

BASINWIDE ASSESSMENT REPORT TAR RIVER BASIN



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

April 2008



This page was intentionally left blank

TABLE OF CONTENTS

	<u>Page</u>
LIST OF APPENDICIES	3
LIST OF TABLES.....	4
LIST OF FIGURES	4
INTRODUCTION TO PROGRAM METHODS.....	5
BASIN DESCRIPTION.....	6
TAR RIVER HUC 03020101-TAR RIVER HEADWATERS.....	8
Description	8
Overview of Water Quality	8
River and Stream Assessment	10
TAR RIVER HUC 03020102-FISHING CREEK	11
Description	11
Overview of Water Quality	12
River and Stream Assessment	13
TAR RIVER HUC 03020103-TAR RIVER	14
Description	14
Overview of Water Quality	15
River and Stream Assessment	16
TAR RIVER HUC 03020104-PAMLICO RIVER	20
Description	20
Overview of Water Quality	21
River and Stream Assessment	21
GLOSSARY	22

LIST OF APPENDICIES

<u>Appendix</u>	<u>Page</u>
B-1 Summary of benthic macroinvertebrate data, sampling methods, and criteria.....	24
F-1 Fish community sampling methods and criteria.....	39
F-2 A summary of fish community assessment data	45
F-3 Fish community data collected from the Tar River basin, 1992-2007	48
F-4 Fish community metric values from 36 wadeable streams in the Tar River basinwide monitoring program 2004. 2007.....	51
F-5 Fish distributional records for the Lumber River basin	52
F-6 Habitat evaluations and stream and riparian habitats at 36 fish community monitoring sites in the Tar River basin, 2004-2007	54
F-7 Water quality at 13 fish community sites in the Lumber River basin, 2006	62
F-8 Fish Kills in the Tar River Basin, 2003-2007.....	64
F-9 Web links.....	69
F-10 Fish community references.....	70
G-1 Flow measurement and flow conditions in the Tar River basin	71

LIST OF TABLES

<u>Table</u>	<u>Page</u>
TAR01. Waterbodies monitored in HUC 03020101 in the Tar River basin for basinwide assessment, 2002 and 2007	8
TAR02. Waterbodies monitored in HUC 03020102 in the Tar River basin for basinwide assessment, 2002 and 2007	11
TAR03. Waterbodies monitored in HUC 03020103 in the Tar River basin for basinwide assessment, 2002 and 2007	15
TAR04. Waterbodies monitored in HUC 03020104 in the Tar River basin for basinwide assessment, 2002 and 2007	20

LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
1. Geographical relationships of the Tar River basin in North Carolina.	6
2. Level IV Ecoregions of the Tar River Basin.....	7
TAR01. Sampling sites in Tar River Headwaters HUC 03020101 in the Tar River basin.....	9
TAR02. Sampling sites in Fishing Creek HUC 03020102 in the Tar River basin.....	12
TAR03. Sampling sites in Tar River HUC 03020103 in the Tar River basin	16
TAR04. Sampling sites in the Pamlico River HUC 03020104 in the Tar River basin.....	21

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 Tar River basin has been sampled by the Environmental Sciences Section (ESS) three times for basinwide monitoring: 1992, 1997, 2002, and 2007.

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 Tar River basin include benthic macroinvertebrates and fish community for the period 2002 - 2007. Details of biological sampling methods (including habitat evaluation) and rating criteria can be found in the appendices of this report. Technical terms are defined in the Glossary.

The document is structured with physical, geographical, and biological data discussions presented by 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 Tar-Pamlico River basin encompasses a 5,440 mi² watershed drained by approximately 2,355 miles of streams, and with 634,400 acres classified as salt waters. It is the fourth largest river basin in the state and is contained entirely within the state (Figure 1). From its headwaters within the eastern piedmont ecoregion the Tar River flows 180 miles southeast towards the coastal plain ecoregion and Pamlico Sound. The river is called the Tar River from its source in Person County to US 17 in the Town of Washington, a distance of about 140 miles. From Washington to Pamlico Sound it is called the Pamlico River. The Pamlico River is entirely estuarine, while the Tar River is primarily freshwater. Major tributaries include Fishing, Swift and Tranters Creeks, Cokey Swamp, and the Pungo River.

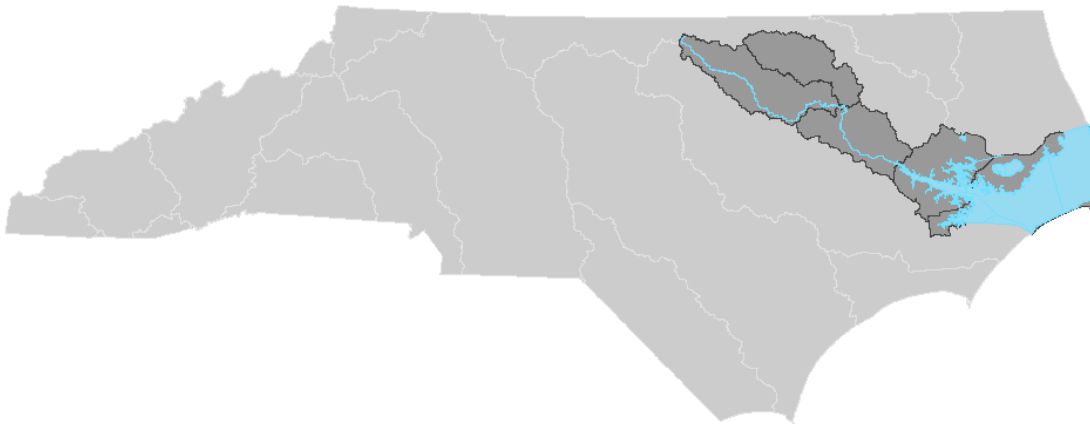


Figure 1. Geographical relationships of the Tar River Basin in North Carolina

Part or all of 16 counties are found within the basin: Beaufort, Dare, Edgecombe, Franklin, Granville, Halifax, Hyde, Martin, Nash, Pamlico, Person, Pitt, Vance, Warren, Washington, and Wilson. The largest urban areas are Greenville, Henderson, Oxford, Rocky Mount, Tarboro, and Washington. In general, land use in most of the basin is forest and wetland, with lesser areas of cultivated cropland, open water, pasture, and urban areas.

Approximately four-fifths of the basin is located in the coastal plain (Figure 2) and is characterized by flat terrain, blackwater streams, low-lying swamps, and estuarine areas. Streams are often slow flowing with extensive swamps and bottomland hardwood forests or marshes in their floodplains. These characteristics increase the difficulty in assessing water quality. Naturally stressful conditions are difficult to separate from anthropogenic stresses. The entire basin was designated as Nutrient Sensitive Waters (NSW) in 1989 in response to the problems associated with nutrient loading and the resulting eutrophication.

As would be expected for such a large river system, the Tar River basin is a physiographically diverse area with several Level-IV ecoregions represented. In the upper portion of the basin (Subbasins 01 and 02, HUC 03020101), the Northern Outer Piedmont, Carolina Slate Belt, Triassic Basins, Rolling Coastal Plain, and Southeastern Floodplains and Low Terraces Level-IV ecoregions can be found (Figure 2). In general, streams in this portion of the Tar River basin are moderate in gradient and typically have a good mix of rock, gravel, and sediment substrates. Areas of this basin that have historically been assessed for benthic macroinvertebrates by NCDWQ include Granville, Vance, Franklin, Nash, and Edgecombe counties. Land use here is largely forested, with lesser amounts of agriculture. Urban areas in this area include Louisburg, Franklinton, Oxford, Henderson, Nashville, and Rocky Mount.

The middle portion of the Tar basin (Subbasins 03 and 04, portions of HUC 03020103) we find the Rolling Coastal Plain, Southeastern Floodplain and Low Terraces, Mid-Atlantic Flatwoods, Northern Outer Piedmont and Rolling Coastal Plain Level-IV ecoregions. Streams in this region of the Tar River basin generally have lower gradient and less rock substrates with higher amounts of sand and silt present. In terms of historic benthic macroinvertebrate sampling, NCDWQ maintains sampling areas in Warren, Wilson, Halifax, Edgecombe, and Pitt counties. The majority of land use in this portion of the basin is forest and agriculture with very small amounts of urban use present associated with Warrenton, Enfield and Tarboro.

The lower portion of this basin (Subbasins 05, 06, 07, and 08, portions of HUC 0302103, and all of HUC 03020104 and HUC 03020105) includes areas of both fresh and brackish water. Waterbodies near the cities of Greenville and Washington are generally freshwater and include the Mid-Atlantic Flatwoods and the Carolina Flatwoods Level-IV ecoregions. Streams here tend to be deep and slow flowing with substrates restricted to sand, silt, and large woody debris. NCDWQ has historically sampled benthic macroinvertebrates from Edgecombe, Pitt, Martin, Beaufort, Washington, and Hyde counties. While Greenville and Washington are the two major urban areas here, most of the landuse in this segment of the basin is forest and agricultural in nature. Downstream of Greenville lies the small town of Grimesland and most of the surface water below this point is brackish and includes the Pamlico River and Pamlico Sound. Freshwater streams here are fairly rare and are typically limited to the headwaters of estuarine creeks and the East Dismal Swamp. Most streams in the East Dismal Swamp are ditched canals. This area lies within the Mid-Atlantic Flatwoods, the Chesapeake-Pamlico Lowlands, Tidal Marshes, and Nonriverine Swamps and Peatlands ecoregions. Primary land use is forest with more developed areas found near the City of Washington and the PCS phosphate mine near the Town of Aurora. Large undeveloped tracts include the Lake Mattamuskeet and Swanquarter National Wildlife Refuges.

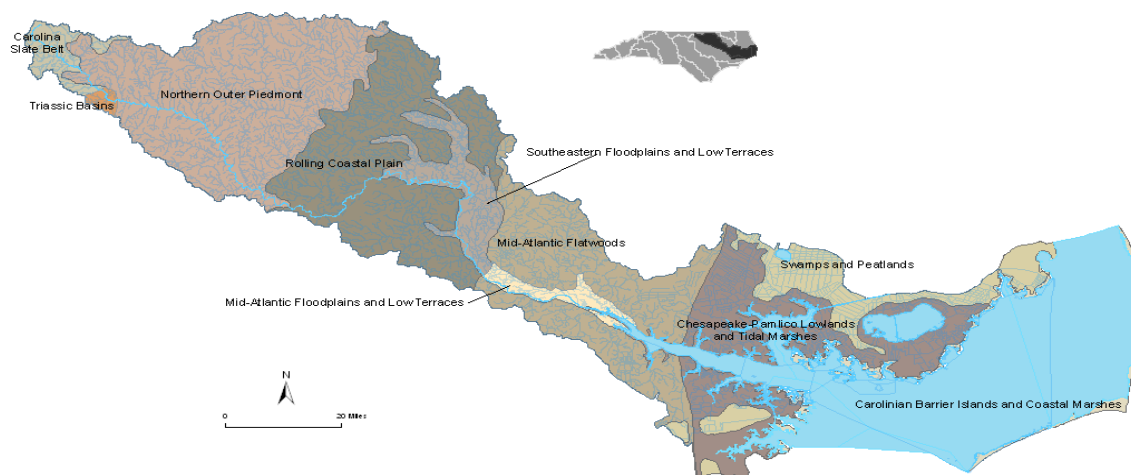


Figure 2. Level IV Ecoregions of the Tar River Basin

TAR RIVER HUC 03020101 – TAR RIVER HEADWATERS

Description

The Hydrologic Unit (HUC) 03020101 is located in the northeastern portion of North Carolina. It contains the Tar River headwaters and its tributaries, and is divided into subbasins 01, 02 (Figure TAR01).

The headwaters of the Tar River originate in Subbasin 01 in eastern Person County, but the majority of the upper portion of this subbasin is in Granville, Nash, and Franklin counties. Interstate 85 bisects the subbasin near the town of Oxford, creating two unequal sections. The subbasin is divided ecologically between three level IV ecoregions; most is in the Northern Outer Piedmont, but smaller portions of the Triassic Basin and Carolina Slate Belt (Griffith et al. 2002) also exist. Streams situated in or near the latter ecoregion are vulnerable to drying during periods of drought because of poor groundwater recharge. The subbasin has several small municipalities, including the towns of Oxford, Henderson, Franklinton, and Louisburg. Most of the land use in this subbasin however consists of a mixture of active and inactive agriculture, rural residences and remnant patches of forest.

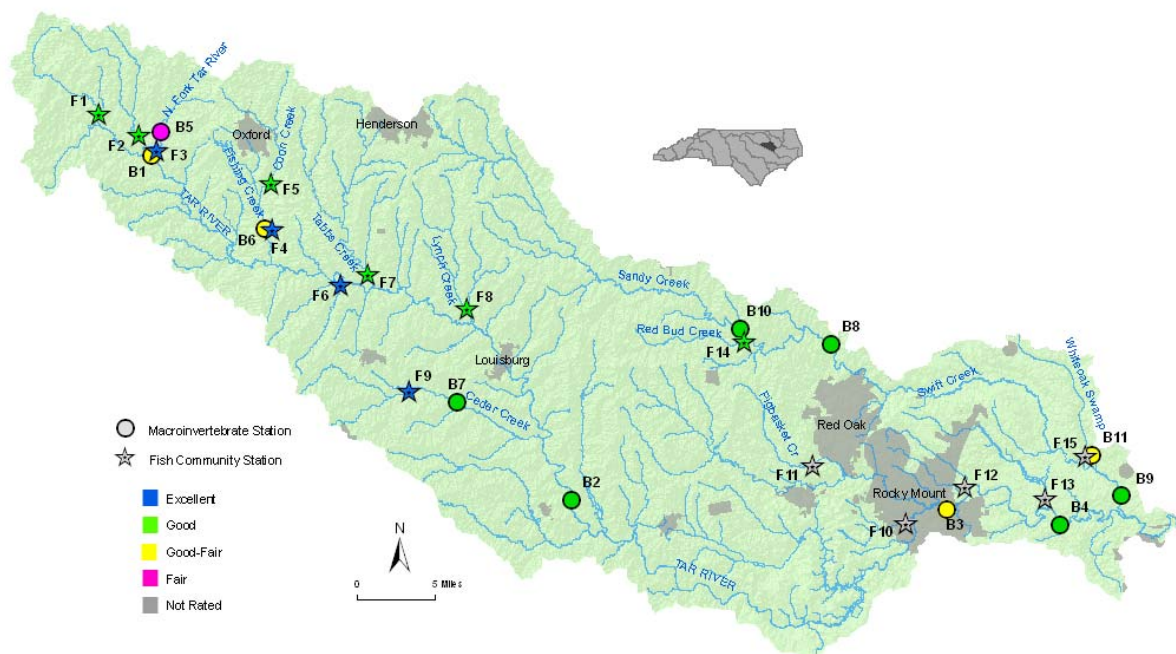


Figure TAR01. Sampling sites in Tar River Headwaters HUC 03020101 in the Tar River basin. Monitoring sites are listed in Table TAR01.

The upper Tar River in subbasin 02 flows through portions of Edgecombe and Nash counties. The lower portion of this subbasin is divided by U.S. Route 64, and is markedly more urbanized than subbasin 01; containing the towns of Spring Hope and Nashville, and the City of Rocky Mount. Land use in this subbasin is divided relatively evenly between agriculture, undisturbed forest, rural residences, and urbanized areas. The subbasin has two level IV ecoregions, but consists mostly of Rolling Coastal Plain but also has smaller patches of Southeastern Floodplains and Low Terraces.

With the exception of the Carolina Slate Belt, the infiltration capacity of soils in the less disturbed areas of this HUC are high, and streamflow is maintained during baseflows via groundwater inputs. However, in more developed areas where impervious surfaces dominate the landscape, overland flow during heavy precipitation events can also contribute, leading to more flashy streamflows.

Overview of Water Quality

Macroinvertebrate and fish data suggest that water quality in this HUC has remained relatively stable between 2002 and 2007 sampling events (Table TAR01).

While four streams within this HUC contain sections that are listed on the State of North Carolina's 303d list, none of the currently reported study locations were in these areas. There are several major and minor NPDES dischargers to the Tar River in this HUC. Major dischargers in subbasin 01 include the Oxford WWTP (3.5 MGD) which discharges into Fishing Creek at SR 1643; and the Franklin County WWTP (3 MGD) and Tar River WRF (1.37 MGD) which discharge to the Tar River at SR 1609. Major dischargers in subbasin 02 include the Sunset Avenue WWTP (not limited) which discharges to the Tar River at NC 97, and the Tar River Regional WWTP (21 MGD) which discharges to the Tar River at SR 1252.

Table TAR01. Waterbodies monitored in Tar River Headwaters HUC 03020101 in the Tar River basin for basinwide assessment, 2002 and 2007.

Map # ¹	Waterbody	County	Location	2002	2007
B-1	Tar R	Granville	SR 1150	---	Good-Fair
B-2	Tar R	Franklin	SR 1609	Good	Good
B-3	Tar R	Edgecombe	NC 97	Good-Fair	Good-Fair
B-4	Tar R	Edgecombe	SR 1252	Good-Fair	Good
B-5	N Fk Tar R	Granville	US 158	---	Fair
B-6	Fishing Cr	Granville	SR 1643	Good-Fair	Good-Fair
B-7	Cedar Cr	Franklin	SR 1109	Good-Fair	Good
B-8	Swift Cr	Nash	SR 1310	Excellent (2003)	Good
B-9	Swift Cr	Edgecombe	SR 1253	Good	Good
B-10	Sandy Cr	Nash	SR 1405	Good	Good
B-11	White Oak Swp	Edgecombe	SR 1428	Moderate Stress	Moderate Stress
F-1	Tar R	Granville	US 158	Excellent (1999)	Good
F-2	Shelton Cr	Granville	US 158	Excellent (1999)	Good (2006)
F-3	N Fk Tar R	Granville	SR 1151	Good	Excellent
F-4	Fishing Cr	Granville	SR 1643	Good	Excellent (2006)
F-5	Coon Cr	Granville	SR 1609	Good	Good (2006)
F-6	Middle Cr	Franklin	SR 1203	Good	Excellent
F-7	Tabbs Cr	Vance	SR 1100	Good (1999)	Good
F-8	Lynch Cr	Franklin	SR 1235	Good (1999)	Good
F-9	Cedar Cr	Franklin	SR 1105	Excellent	Excellent (2004)
F-10	Maple Cr	Nash	SR 1713	---	Not Rated
F-11	Pig Basket Cr	Nash	SR 1433	Not Rated	Not Rated
F-12	Compass Cr	Edgecombe	NC 97	---	Not Rated
F-13	Beech Br	Edgecombe	NC 97	Not Rated	Not Rated
F-14	Red Bud Cr	Nash	SR 1407	Good	Good
F-15	White Oak Swp	Edgecombe	SR 1428	Not Rated	Not Rated

¹B = benthic macroinvertebrate monitoring sites; F = fish community monitoring sites.

²special study site that has become a basinwide site.

Of the remaining five sites that were sampled in subbasin 01; two were given the same Good-Fair and Good bioclassifications as were assigned in 2002 (Fishing Creek at SR 1643 and Tar River at SR 1609); and one was elevated from Good-Fair to Good (Cedar Creek at SR 1109). The Tar River at SR 1150 and the North Fork Tar River at US 158 were not sampled in 2002. However, these study locations maintained a bioclassification of Good-Fair and showed a decrease from Good-Fair to Fair respectively when compared to 1997 data.

Of the six study locations sampled in subbasin 02 in 2007, only the Tar River at SR 1252 was assigned a higher bioclassification than in 2002. Sites that retained the same rating included the Tar River at NC 97 (Good-Fair), Sandy Creek at SR 1405 (Good), Swift Creek at SR 1253 (Good), and White Oak Swamp at SR 1428 (Moderate Stress). The Bioclassification of Swift Creek at SR 1310 decreased from Excellent in 2003 to Good in 2007.

Eleven fish locations were sampled in this HUC in 2007. Of these, two improved from Good at the previous sampling to a current bioclassification of Excellent (NF Tar River at SR 1151 and Middle Creek at SR 1203); six retained the same rating of Good (Tabs Creek at SR 1100, Lynch Creek at SR 1235, and Red Bud Creek at SR 1407) or Not Rated (Pig Basket Creek at SR 1433, Beech Branch at NC 97, and White Oak Swamp at SR 1428); one dropped from Excellent to Good (Tar River at US 158); and two that had not been previously sampled were rated as Not Rated (Maple Creek at SR 1713 and Compass Creek at NC 97).

Four other fish study locations in this HUC are also currently compared with historic data. However, one of these samples was collected in 2004 instead of 2007 and was given the same rating of Excellent as in 2002 (Cedar Creek at SR 1105). The other three streams were compared using data collected in 2006 (BAU Memo F-20060728); Fishing creek at SR 1643 improved from Good to Excellent; Coon Creek at SR 1609 retained the same bioclassification of Good; and Shelton Creek decreased from Excellent to Good.

A single fish kill (approximately 500 mortalities) was documented at Sapony Creek Arm of Tar River Reservoir on 17 September, 2007.

River and Stream Assessment

Fourteen benthic macroinvertebrate study sites were scheduled to be sampled within this HUC during basinwide monitoring in 2007. However, the exceptional drought that occurred in the upper Tar River watershed reduced streamflows severely. These conditions forced the cancellation of several study sites; including the Tar River at NC 96 and SR 1229 in subbasin 01; and Stoney Creek at SR 1603 in subbasin 02. Specific site summaries of the 26 benthic macroinvertebrate and fish community samples may be found at this link: [03020101](#).

Special Studies

In addition to basinwide sampling, four benthic macroinvertebrate requested studies were scheduled for 2007. However, extreme drought conditions decreased streamflows in three of these study locations (Beech Branch at NC 97, Red Bud Creek at SR 1321, and Sandy Creek at SR 1406) below what is necessary for sampling. Sandy Creek at SR 1436 was sampled and received a bioclassification of Good-Fair, matching that assigned during the only previous sampling of this location in 1997 (BAU Memo B-20070627).

TAR RIVER HUC 03020102 – FISHING CREEK

Description

The Tar River basin HUC 03020102 contains DWQ's Subbasin 03-03-04 and encompasses the 893 square mile Fishing Creek watershed from its headwaters in Vance County northeast of the City of Henderson to its confluence with the Tar River near the Town of Tarboro in Edgecombe County (Figure TAR02). Other counties in this watershed are Warren, Halifax, Franklin, and Nash. Smaller subwatersheds include Little Fishing Creek, Rocky Swamp, Beech Swamp, and Deep Creek. This is a physiographically diverse area primarily in the Northern Outer Piedmont and Rolling Coastal Plain ecoregions with a smaller southeastern portion in the Southeastern Floodplains and Low Terraces ecoregion (Griffith, *et al* 2002). Natural stresses to these southeastern streams may be associated with low dissolved oxygen, low current velocity, and low pH – all symptomatic of natural swamp waters. However, only the Beech Swamp watershed is supplementally classified as Swamp Waters (Basin Information Management System query, February 01, 2008).

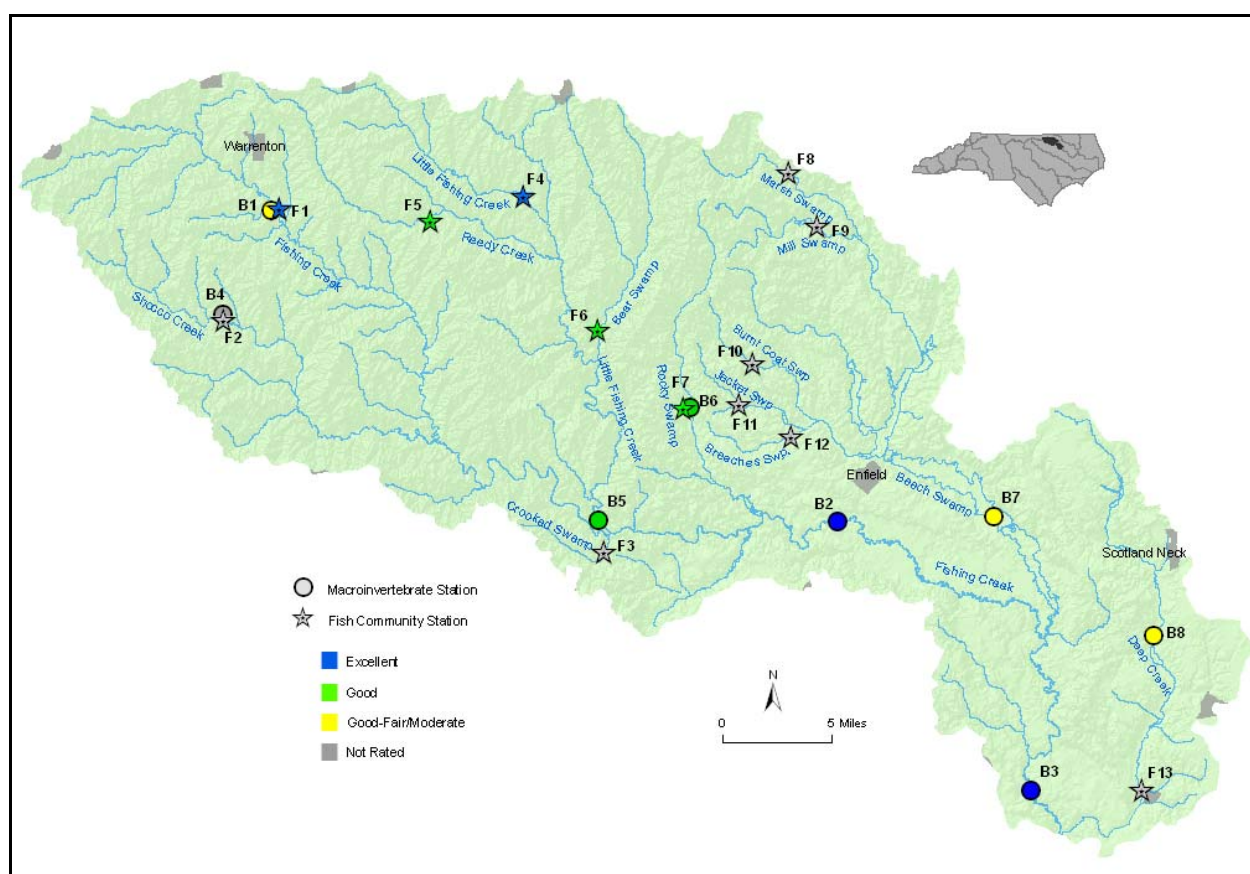


Figure TAR02. Sampling sites in HUC 03020102 in the Tar River basin. Monitoring sites are listed in Table TAR02.

The small towns of Warrenton, Enfield, and Scotland Neck are the only urban areas and their wastewater treatment plants (2.0, 1.0, and 0.675 MGD, respectively) are the only major dischargers in this watershed (Basin Information Management System query, February 01, 2008). The first two town's plants discharge to Fishing Creek; the Scotland Neck facility discharges to Canal Creek, a small tributary to Deep Creek. Four other small facilities discharge a total of 0.302 MGD to small tributaries to Fishing Creek.

Because of the many priority aquatic species in the watershed, such as the Least Brook Lamprey and the Carolina Madtom and a disjunct and relic population of Fantail Darter, the Fishing Creek watershed is a

priority area for habitat protection (NCWRC 2005). However, none of the subwatersheds have been afforded additional water quality protection with supplemental water quality classifications such as High Quality Waters (HQW) or Outstanding Resource Waters (ORW). All of the waters in this watershed are classified as C,NSW or C,SW,NSW or WS-IV,NSW (Basinwide Information System query, February 01, 2008). None of the waters are on the 2006 impaired stream list (NCDENR 2007).

Several small parcels within the Shocco Creek subwatershed in Warren, Franklin, and Halifax counties are managed as part of the Shocco Creek Gamelands by the North Carolina Wildlife Resources Commission. Other gamelands in the watershed include the Embro Gameland encompassing small parcels in the Little Fishing Creek and Reedy Creek watersheds in Warren and Halifax counties. Medoc Mountain State Park is the only large publicly-owned parcel in this watershed. There are five North Carolina Natural Heritage Program's Significant Natural Heritage Areas in this watershed – Fishing Creek Floodplain Forest, Lower Shocco Creek Bluff, Shocco Creek Centerville Bluffs, Medoc Mountain State Park, and Reedy Creek Hardwood Forest (NCDEHNR 1993).

Overview of Water Quality

Twenty-one benthic macroinvertebrate and fish community samples were collected from Fishing Creek and its tributaries during the 2007 basinwide cycle (Table TAR02 and Figure TAR02). Eleven stream bioclassifications ranged from Good-Fair to Excellent; 2 swamp sites rated as Moderate Stress, 2 sites were classified as Not Rated due to hydrological alterations at the sites; and 7 fish community were classified as Not Rated because metrics and criteria have yet to be developed for Coastal Plain streams. Three of the sites qualified as new fish community regional reference sites – Marsh, Mill, and Jacket swamps. One of the sites, Crooked Swamp, borders the Northern Outer Piedmont and would rate as Excellent if Piedmont criteria were applied.

Table TAR02. Waterbodies monitored in HUC 03020102 in the Tar River basin for basinwide assessment, 2002 and 2007.

Map # ¹	Waterbody	County	Location	2002	2007
B-1	Fishing Cr	Warren	SR 1600	---	Good-Fair
B-2	Fishing Cr	Edgecombe	US 301	Good-Fair	Excellent
B-3	Fishing Cr	Edgecombe	SR 1500	Good	Excellent
B-4	Shocco Cr	Warren	SR 1613	---	Not Rated
B-5	Little Fishing Cr	Halifax	SR 1343	Good	Good
B-6	Rocky Swp	Halifax	SR 1002	---	Good
B-7	Beech Swp	Halifax	SR 1003	Moderate Stress	Moderate Stress
B-8	Deep Cr	Halifax	SR 1100	Moderate Stress	Moderate Stress
F-1	Fishing Cr	Warren	SR 1600	Excellent (1999)	Excellent
F-2	Shocco Cr	Warren	SR 1613	Excellent	Not Rated
F-3	Crooked Swp	Nash	SR 1501	---	Not Rated
F-4	Little Fishing Cr	Warren	SR 1509	Good	Excellent
F-5	Reedy Cr	Warren	SR 1511	Good	Good
F-6	Bear Swp	Halifax	NC 561	Good	Good
F-7	Rocky Swp	Halifax	SR 1002	Good	Good
F-8	Marsh Swp	Halifax	SR 1210	---	Not Rated
F-9	Mill Swp	Halifax	SR 1615	---	Not Rated
F-10	Burnt Coat Swp	Halifax	SR 1216	---	Not Rated
F-11	Jacket Swp	Halifax	SR 1216	---	Not Rated
F-12	Breeches Swp	Halifax	SR 1002	---	Not Rated
F-13	Deep Cr	Edgecombe	SR 1506	---	Not Rated

¹B = benthic macroinvertebrate monitoring sites; F = fish community monitoring sites.

No changes in the bioclassifications were observed at seven sites between 2002 and 2007. Three sites improved to Excellent from either Good-Fair or Good. Fishing Creek at SR 1600 in Warren County, which had not been sampled for benthic macroinvertebrates since 1997, declined from Good in 1997 to Good-Fair in 2007. However, the decline was attributed to drought, low flow conditions, and habitat alterations by beavers, not to a decline in water quality. Two months earlier, the fish community at the same site was rated Excellent. Shocco Creek whose fish community rated Excellent in 2002 was not rated in 2007 also due to hydrologic modifications by beavers.

Four sites and their upstream watersheds qualified as HQW or ORW, if so petitioned. These waters are Fishing Creek at SR 1600 (three Excellent fish community ratings since 1997), Fishing Creek at US 301 (Excellent benthic macroinvertebrate rating in 2007 and five Good ratings between 1983 and 1997), Fishing Creek at SR 1500 (Excellent benthic macroinvertebrate rating in 2007), and Little Fishing Creek at SR 1509 (Excellent fish community rating in 2007).

River and Stream Assessment

All benthic macroinvertebrate and fish community sites scheduled to be sampled were sampled in 2007. Specific site summaries of the 21 benthic macroinvertebrate and fish community samples may be found at this link: [03020102](#).

Special Studies

Groundwater Arsenic Study, Unnamed Tributary to Fishing Creek, Halifax County

The purpose of this investigation was to evaluate the possible effects of naturally occurring arsenic in groundwater among small, largely undisturbed headwater streams in the Northern Outer Piedmont ecoregion. As part of the study, the Aquifer Protection Section requested that the Biological Assessment Unit and the Aquatic Toxicity Unit conduct studies at three permanently flowing streams where high concentrations of naturally occurring arsenic had been measured by Aquifer Protection Section staff. While interstitial pore water collected from the sites was highly toxic to ostracods in laboratory testing, the benthic macroinvertebrate communities did not differ markedly from similarly sized reference streams in this ecoregion and for this time of year. Despite the apparent lack of notable response in the macroinvertebrate community to high levels of arsenic (present both interstitially and as precipitate on substrates) in these streams, it was unknown whether other reference streams in this area that were not part of this study (and therefore have no data on *in situ* arsenic concentrations) differed from the study sites. To more precisely test the hypothesis that naturally occurring arsenic levels adversely affect benthic macroinvertebrate communities, other nearby, physically comparable reference streams which lack the high levels of arsenic that the sites in this study would need to be sampled for comparison (BAU Memorandum B-20070918).

Small Stream Reference Site Study, Unnamed Tributary to Bear Swamp and Unnamed Tributary to Powells Creek, Halifax County

Two sites on unnamed tributaries to Bear Swamp and Powell Creek qualified as reference sites for an on-going project to develop a bioclassification hierarchy for streams with drainage areas less than 3 square miles. The streams were sampled in 2005 (Unnamed Tributary to Bear Swamp) or 2006 (Unnamed Tributary to Powells Creek). The study is expected to be completed in 2008.

TAR RIVER HUC 03020103 – TAR RIVER

Description

This HUC contains the mainstem Tar River from about Tarboro downstream to Washington, where the name of the river changes to the Pamlico River. The western section of the Tar River HUC lies within the Southeastern Plains ecoregion while the eastern portion is contained in the Middle Atlantic Coastal Plain ecoregion. Biological sampling sites in the Southern Plains ecoregion are found in the Rolling Coastal Plain and the Southeastern Floodplains and Low Terraces subecoregions. Streams in the Rolling Coastal Plain generally have greater relief and contain better-drained soils. Agriculture dominates much of the landscape in the Rolling Coastal Plain. The Southeastern Floodplains and Low Terraces have less relief and more saturated soils. These areas contain some of the swamp streams sampled in 2007. Biological sampling sites in the Middle Atlantic Coastal Plain ecoregion are found in the Carolina Flatwoods and Mid-Atlantic Floodplains and Low Terraces subecoregions. The Carolina Flatwoods is similar to the Rolling Coastal Plain but with less relief and a plant community more dominated by pines. The Mid-Atlantic Floodplains and Low Terraces is a continuation of the Southeastern Floodplains and Low Terraces with large rivers becoming sluggish and deep.

Urban areas within this HUC include Greenville, Bethel, Pinetops, Tarboro, Elm City and parts of Rocky Mount. Edgecombe and Pitt Counties comprise the core of the upper section of this HUC.

This middle section of HUC 03020103 includes approximately 40 river miles of the Tar River from the confluence of Swift Creek in Edgecombe County to the confluence of Conetoe Creek in Pitt County. It also includes the catchments of Cokey Swamp Ballahack Canal, and Bynums Mill Conetoe, Crisp, Otter, and Town Creeks. Tarboro is the largest urban area. Land use is primarily forest and agriculture. Many streams in this area were channelized 35 or more years.

There are two large dischargers in this subbasin: the Towns of Tarboro and Bethel WWTPs (5.0 and 0.75 MGD, respectively). They discharge to the Tar River and Conetoe Creeks, respectively. The two areas with the greatest potential for nonpoint source pollution (crops and grazing), were the Cokey Swamp and Conetoe Creek catchments (USDA, 1995). Cokey Swamp also receives urban runoff from Rocky Mount.

The lower section of HUC 03020103 includes approximately 35 river miles of the Tar River from the confluence of Conetoe Creek in Pitt County to just upstream of Washington, NC (Figure TAR03) and the most downstream freshwater reach of the Tar River. It is located within the Mid-Atlantic Flatwoods and the Mid-Atlantic Floodplains and Low Terraces ecoregions. The main stem of the Tar River here is deep, slow flowing and tidally influenced, having changed from a Coastal A to Coastal B waterbody in the vicinity of Greenville, the only major urban area in this section of the HUC. Chicod Creek is a major tributary with the greatest potential for nonpoint source pollution. While runoff from crop and forage lands were historic problems in this watershed, an influx of intensive poultry and hog operations during the early 1990s has become the largest nonpoint concern. Tranters Creek is another major tributary, entering the lower Tar River just above Washington (at which point HUC 03020104 begins). Watersheds within the lower Tar River section of this HUC include Cannon, Flat, Old Ford and Horsepen Swamps, Whichard Branch, Chicod, Grindle, Hardee, Parker, Tranters and Tyson Creeks.

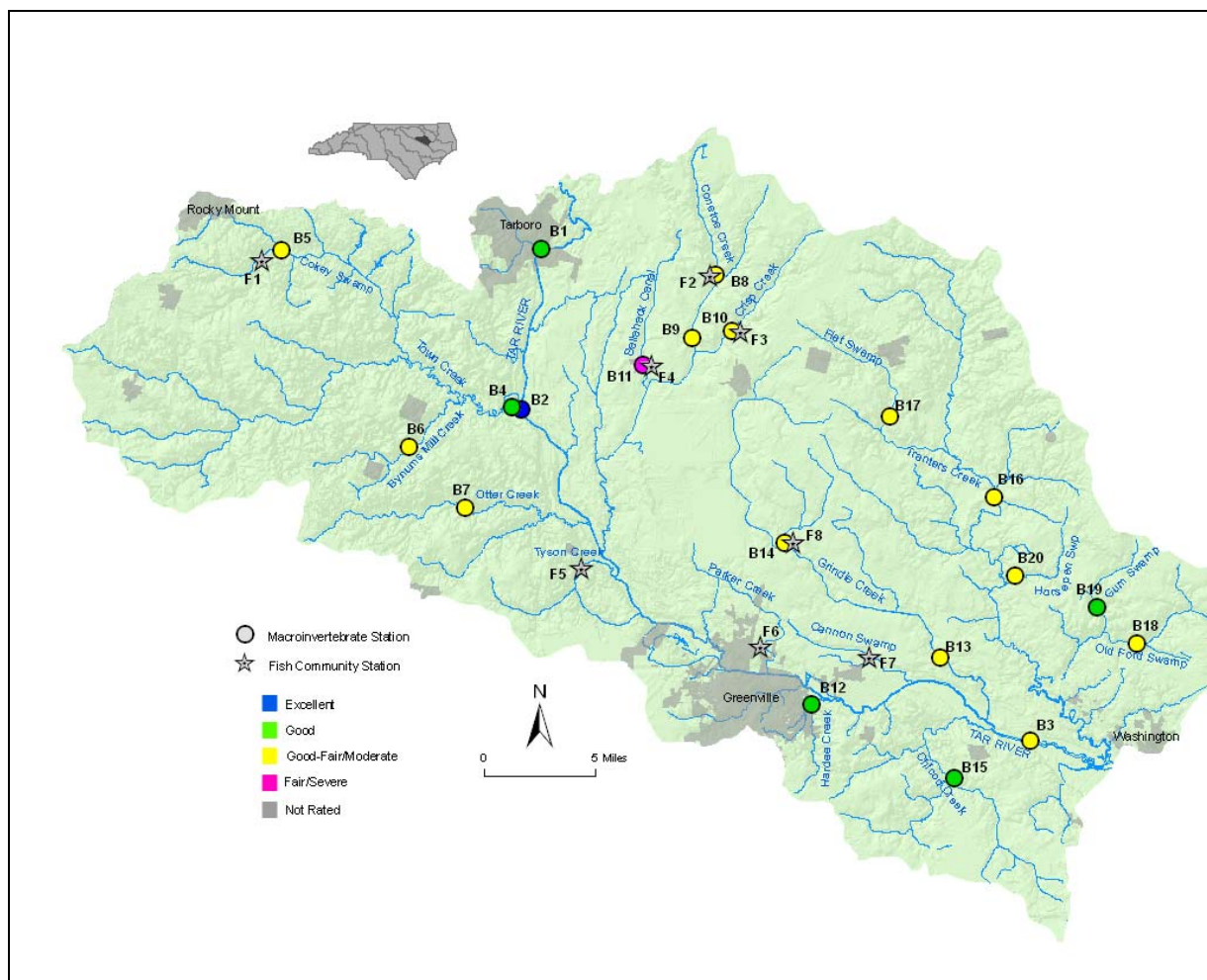


Figure TAR03. Sampling sites in HUC 030020103 in the Tar River basin. Monitoring sites are listed in Table TAR03.

Overview of Water Quality

In 2007, 20 benthic and eight fish community samples were taken from 25 waterbodies (or separate sections thereof) in HUC 03020103 (Table TAR03). Three waterbodies, Conetoe and Crisp Creeks and Ballahack Canal, were sampled for both fish community and benthic macroinvertebrates in 2007.

The 20 benthic sites consisted of five summer sites (Coastal A and B) and 15 winter sites (Swamps). Of the five summer sites, 1 rated Excellent (Tar River at NC 42), two rated Good (Tar River at US 64 Bus, Town Creek) and two rated Good Fair (Tar River at SR 1565, Grindle Creek). Most of the winter swamp sites rated Moderate in 2007. Three streams rated Natural (Hardee, Latham and Chicod Creeks) and only one stream had Severe Stress (Ballahack Canal).

Water quality in the Tar HUC 03020103 appears to have slightly improved since 2002. Even though most sites (n=12), received the same bioclassification in 2007 that they did in 2002, five sites showed improved rating from 2002 to 2007 (Chicod Creek, Cokey Swamp, Bynums Mill Creek, Conetoe Creek (SR 1510) and Crisp Creek). Only one site declined in bioclassification (Old Ford Swamp). The most downstream site on the Tar River (SR 1565) was Not Rated in 2002 due to saltwater intrusion. Town Creek was not sampled in 2002 but the rating it received in 2007 was the same as in 1997.

Table TAR03. Waterbodies monitored in the Tar River HUC 03020103 for basinwide assessment, 2002 and 2007.

Map # ¹	Waterbody	County	Location	2002	2007
B-1	Tar R	Edgecombe	US Bus 64	Good	Good
B-2	Tar R	Edgecombe	NC 42	Excellent	Excellent
B-3	Tar R	Pitt	SR 1565	Not Rated	Good-Fair
B-4	Town Cr	Edgecombe	SR 1601	Not Sampled	Good
B-5	Cokey Swp	Edgecombe	NC 43	Severe Stress	Moderate Stress
B-6	Bynums Mill Cr	Edgecombe	SR 1120	Moderate Stress	Moderate Stress
B-7	Otter Cr	Edgecombe	SR 1614	Moderate Stress	Moderate Stress
B-8	Conetoe Cr	Edgecombe	SR 1510	Moderate Stress	Moderate Stress
B-9	Conetoe Cr	Edgecombe	NC 42	Severe Stress	Moderate Stress
B-10	Crisp Cr	Edgecombe	SR 1527	Severe Stress	Moderate Stress
B-11	Ballahack Canal	Edgecombe	NC 42	Severe Stress	Severe Stress
B-12	Hardee Cr	Pitt	NC 33	Not Rated	Natural
B-13	Grindle Cr	Pitt	US 264	Good-Fair	Good-Fair
B-14	Whichard Br	Pitt	SR 1521	Moderate Stress	Moderate Stress
B-15	Chicod Cr	Pitt	SR 1777	Severe Stress	Natural
B-16	Transters Cr	Pitt	SR 1552	Moderate Stress	Moderate Stress
B-17	Flat Swp	Martin	SR 1152	Moderate Stress	Moderate Stress
B-18	Old Ford Swp	Beaufort	US 17	Natural	Moderate Stress
B-19	Latham Cr	Beaufort	SR 1410	Natural	Natural
B-20	Horsepen Swp	Beaufort	SR 1914	Moderate Stress	Moderate Stress
F-1	Cokey Swp	Edgecombe	SR 1135	Not Sampled	Not Rated
F-2	Conetoe Cr	Edgecombe	SR 1510	Not Sampled	Not Rated
F-3	Crisp Cr	Edgecombe	SR 1527	Not Sampled	Not Rated
F-4	Ballahack Canal	Edgecombe	NC 42	Not Sampled	Not Rated
F-5	Tyson Cr	Pitt	SR 1255	Not Sampled	Not Rated
F-6	Parker Cr	Pitt	NC 33	Not Rated	Not Rated
F-7	Cannon Swp	Pitt	US 264	Not Sampled	Not Rated
F-8	Whichard Br	Pitt	SR 1521	Not Sampled	Not Rated

The fish community metrics for Coastal Plain streams are currently under development; hence all eight of those samples received a Not Rated classification. The eight waterbodies sampled for fish communities can be grouped into two categories: streams that have a natural channel; and streams that have been channelized. Tyson Creek is the best example of a waterbody with a natural channel in this HUC. This is reflected in the habitat score for this site (95). In natural or less modified streams, fish densities are typically lower than in channelized systems. In the channelized Parker Creek and Cannon Swamps fish densities were very high, constituting the second and third highest catch rate of fish sites in the Tar Basin in 2007.

Of the eight streams sampled in 2007, fish have been previously collected at two of them, Cokey Swamp (in 1997) and Parker Creek (in 2002). Both streams saw an increase in the number of species collected in 2007.

In July 2005, a fish kill was reported near the Mary Francis Center in Edgecombe County (Table F-xx). The mortality estimate of Bass and Sunfish affected in this fish kill was 510 individuals. The cause of this event was unknown.

Eastern North Carolina including the Tar River Basin experienced extreme drought in 2007, more pronounced than the drought of 2002. Decreased runoff in 2007, compared with 2002, contributed to less pollution entering streams. Water chemistry data support this conclusion. At nearly all the sites sampled in 2007, pH and specific conductance values were lower than in 2002.

River and Stream Assessment

Specific site summaries of the 28 benthic macroinvertebrate and fish community samples may be found at this link: [03020103](#).

Special Studies

Lower Tar River Watershed Ecosystem Enhancement Program (B-040514)

Streams in eastern Edgecombe County outside of Tarboro (Tar 03) and central and eastern Pitt County outside of Greenville (Tar 05) experience impacts from agricultural nonpoint activities primarily in the form of animal operations (swine and poultry) as well as from row crops (corn, soybeans, and tobacco). Streams in these subbasins with catchments encompassing the urban areas of Tarboro and Greenville are also impacted by nonpoint pollution but are additionally deleteriously affected by altered hydrology due to the large amounts of impervious surface. The adverse impacts associated with these various nonpoint sources resulted in the Ecosystem Enhancement Program (EEP) targeting these catchments for water quality and habitat quality improvement. To aid the EEP in selecting and prioritizing catchments and streams for restoration activities, the Biological Assessment Unit (BAU) surveyed benthic macroinvertebrate communities and habitat characteristics at 5 stream sites in eastern Edgecombe and central Pitt Counties during March 1-5 2004. These sites were Holly Creek, Crisp Creek, Cow Swamp, Greens Mill Run and Hendricks Creek.

The five sites sampled for this study break down into two general categories: 1) streams with catchments dominated by urban run-off (Greens Mill Run and Hendricks Creek) and 2) streams whose catchments are a combination of agriculture, rural residences, and broken tracts of forest (Holly Creek, Crisp Creek, and Cow Swamp). The urbanized streams of Greens Mill Run and Hendricks Creek had the lowest habitat scores in this study (60 and 56), the highest BI values (7.63 and 7.57), the lowest EPT diversities (0 and 1) and were the only streams in this study to receive Severe bioclassifications. Conversely, the less urbanized and more rural catchments of Holly Creek, Crisp Creek and Cow Swamp resulted in these streams having higher habitat scores (77, 63, and 70) the lowest BI values (6.94, 6.97, and 7.11); the highest EPT diversities (3, 4, and 4) and all received Moderate bioclassifications. Habitat problems at Greens Mill Run and Hendricks Creek were typical of highly urbanized streams as evidenced by the very severe bank erosion and scour. The flashy appearance of these streams (e.g., high wrack lines, scour, severe bank erosion) is indicative of highly impervious watersheds. Conversely, these deficiencies were not observed from Holly Creek, Crisp Creek or Cow Swamp.

Despite the fact that Holly Creek, Crisp Creek, and Cow Swamp received Moderate bioclassifications these sites should not be considered “unimpacted”. Rather, these sites should be viewed merely as “less” impacted, particularly when compared to Hendricks Creek and Greens Mill Run. Habitat at Hendricks Creek and Greens Mill Run were adversely impacted due to their highly urbanized catchments. Similarly, water quality at these sites was also extremely degraded for the same reason. As a result, simply addressing the habitat problems alone without addressing water quality would not significantly improve bioclassifications. This conclusion is also applicable to the slightly less degraded sites of Holly Creek, Crisp Creek and Cow Swamp.

ORW/HQW Survey Tar River (B-050906)

A High Quality Waters/Outstanding Resource Waters (HQW/ORW) evaluation was conducted in the Tar River at two sites in Edgecombe County, US 64 Business in Tarboro, and NC 42. Both sites received Excellent bioclassifications. In addition, collections at both sites produced several specimens of the rare mayfly *Asioplax dolani*. Prior to this collection, *A. dolani* has previously only been collected from the Neuse River Basin (three collections), the Broad River Basin (once), and one collection from Swift Creek (Tar 02). Moreover, *Asioplax dolani* is listed on the North Carolina Natural Heritage Program’s list of rare animals of North Carolina as Significantly Rare (LeGrand et al., 2004, Table 3). One other rare mayfly taxon (*Macdunnoa brunnea*) was collected at the NC 42 location and is also listed on the North Carolina Natural Heritage Program’s list of rare animals of North Carolina as Significantly Rare (LeGrand et al., 2004, Table 3). In addition, the rare Unionid mussel *Elliptio roanokensis* was identified from the NC 42 location. *Elliptio roanokensis* is listed on the North Carolina Natural Heritage Program’s list of rare animals of North Carolina as Threatened (LeGrand et al., 2004, Table 3). Between 2000 and 2005, Wildlife Resources Commission (WRC) biologists have collected four Unionid mussel taxa from the Tar River between US 64 Business and NC 42 in Edgecombe County (A. Rodgers, pers. comm., 2005). These taxa included *Lampsilis cariosa*, *L. radiata*, *Alasmidonta undulata*, and *Elliptio roanokensis*. *Lampsilis radiata*, *Alasmidonta undulata*, and *Elliptio roanokensis* are all listed on the North Carolina Natural Heritage

Program's list of rare animals of North Carolina as Threatened (LeGrand et al., 2004), while *Lampsilis cariosa* is listed on the North Carolina Natural Heritage Program's list of rare animals of North Carolina as Endangered in North Carolina and as a Species of Special Concern in the United States (LeGrand et al., 2004, Table 3). Based on these data, these segments of the Tar River may qualify for ORW designation, though both, due to their Excellent bioclassification, qualify for the HQW designation.

Town Creek (B-070312)

The Raleigh Regional Office requested that a sample be taken in Town Creek to address concerns over excess runoff from the town of Elm City WWTP's spray fields (B-070129¹). This spray system has consistently exceeded their limits on a weekly basis and is currently under a Special Order by Consent.

Town Creek at SR 1400 rated Severe indicating degraded water quality. This water body did not support a diversity of aquatic macroinvertebrates. The benthic community that persisted here was made up of a smaller number of highly tolerant organisms. A Deformity Analysis to check for toxics revealed a slightly higher rate of deformities than the natural background rate, but that those deformities did not appear to be caused by highly toxic conditions. Furthermore, the riparian habitat along this reach of stream and within the channel was degraded. This stream appeared to be in the process of transforming into a wetland from the documented (per Raleigh Region Office) increased volume of water from the upstream spray field. Water chemistry parameters such as pH and temperature indicated warmer waters and higher pH levels characteristic of upstream point sources.

Lower Tar River (B-071206)

Historical sampling in the lower Tar River indicated dramatic changes in the benthic community between Tarboro and downstream of Greenville. The Tar River below the town of Tarboro, (at NC 42, Edgecombe County) rated Excellent the four times it was sampled from 1992 to 2005. The next basin site downstream is below Greenville at SR 1565 (Pitt County). This site was characterized by frequent changes in bioclassification, ranging from Fair to Good.

Several factors influenced the benthic community in the lower Tar River including saline waters moving upstream towards Greenville during lower flows, in combination with wind tides from Pamlico River/Sound. Periodic saltwater events stressed the predominately freshwater aquatic benthic community in the lower Tar River. These short-term oligosaline conditions also masked the stresses associated with urban runoff from the City of Greenville and the effects of a 17.5 MGD major discharger, the Greenville Utility Commission's WWTP (NC0023931), downstream of the City. Furthermore, the physical character of the Tar River changes in the vicinity of Greenville, from a shallow water body, with moderate current (Coastal A) to a deeper river with little or no current (Coastal B).

This study investigated possible water quality influences (e.g. urban areas of Greenville, WWTP) one potential source at a time, by sampling upstream and downstream of both the City and the WWTP. Tar River sites sampled in 2007 for this study were: NC 42, US 264, US 264A, SR 1565.

The habitat scores were similar among all four of the sites suggesting that the differences in the biological communities were related to water quality at each site, or natural, physical changes in the lower Tar River. Especially in larger rivers, in-channel snags provide an important colonization habitat for aquatic macroinvertebrates. Both downstream sites (US 264A and SR 1565) had abundant snags, in addition to other habitats.

Aquatic macroinvertebrate data do not suggest any water quality problems in the Tar River below the City of Tarboro downstream to Greenville. These aquatic communities were diverse and many were pollution sensitive. From US 264 to US 264A there was a 35% decrease in the total number of macroinvertebrate taxa collected from the Tar River. Only half the numbers of EPT taxa found at the two sites upstream of Greenville were collected downstream at US 264A. The actual physical change in the Tar River (from Coastal A to Coastal B), as opposed to water quality changes, could account for these decreases.

Water quality degrades from US 264A to SR 1565, below the Greenville WWTP, as indicated by the increase in the Biotic Index and EPT Biotic Index, and the decreases in EPT taxa. Many of the taxa

collected below the Greenville WWTP (i.e. at SR 1565) are pollution tolerant species (but also species tolerant of naturally low levels of dissolved oxygen, oligosaline and lentic conditions). The combination of the natural, physical changes in the lower Tar River, a moderate urban influence from the City of Greenville and the impacts of the Greenville WWTP, resulted in a decline of over 70% of the EPT fauna at the point where the Tar River flows under SR 1565, when compared with upstream sites.

In addition to the Greenville urbanization and the WWTP effects, estuarine and lentic influences, as documented by both water chemistry and the biological community, affected the predominately freshwater benthos in the lower part of the Tar River between Greenville and SR 1565.

TAR RIVER HUC 03020104 – PAMLICO RIVER

Description

This HUC, extending from the Town of Washington to Roos Point, east of the Pungo River (Figure TAR04) lies within the Mid-Atlantic Flatwoods and the Chesapeake-Pamlico Lowlands and Tidal Marshes ecoregions (Griffith *et al* 2002). Freshwater streams in this subbasin are limited to headwaters of estuarine creeks and the East Dismal Swamp. Most streams in the East Dismal Swamp are ditched canals. Non-freshwater streams in this subbasin are primarily estuarine and tides tend to be wind dominated rather than following a lunar cycle.

Primary land use is row-crop agriculture and forest with more developed areas found near Washington. In addition, PCS Phosphate operates a large phosphate mine near the Town of Aurora. Four major dischargers, the largest being the PCS phosphate mine, are located in this subbasin.

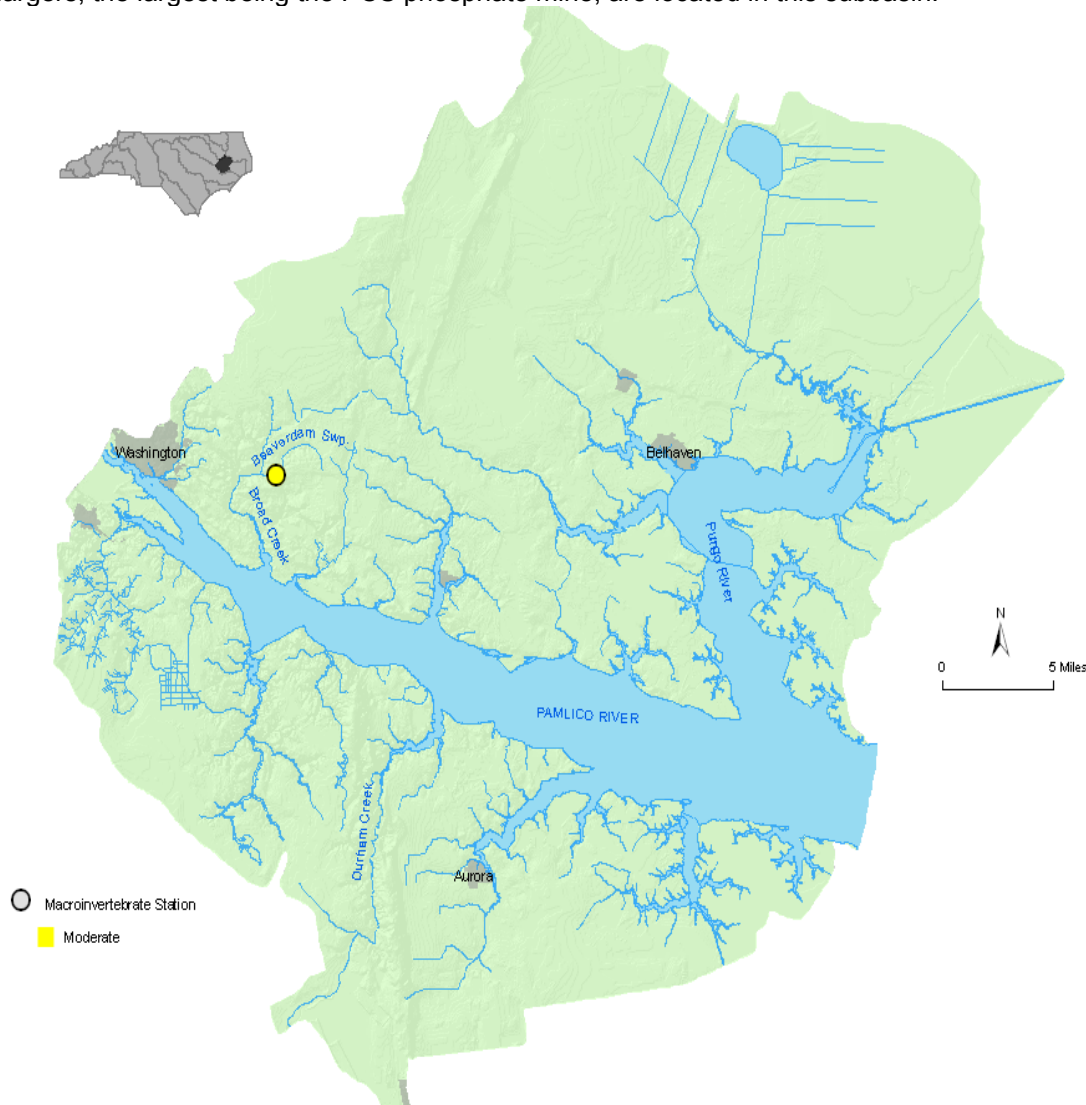


Figure TAR04. Sampling sites in Pamlico River HUC 03020104 in the Tar River Basin

Overview of Water Quality

In terms of freshwater lotic systems, there has been a very limited amount of invertebrate sampling in this subbasin as they are a limited habitat type here. In general, low pH (often near 4.0) and flow extremes limit diversity of the stream fauna. Benthic macroinvertebrate data is limited to just one site on Beaverdam Swamp and has had a Moderate Stress bioclassification in both 2002 and 2007. There were no fish community or fish tissue collections in this subbasin between 2002 and 2007.

Table TAR04. Waterbodies monitored in Pamlico River HUC 03020104 in the Tar River Basin for basinwide assessment, 2002 and 2007.

Map# ¹	Waterbody	County	Location	2002	2007
B-1	Beaverdam Swp	Beaufort	SR 1523	Moderate	Moderate

¹B = benthic macroinvertebrate monitoring sites.

River and Stream Assessment

The site summary of the benthic macroinvertebrate sample may be found at this link: [03020104](#).

Historically, numerous attempts have been made in an effort to find flowing water east of the Suffolk Scarp (Swamp Region C) including the upper Pungo River watershed, Pungo River tributaries, as well as numerous streams near the Town of Bath with each attempt producing few lotic systems. For example, the Pungo River was reconnoitered at several locations in 2007 but all sites lacked flow and were not wadeable. Flowing streams also could not be located on the south side of the Pamlico River despite intensive searches in the vicinities of South, Durham, Blounts, and Chocowinity Creeks. Swamp streams to the west of the Suffolk Scarp were in DWQ Swamp Region B. Most streams north of the Pamlico River were channelized and drained agricultural catchments and this is the geographical setting where the only benthic macroinvertebrate station (Beaverdam Swamp) in the subbasin is maintained.

There were 10 reported fishkills in this HUC between 2002 and 2007. Four kills were reported on the Pamlico River, and one each from Bond Creek, Durham Creek, Jacks Creek, Duck Creek, Pungo River Canal, Blounts Creek, and one kill reported in a Pond. Complete fishkill data can be found in the appendix to the report.

Special Studies

None

GLOSSARY

7Q ₁₀	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. 7Q ₁₀ flow (in cfs) is used to allocate the discharge of toxic substances to streams.
Bioclass or Bioclassification	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 <i>a</i>	Chlorophyll <i>a</i> .
Class C Waters	Freshwaters protected for secondary recreation, fishing, 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 $\mu\text{mhos/cm}$ at 25 °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, vegetation, and soil type. Examples include Mountains, Piedmont, Coastal Plain, Sand Hills, and Carolina 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 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.
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.

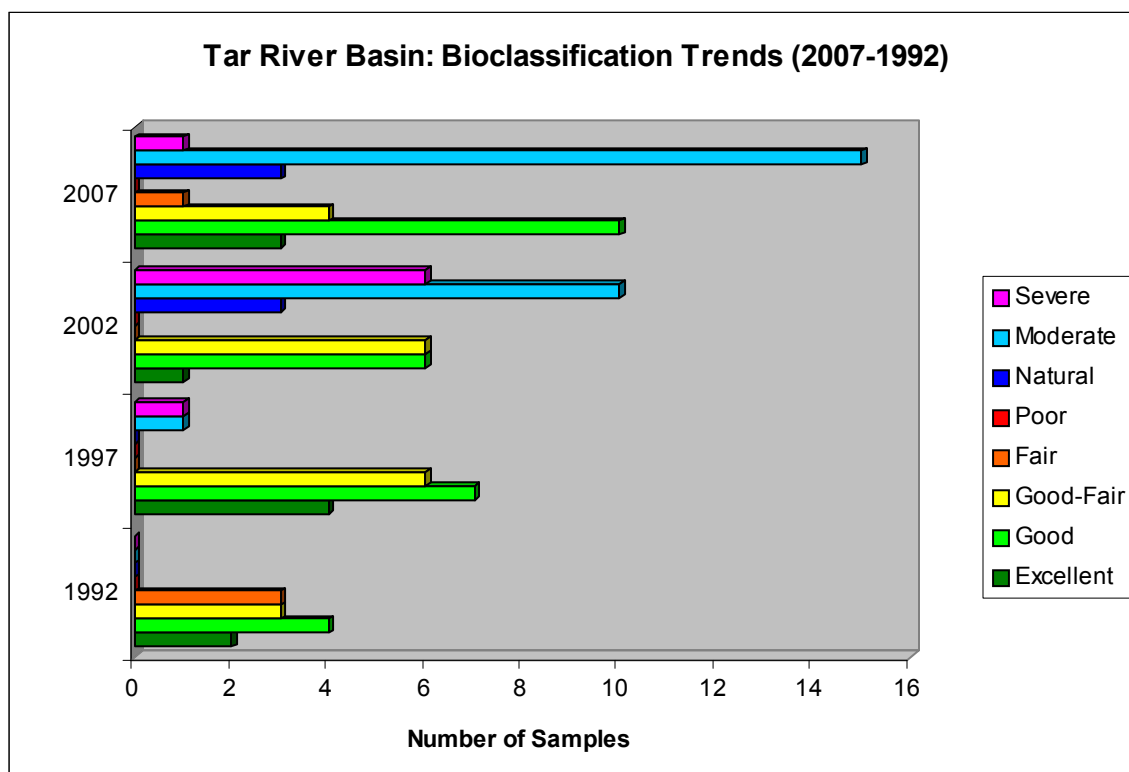
NCBI (EPT BI)	North Carolina Biotic Index, EPT Biotic Index. A summary measure of the tolerance values of organisms found in the sample, relative to their abundance. Sometimes noted as the NCBI or EPT BI.
NCIBI	North Carolina Index of Biotic Integrity (NCIBI); a summary measure of the effects of factors influencing the fish community.
NSW	Nutrient Sensitive Waters. Waters subject to growths of microscopic or macroscopic vegetation requiring limitations on nutrient inputs.
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.
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 are 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 B-1. Summary of benthic macroinvertebrate data, sampling methods, and criteria.

Overall Tar River Basin Summary

A total of 37 long-term basinwide benthos samples were collected of which 19 were swamp samples. Graphical representations of bioclassification trends in swamp, and non-swamp waters among the long-term basinwide benthos sites for the entire Tar River Basin (Figure B-1.1) as well each of the HUCS (Figure B-1.2, 1.5, 1.7, 1.11) and subbasins (Figures B-1.3, 1.4, 1.6, 1.8, 1.9, 1.10) can be found below. As can be seen from this data, the 2007 benthic macroinvertebrate community bioclassifications for non-swamp waters improved in 2007 from levels observed in 2002 and were roughly comparable to bioclassification trends seen in 1992 and 1997. In many of these instances, the improvement is attributable to drought and this trend was most pronounced in areas of the basin where point source dischargers were rare and where the largest potential source of stress to aquatic invertebrate communities were due to nonpoint sources. In general, during droughts, invertebrate communities below large point source dischargers tend to become less diverse and more pollution tolerant in composition as effluent is concentrated as a result of lowered precipitation and groundwater inputs. Conversely, during drought conditions, less runoff from nonpoint sources is introduced from land into waterbodies and this typically results in the development of a more diverse, and less pollution tolerant invertebrate community. In terms of swamp samples, similar trends were observed at several sites in 2002 that received Severe Stress bioclassifications improved to Moderate Stress. These improvements were attributed to a reduction in nonpoint pollution input as a result of the drought. This theory was bolstered by the fact that most swamp sites had much lower pH values in 2007 than from previous samples and was likely due to the reduction in higher pH agricultural runoff.

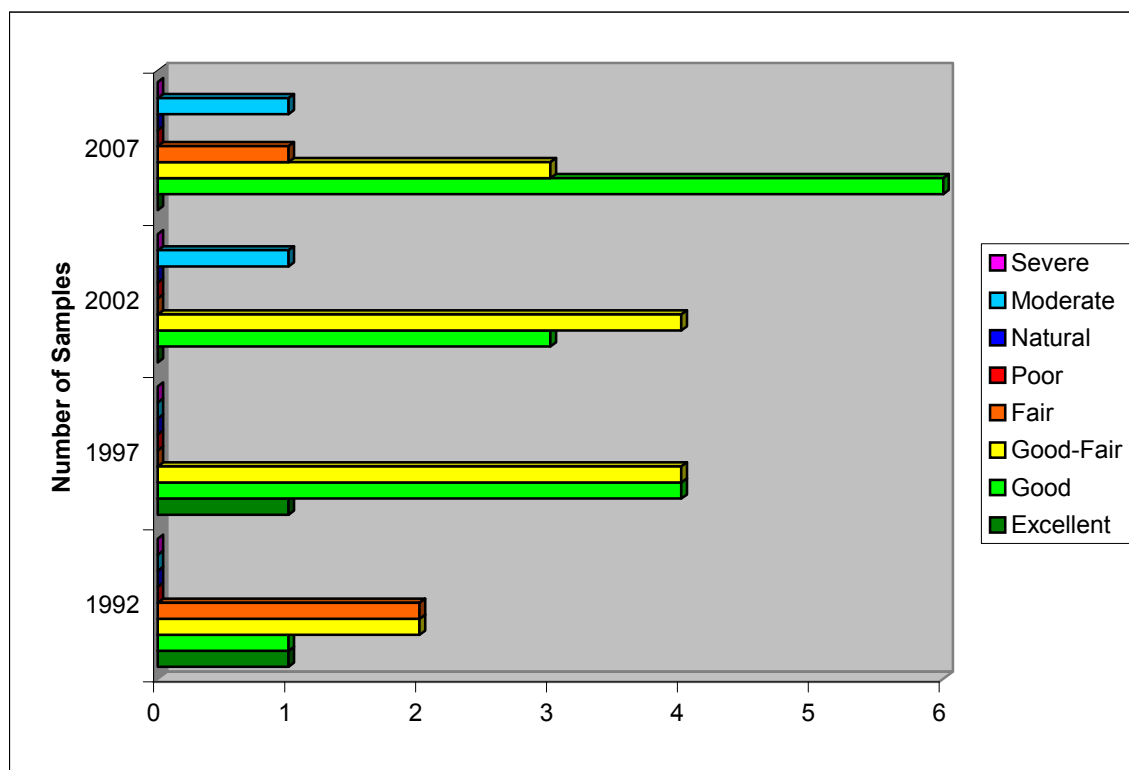
Figure B-1.1 Tar River Basin Bioclassification Trends: (2007-1992)



HUC 03020101 (Tar River Headwaters) Summary

The bioclassification trends for all of HUC 03020101 can be seen below (Figure B-1.2). Substantial portions of this HUC are comprised of a mix of forest and agriculture and lack large point source dischargers. As a result, several sites improved in bioclassification from the 2002 sample period with the number of Good bioclassifications doubling. Examples of this could be seen at Cedar Creek (SR 1109) and Tar River (SR 1252). However, despite these modest improvements, there has been no summer Excellent bioclassifications at the long-term monitoring stations since 1997 in this HUC. Swamp bioclassifications remained unchanged through time in this HUC.

Figure B-1.2: Tar River Basin HUC 03020101 (Subbasins 01 and 02): Bioclassification Trends (2007-1992)



Graphical Summaries by Subbasin

Figure B-1.3. Tar River Subbasin 01 (HUC 03020101): Bioclassification Trends (2007-1992)

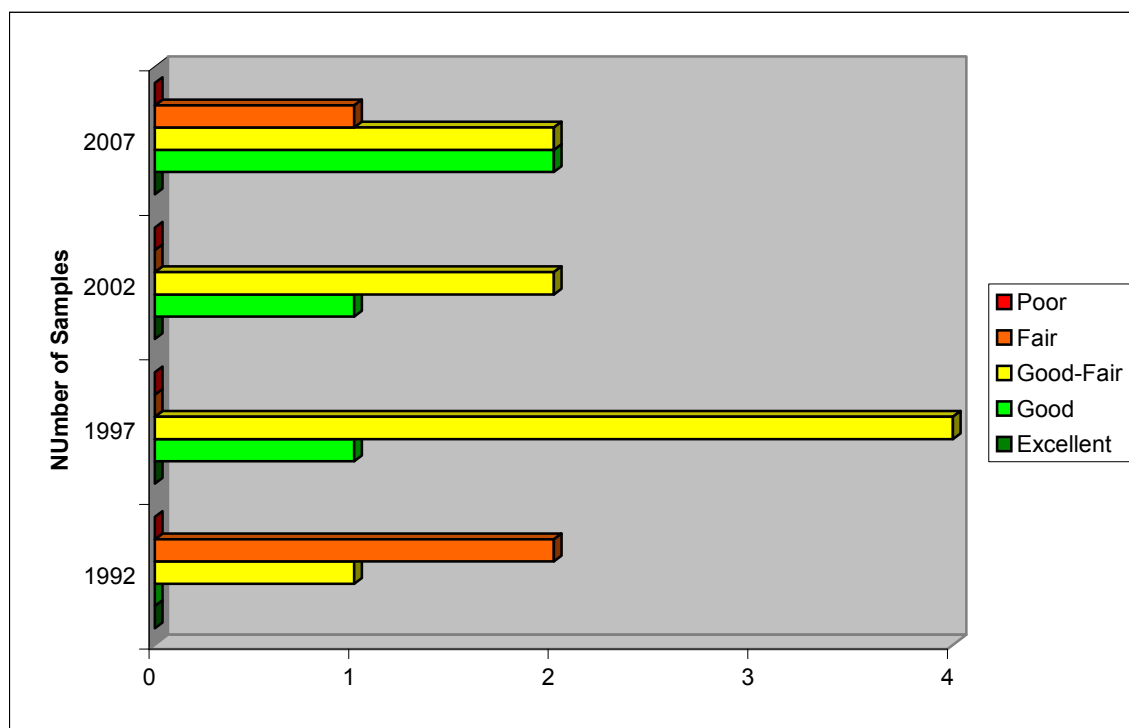
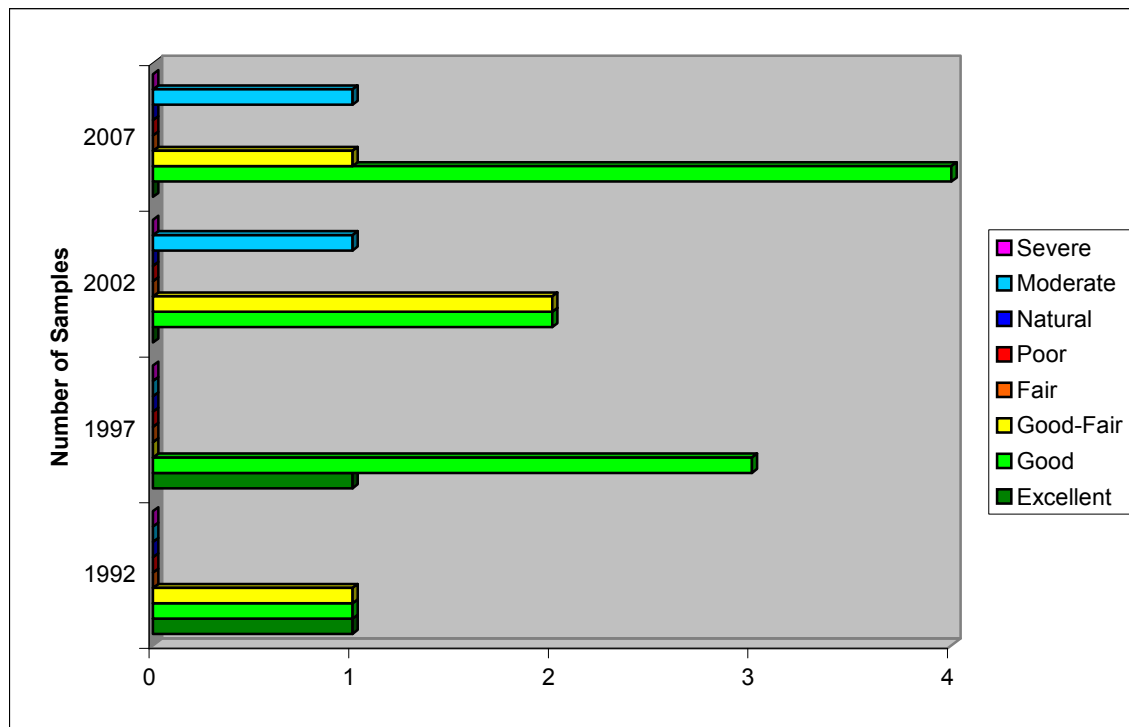


Figure B-1.4. Tar River Subbasin 02 (HUC 03020101): Bioclassification Trends (2007-1992)



HUC 03020102 (Fishing Creek) Summary

The bioclassification trends for all of HUC 03020102 can be seen below (Figure B-1.5). Most of this HUC is comprised of a mix of forest and agriculture and there are very few large point source dischargers present. As a result, bioclassifications generally improved from earlier samples. Notable examples of this could be seen at Fishing Creek (US 301) and Fishing Creek (SR 1500). Swamp bioclassifications remained unchanged through time in this HUC.

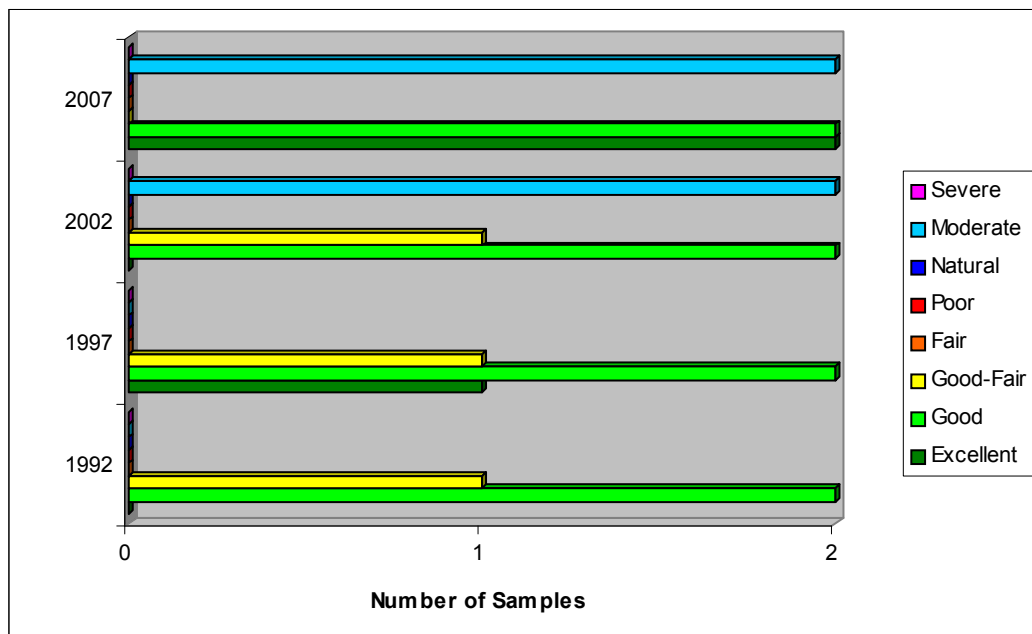


Figure B-1.5. Tar River Basin HUC 03020102 (Subbasin 04): Bioclassification Trends (2007-1992)

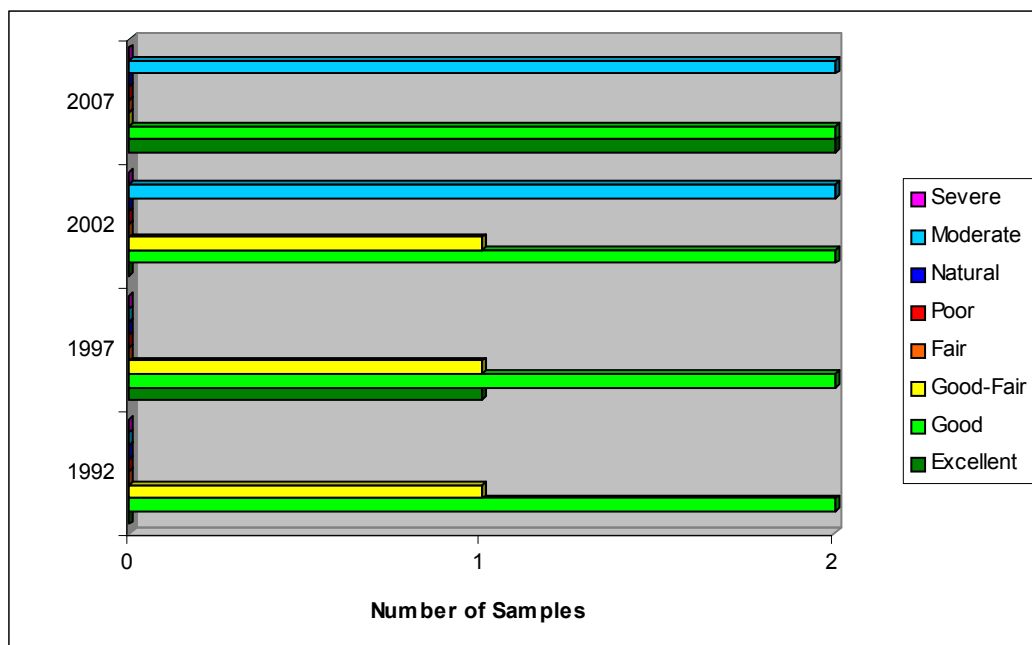


Figure B-1.6. Tar River Subbasin 04 (HUC 03020102): Bioclassification Trends (2007-1992)

HUC 03020103 (Tar River) Summary

The bioclassification trends for all of HUC 03020103 can be seen below (Figure B-1.7). Most of this HUC is comprised of a mix of agriculture and forest with large point source dischargers restricted to the municipalities of Tarboro and Greenville. In terms of non-swamp streams, there has been little change in bioclassification trends in this HUC overtime. However, many of the Swamp samples in this HUC improved in bioclassification with the largest shift being sites improving from Severe Stress to Moderate Stress, Examples of this trend included Crisp Creek (SR 1527), Conetoe Creek (SR 1510), Cokey Swamp (NC 43), and Bynums Mill Creek. The most striking example of a site with a nonpoint dominated watershed improving bioclassification due to drought was observed at Chicod Creek (SR 1777) and improved from Severe in 2002 to Natural in 2007.

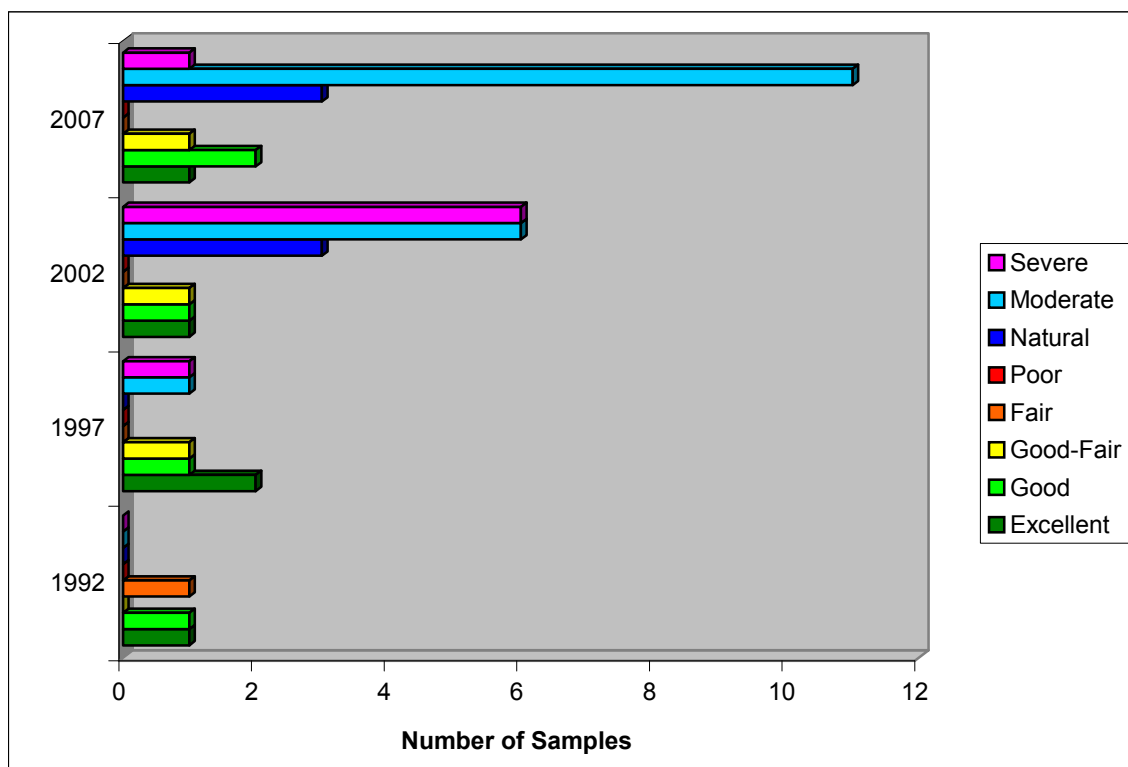


Figure B-1.7 Tar River Basin HUC 03020103 (Subbasins 03, 05, & 06): Bioclassification Trends (2007-1992)

GRAPHICAL SUMMARIES BY SUBBASIN

Figure B-1.8. Tar River Subbasin 03 (HUC 03020103): Bioclassification Trends (2007-1992)

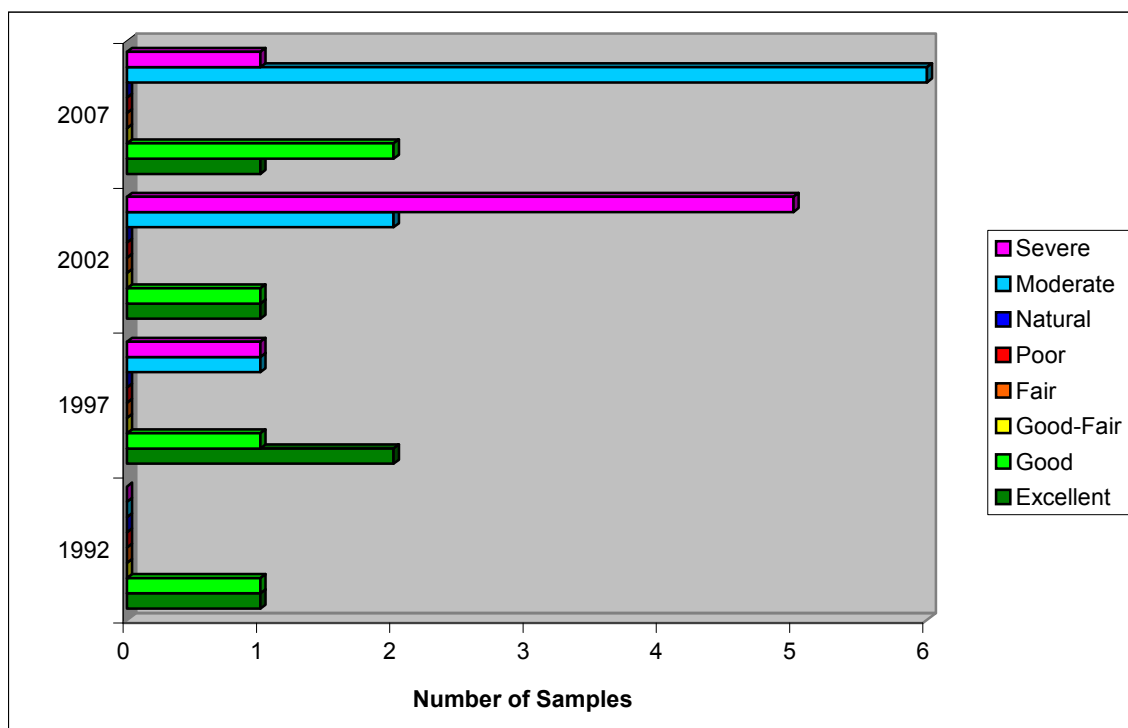


Figure B-1.9. Tar River Subbasin 05 (HUC 03020103): Bioclassification Trends (2007-1992)

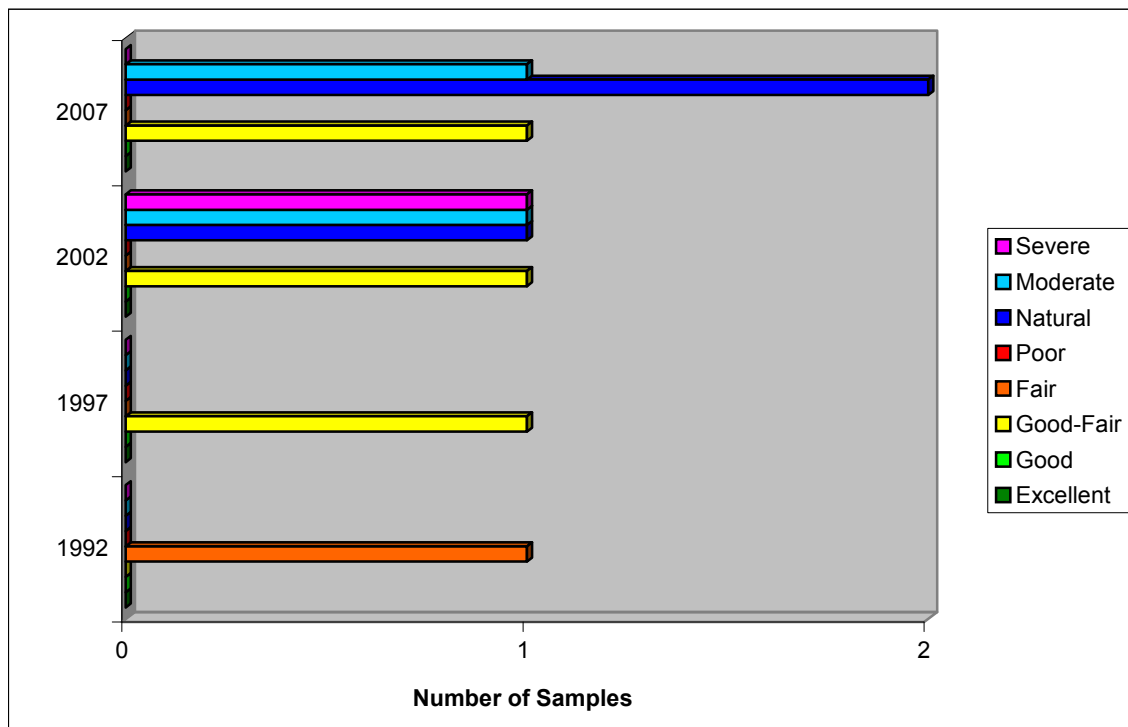
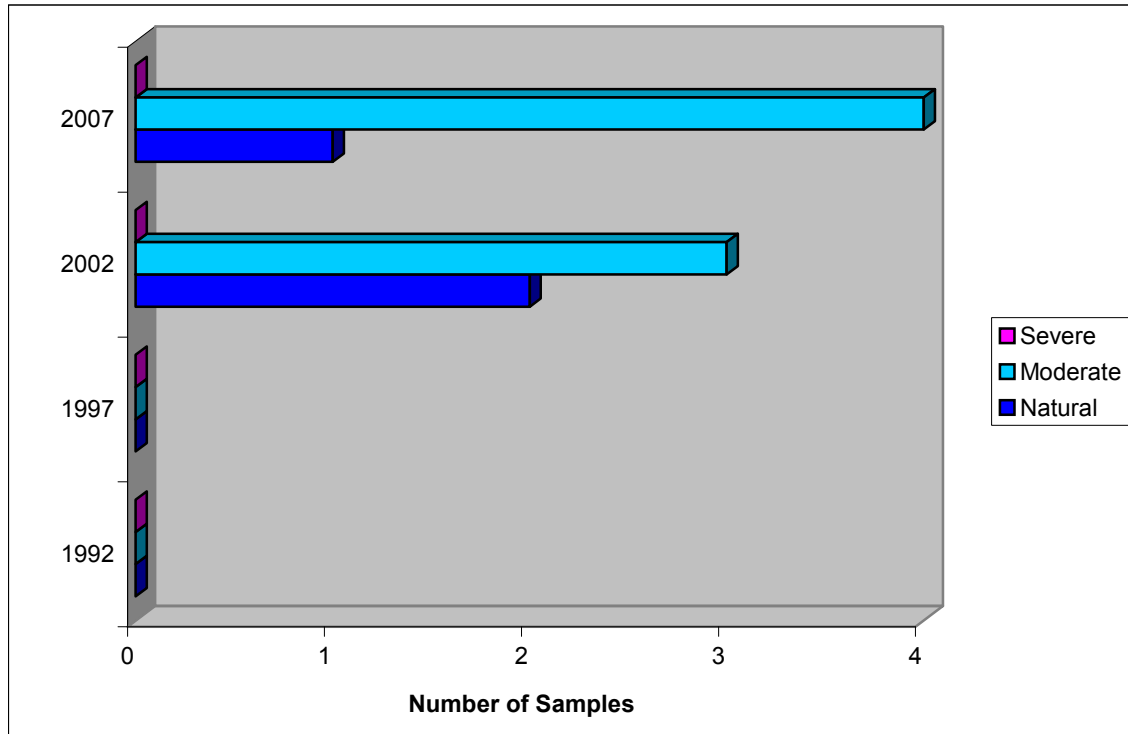


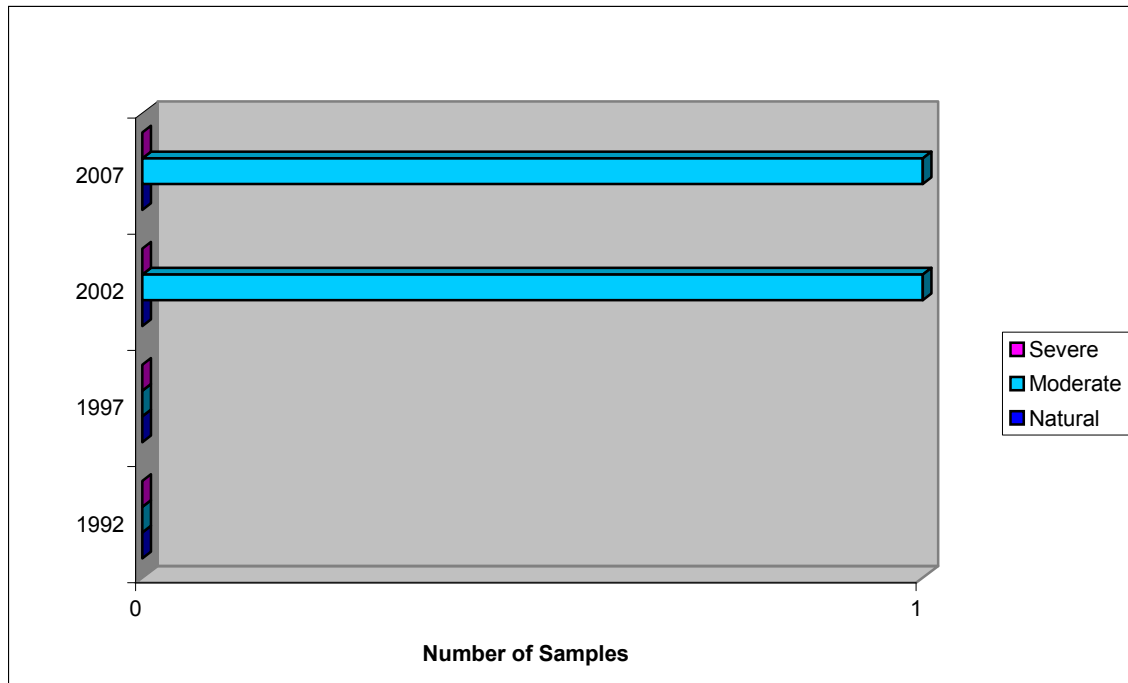
Figure B-1.10. Tar River Subbasin 06 (HUC 03020103): Bioclassification Trends (2007-1992)



HUC 03020104 (Pamlico River) Summary

The bioclassification trend for the one benthos sample for HUC 03020104 (Subbasin 07) can be seen below (Figure B-1.11). Most of this HUC is comprised of a mix of agriculture and forest with few point sources. The only long-term benthos station (Beaverdam Swamp) routinely monitored in this HUC and its bioclassification of Moderate was unchanged in 2007 from the 2002 assessment. All waterbodies assessed in this HUC are swamp streams.

Figure B-1.11: Tar River Basin HUC 03020104 (Subbasin 07): Bioclassification Trends (2007-1992)



There were numerous records of significantly rare invertebrate taxa collected in the Tar River basin from 2002-2007 (Table B-1.13):

Table B-1.12. Significantly Rare Invertebrate Taxa: Tar River Basin, 2002-2007.

Taxon	Number of DWQ Collections	Collection Location(s)	First Time Collected in Tar Basin?
Mayfly: <i>Leptohyphes robacki</i>	16	Tar River (NC 42, <i>Edgecombe</i>), Tar River (US 64 Business, <i>Edgecombe</i>), Tar River (SR 1252, <i>Edgecombe</i>)	Yes
Mayfly: <i>Leptohyphes dolani</i>	12	Swift Creek (SR 1253, <i>Edgecombe</i>), Tar River (US 64 Business, <i>Edgecombe</i>), Tar River (NC 42, <i>Edgecombe</i>), Fishing Creek (SR 1500, <i>Edgecombe</i>)	Yes
Mayfly: <i>Homoeoneuria cahabensis</i>	12	Tar River (NC 42, <i>Edgecombe</i>)	Yes
Mayfly: <i>Macdunnoa brunea</i>	15	Tar River (NC 42, <i>Edgecombe</i>)	No
Mayfly: <i>Acerpenna macdunnoghi</i>	22	UT Fishing Creek (SR 1004, <i>Nash</i>)	Yes
Mayfly: <i>Baetisca becki</i>	7	Swift Creek (SR 1310, <i>Nash</i>)	No
Mayfly: <i>Neophemera youngi</i>	28	Sandy Creek (SR 1405, <i>Nash</i>), Sandy Creek (NC 561, <i>Franklin</i>), Swift Creek (SR 1310, <i>Nash</i>)	No
Mayfly: <i>Ephemerella needhami</i>	38	Shelton Creek (SR 1309, <i>Granville</i>), Gibbs Creek (SR 1620, <i>Granville</i>), Sandy Creek (SR 1405, <i>Nash</i>), Sandy Creek (NC 561, <i>Franklin</i>), Swift Creek (SR 1310, <i>Nash</i>)	No
Stonefly: <i>Acroneuria evoluta</i>	23	Tar River (SR 1150, <i>Granville</i>), North Fork Tar River (US 158, <i>Granville</i>)	Yes
Caddisfly: <i>Oxyethira Sp</i>	29	Grindle Creek (US 264, <i>Pitt</i>), Tar River (SR 1229, <i>Franklin</i>), Tar River (SR 1252, <i>Edgecombe</i>), Swift Creek (SR 1253, <i>Edgecombe</i>)	Yes
Caddisfly: <i>Trienodes mela</i>	10	UT Powells Creek (NC 481, <i>Halifax</i>), North Fork Tar River (SR 1151, <i>Granville</i>)	Yes
Caddisfly: <i>Psilotreta frontalis</i>	50	UT Tar River (SR 1126, <i>Granville</i>)	Yes
Caddisfly: <i>Ceraclea resurgens</i>	47	UT Coon Creek (SR 1515, <i>Granville</i>), Chicod Creek (SR 1777, <i>Pitt</i>), Latham Creek (SR 1410, <i>Beaufort</i>), Tranters Creek (SR 1552, <i>Edgecombe</i>)	No
Caddisfly: <i>Oecetis scalaris</i>	39	Swift Creek (SR 1003, <i>Nash</i>), Swift Creek (SR 1253, <i>Edgecombe</i>), Tar River (SR 1229, <i>Franklin</i>)	No
Caddisfly: <i>Rhyacophila glaberrima</i>	33	UT Tar River (SR 1126, <i>Granville</i>)	Yes
Caddisfly: <i>Ochrotrichia sp</i>	23	Shelton Creek (SR 1309, <i>Granville</i>)	No

SAMPLING METHODS

Standard Qualitative (Full Scale) Method

Benthic macroinvertebrates can be collected from wadeable, freshwater, flowing waters using three sampling procedures. The Biological Assessment Unit's standard qualitative (Full Scale) sampling procedure includes 10 composite samples: two kick-net samples, three bank sweeps, two rock or log washes, one sand sample, one leafpack sample, and visual collections from large rocks and logs (NCDENR 2006). The samples are 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: 1 kick, 1 sweep, 1 leafpack and visual collections (NCDENR 2006). Only EPT taxa are collected and identified and only EPT criteria are 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 cannot 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, EPT, 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.

DATA ANALYSIS

Criteria for bioclassifications for standard qualitative (Full-Scale) samples in piedmont and Coastal Plain ecoregions are given below in Table 1 and are based on EPT S and the NCBI. Criteria for bioclassifications for the EPT sample method are provided in Table 2 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 1. 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 2. 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 Tar Basin are classified as A and B swamp ecoregions and are dependent on geographic location (NCDENR 2006). The metric scores derived below depend on the swamp classification and, in some cases, pH.

Table 3. Determination of Corrected¹ Taxa Richness Scores for Swamp A and B Streams

Swamp Ecoregion Category Metric Score pH	A			B		
	Natural	Moderate	Severe	Natural	Moderate	Severe
	5	3	1	5	3	1
≥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 ²			

¹Add (+) 8 to Total Taxa Richness for Braided Swamp Streams

²ND=No data (so Severe category is not used, and only a score of 3 or 5 is possible)

Table 4. Determination of Biotic Index Scores for Swamp A and B Streams

Swamp Ecoregion		A	B
Category	Metric Score		
Natural	5	<6.8	<7.0
Moderate Stress	3	6.8-7.5	7.0-7.9
Severe Stress	1	>7.5	>7.9

Table 5. Determination of Corrected² EPT Richness Scores for Swamp A and B Streams

Swamp Ecoregion Category Metric Score pH	A			B		
	Natural	Moderate	Severe	Natural	Moderate	Severe
	5	3	1	5	3	1
≥5.5	>17	7-17	0-6	>5	2-4	0-1
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 ²	ND ³			

²Add (+) 2 for swamp streams with a braided channel

³ND=No data (so Severe category is not used, and only a score of 3 or 5 is possible)

Table 6. Determination of Habitat Scores for Swamp Streams.

Category	Natural	Moderate	Severe
Habitat Score	>79	60-79	<60

The site score for calculating swamp bioclassifications are calculated from the following:

$$\text{Site Score} = [(2 \times \text{BI score} + \text{habitat score} + \text{EPT S score} + \text{Taxa Richness score}) - 5] / 2$$

Stress ratings based on the scores are:

Natural (9 - 10) Moderate (4 - 8) Severe (1 - 3)

Table 7. Benthic macroinvertebrate monitoring data collected in the Tar River basin, 2002 – 2007. Basin sites are in bold.

HUC/Waterbody	Location	County	Index No.	Date	ST	EPT	BI	EPTBI	BioClass
03020101									
Tar R	SR 1150	Granville	28-(1)	06/25/07	17	17	5.4	5.4	Good-Fair
UT Fishing Cr	SR 1004	Nash	28-(1)	07/18/07	40	13	4.4	3.2	Not Rated
Tar R	SR 1622	Granville	28-(5.7)	07/22/02	78	23	5.7	4.7	Good
Tar R	SR 1229	Franklin	28-(24.7)	07/22/02	82	24	6.5	5.4	Good-Fair
Tar R	SR 1609	Franklin	28-(24.7)	06/27/07	68	25	4.9	3.9	Good
Tar R	NC 97	Edgecombe	28-(69)	06/27/07	72	21	6.0	5.0	Good-Fair
				07/24/02	89	24	6.0	5.0	Good-Fair
Tar R	SR 1252	Edgecombe	28-(74)	06/27/07	63	23	5.7	4.8	Good
Shelton Cr	SR 1309	Granville	28-4	04/20/06	44	16	5.3	3.5	Not Impaired
N Fk Tar R	US 158	Granville	28-5	06/25/07	12	12	5.3	5.3	Fair
N Fk Tar R	SR 1151	Granville	28-5	05/22/07	97	35	5.8	4.6	Good
Fishing Cr	SR 1643	Granville	28-11	06/25/07	59	19	5.9	5.5	Good-Fair
				03/23/06	79	23	5.5	4.2	Good
				07/22/02	62	16	5.7	5.1	Good-Fair
Fishing Cr	SR 1608	Granville	28-11	03/02/06	70	14	6.7	4.9	Fair
Fishing Cr	SR 1607	Granville	28-11b	03/22/06	63	19	5.4	4.5	Not Impaired
Sand Cr	SR 1623	Granville	28-12	03/22/06	41	16	4.8	4.3	Not Rated
Gibbs Cr	SR 1620	Granville	28-13	03/24/06	97	36	5.6	4.2	Good
Cedar Cr	SR 1109	Franklin	28-29-(2)	06/26/07	21	21	5.2	5.2	Good
				07/22/02	15	15	5.0	5.0	Good-Fair
Swift Cr	SR 1310	Nash	28-78-(0.5)	06/26/07	65	22	5.0	4.1	Good
				04/24/03	89	30	4.8	4.0	Excellent
Swift Cr	I-95	Nash	28-78-(0.5)	06/25/04	85	25	5.6	4.0	Good
Swift Cr	SR 1003	Nash	28-78-(0.5)	06/25/04	93	32	4.9	3.8	Excellent
Swift Cr	SR 1253	Edgecombe	28-78-(6.5)	06/26/07	95	30	5.5	4.1	Excellent
				03/23/06	86	24	5.7	4.2	Good
				04/21/03	73	24	5.0	3.8	Excellent
				06/10/02	74	29	5.2	3.8	Excellent
UT Tar R	SR 1126	Granville	28-79-(21)	04/20/06	36	14	5.3	3.0	Not Rated
				06/10/02	44	6	6.7	5.5	Not Rated
UT Coon Cr	SR 1515	Granville	28-11-5	03/22/06	37	37	4.6	4.6	Excellent
Sandy Cr	SR 1436	Franklin	28-78-1-(8)	06/27/07	65	18	5.9	4.9	Good-Fair
Sandy Cr	NC 561	Franklin	28-78-1-(8)	04/24/03	92	34	5.5	4.7	Excellent
Sandy Cr	SR 1412	Franklin	28-78-1-(8)	04/21/03	61	14	6.2	5.5	Fair
Sandy Cr	SR 1405	Nash	28-78-1-(14)	06/26/07	71	22	5.0	3.9	Good
				03/23/06	89	36	4.9	3.5	Excellent
				04/21/03	84	32	5.2	4.5	Excellent
				06/10/02	61	21	5.3	4.2	Good
Buffalo Cr	US 401	Franklin	28-18-2	04/21/03	51	10	6.1	5.6	Not Impaired
Coon Cr	SR 1609	Granville	28-11-5	03/22/06	83	30	5.6	4.8	Good
Martin Cr	SR 1519	Vance	28-78-1-3	04/23/03	56	18	5.8	4.8	Good-Fair
				06/10/02	31	9	5.9	5.3	Not Rated
Weaver Cr	SR 1533	Vance	28-78-1-7	04/23/03	75	20	6.2	5.4	Good-Fair
Shelly Br	SR 1180	Nash	28-78-1-16	07/18/07	58	15	5.7	4.7	Not Impaired
White Oak Swp	SR 1428	Edgecombe	28-78-7-(2)	02/05/07	51	8	6.6	5.6	Moderate
				02/11/02	40	7	6.5	5.6	Moderate
HUC/Waterbody	Location	County	Index No.	Date	ST	EPT	BI	EPTBI	BioClass
03020102									
Fishing Cr	SR 1600	Warren	28-79-(1)	7/3/2007	19	19	4.4	4.4	Good-Fair
Fishing Cr	US 301	Edgecombe	28-79-21	6/28/2007	86	30	5.3	4.3	Excellent
				8/5/2002	63	15	5.7	4.3	Good-Fair
Shocco Cr	SR 1613	Warren	28-79-22	7/3/2007	12	12	5.2	5.2	Not Rated
L Fishing Cr	SR 1343	Halifax	28-79-25	6/29/2007	95	27	5.2	3.9	Good
				8/5/2002	86	23	5.5	4.2	Good
UT Bear Swamp	Medoc Mt SP	Halifax	28-79-25-7	6/9/2005	58	24	4.6	4	Not Impaired
UT Powells Cr	NC 481	Halifax	28-79-25-8	4/21/2006	44	14	5	2.8	Not Impaired
Rocky Swp	SR 1002	Halifax	28-79-28-(0.7)	6/28/2007	81	20	5.9	5	Good
Fishing Cr	SR 1500	Edgecombe	28-79-29	6/28/2007	102	31	5.2	3.9	Excellent
				8/6/2002	21	21	4.4	4.4	Good
Beech Swp	SR 1003	Halifax	28-79-30	2/5/2007	35	3	7.3	6.9	Moderate
Deep Cr	SR 1100	Halifax	28-79-32-(0.5)	2/5/2007	35	0	7.9	0	Moderate
Town Cr	SR1400	Wilson	28-83	2/7/2007	34	2	8.2	6	Severe

Table 7 continued

HUC/Waterbody	Location	County	Index No.	Date	ST	EPT	BI	EPTBI	BioClass
03020103									
Tar R	US 64 BUS	Edgecombe	28-(80)	6/27/07	92	27	5.8	4.7	Good
				6/28/05	79	29	4.9	4.1	Excellent
				8/6/02	77	27	5.9	4.7	Good
Tar R	NC 42	Edgecombe	28/(80)	6/28/07	68	26	5.1	4.5	Excellent
				6/27/07	---	27	---	4.4	Excellent
				6/28/05	80	30	4.9	4.2	Excellent
				8/6/02	---	24	---	4.5	Excellent
Tar R	US 264	Pitt	28-(84)	6/25/07	88	29	5.5	4.6	Excellent
Tar R	US 264A	Pitt	28-(94)	6/25/07	58	14	6.9	4.6	Excellent
Tar R	SR 1565	Pitt	28-(99.5)	6/26/07	55	8	7.6	6.5	Good-Fair
				8/8/02	43	9	7.9	7.1	Not Rated
Holly Cr	US 64A	Edgecombe	28-53	3/1/04	45	3	6.9	6.0	Moderate
Hendricks Cr	St James St	Edgecombe	28-55-2	3/1/04	38	1	7.6	6.2	Severe
Town Cr	SR 1601	Edgecombe	28-83	6/27/07	82	24	5.9	4.8	Good
Cokey Swp	NC 43	Edgecombe	28-83-3	2/8/07	62	7	7.1	5.7	Moderate
				2/12/02	41	3	7.7	6.4	Severe
Bynums Mill Cr	SR 1120	Edgecombe	28-83-4	2/7/07	58	6	8.2	7.3	Moderate
				2/11/02	36	2	8.1	7.5	Severe
Otter Cr	SR 1614	Edgecombe	28-86-(0.3)	2/7/07	71	9	7.3	6.6	Moderate
				2/11/02	44	5	7.5	6.4	Moderate
Conetoe Cr	SR 1510	Edgecombe	28-87-(0.5)b	2/6/07	40	3	7.1	6.4	Moderate
				2/22/02	47	2	7.5	7.4	Severe
Conetoe Cr	NC 42	Edgecombe	28-87-(0.5)c	2/6/07	48	4	7.3	6.0	Moderate
				2/22/02	53	1	7.2	7.8	Moderate
Crisp Cr	SR 1527	Edgecombe	28-87-1	2/6/07	42	3	7.0	6.2	Moderate
				3/1/04	46	4	7.0	6.1	Moderate
				2/11/02	36	2	7.7	6.4	Severe
Ballahack Canal	NC 42	Edgecombe	28-87-1.2	2/6/07	19	1	8.0	6.2	Severe
				2/22/02	27	2	8.3	8.9	Severe
Greens Mill Run	Greensprings Park	Pitt	28-96	3/2/04	31	0	7.6	---	Severe
Hardee Cr	NC 33	Pitt	28-97	2/14/07	59	8	6.5	5.2	Natural
				2/19/02	59	7	6.7	5.4	Natural
Grindle Cr	US 264	Pitt	28-100b	6/25/07	82	17	6.8	5.9	Good-Fair
				8/7/02	52	12	6.5	4.9	Good-Fair
Whichard Br	SR 1521	Pitt	28-100-2	2/13/07	61	11	6.7	5.7	Moderate
				2/12/02	45	6	7.0	5.8	Moderate
Chicod Cr	SR 1777	Pitt	28-101	2/14/07	90	9	7.0	5.9	Natural
				3/12/02	43	2	7.6	7.5	Severe
Cow Swp	SR 1756	Pitt	28-101-5	3/2/04	59	4	7.1	6.3	Moderate
Tranters Cr	SR 1552	Edgecombe	28-103	2/13/07	60	3	7.4	4.9	Moderate
				2/12/02	40	3	7.8	9.2	Moderate
Flat Swp	SR 1157	Martin	28-103-2b	2/13/07	53	2	7.7	6.8	Moderate
				3/12/02	49	1	7.9	6.2	Moderate
Old Ford Swp	US 17	Beaufort	28-103-14-1	2/12/07	43	5	7.2	6.8	Moderate
				2/19/02	29	4	6.7	6.4	Natural
Lathams Cr	SR 1410	Beaufort	28-103-14-2	2/12/07	59	10	6.8	6.4	Natural
				2/26/02	48	7	6.9	6.6	Natural
Horsepen Swp	SR 1001	Beaufort	29-10-2	2/13/07	58	7	7.1	6.2	Moderate
				2/26/02	27	4	6.5	6.2	Moderate
03020104									
Beaverdam Swp	SR 1523	Beaufort	29-10-2	2/13/07	52	3	7.0	6.4	Moderate
				3/11/02	50	4	7.5	7.3	Moderate

Appendix F-1. Fish community sampling methods and criteria.

Sampling Methods

At each sample site, a 600 ft. section of stream was selected and measured. Fish within the delineated stretch of stream were then collected using two backpack electrofishing units and usually, two persons netting the stunned fish. A seine was also used where there were substantial riffles. During the 2007 basinwide assessment BAU staff were assisted by staff from the NC Natural Heritage Program and DWQ's Wetlands Program Development Unit. After collection, all readily identifiable fish were examined for sores, lesions, fin damage, and 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. All young-of-year were excluded from the analyses.

NCIBI Analysis

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.

The NCIBI has been revised (NCDENR 2006). Currently, the focus of using and applying the NCIBI has been restricted to wadeable streams that can be sampled by a crew of four persons. In 2001, the bioclassifications and criteria were recalibrated against regional reference site data (Biological Assessment Unit Memorandum F-20010922) (Tables 1 – 5). To qualify as a reference site, the site had to satisfy all seven criteria in the order listed in Table 1. Reference sites represented the least impacted streams and the overall biological condition of the fish communities that could be attained (Table 2). With the exception of the Carolina Slate Belt ecoregion, it has been difficult to identify reference sites with the Piedmont and the Coastal Plain that satisfy all of the criteria listed in Table 2. Therefore, revisions to these criteria may be necessary.

Table 1. Reference site selection hierarchy -- a watershed-based approach for streams.

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 ($\sim \leq 0.01$ MGD), the dischargers are more than one mile upstream
3 -- Percent urbanization	$< 10\%$ of the watershed is urban or residential areas
4 -- Percent forested	$\geq 70\%$ 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 $\geq 60\%$ (rather than $\geq 70\%$), then the site still qualified as a reference site. [Note: in the New River Basin this last exception is $\geq 50\%$.]

Table 2. Regional fish community reference sites in the Tar River basin.

HUC/Waterbody	Station	County	Level IV Ecoregion
03020101 Tar River Headwaters			
Tar R	US 158	Granville	Carolina Slate Belt
UT Coon Cr	SR 1515	Granville	Northern Outer Piedmont
Shelton Cr	US 158	Granville	Carolina Slate Belt
Red Bud Cr	SR 1407	Nash	Northern Outer Piedmont
03020102 Fishing Creek			
Little Fishing Cr	SR 1509	Warren	Northern Outer Piedmont
Reedy Cr	SR 1511	Warren	Northern Outer Piedmont
Rocky Swp	SR 1002	Halifax	Northern Outer Piedmont
Marsh Swp	SR 1210	Halifax	Rolling Coastal Plain
Mill Swp	SR 1615	Halifax	Rolling Coastal Plain
Jacket Swp	SR 1216	Halifax	Rolling Coastal Plain
03020104 Pamlico River			
Durham Cr	SR 1932	Beaufort	Mid-Atlantic Flatwoods

Table 3. 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 mi².

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	
	<u>Cape Fear</u>	<u>Neuse, Roanoke, and Tar</u>
	≥ 2 species	≥ 3 species
	1 species	1 or 2 species
	0 species	0 species
		5
		3
		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	
	<u>Cape Fear</u>	<u>Neuse, Roanoke, and Tar</u>
	≥ 2 species	≥ 3 species
	1 species	1 or 2 species
	0 species	0 species
		5
		3
		1
6	No. of intolerant species	
	<u>Cape Fear</u>	<u>Neuse, Roanoke, and Tar</u>
	≥ 1 species	≥ 3 species
	no middle score	1 or 2 species
	0 species	0 species
		5
		3
		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 4. Tolerance ratings and adult trophic guild assignments for fish in the Tar River basin. Species collected in 2004 – 2007 are highlighted in blue. Common and scientific names follow Nelson, *et al.* (2004), except for *Scartomyzon*.

Family/Species	Common Name	Tolerance Rating	Trophic Guild of Adults
Petromyzontidae	Lampreys		
<i>Lampetra aepyptera</i>	Least Brook Lamprey	Intermediate	Non-feeding
<i>Petromyzon marinus</i>	Sea Lamprey	Intermediate	Parasitic
Acipenseridae	Sturgeons		
<i>Acipenser oxyrinchus</i>	Atlantic Sturgeon	Intermediate	Insectivore
Lepisosteidae	Gars		
<i>Lepisosteus osseus</i>	Longnose Gar	Tolerant	Piscivore
Amiidae	Bowfins		
<i>Amia calva</i>	Bowfin	Tolerant	Piscivore
Anguillidae	Eels		
<i>Anguilla rostrata</i>	American Eel	Intermediate	Piscivore
Clupeidae	Herrings and Shads		
<i>Alosa aestivalis</i>	Blueback Herring	Intermediate	Insectivore
<i>A. mediocris</i>	Hickory Shad	Intermediate	Insectivore
<i>A. pseudoharengus</i>	Alewife	Intermediate	Insectivore
<i>A. sapidissima</i>	American Shad	Intermediate	Insectivore
<i>Dorosoma cepedianum</i>	Gizzard Shad	Intermediate	Omnivore
Cyprinidae	Minnnows		
<i>Carassius auratus</i>	Goldfish	Tolerant	Omnivore
<i>Clinostomus funduloides</i>	Rosyside Dace	Intermediate	Insectivore
<i>Ctenopharyngodon idella</i>	Grass Carp	Tolerant	Herbivore
<i>Cyprinella analostana</i>	Satinfin Shiner	Tolerant	Insectivore
<i>Cyprinus carpio</i>	Common Carp	Tolerant	Omnivore
<i>Hybognathus regius</i>	Silvery Minnow	Intermediate	Herbivore
<i>Luxilus albeolus</i>	White Shiner	Intermediate	Insectivore
<i>Lythrurus matutinus</i>	Pinewoods Shiner	Intolerant	Insectivore
<i>Nocomis biguttatus</i>	Bluehead Chub	Intermediate	Omnivore
<i>N. raneyi</i>	Bull Chub	Intermediate	Omnivore
<i>Notemigonus crysoleucas</i>	Golden Shiner	Tolerant	Omnivore
<i>Notropis altipinnis</i>	Highfin Shiner	Intermediate	Insectivore
<i>N. amoenus</i>	Comely Shiner	Intermediate	Insectivore
<i>N. chalybaeus</i>	Ironcolor Shiner	Intolerant	Insectivore
<i>N. cummingsae</i>	Dusky Shiner	Intermediate	Insectivore
<i>N. hudsonius</i>	Spottail Shiner	Intermediate	Omnivore
<i>N. procerus</i>	Swallowtail Shiner	Intermediate	Insectivore
<i>N. volucellus</i>	Mimic Shiner	Intolerant	Insectivore
<i>Phoxinus phoxinus</i>	Mountain Redbelly Dace	Intermediate	Herbivore
<i>Pimephales promelas</i>	Fathead Minnow	Tolerant	Omnivore
<i>Semotilus atromaculatus</i>	Creek Chub	Tolerant	Insectivore
Catostomidae	Suckers		
<i>Catostomus commersoni</i>	White Sucker	Tolerant	Omnivore
<i>Erimyzon oblongus</i>	Creek Chubsucker	Intermediate	Omnivore
<i>E. sucetta</i>	Lake Chubsucker	Intermediate	Insectivore
<i>Hypentelium nigricans</i>	Northern Hogsucker	Intermediate	Insectivore
<i>Moxostoma collapsum</i>	Notchlip Redhorse	Intermediate	Insectivore
<i>M. macrolepidotum</i>	Shorthead Redhorse	Intermediate	Insectivore
<i>M. pappilosum</i>	V-Lip Redhorse	Intermediate	Insectivore
<i>Scartomyzon cervinus</i>	Black Jumprock	Intermediate	Insectivore
Ictaluridae	Catfishes		
<i>Ameiurus nebulosus</i>	Snail Bullhead	Intermediate	Insectivore
<i>A. catus</i>	White Catfish	Tolerant	Omnivore
<i>A. natalis</i>	Yellow Bullhead	Tolerant	Omnivore
<i>A. nebulosus</i>	Brown Bullhead	Tolerant	Omnivore
<i>A. platycephalus</i>	Flat Bullhead	Tolerant	Insectivore
<i>Ictalurus punctatus</i>	Channel Catfish	Intermediate	Omnivore
<i>Noturus furiosus</i>	Carolina Madtom	Intolerant	Insectivore
<i>N. gyrinus</i>	Tadpole Madtom	Intermediate	Insectivore
<i>N. insignis</i>	Margined Madtom	Intermediate	Insectivore
<i>Pygocentrus nattereri</i>	Flathead Catfish	Intermediate	Piscivore
Esocidae	Pikes		
<i>Esox americanus americanus</i>	Redfin Pickerel	Intermediate	Piscivore
<i>E. niger</i>	Chain Pickerel	Intermediate	Piscivore
Umbridae	Mudminnows		
<i>Umbra pygmaea</i>	Eastern Mudminnow	Intermediate	Insectivore

Table 4 (continued).

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

Table 5. 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

Criteria and ratings are applicable only to wadeable streams in the Piedmont region of the Tar River basin. The metrics are the same as those for the Neuse, Cape Fear, and Roanoke River basins. The definition of the Piedmont for these basins 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 and streams in the Coastal Plain region in each of these basins, nor in the Sand Hills region. These streams are currently not rated.

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 1).

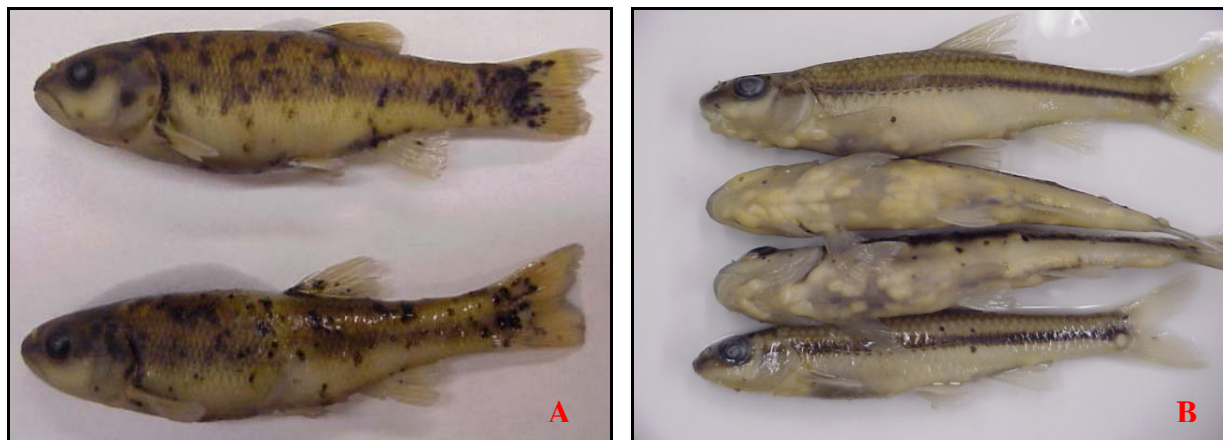


Figure 1. Heavy infestation of blackspot disease in creek chub (A) and yellow grub in bigeye chub (B).

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.

Appendix F-2. A summary of fish community assessment data.

Monitoring efforts from 2003 to 2007 can be summarized as:

- Thirty-nine samples were collected as part of the basinwide monitoring cycle or as special studies. Some of the samples served dual purposes (i.e., as special study and as basinwide samples).
- Thirty-six sites were considered to be basinwide sites and covered the period 2004 – 2007.
- Fifteen of the 36 basinwide sites had not been previously sampled. Some of these sites were in rural watersheds where there were no NPDES dischargers and were selected as potential candidates for fish community regional reference sites. Only Jacket, Marsh, and Mill swamps possessed the instream, riparian, and watershed characteristics of exceptionally high quality to qualify as new fish community regional reference sites (Appendices F-1 and F-6). Others were sampled because of the need to acquire additional data on channelized and unchannelized streams in the Coastal Plain region of the basin.
- The remaining 21 sites had been sampled during the last basinwide cycle in 2002 or as part of special studies conducted in 1999 (Appendix F-3).
- In 2007, 44 sites were planned to be sampled; of these 32 were actually sampled. The 12 remaining sites that were scheduled to be sampled plus others that were visited but could not be sampled were:
 - Sites that were too small to sample or were not flowing -- Jerrys Creek, Savage Mill Run (Edgecombe County) and Briery Swamp (Pitt County);
 - Sites that were not sampled because of braided swamp-like conditions -- Bynums Mill Creek (Edgecombe) and Kitten Creek and Briery Swamp (Pitt);
 - Sites that were not sampled due to depth or macrophyte growths -- Mitchell Swamp, Knight Canal, and Cheeks Mill (Edgecombe County); and
 - Sites that were not sampled due to time constraints -- Town Creek (Wilson County) and Horsepen Swamp, Horse Branch, Blounts Creek, Chocowinity Creek, Broad Creek, and Beaverdam Creek (Beaufort County).
- Four streams were on the impaired waters list (NCDENR 2007):
 - Ballahack Canal from source to Conetoe Creek;
 - Cokey Swamp from source to Dickson Branch;
 - Conetoe Creek from source to 1,350 meters north of NC 42; and
 - Crisp Creek from source to Conetoe Creek
- Seven sites were sampled as part of special studies (Appendix F-3):
 - in 2004 one site (Cedar Creek) was sampled as part of a larger study on the impact of urbanization on aquatic communities in the Piedmont of North Carolina;
 - in 2006 five sites (Fishing Creek above SR 1607, Fishing Creek at SR 1643, Coon Creek, Unnamed tributary to Coon Creek, and Gibbs Creek) were sampled as part of an Ecosystem Enhancement Program study of the Fishing Creek (Granville County) watershed; and
 - in 2007 one site (North Fork Tar River) was sampled as part of a state-wide probabilistic monitoring study.
- The drainage areas of the assessed watersheds ranged from 3.3 to 78.5 square miles (Appendix F-4).
- The most widely distributed species within the Piedmont physiographic region were the White Shiner, Pinewoods Shiner, Redbreast Sunfish, and Green Sunfish (Appendix F-5). The White Shiner was also the most abundant Piedmont species.
- In the Coastal Plain ecoregion, the most widely distributed species were the American Eel and the Pirate Perch. The Eastern Mosquitofish, Bluegill and American were the most abundant species in the Coastal Plain.
- Sixteen Piedmont streams were evaluated and 15 were rated using the North Carolina Index of Biotic Integrity (NCIBI) (Appendices F-1, F-3, and F-4). One site, Shocco Creek, was not rated due to natural hydrological modifications at the site. The NCIBI scores ranged from 46 – 58 and the NCIBI ratings were either Good (n = 9 sites) or Excellent (n = 6 sites).

- These 15 sites had been sampled more than once, either in the previous two basinwide monitoring cycles or as special studies. Of these 15 sites, 7 sites had no appreciable change in their score or NCIBI rating; 4 sites had scores or ratings that increased; and 4 sites had scores or ratings that decreased over the 5 -15 year period (Figure 1).
- The improvements in scores and ratings at Fishing Creek and Cedar Creek, both below wastewater treatment plants, were attributed to more stable and consistent flows and some slight nutrient enrichment.
- Only at 1 of the 4 sites whose rating decreased over time was attributed to a real decline in water quality. At Shelton Creek, a regional reference site, the rating declined from Excellent in 1997 and 1999 to Good in 2006. The percentage of omnivores+herbivores increased from 19 percent in 1997 to 31 percent in 1999 to 48 percent in 2007; the percentage of insectivores decreased over this time period from 80 to 69 to 51 percent, respectively, and the number of intolerant species declined from 4 to 3 to 2; respectively. The reason for the decline was unknown.
- Two sites may qualify as new High Quality Waters or Outstanding Resource Waters, if so petitioned. These sites were Fishing Creek and Little Fishing Creek, both in Warren County.
- Due to the ongoing revision in the NCIBI's scoring and rating criteria for Coastal Plain streams, no fish community sites in this portion of the basin were rated. Generally, channelized streams supported a greater diversity and abundance of fish than natural channel streams.
- The instream and riparian habitat scores for the 19 sites evaluated with Piedmont criteria ranged from 48 (Maple Creek) to 96 (Fishing Creek (Granville County) (Appendix F-6). Two-thirds of the streams had overall moderate to high quality habitats (score ≥ 65); whereas one-third of the streams had overall low to poor quality habitats (score < 65).
- The habitat scores for the 24 sites evaluated with Coastal Plain criteria ranged from 41 (Cannon Swamp) to 100 (Marsh Swamp) (Appendix F-6). More than 80 percent of the streams, including some of those that had historically been channelized, had overall moderate to high quality habitats (score ≥ 65); whereas less than 20 percent of the streams had overall low to poor quality habitats (score < 65).
- All dissolved oxygen concentrations, except at Cokey Swamp, met the water quality standard of 5 mg/L (Appendix F-7). Four pH measurements were less than 6.0 s.u. and were found at sites not classified as Swamp Waters. Elevated specific conductance measurements were associated with dischargers from upstream wastewater treatment plants or from nonpoint sources in agricultural areas.

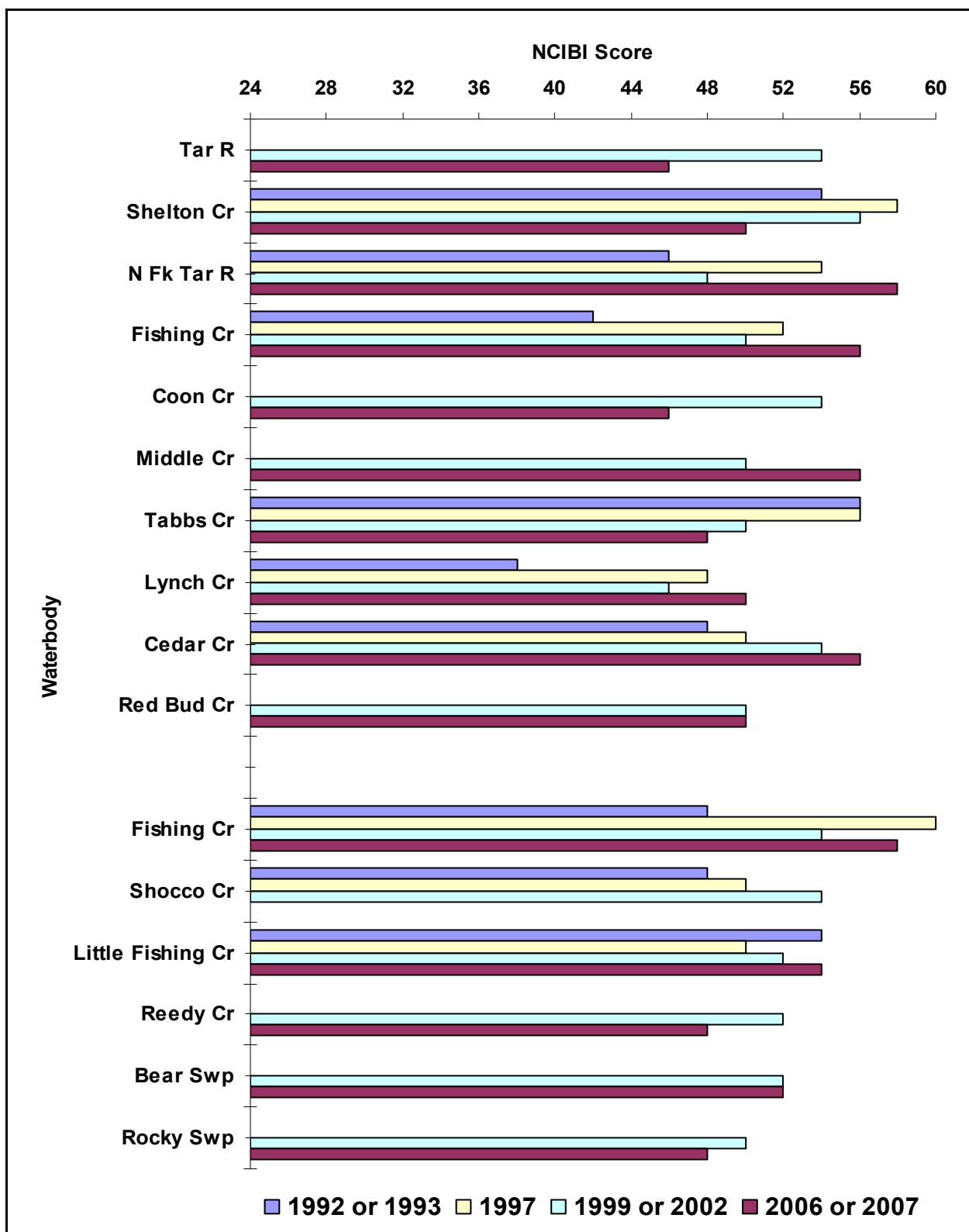


Figure 1. NCIBI scores and ratings of 16 repeat fish community sites in the Piedmont portion of the Tar River basin, 1992 - 2007.

Appendix F-3. Fish community data collected from the Tar River basin, 1992 – 2007. Basinwide sites sampled in 2004 - 2007 are in bold font.

HUC/Waterbody	Station	County	Index No.	Date	NCIBI Score	NCIBI Rating
03020101 Tar River Headwaters						
Tar R	US 158	Granville	28-(1)	04/09/07	46	Good
				10/14/99	54	Excellent
				06/24/99	54	Excellent
				04/27/99	52	Good
Shelton Cr	US 158	Granville	28-4	05/17/06	50	Good
				04/06/99	56	Excellent
				04/14/97	58	Excellent
				04/07/92	54	Excellent
N Fk Tar R	US 158	Granville	28-5	10/14/99	46	Good
				06/24/99	48	Good
				04/06/99	48	Good
				04/14/97	54	Excellent
				04/07/92	46	Good
N Fk Tar R	SR 1151	Granville	28-5	04/09/07	58	Excellent
Tar R	US 1	Franklin	28-(15.5)	09/09/97	50	Good
				09/02/92	46	Good
Tar R	NC 96	Granville	28-(5.7)	09/09/97	56	Excellent
				09/02/92	56	Excellent
Fishing Cr	above SR 1607	Granville	28-11	05/17/06	44	Good-Fair
Fishing Cr	SR 1643	Granville	28-11	05/18/06	56	Excellent
				04/08/02	50	Good
				04/14/97	52	Good
				04/07/92	42	Good-Fair
Coon Cr	SR 1609	Granville	28-11-5	05/18/06	46	Good
				04/08/02	54	Excellent
UT Coon Cr	SR 1515	Granville	28-11-5	05/17/06	48	Good
Gibbs Cr	SR 1620	Granville	28-13	05/18/06	54	Excellent
Middle Cr	SR 1203	Franklin	28-15	04/09/07	56	Excellent
				04/08/02	50	Good
Tabbs Cr	SR 1100	Vance	28-17-(0.5)	04/10/07	48	Good
				10/14/99	46	Good
				06/24/99	48	Good
				04/09/99	50	Good
				04/15/97	56	Excellent
				04/08/92	56	Excellent
Lynch Cr	SR 1235	Franklin	28-21-(0.7)	04/10/07	50	Good
				05/24/99	46	Good
				04/15/97	48	Good
				06/18/92	38	Fair
Cedar Cr	SR 1105	Franklin	28-29-(2)	06/10/04	56	Excellent
Cedar Cr	SR 1109	Franklin	28-29-(2)	04/10/02	54	Excellent
				04/16/97	50	Good
				04/08/92	48	Good
Crooked Cr	NC 98	Franklin	28-30	04/10/02	42	Good-Fair
				04/17/97	34	Fair
Sapony Cr	SR 1145	Nash	28-55-(1)	04/18/02	---	Not Rated
				04/02/97	---	Not Rated
Maple Cr	SR 1713	Nash	28-66	05/08/07	---	Not Rated
Big Peachtree Cr	SR 1321	Nash	28-68-1	04/03/97	52	Good
Big Peachtree Cr	SR 1310	Nash	28-68-1	02/04/93	46	Good
Pig Basket Cr	SR 1433	Nash	28-68-3-(2)	04/10/07	---	Not Rated
				04/18/02	---	Not Rated
Compass Cr	NC 97	Edgecombe	28-72	05/08/07	---	Not Rated
Beech Br	NC 97	Edgecombe	28-75-(4)	05/08/07	---	Not Rated
				04/17/02	---	Not Rated
Swift Cr	SR 1310	Nash	28-78-(0.5)	04/11/97	60	Excellent
				06/19/96	56	Excellent
Swift Cr	SR 1003	Nash	28-78-(0.5)	06/19/96	50	Good
Sandy Cr	SR 1412	Franklin	28-78-1-(8)	04/09/02	40	Good-Fair
				04/15/97	40	Good-Fair
Flatrock Cr	SR 1412	Franklin	28-78-1-12	04/09/02	48	Good
Red Bud Cr	SR 1407	Nash	28-78-1-17	04/11/07	50	Good
				04/09/02	50	Good

Appendix F-3 (continued).

HUC/Waterbody	Station	County	Index No.	Date	NCIBI Score	NCIBI Rating
White Oak Swp	SR 1428	Edgecombe	28-79-23	05/09/07	---	Not Rated
				04/17/02	---	Not Rated
03020102 Fishing Creek						
Fishing Cr	SR 1600	Warren	28-79-(1)	05/07/07	58	Excellent
				05/24/99	54	Excellent
				04/16/97	60	Excellent
				02/04/93	48	Good
Shocco Cr	SR 1613	Warren	28-79-22	04/11/07	---	Not Rated
				04/09/02	54	Excellent
				04/16/97	50	Good
				06/18/92	48	Good
Crooked Swp	SR 1501	Nash	28-79-24	04/11/07	---	Not Rated
Little Fishing Cr	SR 1509	Warren	28-79-25	04/12/07	54	Excellent
				04/11/02	52	Good
				04/16/97	50	Good
				02/03/93	54	Excellent
Little Fishing Cr	SR 1338	Halifax	28-79-25	08/28/97	52	Good
Reedy Cr	SR 1511	Warren	28-79-25-5	04/12/07	48	Good
				04/11/02	52	Good
Bear Swp	NC 561	Halifax	28-79-25-7	05/07/07	52	Good
				04/11/02	52	Good
Beaverdam Swp	NC 561	Halifax	28-79-27	04/03/97	---	Not Rated
Rocky Swp	SR 1002	Halifax	28-79-28-(0.7)	05/07/07	48	Good
				04/12/02	50	Good
				04/03/97	---	Not Rated
				02/03/93	---	Not Rated
Marsh Swp	SR 1210	Halifax	28-79-30-1	05/08/07	---	Not Rated
Mill Swp	SR 1615	Halifax	28-79-30-1-0.5	04/13/07	---	Not Rated
Burnt Coat Swp	SR 1216	Halifax	28-79-30-2	04/13/07	---	Not Rated
Jacket Swp	SR 1216	Halifax	28-79-30-2-1	04/13/07	---	Not Rated
Breeches Swp	SR 1002	Halifax	28-79-30-2-1-2	04/13/07	---	Not Rated
Deep Cr	SR 1506	Edgecombe	28-79-32-(1.5)	05/11/07	---	Not Rated
03020103 Tar River						
Town Cr	NC 43	Edgecombe	28-83	08/28/97	---	Not Rated
				07/08/92	---	Not Rated
Cokey Swp	SR 1135	Edgecombe	28-83-3	05/09/07	---	Not Rated
				04/02/97	---	Not Rated
Otter Cr	SR 1614	Edgecombe	28-86-(0.3)	04/17/02	---	Not Rated
				04/02/97	---	Not Rated
				10/29/96	---	Not Rated
				07/08/92	---	Not Rated
Conetoe Cr	SR 1510	Edgecombe	28-87-(0.5)	05/09/07	---	Not Rated
Crisp Cr	SR 1527	Edgecombe	28-87-1	05/09/07	---	Not Rated
Ballahack Canal	NC 42	Edgecombe	28-87-1.2	05/09/07	---	Not Rated
Tyson Cr	SR 1255	Pitt	28-88	05/10/07	---	Not Rated
Parker Cr	NC 33	Pitt	28-95	05/10/07	---	Not Rated
				04/16/02	---	Not Rated
Hardee Cr	NC 33	Pitt	28-97	04/16/02	---	Not Rated
				04/01/97	---	Not Rated
Cannon Swp	US 264	Pitt	28-99-1-1	05/10/07	---	Not Rated
Grindle Cr	US 264	Pitt	28-100	04/16/02	---	Not Rated
				04/01/97	---	Not Rated
				07/07/92	---	Not Rated
Whichard Br	SR 1521	Pitt	28-100-2	05/10/07	---	Not Rated
Chicod Cr	SR 1565	Pitt	28-101	04/15/93	---	Not Rated
Chicod Cr	SR 1777	Pitt	28-101	04/16/02	---	Not Rated
				05/06/93	---	Not Rated
				07/07/92	---	Not Rated
Cow Swp	SR 1756	Pitt	28-101-5	04/15/93	---	Not Rated
Juniper Swp	SR 1766	Pitt	28-101-6	04/15/93	---	Not Rated
Horsepen Swp	SR 1001	Beaufort	28-103-10	04/01/97	---	Not Rated
UT Turkey Swp	SR 1134	Martin	28-103-5	04/01/97	---	Not Rated

Appendix F-3 (continued).

HUC/Waterbody	Station	County	Index No.	Date	NCIBI Score	NCIBI Rating
<i>03020104 Pamlico River</i>						
Horse Br	SR 1136	Beaufort	29-6-2-1-6-2	05/06/93	---	Not Rated
Durham Cr	SR 1932	Beaufort	29-21-(1)	04/15/02	---	Not Rated
				03/31/97	---	Not Rated
Acre Swp	NC 32	Beaufort	29-34-35-1-1	04/15/02	---	Not Rated
				03/31/97	---	Not Rated

Appendix F-4. Fish community metric values from 36 wadeable streams in the Tar River basinwide monitoring program, 2004 - 2007.¹
Ratable streams, highlighted in bold font, are only those in the Carolina Slate Belt and Northern Outer Piedmont (i.e., in the Piedmont physiographic region).

HUC	Location	County	d. a.	Date	No.	No.	No. Sp.	No. Sp.	No. Sp.	No.	%	% Omni.	%	%	%	%
Waterbody			(mi ²)		Species	Fish	Darters	Sunfish	Suckers	Intol. Sp.	Tolerant	+Herb.	Insect.	Pisc.	DELT	MA
03020101 Tar River Headwaters																
Tar R	US 158	Granville	26.0	04/09/07	16	432	3	3	1	3	9	7	92	0.93	0.00	75
Shelton Cr	US 158	Granville	23.8	05/17/06	18	415	2	4	3	2	13	48	51	0.72	0.00	67
N Fk Tar R	SR 1151	Granville	21.2	04/09/07	18	264	3	3	3	3	24	18	80	2.65	0.76	72
Fishing Cr	SR 1643	Granville	44.1	05/18/06	22	621	4	5	4	3	26	15	85	0.16	0.00	64
Coon Cr	SR 1609	Granville	25.2	05/18/06	20	426	3	5	2	2	30	6	93	0.94	0.23	80
Middle Cr	SR 1203	Franklin	8.8	04/09/07	25	293	4	5	4	3	23	12	87	0.68	0.68	48
Tabbs Cr	SR 1100	Vance	70.8	04/10/07	19	289	4	3	4	3	44	1	97	2.08	0.00	74
Lynch Cr	SR 1235	Franklin	23.9	04/10/07	25	336	5	5	3	3	43	3	95	2.08	0.00	60
Cedar Cr	SR 1105	Franklin	31.5	06/10/04	21	335	5	3	3	2	29	19	79	1.79	0.00	71
Maple Cr	SR 1713	Nash	10.5	05/08/07	10	76	1	3	0	0	50	0	67	32.89	0.00	40
Pig Basket Cr	SR 1433	Nash	19.0	04/10/07	14	85	2	4	1	0	45	4	82	14.12	1.18	57
Compass Cr	NC 97	Edgecombe	10.4	05/08/07	22	592	2	8	1	1	40	1	89	10.14	0.34	50
Beech Br	NC 97	Edgecombe	21.8	05/08/07	27	720	4	7	2	2	28	2	90	8.19	0.14	63
Red Bud Cr	SR 1407	Nash	18.9	04/11/07	22	277	3	5	2	3	15	3	92	4.69	0.00	59
White Oak Swp	SR 1428	Edgecombe	19.1	05/09/07	17	227	2	4	0	2	47	4	87	8.37	0.44	59
03020102 Fishing Creek																
Fishing Cr	SR 1600	Warren	58.4	05/07/07	21	303	4	3	3	3	22	12	81	6.93	0.00	71
Shocco Cr	SR 1613	Warren	25.3	04/11/07	20	143	2	6	1	2	17	6	92	2.10	0.00	45
Crooked Swp	SR 1501	Nash	6.0	04/11/07	20	312	2	6	2	2	10	10	87	3.21	0.00	70
Little Fishing Cr	SR 1509	Warren	28.5	04/12/07	23	157	3	4	3	2	13	15	77	7.64	0.00	43
Reedy Cr	SR 1511	Warren	19.7	04/12/07	16	148	2	3	1	2	10	32	65	3.38	0.00	63
Bear Swp	NC 561	Halifax	42.8	05/07/07	25	288	4	4	4	3	30	5	80	15.63	0.00	64
Rocky Swp	SR 1002	Halifax	19.5	05/07/07	19	225	1	7	1	1	19	3	83	14.67	0.89	47
Marsh Swp	SR 1210	Halifax	6.5	05/08/07	16	92	2	6	1	1	32	18	60	21.74	0.00	56
Mill Swp	SR 1615	Halifax	11.0	04/13/07	8	47	1	3	1	0	17	6	72	21.28	14.89	38
Burnt Coat Swp	SR 1216	Halifax	6.3	04/13/07	11	57	0	2	1	0	19	14	53	33.33	3.51	64
Jacket Swp	SR 1216	Halifax	3.3	04/13/07	15	182	2	6	1	1	15	3	92	4.95	0.00	67
Breeches Swp	SR 1002	Halifax	4.2	04/13/07	8	41	0	1	1	0	27	37	49	14.63	0.00	75
Deep Cr	SR 1506	Edgecombe	78.5	05/11/07	19	1165	2	5	1	0	88	0	94	5.41	0.00	58
03020103 Tar River																
Cokey Swp	SR 1135	Edgecombe	14.2	05/09/07	20	387	3	7	1	1	46	6	86	7.75	0.00	55
Conetoe Cr	SR 1510	Edgecombe	12.0	05/09/07	18	98	1	8	1	1	30	22	57	20.41	0.00	44
Crisp Cr	SR 1527	Edgecombe	17.4	05/09/07	14	80	2	4	1	1	4	4	75	21.25	0.00	43
Ballahack Canal	NC 42	Edgecombe	8.7	05/09/07	13	156	0	4	1	0	11	1	68	30.77	0.00	62
Tyson Cr	SR 1255	Pitt	17.9	05/10/07	15	205	2	5	0	1	25	3	47	49.76	0.00	53
Parker Cr	NC 33	Pitt	5.9	05/10/07	24	703	1	9	1	0	30	4	64	32.01	0.28	63
Cannon Swp	US 264	Pitt	3.6	05/10/07	16	834	1	5	1	0	82	2	92	6.12	0.00	75
Whichard Br	SR 1521	Pitt	4.4	05/10/07	19	254	1	4	1	0	24	6	73	21.65	0.39	58

¹Abbreviations are d. a. = drainage area, No. = number, Sp. = species, Intol. = intolerants, Omni. + Herb. = omnivores+herbivores, Insect. = insectivores, Pisc. = piscivores, DELT = disease, erosion, lesions, and tumors, and MA = species with multiple age groups.

Appendix F-5. Fish distributional records for the Tar River basin.

Based upon Menhinick (1991), NC DWQ's data, and data from other researchers, 88 species of freshwater fish are known from the Tar River basin (Table 4 in Appendix F-1). The known species assemblage now includes 21 species of minnows, 8 species of suckers, 10 species of catfish, 16 species of sunfish and bass, and 10 species of darters. Only a few new county distributional records were recorded in 2004 - 2007 from DWQ's fish community monitoring efforts (Table 1).

Table 1. New distributional records for the Tar River basin.

Family/Species	Common Name	County
Ictaluridae	Catfishes	
<i>Ameiurus platycephalus</i>	Flat Bullhead	Nash
Umbridae	Mudminnows	
<i>Umbra pygmaea</i>	Eastern Mudminnow	Warren
Centrarchidae	Sunfishes And Black Basses	
<i>Lepomis cyanellus</i>	Green Sunfish	Pitt

At least 10 of the 88 species (11 percent of the total basin fauna) are nonindigenous (exotic) and were introduced either as sportfish, forage fish, baitfish, or for reasons unknown (Table 2). In 2004 – 2007, 2 of the 55 species collected were nonindigenous species. Only 7 of the 36 streams sampled in 2004 – 2007 did not have any nonindigenous species present (North Fork Tar River, Pig Basket Creek, and White Oak, Burnt Coat, Jacket, Mill, and Cannon swamps). No nonindigenous species have ever been collected from White Oak Swamp during the past two monitoring cycles.

Table 2. Nonindigenous species in the Tar River basin. Species collected in 2004 – 2007 are highlighted in blue.

Family/Species	Common Name	Family/Species	Common Name
Clupeidae	Herrings	Ictaluridae	North American Catfishes
<i>Dorosoma petenense</i>	Threadfin Shad	<i>Ictalurus punctatus</i>	Channel Catfish
Cyprinidae	Carps and Minnows	<i>Pylodictis olivaris</i>	Flathead Catfish
<i>Carassius auratus</i>	Goldfish	Centrarchidae	Sunfishes
<i>Ctenopharyngodon idella</i>	Grass Carp	<i>Lepomis cyanellus</i>	Green Sunfish
<i>Cyprinus carpio</i>	Common Carp	<i>L. microlophus</i>	Redear Sunfish
<i>Pimephales promelas</i>	Fathead Minnow	<i>Pomoxis annularis</i>	White Crappie

Special protection status has been given to 4 of the 88 species by the U. S. Department of the Interior, the NC Wildlife Resources Commission, or the NC Natural Heritage Program under the NC State Endangered Species Act (G.S. 113-331 to 113-337) (LeGrand et al. 2001; Menhinick and Braswell 1997) (Table 3). During the assessment period, the Carolina Darter was collected from the Tar River site. This represented DWQ's first collection ever of this species in the river basin.

Table 3. Species of fish listed as endangered, of special concern, or significantly rare in the Yadkin River basin.

Species	Common Name	Status	State Rank
<i>Lampetra aepyptera</i>	Least Brook Lamprey	Threatened	S2
<i>Acipenser oxyrinchus</i>	Atlantic Sturgeon	Special Concern	S3
<i>Noturus furiosus</i>	Carolina Madtom	Special Concern	S2
<i>Etheostoma collis</i> pop. 2	Carolina Darter	Special Concern	S2

S2 = Imperiled in North Carolina because of rarity or because of some factor(s) making it very vulnerable to extirpation from North Carolina. S3 = rare or uncommon in North Carolina (LeGrand et al. 2006).

In 2004 – 2007, 55 of the 88 species were collected. Species not collected included those with preferences for larger rivers or reservoirs (e.g. sturgeons, gars, herrings, and some species of catfish) and rare or uncommonly collected species (e.g., lampreys, Carolina Madtom, Blackbanded Sunfish, Banded Sunfish, and Banded Pygmy Sunfish). The most widely distributed species within the Piedmont physiographic region (collected at 16 or 17 of the 17 sites) were the White Shiner, Pinewoods Shiner, Redbreast Sunfish, and Green Sunfish. Less widely distributed species which were collected only at 1 or

2 sites included the Rosyside Dace and Carolina Darter (Table 4). The White Shiner was also the most abundant Piedmont species; representing 11 percent of all the Piedmont fish collected. By contrast, some of the more rarer Piedmont species (less than five specimens which were collected) were the Flat Bullhead and Roanoke Bass (Table 4).

In the Coastal Plain ecoregion, the most widely distributed species (collected at 18 or 19 of the 19 sites) was the American Eel and the Pirate Perch. Less widely distributed species which were collected at only 1 or 2 sites were the Lake Chubsucker and Roanoke Darter (Table 4). The Eastern Mosquitofish was the most abundant species; representing 34 percent of all the fish collected, but 81 percent of them were collected at Deep Creek and Cannon Swamp. Other common species included Bluegill and American Eel. By contrast, some of the more rarer Coastal Plain species (less than five specimens which were collected) included the White Shiner and White Perch (Table 4).

Table 4. Narrowly distributed and uncommonly collected species encountered by the Wadeable Stream Fish Community Assessment Program in the Tar River basin, 2004 – 2007.

Species	Piedmont		Coastal Plain	
	Collected only at 1 or 2 sites	Less than 5 specimens collected	Collected only at 1 or 2 sites	Less than 5 specimens collected
Bowfin	N/A	N/A	X	X
Rosyside Dace	X		N/A	N/A
Eastern Silvery Minnow	X		X	
White Shiner	N/A	N/A	X	X
Pinewoods Shiner	N/A	N/A	X	X
Bull Chub	X		X	X
Golden Shiner	X		N/A	N/A
Mimic Shiner	X		N/A	N/A
Creek Chub	N/A	N/A	X	X
Lake Chubsucker	N/A	N/A	X	
Notchlip Redhorse	X	X	X	X
White Catfish	N/A	N/A	X	X
Brown Bullhead	X	X	X	X
Flat Bullhead	X	X	N/A	N/A
Margined Madtom	N/A	N/A	X	X
Eastern Mudminnow	X	X	N/A	N/A
Chain Pickerel	N/A	N/A	X	X
Swamp Fish	N/A	N/A	X	X
White Perch	N/A	N/A	X	X
Mud Sunfish	X	X	N/A	N/A
Roanoke Bass	X	X	N/A	N/A
Redear Sunfish	X	X	N/A	N/A
Black Crappie	N/A	N/A	X	X
Carolina Darter	X		N/A	N/A
Johnny Darter	N/A	N/A	X	X
Chainback Darter	N/A	N/A	X	
Roanoke Darter	N/A	N/A	X	

Appendix F-6. Habitat evaluations and stream and riparian habitats at 36 fish community monitoring sites in the Tar River basin, 2004 - 2007.

Habitat Assessments

A method and scoring system has been developed to evaluate the physical habitats of a stream (NCDENR 2006). The narrative descriptions of eight habitat characteristics, including channel modification, amount of instream habitat, type of bottom substrate, pool variety, riffle frequency (not evaluated in Sand Hills and Coastal Plain streams), bank stability, light penetration, and riparian zone width, are converted into numerical scores. The total habitat score ranges between 1 and 100. Higher numbers suggest better habitat quality, but criteria have not been developed to assign ratings. Scores greater than 65 generally represent moderate to high quality habitat site, whereas scores less than 65 generally represent low to poor quality habitat sites (DWQ unpublished data).

Fish community sampling was conducted in 2004 - 2007 at 36 sites; 12 of the sites were evaluated with Piedmont criteria, 17 sites with Coastal Plain criteria, and 7 sites with both sets of criteria (Tables 1 and 2). These seven sites were analyzed with both sets of criteria because they are either in a transition area between the Northern Outer Piedmont and the Rolling Coastal Plain (portions of the Tar River Headwaters and Fishing Creek HUCs) or because the stream appeared to have characteristics more of a Coastal Plain stream than of a Piedmont stream. Habitat scores ranged from 35 at Cannon Swamp to 100 at Marsh Swamp (Tables 1 and 2). More than 80 percent of the streams had overall moderate to high quality habitats (score ≥ 65); whereas less than 30 percent of the streams had overall low to poor quality habitats (score < 65) (Figure 1).

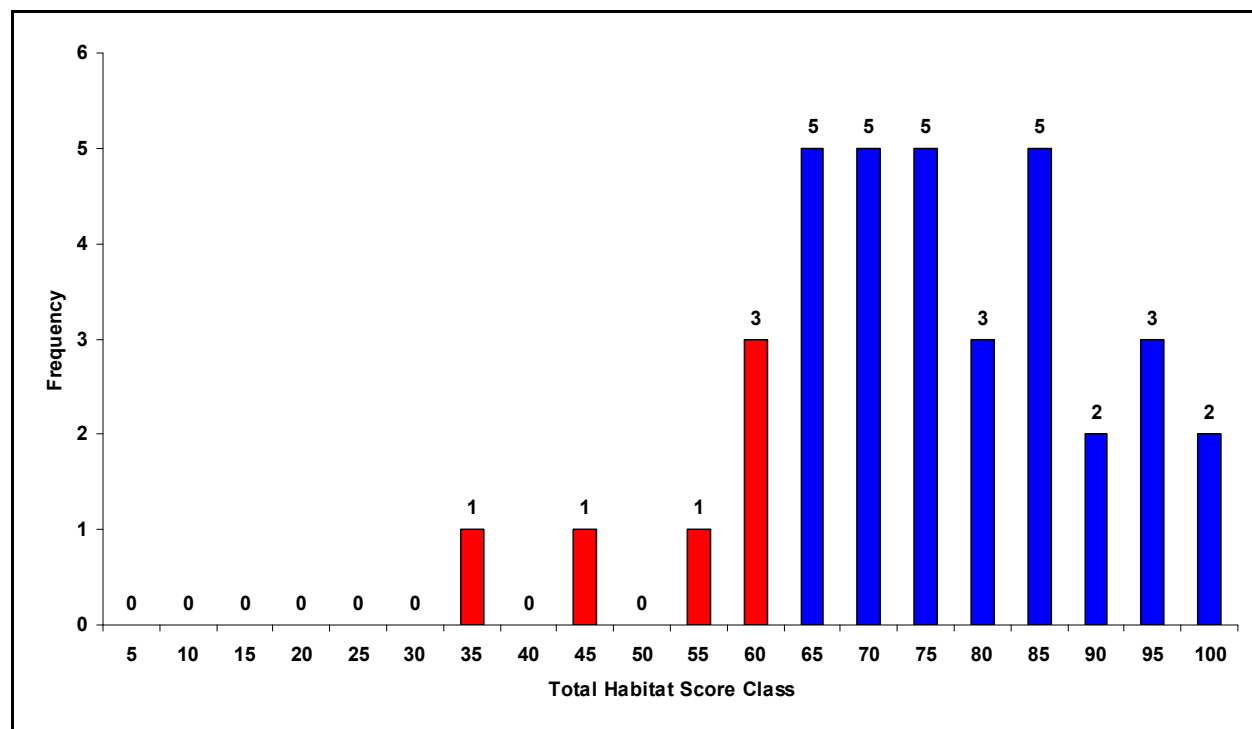


Figure 1. Distribution of the total habitat scores at 36 fish community sites in the Tar River basin, 2004 - 2007. High to moderate quality scores are shown in blue and low to poor quality habitat sites are shown in red.

Table 1. Habitat evaluations using Piedmont criteria at 19 basinwide fish community sites in the Tar River basin, 2004 - 2007. Red bold denotes less than optimal habitat conditions.

HUC	Waterbody	Location	County	Channel	Instream Habitat	Substrate	Pools	Riffles	Bank Stability-L	Bank Stability-R	Shade	Riparian Zone-L	Riparian Zone-R	Total Score
03020101 Tar River Headwaters														
	Tar R	US 158	Granville	5	19	12	10	7	7	7	8	5	5	85
	Shelton Cr	US 158	Granville	5	16	10	10	7	6	6	9	5	5	79
	N Fk Tar R	SR 1151	Granville	5	16	4	10	5	2	2	9	5	5	63
	Fishing Cr	SR 1643	Granville	5	18	14	10	16	7	7	9	5	5	96
	Coon Cr	SR 1609	Granville	5	18	3	9	0	5	5	10	5	5	65
	Middle Cr	SR 1203	Franklin	5	13	3	10	0	2	2	9	5	5	54
	Tabbs Cr	SR 1100	Vance	5	10	4	10	0	4	4	9	5	5	56
	Lynch Cr	SR 1235	Franklin	5	18	3	10	5	6	6	9	5	5	72
	Cedar Cr	SR 1105	Franklin	5	14	4	6	2	4	4	8	5	5	57
	Maple Cr	SR 1713	Nash	5	9	3	8	0	2	2	10	5	4	48
	Red Bud Cr	SR 1407	Nash	5	18	12	6	16	6	6	9	5	5	88
03020102 Fishing Creek														
	Fishing Cr	SR 1600	Warren	5	18	3	7	5	6	6	10	5	5	70
	Shocco Cr	SR 1613	Warren	4	13	3	10	4	6	6	10	5	5	66
	Crooked Swp	SR 1501	Nash	5	17	7	10	7	6	6	9	5	4	76
	Little Fishing Cr	SR 1509	Warren	5	16	5	9	12	4	4	10	5	5	75
	Reedy Cr	SR 1511	Warren	5	18	6	9	3	6	6	10	5	5	73
	Bear Swp	NC 561	Halifax	5	18	6	6	5	6	6	10	5	5	72
	Rocky Swp	SR 1002	Halifax	5	16	5	6	2	6	6	7	5	5	63
	Marsh Swp	SR 1210	Halifax	5	19	12	10	15	7	7	10	5	5	95
Maximum possible scores				5	20	15	10	16	7	7	10	5	5	100

¹also evaluated with Coastal Plain habitat criteria (Table 2).

Table 2. Habitat evaluations using Coastal Plain criteria at 24 basinwide fish community sites in the Tar River basin, 2004 - 2007. Red bold denotes less than optimal habitat conditions.

HUC	Waterbody	Location	County	Channel	Instream Habitat	Substrate	Pools	Bank Stability-L	Bank Stability-R	Shade	Riparian Zone-L	Riparian Zone-R	Total Score
03020101 Tar River Headwaters													
	Lynch Cr	SR 1235	Franklin	15	18	13	10	9	9	9	5	5	93
	Maple Cr	SR 1713	Nash	15	8	7	8	4	4	10	5	4	65
	Pig Basket Cr	SR 1433	Nash	15	15	4	10	9	9	10	5	5	82
	Compass Cr	NC 97	Edgecombe	15	17	7	10	6	6	10	5	5	81
	Beech Br	NC 97	Halifax	10	15	13	6	9	9	5	5	5	77
	White Oak Swp	SR 1428	Edgecombe	13	12	7	4	6	6	10	5	5	68
03020102 Fishing Creek													
	Shocco Cr	SR 1613	Warren	10	15	7	10	9	9	10	5	5	80
	Crooked Swp	SR 1501	Nash	15	18	10	10	9	9	9	5	4	89
	Bear Swp	NC 561	Halifax	15	18	14	6	9	9	10	5	5	91
	Rocky Swp	SR 1002	Halifax	15	15	13	6	9	9	7	5	5	84
	Marsh Swp	SR 1210	Halifax	15	20	15	10	10	10	10	5	5	100
	Mill Swp	SR 1615	Halifax	15	18	13	10	10	10	9	5	5	95
	Burnt Coat Swp	SR 1216	Halifax	15	15	13	9	9	9	10	5	5	90
	Jacket Swp	SR 1216	Halifax	15	18	8	9	9	9	6	5	5	84
	Breeches Swp	SR 1002	Halifax	15	18	10	10	10	10	10	5	5	93
	Deep Cr	SR 1506	Edgecombe	7	11	4	8	9	9	10	5	5	68
03020103 Tar River													
	Cokey Swp	SR 1135	Edgecombe	15	18	4	6	10	10	10	5	5	83
	Conetoe Cr	SR 1510	Edgecombe	10	13	7	6	9	9	10	5	5	74
	Crisp Cr	SR 1527	Edgecombe	5	8	7	2	8	8	10	5	4	57
	Ballahack Canal	NC 42	Edgecombe	5	8	4	7	4	4	6	2	1	41
	Tyson Cr	SR 1255	Pitt	15	17	13	10	10	10	10	5	5	95
	Parker Cr	NC 33	Pitt	7	18	7	4	5	9	7	2	5	64
	Cannon Swp	US 264	Pitt	5	13	7	4	2	2	0	1	1	35
	Whichard Br	SR 1521	Pitt	10	13	7	4	7	7	10	4	5	67
Maximum possible score				15	20	15	10	10	10	10	5	5	100

¹also evaluated with Piedmont habitat criteria (Table 1).

The habitat scores for the 19 sites evaluated with Piedmont criteria ranged from 48 (Maple Creek) to 96 (Fishing Creek (Granville County) (Tables 1 and 3). Two-thirds of the streams had overall moderate to high quality habitats (score ≥ 65); whereas one-third of the streams had overall low to poor quality habitats (score < 65).

Table 3. Rankings of 19 waterbodies using Piedmont criteria in the Tar River basin according to the total habitat scores, 2004 – 2007.

HUC	Waterbody	Location	County	Level IV Ecoregion	Score
High to Moderate Quality Habitats					
03020101	Fishing Cr	SR 1643	Granville	Northern Outer Piedmont	96
03020102	Marsh Swp	SR 1210	Halifax	Rolling Coastal Plain	95
03020101	Red Bud Cr	SR 1407	Nash	Northern Outer Piedmont	88
03020101	Tar R	US 158	Granville	Carolina Slate Belt	85
03020101	Shelton Cr	US 158	Granville	Carolina Slate Belt	79
03020102	Crooked Swp	SR 1501	Nash	Rolling Coastal Plain	76
03020102	Little Fishing Cr	SR 1509	Warren	Northern Outer Piedmont	75
03020102	Reedy Cr	SR 1511	Warren	Northern Outer Piedmont	73
03020102	Bear Swp	NC 561	Halifax	Northern Outer Piedmont	72
03020101	Lynch Cr	SR 1235	Franklin	Northern Outer Piedmont	72
03020102	Fishing Cr	SR 1600	Warren	Northern Outer Piedmont	70
03020102	Shocco Cr	SR 1613	Warren	Northern Outer Piedmont	66
03020101	Coon Cr	SR 1609	Granville	Northern Outer Piedmont	65
Low to Poor Quality Habitats					
03020101	N Fk Tar R	SR 1151	Granville	Carolina Slate Belt	63
03020102	Rocky Swp	SR 1002	Halifax	Northern Outer Piedmont	63
03020101	Cedar Cr	SR 1105	Franklin	Northern Outer Piedmont	57
03020101	Tabbs Cr	SR 1100	Vance	Northern Outer Piedmont	56
03020101	Middle Cr	SR 1203	Franklin	Northern Outer Piedmont	54
03020101	Maple Cr	SR 1713	Nash	Rolling Coastal Plain	48

Major differences between the high to moderate and the low to poor quality habitat types were in the instream habitats, substrates, riffles, and bank stabilities (Table 4). Differences were not as pronounced in the degree of channel modification, substrate, abundance of pools, extent of canopy cover, or width of riparian zones. Extremely low scores were attributable to poor landuse practices, chronic erosion of the easily eroded soils, and nonpoint source sedimentation within the respective watersheds.

Table 4. Mean habitat scores for 19 fish community sites using Piedmont criteria in the Tar River basin, 2004 - 2007.

Habitat characteristics	Low - Poor Quality Habitat	Moderate - High Quality Habitat	Max. score
Instream habitat	13.0	17.4	20
Riffles	7.8	1.5	16
Bank stability (right and left)	6.6	12.0	14

Characteristics of moderate to high quality habitat Piedmont streams include:

- instream habitats composed of rocks, sticks, leafpacks, snags and logs, and undercut banks and root mats;
- a substrate of cobble and gravel with low embeddedness;
- frequent pools and riffles of varying depths and widths; and
- stable banks with a good tree canopy and a medium to wide riparian zone with no or rare breaks in riparian coverage (Figure 2).



Figure 2. Instream habitats composed of rocks, sticks, leafpacks, snags and logs, and root mats; stable banks with a good tree canopy and a wide riparian zone, Fishing Creek at SR 1643, Granville County (left) and Red Bud Creek at SR 1407, Nash County (right).

Characteristics of low to poor quality habitat Piedmont streams include:

- highly embedded substrates of primarily sand;
- an absence of riffles; if present, they are usually caused by embedded, coarse woody debris in the current, and
- entrenched channel with unstable, vertical, and sparsely vegetated banks (Figure 3).



Figure 3. Sandy and gravelly substrates without riffles and vertical and eroding banks, the North Fork Tar River at SR 1151, Granville County (left) and Tabbs Creek at SR 1100, Vance County (right).

In the Coastal Plain there are two major types of wadeable streams that are sampled for the fish community assessment program – those that have a natural channel with sinuosity and those that been channelized, either historically or still being periodically maintained. In eastern North Carolina, streams were channelized to convey water away from the land to render the lands suitable for agricultural and forestry purposes. In some areas, streams were channelized to alleviate flooding in residential and urban areas upstream. The degree of channelization may range from those that are “straight as an arrow” (e.g., Crisp Creek and Cannon Swamp) to those that are beginning to have some degree of sinuosity again (e.g., White Oak Swamp and Whichard Branch).

The habitat scores for the 24 sites evaluated with Coastal Plain criteria ranged from 41 (Cannon Swamp) to 100 (Marsh Swamp) (Tables 2 and 5). More than 80 percent of the streams had overall moderate to high quality habitats (score ≥ 65); whereas less than 20 percent of the streams had overall low to poor quality habitats (score < 65). However, not all the streams that had been channelized had habitat score less than 65. Many of the sites (e.g., Beech Branch, Conetoe Creek, and Whichard Branch) had been channelized a long time ago, but the riparian zones have re-forested and now provide a good shaded canopy over the stream

Table 5. Rankings of 24 waterbodies using Coastal Plain criteria in the Tar River basin according to the total habitat scores, 2004 - 2007.

HUC	Waterbody	Location	County	Level IV Ecoregion	Score
High to Moderate Quality Habitats					
03020102	Marsh Swp	SR 1210	Halifax	Rolling Coastal Plain	100
03020102	Mill Swp	SR 1615	Halifax	Rolling Coastal Plain	95
03020103	Tyson Cr	SR 1255	Pitt	Rolling Coastal Plain	95
03020102	Breeches Swp	SR 1002	Halifax	Rolling Coastal Plain	93
03020101	Lynch Cr	SR 1235	Franklin	Northern Outer Piedmont	93
03020102	Bear Swp	NC 561	Halifax	Northern Outer Piedmont	91
03020102	Burnt Coat Swp	SR 1216	Halifax	Rolling Coastal Plain	90
03020102	Crooked Swp	SR 1501	Nash	Rolling Coastal Plain	89
03020102	Jacket Swp	SR 1216	Halifax	Rolling Coastal Plain	84
03020102	Rocky Swp	SR 1002	Halifax	Northern Outer Piedmont	84
03020103	Cokey Swp	SR 1135	Edgecombe	Rolling Coastal Plain	83
03020101	Pig Basket Cr	SR 1433	Nash	Rolling Coastal Plain	82
03020101	Compass Cr	NC 97	Edgecombe	Southeastern Floodplains & Low Terraces	81
03020102	Shocco Cr	SR 1613	Warren	Northern Outer Piedmont	80
03020101	Beech Br	NC 97	Halifax	Southeastern Floodplains & Low Terraces	77
03020103	Conetoe Cr	SR 1510	Edgecombe	Mid-Atlantic Flatwoods	74
03020102	Deep Cr	SR 1506	Edgecombe	Southeastern Floodplains & Low Terraces	68
03020101	White Oak Swp	SR 1428	Edgecombe	Southeastern Floodplains & Low Terraces	68
03020103	Whichard Br	SR 1521	Pitt	Mid-Atlantic Flatwoods	67
03020101	Maple Cr	SR 1713	Nash	Rolling Coastal Plain	65
Low to Poor Quality Habitats					
03020103	Parker Cr	NC 33	Pitt	Mid-Atlantic Floodplains & Low Terraces	64
03020103	Crisp Cr	SR 1527	Edgecombe	Mid-Atlantic Flatwoods	57
03020103	Ballahack Canal	NC 42	Edgecombe	Southeastern Floodplains & Low Terraces	41
03020103	Cannon Swp	US 264	Pitt	Mid-Atlantic Floodplains & Low Terraces	35

This single habitat manipulation (channelization) has had a profound effect on the other habitat characteristics of the streams (Tables 2 and 6). However, in this data set, instream habitats, substrates, pools, and shading did not differ appreciably between the low-poor quality and the moderate-high quality habitat stream types.

Table 6. Mean habitat scores for 24 fish community sites using Coastal Plain criteria in the Tar River basin, 2004 - 2007.

Habitat characteristics	Low - Poor Quality Habitat (channelized)	Moderate - High Quality Habitat (natural channel)	Maximum score
Channel Modification	5.5	13.5	15
Bank stability (right and left)	10.6	17.2	20
Riparian zones	5.3	9.9	10

Characteristics of natural channel streams are (Figure 4):

- Natural channel streams have greater sinuosity than channelized streams.
- Natural channel streams have diverse instream habitats including coarse woody debris, undercut banks and root mats, macrophytes and leaf packs.
- Natural channel streams have frequent pools of varied depths.
- Natural channel streams have stable vegetated banks which provides shade.

- Natural channel streams may have more stable flows than channelized streams during periods of low precipitation.



Figure 4. Natural channel streams showing coarse woody debris, a densely forested canopy, and stable banks, Tyson Creek at SR 1255, Pitt County (left) and Marsh Swamp at SR 1210, Halifax County (right).

Characteristics of channelized streams are (Figures 5 and 6):

- Channelized streams have less diverse instream habitats and have the pools of uniform depths.
- Channelized streams have banks that may be unstable and sparsely vegetated.
- Channelized streams have a more open canopy than natural channel streams which ultimately provides more light to reach the stream. An open canopy provides light for abundant growths of macrophytes, benthic and planktonic algae, and increase the temperature of the water.
- Channelized streams may have larger diurnal fluctuations in temperature and dissolved oxygen than in natural channel streams
- Channelized streams usually have one or both of the riparian zones cleared of trees and shrubs to provide access to the stream for dredging and channel clearing equipment.
- Channelized streams are, by design, deeply entrenched and detached from their floodplains, except during extreme high water (i.e., tropical storm- and hurricane-induced flooding).
- Channelized streams may also have flows that fluctuate dramatically due to storm events. However, the flows may also be more permanent because the streams are usually entrenched below the level of the water table.



Figure 5. A channelized stream showing a lack of sinuosity, entrenchment, unstable banks, and absence of forested riparian zones, Cannon Swamp at US 264, Pitt County.



Figure 6. Channelized streams showing entrenchment, but with forested riparian zones, Crisp Creek at SR 1527, Edgecombe County (left) and Ballahack Canal at NC 42, Edgecombe County (right).

Appendix F-7. Water quality at 36 fish community sites in the Tar River basin, 2004 - 2007.

Temperature, specific conductance, dissolved oxygen, and pH were collected at every site during fish community assessments during the period 2004 – 2007 (Table 1). All dissolved oxygen concentrations met the water quality standard of 5 mg/L, except for the measurement at Cokey Swamp. Cokey Swamp is currently classified as C; NSW (Nutrient Sensitive Waters) not as Swamp Waters even though physically and biologically it appears to be Swamp Waters. Swamp Waters may have concentrations less than 5.0 mg/L if caused by natural conditions (NCAC 2007). Dissolved oxygen saturation ranged from 52 percent at Cokey Swamp to 100 percent at Parker Creek. Four pH measurements were less than 6.0 s.u. Swamp Waters may have pH less than 6.0 s.u. as the result of natural conditions, but none of these four waterbodies is classified as Swamp Waters. Conductivity ranged from 63 μ S/cm at Reedy Creek to 215 μ S/cm at Ballahack Canal (Figure 1). Elevated readings were associated with dischargers from upstream wastewater treatment plants (e.g., at Fishing Creek, Cedar Creek, and Beech Branch) or from nonpoint sources in agricultural areas (e.g. at Ballahack Canal, Whichard Branch and Cannon Swamp).

Table 1. Water quality measurements at 36 fish community sites in the Tar River basin, 2004 - 2007. Red bold denotes less than the water quality standard.

HUC/ Waterbody	Location	County	Date	Temperature (°C)	Specific conductance (μ S/cm)	Dissolved oxygen (mg/L)	Saturation (%)	pH (s.u.)
03020101 Tar River Headwaters								
Tar R	US 158	Granville	04/09/07	8.5	72	10.4	89	6.9
Shelton Cr	US 158	Granville	05/17/06	14.2	73	8.5	83	6.0
N Fk Tar R	SR 1151	Granville	04/09/07	8.8	87	11.1	96	7.0
Fishing Cr	SR 1643	Granville	05/18/06	15.6	186	8.4	84	6.1
Coon Cr	SR 1609	Granville	05/18/06	14.6	125	7.8	77	6.1
Middle Cr	SR 1203	Franklin	04/09/07	9.8	83	11.1	98	7.3
Tabbs Cr	SR 1100	Vance	04/10/07	8.2	101	10.3	87	6.3
Lynch Cr	SR 1235	Franklin	04/10/07	8.1	70	10.4	88	6.8
Cedar Cr	SR 1105	Franklin	06/10/04	27.0	180	6.6	83	6.2
Maple Cr	SR 1713	Nash	05/08/07	13.7	116	6.5	63	6.8
Pig Basket Cr	SR 1433	Nash	04/10/07	13.4	99	9.1	87	6.7
Compass Cr	NC 97	Edgecombe	05/08/07	15.2	132	6.7	67	6.3
Beech Br	NC 97	Halifax	05/08/07	16.6	171	9.4	96	6.9
Red Bud Cr	SR 1407	Nash	04/11/07	10.8	80	10.1	91	6.1
White Oak Swp	SR 1428	Edgecombe	05/09/07	15.7	113	7.4	75	5.9
03020102 Fishing Creek								
Fishing Cr	SR 1600	Warren	05/07/07	14.6	95	8.2	81	6.4
Shocco Cr	SR 1613	Warren	04/11/07	11.1	73	9.8	89	6.6
Crooked Swp	SR 1501	Nash	04/11/07	11.5	89	8.6	79	6.6
Little Fishing Cr	SR 1509	Warren	04/12/07	13.9	74	10.0	97	6.6
Reedy Cr	SR 1511	Warren	04/12/07	13.1	63	9.3	88	6.5
Bear Swp	NC 561	Halifax	05/07/07	15.4	83	7.5	75	6.5
Rocky Swp	SR 1002	Halifax	05/07/07	16.7	97	7.3	75	6.8
Marsh Swp	SR 1210	Halifax	05/08/07	16.0	97	6.8	69	6.8
Mill Swp	SR 1615	Halifax	04/13/07	18.0	76	9.0	95	5.8
Burnt Coat Swp	SR 1216	Halifax	04/13/07	11.7	96	8.7	80	6.4
Jacket Swp	SR 1216	Halifax	04/13/07	13.6	102	6.7	64	6.7
Breeches Swp	SR 1002	Halifax	04/13/07	14.9	90	5.6	55	5.6
Deep Cr	SR 1506	Edgecombe	05/11/07	19.3	115	5.1	55	6.4
03020103 Tar River								
Cokey Swp	SR 1135	Edgecombe	05/09/07	18.9	105	4.8	52	6.1
Conetoe Cr	SR 1510	Edgecombe	05/09/07	15.8	82	6.5	66	5.8
Crisp Cr	SR 1527	Edgecombe	05/09/07	16.5	132	5.4	55	6.0
Ballahack Canal	NC 42	Edgecombe	05/09/07	17.7	215	6.0	63	5.7
Tyson Cr	SR 1255	Pitt	05/10/07	21.8	84	7.4	84	5.8
Parker Cr	NC 33	Pitt	05/10/07	20.6	140	9.0	100	6.4
Cannon Swp	US 264	Pitt	05/09/07	19.0	160	7.9	85	6.2
Whichard Br	SR 1521	Pitt	05/10/07	17.9	168	7.5	79	6.2

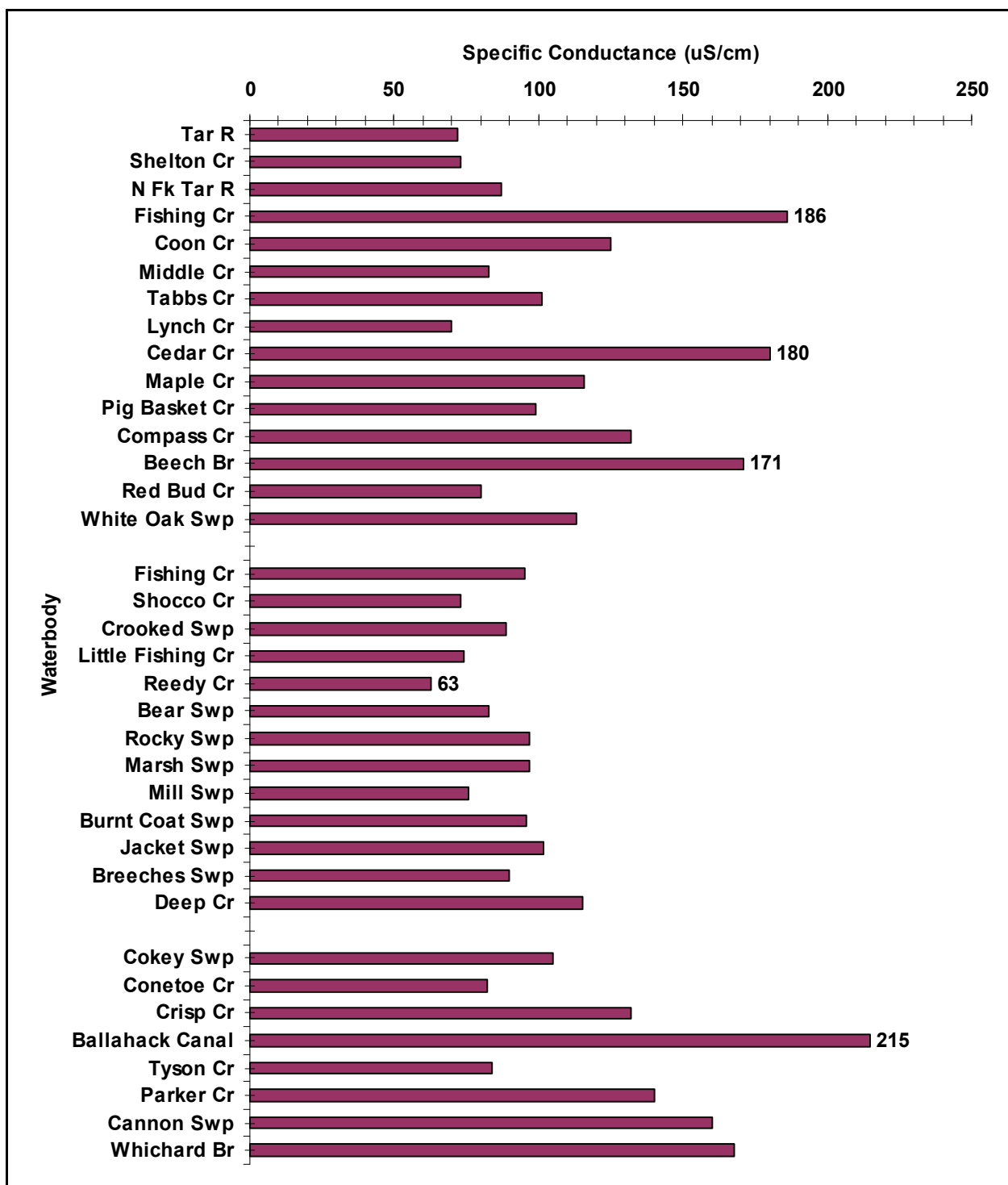


Figure 1. Specific conductance at 36 fish community sites in the Tar River basin, 2004 - 2007.

Appendix F-8. Fish kills in the Tar River Basin, 2003 - 2007.

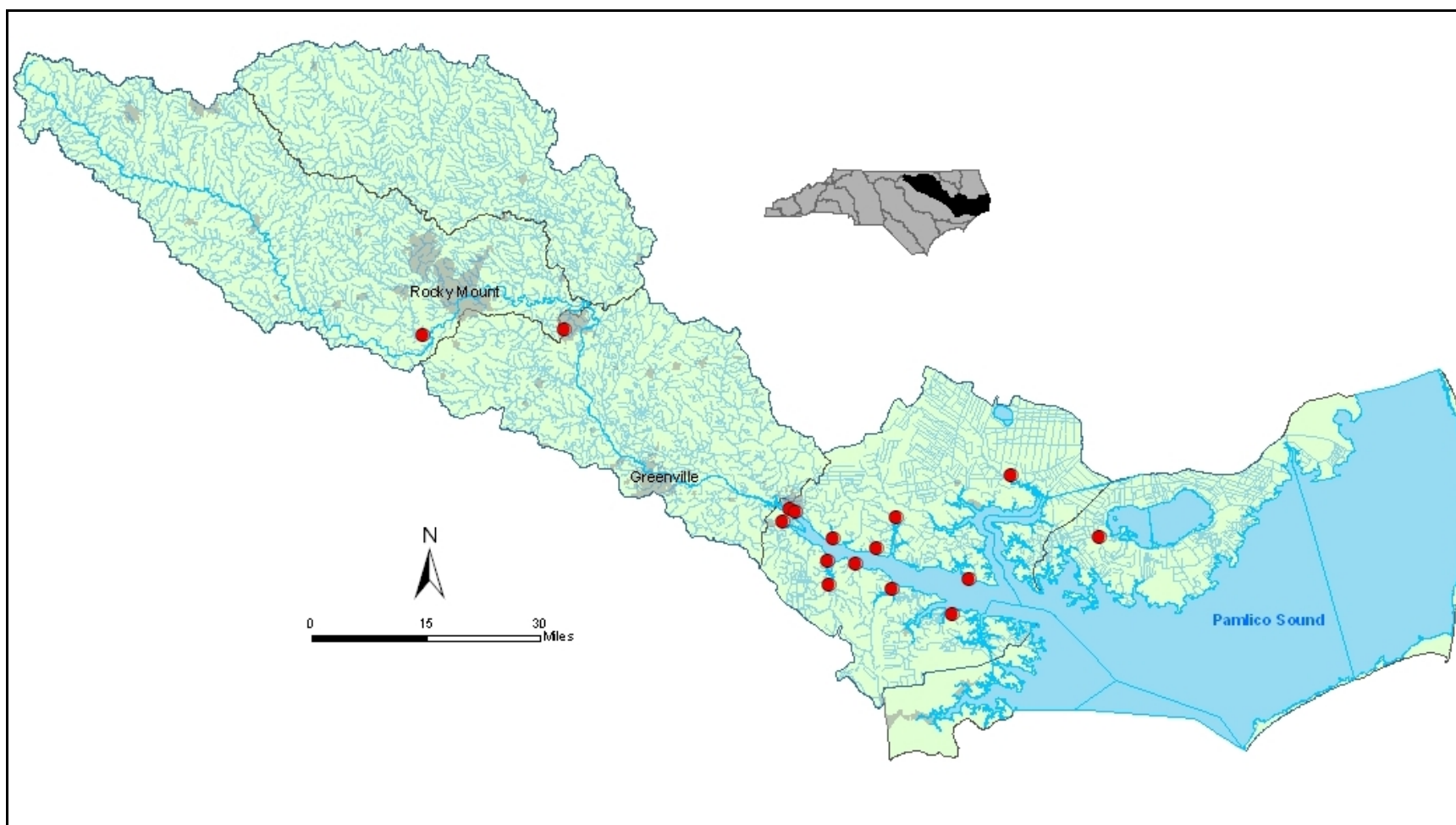


Figure 1. Locations of fish kills in the Tar River Basin, 2003 – 2007.

Table 1. Fish kills in the Tar River Basin, 2003 – 2007.

Date	Kill Number	Waterbody	Location	County	Subbasin	Species	Mortality
1/24/2003	WA03001	Pamlico River	from Blounts Creek	Beaufort	030307	Speckled Trout	2000
Notes: Investigators reported extremely low water temperatures. Areas of Pamlico R. reported frozen over. Low temperatures were cited a cause of kill.							
4/19/2003	WA03002	Rose Bay Canal	near Lake	Hyde	030308	Catfish Carp Gar	1234
Notes: Kill covered approx 1.67 mi. of Rose Bay canal that drains from Lake Mattamuskeet. The majority of the fish affected were carp which appeared to have been dead for 2-3 days. DO levels at the time of the investigation were within normal ranges (4.8 to 7.6 mg/l). Salinity levels were also low. One side of the canal appears to have been sprayed with an herbicide at some point. A water sample was collected to test for the presence of pesticides/herbicides that may have leaked into the canal from the canal side spraying or from local Ag fields. The results were negative for both pesticides and herbicides.							
6/30/2003	WA03008	Bond Creek	near Aurora	Beaufort	030307	None	300
Notes: Original report was for 10,000 dead clams floating on surface, fish eating them. At the time of investigation only 300 clams counted. Clams reported floating about 36 hrs prior. Areas of low DO and warm surface water temps. Algae bloom also found in area. Clams were <i>Macoma</i> species.							
7/2/2003	WA03009	Durham Creek	Bogus Pt.	Beaufort	030307	None	148000
Notes: An estimated 148,000 clams were found mostly washed up in wrack lines on the shore along a 1.5 mile stretch of Durham Creek from Bogus Pt. down to Horse Pt. at Porter Creek. Low dissolved oxygen levels on the bottom of the water column are suspected as the cause of this kill.							
7/23/2003	WA03012	Pamlico River	near Pamlico Beach	Beaufort	030308	Menhaden	1000
Notes: Water quality meter readings at Pamlico Beach were within normal level, fish dying outside of Pamlico Beach area and being pushed by SW wind.							
10/1/2003	WA03023	Pond	off Hwy 17	Beaufort	030307	Bass Sunfish Shad	86
Notes: Kill caused by low DO levels resulting from an influx of swamp water and organic matter following Hurricane Isabel. Some remaining fish found swimming in pond at time of investigation							
3/21/2004	WA04001	Jacks Creek	near mouth	Beaufort	030307	Gizzard Shad	500
Notes: Cause of kill unknown. Kill limited to gizzard shad. Kill reported on Sunday, 3/21 by WRC, but residents in the area first noticed dead fish as early as Friday, 3/19. At the time of investigation, dissolved oxygen levels appeared normal.							
10/29/2004	WA04008	Pamlico River	mouth of Broad Creek	Beaufort	030307	American Eel	78
Notes: Upon investigation PRRT found 78 eels from 8- 22 in. washed up on the shore and in the rock rip-rap. High surface DO and pH levels indicate an algae bloom. PRRT suspect the algae bloom may have caused the DO to drop out the night before and the eels beached themselves in an effort to get oxygen and eventually suffocated.							
7/8/2005	RA05005	Stormwater Pond	Mary Francis Center	Edgecombe	030303	Bass Sunfish	510
Notes: Some lesions noted on fish. Lesions reported to be 1/4 inch in size. Cause unknown.							
7/19/2006	WA06005	Duck Creek	near Bath	Beaufort	030307	Silver Perch Catfish	210
Notes: The kill involved about 100 Silver Perch about 3-6 inches in length and 10 catfish from 5-9" long. Dissolved Oxygen at midday was above 130% saturation, and the pH was 7.6 suggesting an algal bloom was present. Water temperature was about 91degrees F. Algal samples were collected and forwarded to DWQ/ESS. The fish were fresh and likely died the previous night or early morning. No lesions were observed. ESS staff identified a dense bloom of the filamentous bluegreen alga <i>Pseudanabaena</i> (previously identified as <i>Oscillatoria limnetica</i>). This is a harmless alga which frequently blooms in the state's coastal rivers during summer.							

Table 1 (continued).

Date	Kill Number	Waterbody	Location	County	Subbasin	Species	Mortality
8/2/2006	WA06003	Pamlico River	Blounts Bay	Beaufort	030307	Menhaden Spot Pumpkinseed Croaker	13220
Notes: A citizen reported the kill at about 9:30am. It was a multi-species kill made up primarily of juvenile spot and croaker about 3-4" in length. Investigators also saw Blue Crab and Menhaden. They estimated over 13,000 dead fish over about a 1/2 mile section of shoreline near the mouth of Blounts Creek in Western Blounts Bay. This included about 11,000 spot and over 1,000 croaker. The fish appeared to be less than 24 hours old. Measurements from the real time monitoring platform at marker number 5 (a few miles downstream) revealed a sudden drop in dissolved oxygen the previous night between midnight and 3:AM. Water quality measurements during the investigation indicated dissolved oxygen had rebounded in the area and fish ceased to die. The recent heat and calm weather resulted in threatening conditions for fish in the area. Surface water temperatures approaching and exceeding 90 degrees Fahrenheit were measured. The deeper waters throughout the river were reported as hypoxic.							
5/29/2007	WA07003	Pamlico River	Crystal Beach	Beaufort	030307	Striped Mullet Sunfish Striped Bass	31
Notes: Upon investigation PRRT staff discovered over 30 badly decomposed mullet, bream and striped bass in a canal near the mouth of Nevil Creek and Crystal Beach Community Campground. Decomposition suggested these fish died during the weekend. This area sees large numbers of recreational fishermen, especially during memorial day weekend. Staff notice the bream heads were cut off. There were no net marks visible. Real-time data near the area showed some drops in dissolved oxygen, but none for a long period of time. PRRT staff agrees that these fish most likely died as a result of some aspect of recreational fishing.							
8/11/2007	WA07009	Blounts Creek	above Cotton Patch	Beaufort	030307	Yellow Perch Striped Mullet Silver Perch Bluegill Sunfish Striped Bass Catfish Atlantic Menhaden Shad	100000
Notes: Fish kill was reported by PTRF Riverkeeper Heather Jacobs August 11th, 2007. PRRT's pager system was faulty and were not notified until August 13. On site, Riverkeeper 1st recorded multiple species fish kill along a 2 mile stretch in the headwaters of Blounts Creek adjacent to the Cotton Patch Landing. PTRF official total numbers were from 50,000-100,000. Their data indicated very low DO (2 mg/L) and salinities near 6‰. PRRT staff arrived on scene 2 days later, August 13, approximately 10:45 a.m. Species affected included juvenile menhaden (80-200mm), striped bass (350 mm), shad, catfish (350 mm), mullet (300 mm), bluegill (200 mm), and perch (100mm). Water levels had dropped nearly 6-8 inches since the weekend. Fish were observed lying on shoreline banks. Count was not performed since most fish had decayed or were consumed within past days. PRRT transect data on August 13th showed salinities spanning from 3 ‰ (headwaters) to 6 ‰ (near Cotton Patch Landing). DO levels were from 3 mg/L (surface) to near 0 (bottom). An algae bloom was observed along the stretch of the kill area, however DO% saturation values were highest further upstream. Bloom samples were collected and sent to ESS for further evaluation. The kill event coincides with a previous strong wind and rain event in the area. The storm event exhibited north winds up to 65 mph gusts, and large amounts of rainfall. Real-time data near Channel marker 5 indicated surface salinity changes from 12 ‰ to 0 ‰ coinciding with DO drop to zero and a water level increase of 5 feet in less than 12 hours. These Northerly winds may have pushed waters levels up into Blounts Creek, while rainfall caused a pulse of freshwater in the system. Low DO and a sudden drops in salinity were cited as factors in the event. Water samples submitted to ESS showed a dense bloom of the raphidophyte flagellate <i>Heterosigma</i> .							
8/25/2007	WA07011	Pungo River Canal	above Leachville	Hyde	030307	White Catfish	778
Notes: PRRT staff responded August 25th. A fisherman noticed dead catfish along the Pungo River August 24th. The fish kill began north of the Leachville Bridge near the confluence of Herring Run and extended approximately 3.5 miles to where the Piney Grove Landing area connects with the Pungo Canal. Over 778 catfish were counted. Sizes ranged from 100 to 250 mm in length. These fish were estimated from 24-48 hours old. No obvious lesions were observed. Staff observed heavy organic algal film along the surface waters over several miles although there was no indication of an algal bloom at present. Physical water quality data closest to the upstream portion of the kill indicated salinities from 4 to 5 parts per thousand from the surface to the bottom with DO values from 4 to 1 mg/L top to bottom respectively. Downstream data seemed to be more homogeneous with consistent salinities of 5 ppt and DO values of 3 mg/L. This area had periods of heavy rainfall on August 22nd. The cause of this fish kill may have been a combination of previous algal bloom activity, low DO, and sudden pulses of rainfall into the system.							

Table 1 (continued).

Date	Kill Number	Waterbody	Location	County	Subbasin	Species	Mortality
9/17/2007	RA07002	Tar River Reservoir	Sapony Creek Arm	Nash	030302	Carp Largemouth Bass Sunfish Catfish	500
<p>Notes: The drought conditions were severe in this area and played a significant role in this fish kill. The Sapony Creek arm of the reservoir is stocked in the fall-winter yearly with fish. It would be unlikely that the waterbody could support fish life anytime in the near future, as the reservoir is almost completely dry with little to no moving water. An algal bloom may have occurred during the low flow conditions, worsening the situation. Possible sources of agricultural chemicals and nutrients are in the area, as many farms surround the Sapony Creek, but no evidence suggest this was a primary cause of the fish kill.</p>							
10/19/2007	WA07016	Tankard Creek	at Hunter's Bridge	Beaufort	030307	Shad White Catfish Black Crappie White Perch Bluegill Sunfish Redear Sunfish	60
<p>Notes: The Pamlico Rapid Response Team investigated a fish kill that occurred in the headwaters of Bath Creek (Tankard Creek) on Friday October 19th. The kill extended 1.2 miles up Tankard Creek from Bath Creek. The fish, mostly freshwater, averaged 150 mm in length, consisted of catfish, crappie, perch, bluegill, and sunfish. Some of these fish were partially eaten and appeared to be at least 48 hours old. No lesions were observed. Chlorophyll A, nutrient and phytoplankton samples were taken in the kill area, as a remnant algal bloom surface film was evident. The current drought conditions most likely created higher salinity conditions (12-14 ppt) than typically observed in this area. Saltwater stress and low dissolved oxygen readings (0.8 mg/l surface and 0.5 mg/l bottom) combined to create stressful conditions for these resident freshwater fish. Water samples indicated there was a bloom of the dinoflagellates <i>Karlodinium</i> and <i>Peridiniella</i> at the site. Both algal taxa are common in the state's coastal estuarine rivers. Karlodinium is known to produce toxins but it is not known to kill fish in the open waters of North Carolina.</p>							

Appendix F-9. Web links.

National Weather Service and North Carolina State University's Marine, Earth, and Atmospheric Sciences Case Studies

<http://www.meas.ncsu.edu/nws/www/cases/>

North Carolina Division of Water Quality, Stream Fish Community Assessment (including Habitat Assessment) Standard Operating Procedures

<http://www.esb.enr.state.nc.us/BAU.html>

North Carolina Division of Water Quality (native and exotic freshwater fish in North Carolina)

[http://www.esb.enr.state.nc.us/www.esb.enr.state.nc.us/Native and Introduced Freshwater Fish in North Carolina.2-1.htm](http://www.esb.enr.state.nc.us/www.esb.enr.state.nc.us/Native_and_Introduced_Freshwater_Fish_in_North_Carolina.2-1.htm)

North Carolina Division of Water Resources, Drought Monitoring

http://www.ncwater.org/Drought_Monitoring/

North Carolina Wildlife Action Plan

http://www.ncwildlife.org/fs_index_07_conservation.htm

US Geological Survey (real-time streamflow data for North Carolina)

<http://waterdata.usgs.gov/nc/nwis/current?type=flow>

Appendix F-10. Fish community references.

- Fels, J. 1997. North Carolina watersheds map. North Carolina State University Cooperative Extension Service. Raleigh, NC.
- Griffith, G., Omernik, J. and J. Comstock. 2002. Ecoregions of North Carolina. United States Environmental Protection Agency. Research and Development. NHEERL. Western Ecology Division. Corvallis, OR.
- Karr, J. R. 1981. Assessment of biotic integrity using fish communities. *Fisheries*. 6: 21 - 27.
- _____, Fausch, K. D., Angermeier, P. L., Yant, P. R., and I. J. Schlosser. 1986. Assessing biological integrity in running water: a method and its rationale. III. *Nat. Hist. Surv. Spec. Publ.* 5.
- LeGrand, H. E., Hall, S. P., McRae, S. E., and J. T. Finnegan. 2006. Natural Heritage Program list of the rare animal species of North Carolina. North Carolina Natural Heritage Program, Office of Conservation and Community Affairs, North Carolina Department of Environment and Natural Resources. Raleigh, NC.
- Menhinick, E. F. 1991. The freshwater fishes of North Carolina. North Carolina Wildlife Resources Commission. Raleigh, NC.
- _____, and A. L. Braswell (eds). 1997. Endangered, threatened, and rare fauna of North Carolina. Part IV. A reevaluation of the freshwater fishes. *Occas. Papers N.C. State Mus. Nat. Sci. and N.C. Biol. Surv.* No. 11. Raleigh, NC.
- NCAC. 2007. North Carolina administrative code. Effective May 1, 2007. Environmental Management Commission. North Carolina Department of Environment and Natural Resources. Division of Water Quality. Raleigh, NC.
- NCDEHNR. 1993. Regional inventory for critical areas, wetland ecosystems, and endangered species habitats of the Albemarle-Pamlico estuarine region. Phase III report. Albemarle-Pamlico Estuarine study. Report No. 92-21. North Carolina Department of Environment, Health, and Natural Resources. Raleigh, NC.
- NCDENR. 2003. Basinwide assessment report. Tar River basin. North Carolina Department of Environment and Natural Resources. Division of Water Quality. Water Quality Section. Environmental Sciences Branch. Raleigh, NC.
- _____. 2006a. Standard operating procedure. Biological monitoring. Stream fish community assessment program. Biological Assessment Unit. North Carolina Department of Environment and Natural Resources. Division of Water Quality. Environmental Sciences Section. Raleigh, NC.
- _____. 2007. North Carolina. Water quality assessment and impaired waters list (2006 integrated 305(b) and 303(d) report). Final. Approved May 17, 2007. North Carolina Department of Environment and Natural Resources. Division of Water Quality. Planning Section. Raleigh, NC.
- NCWRC. 2005. North Carolina wildlife action plan. North Carolina Wildlife Resources Commission. Raleigh, NC.
- Nelson, J. S., Crossman, E. J., Espinosa-Pérez, H., Findley, L. T., Gilbert, C. R., Lea, R. N., and J. D. Williams. 2004. Common and scientific names of fishes from the United States, Canada, and Mexico. American Fisheries Society, Special Publication 29, Bethesda, MD.
- Noga, E. J. 1996. Fish disease. Diagnosis and treatment. Mosby-Year Book, Inc. St. Louis, MO.

- Sanders, R. E., Miltner, R. J., Yoder, C. O., and E. T. Rankin. 1999. The use of external deformities, erosion, lesions, and tumors (DELT anomalies) in fish assemblages for characterizing aquatic resources: a case study of seven Ohio streams. pp. 25-246. *In* Simon, T. P. (ed.). Assessing the sustainability and biological integrity of water resources using fish communities. CRC Press. Boca Raton, FL.
- Steedman, R. J. 1991. Occurrence and environmental correlates of blackspot disease in stream fishes near Toronto, Ontario. *Trans. American Fisheries Soc.* 120: 494 - 499.
- Weaver, J. C. 2005. The drought of 1998 – 2002 in North Carolina – precipitation and hydrologic conditions. U. S. Geological Survey. Scientific Investigations Report 2005-5053.

Appendix G-1. Flow measurement and flow conditions in the Tar River basin.

The onset of the 2007 drought began to be noticed in early March 2007 when the entire basin was first described as being abnormally dry based upon drought indicators. By July 10, 2007 the upper two-thirds of the basin was in a moderate drought, and by August 14th portions of the upper and middle part of the basin were in a severe drought. By August 21st the entire basin was in either a moderate to severe drought and by September 4th the entire basin was in a severe to an extreme drought. By November 20th portions of the basin were now in an exceptional drought and by the end of 2007 portions of the basin were in either an exceptional, extreme, or severe drought. This drought has persisted into 2008.

During fish community sampling (April 09-13 and May 07-11, 2007) flows were generally at or less than median daily flows at nearby USGS gauge sites with occasional above median flows for short durations (Figures 1 – 6). During benthic macroinvertebrate sampling from July through August water levels were often well below median flow.

However, even before the last basinwide monitoring cycle was completed in 2002, the Tar River basin had been experiencing a prolonged drought which started in 1998 and continued through 2002 (NCDENR 2003; Table 1; Figures 1- 6). This drought was most severe during summer 2002 (Weaver 2002). The lowest daily mean discharges flows ever recorded occurred in August and September 2002 at several sites in the basin (Table 1). The drought was halted abruptly by above normal precipitation in late 2002 and into 2003. Extremely high flows have been periodically recorded since then, usually the result of tropical storms or hurricanes, until 2007 when the most recent drought commenced. In August to October 2007, new all time record low flows, in many instances zero flow for a prolonged period of days, have been documented at the gaging sites at the Tar River near Tar River, Tar River below Tar River reservoir near Rocky Mount, Little Fishing Creek near White Oak, Fishing Creek near Enfield, and the Tar River at Tarboro (pers. comm. with Mr. J. Curtis Weaver, USGS North Carolina Water Science Center, Raleigh, NC, January 30, 2008).

Table 1. Record-low daily mean discharges at select U. S. Geological Survey streamgaging stations. Data adopted from Weaver (2005).

Station, County	Drainage Area (mi ²)	Annual 90% exceedence flow (ft ³ /s)	Lowest Daily Mean Discharge			
			Prior to 1988		During 1998-2002	
			Min (ft ³ /s)	Date	Min (ft ³ /s)	Date
Tar River near Tar River, Granville	167	3.3	0.02	08/13/1977	0.19	08/12/2002
Tar River at US 401 at Louisburg, Franklin	427	37	8.1	08/14/1977	2.1	08/14/2002
Swift Creek at Hilliardston, Nash	166	24	23	09/25/1968	2.0	08/25/1999
Little Fishing Creek near White Oak, Halifax	177	14	0.78	09/04/1980	0.51	08/15/2002
Tar River at Tarboro, Edgecombe	2,183	281	36	10/17/1933	73.0	08/24/2002

During droughts, many of the streams draining smaller Piedmont watersheds (i.e., those in the Northern Outer Piedmont and the Carolina Slate Belt) probably went completely dry or became a series of isolated pools with subsurface flows. A fish community's recovery is affected by the limited avenues available for recolonization, proximity to riverine reservoirs, blockage of upstream migration routes by hydroelectric and old mill dams, and by the lack of larger nearby tributaries as recolonization sources. Run-of-the-river reservoirs, even those on short reaches of rivers, can be inhospitable for many of the smaller species such as darters and shiners. Many of these species also have limited home ranges and are not migratory.

Changes in the benthic macroinvertebrate community are often used to help assess between-year changes in water quality. However, some between-year changes in the communities may be due partly to changes in flow. High flows magnify the potential effects of nonpoint source runoff and in areas of high imperviousness, this can lead to scour, substrate instability, and reduced periphyton. Low flows may

accentuate the effect of point source dischargers by providing less dilution of wastes. Whether a change is flow-related is decided on a site-by-site basis, looking at:

- Flow. The daily flow patterns over a six to twelve month period prior to the collections are examined using the most comparable records from USGS gaging stations. Areas primarily affected by nonpoint source runoff are expected to have a decline in water quality after high flow, but may improve during low flow. The exception to this rule is the smaller headwater streams, which may cease flowing during extreme droughts. Streams affected primarily by point source dischargers may improve after high flow (with dilution of the effluent) and decline after low flows. These changes, however, occasionally produce a between-year change of only one bioclassification.
- Changes throughout the subbasin., especially at reference sites. Flow-related changes usually affect a whole group of sites, not just single sites.
- Changes in species composition. Real changes in water quality are usually reflected in a significant change in the composition of the invertebrate community.

Consequently, all between-year changes in the biological communities are considered in light of flow conditions. Daily flow information is obtained from the closest available USGS monitoring site and compared to the long-term median flows. High flow is defined by BUA Staff as a median flow greater than 140 percent of the long-term median for that time period, usually July or August. Low flow is defined as a median flow less than 60 percent of the long-term median, while normal flow is 60 - 140% of the median. Although broad scale regional patterns are often observed, there may be large geographical variation within the state and large variation within a single summer period.

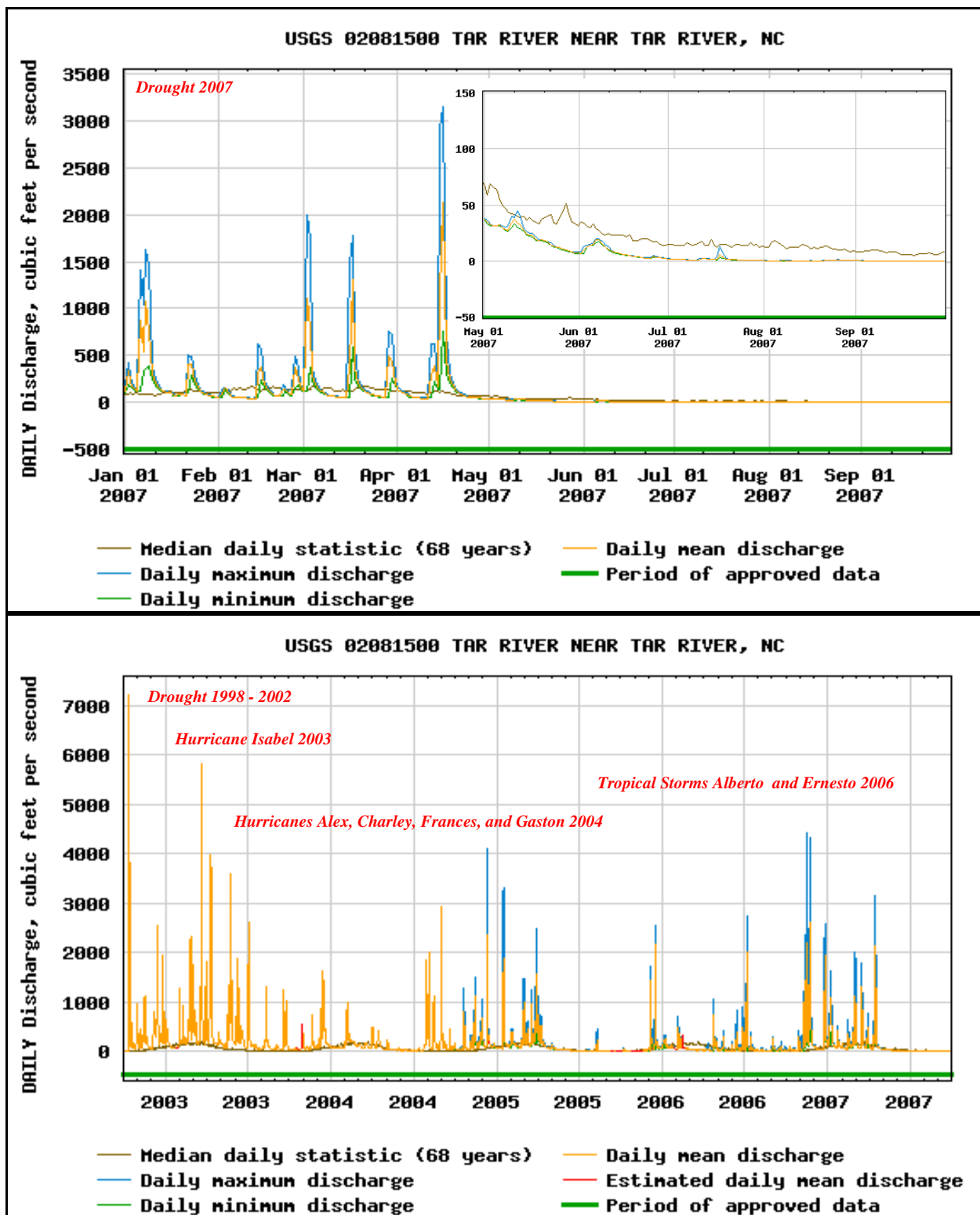


Figure 1. Flows in the Tar River near Tar River, January 01, 2007 – September 30, 2007 (top) and September 30, 2002 to September 30, 2007 (bottom). Inset represents the period of record May 01, 2007 – September 30, 2007.

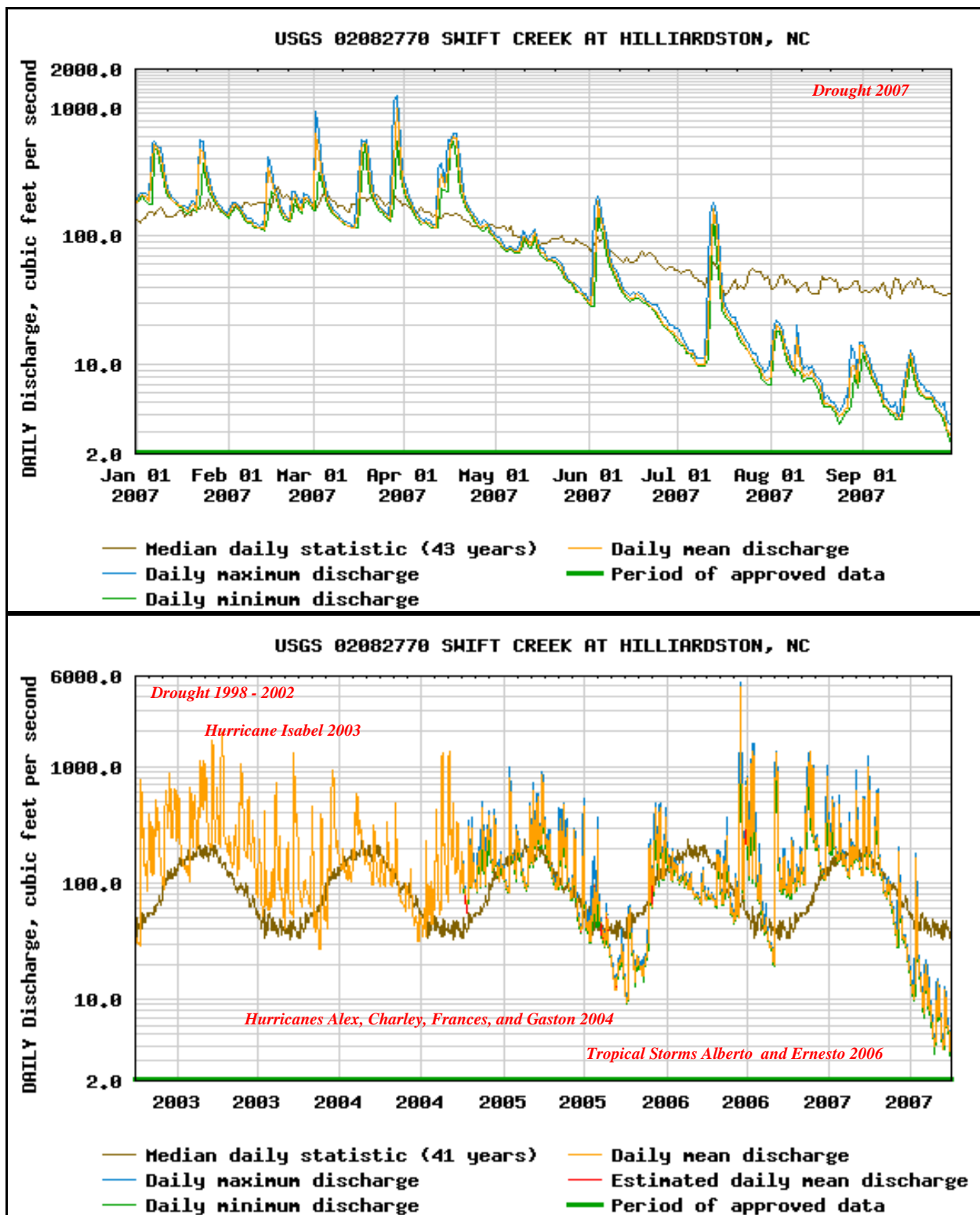


Figure 2. Flows in Swift Creek at Hilliardston, January 01, 2007 – September 30, 2007 (top) and September 30, 2002 to September 30, 2007 (bottom).

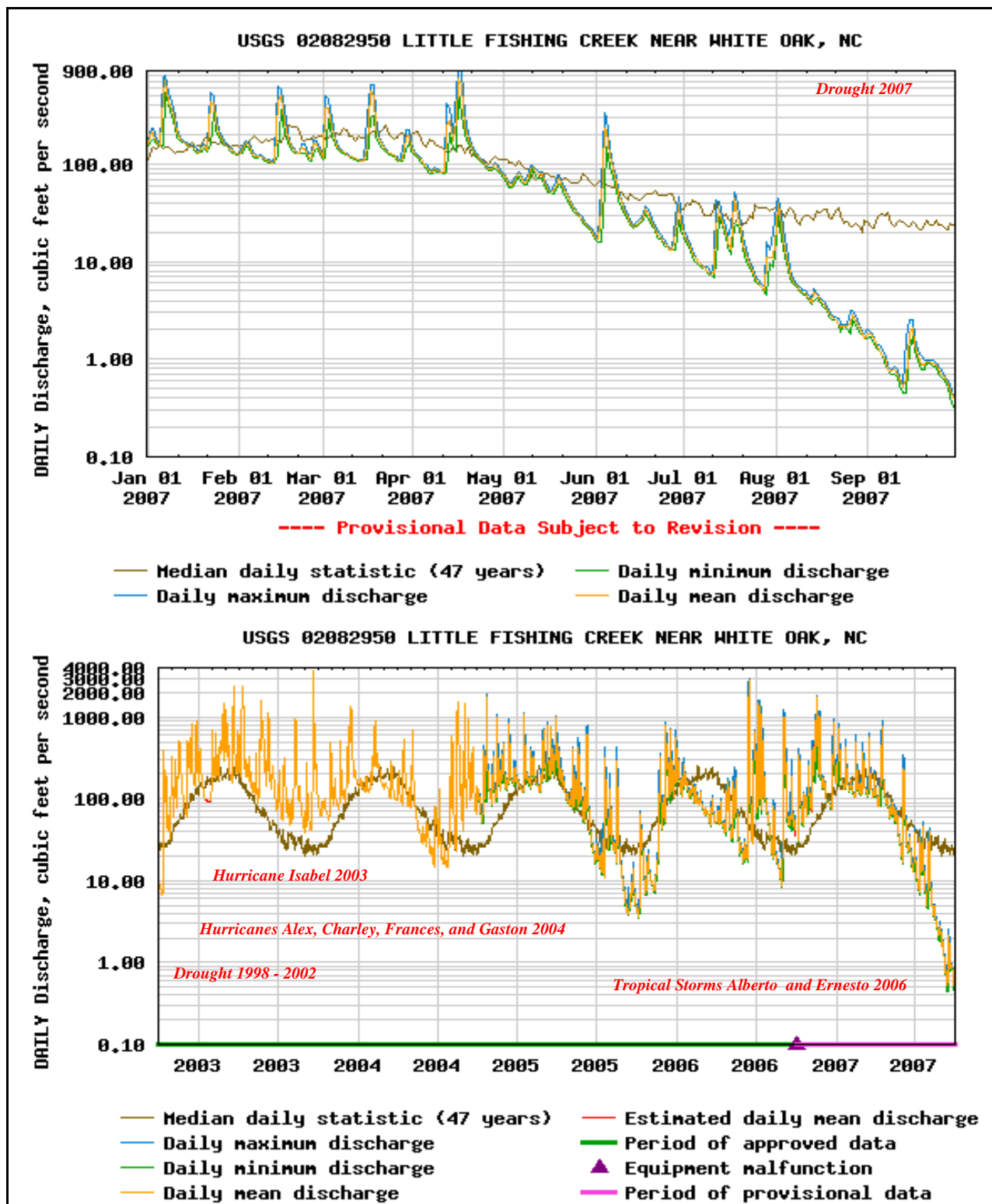


Figure 3. Flows in Little Fishing Creek near White Oak, January 01, 2007 – September 30, 2007 (top) and September 30, 2002 to September 30, 2007 (bottom).

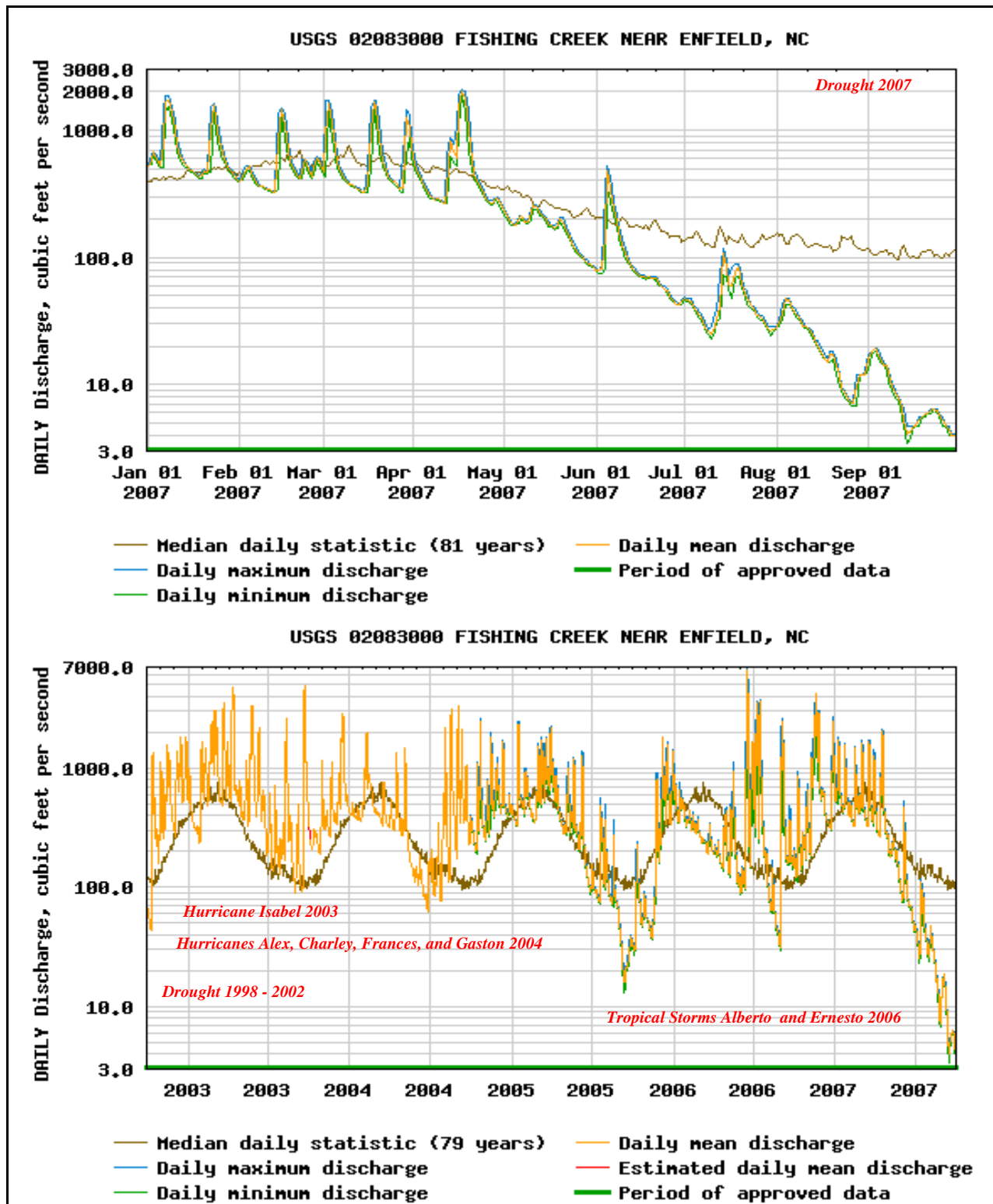


Figure 4. Flows in Little Fishing Creek near White Oak, January 01, 2007 – September 30, 2007 (top) and September 30, 2002 to September 30, 2007 (bottom).

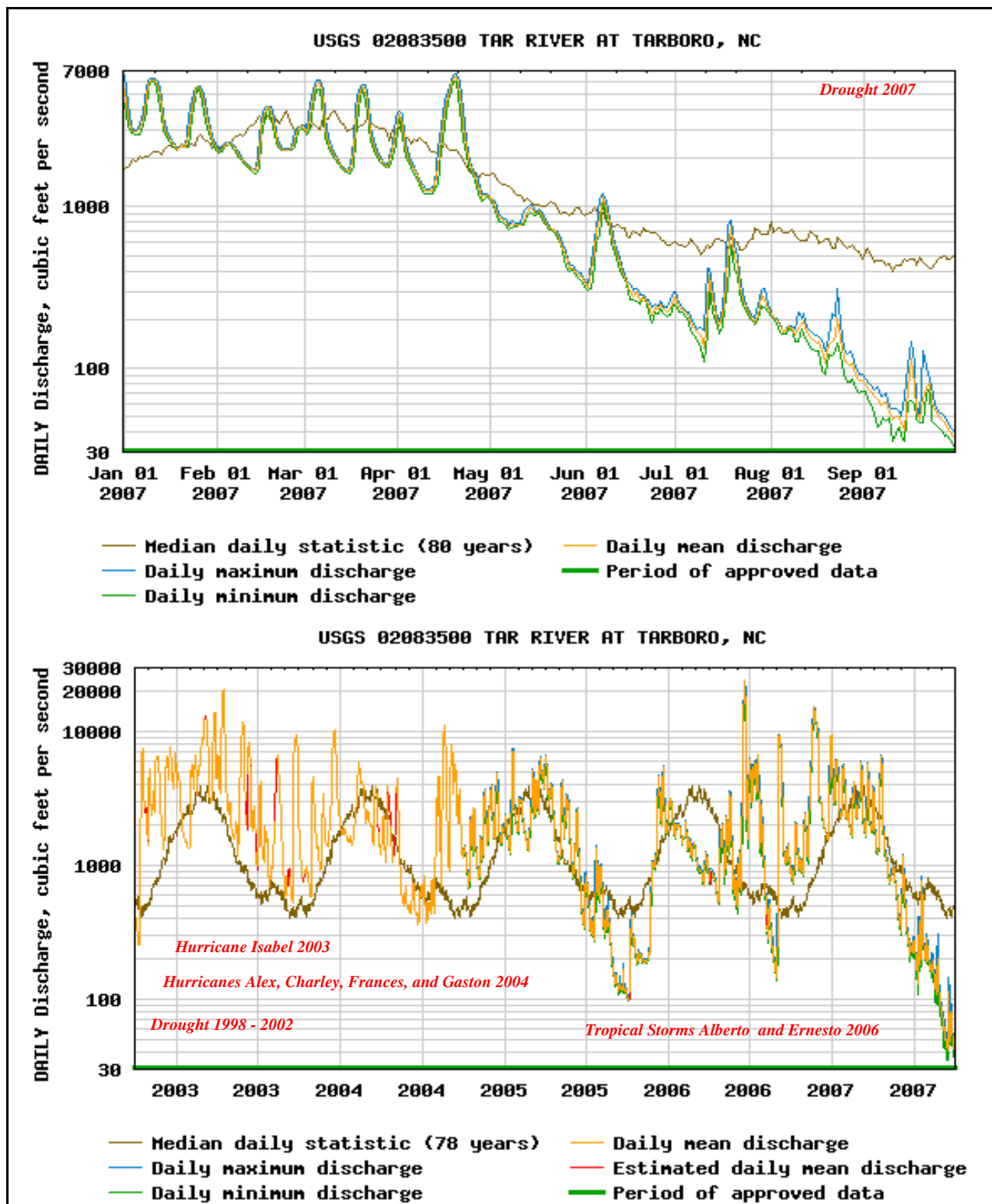


Figure 5. Flows in the Tar River at Tarboro, January 01, 2007 – September 30, 2007 (top) and September 30, 2002 to September 30, 2007 (bottom).

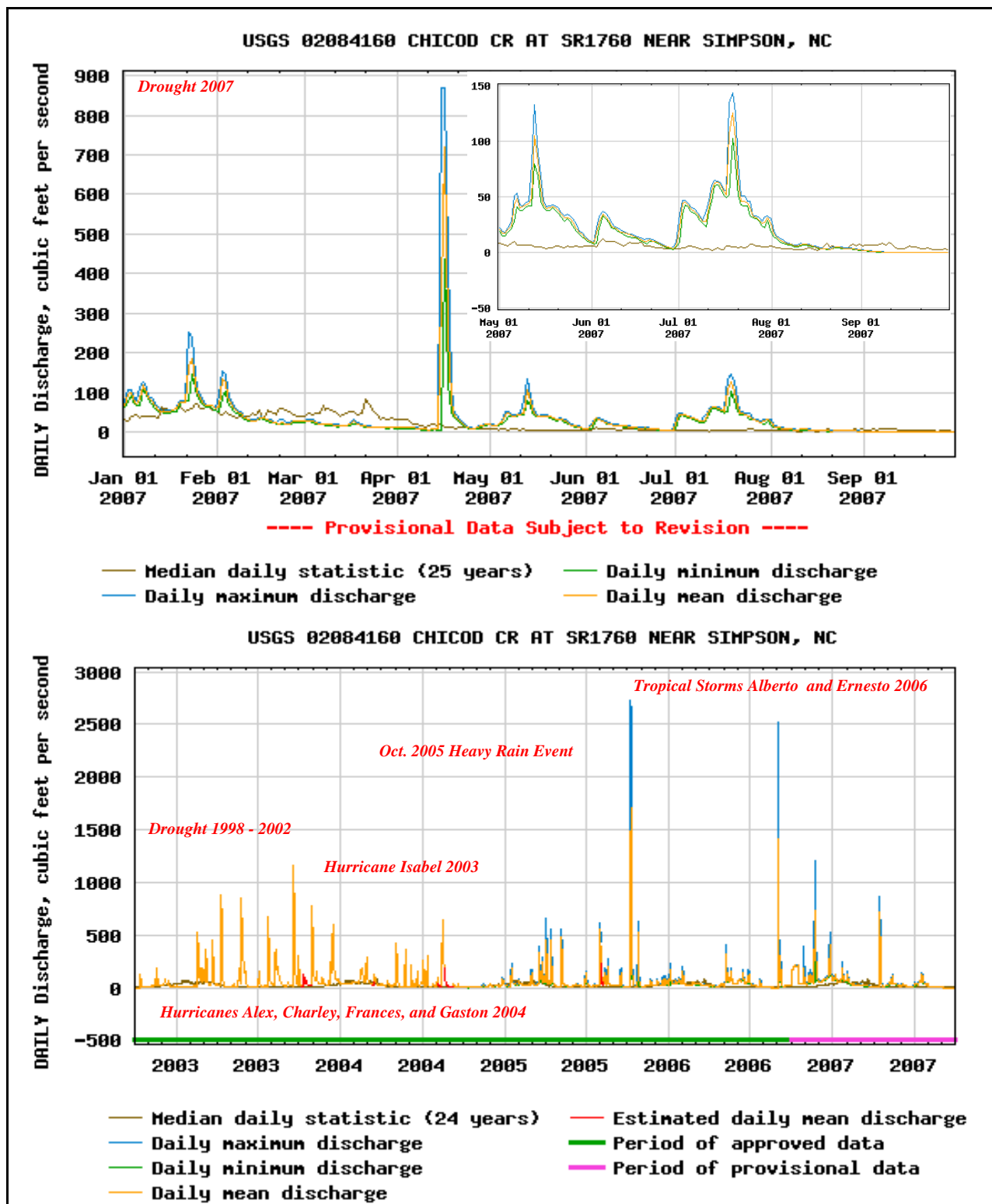


Figure 6. Flows in Chicod Creek at SR 1760 near Simpson, January 01, 2007 – September 30, 2007 (top) and September 30, 2002 to September 30, 2007 (bottom). Inset represents the period of record May 01, 2007 – September 30, 2007.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
TAR R	US 158	04/09/07	OF44	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRANVILLE	1	03020101	36.33333333	-78.76833333	28-(1)	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-IV;NSW	26	470	11	0.4	Yes

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

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

Water Quality Parameters

Temperature (°C)	8.5
Dissolved Oxygen (mg/L)	10.4
Specific Conductance (µS/cm)	72
pH (s.u.)	6.9

Water Clarity	Clear
---------------	-------

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	19
Bottom Substrate (15)	12
Pool Variety (10)	10
Riffle Habitat (16)	7
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	8
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	85

Site Photograph



Substrate	cobble, boulder, bedrock
-----------	--------------------------

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/09/07	2007-07	16	46	Good
10/14/99	99-63	18	54	Excellent
06/24/99	99-53	18	54	Excellent
04/27/99	99-25	17	52	Good

Most Abundant Species

Highfin Shiner

Exotic Species

Green Sunfish

Species Change Since Last Cycle

Gains -- Pirate Perch, Creek Chubsucker, Carolina Darter, and Highfin Shiner. **Losses** -- Roanoke Bass, Brown Bullhead, White Sucker, Eastern Mosquitofish, Largemouth Bass, and Chainback Darter.

Data Analysis

Watershed -- the extreme headwaters of the Tar River basin; drains the eastern edge of Person County and part of Granville County; includes no major municipalities. **Habitat** -- high quality Carolina Slate Belt type habitats with an abundance of rocky pools, undercut banks, root mats, and lots of *Podostemum* on the rocky substrates; good bank stabilities and extensive riparian zones. **2007** -- a relatively diverse assemblage of fish including 3 intolerant species and the first collection of Carolina Darter or Pirate Perch at this site. **1999 - 2007** -- the drop in NCIBI score and bioclassification since 1999 is mostly related to a slight shift in trophic structure towards more insectivores and fewer piscivores, including Roanoke Bass and Largemouth Bass. Twenty six fish species are known from this site, including 4 species of suckers, 4 species of darters, and 6 species of minnows. This site continues to exhibit good water quality, with no apparent issues.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
TAR R	SR 1150	OB25	06/25/07	Good-Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRANVILLE	1	03020101	361738	784221	0	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV;NSW	51.4	400	8	0.1

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

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

Water Quality Parameters

Temperature (°C)	23.7
Dissolved Oxygen (mg/L)	5.1
Specific Conductance (µS/cm)	90
pH (s.u.)	6.5

Water Clarity	clear
---------------	-------

Site Photograph

Habitat Assessment Scores (max)

Channel Modification (5)	3
Instream Habitat (20)	16
Bottom Substrate (15)	15
Pool Variety (10)	8
Riffle Habitat (16)	10
Left Bank Stability (7)	6
Right Bank Stability (7)	5
Light Penetration (10)	8
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	81

Substrate	Mixture of gravel, cobble, and boulder
-----------	--

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
06/25/07	10193	17	17	5.4	5.4	Good-Fair
07/21/97	7374	14	14	5.6	5.6	Good-Fair
09/09/92	6013	65	12	6.5	4.9	Fair

Taxonomic Analysis

Several new mayflies, stoneflies, and caddisflies were added to the taxa list for this location in 2007. Mayflies included *Plauditus dubius* group, *Baetis intercalaris*, *Baetis pluto*, and *Tricorythodes* sp. Caddisflies included *Chimarra* sp. and *Dolophilodes* sp., both of which are sensitive to pollution as well as the more tolerant *Nectopsyche exquisita*. No stoneflies were collected at this location during the current sampling event.

Data Analysis

The bioclassification of this study location has improved from Fair in 1992 to Good-Fair in both 1997 and 2007. It was not sampled in 2002 because access was restricted to protect a federally endangered mussel. There are no upstream NPDES dischargers and the habitat received a high score. The number of EPT taxa has increased slightly over the 15 years of sampling at this site. The current bioclassification may have been negatively affected by the severity of drought conditions in 2007. This suggestion is supported by the low levels of dissolved oxygen at this site at the time of sampling; many pollution sensitive taxa (i.e. some EPT) are affected by physico-chemical stress.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
TAR R	SR 1609	OB27	06/27/07	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
FRANKLIN	1	03020101	355805	781320	0	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-V;NSW	633.1	200	18	0.3

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

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Oxford WWTP	NC0025054	3.5
Franklin County WWTP	NC0069311	3.0
Tar River WRF	NC0020231	1.37

Water Quality Parameters

Temperature (°C)	27.9
Dissolved Oxygen (mg/L)	6.4
Specific Conductance (µS/cm)	120
pH (s.u.)	7.3

Water Clarity	slightly turbid
---------------	-----------------

Site Photograph



Habitat Assessment Scores (max)

Channel Modification (5)	3
Instream Habitat (20)	15
Bottom Substrate (15)	7
Pool Variety (10)	9
Riffle Habitat (16)	14
Left Bank Stability (7)	5
Right Bank Stability (7)	5
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	75

Substrate	Mostly gravel and sand
-----------	------------------------

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
06/27/07	10199	68	25	4.9	3.9	Good
07/23/02	8917	68	26	5.2	4.6	Good
08/27/97	7462	73	23	5.2	4.6	Good

Taxonomic Analysis

Several pollution sensitive taxa were collecting during the 2007 sampling event; these included the mayflies *Isonychia* sp., *Heptagenia pulla*; the stoneflies *Acroneuria abnormis*, *Neoperla* sp. *Paragnetina fumosa*, and *Pteronarcys dorsata*; and the caddisflies *Chimarra* sp., and *Micrasema rusticum*. New EPT taxa included *Pseudocloeon propinquum*, *Maccaffertium lenati*, *Perlesta* sp., and *Micrasema rusticum*.

Data Analysis

This study location has rated Good all three times that it has been sampled between 1997 and 2007. There are three major NPDES dischargers upstream of the study site contributing to the high conductivity measured during the current sampling event. The habitat at this study location was fairly high quality except for the marginal instream habitat for invertebrate colonization and the homogeneous streambed substrata consisting of mostly sand and gravel.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
TAR R	NC 97	OB58	06/27/07	Good-Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
EDGECOMBE	2	03020101	355719	774716	0	Rolling Coastal Plain

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;NSW	867.4	75	40	0.2

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

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Oxford WWTP	NC0025054	3.5
Franklin County WWTP	NC0069311	3.0
Tar River WRF	NC0020231	1.37
Sunset Avenue WWTP	NC0072133	not limited

Water Quality Parameters

Temperature (°C)	28
Dissolved Oxygen (mg/L)	7.3
Specific Conductance (µS/cm)	110
pH (s.u.)	6.9

Water Clarity	Clear
---------------	-------

Site Photograph



Habitat Assessment Scores (max)

Channel Modification (5)	2
Instream Habitat (20)	11
Bottom Substrate (15)	9
Pool Variety (10)	9
Riffle Habitat (16)	3
Left Bank Stability (7)	5
Right Bank Stability (7)	5
Light Penetration (10)	2
Left Riparian Score (5)	2
Right Riparian Score (5)	3
Total Habitat Score (100)	51

Substrate	Mostly gravel and cobble
-----------	--------------------------

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
06/27/07	10201	72	21	6.0	5.0	Good-Fair
07/24/02	8916	89	24	6.0	5.0	Good-Fair
07/22/97	7381	71	26	5.9	5.0	Good
07/23/92	5913	79	24	5.9	4.8	Good-Fair
07/12/90	5359	77	23	5.6	4.7	Good

Taxonomic Analysis

Stoneflies have not been collected at this location since 1990. EPT Taxa not previously collected at NC 97 were limited to the mayflies *Pseudocloeon dardanum* and *Maccaffertium terminatum*. Most of the EPT taxa collected are considered relatively pollution tolerant; exceptions included the sensitive mayfly *Leucrocota* sp. and the caddisflies *Oecetis morsei* and *Chimarra* sp.

Data Analysis

This location has been given the bioclassification of either Good or Good-Fair during the last five sampling events. Likely contributing to the current rating of Good-Fair are the presence of four major upstream dischargers. In addition to these point source pollutants, this study location is within the City of Rocky Mount, and therefore likely receives significant nonpoint source pollution as well. In addition to the chemical stressors at this site, the habitat was also degraded. Contributing to this score was a combination of stream channelization, a lack of quality colonizable habitats, infrequent riffles, and an open stream canopy.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
TAR R	SR 1252	OB63	06/27/07	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
EDGECOMBE	2	03010107	355622	773926	0	Rolling Coastal Plain

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV;NSW	1006.8	39	30	0.1

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

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Oxford WWTP	NC0025054	3.5
Franklin County WWTP	NC0069311	3.0
Tar River WRF	NC0020231	1.37
Tar River Regional WWTP	NC0030317	21

Water Quality Parameters

Temperature (°C)	30.7
Dissolved Oxygen (mg/L)	9
Specific Conductance (µS/cm)	153
pH (s.u.)	7.8

Water Clarity	slightly turbid
---------------	-----------------

Site Photograph



Habitat Assessment Scores (max)

Channel Modification (5)	2
Instream Habitat (20)	15
Bottom Substrate (15)	6
Pool Variety (10)	10
Riffle Habitat (16)	7
Left Bank Stability (7)	3
Right Bank Stability (7)	3
Light Penetration (10)	2
Left Riparian Score (5)	4
Right Riparian Score (5)	5
Total Habitat Score (100)	57

Substrate	Mostly gravel
-----------	---------------

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
06/27/07	10203	63	23	5.7	4.8	Good
08/01/02	8897	79	19	5.8	4.8	Good-Fair
07/22/97	7379	68	26	5.4	4.4	Good
03/02/88	4499	66	14	6.9	5.1	Fair

Taxonomic Analysis

Several pollution sensitive taxa were collected during this sampling event including the mayfly *Isonychia* sp., the stoneflies *Acroneuria abnormis* and *Neoperla* sp., and the caddisflies *Chimarra* sp., *Oecetis morsei*, and *Oxyethira* sp. However, most of the EPT taxa collected are considered facultative.

Data Analysis

The bioclassification of this location has steadily improved from Fair in 1988 to Good in 2007. There are several major NPDES dischargers upstream of SR 1252. The drought that occurred in 2007 may have concentrated the various effluents, and the high conductivity reported here seems to support this assertion. In addition to chemical stressors the habitat received a low score because it lacked quality streambed substrate and riffle habitats, and a stream canopy. Although a combination of stressors is likely at work at this location, a trend of increasing bioclassification still persists.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
SHELTON CR	US 158	05/17/06	OF38	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRANVILLE	1	03020101	36.31305556	-78.72111111	28-4	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-IV,NSW	23.8	0	12	0.4	Yes

Visible Landuse (%)	Forested/Wetland	Urban	Agriculture	Other (describe)
	75	10 (rural residential)	15	0

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

Water Quality Parameters

Temperature (°C)	14.2
Dissolved Oxygen (mg/L)	8.5
Specific Conductance (µS/cm)	73
pH (s.u.)	6.0

Water Clarity

Turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	10
Pool Variety (10)	10
Riffle Habitat (16)	7
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	9
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	79

Site Photograph



Substrate

cobble, gravel, sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/17/06	2006-49	18	50	Good
04/06/99	99-01	20	56	Excellent
04/14/97	97-20	24	58	Excellent
04/07/92	92-04	19	54	Excellent

Most Abundant Species

Bluehead Chub

Exotic Species

Green Sunfish

Species Change Since Last Cycle

Gains -- White Sucker, Eastern Mosquitofish, Largemouth Bass, and Creek Chub. **Losses** -- Warmouth, Notchlip Redhorse, Golden Shiner, Highfin Shiner, and Chainback Darter.

Data Analysis

Sampled in 2006 as part of an EEP Local Watershed study (BAU Memo 20060728). **Watershed** -- a headwater tributary to the Tar River located in west-central Granville County; this catchment lies between the Tar River headwaters and the North Fork Tar River watersheds. **Habitat** -- pools, runs with snags, riffles, *Valisneria*, and deadfalls crossing the stream; good riparian zone widths. **2006** -- fewer total species than expected, but still a diverse and abundant fish community present; the change in NCIBI score and rating comes from a slight shift in the trophic structure including the loss of the intolerant Chainback Darter. **1992 - 2006** -- there are a total of 29 known species from this watershed including 4 species of suckers, 8 species of minnows, 6 species of sunfish, 3 species of darters, and 2 species of catfish. Even with the slight decline in NCIBI score and rating, water quality remains high in this watershed.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
N FK TAR R	US 158	OB19	06/25/07	Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRANVILLE	1	03020101	361856	784143	0	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV; NSW	276.8	407	8	0.3

Visible Landuse (%)	Forested/Wetland	Urban	Agriculture	Other (describe)
	20	0	80	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)	3.4
Specific Conductance (µS/cm)	113
pH (s.u.)	6.8

Water Clarity	slightly turbid
---------------	-----------------

Habitat Assessment Scores (max)

Channel Modification (5)	3
Instream Habitat (20)	12
Bottom Substrate (15)	14
Pool Variety (10)	8
Riffle Habitat (16)	3
Left Bank Stability (7)	4
Right Bank Stability (7)	6
Light Penetration (10)	10
Left Riparian Score (5)	4
Right Riparian Score (5)	4
Total Habitat Score (100)	68

Site Photograph



Substrate	Mostly gravel and cobble
-----------	--------------------------

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
06/25/07	10192	12	12	5.3	5.3	Fair
07/21/97	7375	17	17	5.3	5.3	Good-Fair
07/27/92	5915	8	8	6.3	6.3	Fair

Taxonomic Analysis

Several taxa occurred in the 2007 sample that have not been previously collected at this location; including the mayflies *Baetis flavistriga* and *B. intercalaris*; the stonefly *Perlesta* sp.; and the caddisfly *Mystacides sepulchralis*. Most of the species collected are relatively tolerant of pollution, but a few, including the mayflies *Isonychia* sp. and *Leucrocota* sp. are sensitive.

Data Analysis

This study site has been given Fair and Good-Fair bioclassifications for the years 1992 and 1997, and the current sample was given a Fair rating. The habitat at this site received a correspondingly low score that was largely affected by a lack of colonizable habitats such as rootmats and woody debris and the infrequency of riffles. In addition, the remains of a beaver dam upstream suggested that flow may have been severely interrupted in the recent past. The majority of pollution coming into this stream originates from nonpoint sources in this agricultural watershed. Since 2007 was a year of extreme drought, it seems unlikely that these were a major factor affecting water quality.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
N FK TAR RIVER	SR 1151	04/09/07	OF60	Excellent

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRANVILLE	1	03020101	36.299579	-78.7007895	28-5	Carolina Slate Belt

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-IV;NSW	21.2	400	10	0.5	No

Visible Landuse (%)	Forested/Wetland	Urban	Agriculture	Other (describe)
	70	5 (rural residential)	0	25 (logged a few years ago)

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

Water Quality Parameters

Temperature (°C)	8.8
Dissolved Oxygen (mg/L)	11.1
Specific Conductance (µS/cm)	87
pH (s.u.)	7.0

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)	5
Left Bank Stability (7)	2
Right Bank Stability (7)	2
Light Penetration (10)	9
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	63

Site Photograph



Substrate

Gravel, sand, clay banks

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/09/07	2007-08	18	58	Excellent
10/14/99	99-64	15	46	Good
06/24/99	99-54	20	48	Good
04/06/99	99-02	18	48	Good
04/14/97	97-21	23	54	Excellent
04/07/92	92-05	16	46	Good

Most Abundant Species

Swallowtail Shiner

Exotic Species

None

Species Change Since Last Cycle

Gains -- Roanoke Bass, Satinfish Shiner, Chain Pickerel, Northern Hogsucker, Largemouth Bass, Highfin Shiner, Margined Madtom, and Roanoke Darter (intolerant). **Losses** -- Green Sunfish, Warmouth, Redear Sunfish, V-lip Redhorse, and Creek Chub.

Data Analysis

Sampled this location as a 2007 Random Ambient Monitoring site, but will also serve as the new basinwide site; formerly sampled at US 158 (one bridge and 1.9 miles upstream). **Watershed** -- a transitional site with its catchment in both the Carolina Slate Belt and the Northern Outer Piedmont ecoregions; drains the north-central part of Granville County, west of Oxford. Land use is largely forest and agriculture. **Habitats** -- lots of coarse woody debris including snags and large deadfalls (some creating riffles accross the channel), and gravel riffles; low flow. **2007** -- a diverse and trophically balanced assemblage of fish including 18 species, three of which are considered intolerant to pollution. This sample represents the highest NCIBI score to date for this stream. **1992 - 2007** -- good water quality continues to be displayed in this watershed, with a total of 34 known fish species, including 5 suckers, 10 minnows, 6 sunfish, 3 catfish, and 3 darters.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
FISHING CR	SR 1643	OB10	06/25/07	Good-Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRANVILLE	1	03020101	361326	783430	0	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;NSW	76.9	310	20	0.2

Visible Landuse (%)	Forested/Wetland	Urban	Agriculture	Other (describe)
	30	30	40	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Oxford WWTP	NC0025054	3.5

Water Quality Parameters

Temperature (°C)	24.3
Dissolved Oxygen (mg/L)	8.3
Specific Conductance (µS/cm)	339
pH (s.u.)	7.7

Water Clarity	clear
---------------	-------

Site Photograph



Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	12
Pool Variety (10)	9
Riffle Habitat (16)	10
Left Bank Stability (7)	6
Right Bank Stability (7)	5
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	80

Substrate	Mixture of gravel, cobble, and boulders
-----------	---

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
06/25/07	10194	59	19	5.9	5.5	Good-Fair
03/23/06	9820	79	23	5.5	4.2	Good
07/22/02	8812	62	16	5.7	5.1	Good-Fair
05/18/99	7855	11	11	5.6	5.6	Fair
07/21/97	7376	61	18	5.8	5.3	Good-Fair

Taxonomic Analysis

While the number of EPT taxa declined from 23 in 2006 to 19 in 2007, there is an overall trend of increasing diversity for these orders since 1997. There were more Ephemeroptera collected in 2007 (12) than in 2006 (9), including the sensitive taxa *Isonychia* sp., *Leucrocota* sp., and *Stenacron pallidum*. There were no Plecoptera collected in 2007, whereas 6 species were recorded in 2006. However, seasonal differences were likely important in this and other taxonomic dissimilarities between the 2006 and 2007 data.

Data Analysis

Bioclassifications at SR 1643 have fluctuated between Fair and Good since 1997. For the 2007 sampling event, riffles were infrequent along the study reach, but the overall habitat at this study site was still good and received a score of 80. Interestingly, of the five years of data compared here, all but those of 2007 had stoneflies. The absence of these animals negatively affected the bioclassification of this site. Although the severe drought of 2007 may have affected the benthic community directly (i.e. stoneflies require flowing water) the specific conductance was 339, indicating that wastewater effluent may have also been concentrated and an additional stressor to aquatic life.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
FISHING CR	SR 1643	05/18/06	OF17	Excellent

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRANVILLE	1	03020101	36.22277778	-78.57638889	28-11e	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;NSW	44.1	0	12	0.4	No

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

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

Oxford Waste Water Treatment Plant (~5.25 miles upstream)	NC0025054	3.5
---	-----------	-----

Water Quality Parameters

Temperature (°C)	15.6
Dissolved Oxygen (mg/L)	8.4
Specific Conductance (µS/cm)	186
pH (s.u.)	6.1

Water Clarity

Turbid

Site Photograph



Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	14
Pool Variety (10)	10
Riffle Habitat (16)	16
Left Bank Stability (7)	7
Right Bank Stability (7)	7
Light Penetration (10)	9
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	96

Substrate

cobble, boulder, gravel

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/18/06	2006-52	22	56	Excellent
04/08/02	2002-02	20	50	Good
04/14/97	97-22	18	52	Good
04/07/92	92-06	18	42	Good-Fair

Most Abundant Species

Swallowtail Shiner

Exotic Species

Green Sunfish

Species Change Since Last Cycle

Gains -- Roanoke Bass, Eastern Mosquitofish, Bull Chub, Chainback Darter, and Blacktip Jumprock. **Losses** -- Rosyside Dace, Largemouth Bass, and Creek Chub.

Data Analysis

Sampled in 2006 as part of an EEP Local Watershed study (BAU Memo 20060728). **Watershed** -- a tributary to the Tar River, located about 3 miles above its confluence; drains part of central Granville County, including the Town of Oxford. **Habitat** -- high quality Carolina Slate Belt type habitats; runs, riffles, and boulder pools; great forested riparian zones including bluffs with mountain laurel. **2006** -- high abundance (n = 621) and diversity of the fish community, including 3 intolerant species, over 400 more fish than in 2002, and the highest rating ever at this site. **1992 - 2006** -- high diversity site; 27 species of fish are known from this watershed, including 4 species of suckers, 5 species of sunfish, 10 species of minnows, and 4 species of darters. Despite a slightly higher conductivity (9% higher than 2002), the additional effluent flow from the Oxford WWTP (increased from 2.17 to 3.5 MGD in early 2004) appears to be benefiting the fish community through consistent flows in this part of the watershed.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
COON CR	SR 1609	05/18/06	OF11	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRANVILLE	1	03020101	36.26805556	-78.56777778	28-11-5	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C,NSW	25.2	0	10	0.4	No

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

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

Water Quality Parameters

Temperature (°C)	14.6
Dissolved Oxygen (mg/L)	7.8
Specific Conductance (µS/cm)	125
pH (s.u.)	6.1

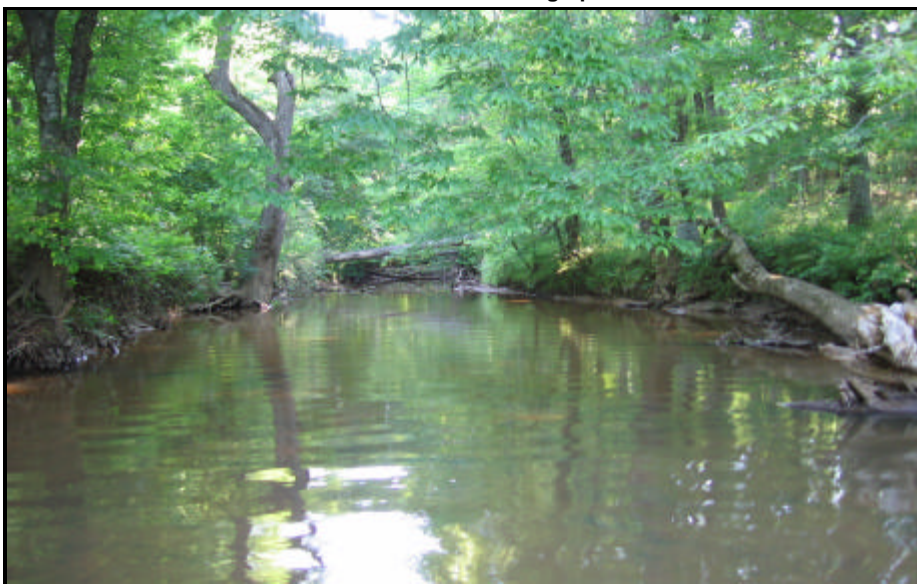
Water Clarity

Slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	3
Pool Variety (10)	9
Riffle Habitat (16)	0
Left Bank Stability (7)	5
Right Bank Stability (7)	5
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	65

Site Photograph



Substrate

sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/18/06	2006-51	20	46	Good
04/08/02	2002-03	18	54	Excellent

Most Abundant Species

Johnny Darter

Exotic Species

Green Sunfish and Redear Sunfish

Species Change Since Last Cycle

Gains -- Redfin Pickerel, Eastern Mosquitofish, Green Sunfish, and Redear Sunfish. **Losses** -- Rosyside Dace and Chainback Darter.

Data Analysis

Sampled in 2006 as part of an EEP Local Watershed study (BAU Memo 20060728). **Watershed** -- a tributary to Fishing Creek located in east-central Granville County; drains the northern and eastern portions of the Town of Oxford. **Habitat** -- shallow runs with snags, undercuts, coarse woody debris, and no riffles; good canopy and riparian zone widths; moderately elevated conductivity due to the urban drainage. **2006** -- a diverse and abundant (n = 426) fish community present; although the NCIBI score and rating fell in 2006, the changes within the trophic structure causing the decline were not substantial. **2002 - 2006** -- a total of 22 fish species are known from this stream including 2 sucker species, 7 minnow species, and 4 darter species; despite the non point urban runoff from Oxford, water quality remains pretty good in this catchment.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
MIDDLE CR	SR 1203	04/09/07	OF28	Excellent

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
FRANKLIN	1	03020101	36.17194444	-78.4875	28-15	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;NSW	8.8	295	7	0.5	No

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

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

Water Quality Parameters

Temperature (°C)	9.8
Dissolved Oxygen (mg/L)	11.1
Specific Conductance (µS/cm)	83
pH (s.u.)	7.3

Water Clarity

Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	13
Bottom Substrate (15)	3
Pool Variety (10)	10
Riffle Habitat (16)	0
Left Bank Stability (7)	2
Right Bank Stability (7)	2
Light Penetration (10)	9
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	54

Site Photograph



Substrate

sand, silt

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/09/07	2007-09	25	56	Excellent
04/08/02	2002-01	19	50	Good

Most Abundant Species

Pinewoods Shiner

Exotic Species

Green Sunfish

Species Change Since Last Cycle

Gains -- White Sucker, Redfin Pickerel, Eastern Silvery Minnow, Pumpkinseed, Warmouth, Bluegill, Largemouth Bass, and Blacktip Jumprock. **Losses** -- Yellow Bullhead and Rosyside Dace.

Data Analysis

Watershed -- a small tributary to the Tar River; drains a forested area along the Granville and Franklin county line. **Habitat** -- deep pools and runs (influenced by beaver activity), side snags, undercuts, and no riffles; the habitat score was low primarily because of the sandy substrates and the lack of riffle habitats; bank stabilities also suffer in places because of sandy soils; good canopy and riparian zones. **2007** -- very diverse and trophically balanced fish population including two intolerant darters (Chainback Darter and Roanoke Darter) and one intolerant minnow species (Pinewoods Shiner). **2002 - 2007** -- the bioclass improvement to Excellent is primarily due to an increase in the species richness and composition metrics; an additional 3 sunfish species and 2 sucker species were collected in 2007. Twenty seven fish species are now known from this site, including 4 species of suckers, 9 species of minnows, and 4 species of darters.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
TABBS CR	SR 1100	04/10/07	OF41	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
VANCE	1	03020101	36.18222222	-78.45583333	28-17-(0.5)b	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;NSW	70.8	270	11	0.5	No

Visible Landuse (%)	Forested/Wetland	Urban	Agriculture	Other (describe)
	95	5 (rural residential)	0	0

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

Water Quality Parameters

Temperature (°C)	8.2
Dissolved Oxygen (mg/L)	10.3
Specific Conductance (µS/cm)	101
pH (s.u.)	6.3

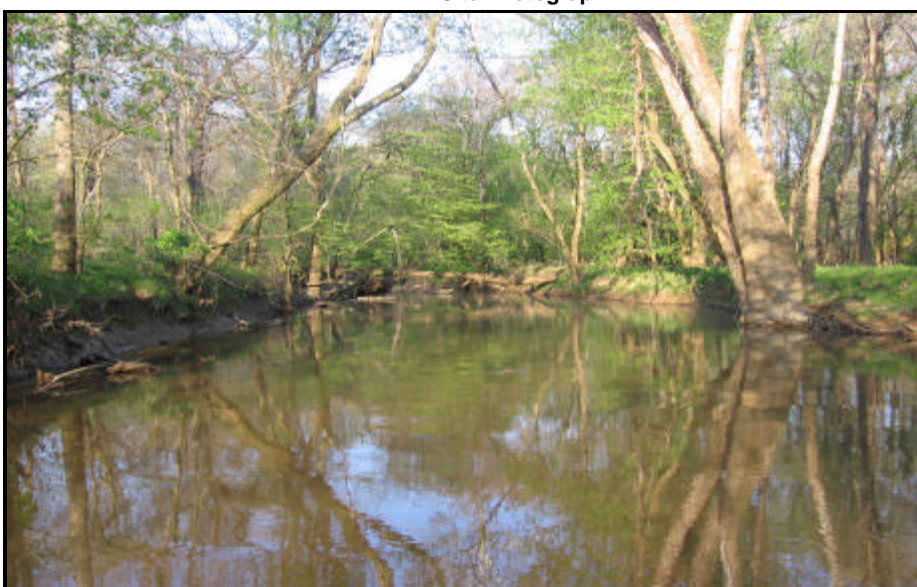
Water Clarity

Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	10
Bottom Substrate (15)	4
Pool Variety (10)	10
Riffle Habitat (16)	0
Left Bank Stability (7)	4
Right Bank Stability (7)	4
Light Penetration (10)	9
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	56

Site Photograph



Substrate

gravel, sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/10/07	2007-10	19	48	Good
10/14/99	99-65	21	46	Good
06/24/99	99-55	21	48	Good
04/09/99	99-05	21	50	Good
04/15/97	97-23	25	56	Excellent
04/08/92	92-07	24	56	Excellent

Most Abundant Species

Redbreast Sunfish

Exotic Species

Green Sunfish

Species Change Since Last Cycle

Gains -- Yellow Bullhead, Redfin Pickerel, Northern Hogsucker, and Largemouth Bass. **Losses** -- Pirate Perch, Warmouth, Bluehead Chub, Bull Chub, Mimic Shiner, and Blacktip Jumprock.

Data Analysis

Watershed -- a large tributary to the Tar River located about 1.5 miles above its confluence; drains the rural southwest area of Vance County, the southern edge of Henderson County, and part of western Granville County. **Habitat** -- mostly run habitats with good woody snags and deadfalls, and no true riffles; fairly straight channel. **2007** -- diverse community of fish present, including 5 species of suckers and 4 species of darters. **1992 - 2007** -- stable NCIBI metrics and bioclassifications across sampling years; the fish community remains dominated by insectivores. A total of 36 species are known from this site including 6 species of suckers, 10 species of minnows, and 4 species of darters.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
LYNCH CR	SR 1235	04/10/07	OF27	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
FRANKLIN	1	03020101	36.14861111	-78.34166667	28-21-(0.7)	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-IV;NSW	23.9	220	9	0.5	No

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

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

Water Quality Parameters

Temperature (°C)	8.1
Dissolved Oxygen (mg/L)	10.4
Specific Conductance (µS/cm)	70
pH (s.u.)	6.8

Water Clarity

Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	3
Pool Variety (10)	10
Riffle Habitat (16)	5
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	9
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	72

Site Photograph



Substrate

clay, silt, sand, gravel

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/10/07	2007-11	25	50	Good
05/24/99	99-35	19	46	Good
04/15/97	97-25	24	48	Good
06/18/92	92-20	15	38	Fair

Most Abundant Species

Satinfin Shiner

Exotic Species

Green Sunfish

Species Change Since Last Cycle

Gains -- Chain Pickerel, Tessellated Darter, Eastern Mosquitofish, Eastern Silvery Minnow, Northern Hogsucker, Warmouth, Bluegill, and Notchlip Redhorse. **Losses** -- American Eel and Bluehead Chub.

Data Analysis

Watershed -- a tributary to the Tar River located about one mile above its confluence; drains parts of northwest Franklin County and southeast Vance County. **Habitat** -- although well within the Northern Outer Piedmont, this site exhibits habitat types that resemble a bottom lands stream of the Rolling Coastal Plain; slightly stained runs and pools with coarse woody debris, snags, and deadfalls; good riparian zone widths. **2007** -- very diverse fish community present with the highest NCIBI score yet at this site. **1992 - 2007** -- this site continues to maintain an abundant and highly diverse fish community, with relatively stable metric scores and no apparent water quality issues. Thirty three species are known from this site including 5 species of suckers, 5 species of darters, and 9 species of minnows.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
CEDAR CR	SR 1105	06/10/04	OF6	Excellent

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
FRANKLIN	1	03020101	36.07166667	-78.40916667	28-29-(2)b	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C, NSW	31.5	240	6	0.4	No

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

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

NPDES Number	Volume (MGD)
Franklin County WWTP	NC0069311
Franklin County WWTP	NC0069311
	1.0 (prior to 12/2002)
	3.0 (since 12/2002)

Water Quality Parameters

Temperature (°C)	27.0
Dissolved Oxygen (mg/L)	6.6
Specific Conductance (µS/cm)	180
pH (s.u.)	6.2

Water Clarity

Slightly turbid

Site Photograph



Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	14
Bottom Substrate (15)	4
Pool Variety (10)	6
Riffle Habitat (16)	2
Left Bank Stability (7)	4
Right Bank Stability (7)	4
Light Penetration (10)	8
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	57

Substrate

Sand and coarse woody debris

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
06/10/04	2004-80	21	56	Excellent
04/10/02	2002-09	22	54	Excellent
04/16/97	97-26	17	50	Good
04/08/92	92-08	19	48	Good

Most Abundant Species

Bluehead Chub and Green Sunfish

Exotic Species

Green Sunfish

Species Change Since Last Cycle

Gains -- Yellow Bullhead, Brown Bullhead, and Green Sunfish. **Losses** -- Pinewoods Shiner, Golden Shiner, Blacktip Jumprock, and Redear Sunfish.

Data Analysis

Watershed -- drains central Franklin County, including the southwest part of the Town of Franklin; site is ~1.1 miles below WWTP; site is ~ 4.2 miles above the basinwide site sampled from 1992-2002 and the difference in the drainage area was 8.7 sq. miles; treated as the same site (Station ID OF6 and OF7).

Habitat -- sandy runs, coarse woody debris on current; snag pools; gravelly riffles; good riparian zones. **2004** -- almost twice as many fish collected in 2004 than in 2002 5 species of darters were present; Creek Chub represented only by young-of-year. **1992 - 2004** -- conductivity has steadily increased from 74 µS/cm in 1992 to 180 µS/cm in 2004; 26 species known from the site, including 5 species of darters, 4 species of suckers, and 3 intolerant species; NCIBI Score has gradually increased from 48 (Good) in 1992 to 56 (Excellent) in 2004; 2004 data were also used as part of a NCSU Urban Fish Study.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CEDAR CR	SR 1109	OB4	06/26/07	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
FRANKLIN	1	03020201	360337	782114	0	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;NSW	633.1	229	5	0.2

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

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Franklin County WWTP	NC0069311	3.0

Water Quality Parameters

Temperature (°C)	23.9
Dissolved Oxygen (mg/L)	6.5
Specific Conductance (µS/cm)	282
pH (s.u.)	7.1

Water Clarity

turbid

Site Photograph

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	10
Bottom Substrate (15)	3
Pool Variety (10)	9
Riffle Habitat (16)	3
Left Bank Stability (7)	5
Right Bank Stability (7)	5
Light Penetration (10)	7
Left Riparian Score (5)	4
Right Riparian Score (5)	4
Total Habitat Score (100)	55

Substrate

Predominantly sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
06/26/07	10195	21	21	5.2	5.2	Good
07/22/02	8863	15	15	5.0	5.0	Good-Fair
07/28/97	7384	14	14	4.4	4.4	Good-Fair

Taxonomic Analysis

The number of Ephemeroptera or mayfly taxa increased from 4 and 6 in 1997 and 2002 respectively to 9 in 2007. New taxa included *Paracloeodes minutus*, *Proclaeon* sp., and *Tricorythodes* sp.. In addition, the number of Plecoptera or stonefly taxa increased from 3 in 1997 and 2002 to 5 in 2007; new species included *Perlesta* sp. and the pollution sensitive taxon *Pteronarcys dorsata*. Of the 7 Trichoptera taxa collected in 2007, only *Brachycentrus nigrosoma* is considered pollution sensitive.

Data Analysis

The streambed substrata was mostly sand, which is a poor habitat for many EPT taxa. In addition, few colonizable habitats were noted, and many of those present were no longer viable due to the severe drought conditions of 2007. Further, riffle habitats were considered rare and of poor quality due to a lack of larger streambed substrata that many macroinvertebrates prefer. The high conductivity measured at SR 1109 may indicate that the upstream Franklin County WWTP is negatively affecting water quality. Despite the effects of poor habitat, drought, and possibly water quality, the bioclassification at this site improved slightly from Good-Fair in 1997-2002, to Good in 2007.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
MAPLE CR	SR 1713	05/08/07	OF50	Not Rated

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
NASH	2	03020101	35.943983	-77.835555	28-66	Rolling Coastal Plain

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-IV,NSW	10.5	100	8	0.3	No

Visible Landuse (%)	Forested/Wetland	Urban/Suburban	Agriculture	Other (describe)
	50	40	0	10 (old quarry pond)

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

Water Quality Parameters

Temperature (°C)	13.7
Dissolved Oxygen (mg/L)	6.5
Specific Conductance (µS/cm)	116
pH (s.u.)	6.8

Water Clarity

Slightly turbid

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	8
Bottom Substrate (15)	7
Pool Variety (10)	8
Left Bank Stability (10)	4
Right Bank Stability (10)	4
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	4
Total Habitat Score (100)	65

Site Photograph



Substrate

Sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/08/07	2007-43	10	---	Not Rated

Most Abundant Species

Eastern Mosquitofish and American Eel

Exotic Species

Green Sunfish

Species Change Since Last Cycle

N/A

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- tributary to the Tar River; drains eastern Nash County; urban/suburban watershed. **Habitat** -- natural channel with bends; an urban stream; shallow, slow moving runs; a few snags and undercuts; bottomland forest; low quality instream habitats; very low flow. **2007** -- low abundance and diversity (fewest species and fish of any site in 2007); 6 of 10 species represented by only 1 or 2 fish/species; dominant species accounted for 63 percent of all the fish; percentage of tolerant fish high (50 percent); intolerant species absent. This site is not rated because the appropriate NCIBI metrics and criteria have yet to be developed for coastal plain streams.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
PIG BASKET CR	SR 1433	04/10/07	OF32	Not Rated

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
NASH	2	03020101	35.99861111	-77.94388889	28-68-3-(2)	Rolling Coastal Plain

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;NSW	19	50	6	0.5	No

Visible Landuse (%)	Forested/Wetland	Urban	Agriculture	Other (describe)
	85	15 (rural residential)	0	0

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

Water Quality Parameters

Temperature (°C)	13.4
Dissolved Oxygen (mg/L)	9.1
Specific Conductance (µS/cm)	99
pH (s.u.)	6.7

Water Clarity

Slightly turbid, tannin stained

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	15
Bottom Substrate (15)	4
Pool Variety (10)	10
Left Bank Stability (10)	9
Right Bank Stability (10)	9
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	82

Site Photograph



Substrate

clay, sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/10/07	2007-12	14	--	Not Rated
04/18/02	2002-23	20	--	Not Rated

Most Abundant Species

Eastern Mosquitofish

Exotic Species

None

Species Change Since Last Cycle

Gains -- None. **Losses** -- Mud Sunfish, Flier, Pumpkinseed, Redear Sunfish, Golden Shiner, and Margined Madtom.

Data Analysis

Watershed -- a tributary to Stony Creek located just west of the Town of Red Oak, approximately three miles above its confluence; a coastal plain stream that drains part of the Northern Outer Piedmont ecoregion. **Habitat** -- coastal plain habitat types with lots of coarse woody debris (snags and deadfalls), and undercut banks; the extensive riparian zones are primarily privet and briar. **2007** -- a fairly typical coastal plain fish community was collected, but with no minnow species; the total abundance of collected fish was about 50% when compared to the previous sample (n = 85 vs. 162 in 2002). **2002 - 2007** -- a total of 20 fish species are known from this site including 1 species of sucker, 8 species of sunfish, 1 minnow species, and 2 species of darter; although not rateable, water quality appears to be good in this watershed.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
COMPASS CR	NC 97	05/08/07	OF51	Not Rated

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
EDGEcombe	2	03020101	35.977145	-77.766907	28-72	SE Floodplains & Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C,NSW	10.4	45	5	0.3	No

Visible Landuse (%)	Forested/Wetland	Urban	Agriculture	Other (describe)
	45	0	40	15 (utility switch yard)

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

Water Quality Parameters

Temperature (°C)	15.2
Dissolved Oxygen (mg/L)	6.7
Specific Conductance (µS/cm)	132
pH (s.u.)	6.3

Water Clarity

Clear, slightly stained

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	17
Bottom Substrate (15)	7
Pool Variety (10)	10
Left Bank Stability (10)	6
Right Bank Stability (10)	6
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	81

Site Photograph



Substrate

Sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/08/07	2007-44	22	---	Not Rated

Most Abundant Species

Satinfin Shiner, Swallowtail Shiner, and Bluegill

Exotic Species

Green Sunfish, Redear Sunfish

Species Change Since Last Cycle

N/A

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- site is ~ 1 mile above the confluence with the Tar River; drains eastern Nash County, including the US 301 corridor and the northern area of the City of Rocky Mount. **Habitat** -- natural channel; very shallow, sandy runs; good snags and roots; wide riparian zones along both banks; very low flow. **2007** -- primarily coastal plain species; abundant and diverse, 22 species, including 8 species of sunfish (most species of sunfish at any site in 2007); tolerant species abundant (Satinfin Shiner, Redbreast Sunfish, and Eastern Mosquitofish); one intolerant species (Pinewoods Shiner) present. This site is not rated because the appropriate NCIBI metrics and criteria have yet to be developed for coastal plain streams.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
BEECH BR	NC 97	05/08/07	OF3	Not Rated

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
EDGEcombe	2	03020101	35.96472222	-77.67527778	28-75-(4)	SE Floodplains & Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-IV;NSW	21.8	45	5	0.3	No

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

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

Water Quality Parameters

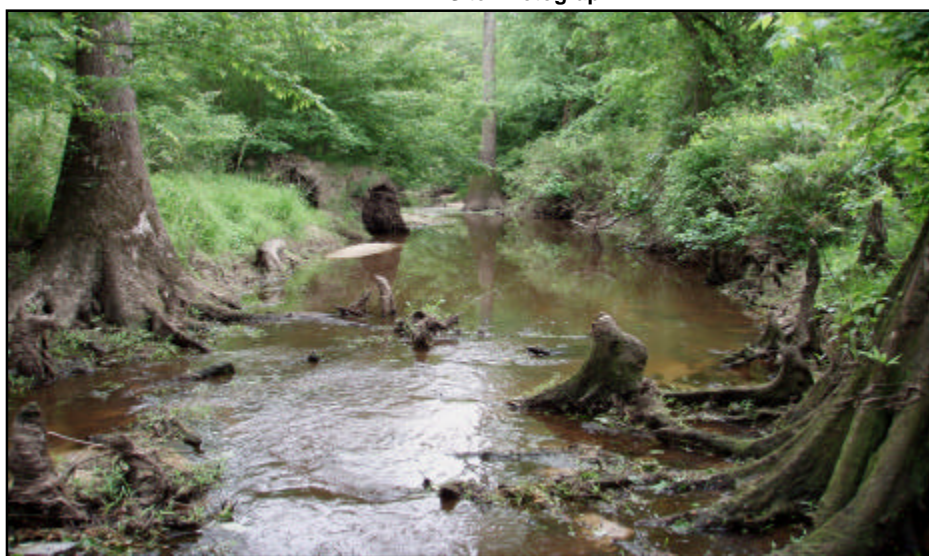
Temperature (°C)	16.6
Dissolved Oxygen (mg/L)	9.4
Specific Conductance (µS/cm)	171
pH (s.u.)	6.9

Water Clarity	Clear, tannin stained
---------------	-----------------------

Habitat Assessment Scores (max)

Channel Modification (15)	10
Instream Habitat (20)	15
Bottom Substrate (15)	13
Pool Variety (10)	6
Left Bank Stability (10)	9
Right Bank Stability (10)	9
Light Penetration (10)	5
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	77

Site Photograph



Substrate	Sand and gravel
-----------	-----------------

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/08/07	2007-45	28 (including 1 hybrid)	---	Not Rated
04/17/02	2002-22	20	---	Not Rated

Most Abundant Species	Bluegill	Exotic Species	Redear Sunfish
-----------------------	----------	----------------	----------------

Species Change Since Last Cycle

Losses -- Bowfin and Green Sunfish. **Gains** -- White Shiner, Bull Chub, Golden Shiner, Notchlip Redhorse, White Perch, Mud Sunfish, Largemouth Bass, Johnny Darter, and Chainback Darter.

Data Analysis

Watershed -- site is ~ 0.5 mile from the confluence with the Tar River; drains the northeast portion of the City of Rocky Mount, a portion of the Town of Battleboro, and northwestern Edgecombe County. **Habitat** -- channelized and logged a long time ago; open canopy; cane brakes along both shorelines; thick filamentous algae (*Vaucheria*); macrophytes; very shallow with pools; conductivity elevated; very low flow. **2007** -- 27 species, most species of any site in the basin in 2007, including 7 species of sunfish, 4 species of darters, and 2 species of suckers; 3 species migrants from the Tar River (Bull Chub, Notchlip Redhorse, and White Perch). **2002 & 2007** -- extremely diverse and abundant, 29 species, including 9 species of sunfish; dominant species were Bluegill, Eastern Mosquitofish, Tessellated Darter, and Satinfish Shiner; ~ twice as many fish collected in 2007 than in 2002, primarily due to low flow in 2007; Bluegill increased 7-fold, represented by Age 1 and 2 year old fish; conductivity elevated (181 and 171 µS/cm, respectively in 2002 and 2007). This site is not rated because the appropriate NCIBI metrics and criteria have yet to be developed for coastal plain streams.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
SWIFT CR	SR 1310	OB56	06/26/07	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
NASH	2	03020101	360642	775511	0	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;ORW;NSW	153.9	147	15	0.2

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

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

Water Quality Parameters

Temperature (°C)	24.6
Dissolved Oxygen (mg/L)	6.2
Specific Conductance (µS/cm)	86
pH (s.u.)	6.7

Water Clarity	slightly turbid
---------------	-----------------

Habitat Assessment Scores (max)

Channel Modification (15)	10
Instream Habitat (20)	15
Bottom Substrate (15)	15
Pool Variety (10)	6
Left Bank Stability (10)	7
Right Bank Stability (10)	7
Light Penetration (10)	3
Left Riparian Score (5)	3
Right Riparian Score (5)	3
Total Habitat Score (100)	69

Site Photograph



Substrate	Mostly gravel and cobble
-----------	--------------------------

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
06/26/07	10197	65	22	5.0	4.1	Good
04/24/03	9113	89	30	4.8	4.0	Excellent
07/23/97	7382	62	20	5.3	4.2	Good
11/12/96	7234	20	20	4.1	4.1	Good-Fair
03/05/96	7016	87	33	4.7	2.9	Excellent

Taxonomic Analysis

The mayfly taxa list generated in 2007 matched that of 1997 relatively closely with the additions of *Pseudocloeon ephippium* and *Maccaffertium terminatum*. The stonefly list was also similar between these years, but *Perlesta* sp. was added in 2007. Pollution sensitive taxa collected in the current sample included the mayfly *Isonychia* sp., the stoneflies *Paragnetina fumosa* and *Pteronarcys dorsata*, and the caddisflies *Brachycentrus nigrosoma*, *B. numerosus*, *Micrasema wataga*, and *Pycnopsyche* sp.

Data Analysis

This study location was given a bioclassification of Excellent and Good-Fair during separate collections in 1996, it rated Good in 1997, Excellent in 2003, and Good during the current sampling event. The benthic community at this location likely benefits from having no upstream NPDES dischargers and from habitats such as mixed streambed substrata and abundant riffles. These two habitat features are known to promote colonization for many sensitive (i.e. EPT) invertebrate groups. The bioclassification at this study location may have been adversely affected by the severe drought occurring during 2007, which could explain in part the decline in rating from 2003 to 2007.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
SWIFT CR	SR 1253	OB55	06/27/07	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
EDGEcombe	2	03020101	355757	773510	0	SE Floodplains and Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV;NSW	254.3	39	15	0.2

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

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
North Edgecombe High School	NC0050431	0.02

Water Quality Parameters

Temperature (°C)	27.3
Dissolved Oxygen (mg/L)	8.2
Specific Conductance (µS/cm)	100
pH (s.u.)	6.6

Water Clarity	clear
---------------	-------

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	17
Bottom Substrate (15)	12
Pool Variety (10)	9
Left Bank Stability (10)	9
Right Bank Stability (10)	9
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	88

Site Photograph



Substrate	Mostly gravel
-----------	---------------

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
06/27/07	10202	87	28	5.5	4.0	Good
06/24/04	9392	95	30	5.5	4.1	Excellent
07/25/02	8914	86	24	5.7	4.2	Good
07/22/97	7380	73	24	5.0	3.8	Excellent
02/01/89	4819	74	29	5.2	3.8	Excellent

Taxonomic Analysis

Although the taxonomic richness of the EPT decreased slightly from the last sampling in 2004, there were several species present that had not been previously collected. These included the mayflies *Maccaffertium terminatum*, *Pseudocloeon dardanum*, and *P. ephippiatum*; and the caddisflies *Hydropsyche rossi* and *Oxyethira* sp. (an uncommon and sensitive taxon). Four stonefly taxa were also collected during sampling, including the "sensitive", or pollution intolerant taxa *Acronuria abnormis*, *Paragnetina fumosa*, and *Pteronarcys dorsata*.

Data Analysis

The water quality at this study location has either rated Good or Excellent during five sampling events spanning 18 years. The only two years in which the bioclassification was lowered to good were during two years of severe drought (2002, 2007). This trend has also been observed at other locations (Sandy Creek, SR 1405) for these two years and within this basin and HUC. Edgecombe High School is the only NPDES discharger (minor) located upstream. The good habitat score at this site was positively affected by a lack of channelization, bank stability, and great riparian habitat.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
SANDY CR	SR 1405	OB35	06/26/07	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
NASH	2	03020101	360738	780130	0	Rolling Coastal Plain

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;NSW;+	121.5	192	6	0.2

Visible Landuse (%)	Forested/Wetland	Urban	Agriculture	Other (describe)
	30	0	70	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)	6.7
Specific Conductance (µS/cm)	83
pH (s.u.)	7.1

Water Clarity	slightly turbid
---------------	-----------------

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	11
Pool Variety (10)	9
Riffle Habitat (16)	12
Left Bank Stability (7)	5
Right Bank Stability (7)	5
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	80

Site Photograph



Substrate	Mostly gravel and cobble
-----------	--------------------------

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
06/26/07	10196	71	22	5.0	3.9	Good
03/23/06	9819	89	36	4.9	3.5	Excellent
04/21/03	9109	84	32	5.2	4.5	Excellent
06/10/02	8788	61	21	5.3	4.2	Good

Taxonomic Analysis

Considerably fewer EPT taxa were collected in 2007 than in 2006. Of these, only the mayfly *Isonychia* sp., and the stoneflies *Acroneuria abnormis* and *Pteronarcys dorsata* are considered sensitive to poor water quality. Sensitive caddisflies were more common, and included *Brachycentrus nigrosoma*, *B. numerosus*, *Neophylax fuscus*, and *N. oligius*. The mayflies *Maccaffertium terminatum*, and *Tricorythodes* sp. were collected for the first time in 2007 at this location.

Data Analysis

There are no NPDES dischargers upstream of this study location, and the historic and current bioclassifications reflect the good water quality. This study site was rated Good in 2002, Excellent in 2003 and 2006, and again Good during the current sampling event. The habitat in 2007 was also given a relatively high score. The ratings of Good instead of Excellent given to this location in 2002 and 2007 may be in part attributable to the severe drought that occurred during both years. The number of EPT taxa collected was considerably lower during these years, but this was likely a seasonal effect as many of these species emerge as adults during spring months.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
RED BUD CR	SR 1407	04/11/07	OF33	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
NASH	2	03020101	36.11611111	-78.02111111	28-78-1-17	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;NSW:+	18.9	190	7	0.4	Yes

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

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

Water Quality Parameters

Temperature (°C)	10.8
Dissolved Oxygen (mg/L)	10.1
Specific Conductance (µS/cm)	80
pH (s.u.)	6.1

Water Clarity

Slightly tannin stained

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	12
Pool Variety (10)	6
Riffle Habitat (16)	16
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	9
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	88

Site Photograph



Substrate

cobble, gravel, flat bedrock

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/11/07	2007-13	22	50	Good
04/09/02	2002-06	16	50	Good

Most Abundant Species

Pinewoods Shiner

Exotic Species

Green Sunfish

Species Change Since Last Cycle

Gains -- Flat Bullhead, Satinfish Shiner, Redfin Pickerel, Warmouth, Largemouth Bass, Highfin Shiner, and Swallowtail Shiner. **Losses** -- Notchlip Redhorse.

Data Analysis

Watershed -- a tributary to Sandy Creek, and ultimately Swift Creek; drains northeastern Franklin and northwestern Nash counties. **Habitat** -- much like a Carolina Slate Belt stream with good riffles, runs, and undercuts; good forested riparian. **2007** -- good diversity and abundance for a stream of this size. **2002 - 2007** -- nearly identical NCIBI metrics between sample years; the most notable difference was the increase in total abundance (n = 277 vs. 191 in 2002) and diversity (n = 22 species vs. 16 in 2002) of the fish population in 2007; a total of 23 species are known from this regional reference site including 3 species of darters, 6 species of minnows, and 3 species of suckers; this watershed continues to support a diverse community of fish with good water quality.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
WHITE OAK SWP	SR 1428	0	02/05/07	Moderate

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
EDGECOMBE	2	03020101	360016	773713	0	Rolling Coastal Plain

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV;NSW	47.7	49	5	0.3

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

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

Water Quality Parameters

Temperature (°C)	4
Dissolved Oxygen (mg/L)	11.5
Specific Conductance (µS/cm)	76
pH (s.u.)	5.7

Water Clarity	clear/tannic
---------------	--------------

Habitat Assessment Scores (max)

Channel Modification (10)	5
Instream Habitat (20)	10
Bottom Substrate (15)	7
Pool Variety (10)	6
Left Bank Stability (10)	7
Right Bank Stability (10)	7
Light Penetration (10)	10
Left Riparian Score (5)	4
Right Riparian Score (5)	5
Total Habitat Score (100)	61

Site Photograph



Substrate	Nearly all sand
-----------	-----------------

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/05/07	10133	50	8	6.6	5.6	Moderate
02/11/02	8670	40	7	6.5	5.6	Moderate
05/03/88	4540	11	11	5.2	5.2	Not Rated

Taxonomic Analysis

The total number of taxa (ST), and the number of EPT taxa collected at this study site has increased from 2002 to 2007. Additions to this sites taxa list include the stonefly *Perlesta* sp., and the caddisfly *Ptilostomis* sp.. The Odonata increased substantially from two taxa in 2002 to 10 in 2007. New additions to the taxa list from this group included dragonflies such as *Basiaeschna janata*, *Gomphus* sp., *Macromia* sp. and *Pachydiplax longipennis*; and damselflies included *Argia* sp., *Enallagma* sp., and *Ischnura* sp..

Data Analysis

This basinwide study location was not rated in 1988, while in both 2002 and for the current sampling event, a bioclassification of Moderate was assigned. This rating implies that there is moderate environmental stress at SR 1428. However, there are no NPDES dischargers upstream of this study site and water chemistry parameters are typical for the region. Therefore, the poor habitat quality at this site may instead be the dominant stressor affecting the benthic community. Indeed, White Oak Swamp at this location is a channelized and deeply incised ditch with few colonizable instream structures, and a homogeneous bottom substrate composed of sand.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
WHITE OAK SWP	SR 1428	05/09/07	OF48	Not Rated

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
EDGECOMBE	2	03020101	36.00388889	-77.62	28-78-7-(2)	SE Floodplains & Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;NSW	19.1	45	5	0.3	No

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

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

Water Quality Parameters

Temperature (°C)	15.7
Dissolved Oxygen (mg/L)	7.4
Specific Conductance (µS/cm)	113
pH (s.u.)	5.9

Water Clarity

Clear, tannin stained

Habitat Assessment Scores (max)

Channel Modification (15)	13
Instream Habitat (20)	12
Bottom Substrate (15)	7
Pool Variety (10)	4
Left Bank Stability (10)	6
Right Bank Stability (10)	6
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	68

Site Photograph



Substrate

Sand and organic matter

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/09/07	2007-46	17	---	Not Rated
04/17/02	2002-21	18	---	Not Rated

Most Abundant Species

Satinfin Shiner

Exotic Species

None

Species Change Since Last Cycle

Losses -- White Shiner, Creek Chubsucker, Margined Madtom, and Mud Sunfish. **Gains** -- American Eel, Silvery Minnow, and Chainback Darter.

Data Analysis

Watershed -- tributary to Swift Creek; drains rural north-central Edgecombe County; headwaters originate within the Town of Whitakers. **Habitat** -- channelized a long time ago; mature trees along both banks providing the canopy; white sand covered with organic matter; shallow, sandy runs; very low flow. **2007** -- coastal plain species; abundant and diverse, including 2 intolerant species (Pinewoods Shiner and Chainback Darter). **2002 & 2007** -- 21 species known from the site; no exotics have been collected from the site; dominant species have been Satinfin Shiner, Bluespotted Sunfish, and Tessellated Darter; percentage of tolerant fish, primarily Satinfin Shiner, increased from 28% in 2002 to 47% in 2007; sunfish decreased from 39% to 20% due to loss of snags and pools. This site is not rated because the appropriate NCIBI metrics and criteria have yet to be developed for coastal plain streams.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
FISHING CR	SR 1600	OB100	07/03/07	Good-Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WARREN	4	3020102	362128	780844	28-79-(1)	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C, NSW	54.5	230	6	0.3

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

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Town of Warrenton WWTP	NC0020834	2.0

Water Quality Parameters

Temperature (°C)	22
Dissolved Oxygen (mg/L)	7.1
Specific Conductance (µS/cm)	116
pH (s.u.)	7.1

Water Clarity	slightly turbid
---------------	-----------------

Site Photograph



Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	11
Bottom Substrate (15)	3
Pool Variety (10)	10
Riffle Habitat (16)	7
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	3
Total Habitat Score (100)	66

Substrate	trace of rubble, 10% gravel, 50% sand, 40% silt
-----------	---

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/03/07	10230	19	19	4.5	4.5	Good-Fair
08/18/97	7448	22	22	4.0	4.0	Good
07/28/92	5944	18	18	4.2	4.2	Good-Fair

Taxonomic Analysis

EPT taxa collected in 1992 and 1997 samples were found in 2007 with the exception of the stonefly *Paragnetina fumosa* and the caddisfly *Pycnopsyche*. *Paragnetina fumosa* was abundant in 1992 and 1997 and *Pycnopsyche* was common. Lower water levels in 2007, that exposed root mats and snags, could be one reason why *Pycnopsyche* was not found as they favor these edge habitats. Both taxa are sensitive to water pollution.

Data Analysis

Fishing Creek at SR 1600 declined from Good in 1997 to Good-Fair in 2007. Since only three sampling events have occurred at this location, the differences in the number of EPT collected among the three samples may reflect natural fluxes. A lack of flow in 2002 prevented this site from being sampled. Of future importance to lotic conditions in the Fishing Creek watershed is evidence of beaver activity. One dam was observed in a Fishing Creek tributary near the sampling location.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
FISHING CR	SR 1600	05/07/07	OF15	Excellent

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WARREN	4	03020102	36.35722222	-78.1425	28-79-(1)	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;NSW	58.4	250	12	0.4	No

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

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Town of Warrenton's WWTP	NC0020834	2.0

Water Quality Parameters

Temperature (°C)	14.6
Dissolved Oxygen (mg/L)	8.2
Specific Conductance (µS/cm)	95
pH (s.u.)	6.4

Water Clarity

Slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	3
Pool Variety (10)	7
Riffle Habitat (16)	5
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	70

Site Photograph



Substrate

Sand and clay

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/07/07	2007-39	21	58	Excellent
05/24/99	99-36	24	54	Excellent
04/16/97	97-28	24	60	Excellent
02/04/93	93-04	26	48	Good

Most Abundant Species

White Shiner

Exotic Species

Green Sunfish

Species Change Since Last Cycle

Losses -- Rosyside Dace, Bull Chub, Blacktip Jumprock, Redfin Pickerel (only young-of-year), Pumpkinseed Sunfish, and Bluegill. **Gains** -- Creek Chub, Northern Hog Sucker, Yellow Bullhead, and Green Sunfish.

Data Analysis

Watershed -- large tributary to the Tar River; drains north central Vance and central Warren counties; small municipalities include the Towns of Norlina and Warrenton. **Habitat** -- runs, deadfalls, logs, and sticks in the current creating snags and riffles; good undercuts and roots. **2007** -- 4 species of darters and 3 intolerant species collected; first time an exotic species had been collected. **1993 - 2007** -- primarily Piedmont species; very diverse, 33 species known from the site, including 5 species of suckers and 4 intolerant species; dominant species include Tessellated Darter, Pinewoods Shiner, and White Shiner; has rated Excellent since 1997; may qualify as High Quality Waters if so petitioned.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
FISHING CR	US 301	OB101	06/28/07	Excellent

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
EDGEcombe	4	03020102	360903	774135	28-79-(29)	Southeastern Floodplains and Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV, NSW, CA	529.6	83	10	0.3

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

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Town of Warrenton WWTP	NC0020834	2.0
Town of Enfield WTP	NC0084034	not limited

Water Quality Parameters

Temperature (°C)	28
Dissolved Oxygen (mg/L)	4.9
Specific Conductance (µS/cm)	106
pH (s.u.)	6.8

Water Clarity	slightly turbid
---------------	-----------------

Habitat Assessment Scores (max)

Channel Modification (5)	15
Instream Habitat (20)	15
Bottom Substrate (15)	13
Pool Variety (10)	9
Riffle Habitat (16)	0
Left Bank Stability (7)	9
Right Bank Stability (7)	10
Light Penetration (10)	2
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	83

Site Photograph



Substrate	30% gravel, 45% sand, 25% silt, trace of rubble and bedrock
-----------	---

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
06/28/07	10226	86	30	5.4	4.4	Excellent
08/05/02	8898	63	15	5.8	4.4	Good-Fair
08/18/97	7451	86	25	5.7	4.3	Good
07/22/92	5910	92	26	5.7	4.5	Good
07/13/88	4598	75	21	6.0	4.7	Good
07/24/85	3621	88	26	5.4	4.4	Good
07/25/83	2981	71	27	5.6	4.5	Good

Taxonomic Analysis

Eighty-six taxa were collected here, many of which are sensitive to aquatic pollution. Abundant mayflies included, *Maccaffertium modestum* and *Baetis intercalaris*. Four stonefly taxa were collected: *Acroneuria abnormis*, *Paragnetina fumosa*, *Pteronarcys dorsata* and *Perlesta*. There were 14 caddisfly taxa with *Cheumatopsyche*, *Chimarra*, *Hydropsyche venularis* and *Oecetis persimilis* being abundant. The rock-case caddisfly *Neophylax fuscus*, common here, was found at two other sites in the Tar River watershed in 2007 (both were upstream Piedmont sites). Its presence here highlights some of the Piedmont features (gravel, rubble) of this waterbody not seen at downstream sites. This site also contained the only 2007 record of the uncommonly collected damselfly, *Hetaerina*.

Data Analysis

Seven samples have been collected here since 1983 with ratings from Good-Fair to Excellent. A greater than average number of EPT taxa were found here in 2007, possibly the result of an earlier summer sampling effort (June) compared with past years (July and August). Active discharging from a pipe next to the US 301 bridge was observed presumably associated with the Enfield WTP.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
FISHING CR	SR 1500	OB99	06/28/07	Excellent

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
EDGEcombe	4	03020102	355827	773225	28-79-(30.5)	Southeastern Floodplains and Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C, NSW	784	9	14	1

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

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	n/a	n/a

Water Quality Parameters

Temperature (°C)	27.2
Dissolved Oxygen (mg/L)	5
Specific Conductance (µS/cm)	109
pH (s.u.)	6.9

Water Clarity	clear
---------------	-------

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	13
Bottom Substrate (15)	13
Pool Variety (10)	6
Left Bank Stability (10)	9
Right Bank Stability (10)	9
Light Penetration (8)	7
Left Riparian Score (5)	3
Right Riparian Score (5)	4
Total Habitat Score (100)	79

Site Photograph



Substrate	10% gravel, 70% sand, 20% silt
-----------	--------------------------------

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
06/28/07	10225	102	31	5.2	3.9	Excellent
08/06/02	8901	21	21	4.5	4.5	Good
08/18/97	7452	56	28	4.7	3.9	Excellent
07/22/92	5911	23	23	3.8	3.8	Good

Taxonomic Analysis

Over 100 taxa were collected here, many of which are sensitive to aquatic pollution. A total of 11 taxa of snails, bivalves and other gastropods were found in this reach. Of these *Elimia* and *Elliptio* were abundant. Abundant mayflies included *Tricorythodes*, *Maccaffertium modestum*, *Proclonon*, *Isonychia*, *Heptagenia* and *Baetis intercalaris*. Four stonefly taxa were collected: *Acroneria abnormis*, *Neoperla*, *Pteronarcys dorsata* and *Perlesta*. There were 14 caddisfly taxa with *Brachycentrus numerosus*, *Cheumatopsyche*, *Chimarra*, *Hydropsyche rossi*, *Nectopsyche exquisita*, *Oecetis morsei* and *O. persimilis* being abundant. Seven riffle beetle taxa were recorded here including *Stenelmis antennalis*, *S. fuscata*, *S. lignicola* and *S. xylonastis*.

Data Analysis

Fishing Cr at SR 1500 rated Excellent in 2007. This site rated Good in 2002. A diverse and pollution sensitive benthic community resides here. The highest number of EPT (31) and Total Taxa (102) were collected in 2007. The four samples collected here since 1992 employed two methods (EPT and Full Scale). Minor differences existed in the number of EPT taxa between Full Scale samples (28 and 31) and between EPT samples (21 and 23), thus suggesting a stable benthic community over the 15-year data record.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
SHOCCO CR	SR 1613	OB105	07/03/07	Not Rated

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WARREN	4	03020102	361725	781109	28-79-22	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C, NSW	23.4	250	4	0.3

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

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

Water Quality Parameters

Temperature (°C)	22
Dissolved Oxygen (mg/L)	5.1
Specific Conductance (µS/cm)	106
pH (s.u.)	6.4

Water Clarity	turbid
---------------	--------

Site Photograph

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	11
Bottom Substrate (15)	3
Pool Variety (10)	10
Riffle Habitat (16)	10
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	8
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	69

Substrate	50% sand, 50% silt
-----------	--------------------

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/03/07	10229	12	12	5.3	5.3	Not Rated
08/18/97	7447	16	16	4.6	4.6	Good-Fair
07/28/92	5947	15	15	4.3	4.3	Good-Fair

Taxonomic Analysis

Stoneflies were absent in 2007, whereas in 1997 and 1992 three and four taxa, respectively, were collected. Only half the number of mayfly taxa collected in 1997 (6) were found in 2007 (3). Caddisflies found in 2007 were similar to previous years with one exception, *Trienodes marginatus*. This uncommon taxon (n=34 records) appears to favor more lentic conditions. This was only the second record of this taxon for the Tar River basin and the only one found in 2007.

Data Analysis

The decline in the number of taxa here from 1992 and 1997 to 2007 can be attributed to the presence of a large beaver impoundment (see photo). The new hydrologic regime in this waterbody, though still favorable to caddisflies, has discouraged stoneflies and some mayflies, which were present in prior years, from residing in this reach. This site was not sampled in 2002 due to low flows in July and August of that year.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
SHOCCO CR	SR 1613	04/11/07	OF39	Good-Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WARREN	4	03020102	36.28722222	-78.18583333	28-79-22	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;NSW	25.3	265	6.5	0.5	No

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

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

Water Quality Parameters

Temperature (°C)	11.1
Dissolved Oxygen (mg/L)	9.8
Specific Conductance (µS/cm)	73
pH (s.u.)	6.6

Water Clarity

Slightly tannin stained

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	13
Bottom Substrate (15)	3
Pool Variety (10)	10
Riffle Habitat (16)	4
Left Bank Stability (7)	6
Right Bank Stability (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, silt, clay

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/11/07	2007-15	20	---	Not Rated
04/09/02	2002-07	18	54	Excellent
04/16/97	97-27	17	50	Good
06/18/92	92-21	18	48	Good

Most Abundant Species

Highfin Shiner

Exotic Species

Green Sunfish

Species Change Since Last Cycle

Gains -- Yellow Bullhead, Flier, Rosyside Dace, Eastern Mosquitofish, Green Sunfish, Warmouth, and Largemouth Bass. **Losses** -- American Eel, Glassy Darter, Least Brook Lamprey (a state Threatened species), Redear Sunfish, and Chainback Darter.

Data Analysis

Watershed -- a tributary to Fishing Creek; drains part of the southwest corner of Warren County. **Habitat** -- primarily runs with abundant woody debris, clay bank shelves, and some undercuts; a large beaver dam near the top of the sample reach had flooded the surrounding wetlands, causing water to cascade over the banks down into the stream channel (see photo). **2007** -- a diverse fish assemblage was collected at this site including 4 new species of sunfish and bass. However, the altered hydrology in this section of the stream has caused a shift in the trophic function of the fish community, the loss of two darter species (intolerant Chainback Darter and Glassy Darter), and a decline in reproductive function of the fish population. If rated, the altered hydrology would cause an inappropriate decline to Good-Fair. Therefore this site is Not Rated and should be resampled during normal hydrologic conditions. **1992 - 2007** -- overall, 27 species are known from this site including 2 species of suckers, 7 species of sunfish, 6 species of minnows, and 4 species of darters. Despite being Not Rated, this watershed maintains good water quality.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
CROOKED SWP	SR 1501	04/11/07	OF66	Not Rated

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
NASH	4	03020102	36.1331	-77.88094	28-79-24	Rolling Coastal Plain

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C; NSW	6	147	6	0.4	No

Visible Landuse (%)	Forested/Wetland	Urban	Agriculture	Other (describe)
	95	5 (rural residential)	0	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)	8.6
Specific Conductance (µS/cm)	89
pH (s.u.)	6.6

Water Clarity

Slightly tannin stained

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	18
Bottom Substrate (15)	10
Pool Variety (10)	10
Left Bank Stability (10)	9
Right Bank Stability (10)	9
Light Penetration (10)	9
Left Riparian Score (5)	5
Right Riparian Score (5)	4
Total Habitat Score (100)	89

Site Photograph



Substrate

sand, gravel, clay

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/11/07	2007-14	20	--	Not Rated

Most Abundant Species

Pinewoods Shiner

Exotic Species

Green Sunfish

Species Change Since Last Cycle

N/A

Data Analysis

Watershed -- a small tributary to Fishing Creek located about one mile above its confluence; drains part of rural north central Nash County above the Town of Red Oak. **Habitat** -- primarily runs with undercuts, side snags, pools, good roots, and a few gravel riffles. **2007** -- a diverse mixed assemblage of coastal plain and piedmont fish species, including 6 sunfish species, 6 minnow species, 2 sucker species, and 2 darter species; the number of species far exceeds what is typically found in a coastal plain stream. This watershed is located very close to, but not within the Northern Outer Piedmont level IV ecoregion. If this site were located within the Northern Outer Piedmont ecoregion and therefore ratable with the NCIBI, the fish community would receive an NCIBI score of 54 and bioclass of Excellent. Currently, coastal plain streams are Not Rated with the NCIBI because the appropriate metrics have yet to be developed.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
LITTLE FISHING CR	SR 1509	04/12/07	OF26	Excellent

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WARREN	4	03020102	36.36583333	-77.94333333	28-79-25	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;NSW	28.5	250	10	0.6	No

Visible Landuse (%)	Forested/Wetland	Urban	Agriculture	Other (describe)
	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)	10.0
Specific Conductance (µS/cm)	74
pH (s.u.)	6.6

Water Clarity

Turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	5
Pool Variety (10)	9
Riffle Habitat (16)	12
Left Bank Stability (7)	4
Right Bank Stability (7)	4
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	75

Site Photograph



Substrate

clay, sand, silt, cobble

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/12/07	2007-17	23	54	Excellent
04/11/02	2002-11	23	52	Good
04/16/97	97-29	19	50	Good
02/03/93	93-02	20	54	Excellent

Most Abundant Species

Tessellated Darter

Exotic Species

Green Sunfish

Species Change Since Last Cycle

Gains -- Yellow Bullhead, White Sucker, Satinfish Shiner, Redfin Pickerel, Pinewoods Shiner, Blacktip Jumprock, Creek Chub, and Eastern Mudminnow. **Losses** -- Rosyside Dace, Bluespotted Sunfish, Warmouth, Notchlip Redhorse, Sicklefin Redhorse, V-lip Redhorse, Golden Shiner, and Swallowtail Shiner.

Data Analysis

Watershed -- a tributary to Fishing Creek; drains part of east central Warren County. **Habitat** -- fast riffles, deep clay lined runs and pools with submerged deadfalls and side snags. **2007** -- very diverse fish community including 6 species of minnows, 3 species of suckers, and 3 species of darters were collected; almost identical NCIBI metric scores as in 2002; the bioclass improvement in 2007 can be attributed to a slightly higher reproductive function of the fish community. **1993 - 2007** -- this watershed has maintained good water quality and a diverse assemblage of fish fauna over a 14 year period, with a total of 34 known species. This site has the potential to qualify for HQW or ORW status if petitioned.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
L FISHING CR	SR 1343	OB103	06/29/07	GOOD

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HALIFAX	4	03020102	360914	775305	28-79-25	Rolling Coastal Plain

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C, NSW	187.1	110	9	0.3

Visible Landuse (%)	Forested/Wetland	Urban	Agriculture	Other (describe)
	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
Dissolved Oxygen (mg/L)	53
Specific Conductance (µS/cm)	99
pH (s.u.)	6.8

Water Clarity	slightly turbid
---------------	-----------------

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	15
Bottom Substrate (15)	13
Pool Variety (10)	8
Left Bank Stability (10)	9
Right Bank Stability (10)	9
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	86

Site Photograph



Substrate	10% Boulder, 10% rubble, 20% Gravel, 50% sand, 10% silt
-----------	---

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
06/29/07	10228	95	27	5.2	4.0	Good
08/05/02	8899	86	23	5.6	4.2	Good
8/15/1997*	7449	85	23	5.3	4.1	Good
9/10/1992*	5948	64	18	5.6	4.8	Good-Fair
7/14/1988*	4599	89	24	5.3	3.8	Good

Taxonomic Analysis

A diverse and healthy benthic community resides in this lower reach of Little Fishing Creek. Pollution intolerant taxa dominate the taxa list for this site and include: the mayflies *Serratella serratoides*, *Leucrocota*, and *Stenacron pallidum*; the caddisfly *Trietodes perna/helo*; and the stoneflies *Pteronarcys dorsata* and *Paragnetina fumosa*. Ten Mollusk taxa were reported from this site in 2007 including the rare *Lioplax subcarinata*. Another rare taxon collected here in 2007 was the water beetle, *Lioporeus pilatei*. This taxon was also collected here in 2002. The hemipteran, *Hydrometra*, that has only been found at 13 locations in North Carolina, was collected here in 2007.

Data Analysis

Water quality in the lower reaches of Little Fishing Creek has remained stable since sampling began in 1988. Though this site lies just inside the Coastal Plain, its watershed is Piedmont, indicated by species such as the rock case caddisfly *Neophylax fuscus*. This species is found in this upper region of the Tar River watershed but not downstream in more Coastal A waters. Medoc Mountain State Park lies upstream of this location and likely contributes to the high water quality at SR 1343.

*Note: prior to 2002, Little Fishing Creek was sampled at SR 1338, approximately 3 miles upstream of SR 1343.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
REEDY CR	SR 1511	04/12/07	OF34	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
WARREN	4	03020102	36.35	-78.01833333	28-79-25.5	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;NSW	19.7	270	12	0.4	Yes

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

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

Water Quality Parameters

Temperature (°C)	13.1
Dissolved Oxygen (mg/L)	9.3
Specific Conductance (µS/cm)	63
pH (s.u.)	6.5

Water Clarity

Slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	6
Pool Variety (10)	9
Riffle Habitat (16)	3
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	73

Site Photograph



Substrate

gravel, sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/12/07	2007-16	16	48	Good
04/11/02	2002-12	17	52	Good

Most Abundant Species

Bluehead Chub

Exotic Species

Green Sunfish

Species Change Since Last Cycle

Gains -- Creek Chubsucker, Redfin Pickerel, Green Sunfish, Bluegill, and Swallowtail Shiner. **Losses** -- Yellow Bullhead, Pumpkinseed, Golden Shiner, Roanoke Darter, Blacktip Jumprock, and Creek Chub.

Data Analysis

Watershed -- a tributary to Little Fishing Creek located about 8 miles above its confluence; drains part of central Warren County. **Habitat** -- primarily runs with side snags, good roots, and coarse woody debris; good riparian forest. **2007** -- a fairly diverse fish community in 2007, with relatively stable metric scores, notwithstanding a slightly lower total abundance and the loss of the intolerant Roanoke Darter. **2002 - 2007** -- there are 22 fish species that are known from this site including 2 species of suckers, 8 species of minnows, and 3 species of darters. Water quality in this catchment remains good with no apparent issues.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
BEAR SWP	NC 561	05/07/07	OF2	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HALIFAX	4	03020102	36.2779312	-77.8841524	28-79-25-7	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;NSW	42.8	200	8	0.4	No

Visible Landuse (%)	Forested/Wetland	Urban	Agriculture	Other (describe)
	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)	7.5
Specific Conductance (µS/cm)	83
pH (s.u.)	6.5

Water Clarity

Clear, tannin stained

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	6
Pool Variety (10)	6
Riffle Habitat (16)	5
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	72

Site Photograph



Substrate

Sand, gravel, cobble, and silt

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/07/07	2007-40	25	52	Good
04/11/02	2002-10	20	52	Good

Most Abundant Species

Redbreast Sunfish and American Eel

Exotic Species

Green Sunfish

Species Change Since Last Cycle

Losses -- Golden Shiner, White Sucker, Notchlip Redhorse, and Bluegill. **Gains** -- Satinfish Shiner, Northern Hog Sucker, V-lip Redhorse, Yellow Bullhead, Redfin Pickerel, Eastern Mosquitofish, Flier, Green Sunfish, and Glassy Darter.

Data Analysis

Watershed -- tributary to Little Fishing Creek; drains the west-southwest corner of Halifax County; the Town of Littleton is located within the extreme headwaters; borders the Rolling Coastal Plain; one NPDES permitted facility located approximately 11 miles upstream on Butterwood Creek (discharge = 0.28 MGD). **Habitat** -- *Fissidens* and several species of macrophytes; root mats; coarse woody debris and deadfalls in the channel; wide riparian zones. **2007** -- 4 species each of darters and suckers and 3 intolerant species (Pinewoods Shiner, Roanoke Darter, and the Chainback Darter). **2002 & 2007** -- a diverse piedmont and coastal plain fauna, 29 species present including 7 species of minnows, 6 species of suckers, 5 species of sunfish, 4 species of darters, and 3 intolerant species; most abundant species in 2002 was the Highfin Shiner; similar to other streams in the transitional zone between the Piedmont and the Coastal Plain, the trophic structure is skewed with a very low percentage of omnivores+herbivores and a high percentage of piscivores.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
ROCKY SWP	SR 1002	OB104	06/28/07	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HALIFAX	4	03020102	361335	774835	28-79-28-(0.7)	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV	19.6	130	6	0.2

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

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

Water Quality Parameters

Temperature (°C)	24.7
Dissolved Oxygen (mg/L)	4.9
Specific Conductance (µS/cm)	70
pH (s.u.)	6.7

Water Clarity	clear
---------------	-------

Site Photograph



Habitat Assessment Scores (max)

Channel Modification (5)	15
Instream Habitat (20)	13
Bottom Substrate (15)	7
Pool Variety (10)	10
Riffle Habitat (16)	0
Left Bank Stability (7)	10
Right Bank Stability (7)	10
Light Penetration (10)	10
Left Riparian Score (5)	4
Right Riparian Score (5)	4
Total Habitat Score (100)	83

Substrate	80% sand, 20% silt, traces of bedrock, boulder rubble and gravel
-----------	--

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
06/28/07	10227	81	20	6.0	5.1	Good
08/18/97	7450	39	13	5.6	4.6	Good-Fair

Taxonomic Analysis

The taxa composition was typical of that found in sandy substrates. The psammophilic midge, *Cryptochironomus*, dominated the chironomid community. The burrowing mayfly, *Hexagenia*, was abundant here, as were *Isonychia*, *Maccaffertium modestum*, and *Caenis*. Abundant caddisflies included *Cheumatopsyche*, *Triaenodes ignitus*, and *Oecetis persimilis*. An uncommonly collected beetle, *Helophorus*, was found here. This is only the third collection of this taxon in the Tar River Basin. Like most Tar River sites, gastropod taxa were well represented at Rocky Swamp (seven taxa), however, no live mussels were observed (just their shells). It is unclear why only one chironomid taxa was collected in 1997 whereas 19 were found in 2007. Beetles were well represented in 2007 (10 taxa) but scarce in 1997 (3 taxa).

Data Analysis

Rocky Swamp at SR 1002 appears to be a transitional reach from Piedmont to Coastal A. The majority of the watershed upstream of SR 1002 is Piedmont, however, the previous sampling effort (1997) used CA criteria for assigning a bioclassification. For consistency the same was done in 2007 resulting in a Good bioclassification. Regardless of the methodology used, the 1997 effort would have resulted in a Good-Fair. This site was not sampled in 2002 due to a lack of flow in July and August.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
ROCKY SWP	SR 1002	05/07/07	OF35	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HALIFAX	4	03020102	36.22638889	-77.80916667	28-79-28-(0.7)	Northern Outer Piedmont

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-IV;NSW	19.5	145	7	0.4	Yes

Visible Landuse (%)	Forested/Wetland	Urban	Agriculture	Other (describe)
	60	0	35	5 (utility right-of-way)

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)	7.3
Specific Conductance (µS/cm)	97
pH (s.u.)	6.8

Water Clarity	Slightly tannin stained
---------------	-------------------------

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	5
Pool Variety (10)	6
Riffle Habitat (16)	2
Left Bank Stability (7)	6
Right Bank Stability (7)	6
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	63

Site Photograph



Substrate	Sand, gravel, cobble, bedrock, and boulder
-----------	--

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/07/07	2007-41	19	48	Good
04/12/02	2002-13	19	50	Good
04/03/97	97-11	14	---	Not Rated
02/03/93	93-01	15	---	Not Rated

Most Abundant Species	White Shiner and Tessellated Darter	Exotic Species	Green Sunfish
-----------------------	-------------------------------------	----------------	---------------

Species Change Since Last Cycle

Losses -- Margined Madtom, Redfin Pickerel (represented only by young-of-year), and Swamp Darter. **Gains** -- Mud Sunfish, Pumpkinseed, and Bluegill.

Data Analysis

Watershed -- tributary to Fishing Creek; drains rural north-central Warren County; a transitional area between the Northern Outer Piedmont and the Rolling Coastal Plain. **Habitat** -- sandy runs; good snags, roots, and deadfalls; open canopy at two utility right-of-ways; total habitat score using coastal plain criteria = 82. **2007** -- 7 species of sunfish, most species ever, Bluegill and Mud Sunfish collected for the first time; only 1 species of darter, sucker, and intolerant species collected. **1993 - 2007** -- 28 species known from the site, including 8 species of sunfish and 7 species of minnows; Least Brook Lamprey, Bowfin, Mimic Shiner, and Chainback Darter have not been collected since 1993; similar to other streams in the transitional zone between the Piedmont and the Coastal Plain, the trophic structure is skewed with a very low percentage of omnivores+herbivores and a high percentage of piscivores.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
BEECH SWP	SR 1003	OB94	02/05/07	Moderate

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HALIFAX	4	03020102	360847	773326	28-79-30	Rolling Coastal Plain

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;SW;NSW	151.6	85	10	0.4

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

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

Water Quality Parameters

Temperature (°C)	1.9
Dissolved Oxygen (mg/L)	16.2
Specific Conductance (µS/cm)	63
pH (s.u.)	6.1

Water Clarity	clear
---------------	-------

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	17
Bottom Substrate (15)	7
Pool Variety (10)	10
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	89

Site Photograph



Substrate	Nearly all sand
-----------	-----------------

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/05/07	10131	35	3	7.4	6.9	Moderate
02/15/02	8677	37	2	7.2	7.8	Moderate

Taxonomic Analysis

Two new mayfly species were added to the species list for SR 1003 in 2007; these included *Maccaffertium modestum* and *Pseudocloeon frondale*. Overall, the taxa diversity (ST) and the number of EPT remained relatively constant between the 2002 and 2007 sampling events. This study site is dominated by pollution tolerant macroinvertebrate species, and midges and crustaceans were the most abundant and diverse groups.

Data Analysis

There are no upstream NPDES dischargers above this study site. The habitat at this site rated high in 2007 because of the presence of a relatively natural stream channel with good (i.e. suitable for colonization) instream habitat and a healthy and intact riparian zone. The only negative aspect of the habitat at SR 1003 was the homogeneous streambed substrate composed almost entirely of sand. This study location was given a bioclassification of Moderate during both 2002 and 2007 sampling events. This bioclassification implies that there is moderate environmental stress at this study site.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
MARSH SWP	SR 1210	05/08/07	OF49	Not Rated

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HALIFAX	4	03020102	36.379309	-77.728805	28-79-30-1	Rolling Coastal Plain

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C,Sw,NSW	6.5	190	5	0.4	Yes

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

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

Water Quality Parameters

Temperature (°C)	16.0
Dissolved Oxygen (mg/L)	6.8
Specific Conductance (µS/cm)	97
pH (s.u.)	6.8

Water Clarity

Blackwater

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	20
Bottom Substrate (15)	15
Pool Variety (10)	10
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	100

Site Photograph



Substrate

Cobble, boulder, gravel, sticks, and logs

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/08/07	2007-42	16	---	Not Rated

Most Abundant Species

Redbreast Sunfish, Highfin Shiner,
American Eel, Creek Chubsucker, and
Redfin Pickerel.

Exotic Species

Green Sunfish

Species Change Since Last Cycle

N/A

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- tributary to Beech Swamp; drains rural northern Halifax County; on the Fall Line, in a transitional area between the Northern Outer Piedmont and the Rolling Coastal Plain. **Habitat** -- a perfect score using coastal plain criteria (95 using Piedmont criteria); natural channel, boulder bluff on the left; boulders in the stream; riffles, runs, deep and shallow pools, undercuts, roots, and snags; low specific conductance for a coastal plain stream. **2007** -- sparse (n = 92 fish), coastal plain fauna and very low productivity, but not low pH; diverse fauna for a small stream, including six species of sunfish and one intolerant species (Sawcheek Darter). This site is not rated because the appropriate NCIBI metrics and criteria have yet to be developed for coastal plain streams.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
MILL SWP	SR 1615	04/13/07	OF73	Not Rated

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HALIFAX	4	03020102	36.34398	-77.70671	28-79-30-1-0.5	Rolling Coastal Plain

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C; SW, NSW	11	147	6	0.5	Yes

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

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

Water Quality Parameters

Temperature (°C)	18.0
Dissolved Oxygen (mg/L)	9.0
Specific Conductance (µS/cm)	76
pH (s.u.)	5.8

Water Clarity

Tannin stained

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	18
Bottom Substrate (15)	13
Pool Variety (10)	10
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (10)	9
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	95

Site Photograph



Substrate

sand, gravel, cobble

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/13/07	2007-21	8	--	Not Rated

Most Abundant Species

Bluegill

Exotic Species

None

Species Change Since Last Cycle

N/A

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- a tributary to Marsh Swamp, Beech Swamp, and ultimately Fishing Creek; drains the western edge of the Rolling Coastal Plain ecoregion in central Halifax County; located to the north of the Beaverdam Swamp and Burnt Coat Swamp watersheds; site is about 1 mile above Bradley Lake. **Habitat** -- a natural meandering channel with good flow; runs with submerged logs, and macrophytes; extensive riparian zone widths; 2nd lowest pH for all Tar basin sites. **2007** -- low abundance (n = 47) and diversity of the fish community (fewest number of species for all Tar sites), typical for a low pH coastal plain stream; fish community is dominated by sunfish; no crayfish collected; this site is not rated because the appropriate NCIBI metrics have yet to be developed for coastal plain streams; although not rateable, there are no apparent water quality issues in this watershed.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
BURNT COAT SWP	SR 1216	04/13/07	OF70	Not Rated

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HALIFAX	4	03020102	36.25521	-77.75957	28-79-30-2	Rolling Coastal Plain

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C: SW, NSW	6.3	147	4	0.4	No

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

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

Water Quality Parameters

Temperature (°C)	11.7
Dissolved Oxygen (mg/L)	8.7
Specific Conductance (µS/cm)	96
pH (s.u.)	6.4

Water Clarity

Slightly tannin stained

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	15
Bottom Substrate (15)	13
Pool Variety (10)	9
Left Bank Stability (10)	9
Right Bank Stability (10)	9
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	90

Site Photograph



Substrate

sand, clay

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/13/07	2007-18	11	--	Not Rated

Most Abundant Species

Redfin Pickerel

Exotic Species

None

Species Change Since Last Cycle

N/A

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- a small tributary to Beech Swamp; drains a small section of central Halifax County. **Habitat** -- shallow meandering runs with side snags, and coarse woody debris in the channel, creating some "stick riffles"; good flow; natural channel; good riparian zone widths. **2007** -- fairly typical coastal plain fish community present with moderate to low diversity and abundance; includes 1 species of sucker, 2 species of sunfish, 2 species of minnows, and no darters; this site is not rateable because the appropriate NCIBI metrics have yet to be developed for rating coastal plain streams; although not rateable, there are no apparent water quality issues in this watershed.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
JACKET SWP	SR 1216	04/13/07	OF71	Not Rated

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HALIFAX	4	03020102	36.2280903	-77.7708477	28-79-30-2-1	Rolling Coastal Plain

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C; SW, NSW	3.3	147	3	0.4	Yes

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

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

Water Quality Parameters

Temperature (°C)	13.6
Dissolved Oxygen (mg/L)	6.8
Specific Conductance (µS/cm)	102
pH (s.u.)	6.7

Water Clarity

Slightly turbid

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	18
Bottom Substrate (15)	8
Pool Variety (10)	9
Left Bank Stability (10)	9
Right Bank Stability (10)	9
Light Penetration (10)	6
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	84

Site Photograph



Substrate

sand, clay

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/13/07	2007-19	15	--	Not Rated

Most Abundant Species

Bluespotted Sunfish

Exotic Species

None

Species Change Since Last Cycle

N/A

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- a small tributary to (and just south of) Burnt Coat Swamp; drains part of central Halifax County. **Habitat** -- runs with macrophytes, deadfalls, and snags; natural channel; the upper 1/3 of the sample reach is more open and sunlit due to an old logging operation. **2007** -- good diversity and abundance for a coastal plain stream, except that there were no minnows collected; the 2007 sample included 1 species of sucker, 6 species of sunfish, and 2 species of darters; this site is not rated because the appropriate NCIBI metrics have yet to be developed for coastal streams; although not ratable, there are no apparent water quality issues in this watershed.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
BREECHES SWP	SR 1002	04/13/07	OF72	Not Rated

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HALIFAX	4	03020102	36.2066781	-77.7300272	28-79-30-2-1-2	Rolling Coastal Plain

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C; SW, NSW	4.2	98	4	0.4	No

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

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

Water Quality Parameters

Temperature (°C)	14.9
Dissolved Oxygen (mg/L)	5.6
Specific Conductance (µS/cm)	90
pH (s.u.)	5.6

Water Clarity

Tannin stained

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	18
Bottom Substrate (15)	10
Pool Variety (10)	10
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	93

Site Photograph



Substrate

sand, white gravel

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/13/07	2007-20	8	--	Not Rated

Most Abundant Species

Bluespotted Sunfish and Golden Shiner

Exotic Species

None

Species Change Since Last Cycle

N/A

Data Analysis

This is the first fish community sample at this site. **Watershed** -- a small tributary to Jacket Swamp and ultimately Burnt Coat Swamp; drains part of south central Halifax County, immediately south of the Jacket Swamp watershed. **Habitat** -- meandering run through bottomland forest with good flow and a natural channel; lowest pH among all Tar basin sites. **2007** -- low abundance (n = 41, lowest among all Tar basin sites) and diversity of the fish community, typical for a low pH black water coastal plain system; no darters and only one sunfish species collected; this site is not rated because the appropriate NCIBI metrics have yet to be developed for coastal plain streams; although not ratable, there are no apparent water quality issues in this watershed.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
DEEP CR	SR 1100	OB96	02/05/07	Moderate

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
HALIFAX	4	03020102	360426	772625	28-79-32-(0.5)	Rolling Coastal Plain

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV;NSW	41.4	49	5	0.8

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

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

Water Quality Parameters

Temperature (°C)	3.1
Dissolved Oxygen (mg/L)	14.7
Specific Conductance (µS/cm)	90
pH (s.u.)	5.6

Water Clarity	clear/tannic
---------------	--------------

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	15
Bottom Substrate (15)	4
Pool Variety (10)	8
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	82

Site Photograph



Substrate	Nearly all detritus
-----------	---------------------

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/05/07	10132	34	0	7.9	0.0	Moderate
02/15/02	8678	33	2	8.1	8.8	Moderate

Taxonomic Analysis

No mayflies, stoneflies, or caddisflies (EPT taxa) were collected during the current basinwide sampling of SR 1100. However, the absence of these insect groups was only a slight change from the 2002, during which only 2 taxa were collected. The majority (53%) of the invertebrates collected in 2007 were chironomids (midges) and crustaceans, but additional taxa included the Hemipteran *Belostoma* sp.; and the Coleopterans *Dineutus* sp., *Hydrocanthus* sp., *Neoporus* sp., and *Peltodytes* sp..

Data Analysis

There are no registered NPDES dischargers upstream of the study site. The habitat score was high during the current sampling in part because of the presence of a natural channel and a healthy riparian zone. The only two factors substantially detracting from this habitat rating were the lack of substrates conducive to macroinvertebrate colonization and a homogeneous streambed of detritus. This study location has been given a bioclassification of moderate during both the 2002 and 2007 sampling events. This bioclassification implies that there is moderate environmental stress at this study site.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
DEEP CR	SR 1506	05/11/07	OF58	Not Rated

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
EDGEcombe	4	03020102	35.973719	-77.451783	28-79-32-(1.5)	SE Floodplains & Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-IV,NSW	78.5	35	6	0.4	No

Visible Landuse (%)	Forested/Wetland	Urban	Agriculture	Other (describe)
	90	0	10	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)	5.1
Specific Conductance (µS/cm)	115
pH (s.u.)	6.4

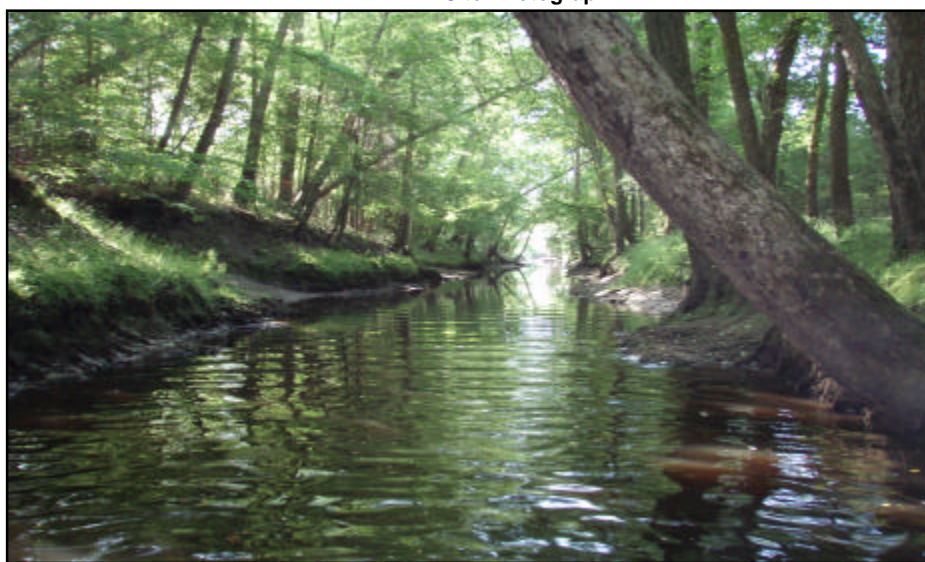
Water Clarity

Blackwater

Habitat Assessment Scores (max)

Channel Modification (15)	7
Instream Habitat (20)	11
Bottom Substrate (15)	4
Pool Variety (10)	8
Left Bank Stability (10)	9
Right Bank Stability (10)	9
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	68

Site Photograph



Substrate

Hard, slippery clay

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/11/07	2007-55	19	---	Not Rated

Most Abundant Species

Eastern Mosquitofish

Exotic Species

None

Species Change Since Last Cycle

N/A

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- large tributary to Fishing Creek; drains southeastern Halifax and northeast Edgecombe counties; one small municipality (the Town of Scotland Neck) within the watershed. **Habitat** -- very old channelization with a mature tree canopy; stable banks with wide riparian zones; long run/pool with some side snags; below the bridge, the levee is maintained by the U.S. Army COE; very low flow; second lowest dissolved oxygen measurement and saturation. **2007** -- a diverse coastal plain community, but 10 of the 19 species represented by only 1-3 fish/species; most fish (n = 1,165) and the greatest catch rate (CPUE = 36.2fish/100 seconds shocking time) at any site in 2007; 85 percent (n = 994) of all the fish were Eastern Mosquitofish, a tolerant species; the greatest percentage of tolerant fish at any site in 2007. This site is not rated because the appropriate NCIBI metrics and criteria have yet to be developed for coastal plain streams.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
TAR R	US 64 BUS	OB90	06/27/07	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
EDGECOMBE	3	03020103	355338	773200	28-(80)	Southeastern Floodplains and Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV, NSW, CA	2207.9	10	30	0.75

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

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Franklin County WWTP	NC0069311	3.0
Oxford WWTP	NC0025054	3.5
Tar River WRF (Louisburg)	NC0020231	1.4
Tar River Regional WWTP (Rocky Mount)	NC0030317	21.0

Water Quality Parameters

Temperature (°C)	30.2
Dissolved Oxygen (mg/L)	3.4
Specific Conductance (µS/cm)	132
pH (s.u.)	7.4

Water Clarity

clear/tannic

Site Photograph



Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	8
Bottom Substrate (15)	7
Pool Variety (10)	6
Left Bank Stability (10)	9
Right Bank Stability (10)	9
Light Penetration (10)	2
Left Riparian Score (5)	2
Right Riparian Score (5)	4
Total Habitat Score (100)	62

Substrate

70% sand, 30% silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
06/27/07	10224	92	27	5.8	4.7	Good
06/28/05	9658	79	29	4.9	4.1	Excellent
08/06/02	8900	77	27	5.9	4.7	Good
08/19/97	7453	79	28	5.4	4.6	Excellent
07/20/92	5899	81	29	5.8	4.8	Good
07/12/90	5358	69	28	5.4	4.6	Excellent
07/11/88	4592	80	21	5.6	4.7	Good
07/06/87	4142	81	23	5.8	4.9	Good
07/11/86	3790	92	27	6.1	4.9	Good
05/12/86	3757	92	27	6.0	5.0	Good
07/24/85	3622	73	23	5.8	5.1	Good
07/25/83	3100	78	27	5.8	4.5	Good

Taxonomic Analysis

A diverse macroinvertebrate community was found in the Tar River at this location (92 Total Taxa). The 27 EPT taxa collected in 2007 are very close to the average EPT found here across all samples since 1983. Mayflies characteristic of this site include *Tricorythodes*, *Isonychia*, *Caenis*, *Mesocricetum ovatum*, *M. integrum*, *M. modestum* and *Stenonema intermedium*. One stonefly, *Acroneuria abnormis*, occurred in each collection.

Maccaffertium exiguum, *M. integrum*, *M. modestum* and *Stenacron interpunctatum*. One stonefly, *Acrocheura abnormis*, occurred in each collection taken here. Caddisflies found most often include *Brachycentrus numerosus*, *Hydropsyche incommoda*, *H. rossi*, *Nectopsyche exquisita* and *Cheumatopsyche*. The riffle beetle, *Stenelmis*, was diverse and included the following species recorded: *S. antennalis*, *S. fuscata*, *S. lignicola* and *S. xylonastis*. Rare taxa collected here in 2007 include the mayfly *Leptohyphes dolani*, (found at only one other site in the Tar basin in 2007) and the dragonfly *Didymops transversa* (only 2007 Tar basin record).

Data Analysis

This site has been sampled 12 times since 1983. The macroinvertebrate community residing here has remained diverse and pollution intolerant. Since 1990, in years of lower flows (but not extreme drought as in 2002 and 2007), Excellent bioclassifications have resulted, likely due to less pollutant runoff from urban areas of Tarboro (and possibly Rocky Mount, approximately 15 miles upstream). Considerable amounts of effluent are discharged into the Tar River upstream of US 64 Bus. The high water quality tributaries of Swift and Fishing Creeks, that enter the Tar River above this sampling location, help to dilute upstream point sources.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
TAR R	NC 42	OB89	06/27/07	Excellent

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
EDGEcombe	3	03020103	354725	773305	28-(80)	Southeastern Floodplains and Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV, NSW, CA	2435.4	5	30	0.6

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

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Franklin County WWTP	NC0069311	3.0
Oxford WWTP	NC0025054	3.5
Tar River WRF (Louisburg)	NC0020231	1.4
Tar River Regional WWTP (Rocky Mount)	NC0030317	21.0
Tarborro WWTP	NC0020605	5.0

Water Quality Parameters

Temperature (°C)	28.8
Dissolved Oxygen (mg/L)	2.2
Specific Conductance (µS/cm)	142
pH (s.u.)	7.3

Water Clarity	clear
---------------	-------

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	13
Bottom Substrate (15)	7
Pool Variety (10)	6
Left Bank Stability (10)	9
Right Bank Stability (10)	9
Light Penetration (10)	2
Left Riparian Score (5)	5
Right Riparian Score (5)	3
Total Habitat Score (100)	69

Site Photograph



Substrate	80% sand, 20% silt
-----------	--------------------

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
06/28/07	10204	68	26	5.1	4.5	Excellent
06/27/07	10223	27	27	4.4	4.4	Excellent
06/28/05	9659	80	30	4.9	4.2	Excellent
08/06/02	8919	24	24	4.5	4.5	Excellent
08/19/97	7455	26	26	4.6	4.6	Excellent
07/20/92	5898	26	26	4.2	4.2	Excellent

Taxonomic Analysis

A large number of EPT taxa are regularly collected here (24-30). Characteristic of this site are mayflies, such as: *Baetis intercalaris*, *Pseudocloeon ephippiatum*, *Isonychia*, *Maccaffertium exiguum*, *M. integrum*, *M. modestum* and *Tricorythodes*; the stoneflies: *Acroneuria abnormis*, *Neoperla* and *Pteronarcys dorsata*; and the caddisflies: *Brachycentrus numerosus*, *Cheumatopsyche*, *Chimarra*, *H. incommoda*, *H. venularis*, *Oecetis persimilis*, and *Nectopsyche exquisita*. This site had the only occurrence of the midge *Robackia claviger* in 2007 in the Tar basin. The unusual mayfly *Homoeoneuria* was collected here for the first time in 2007. The next closest *Homoeoneuria* population to NC 42 is located 200 miles west in Rowan County. The rarely collected snail, *Gillia altilis* was found here in 2007 (only one other database record of this species-from the Neuse River watershed).

Data Analysis

A diverse, stable and pollution intolerant aquatic population resides in this section of the Tar River. EPT BI ranges from 4.2-4.6 in the samples 1992 to 2007.

2007, suggesting that no downstream degradation of water quality exists from either the urban areas of Tarboro or its WWTP, located approximately six miles upstream. The second sample in 2007 was collected for part of a quality control procedure.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
TAR R	SR 1565	OB119	06/26/07	Good-Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
PITT	5	03020103	353409	770858	28-(99.5)	Mid Atlantic Floodplains and low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B, NSW	2875.8	sea level	25	4

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

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Franklin County WWTP	NC0069311	3.0
Oxford WWTP	NC0025054	3.5
Tar River WRF (Louisburg)	NC0020231	1.4
Tar River Regional WWTP (Rocky Mount)	NC0030317	21.0
Tarboro WWTP	NC0020605	5.0
Greenville WWTP	NC 0023931	17.5

Water Quality Parameters

Temperature (°C)	27.7
Dissolved Oxygen (mg/L)	4.5
Specific Conductance (µS/cm)	134
pH (s.u.)	6.6

Water Clarity	slightly turbid
---------------	-----------------

Site Photograph

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	13
Bottom Substrate (15)	7
Pool Variety (10)	10
Left Bank Stability (10)	9
Right Bank Stability (10)	10
Light Penetration (10)	2
Left Riparian Score (5)	4
Right Riparian Score (5)	4
Total Habitat Score (100)	74

Substrate	70% sand, 20% silt, 10% detritus
-----------	----------------------------------

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
06/26/07	10220	55	8	7.6	6.5	Good-Fair
08/08/02	8921	43	9	7.9	7.1	Not Rated
08/21/97	7460	67	13	7.4	5.4	Not Rated
06/22/92	5865	57	10	7.4	6.3	Good
07/12/89	4990	66	16	6.9	5.9	Good-Fair
07/10/86	3788	70	8	7.8	6.9	Good-Fair
11/19/85	3704	53	10	7.5	5.9	Good-Fair
07/23/84	3262	74	15	7.1	6.0	Fair

Taxonomic Analysis

A long data record exists for this site (1984-2007). EPT numbers are low here, compared with upstream sites along the main stem Tar River. The pollution tolerant mayfly, *Callibaetis*, was only collected here, among main stem Tar River sites. The chironomid *Cricotopus sylvestris* (tolerance value = 10) was very abundant here but not collected at upstream sites suggesting some degradation in water quality. The estuarine crustaceans (*Cassidinidea lunifrons*, *Cyathura polita*) and the phantom midge (*Chaoborus punctipennis*), a lentic species, were only collected here. Oligochaetes and leeches were more abundant here than upstream.

Data Analysis

This stretch of the Tar River is nine miles below the Greenville WWTP and 11 miles below Greenville. The Biotic Index has been as low as 6.9 (1989) and as high as 7.9 (1986, 2002), averaging 7.5 and suggesting that a tolerant benthic community resides in this stretch of the Tar River. The combination of the natural, physical changes in the lower Tar River, a moderate urban influence from the City of Greenville and the impacts of the Greenville WWTP, result in a decline of over 70% of the EPT fauna at the point where the Tar River flows under SR 1565, when compared with upstream sites.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
TOWN CR	SR 1601	OB91	06/27/07	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
EDGEcombe	3	03020103	354730	773330	28-83	Southeastern Floodplains and Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C, NSW	193.7	5	4	0.2

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

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

Water Quality Parameters

Temperature (°C)	25.5
Dissolved Oxygen (mg/L)	3.3
Specific Conductance (µS/cm)	111
pH (s.u.)	6.3

Water Clarity	clear/tannic
---------------	--------------

Site Photograph



Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	15
Bottom Substrate (15)	7
Pool Variety (10)	10
Left Bank Stability (10)	9
Right Bank Stability (10)	9
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	85

Substrate	90% sand, 10% silt, clay along banks
-----------	--------------------------------------

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
06/27/07	10222	82	24	5.9	4.8	Good
08/19/97	7454	84	24	6.0	4.8	Good
07/20/92	5905	64	14	6.1	5.7	Not Rated

Taxonomic Analysis

The macroinvertebrate community in Town Creek at SR 1601 differs little among the three samples collected here. Mayfly and caddisfly taxa found in multiple years include *Acerpenna pygmaea*, *Maccaffertium modestum*, *M. exiguum*, *Stenacron interpunctatum*, *Triaenodes ignitus*, *Nectopsyche exquisita*, *Chimarra*, *Cheumatopsyche* and *Brachycentrus numerosus*. Stoneflies had not been collected here until 2007 when *Perlesta* and *Neoperla* were found in low numbers. This is likely the result of sampling earlier in the year.

Data Analysis

Town Creek at SR 1601 contains a diverse and relatively pollution sensitive macroinvertebrate community. This stream rated Good in 2007 and in 1997. The site was not sampled in 2002 likely due to the drought. In June 2007, water levels were low, but sampling was still possible. By July or August 2007, it is reasonable to assume that flows would not have permitted sampling here. A stable, diverse and pollution intolerant macroinvertebrate community resides in this lower section of Town Creek.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
COKEY SWP	SR 1135	05/09/07	OF10	Not Rated

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
EDGEcombe	3	03020103	35.89000	-77.7575	28-83-3a	Rolling Coastal Plain

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;NSW	14.2	50	3	0.3	No

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

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

Water Quality Parameters

Temperature (°C)	18.9
Dissolved Oxygen (mg/L)	4.8
Specific Conductance (µS/cm)	105
pH (s.u.)	6.1

Water Clarity	Slightly turbid, became very turbid
---------------	-------------------------------------

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	18
Bottom Substrate (15)	4
Pool Variety (10)	6
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	83

Site Photograph



Substrate	Soft muck, silt, and sand
-----------	---------------------------

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/09/07	2007-50	20	---	Not Rated
04/02/97	97-08	15	---	Not Rated

Most Abundant Species	Eastern Mosquitofish	Exotic Species	Green Sunfish and Redear Sunfish
-----------------------	----------------------	----------------	----------------------------------

Species Change Since Last Cycle

Losses -- Redbreast Sunfish and Largemouth Bass. **Gains** -- Yellow Bullhead, Tadpole Madtom, Mud Sunfish, Bluespotted Sunfish, Green Sunfish, Redear Sunfish, and Swamp Darter.

Data Analysis

Watershed -- tributary to Town Creek; drains eastern Nash and western Edgecombe counties including a portion of the southern area of the City of Rocky Mount; site is just upstream of the NC Natural Heritage Program's Cokey Swamp Significant Natural Heritage Area. **Habitat** -- natural channel with very good floodplain forest; narrow flow within the channel, some macrophytes; coarse woody debris; low dissolved oxygen and percent saturation; very low flow. **2007** -- a diverse coastal plain community, including 7 species of sunfish and 3 species of darters; Eastern Mosquitofish constituted 40% of the fauna. **1997 & 2007** -- 22 species known from the site, including 9 species of sunfish and 3 species of darters; dominant species in 1997 was Bluegill (38%), Eastern Mosquitofish constituted only 3% of the fauna then; no Bluespotted Sunfish collected in 1997, but was abundant in 2007. This site is not rated because the appropriate NCIBI metrics and criteria have yet to be developed for coastal plain streams.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
COKEY SWP	NC 43	OB71	02/08/07	Moderate

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
EDGEcombe	3	3020103	355344	774427	28-83-3	Rolling Coastal Plain

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; NSW	26.3	50	10	0.5

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

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

Water Quality Parameters

Temperature (°C)	4.2
Dissolved Oxygen (mg/L)	15.8
Specific Conductance (µS/cm)	73
pH (s.u.)	6.5

Water Clarity

clear

Site Photograph



Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	13
Bottom Substrate (15)	7
Pool Variety (10)	6
Left Bank Stability (7)	9
Right Bank Stability (7)	9
Light Penetration (10)	10
Left Riparian Score (5)	4
Right Riparian Score (5)	1
Total Habitat Score (100)	64

Substrate

Mostly sand with a small amount of silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/08/07	10141	62	7	7.1	5.7	Moderate
02/12/02	8674	41	3	7.6	6.4	Severe

Taxonomic Analysis

Four more EPT taxa, which had not been previously collected, were collected in 2007 than in 2002. Those four included *Eurylophella doris*, *Maccaffertium modestum*, *Isoperla transmarina* and *Ptilostomis*. Abundant taxa included the stonefly, *Isoperla transmarina*; the caddisfly, *Cheumatopsyche*; the beetle, *Peltodytes*; and the midges, *Orthocladius oliveri* and *Tribelos jucundum*.

Data Analysis

Cokey Swamp drains agricultural areas as well as urban areas near the towns of Sharpsburg and Rocky Mount. However, slightly better conditions were noted in 2007. There was an increase in EPT taxa richness from three in 2002 to seven in 2007 and a decrease in EPT Biotic Index from 6.40 in 2002 to 5.68 in 2007.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
BYNUMS MILL CR	SR 1120	OB70	02/07/07	Moderate

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
EDGEcombe	3	03020103	354600	773829	28-83-4	Rolling Coastal Plain

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C, NSW	15.3	15	8	0.3

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

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

Water Quality Parameters

Temperature (°C)	5.6
Dissolved Oxygen (mg/L)	15.6
Specific Conductance (µS/cm)	77
pH (s.u.)	5.6

Water Clarity	clear
---------------	-------

Site Photograph



Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	20
Bottom Substrate (15)	7
Pool Variety (10)	10
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (8)	8
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	90

Substrate	50% sand, 50% silt
-----------	--------------------

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/07/07	10139	58	6	8.2	7.3	Moderate
02/11/02	8671	36	2	8.1	7.5	Severe
08/16/93	6324	29	2	8.5	7.6	Not Rated
05/05/93	6169	49	2	8.0	7.9	Not Rated
02/19/93	6105	51	3	7.9	8.5	Not Rated
08/12/92	5975	31	2	8.7	8.0	Not Rated
05/06/92	5484	44	1	8.0	4.7	Not Rated
02/19/92	5785	49	4	7.9	7.2	Not Rated

Taxonomic Analysis

Bynums Mill Creek contained very low numbers of EPT taxa in 2007 (only 13 individual EPT specimens). All of these taxa were rare (one or two specimens) with the exception of the caddisfly *Isonychia punctatissima* (eight individuals). Chironomids were the dominant macroinvertebrates here totaling 21 taxa. Abundant chironomids included species known to be very tolerant of aquatic pollution such as *Chironomus*, *Kiefferiulus* and *Polypedilum illinoense*.

Data Analysis

A high Biotic Index and low EPT numbers characterize this waterbody. Though it rated Moderate in 2007 than 2002, degraded water quality continues to be a problem here as habitat problems can be ruled out (habitat scored 90 out of 100 in 2007). The 2002 Tar Basinwide report cited the Macclesfield WWTP (located approximately two miles upstream of SR 1120) as the potential source of increased nutrients that encouraged a filamentous algae bloom seen here during sampling in that year. No bloom was witnessed in 2007. Decreased flow was seen here in 2007, as was evidence of beaver activity.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
OTTER CR	SR 1614	OB86	02/07/07	Moderate

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
EDGEcombe	3	03020103	354336	773549	28-86-(0.3)	Rolling Coastal Plain

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C, NSW	20.0	11	5	0.4

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

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

Water Quality Parameters

Temperature (°C)	4
Dissolved Oxygen (mg/L)	16.4
Specific Conductance (µS/cm)	84
pH (s.u.)	5.4

Water Clarity

tannin stained

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	15
Bottom Substrate (15)	7
Pool Variety (10)	6
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (8)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	83

Site Photograph



Substrate

65% sand, 35% silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/07/07	10138	71	9	7.3	6.6	Moderate
02/11/02	8672	44	5	7.5	6.4	Moderate
05/05/93	6168	71	10	7.3	5.7	Not Rated
02/16/93	6106	62	9	7.1	5.6	Not Rated
08/12/92	5974	31	1	8.3	9.8	Not Rated
05/06/92	5847	62	9	7.2	5.4	Not Rated
02/20/92	5788	83	15	6.9	5.4	Not Rated

Taxonomic Analysis

Nine EPT taxa were found in 2007, an increase of four from 2002 and equaling the February 1993 effort. Abundant EPT taxa included the mayfly *Caenis* and the hydropsychid caddisfly *Cheumatopsyche*. The presence of this caddisfly suggests that this site had some flow in summer and fall 2006, as *Cheumatopsyche* requires nearly year around flow for its life cycle. It was absent in 2002. A large number of mollusks were found including abundant freshwater mussels (*Elliptio* sp). A rarely collected dragonfly, *Ladona deplanata* was captured. It is only the forth record in NC and the first this species has been seen in the Tar River watershed.

Data Analysis

This site has been sampled seven times since 1992. Four of these samples were taken in what is now the swamp stream sampling time frame (February and March). Habitat here scored well, suggesting that the Moderate bioclassification is due more to water quality. The aquatic macroinvertebrate data is representative of a moderately stressed benthic community.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CONETOE CR	SR 1510	OB75	02/06/07	Moderate

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
EDGEcombe	3	03020103	355232	772338	28-87-(0.5)b	Mid-Atlantic Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; NSW	12	52	5	0.3

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

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

Water Quality Parameters

Temperature (°C)	4
Dissolved Oxygen (mg/L)	14.7
Specific Conductance (µS/cm)	77
pH (s.u.)	5.1

Water Clarity

slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	8
Bottom Substrate (15)	7
Pool Variety (10)	4
Left Bank Stability (7)	8
Right Bank Stability (7)	5
Light Penetration (10)	9
Left Riparian Score (5)	5
Right Riparian Score (5)	2
Total Habitat Score (100)	53

Site Photograph



Substrate

sand with some silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/06/07	10134	40	3	7.1	6.4	Moderate
02/22/02	8679	47	2	7.5	7.4	Severe

Taxonomic Analysis

Two Trichoptera taxa were present in both 2002 and 2007: *Cheumatopsyche* and *Isonychia punctatissima*. No mayflies have been collected by BAU from the site. In 2007 a single specimen of *Prostoia* was collected, thereby increasing EPT Richness by one between 2002 and 2007. Chironomidae were the dominant group at the site for the two sampling events, with 43 to 45 percent of the total taxa composed of midge taxa.

Data Analysis

Conetoe Creek is a tributary to Tar River. The site is 8 miles east of downtown Tarboro NC. The better bioclassification in 2007 over 2002 is due to a lower pH measurement (5.1 and 6.3 respectively) and an additional EPT taxon in 2007 over 2002 (see the BAU criteria for information on swamp classifications). Monthly measurements of pH for the period of February 2002 through December 2006 at an ambient monitoring station (O6205000 at SR 1409/Pitt County) 9.3 stream miles downstream of the benthic site indicate that such temporal differences in pH are normal for area sites. The three lowest pH values for the ambient station for that period were recorded in April and May of 2003 and December of 2005 (pH values of 5.0, 5.5, and 5.2 respectively) and the three highest in December 2004 and March and May of 2005 (7.7, 7.9, and 7.6 respectively); no trend is indicated for pH at the ambient station. Therefore, the difference in bioclassifications between 2002 and 2007 are likely due to artifacts (i.e. the presence/absence of a single EPT specimen and pH measurements, both of which include an element of chance) rather than any real change in water quality.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
CONETOE CR	SR 1510	05/09/07	OF52	Not Rated

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
EDGEcombe	3	03020103	35.875856	-77.393434	28-87-(0.5)b	Mid-Atlantic Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C,NSW	12	45	5	0.2	No

Visible Landuse (%)	Forested/Wetland	Urban	Agriculture	Other (describe)
	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)	6.5
Specific Conductance (µS/cm)	82
pH (s.u.)	5.8

Water Clarity	Slightly turbid, stained
---------------	--------------------------

Habitat Assessment Scores (max)

Channel Modification (15)	10
Instream Habitat (20)	13
Bottom Substrate (15)	7
Pool Variety (10)	6
Left Bank Stability (10)	9
Right Bank Stability (10)	9
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	74

Site Photograph



Substrate	Sand
-----------	------

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/09/07	2007-47	18	---	Not Rated

Most Abundant Species	Golden Shiner and Bluespotted Sunfish	Exotic Species	Green Sunfish
-----------------------	---------------------------------------	----------------	---------------

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

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- tributary to the Tar River; drains rural southeastern Edgecombe County; site is just upstream of the NC Natural Heritage Program's Conetoe Creek Bottomland Forest Significant Natural Heritage Area. **Habitat** -- channelized a long time ago; straight channel; macrophytes; mature trees providing the canopy, especially along the left shoreline; maintenance road on the right shoreline; wide riparian zones; very little coarse woody debris within the channel (removed during maintenance of channel); specific conductance relatively low. **2007** -- coastal plain fauna, but rather sparse (n = 98 fish); 18 species present, including 8 species of sunfish; Pirate Perch and American Eel were also common. This site is not rated because the appropriate NCIBI metrics and criteria have yet to be developed for coastal plain streams.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CONETOE CR	NC 42	OB73	02/06/07	Moderate

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
EDGEcombe	3	03020103	355006	772449	28-87-(0.5)c	Southeastern Floodplains and Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; NSW	27	46	9	0.7

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

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

Water Quality Parameters

Temperature (°C)	4.6
Dissolved Oxygen (mg/L)	14.4
Specific Conductance (µS/cm)	94
pH (s.u.)	5.2

Water Clarity

slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	6
Bottom Substrate (15)	7
Pool Variety (10)	4
Left Bank Stability (7)	9
Right Bank Stability (7)	9
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	3
Total Habitat Score (100)	58

Site Photograph



Substrate

sand, with some silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/06/07	10136	48	4	7.3	6.0	Moderate
02/22/02	8690	53	1	7.2	7.8	Moderate

Taxonomic Analysis

The four EPT taxa collected in 2007 were *Maccaffertium modestum*, *Isoperla transmarina*, *Cheumatopsyche*, and *Ptilostomis*. In 2002 the only EPT taxon collected was *Isonychia punctatissima*. Each of the three EPT taxa collected in 2007 have a lower tolerance value than the *Isonychia* collected in 2002, resulting in a lower EPT BI in 2007. Though abundant in 2002, *Elliptio complanata* was not observed at the site in 2007. Overall, mollusks declined from five taxa in 2002 to a single taxon in 2007 (*Pisidium*, which was common in both years). Chironomids were dominant in both years; 40% and 38% of all taxa were midge taxa in 2002 and 2007 respectively.

Data Analysis

Conetoe Creek is a tributary to Tar River. The site is 8 miles ESE of downtown Tarboro NC. Though EPT richness was higher and the EPT BI was markedly lower in 2007 than in 2002, the NCBI was similar between the two sampling events.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CRISP CR	SR 1527	OB78	02/06/07	Moderate

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
EDGEcombe	3	03020103	355019	772254	28-87-1	Mid-Atlantic Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; NSW	18	46	5	1.3

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

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

Water Quality Parameters

Temperature (°C)	4.2
Dissolved Oxygen (mg/L)	15.5
Specific Conductance (µS/cm)	106
pH (s.u.)	5.4

Water Clarity	slightly turbid
---------------	-----------------

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	10
Bottom Substrate (15)	7
Pool Variety (10)	5
Left Bank Stability (7)	8
Right Bank Stability (7)	8
Light Penetration (10)	10
Left Riparian Score (5)	2
Right Riparian Score (5)	5
Total Habitat Score (100)	60

Site Photograph



Substrate	sand with a small amount of silt
-----------	----------------------------------

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/06/07	10135	42	3	7.0	6.2	Moderate
03/01/04	9357	46	4	7.0	6.1	Moderate
02/11/02	8673	36	2	7.7	6.4	Severe

Taxonomic Analysis

The same two Trichoptera taxa have been present at each of the three sampling events in 2002, 2004, and 2007: *Cheumatopsyche* and *Isonychia punctatissima*. During the most recent two sampling events a rather ubiquitous mayfly, *Maccaffertium modestum*, has been collected. The only stonefly collected at the site, *Taeniopteryx*, was present in only the 2004 sample. Chironomids make up much of the taxa present at the site, though less so for the latest sampling event (44%, 48%, and 29% of the taxa in 2002, 2004, and 2007 respectively). Odonates are also fairly well represented (five, six, and six taxa in 2002, 2004, and 2007 respectively). *Physella* was noted as being abundant for 2002 in the prior basinwide report; the snails were not collected in 2007.

Data Analysis

Crisp Creek is a tributary to Conetoe Creek. The site is about 9 miles ESE of Tarboro NC. A single downed tree that traversed the width of the stream provided a small amount of habitat heterogeneity to the straight sand-bottom channel. The better bioclassification from 2002 to 2004 and 2007 is due to the markedly lower NCBI values and better habitat scores for the latter two sampling events.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
CRISP CR	SR 1527	05/09/07	OF53	Not Rated

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
EDGEcombe	3	03020103	35.838656	-77.381202	28-87-1	Mid-Atlantic Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C,NSW	17.4	40	6	0.2	No

Visible Landuse (%)	Forested/Wetland	Urban	Agriculture	Other (describe)
	70	0	15	15 (logged)

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)	5.4
Specific Conductance (µS/cm)	132
pH (s.u.)	6.0

Water Clarity

Clear, slightly stained

Habitat Assessment Scores (max)

Channel Modification (15)	5
Instream Habitat (20)	8
Bottom Substrate (15)	7
Pool Variety (10)	2
Left Bank Stability (10)	8
Right Bank Stability (10)	8
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	4
Total Habitat Score (100)	57

Site Photograph



Substrate

Sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/09/07	2007-48	14	---	Not Rated

Most Abundant Species

Swallowtail Shiner and Tessellated Darter

Exotic Species

Green Sunfish

Species Change Since Last Cycle

N/A

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- tributary to Conetoe Creek; drains rural southeastern Edgecombe and southwestern Martin counties. **Habitat** -- straight channel; channelized, but mature trees providing a canopy; stable banks, but entrenched; very shallow and of uniform depth; sandy runs, several species of macrophytes; little woody debris in the channel; specific conductance slightly elevated; low concentration and saturation of dissolved oxygen; very low flow. **2007** -- coastal plain fauna, but rather sparse (n = 80) and low diversity for a stream of its size; 14 species present, including 4 species of sunfish; American Eel was also common, but 8 of the 14 species were represented by only 1 or 2 fish/species; lowest percentage of tolerant fish of any site in the Tar River basin in 2007; Eastern Mosquitofish absent. This site is not rated because the appropriate NCIBI metrics and criteria have yet to be developed for coastal plain streams.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
BALLAHACK CAN	NC 42	OB68	02/06/07	Severe

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
EDGEcombe	3	3020103	354903	772714	28-87-1.2	Southeastern Floodplains and Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; NSW	8.7	40	5	0.2

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

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

Water Quality Parameters

Temperature (°C)	7.4
Dissolved Oxygen (mg/L)	12.6
Specific Conductance (µS/cm)	179
pH (s.u.)	5.4

Water Clarity	clear
---------------	-------

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	7
Bottom Substrate (15)	7
Pool Variety (10)	2
Left Bank Stability (7)	4
Right Bank Stability (7)	4
Light Penetration (10)	7
Left Riparian Score (5)	3
Right Riparian Score (5)	0
Total Habitat Score (100)	39

Site Photograph



Substrate	sand and silt
-----------	---------------

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/06/07	10137	19	1	8.0	6.2	Severe
02/22/02	8680	27	2	8.3	8.9	Severe

Taxonomic Analysis

Callibaetis was common in 2002 but not collected in 2007, thereby lowering the EPT abundance from two in 2002 to one in 2007. That one EPT taxa was a single individual *Cheumatopsyche*. Midges were the dominant taxa collected and included *Cricotopus bicinctus*, *Conchapelopia*, and *Dicrotendipes neomodestus*.

Data Analysis

Ballahack Canal is a highly channelized tributary of Conetoe Creek. Located in the town of Conetoe, it has rated Severe since 2002. This site had a very low habitat score (39) due to the straight channel, lack of instream habitat, homogenous substrate (sand/silt), lack of pools, eroding banks, open canopy and little riparian buffer zone. In addition to the low habitat score, algal mats were abundant and the conductivity was elevated (179 umhos/cm).

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
BALLAHACK CANAL	NC 42	05/09/07	OF54	Not Rated

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
EDGEcombe	3	03020103	35.817232	-77.45367	28-87-1.2	SE Floodplains & Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C,NSW	8.7	35	5	0.4	No

Visible Landuse (%)	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
	25	30	30	15 (Whitehurst Farms - tractor supply)

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

Water Quality Parameters

Temperature (°C)	17.7
Dissolved Oxygen (mg/L)	6.0
Specific Conductance (µS/cm)	215
pH (s.u.)	5.7

Water Clarity

Clear, but with a greenish tinge

Habitat Assessment Scores (max)

Channel Modification (15)	5
Instream Habitat (20)	8
Bottom Substrate (15)	4
Pool Variety (10)	7
Left Bank Stability (10)	4
Right Bank Stability (10)	4
Light Penetration (10)	6
Left Riparian Score (5)	2
Right Riparian Score (5)	1
Total Habitat Score (100)	41

Site Photograph



Substrate

Sand, silt, and muck

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/09/07	2007-49	13	---	Not Rated

Most Abundant Species

Bluespotted Sunfish

Exotic Species

Redear Sunfish

Species Change Since Last Cycle

N/A

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- tributary to Conetoe Creek; drains southeastern Edgecombe County; site is within the community of Conetoe. **Habitat** -- straight, channelized, first 300 ft. were affected by commercial enterprise (stormwater runoff from maintenance yard, rip/rap banks, industrial debris, etc.), poor canopy; second 300 ft. with good canopy; sandy runs; greatest specific conductance of any fish community site in the Tar River basin in 2007. **2007** -- no darters or intolerant species collected; Bluespotted Sunfish found within the snags and rip/rap; Bluespotted Sunfish and the American Eel constituted two-thirds of all the fish; only site from which the Lake Chubsucker was collected. This site is not rated because the appropriate NCIBI metrics and criteria have yet to be developed for coastal plain streams.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
TYSON CR	SR 1255	05/10/07	OF57	Not Rated

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
PITT	5	03020103	35.68693	-77.505072	28-88	Rolling Coastal Plain

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-IV,NSW	17.9	45	6	0.3	No

Visible Landuse (%)	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
	99	1	0	0

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

Water Quality Parameters

Temperature (°C)	21.8
Dissolved Oxygen (mg/L)	7.4
Specific Conductance (µS/cm)	84
pH (s.u.)	5.8

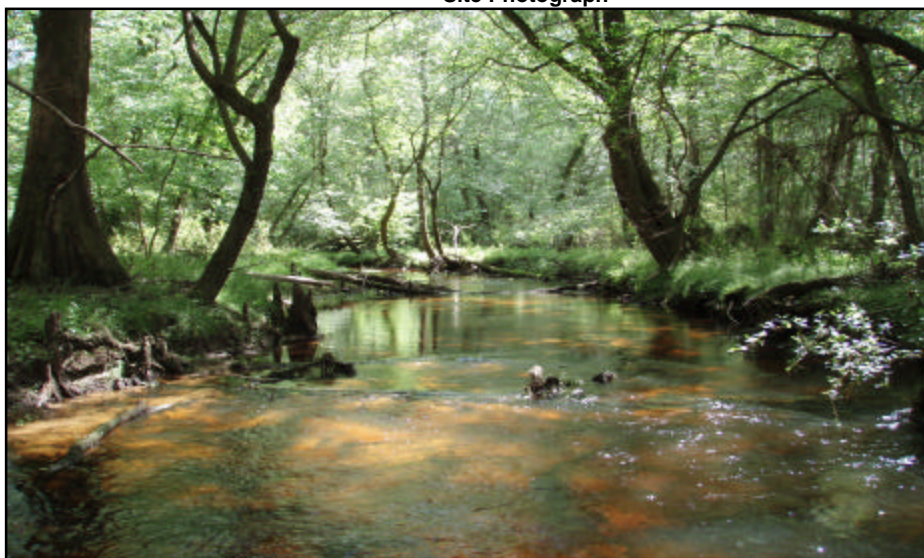
Water Clarity

Clear, tannin stained

Habitat Assessment Scores (max)

Channel Modification (15)	15
Instream Habitat (20)	17
Bottom Substrate (15)	13
Pool Variety (10)	10
Left Bank Stability (10)	10
Right Bank Stability (10)	10
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	95

Site Photograph



Substrate

Sand and gravel

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/10/07	2007-54	15	---	Not Rated

Most Abundant Species

American Eel

Exotic Species

Green Sunfish and Redear Sunfish

Species Change Since Last Cycle

N/A

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- tributary to the Tar River; drains rural southwestern Pitt County. **Habitat** -- natural channel; very good riparian and instream habitats; gravel and log riffles; runs, pools, macrophytes, coarse woody debris; cypress bottomland forest; low specific conductance for a coastal plain stream. **2007** -- a diverse, coastal plain community; the piscivorous American Eel comprised almost 50% of all the fish; one intolerant species (Sawcheek Darter) collected. This site is not rated because the appropriate NCIBI metrics and criteria have yet to be developed for coastal plain streams.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
PARKER CR	NC 33	05/10/07	OF31	Not Rated

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
PITT	5	03020103	35.63388889	-77.36388889	28-95	Mid-Atlantic Floodplains & Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;NSW	5.9	20	6	0.4	No

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

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

Water Quality Parameters

Temperature (°C)	20.6
Dissolved Oxygen (mg/L)	9.0
Specific Conductance (µS/cm)	140
pH (s.u.)	6.4

Water Clarity

Clear, not stained

Habitat Assessment Scores (max)

Channel Modification (15)	7
Instream Habitat (20)	18
Bottom Substrate (15)	7
Pool Variety (10)	4
Left Bank Stability (10)	5
Right Bank Stability (10)	9
Light Penetration (10)	7
Left Riparian Score (5)	2
Right Riparian Score (5)	5
Total Habitat Score (100)	64

Site Photograph



Substrate

Sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/10/07	2007-53	24	----	Not Rated
04/16/02	2002-19	15	----	Not Rated

Most Abundant Species

American Eel, Redbreast Sunfish, and Bluegill

Exotic Species

Green Sunfish and Redear Sunfish

Species Change Since Last Cycle

Losses -- Satfin Shiner and Golden Shiner. **Gains** -- White Catfish, Yellow Bullhead, Brown Bullhead, Tadpole Madtom, Chain Pickerel, Eastern Mudminnow, Mud Sunfish, Flier, Green Sunfish, Redear Sunfish, and Black Crappie.

Data Analysis

Watershed -- tributary to the Tar River, drains central Pitt County, including the northern part of the City of Greenville, one small NPDES permitted facility in the watershed and its discharge is unlimited. **Habitat** -- channelized with 50% open canopy; sewer right-of-way along the left riparian zone; runs with several species of macrophytes providing instream structure and habitat; banks more stable and vegetated in 2007 than in 2002; habitat score in 2002 was 39. **2007** -- coastal plain species; very diverse and abundant community for such a small stream; 9 species of sunfish and 4 species of catfish present; large biomass of sunfish, pickerels, and Creek Chubsucker; no intolerant species collected; third highest catch rate (18.0 fish/100 seconds shocking time) of any site in the Tar River basin in 2007. **2002 & 2007** -- 26 species known from the site, including 11 species of sunfish; more species and fish in 2007 than in 2002; species lost and gained between 2002 and 2007 were primarily uncommon species (1-5 fish/species); no intolerant species known from the site. This site is not rated because the appropriate NCIBI metrics and criteria have yet to be developed for coastal plain streams.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
Hardee Cr	NC 33	OB112	02/14/07	Natural

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Pitt	5	03020103	353541	771923	28-97	Mid-Atlantic Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; NSW	9.2	25	4	0.5

Visible Landuse (%)	Forested/Wetland	Urban	Agriculture	Other (describe)
	20	60	0	20

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

Water Quality Parameters

Temperature (°C)	9
Dissolved Oxygen (mg/L)	9.4
Specific Conductance (µS/cm)	123
pH (s.u.)	6.3

Water Clarity	slightly turbid
---------------	-----------------

Habitat Assessment Scores (max)

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

Site Photograph



Substrate	Silt and sand.
-----------	----------------

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/14/07	10128	59	8	6.5	5.2	Natural
02/19/02	8688	59	7	6.7	5.4	Natural

Taxonomic Analysis

In terms of total taxa richness and EPT taxa richness, the 2007 invertebrate community is essentially unchanged from the 2002 sample. However, the BI and EPTBI both decreased in 2007 and EPT abundance increased (64 in 2007, 49 in 2002). Tolerant taxa present in 2002 but absent in 2007 include the chironomids *Orthocladius robacki*, *Clinotanytus pinguis*, *Micropsectra* sp., and the oligochaetes *Nais* sp., *Slavina appendiculata*, and *Stylaria lacustris*. Indeed, overall oligochaete diversity decreased from five in 2002 to only two in 2007. The reduction of tolerant taxa and decrease in BI, EPTBI and increase in EPT abundance suggest slightly improved physical conditions at this location for 2007.

Data Analysis

Total taxa richness metrics have been unchanged at this location from 2002 to 2007. However, the BI, EPTBI, EPT species richness, and EPT abundance all demonstrated slight improvements in 2007. Landuse upstream of this location is largely suburban with some remnant areas of forest. Typical of catchments where point sources are absent and where nonpoint pollution is the largest potential stressor, reduced runoff usually engenders improvements in water chemistry. 2007 invertebrate community data support this hypothesis and is likely related to the drought.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
CANNON SWP	US 264	05/10/07	OF56	Not Rated

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
PITT	5	03020103	35.625572	-77.276981	28-99-1-1	Mid-Atlantic Floodplains & Low Terraces

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C,NSW	3.6	20	5	0.4	No

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

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

Water Quality Parameters

Temperature (°C)	19.0
Dissolved Oxygen (mg/L)	7.9
Specific Conductance (µS/cm)	160
pH (s.u.)	6.2

Water Clarity

Clear, not stained

Habitat Assessment Scores (max)

Channel Modification (15)	5
Instream Habitat (20)	13
Bottom Substrate (15)	7
Pool Variety (10)	4
Left Bank Stability (10)	2
Right Bank Stability (10)	2
Light Penetration (10)	0
Left Riparian Score (5)	1
Right Riparian Score (5)	1
Total Habitat Score (100)	35

Site Photograph



Substrate

Sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/10/07	2007-52	16	----	Not Rated

Most Abundant Species

Eastern Mosquitofish (n = 650, 78%)

Exotic Species

None

Species Change Since Last Cycle

N/A

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- small tributary to Moyes (Broad) Run (a tributary to the Tar River); drains central Pitt County; rural, agricultural watershed. **Habitat** -- channelized with one 90 degree bend; 100% open canopy; severe bank erosion on right bank at the bend; macrophytes abundant and provided instream habitats; low flow; smallest watershed assessed in 2007. **2007** -- very productive and diverse coastal plain stream; second greatest catch rate (29.7 fish/100 seconds shocking time) of any stream in the Tar River basin in 2007; intolerant species absent; high percentage (82%) of tolerant fish (Eastern Mosquitofish, Redbreast Sunfish, and Yellow Bullhead). This site is not rated because the appropriate NCIBI metrics and criteria have yet to be developed for coastal plain streams.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
GRINDLE CR	US 264	OB111	06/25/07	Good-Fair

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
PITT	5	03020103	353728	771314	28-100b	Mid-Atlantic Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C, NSW	74.0	5	5	0.2

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

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

Water Quality Parameters

Temperature (°C)	28.7
Dissolved Oxygen (mg/L)	5.6
Specific Conductance (µS/cm)	149
pH (s.u.)	8.8

Water Clarity	clear
---------------	-------

Site Photograph

Habitat Assessment Scores (max)

Channel Modification (15)	5
Instream Habitat (20)	13
Bottom Substrate (15)	7
Pool Variety (10)	0
Left Bank Stability (10)	2
Right Bank Stability (10)	9
Light Penetration (8)	4
Left Riparian Score (5)	0
Right Riparian Score (5)	2
Total Habitat Score (100)	42

Substrate	100% sand, trace of silt
-----------	--------------------------

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
06/25/07	10221	82	17	6.8	5.9	Good-Fair
08/07/02	8920	52	12	6.5	4.9	Good-Fair
08/20/97	7457	67	13	6.7	5.6	Good-Fair
07/21/92	5908	10	10	5.2	5.2	Fair

Taxonomic Analysis

Stoneflies have never been collected from this channelized sandy bottom stream. The number of mayflies and caddisflies increased from 12 in 2002 to 17 in 2007. Many of the more common taxa are found in all four samples collected here from 1992 to 2007. Several taxa that are less frequently encountered in the Tar River watershed occur here. These include: the mayfly *Pseudocloeon frondale*, the caddisflies *Oecetis* sp A, *O.* sp C, *Oxyethira* and the beetles *Hydrochus* and *Tropisternus collaris*.

Data Analysis

The Grindle Creek watershed is highly agricultural. Overall habitat scores are consistently low here, and nutrients entering the stream are high. Abundant filamentous algae and macrophytes clog the channel (see photo). Due to its channelized nature, year-round flow persists, which increases the numbers of aquatic macroinvertebrates. This increase however, is mitigated by higher numbers of pollution tolerant taxa (e.g. many of the 25 chironomid taxa collected in 2007).

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
Chicod Cr	SR 1777	OB107	02/14/07	Natural

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Pitt	5	03020103	353244	771238	28-101	Mid-Atlantic Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; NSW	21.6	26	5	0.4

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

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

Water Quality Parameters

Temperature (°C)	9.4
Dissolved Oxygen (mg/L)	7.94
Specific Conductance (µS/cm)	95
pH (s.u.)	5.47

Water Clarity	slightly turbid
---------------	-----------------

Habitat Assessment Scores (max)

Channel Modification (5)	15
Instream Habitat (20)	14
Bottom Substrate (15)	6
Pool Variety (10)	5
Riffle Habitat (16)	0
Left Bank Stability (7)	10
Right Bank Stability (7)	10
Light Penetration (10)	9
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	79

Site Photograph



Substrate	Sand and silt
-----------	---------------

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/14/07	10127	70	9	7.0	5.9	Natural
03/12/02	8701	43	2	7.6	7.5	Severe

Taxonomic Analysis

Relative to the 2002 sample, all metrics drastically improved in 2007 resulting in a Natural bioclassification. In addition to BI, EPTBI, EPT and total taxa richness, EPT abundance also improved from four in 2002 to 47 in 2007. EPT taxa present in 2007 for the first time included the mayflies *Caenis* sp., *Pseudocloeon frondale*, *Mccaffertium modestum*, *Stenacron interpunctatum*, the stonefly *Perlesta* sp., and the caddisflies *Ceraclea resurgens*, and *Cheumatopsyche* sp. Although chironomid taxa increased from 10 in 2002 to 21 in 2007 many of the most pollution tolerant chironomids present in 2002 were absent in 2007 and included *Ablabesmyia peleensis*, *Hydrobaenus* sp., and *Procladius* sp. This fact helped keep the BI suppressed despite the doubling of chironomid diversity.

Data Analysis

The profound improvement in the invertebrate community seen in 2007 is likely the result of lowered inputs of nonpoint pollution due to drought conditions in this agricultural watershed. Indeed, the 2007 pH (5.4) was the lowest ever observed at this location and three previous pH measurements between 1997 and 2002 ranged from 6.7-6.5. This indicates decreased runoff from agricultural sources and supports the large improvement seen in the invertebrate community. In addition to the 2007 and 2002 samples, this site has also been sampled twice in 1997 and twice in 1993 to ascertain summer flows and determine proper collection methodology. None of these samples (including 2002) have ever produced total taxa richness values (previous high was 56), EPT taxa richness values (previous high was five), or EPT abundances (previous high was 32) comparable to levels measured in 2007. These data indicate improved physical and chemical conditions in the segment of Chicod Creek in 2007.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
WHICHARD BR	SR 1521	OB120	02/13/07	Moderate

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
PITT	5	03020103	354202	772034	28-100-2	Mid-Atlantic Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; NSW	4.3	38	5	0.2

Visible Landuse (%)	Forested/Wetland	Urban	Agriculture	Other (describe)
	60	20	20	0

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

Water Quality Parameters

Temperature (°C)	10.5
Dissolved Oxygen (mg/L)	9.6
Specific Conductance (µS/cm)	149
pH (s.u.)	6.3

Water Clarity	Clear
---------------	-------

Site Photograph



Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	13
Bottom Substrate (15)	7
Pool Variety (10)	2
Left Bank Stability (7)	7
Right Bank Stability (7)	9
Light Penetration (10)	7
Left Riparian Score (5)	2
Right Riparian Score (5)	2
Total Habitat Score (100)	54

Substrate	Sand
-----------	------

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/13/07	10126	61	11	6.7	5.7	Moderate
02/12/02	8675	45	6	7.0	5.8	Moderate
02/08/01	8392	41	7	6.9	5.5	Not Rated

Taxonomic Analysis

The 2007 sample produced a record high EPT taxa richness. EPT present for the first time in 2007 include the mayflies *Caenis* sp., *Pseudocloeon frondale*, and the caddisflies *Hydropsyche betteni* and *Trienodes ignitus*. In addition, the BI set a record low for 2007 as several tolerant taxa collected in 2001 and 2002 were absent in 2007 and included the chironomids *Orthocladius oliveri*, *Tanytarsus* sp. 2, and the low dissolved oxygen-indicating gastrod *Physella* sp.

Data Analysis

The Whichard Branch watershed is a mix of agriculture, suburban, and forest uses. As would be expected in a watershed where non-point inputs are the largest potential stressor, the record 2007 drought has resulted in reduced pollutant runoff. The improved invertebrate metrics for 2007 invertebrate data support this conclusion as do the water chemistry data. The 2007 conductivity levels were the lowest ever measured at this location (149 µS/cm), while the 2001 and 2002 conductivity levels were 156 µS/cm and 165 µS/cm respectively.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
WHICHARD BR	SR 1521	05/10/07	OF55	Not Rated

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
PITT	5	03020103	35.700922	-77.342795	28-100-2	Mid-Atlantic Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	4.4	35	6	0.3	No

Visible Landuse (%)	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
	70	15	15	0

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

Water Quality Parameters

Temperature (°C)	17.9
Dissolved Oxygen (mg/L)	7.5
Specific Conductance (µS/cm)	168
pH (s.u.)	6.2

Water Clarity

Clear, not stained

Habitat Assessment Scores (max)

Channel Modification (15)	10
Instream Habitat (20)	13
Bottom Substrate (15)	7
Pool Variety (10)	4
Left Bank Stability (10)	7
Right Bank Stability (10)	7
Light Penetration (10)	10
Left Riparian Score (5)	4
Right Riparian Score (5)	5
Total Habitat Score (100)	67

Site Photograph



Substrate

Sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/10/07	2007-51	19	---	Not Rated

Most Abundant Species

Swallowtail Shiner

Exotic Species

Redear Sunfish

Species Change Since Last Cycle

N/A

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- small tributary to Grindle Creek; drains rural northern Pitt County. **Habitat** -- straight; very old chanellization with a mature tree canopy; deeply entrenched; side snags; very shallow runs; field drain pipes discharging to the creek; low flow; specific conductance elevated. **2007** -- for its size, a diverse and abundant coastal plain community; intolerant species absent; four species of catfish present. This site is not rated because the appropriate NCIBI metrics and criteria have yet to be developed for coastal plain streams.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
Tranters Cr	SR 1552	OB126	02/13/07	Moderate

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Edgecombe	6	03020103	354340	771030	28-103	Mid Atlantic Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Sw, NSW	111.4	27	100	0.6

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

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

Water Quality Parameters

Temperature (°C)	6
Dissolved Oxygen (mg/L)	10.7
Specific Conductance (µS/cm)	136
pH (s.u.)	5.6

Water Clarity	Clear
---------------	-------

Habitat Assessment Scores (max)

Channel Modification (5)	15
Instream Habitat (20)	16
Bottom Substrate (15)	6
Pool Variety (10)	5
Left Bank Stability (7)	10
Right Bank Stability (7)	10
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	82

Site Photograph



Substrate	silt and sand
-----------	---------------

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/13/07	10124	60	6	7.44	4.48	Moderate
02/12/02	8676	40	3	7.80	9.20	Moderate

Taxonomic Analysis

The 2007 sample had many more overall taxa and twice the number of EPT taxa than did the 2002 sample. The BI actually decreased in 2007 even though the 2007 sample had 24 chironomid taxa versus only six collected in 2002. The additional chironomid taxa were balanced out by the addition of three new EPT taxa and the overall lowering of the BI can be seen by the substantial reduction in the EPTBI. EPT taxa collected here for the first time include the mayflies *Caenis* sp., *Stenacron interpunctatum*, the stonefly *Taeniopteryx* sp., and the caddisflies *Ceraclea resurgens*, and *Ptilostomis* sp.

Data Analysis

The substantial increase in the total taxa and EPT taxa, coupled with a somewhat lowered BI and drastically lessened EPTBI suggests slightly improved conditions in the Tranters Creek watershed in 2007. The Tranters Creek catchment is a combination of agriculture and forest with no dischargers. As a result, non-point pollution is the largest potential stressor here and the 2007 drought may have induced a slight improvement in the invertebrate community as a result of decreased runoff. This hypothesis is supported by the water chemistry data. The 2002 sample had a higher pH (6.3) and higher conductivity (184 µS/cm) than did the 2007 sample which produced a lower pH (5.6) and lower conductivity (136 µS/cm).

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
Flat Swp	SR 1157	OB121	02/13/07	Moderate

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Martin	6	03020103	354654	771525	28-103-2b	Mid-Atlantic Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Sw, NSW	20.3	24	8	0.6

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

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Robersonville	NC0026042001	1.8

Water Quality Parameters

Temperature (°C)	7.5
Dissolved Oxygen (mg/L)	11
Specific Conductance (µS/cm)	161
pH (s.u.)	6.1

Water Clarity	slightly turbid
---------------	-----------------

Site Photograph



Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	10
Bottom Substrate (15)	3
Pool Variety (10)	4
Riffle Habitat (16)	3
Left Bank Stability (7)	10
Right Bank Stability (7)	10
Light Penetration (10)	9
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	61

Substrate	Silt and sand.
-----------	----------------

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/13/07	10125	53	2	7.7	6.8	Moderate
03/12/02	8702	49	1	7.9	6.2	Moderate

Taxonomic Analysis

Most community metrics have been remarkably stable at this location between sample events. However, the BI did decrease slightly in 2007 relative to 2002 and was due to a reduction in oligochaete taxa (three in 2002, zero in 2007) as well as a reduction in several tolerant chironomids that were common or abundant in 2002 but absent in 2007 and included *Cricotopus bicinctus*, *Chironomus* sp., *Hydrobaenus* sp. The small increase in EPTBI measured in 2007 was the result of the addition of *Caenis* sp and an increase in abundance of *Cheumatopsyche* sp from Rare in 2002 to Abundant in 2007.

Data Analysis

The reduction in several very tolerant taxa and corresponding decrease in BI suggest slightly improved conditions along this segment of Flat Swamp for 2007. Considering that this location is below the Robersonville WWTP, these results are surprising given that decreased flows due to drought tend to concentrate effluent and therefore usually depress invertebrate community metrics. Analysis of toxicity testing data for the five years prior to the 3/12/2002 sample show that the Robersonville WWTP had seven failing tests including one in February 2002 and one in March 2002 both of which were just prior to sampling. Conversely, from April 2002 to November 2007 there has been only one failing toxicity test. The improvement in toxicity results may explain the slight improvement in the invertebrate community. However, reduced non-point runoff from the large amount of agriculture in this watershed may also be contributing to slightly improved metrics for 2007.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
Horsepen Swamp	SR 1001	OB122	02/13/07	Moderate

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Beaufort	6	03020103	354035	770934	28-103-10	Mid-Atlantic Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Sw, NSW	10	21	4	0.5

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

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

Water Quality Parameters

Temperature (°C)	6
Dissolved Oxygen (mg/L)	9.3
Specific Conductance (µS/cm)	75.5
pH (s.u.)	5.7

Water Clarity

Slightly Turbid

Habitat Assessment Scores (max)

Channel Modification (5)	15
Instream Habitat (20)	14
Bottom Substrate (15)	7
Pool Variety (10)	5
Left Bank Stability (7)	10
Right Bank Stability (7)	7
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	3
Total Habitat Score (100)	73

Site Photograph



Substrate

Sand and silt.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/13/07	10152	58	7	7.1	6.2	Moderate
02/26/02	8681	27	4	6.5	6.1	Moderate

Taxonomic Analysis

Although the EPTBI remains essentially identical from 2002, the 2007 sample did result in a large increase in overall EPT taxa. EPT collected here for the first time in 2007 include five species of mayflies (there were no mayfly taxa collected in 2002) and included *Acerpenna pygmaea*, *Caenis* sp., *Leptophlebia* sp., *Maccaffertium modestum*, and *Stenacron interpunctatum*. The stonefly *Perlesta* sp., and the caddisfly *Cheumatopsyche* sp. were also collected here for the first time in 2007. The caddisflies *Ptilostomis* sp., and *Ironoquia punctatissima* were present in 2002 but were absent in 2007 and may be the result of reduced edge habitat due to drought-induced low water levels. The increase in the BI was the result of an increase in chironomid taxa up from only five in 2002 to 22 in 2007.

Data Analysis

The Horsepen Swamp watershed is a mix of agriculture and forest and there are no NPDES dischargers present. As such, non-point inputs are likely the greatest potential stressor in this system. However, unlike many swamp sites characterized by non-point sources that were sampled in the lower Tar during the 2007 drought, the biotic index worsened slightly here. The increase in the biotic index was primarily due to a large increase in the diversity and abundance of chironomid taxa. The large increase in chironomid taxa is somewhat contradicted by the increase in EPT taxa. These data suggest that overall there has been little change in water quality at this location through time. This conclusion is supported by the water chemistry data as the 2002 sample had a pH of 6.0 (57 µS/cm in 2007) and a conductivity of 94 (76 µS/cm in 2007).

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
Old Ford Swp	US 17	OB124	02/12/07	Moderate

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Beaufort	6	03020103	353751	770348	28-103-14-1	Mid Atlantic Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; SW, NSW	23.6	18	100	0.3

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

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	N/A	N/A

Water Quality Parameters

Temperature (°C)	5.9
Dissolved Oxygen (mg/L)	10.7
Specific Conductance (µS/cm)	59
pH (s.u.)	4.9

Water Clarity	Slightly Turbid
---------------	-----------------

Site Photograph



Habitat Assessment Scores (max)

Channel Modification (5)	15
Instream Habitat (20)	18
Bottom Substrate (15)	3
Pool Variety (10)	2
Left Bank Stability (7)	10
Right Bank Stability (7)	10
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	78

Substrate	silt
-----------	------

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/12/07	10150	43	5	7.2	6.8	Moderate
02/19/02	8689	29	4	6.7	6.4	Natural

Taxonomic Analysis

Nearly all of the difference in the invertebrate community between the 2002 and 2007 samples were the result of additional chironomid taxa (16 in 2007, 7 in 2002) and oligochaete taxa (1 in 2002, and 4 in 2007). EPT species richness, EPT abundance (17 in 2002 and 18 in 2007), and EPTBI were essentially the same between years. Pollution tolerant taxa present in the 2007 sample but absent in 2002 include the chironomids *Kiefferulus* sp., *Nanocladius crassicornus*, *Polypedilum illinoense*, *Polypedilum tritum*, *Paratanytarsus dissimilis*, *Paratendipes* sp., *Procladius* sp., *Stictochironomus* sp., and *Tribelos jucundum* and the oligochaetes *Cambarinicola* sp. and *Spirosperma nikolskyi*. The addition of these taxa explains the large increase in BI and the lowered bioclassification for

Data Analysis

The large increase in chironomids and oligochaetes seen in 2007 resulted in an increase in the BI. This increase in BI was enough to lower the bioclassification from Natural to Moderate. The addition of several tolerant chironomids and oligochaetes in 2007 but absent in 2002 suggest that some aspect of water chemistry along this segment of Old Ford Swamp has deteriorated since 2002. Although most of this watershed is agriculture (with some forest) and would therefore be expected to improve during a drought due to reduced pollution runoff, it is possible that the reduction in higher pH agricultural runoff and subsequent concentration of low pH swamp water is the reason for the depressed invertebrate community in 2007. Indeed, the 4.9 pH measured in 2007 is much lower than the 5.7 value measured in 2002. Moreover, conductivity was lower in 2007 (59 µS/cm) versus (94 µS/cm) in 2002 further supporting this hypothesis. Values of pH approaching 4.0 have been shown to adversely impact invertebrate communities and this may explain the decline seen in 2007. Indeed, the 4.9 pH was the lowest measured in all of the Tar Basin in 2007.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
Lathams Cr	SR 1410	OB123	02/12/07	Natural

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Beaufort	6	3020103	353918	770541	28-103-14-2	Mid Atlantic Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Sw, NSW	6.4	25	4	0.5

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

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

Water Quality Parameters

Temperature (°C)	6.6
Dissolved Oxygen (mg/L)	11.3
Specific Conductance (µS/cm)	64
pH (s.u.)	5.2

Water Clarity	Clear
---------------	-------

Habitat Assessment Scores (max)

Channel Modification (5)	15
Instream Habitat (20)	16
Bottom Substrate (15)	4
Pool Variety (10)	3
Left Bank Stability (7)	10
Right Bank Stability (7)	10
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	78

Site Photograph



Substrate	Silt.
-----------	-------

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/12/07	10151	59	10	6.8	6.4	Natural
02/26/02	8682	48	7	6.9	6.6	Natural

Taxonomic Analysis

Every community metric evaluated in 2007 improved from 2002 levels. EPT taxa present in 2007 but not collected in 2002 include the mayflies *Leptophlebia bradleyi*, *Pseudocloeon frondale*, and *Stenacron interpunctatum* and the caddisflies *Ceraclea resurgens* and *Cheumatopsyche* sp. Tolerant taxa present in 2002 but absent from 2007 included the chironomids *Cricotopus bicinctus*, *C/O Sp 7*, *Natarsia* sp., and *Polypedilum illinoense*.

Data Analysis

While most of the increase in total taxa richness was due to additional chironomid taxa in 2007 (22 versus 15 in 2002) many of these taxa were rare and many of the most tolerant chironomids that were present in 2002 were absent in 2007. This, combined with the increased in EPT taxa richness helped lower the BI and EPTBI respectively for 2007 and indicates a more intolerant community here in 2007 relative to the 2002 sample. While much of the Lathams Creek watershed is forest, there are some agricultural inputs. The 2007 drought likely reduced the agricultural non-point impacts and therefore helped improved invertebrate community metrics. Water chemistry supports this assertion as conductivity was 64 µS/cm in 2007 and was nearly twice as high (115 µS/cm) in 2002. In addition, the pH in 2007 was much lower (5.2) versus 6.2 measured in 2002 indicating a reduction in higher pH agricultural runoff.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
Beaverdam Swamp	SR 1523	OB129	02/13/07	Moderate

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Beaufort	7	03020104	353210	765641	29-10-2	Mid-Atlantic Flatwoods

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; NSW	9.5	21	4	0.4

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

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

Water Quality Parameters

Temperature (°C)	4.3
Dissolved Oxygen (mg/L)	11.5
Specific Conductance (µS/cm)	106
pH (s.u.)	5.1

Water Clarity	slightly turbid
---------------	-----------------

Site Photograph



Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	10
Bottom Substrate (15)	7
Pool Variety (10)	2
Left Bank Stability (7)	8
Right Bank Stability (7)	2
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	1
Total Habitat Score (100)	47

Substrate	Sand and silt.
-----------	----------------

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
02/13/07	10149	52	3	7.02	6.43	Moderate
03/11/02	8700	50	4	7.50	7.25	Moderate

Taxonomic Analysis

Since 2002, EPT taxa richness, total taxa richness, and EPT abundance (13 in 2002 and 14 in 2007) have remained essentially unchanged between sampling events. The only community metric that has shown any change was the BI and EPTBI both of which decreased in 2007. Although overall taxa richness is basically unchanged, there were several very tolerant taxa that were present in 2002 but were not found in 2007 and include the chironomids *Cricotopus bicinctus*, *Orthocladius clarkei*, *Cladotanytarsus* sp., *Dicortendipes fumidus*, *Endochironomus nigricans*, *Procladius* sp., *Tanytus carinatus* and *Glyptotendipes* sp., as well as the low-dissolved oxygen indicator gastropod *Physella* sp. The lack of these taxa suggest slightly improved water quality for

Data Analysis

The large decrease in the BI and EPTBI indicate that the invertebrate community has shifted towards a slightly more intolerant community in 2007 versus that observed in 2002 and suggests slightly improved water chemistry. Indeed, pH in 2002 was 6.2 and was only 5.1 in 2007. This suggests lowered runoff from adjacent agricultural fields of which most of the Beaverdam Swamp watershed is comprised. The fact that taxa richness metrics did not increase is likely the result of the poor habitat as Beaverdam Swamp is a channelized system and appears to be regularly maintained.