conductance has steadily increased since 1995 from 74 to 89 to 104 µS/cm, indicative of an increasingly urbanized watershed. **2010** -- declines in the total species diversity, diversities of suckers and sunfish, and in the percentage of piscivores (Largemouth Bass and American Eel) were responsible for the substantial decline in the rating. **1995-2010** -- 24 species are known from the site, including 4 species of suckers, 2 species of darters, but no intolerant species; dominant species are Bluegill and Bluehead Chub in 1995 and White Shiner in 2005 and 2010. **Recommendation** -- site should be re-sampled in 2011 to determine if the substantial declines in the diversity and overall biological integrity of the fish community and water quality are permanent; continue basinwide monitoring of this site to document continuing urbanization of the watershed; stream bank restoration efforts should also be undertaken to reduce sediment inputs to the stream.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
SMITH CR	**SR 2045**	**04/07/10**	**JF31**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WAKE	2	03020201	35.91944444	-78.53444444	27-23-(2)	Northern Outer Piedmont

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;NSW	22.6	230	9	0.4	No

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	85	5	0	10 (road)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Whippoorwill Valley WWTP	NC0073318	0.2

Water Quality Parameters

Temperature (°C)	17.9
Dissolved Oxygen (mg/L)	8.5
Specific Conductance (µS/cm)	104
pH (s.u.)	6.3
Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	14
Bottom Substrate (15)	4
Pool Variety (10)	6
Riffle Habitat (16)	7
Erosion (7)	4
Bank Vegetation (7)	6
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**66**

Site Photograph

Substrate Sand, gravel

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/07/10	2010-05	22	50	Good
04/05/05	2005-09	23	36	Fair
04/03/00	2000-02	17	56	Excellent
05/18/95	95-45	14	42	Good-Fair

Most Abundant Species, 2010 Swallowtail Shiner (43%)

Exotic Species Green Sunfish (n=11), Redear Sunfish (n=1)

Species Change Since Last Cycle

Gains -- first collection for Northern Hog Sucker, Speckled Killifish, & Yellow Perch; Notchlip Redhorse, Yellow Bullhead, Tessellated Darter, Glassy Darter, Chainback Darter. **Lost** -- Eastern Mudminnow, Snail Bullhead, Tadpole Madtom, Pirate Perch, Flier, Bluespotted Sunfish, Warmouth, Black Crappie. All species gained or lost were represented by 1-6 fish/species.

Data Analysis

Watershed -- drains Wake Forest and surrounding suburbs in northeast Wake and southwest Franklin counties; one NPDES permitted discharger in the watershed (NC0073318, located ~ 1.1 miles upstream); tributary to the Neuse River, site is ~ 0.8 miles above the creek's confluence with the river. **Habitats** -- shallow sandy runs, undercuts, and abundant periphyton. **Water Quality** -- despite the increasingly developed watershed and the upstream discharger, the specific conductance has been relatively stable, ranging from 90 µS/cm to 104 µS/cm. **2010** -- increases in the diversities of darters, suckers, and intolerant species, along with an increase of piscivores and fewer tolerant Eastern Mosquitofish, were responsible for the substantial increase in the rating. **1995-2010** -- a variable community, in addition to the watershed impacts, the site's proximity to the river may influence the community's overall diversity and abundance (i.e. readily available avenues for recolonization following droughts and other perturbations); very diverse with 33 species, including 10 species of sunfish, 4 species of darters, and 3 species of suckers; dominant species are Bluehead Chub (1995), Eastern Mosquitofish (2005), and Swallowtail Shiner (2000 and 2010); since 1995, the dominance of Bluehead Chub has been steadily decreasing, while the dominance of Swallowtail Shiner has been steadily increasing, perhaps indicating a shift from coarse gravel to a finer sand substrate and less nonpoint nutrient enrichment. **Recommendation** -- continue basinwide monitoring to document the watershed's increasing urbanization.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
CRABTREE CR	SR 1664	04/07/10	JF24	Excellent

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WAKE	2	03020201	35.84472222	-78.71222222	27-33-(10)a	Northern Outer Piedmont

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;NSW	84	210	13	0.4	No

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	80	10	0	10 (sewer line R-O-W)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Town of Cary's North Cary Water Reclamation Facility	NC0048879	12

Water Quality Parameters

Temperature (°C)	22.2
Dissolved Oxygen (mg/L)	7.9
Specific Conductance (µS/cm)	213
pH (s.u.)	7.0

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	17
Bottom Substrate (15)	12
Pool Variety (10)	7
Riffle Habitat (16)	8
Erosion (7)	5
Bank Vegetation (7)	7
Light Penetration (10)	7
Left Riparian Score (5)	4
Right Riparian Score (5)	5
Total Habitat Score (100)	**77**

Site Photograph

Substrate Cobble, gravel, boulder, bedrock

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/07/10	2010-06	22	54	Excellent
05/13/05	2005-49	26	58	Excellent
06/22/00	2000-46	19	54	Excellent

Most Abundant Species, 2010 Fantail Darter (18%)

Exotic Species Green Sunfish and White Crappie (n=1, each), Channel Catfish (n=2)

Species Change Since Last Cycle

Gains -- first collection for Warmouth. **Lost** -- Pinewood Shiner, Comely Shiner, Blacktip Jumprock, Pumpkinseed, Redear Sunfish. All species gained or lost were represented by 1 or 2 fish/species.

Data Analysis

Watershed -- drains the extensively urbanized area of northwest Wake and southeast Durham counties including the cities of Raleigh, Durham, Cary, and Morrisville, and Umstead State Park; one NPDES permitted discharger in the watershed (NC0048879, located ~ 7 miles upstream); tributary to Neuse River. **Habitats** -- abundant periphyton, shallow riffles, runs, deep pool at the end of the reach at the bridge. **Water Quality** -- second greatest specific conductance of any fish community site in 2010 resulting from the upstream WWTP discharge, has ranged from 190 µS/cm to 236 µS/cm since 2000. **2010** -- a slight decrease in the percentage of omnivores (Bluehead Chub and Bull Chub) resulted in a slight decrease in the NCIBI score but not the rating. **2000-2010** -- 28 species are known from this site, including 4 species of suckers, 3 species of darters, and 2 intolerant species; dominant species are Swallowtail Shiner (2000), Bluegill and Redbreast Sunfish (2005), and Fantail Darter (2010); WWTP discharge provides stable flows during droughts and nutrient enrichment that proves beneficial to the fish community. **Recommendation** -- continue monitoring this unique basinwide site to determine any impacts from the WWTP and the continued urbanization of its watershed.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
WALNUT CR	**SR 1348**	**04/08/10**	**JF99**	**Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WAKE	2	03020201	35.768235	-78.691193	27-34-(1.7)	Northern Outer Piedmont

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;NSW	8	295	4	0.4	No

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	80	20	0	0

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

Water Quality Parameters

Temperature (°C)	19.3
Dissolved Oxygen (mg/L)	7.0
Specific Conductance (µS/cm)	116
pH (s.u.)	6.3

Water Clarity	Clear, but dark

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	12
Bottom Substrate (15)	4
Pool Variety (10)	10
Riffle Habitat (16)	7
Erosion (7)	4
Bank Vegetation (7)	6
Light Penetration (10)	9
Left Riparian Score (5)	4
Right Riparian Score (5)	5
Total Habitat Score (100)	**66**

Site Photograph

Substrate Cobble, gravel, bedrock

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/08/10	2010-08	10	34	Fair
04/03/95	95-11	8	32	Poor
06/25/91	91-13	14	46	Good

Most Abundant Species, 2010 Bluegill (50%)

Exotic Species Redear Sunfish (n=14)

Species Change Since Last Cycle

Gains -- first collection for Golden Shiner (n=1) and Swallowtail Shiner (n=27); Redear Sunfish (n=14). **Lost** -- Green Sunfish (n=6).

Data Analysis

Watershed -- drains the southern region of Raleigh and the eastern area of Cary; no NPDES permitted dischargers in the watershed; site is approximately equidistance between lakes Johnson and Raleigh (~0.8 miles), no minimum flow requirement below Lake Johnson; tributary to Neuse River. **Habitats** -- a flashy urban stream with eroded banks, abundant periphyton, large deadfalls, deep pools, and urban debris. **Water Quality** -- specific conductance has ranged from 50 µS/cm in 1995 to 116 µS/cm in 2010. **2010** -- along with the site at Walnut Creek at South State Street, the lowest rating and least diverse of any fish community site in the basin; ~ 25% of all the fish (primarily sunfish) exhibited signs of disease (primarily popeye, caused by a roundworm infection); ~ 75% of all the fish collected were sunfish, typical of a fish community in a stressed urban stream. **1991-2010** -- 17 species are known from the site, including 8 species of sunfish and 1 species each of suckers and darters; Bluehead Chub and intolerant species are absent; ~ 75% off all the fish that have been collected were sunfish (primarily Bluegill), typical of a stressed urban stream and a stream in close proximity to a reservoir. **Recommendation** -- the cites of Raleigh and Cary, along with Wake County, should initiate a stream cleanup program to remove urban debris carried into the stream by stormwater; until stormwater controls within the watershed are implemented, continued monitoring of the impaired fish community is unnecessary.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
WALNUT CR	**South State Street**	**04/21/10**	**JF104**	**Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WAKE	2	03020201	35.7579374	-78.6237734	27-34-(4)a	Northern Outer Piedmont

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;NSW	22.7	210	9	0.4	No

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

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

Water Quality Parameters

Temperature (°C)	15.8
Dissolved Oxygen (mg/L)	7.1
Specific Conductance (µS/cm)	187
pH (s.u.)	5.5

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	7
Bottom Substrate (15)	3
Pool Variety (10)	8
Riffle Habitat (16)	2
Erosion (7)	2
Bank Vegetation (7)	6
Light Penetration (10)	8
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**51**

Site Photograph

Substrate Sand, gravel

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/21/10	2010-12	16	34	Fair

Most Abundant Species, 2010 Bluegill (31%)

Exotic Species Green Sunfish (n=6)

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

Data Analysis

This is the first fish community sample collected at this site. Watershed -- an urban stream draining the southern region of Raleigh and the eastern area of Cary; no NPDES permitted dischargers in the watershed; site is ~ 4 miles below Lake Raleigh which has no minimum flow requirement; tributary to Neuse River. Habitats -- low quality instream and riparian habitats; a flashy entrenched stream with the channel and riparian zones littered with urban trash and illegally dumped tires; eroded banks; large woody debris, side snags, and deadfalls; riffles created by sticks and deadfalls in the current. Water Quality -- specific conductance elevated due to nonpoint and stormwater runoff; hydrocarbon odor and an oily sheen atop the water surface in quiescent places. 2010 -- along with the site at Walnut Creek at SR 1348, the lowest rating of any fish community site in the basin; high percentages of tolerant fish (Satinfin Shiner, Eastern Mosquitofish, Green Sunfish, and Redbreast Sunfish) and diseased fish (primarily popeye in Bluegill caused by a roundworm infection); very skewed trophic structure due to the dominance by sunfish, 56% of all the fish were sunfish. Recommendation -- the cites of Cary and Raleigh, along with Wake County, should initiate a stream cleanup to remove urban debris illegally dumped into the stream and carried into the stream by stormwater runoff; until watershed stormwater controls are implemented, continued monitoring of the impaired fish community is unnecessary.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
WALNUT CR	**SR 2544**	**04/08/10**	**JF32**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WAKE	2	03020201	35.75833333	-78.58333333	27-34-(4)a	Northern Outer Piedmont

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;NSW	29.4	205	12	0.8	No

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

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

Water Quality Parameters

Temperature (°C)	20.1
Dissolved Oxygen (mg/L)	7.6
Specific Conductance (µS/cm)	206
pH (s.u.)	6.3

Water Clarity	Slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	12
Bottom Substrate (15)	4
Pool Variety (10)	10
Riffle Habitat (16)	4
Erosion (7)	4
Bank Vegetation (7)	6
Light Penetration (10)	8
Left Riparian Score (5)	4
Right Riparian Score (5)	5
Total Habitat Score (100)	**62**

Site Photograph

Substrate Sand, boulder, bedrock

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/08/10	2010-09	18	40	Good-Fair
04/05/05	2005-11	18	44	Good-Fair
04/11/00	2000-14	18	44	Good-Fair
04/04/95	95-13	12	34	Fair
06/25/91	91-15	20	48	Good

Most Abundant Species, 2010 Satinfin Shiner (20%), Swallowtail Shiner (19%)

Exotic Species Green Sunfish (n=6), Flathead Catfish (n=2)

Species Change Since Last Cycle

Gains -- first collection for Northern Hog Sucker and Pirate Perch; Bluespotted Sunfish. **Lost** -- Eastern Mosquitofish, Margined Madtom, Johnny Darter. All species gained or lost were represented by 1-3 fish/species, except for Pirate Perch (n=6) and Johnny Darter (n=8).

Data Analysis

Watershed -- drains southern Raleigh and eastern Cary; no NPDES permitted dischargers in the watershed; site is ~ 3.2 miles below the site on Walnut Creek at South State Street; tributary to Neuse River. **Habitats** -- deep pools, blowouts; shallow sandy areas that were present in 2005 were gone; riffle only at the bridge; difficult to sample due to hydrologically altered habitats. **Water Quality** -- specific conductance elevated due to nonpoint and stormwater runoff; since 1995 has ranged from 139 µS/cm to 206 µS/cm. **2010** -- since 1995 a community with a very skewed trophic structure with almost an absence of omnivorous Bluehead Chub; a greater than expected percentage of diseased fish (Bluegill with popeye caused by a roundworm infection); and few species with multiple ages indicative of the loss of age classes. **1991-2010** -- despite its urban setting, a very diverse community of 32 species, including 7 species of sunfish, 5 species of darters, and 3 intolerant species; dominant species are Eastern Mosquitofish (1991), Satin Shiner (1995 and 2010), and Swallowtail Shiner (2000-2010). **Recommendation** -- site should be sampled at lower flows than those experienced in 2010 or be discontinued as a basin monitoring site because of the difficulty in sampling the deep blowout pools and runs.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
MARKS CR	**SR 1714**	**04/28/10**	**JF26**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
JOHNSTON	2	03020201	35.70611111	-78.43166667	27-38	Northern Outer Piedmont

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;NSW	25.2	140	8	0.4	No

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	80	0	20	0

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

Water Quality Parameters

Temperature (°C)	16.7
Dissolved Oxygen (mg/L)	7.9
Specific Conductance (µS/cm)	82
pH (s.u.)	6.1
Water Clarity	Slightly turbid,tannin stained

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	4
Pool Variety (10)	10
Riffle Habitat (16)	3
Erosion (7)	6
Bank Vegetation (7)	5
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**69**

Site Photograph

Substrate Sand, gravel, bedrock, boulder

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/28/10	2010-20	20	48	Good
04/08/05	2005-19	23	52	Good
04/05/00	2000-07	19	50	Good
05/18/95	95-46	19	50	Good
09/23/91	91-24	17	46	Good

Most Abundant Species, 2010 Redbreast Sunfish (21%)

Exotic Species Green Sunfish (n=2)

Species Change Since Last Cycle

Gains -- first collection for Comely Shiner and Green Sunfish; Notchlip Redhorse, Margined Madtom, Pirate Perch. **Lost** -- Sea Lamprey, Bluehead Chub, Highfin Shiner, Creek Chubsucker, Channel Catfish, Flathead Catfish, Johnny Darter, Chainback Darter. All species gained or lost were represented by 1 or 2 fish/species, except for Johnny Darter (n=5) and Bluehead Chub (n=7).

Data Analysis

Watershed -- drains east-central Wake County, below Knightdale and Wendell; no NPDES permitted dischargers in the watershed; transitional zone between the Northern Outer Piedmont and the Rolling Coastal Plain; tributary to Neuse River, site is ~1.4 miles above the creek's confluence with the river. **Habitats** -- riparian densely vegetated with catbrier and vines; open canopy over the stream; riffles created by coarse woody debris in the current. **Water Quality** -- since 1995 the specific conductance has ranged from 65 µS/cm to 82 µS/cm; data were not collected in 1991. **2010** -- as at other transitional sites, the percentage of omnivores (primarily Bluehead Chub) was very low and the percentage of insectivores was high, resulting in an conservatively (artificially) lower than expected NCIBI score and rating. **1991-2010** -- a diverse fish community with 30 species, including 6 species of sunfish, 5 species of darters, 3 intolerant species, and 2 species of suckers; dominant species are Redbreast Sunfish (1991 and 2010), Bluehead Chub (1995), Swallowtail Shiner and Tessellated Darter (2000), and White Shiner (2005); no substantial changes in the biological integrity or water quality of this stream since 1991. **Recommendation** -- continue monitoring of this site to document urbanization of the watershed which is also a priority conservation area according to the Triangle Land Conservancy.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
SWIFT CR	**SR 1152**	**04/08/10**	**JF91**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WAKE	2	03020201	35.71861111	-78.7525	27-43-(1)b	Northern Outer Piedmont

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-III;NSW	21	295	5	0.4	No

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	95	0	0	5 (WWTP pumping station)

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

Water Quality Parameters

Temperature (°C)	19.7
Dissolved Oxygen (mg/L)	5.2
Specific Conductance (µS/cm)	140
pH (s.u.)	6.0

Water Clarity	Clear, but dark

Habitat Assessment Scores (max)

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

Site Photograph

Substrate cobble, gravel, bedrock, sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/08/10	2010-07	15	40	Good-Fair
04/24/00	2000-16	13	34	Fair
04/24/00	2000-17	18	40	Good-Fair
04/28/99	99-27	13	38	Fair
04/28/99	99-26	16	42	Good-Fair
04/27/95	95-29	9	28	Poor

Most Abundant Species, 2010 Swallowtail Shiner (38%)

Exotic Species Green Sunfish (n =3)

Species Change Since Last Cycle

Gains -- first collection for Golden Shiner, Redfin Pickerel, and Pirate Perch. **Lost** -- Gizzard Shad, Comely Shiner, Notchlip Redhorse, Brown Bullhead, Eastern Mosquitofish, Redear Sunfish, Yellow Perch. All species gained or lost were represented by 1-3 fish/species, except for Pirate Perch (n=6), Comely Shiner (n=7), and Gizzard Shad (n=23).

Data Analysis

Watershed -- an urban stream draining Apex and Cary; golf course immediately upstream; no NPDES permitted dischargers in the watershed; site is ~1.5 miles upstream from the backwaters of Lake Wheeler; tributary to Neuse River. **Habitats** -- entrenched and flashy with eroded banks, large debris dams, snags, undercuts, and abundant periphyton. **Water Quality** -- since 1995 specific conductance has ranged from 78 µS/cm in 1999 to 140 µS/cm in 2010. **2010** -- lower than expected species diversities including suckers and darters; skewed trophic structure due to the prevalence of sunfish; moderately high percentage of diseased fish (primarily Bluegill with popeye caused by a roundworm infection). **1995-2010** -- 25 species are known from the site, including 7 species of sunfish, 2 species of suckers, and 1 species of darter, but no Bluehead Chub or intolerant species; ~ 70% of all fish collected since 1995 have been sunfish, typical of a stressed community in an urban stream and one that is in close proximity to a reservoir; the dominant species from 1995-2000 was Bluegill and in 2010 the Swallowtail Shiner. **Recommendation** -- until additional stormwater controls within the watershed are implemented, continued monitoring is unnecessary because no improvements in the fish community are to be expected.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
LITTLE CR	**SR 1562**	**04/28/10**	**JF25**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
JOHNSTON	2	03020201	35.57527778	-78.44333333	27-43-12	Northern Outer Piedmont

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;NSW	17.3	140	8	0.4	No

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

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

Water Quality Parameters

Temperature (°C)	15.4
Dissolved Oxygen (mg/L)	6.4
Specific Conductance (µS/cm)	88
pH (s.u.)	6.0

Water Clarity	Slightly turbid,tannin stained

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	3
Pool Variety (10)	10
Riffle Habitat (16)	3
Erosion (7)	7
Bank Vegetation (7)	6
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**69**

Site Photograph

Substrate Gravel, sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/28/10	2010-18	28	56	Excellent
04/18/05	2005-25	24	46	Good

Most Abundant Species, 2010 White Shiner and Redbreast Sunfish (17% each)

Exotic Species Green Sunfish (n=2), Redear Sunfish (n=1)

Species Change Since Last Cycle

Gains -- Eastern Silvery Minnow, Bluehead Chub, Golden Shiner, Creek Chub, Creek Chubsucker, and Yellow Perch. **Lost** -- Sea Lamprey, Redfin Pickerel. All species gained or lost were represented by 1 or 2 fish/species, except for Golden Shiner (n=6) and Bluehead Chub (n=26).

Data Analysis

Watershed -- drains the increasingly urbanized area of western Johnson County and Clayton, headwaters flow along the US 70 corridor; no NPDES permitted dischargers in the watershed; transitional zone between the Northern Outer Piedmont and the Rolling Coastal Plain; tributary to Swift Creek, site is ~ 1.3 miles upstream of the stream's confluence with Swift Creek. **Habitats** -- riparian zones comprised primarily of exotics (Oriental privet and Japanese honeysuckle); snags and deadfalls, infrequent gravel riffles. **Water Quality** -- specific conductance during the past two cycles has been 82 µS/cm and 88 µS/cm. **2010** -- the most speciose of any fish community site in 2010, including 8 species of sunfish and 3 species each of suckers and darters; increases in the total abundance of fish, diversity of darters, and a more balanced trophic structure contributed to the substantial increase in the NCIBI score and rating; as at other transitional sites, the trophic structure may be naturally skewed at times due to an abundance of insectivores and piscivores. **2005 & 2010** -- a very diverse community of 31 species, including 8 species of sunfish, 3 species each of suckers and darters, and 2 intolerant species; dominant species are Redbreast Sunfish (2005 and 2010) and White Shiner (2010). **Recommendation** -- continue basinwide monitoring of this site to document urbanization of the watershed.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
MIDDLE CR	**SR 1375**	**04/21/10**	**JF34**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WAKE	3	03020201	35.63555556	-78.72805556	27-43-15-(4)a	Northern Outer Piedmont

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;NSW	35.6	250	10	0.5	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	98	2	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Brighton Forest WWTP	NC0066150	0.117
Amherst WWTP	NC0061638	0.053
Crooked Creek WWTP	NC0062715	0.150
City of Cary's South Cary Water Reclamation Facility	NC0065102	16
Town of Apex's Water Reclamation Facility	NC0064050	3.6

Water Quality Parameters

Temperature (°C)	17.5
Dissolved Oxygen (mg/L)	6.5
Specific Conductance (µS/cm)	250
pH (s.u.)	6.6

Water Clarity	Clear, tannin stained

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	4
Pool Variety (10)	10
Riffle Habitat (16)	10
Erosion (7)	6
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**78**

Site Photograph

Substrate Sand, gravel

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/21/10	2010-11	20	44	Good-Fair
07/20/04	2004-131	28	54	Excellent

Most Abundant Species, 2010 Redbreast Sunfish (19%), White Shiner (17%)

Exotic Species Green Sunfish (n=1)

Species Change Since Last Cycle

Gains -- Pinewoods Shiner, Bluehead Chub, Warmouth, Black Crappie. **Lost** -- Comely Shiner, V-lip Redhorse, Snail Bullhead, Yellow Bullhead, Flat Bullhead, Pirate Perch, Bluespotted Sunfish, Pumpkinseed, Redear Sunfish, Johnny Darter, Glassy Darter, Chainback Darter. All species gained or lost were represented by 1-3 fish/species, except for Flat Bullhead (n=5) and Black Crappie and Johnny Darter (n=6, each)

Data Analysis

Watershed -- drains southeastern Wake County, including the Fuquay-Varina, Cary, and Apex suburbs; eight NPDES facilities upstream discharging a total Q_w = 19.963 MGD; transitional zone between the Northern Outer Piedmont and the Rolling Coastal Plain; tributary to Neuse River. **Habitats** -- Coastal Plain-like with submerged woody debris; blow-out pools at bends in the creek; high quality instream and riparian habitats, except for the riffles and bottom substrate. **Water Quality** -- chlorine odor detectable; greatest specific conductance of any fish community site in 2010, was 283 µS/cm in 2004. **2010** -- eight fewer species, including the loss of three species of darters, fewer but more tolerant fish, and a decline in the percentage of omnivores resulted in the substantial decline in the NCIBI score and rating; as at other transitional sites, the percentage of omnivores was very low and the percentage of insectivores was high, often resulting in an skewed trophic structure and a conservatively (artificially) lower than expected rating. **2004 & 2010** -- a diverse community of 32 species including 10 species of sunfish, 5 species of darters, 3 intolerant species, and 2 species of suckers; dominant species are Redbreast Sunfish (2004 and 2010) and White Shiner (2010). **Recommendation** -- site should be re-sampled in 2011 to determine if declines in the biological integrity of the fish community and water quality are the result of the WWTP discharges and if the declines are temporary or permanent.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
TERRIBLE CR	**SR 2751**	**04/21/10**	**JF35**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WAKE	3	03020201	35.61444444	-78.725	27-43-15-8-(2)	Northern Outer Piedmont

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;NSW	9.9	260	5	0.5	No

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

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Town of Fuquay-Varina's Terrible Creek WWTP	NC0066516	6

Water Quality Parameters

Temperature (°C)	16.0
Dissolved Oxygen (mg/L)	7.6
Specific Conductance (µS/cm)	138
pH (s.u.)	6.5

Water Clarity	Clear, slightly stained

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	4
Pool Variety (10)	8
Riffle Habitat (16)	7
Erosion (7)	5
Bank Vegetation (7)	7
Light Penetration (10)	9
Left Riparian Score (5)	3
Right Riparian Score (5)	5
Total Habitat Score (100)	**69**

Site Photograph

Substrate Gravel, sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/21/10	2010-10	17	52	Good
04/08/05	2005-18	15	52	Good

Most Abundant Species, 2010 Redbreast Sunfish (38%)

Exotic Species Redear Sunfish (n=1)

Species Change Since Last Cycle

Gains -- Golden Shiner, Pirate Perch, Bluespotted Sunfish, Warmouth, Chainback Darter. **Lost** -- Pinewood Shiner, Margined Madtom, Johnny Darter. All species gained or lost were represented 1-4 fish/species, except for Margined Madtom and Pirate Perch (n=10, each).

Data Analysis

Watershed -- drains southeast Wake County northeast of Fuquay-Varina; one NPDES permitted discharger in the watershed (NC0066516, located ~ 0.3 miles upstream); tributary to Middle Creek. **Habitats** -- same as in 2005; bank sloughing on the left at the beginning of the reach; gravel riffles, side undercuts. **Water Quality** -- chlorine odor detectable; specific conductance has varied from 97 µS/cm in 2005 to 138 µS/cm in 2010. **2010** -- slight increases in overall diversity and diversity of sunfish were offset by a increase in the percentage of tolerant fish (primarily Redbreast Sunfish) and a decline in the percentage of piscivores; community may be shifting from Bluehead Chub and Swallowtail Shiner to Redbreast Sunfish. **2005 & 2010** -- 20 species are known from the site, including 4 species of darters, 3 intolerant species, and 1 species of sucker; dominant species are Bluehead Chub (2005) and Redbreast Sunfish (2010); the percent abundance of the tolerant Redbreast Sunfish increased from 11% to 38% while the Swallowtail Shiner decreased from 19% to 2%; no change in the biological integrity rating of this stream. **Recommendation** -- continue basinwide monitoring of this site to document any impacts from future expansion of the WWTP discharge from 1 to 2 to 4 to 6 MGD and the increasing urbanization of the watershed.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
LITTLE R	**SR 2224**	**04/29/10**	**JF43**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WAKE	6	03020201	35.91361111	-78.38722222	27-57-(1)a	Northern Outer Piedmont

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-II,HQW,NSW	25.5	260	8	0.5	No

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

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

Water Quality Parameters

Temperature (°C)	15.9
Dissolved Oxygen (mg/L)	7.9
Specific Conductance (µS/cm)	67
pH (s.u.)	6.2

Water Clarity	Slightly turbid,tannin stained

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	14
Bottom Substrate (15)	3
Pool Variety (10)	10
Riffle Habitat (16)	7
Erosion (7)	7
Bank Vegetation (7)	6
Light Penetration (10)	4
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**66**

Site Photograph

Substrate Gravel, sand, silt

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/29/10	2010-22	19	46	Good
06/11/04	2004-81	20	52	Good

Most Abundant Species, 2010 Eastern Mosquitofish (35%)

Exotic Species Green Sunfish (n=1)

Species Change Since Last Cycle

Gains -- Mud Sunfish, Green Sunfish. **Lost** -- Brown Bullhead, Flier, Sawcheek Darter. All fish gained or lost were represented by 1 fish/species.

Data Analysis

Watershed -- drains northeast Wake and southeast Franklin counties with encroaching urbanization; no NPDES permitted dischargers in the watershed; remnants of Mitchell Millpond are immediately upstream; a unique geological area transitioning between the Northern Outer Piedmont and the Rolling Coastal Plain; part of a state natural area; tributary to Neuse River. **Habitats** -- same as in 2004; Coastal Plain-like habitats; coarse woody debris, deep, silty bottom pools, open canopy. **Water Quality** -- lowest specific conductance of any fish community site in 2010. **2010** -- as at other transitional sites, the percentage of omnivores was low and the percentage of insectivores and piscivores were high, resulting in an skewed trophic structure and a conservatively lower than expected rating; percentage of tolerant fish (primarily Eastern Mosquitofish) increased from 30% to 55%. **2004 & 2010** -- 22 species are known from the site, including many Coastal Plain species, 8 species of sunfish, 3 species of darters, 2 intolerant species, and 1 species of suckers; dominant species are Bluegill (2004) and Eastern Mosquitofish (2010); no change in the biological integrity rating of this stream.
Recommendation -- continue basinwide monitoring of this site prior to impoundment of the river by the proposed downstream Little River Reservoir.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
BUFFALO CR	**SR 1941**	**04/28/10**	**JF41**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
JOHNSTON	6	03020201	35.63416667	-78.31944444	27-57-16-(3)b	Northern Outer Piedmont

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;NSW	41.2	180	8	0.4	No

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

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

Water Quality Parameters

Temperature (°C)	16.4
Dissolved Oxygen (mg/L)	6.7
Specific Conductance (µS/cm)	77
pH (s.u.)	6.0
Water Clarity	Slightly turbid,tannin stained

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	4
Pool Variety (10)	10
Riffle Habitat (16)	3
Erosion (7)	7
Bank Vegetation (7)	6
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**73**

Site Photograph

Substrate Sand, gravel

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/28/10	2010-19	17	44	Good-Fair
04/18/05	2005-26	16	44	Good-Fair
04/05/00	2000-06	15	44	Good-Fair
07/19/95	95-67	21	52	Good

Most Abundant Species, 2010 Tessellated Darter (18%)

Exotic Species None since 2000

Species Change Since Last Cycle

Gains -- first collection for Mud Sunfish, Black Crappie, and Sawcheek Darter; American Eel, Flat Bullhead, Largemouth Bass. **Lost** -- White Shiner, Bull Chub, Margined Madtom, Bluespotted Sunfish, Chainback Darter, Roanoke Darter. All fish gained or lost were represented by 1 or 2 fish/species, except for White Shiner (n=5), American Eel (n=6), and Margined Madtom (n=8).

Data Analysis

Watershed -- drains east Wake and northwest Johnston counties, including Wendell and the increasingly urbanized area around Flowers Crossroads; transitional zone between the Northern Outer Piedmont and the Rolling Coastal Plain; no NPDES permitted dischargers in the watershed; tributary to Little River. **Habitats** -- Coastal Plain-like with tannin stained water, deadfalls and coarse woody debris. **Water Quality** -- specific conductance had been gradually declining from 90 to 65 to 53 µS/cm, although a greater value (77 µS/cm) was recorded in 2010. **2010** -- as at other transitional sites and typical of low productivity Coastal Plain streams, few fish were collected, the fewest of any site (n=109); the percentage of omnivores was very low and the percentage of insectivores and piscivores were high, resulting in an skewed trophic structure and a conservatively (artificially) lower than expected rating. **1995-2010** -- number of fish collected has ranged from 73 in 2005 to 181 in 1995; a diverse community of 28 species including many Coastal Plain species, 8 species of sunfish, 5 species of darters, and 4 intolerant species; dominant species are Redbreast Sunfish (1995-2005), Dusky Shiner (2000), and Tessellated Darter (2010); percentage of tolerant fish has gradually declined since 2000, but no substantial change in the biological integrity or water quality of this stream; rating maybe lower than expected due to the Coastal Plain-like community. **Recommendation** -- continue basinwide monitoring of this site to document urbanization of the watershed and develop criteria that reflect more accurately the fish communities in ecotonal streams.

Contentnea Creek Watershed (HUC 03020203)

Benthos Template Reports

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
MOCCASIN CR	**NC 231**	**JB105**	**08/03/10**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
NASH	7	03020203	35.729167	-78.204444	27-86-2	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; NSW	56.6	160	12	0.2

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

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

Water Quality Parameters

Temperature (°C)	25.0
Dissolved Oxygen (mg/L)	8.5
Specific Conductance (µS/cm)	127
pH (s.u.)	6.3

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	19
Bottom Substrate (15)	12
Pool Variety (10)	8
Riffle Habitat (16)	8
Bank Erosion (7)	4
Bank Vegetation (7)	5
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	81

Site Photograph

Substrate Good mix of boulder, cobble, gravel, sand, and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/03/10	11069	17	17	4.52	4.52	Good-Fair
07/25/05	9706	15	15	5.37	5.37	Good-Fair
10/08/02	9038	12	12	5.46	5.46	Not Rated
09/22/00	8314	17	17	5.20	5.20	Good-Fair
08/15/00	8256	14	14	5.79	5.79	Good-Fair

Data Analysis

Moccasin Creek at NC 231 has been sampled using EPT methods since 1991. Six out of eight samples have obtained a Good-Fair rating with the one Fair rating in 1996. This stream segment was not rated in 2002 as part of an investigation studying the effects of drought on the benthic community. The habitat score (81) continues to reflect healthy riparian zones, slightly embedded riffles, a good substrate mix, and minimal erosion. Benthic metrics and physiochemical parameters have remained simliar from year to year suggesting minimal alterations in upstream anthropogenic activities. Improvements in EPT richness have ocurred at the site following the drought conditions in 2002.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CONTENTNEA CR	**NC 222**	**JB99**	**08/04/10**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WILSON	7	03020203	35.602222	-77.831111	27-86-(7)a	Southeastern Floodplains and Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Sw, NSW	382.8	56	16	0.5

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	80	0	0	0	20 (residential)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Wilson WWTP	NC0023906	14

Water Quality Parameters

Temperature (°C)	28.6
Dissolved Oxygen (mg/L)	7.0
Specific Conductance (µS/cm)	168
pH (s.u.)	6.2

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	13
Instream Habitat (20)	13
Bottom Substrate (15)	10
Pool Variety (10)	8
Riffle Habitat (16)	0
Bank Erosion (7)	9
Bank Vegetation (7)	9
Light Penetration (10)	2
Left Riparian Score (5)	3
Right Riparian Score (5)	3
Total Habitat Score (100)	70

Site Photograph

Substrate Mostly sand with some cobble, gravel, and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/04/10	11070	76	18	6.13	4.65	Good-Fair
07/26/05	9709	81	22	6.21	5.08	Good
08/29/00	8266	78	20	6.31	5.28	Good-Fair

Data Analysis

The Contentnea Creek basinwide sampling station is located approximately seven miles south of Wilson, NC. Visual land use at the site was mostly forest with some residential components. The NCBI has remained similar since sampling began in 2000, however the bioclassification declined to Good-Fair most likely due to the slight EPT richness decrease. Habitat scores were similar in 2010 (70) compared to 2005 (77). Low water levels were noted in 2010 with some potential macroinvertebrate habitat such as root mats, logs, and stumps remaining exposed along banks. In the past (2001-2005) and recently (2009), the Wilson Wastewater Treatment Plant (NC0023906) has been issued Notices of Violation for fecal coliform bacteria (2001), flow and BOD (2003), and ammonia (2005 and 2009). These parameters have potential effects on the benthos, however; the facility is located seven miles upstream from NC 222. The decline in bioclassification from Good to Good-Fair from 2005 could be caused by a mixture of chronic low flows in 2010 and upstream point-source discharges.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
NAHUNTA SWP	**SR 1058**	**JB106**	**08/12/10**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GREENE	7	03020203	35.488889	-77.806111	27-86-14	Rolling Coastal Plain

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Sw, NSW	78.6	89	10	0.2

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

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

Water Quality Parameters

Temperature (°C)	27.2
Dissolved Oxygen (mg/L)	6.5
Specific Conductance (µS/cm)	116
pH (s.u.)	6.0

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	15
Instream Habitat (20)	10
Bottom Substrate (15)	7
Pool Variety (10)	4
Riffle Habitat (16)	0
Bank Erosion (7)	9
Bank Vegetation (7)	9
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	4
Total Habitat Score (100)	70

Site Photograph

Substrate Mostly sand and silt with patches of gravel and detritus

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/12/10	11072	75	14	6.00	4.87	Good-Fair
07/27/05	9711	96	19	6.40	4.99	Good-Fair
08/16/00	8260	72	9	6.57	5.56	Fair
11/18/99	8054	6	6	5.90	5.90	Fair
08/22/95	6955	57	6	6.36	6.01	Fair

Data Analysis

Nahunta Swamp rated Good-Fair for the second consecutive Basinwide cycle in 2010 despite the lower water levels observed. Approximately 25% of the channel bed was exposed at the time of sampling including many root mats that are typically submerged. Based on EPT richness and the NCBI, water quality at the sampling site improved beginning in 2005. EPT richness (14) has increased substantially since 2000 (EPTS=9). Sensitive EPT taxa abundant or common at the site that were not present in 2000 included the mayfly *Baetisca giberra* and caddisfly *Pycnopsyche spp* ., respectively. The EPT BI (4.87) was the lowest yet from this site since sampling began in 1988 supporting better water quality at this location in recent years. The homogenous, mostly sand dominated substrate and low water levels at this site are most likely inhibiting colonation of many EPT taxa. Conductivity has remained consistent near 100 µS/cm since 1995.

Contentnea Creek Watershed (HUC 03020203)

Fish Community Template Report

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
MOCCASIN CR	**NC 231**	**04/29/10**	**JF48**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
JOHNSTON	7	03020203	35.72888889	-78.2075	27-86-2	Northern Outer Piedmont

Stream Classification	Drainage Area (mi^2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;NSW	56.6	150	9	0.4	No

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

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
City of Raleigh's Little Creek WWTP	NC0079316	2.2

Water Quality Parameters

Temperature (°C)	13.9
Dissolved Oxygen (mg/L)	7.9
Specific Conductance (µS/cm)	88
pH (s.u.)	5.6
Water Clarity	Slightly turbid,tannin stained

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	10
Pool Variety (10)	10
Riffle Habitat (16)	14
Erosion (7)	3
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**87**

Site Photograph

Substrate Gravel, cobble, sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/29/10	2010-21	22	54	Excellent
05/02/05	2005-38	25	52	Good
06/22/00	2000-45	26	58	Excellent
10/31/96	96-79	17	54	Excellent
07/21/95	95-70	18	56	Excellent
06/06/91	91-11	21	54	Excellent

Most Abundant Species, 2010 White Shiner (21%)

Exotic Species None

Species Change Since Last Cycle

Gains -- first collection for White Catfish; Chain Pickerel, Pirate Perch, Pumpkinseed. **Lost** -- Comely Shiner, V-lip Redhorse, Tadpole Madtom, Redfin Pickerel, Redear Sunfish, Black Crappie, Johnny Darter. All species gained or lost were represented by 1 or 2 fish/species, except for Pirate Perch (n=4).

Data Analysis

Watershed -- drains northwest Johnston, eastern Wake (including Zebulon), southwest Nash, and southeast Franklin counties, including the US 64 and US 264 corridors; one NPDES permitted discharger in the watershed (NC0079316, located > 10 miles upstream); tributary to Buckhorn Reservoir (Contentnea Creek). **Habitats** -- same as in 2005; high quality riffles and riparian zones, pools, undercuts, some snags. **Water Quality** -- except for 2005 (27 µS/cm), specific conductance has been relatively stable since 1991 ranging from 72 µS/cm to 88 µS/cm. **2010** -- a diverse and abundant community; only metrics not scoring the maximum value of "5" were the diversity of suckers and percentage of piscivores. **1991-2010** -- an extremely diverse community of 37 species with 11 species of sunfish, 5 species of darters, 3 intolerant species, but only 1 species of sucker is known from this site, V-lip Redhorse, and it is very rare, just 2 collected since 1991; dominant species are White Shiner (1991, 1995, and 2010), Bluegill (1995 and 2005), and Roanoke Darter (1996 and 2000); no substantial change in the biological integrity or water quality of this stream. **Recommendation** -- with consistently high quality instream and riparian habitats, a fish community with five Excellent ratings since 1991, and as a tributary to a water supply reservoir, this stream should be given priority for reclassification to High Quality Waters.

Middle Neuse River (HUC 03020202)

Benthos Template Reports

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
STONEY CR	**SR 1920**	**JB85**	**08/03/10**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WAYNE	5	03020202	35.348333	-77.980000	27-62	Southeastern Floodplains and Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; NSW	26.3	62	6	0.2

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

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

Water Quality Parameters

Temperature (°C)	24.2
Dissolved Oxygen (mg/L)	8.5
Specific Conductance (µS/cm)	98
pH (s.u.)	5.6

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	13
Instream Habitat (20)	15
Bottom Substrate (15)	7
Pool Variety (10)	10
Riffle Habitat (16)	0
Bank Erosion (7)	9
Bank Vegetation (7)	9
Light Penetration (10)	9
Left Riparian Score (5)	4
Right Riparian Score (5)	3
Total Habitat Score (100)	79

Site Photograph

Substrate Mostly sand with some gravel and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/03/10	11068	55	8	6.58	5.70	Good-Fair
09/29/05	9718	65	7	6.62	5.54	Fair
02/19/01	8365	65	7	6.90	5.60	Fair
08/22/00	8269	8	8	5.68	5.68	Fair
06/15/00	8131	50	5	6.90	5.98	Fair

Data Analysis

Stoney Creek at SR 1920 is directly adjacent to Seymour Johnson Air Force Base with forested and urban visual land use occuring upstream. This creek is currently on the EPA's 303d list as impaired due to ecological and biological integrity. However, benthic metrics obtained from standard qualitative samples since 1998 have slowly improved. In 2010 this station recieved a Good-Fair bioclassification, however, the site was on the cusp of rating Fair again with only eight EPT taxa present. Due to this low EPT richness but slightly improved NCBI (6.58), the Good-Fair bioclassification was dependent on the site's EPT abundance (46). Bioclassifications for Coastal A stream standard qualitative samples are made based on EPT richness and NCBI scores. In this case, the bioclassification score for EPT richness and NCBI differed by exactly one triggering a rounding decision based on EPT abundance ranges. If EPT abundance is equal to or above 46 in Coastal A streams the bioclassification is rounded up to Good-Fair. In this case it is exactly 46. The continual slow improvement in both EPT richness, NCBI, and conductivity (98 µS/cm in 2010 vs. 121 µS/cm in 2005) suggest better water quality, however; since the 2005 and 2010 ratings were on the Fair/Good-Fair cusp further investigations are needed to insure water quality improvements.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
BEAR CR	**SR 1311**	**JB74**	**08/02/10**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
LENOIR	5	03020202	35.248333	-77.784444	27-72-(5)	Southeastern Floodplains and Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV; Sw, NSW	62.3	46	7	0.3

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	70	10	20	0	

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

Water Quality Parameters

Temperature (°C)	23.0
Dissolved Oxygen (mg/L)	6.5
Specific Conductance (µS/cm)	102
pH (s.u.)	5.6

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	15
Instream Habitat (20)	18
Bottom Substrate (15)	7
Pool Variety (10)	9
Riffle Habitat (16)	0
Bank Erosion (7)	9
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	3
Total Habitat Score (100)	83

Site Photograph

Substrate Mostly sand with silt along the margins

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/02/10	11066	15	15	4.73	4.73	Good-Fair
07/26/05	9670	15	15	4.67	4.67	Good-Fair
08/22/00	8263	13	13	5.21	5.21	Good-Fair
08/07/95	6937	7	7	5.58	5.58	Fair
07/10/91	5643	14	14	4.97	4.97	Good-Fair

Data Analysis

Bear Creek is surrounded mostly by forest with some active pasture and a portion of its catchment within the town of LeGrange, NC. This stream segment has rated Good-Fair since 2000 and both benthic metrics (EPTS = 15, and EPTBI = 4.73) and physiochemical parameters have remained similar since 2005 suggesting little alterations in habitats or upstream anthropogenic activities. Using coastal criteria, the habitat score (83) reflects little channel modification, a good mix of instream habitat, pool varieties, and little erosion with minimal riparian disturbance. However, the homogenous sandy substrate may be limiting further increases in EPT richness given that many rheophilic EPT taxa rely on courser substrates such as cobble or detritius within areas of flow.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
NEUSE R	**NC 58**	**JB81**	**08/02/10**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
LENOIR	5	03020202	35.245833	-77.583056	27-(75.7)a	Southeastern Floodplains and Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; NSW	2687.7	26	40	1.0

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	50	20	0	0	30 (fallow fields and commercial)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Goldsboro WWTP	NC0023949	17.6

Water Quality Parameters

Temperature (°C)	27.9
Dissolved Oxygen (mg/L)	5.9
Specific Conductance (µS/cm)	203
pH (s.u.)	6.4
Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	15
Bottom Substrate (15)	3
Pool Variety (10)	8
Riffle Habitat (16)	3
Bank Erosion (7)	5
Bank Vegetation (7)	7
Light Penetration (10)	2
Left Riparian Score (5)	2
Right Riparian Score (5)	4
Total Habitat Score (100)	53

Site Photograph

Substrate Mostly sand and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/02/10	11064	62	24	5.36	4.38	Good
09/16/05	9740	62	20	5.43	4.48	Good
10/17/00	8338	62	22	5.36	4.03	Good
08/07/95	6923	58	20	5.09	4.12	Good
07/19/91	5629	60	21	5.11	4.51	Good

Data Analysis

This segment of the Neuse River has received a Good bioclassification since 1988. In 2010 the Neuse River at NC 58 received the highest EPT richness (24) since 1988 and the BI (5.36) remains low continuiing to suggest little upstream pollution affecting water quality at this location. Total taxa present has remained similar since 2000 at 62. Two new Genera to North Carolina were collected at this site in 2010 including the small minnow mayfly, *Apobaetis etowah* and the tiny beetle, *Notomicrus nanulus* further supporting indications of good water quality. The soft silty sand substrate with some detrital riffles continues to support a diverse and mostly intolerant community of mayflies (16 taxa). Despite the rich benthic fauna, conductivity in 2010 (203 µS/cm) appears to have slowly increased since 2000 (135 µS/cm) and 2005 (185 µS/cm) suggesting some pollution inputs from unknown upstream sources. The LaGrange WWTP is located approximately 12 miles upstream and the larger Goldsboro WWTP (NC0023949) discharges into the Neuse River 25 straight-line miles upstream. Conductivity was slightly elevated at the site, however, the benthic community overall reflects minimal point source discharger effects on water quality in this river reach.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
FALLING CR	**NR SR 1546**	**JB78**	**08/02/10**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
LENOIR	5	03020202	35.276389	-77.693611	27-77	Southeastern Floodplains and Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Sw, NSW	43.3	150	7	0.1

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	50	10	40	0	

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

Water Quality Parameters

Temperature (°C)	23.8
Dissolved Oxygen (mg/L)	6.9
Specific Conductance (µS/cm)	103
pH (s.u.)	5.8
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	15
Instream Habitat (20)	15
Bottom Substrate (15)	7
Pool Variety (10)	8
Riffle Habitat (16)	0
Bank Erosion (7)	9
Bank Vegetation (7)	9
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	83

Site Photograph

Substrate Dominated by sand with with silty margins

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/02/10	11065	13	13	5.06	5.06	Good-Fair
07/26/05	9669	12	12	5.45	5.45	Good-Fair
09/05/01	8626	64	14	5.84	5.08	Good-Fair
10/05/00	8331	11	11	5.17	5.17	Fair
01/07/97	7238	8	8	5.63	5.63	Poor

Data Analysis

This stream segment continues to receive a Good-Fair bioclassification. All benthic metrics have remained virtually static since 2001 with the NCBI and EPTBI suggesting a slight trend toward better water quality. The Fair and Poor bioclassfications observed before 2001 were most likely a result of samples collected outside of the typical EPT sampling window. Homogenous sandy substrate coupled with infrequent riffle habitats could limit the presence of a more diverse EPT community at this site. Both tolerant and intolerant mayfly and caddisfly taxa were present, however, stoneflies were absent reflecting the sand dominated substrate with very little course sustrata within areas of flow.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
FLAT SWP	**NC 55**	**JB115**	**03/10/10**	**Natural**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
CRAVEN	8	03020202	35.277222	-77.304167	27-90-3	Carolina Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Sw, NSW	11.9	16	4	0.3

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

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

Water Quality Parameters

Temperature (°C)	12.5
Dissolved Oxygen (mg/L)	8.2
Specific Conductance (µS/cm)	127
pH (s.u.)	6.4

Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	15
Instream Habitat (20)	15
Bottom Substrate (15)	13
Pool Variety (10)	6
Riffle Habitat (16)	0
Bank Erosion (7)	6
Bank Vegetation (7)	7
Light Penetration (10)	2
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	74

Site Photograph

Substrate Sand and detritus

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/10/10	10920	49	13	6.43	5.87	Natural
02/08/05	9553	49	11	6.72	5.44	Natural
02/23/00	8090	55	8	5.73	7.46	Natural

Data Analysis

Flat Swamp drains the Dover Pocosin and has a well defined channel with large patches of water milfoil (*Myriophyllum*) conductivity has been consistently high in this location (121, 136 and 127µS/cm in 200,2005,and 2010 respectively) Flat Swamp retained the Natural rating it has obtained in previous sampling efforts. The 2010 collection, by most measurements,was nearly identical to that in 2005. The BI improved slightly suggesting that the biological community is stable here.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CREEPING SWP	**NC 102**	**JB118**	**03/10/10**	**Natural**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
PITT	9	03020202	35.428889	-77.189722	27-97-5-3	Mid-Atlantic Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Sw, NSW	7.3	0	5	0.4

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

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

Water Quality Parameters

Temperature (°C)	12.9
Dissolved Oxygen (mg/L)	6.7
Specific Conductance (µS/cm)	60
pH (s.u.)	5.1

Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	15
Instream Habitat (20)	13
Bottom Substrate (15)	13
Pool Variety (10)	10
Riffle Habitat (16)	0
Bank Erosion (7)	10
Bank Vegetation (7)	10
Light Penetration (10)	8
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	89

Site Photograph

Substrate sand and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/10/10	10922	24	2	6.70	6.52	Natural
02/08/05	9554	26	2	6.52	6.68	Moderate
02/24/00	8092	30	2	7.14	6.37	Natural

Data Analysis

Creeping Swamp has a braided channel and solid sand substrate, but little in the way of colonizable habitat. Consistently low conductivity (60µS/cm in 2005 and 2010) indicates a fairly undisturbed watershed, however, a large (new) clearcut was located upstream in 2010. This location has been previously rated Natural in 2000, but dropped very slightly to a Moderate rating in 2005. A slight improvement in EPT BI pushed the rating back into the Natural category.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
PALMETTO SWP	**NC 43**	**JB119**	**03/10/10**	**Natural**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
CRAVEN	9	03020202	35.336667	-77.174444	27-97-5.3	Mid-Atlantic Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Sw, NSW	22.3	0	4	0.4

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

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

Water Quality Parameters

Temperature (°C)	13.9
Dissolved Oxygen (mg/L)	9.1
Specific Conductance (µS/cm)	188
pH (s.u.)	6.9

Water Clarity: slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	15
Instream Habitat (20)	15
Bottom Substrate (15)	13
Pool Variety (10)	10
Riffle Habitat (16)	0
Bank Erosion (7)	10
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	90

Site Photograph

Substrate: Sand and silt with a small amount of gravel in some areas

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/10/10	10921	46	10	6.67	5.33	Natural
02/28/05	9552	40	6	6.60	6.21	Natural
02/24/00	8094	60	8	6.85	6.20	Natural

Data Analysis

In 2010, Palmetto Swamp retained the Natural bioclassification it has received in the past two sampling years. Despite an elevated conductivity of 188µS/cm, suggesting some impact to the catchment, there were increases in both total taxa and EPT numbers. The stonely *Taeniopteryx* was common here in 2000 and 2005, but was absent in 2010. However EPT abundance increased from 28 in 2005 to 41 in 2010. The channel was braided with excellent habitat and solid sand substrate. Robust flow was evident even in the smaller side channels.

Lower Neuse River (HUC 03020204)

Benthos Template Reports

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
TUCKAHOE SWP	**SR 1142**	**JB135**	**03/01/10**	**Moderate**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
JONES	11	03020204	35.031944	-77.579444	27-101-5	Carolina Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Sw, NSW	52.4	0	9	1.1

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	80	0	10	10	

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

Water Quality Parameters

Temperature (°C)	7.1
Dissolved Oxygen (mg/L)	9.9
Specific Conductance (µS/cm)	119
pH (s.u.)	6.5

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	15
Instream Habitat (20)	17
Bottom Substrate (15)	13
Pool Variety (10)	10
Riffle Habitat (16)	0
Bank Erosion (7)	10
Bank Vegetation (7)	10
Light Penetration (10)	7
Left Riparian Score (5)	4
Right Riparian Score (5)	4
Total Habitat Score (100)	90

Site Photograph

Substrate Primarily sand with a little silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/01/10	10916	40	10	6.28	5.49	Moderate
02/23/05	9574	64	13	6.21	5.45	Natural
02/23/00	8074	69	10	6.46	5.40	Natural

Data Analysis

The Tuckahoe Creek watershed is mainly agricultural with animal operations upstream of this sampling location. Elevated conductivity values (119µS/cm in 2010) indicate there is some impact. In 2010, this site had a significant decrease in total taxa along with a slightly elevated BI score which dropped it down from Natural in 2005 to a borderline Moderate. Most of the decline in total taxa was within the Chironomidae with twenty-two species found in 2005 compared to just five in 2010. EPT diversity remained comparable to earlier sampling efforts.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
MUSSELSHELL CR	**SR 1320**	**JB132**	**03/01/10**	**Moderate**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
JONES	11	03020204	35.107222	-77.330000	27-101-17	Carolina Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Sw, NSW	6.3	12	3	0.6

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

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

Water Quality Parameters

Temperature (°C)	11.5
Dissolved Oxygen (mg/L)	10.5
Specific Conductance (µS/cm)	107
pH (s.u.)	6.5

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	8
Bottom Substrate (15)	7
Pool Variety (10)	4
Riffle Habitat (16)	0
Bank Erosion (7)	2
Bank Vegetation (7)	0
Light Penetration (10)	0
Left Riparian Score (5)	5
Right Riparian Score (5)	0
Total Habitat Score (100)	31

Site Photograph

Substrate Mostly silt with some sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/01/10	10917	32	6	6.45	5.55	Moderate
03/03/05	9580	31	4	6.70	5.27	Severe
02/24/00	8075	26	2	7.40	6.36	Severe
03/15/95	6781	15	1	7.50	6.80	Not Rated

Data Analysis

Musselshell Creek at this location is a completely channelized ditch flowing through an agricultural field. Habitat is very poor with heavy sedimentation and bank failure, as well as a total lack of riparian on the right bank. With a slight increse in total taxa, and an even better increase in BI , Musselshell Creek was able to edge up into the Moderate bioclass. This location has shown a small, but steady improvement since first being sampled in 1995. Heptageniid mayflies and a stonefly (*Perlesta*) were collected here for the first time in 2010.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
BEAVERDAM CR	**SR 1002**	**JB130**	**03/02/10**	**Moderate**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
JONES	11	03020204	35.067500	-77.276944	27-101-21	Carolina Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Sw, NSW	5.9	12	4	0.5

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

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

Water Quality Parameters

Temperature (°C)	6.8
Dissolved Oxygen (mg/L)	10.6
Specific Conductance (µS/cm)	59
pH (s.u.)	6.3

Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	15
Instream Habitat (20)	15
Bottom Substrate (15)	13
Pool Variety (10)	8
Riffle Habitat (16)	0
Bank Erosion (7)	6
Bank Vegetation (7)	10
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	87

Site Photograph

Substrate Mucky margins with solid sand in the middle of the channel

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/02/10	10918	42	7	6.17	6.04	Moderate
03/03/05	9536	43	10	6.59	6.01	Moderate
02/24/00	8076	52	8	6.88	6.28	Natural
02/25/97	7249	43	7	6.79	6.17	Moderate

Data Analysis

This location on Beaverdam Creek lies within a forested area with little agriculture. The channel is well defined with a solid sand substrate. Instream habitat was good with large amounts of woody debris. In 2010, Beaverdam Creek retains a rating of Moderate despite an improvement in the BI value. Total taxa numbers remain just small enough to keep this swamp from achieving a Natural rating. The downward trend of BI values does suggest that conditions are improving. Low conductivity measurements (59umhos/cm in 2010) have been stable here since 1995.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
ISLAND CR	**SR 1004**	**JB131**	**03/02/10**	**Moderate**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
JONES	11	03020204	35.026667	-77.135556	27-101-33	Carolina Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Sw, NSW	7.8	13	5	0.6

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

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)

Water Quality Parameters

Temperature (°C)	7.1
Dissolved Oxygen (mg/L)	8.8
Specific Conductance (µS/cm)	99
pH (s.u.)	6.6

Water Clarity	tannin stained

Habitat Assessment Scores (max)

Channel Modification (5)	15
Instream Habitat (20)	18
Bottom Substrate (15)	13
Pool Variety (10)	6
Riffle Habitat (16)	0
Bank Erosion (7)	8
Bank Vegetation (7)	10
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	90

Site Photograph

Substrate Sand with some detritus along the margins

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
03/02/10	10919	34	15	5.97	5.07	Moderate
03/10/05	9577	76	25	5.48	4.53	Natural
02/22/99	7831	67	20	5.55	4.30	Natural
03/15/95	6780	60	18	6.12	5.10	Not Rated

Data Analysis

The catchment for this segment of Island Creek lies entirely within the Croatan National forest. At the time of sampling, flow was excellent with the water tannic but clear.The bioclassification of Island Creek dropped to Moderate from previous ratings of Natural. The decline was the result of a significant decrease in Total Taxa and EPT numbers. Most of the intolerant EPT taxa noted in 2005, were largely absent in 2010. Only two facultative EPT taxa, the mayfly *Maccaffertium modestum* and the caddisfly *Cheumatopsyche* , were abundant in 2010. Seven of the remaining EPT were rare. Since habitat and water quality measurements are good, this loss of diversity suggests that the stream has had recent periods of no flow.